# Progress Report to NOAA 2010

NA05OAR4311004

November 2009 - October 2010


The International Research Institute for Climate and Society

Columbia University in the City of New York


# Progress Report to NOAA
# NA05OAR4311004
# November 1, 2009 - October 31, 2010

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Selected Abstracts, continued

# From the Director-General

The past year has been an active one for IRI on many different fronts, spanning the research, demonstration, outreach, capacity building and education fronts. The year was significantly shaped by special activities – notably around the development of a two-year continuation proposal to NOAA. The work associated with major proposals (both conceptual and technical) is intense, but the benefits are always very visible at the end. In this instance, IRI took the additional steps of revisiting our mission statement and institutional goals. The end products affirm our prior commitments but also update them, and generally remind us all what we are working for collectively and why that is important. The proposal itself, as is usually the case, helped us sharpen our objectives and work plans for the next couple of years. Comments and suggestions from external reviewers were helpful, as were inputs from members of the IRI Board and its International Scientific and Technical Advisory Committee, colleagues at The Earth Institute, and faculty and leaders at Columbia University. We sincerely appreciate the funding and active support of the NOAA Climate Program Office.

As this report shows, IRI was busy on the research and innovation front this year. Important developments in the seasonal forecast methodologies are allowing more flexible (and adaptable) probabilistic formats and incorporation of spatial bias corrections. Ensemble systems based on coupled GCMs are now being evaluated alongside IRI's continuing 2-tier forecast system. A host of studies are addressing the dynamics, predictability and prediction of regional climate at the seasonal time scale, as well as methodologies to characterize climate risk at longer time scales, in many of the developing country regions we are working. Several developments in the IRI Data Library are notable, including innovations in the use of metadata (allowing more powerful search and manipulation of multisectoral data) and a stand-alone Data Library that can easily be ported to sites lacking in broadband internet access.

Climate risk management demonstrations remain a core element of IRI work. This year there were important advancements in each of our regional programs (Africa, Latin America/Caribbean, and Asia-Pacific). To cite one example: in Ethiopia efforts with the health and climate communities are building capacities to both produce and incorporate climate information products in operational health practices; and together with the Ethiopian Meteorological Service new technologies to merge satellite and in situ data are being piloted. Another exciting development is the development and deployment of new tools around index

insurance, being incorporated into a “scaled-up” program with Oxfam and Swiss Re addressing agricultural livelihoods in Ethiopia.

More generally on the capacity building and education front IRI’s activity continues to grow. This year we hosted or supported 20 formal training courses, delivered 6 formal education courses at Columbia University, and mentored more than 30 undergraduate and graduate students in research or internships. The highly innovative Summer Institute on Climate Information for Public Health, fourth edition, was offered this year. This program is creating a genuinely new cadre of professionals and serving as a platform for continued communication and collaboration worldwide.

Finally, a word about evolving collaboration and partnerships. Virtually all of IRI’s work depends on partnerships – in research, practice, and outreach. This year there were several important developments with global scale partners. We initiated a partnership with the Consultative Group in International Agricultural Research to participate in the new Challenge Program on Climate Change, Agriculture and Food Security, with IRI’s Dr. Jim Hansen designated as a Theme Leader. This enables an entirely new scale of engagement for IRI in agricultural climate risk management. IRI continues to build on an active collaboration with the International Federation of Red Cross/Red Crescent Societies, with further tailoring of information to inform global disaster risk assessment, and with regional interactions and capacity building, including opportunities for student internships at Red Cross sites throughout the world. And we were delighted to begin a formal collaboration with the World Food Program this year, focusing on climate information to inform food security risk assessment and response.

In the pages that follow we summarize results of efforts from dedicated, innovative, and highly collaborative scientists and staff. We hope they convey the growing scope and reach of our work. Please also visit us at http://iri.columbia.edu.

Stephen E. Zebiak

*Selected Features* . November 2009 - October 2010

**The IRI** recognizes the importance of communicating our research, innovations and the practical ways in which decision makers use climate information. One area of effort involves the regular publication of web stories and multimedia presentations, available at **http://iri.columbia.edu/features**. We have been able to generate an ongoing interest in these stories among members of the media, our partners, Columbia University and National Oceanic and Atmospheric Administration Climate Program Office. Many features are now linked to a number of humanitarian and relief-oriented news organizations as well.

## IRI Scientist wins NSF CAREER award *10.15.2010*

Alessandra Giannini discusses her research as well as what motivates her as a scientist.

Alessandra Giannini, a research scientist at the International Research Institute for Climate and Society, has been awarded a National Science Foundation CAREER award to advance our understanding of climate model projections in the African Sahel, a semi-arid region south of the Sahara Desert that stretches from the Atlantic Ocean to the Red Sea.

The Faculty Early Career Development Program, known as CAREER, is the National Science Foundation's most prestigious award for junior professors that are exemplary "teacher-scholars" who can integrate education and research within the context of the mission of their organizations.

At the heart of Giannini's research is a quest to understand why 21st century climate-change projections diverge in the Sahel and other parts of the developing world.

"Anthropogenic climate change is expected to affect less-developed societies with greater severity, yet it's in the tropics, where these societies are located, that projections of change, especially of changes in regional rainfall, have the greatest uncertainty," says Giannini.

The global models that the Intergovernmental Panel on Climate Change uses in its assessments are inconsistent for the Sahel. Some of the models project the region to become wetter than it is currently, while others project it to

be dryer, she says. "Having a better grasp of the situation is critical, because this region is highly vulnerable to rainfall variability and change."

In the 1970s and 80s, the Sahel suffered from devastating droughts and famines that killed hundreds of thousands of people and forced hundreds of thousands to migrate elsewhere. Giannini and her colleagues at the National Center for Atmospheric Research and at Texas A&M University conclusively demonstrated that those droughts could have been caused not by deforestation and land-use change, but by changes in global ocean temperatures. They published their results in the journal Science in 2003.

The CAREER award will fund Giannini's work for five years, and includes support for a doctoral student in climate science. In their research, Giannini and the student will analyze output from global models that diverge in order to try to identify any mechanisms attributable to natural variability, land use change or global warming. They will then look for the 'fingerprints' of such mechanisms in actual observations of the Earth's atmosphere collected by the U.S. Department of Energy's Atmospheric Radiation Measurement Mobile Facility (AMF) in Niamey, Niger - in the heart of the Sahel. The AMF is a portable laboratory equipped with a suite of instruments designed to collect data on clouds and other components of the atmosphere. Finally, they will test sensitivity in the models' behavior to such mechanisms with carefully crafted simulations.

## Reaching out to the Columbia Community

Giannini's CAREER award also funds a particularly interesting educational component. She will be working with Columbia's Institute of African Studies to develop lessons and materials that benefit community organizations and public schools in Harlem, a historically African-American neighborhood near Columbia University with a sizable immigrant population from West African countries such as Senegal and Mali. Her aim is to teach climate-change science to high-school students from an environmental justice perspective, using air pollution as a way to connect local and global issues. "I applaud Dr. Giannini's willingness to share knowledge, broaden connections between people and ideas and create opportunities for participatory growth," says Mamadou Diouf, the director of the Institute of African Studies.

Giannini wants to open up dialogue with immigrant community organizations in Harlem to share perspectives on climate change and its impacts. "Of great interest to me is to understand how they understand and explain drought, which may have ultimately led them to leave their countries. It's a mutual education - reaching a common understanding can help the IRI build projects in the region so it and its partners can act in the best informed way possible, with local support, to help avert the worst consequences of future change."

Immigrants routinely contribute to the survival of their communities of origin through remittances. Ultimately, Giannini hopes that scientific knowledge will empower them to learn from the past in order to shape a different future - a future that confronts head-on the same problems of poverty eradication and sustainable development that form the core of the mission of the IRI. ■

*Selected Features* . November 2009 - October 2010

# New Report: State of Climate Prediction *9.22.2010*

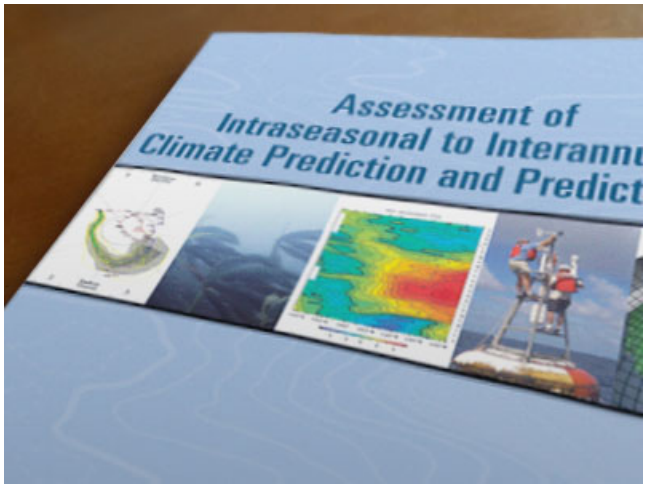


Image: The National Academies Press

A report recently released by the National Research Council called "Assessment of Intraseasonal to Interannual Climate Prediction and Predictability" examines the current state of medium-term climate forecasting--over time periods of a few weeks to a few years. It makes suggestions on how these forecasts might be improved.

The International Research Institute for Climate and Society is among a number of institutions that regularly produce climate predictions, such as seasonal or longer-term rainfall and temperature forecasts. These institutions, the report states, could increase the value of such products to decision makers by improving the procedures for archiving and disseminating the information. In addition, the report concludes that making advances in observational capabilities, statistical and dynamical models and data assimilation systems could improve our understanding of key climate processes, as well as improve the forecasts themselves.

IRI research scientist Lisa Goddard was on the committee that wrote the report. In a brief Q&A below, she discusses the publication and some of its key recommendations.

**Q: First, why is such a report necessary?**

LG: The report was primarily commissioned by the National Oceanic and Atmospheric Administration, which wanted an assessment of the current capabilities in seasonal prediction and what additional efforts might improve the quality of forecast information. We know we have some skill in predicting the climate on intraseasonal-to-interannual time scales. For the United States, much of this skill is realized during El Niño or La Niña events. In order to improve our skill, we would not only need better models, but more complete observing systems, as well as better techniques for inserting those observations into the models' initial conditions for prediction. There are other aspects of the climate system that may influence the climate on these time scales, such as the stratosphere or land-atmosphere interactions. These will require much more research, observations, and modeling before the operational community can quantify their impact on intraseasonal-to-interannual predictions.

However, we wrote the report with a broader audience in mind. We included sections on the history of prediction, on how forecasts are made, plus the extensive observations, scientific research and operational efforts required to develop, improve and communicate these forecasts.

**Q: The report recommends some "best practices" for improving the utility and accessibility of forecasts to researchers and decision makers.**

**What are the major impediments that prevent the uptake of this information by these groups currently? Is there one best practice that stands out from the rest in your opinion?**

LG: In my opinion, creating publicly-available archives of information associated with forecasts is paramount. IRI's experience is that the needs of researchers, decision makers and others who would use climate forecasts, or the model predictions on which they are based, are too diverse and difficult for any operational center to address thoroughly. So making available the data from the models and the observations, as well as what considerations went into the issued forecasts is very important. It allows different communities to tailor or assess the information in ways that are more consistent with their decision processes or risk thresholds.

**Q: The report also lays out some key research questions that need addressing if we are to improve our forecasts. Which of these intersect directly with your work and why are they important to answer?**

LG: The focus of my research is on how to make the best use of available prediction information, especially to those who might be able to act on that information. This is related to the report's recommendations on improving the development and understanding of multi-model ensemble prediction and merging statistical and dynamical techniques

I think this is an important issue because models are still deficient when it comes to representing some of the characteristics of the climate and its variability. These deficiencies aren't necessarily the same from one model to the next. The better the models and their use of observations become, the more robust the data I have to plug into my own research. So the key research questions that others throughout the climate community are addressing to improve forecasts also intersect directly with my work. ■

> *"Many important decisions regarding water management, agriculture, and energy are made on weekly, monthly, seasonal, and annual timescales. These decisions can benefit from high quality, reliable predictions. Yet making useful predictions about the climate system on these timescales is a challenge."*
>
> *Assessment of Intraseasonal to Interannual Climate Prediction and Predictability*

Permalink for this story:
***http://iri.columbia.edu/features/2010/new_report_state_of_climate_prediction.html n***

# Managing Risk in a Changing Climate: Obstacles *8.27.2010*

Farmers in Srirangapur Village, India, discuss climate risk management. (Haresh Bhojwani/IRI)

***by Steve Zebiak***

As I wrote in the previous installment, climate risk management is a process that informs decision-making through the application of climate knowledge and information. IRI's approach to climate risk management consists of four components. The first is identifying vulnerabilities and potential opportunities posed by climate variability or change in a given part of the world and in a given sector. For example, an extended drought or a delayed rainy season could have serious impacts on farmers who grow rain-fed crops. On the other hand, there might be periods of above-normal rainfall they could take advantage of, if they had access to information on the likelihood of when and where those rains would occur.

The second component is assessing the relevant climate risks. Relevance here is determined by the problem at hand. For example, are wheat farmers in Ethiopia more concerned about the predicted timing of the rainy season--how early or late it starts--or how much total rain is predicted to fall? Perhaps instead they are most interested in the predicted total number of dry days or dry spells. Using the best science and available data, we endeavor to assess the range of possible future conditions for whatever climate parameters are targeted. This typically involves gleaning information from historical records; assessing the skill of climate forecast products; estimating the uncertainties in monitored information. It also requires us to understand the nature of climate variability at the different time scales defined by stakeholders. Farmers and health workers might need information at seasonal to interannual scales-three months to a year ahead of time. Development banks, foresters and dam builders may need decade-level outlooks; national authorities negotiating in the United Nations Framework Convention on Climate Change may require climate scenarios for the next 50-100 years. Each satisfies a set group of stakeholders, and each comes with its own set of uncertainties and limitations.

The third component is identifying technologies and practices that optimize results in normal or favorable years as well as those that can reduce vulnerabilities during unfavorable years or during extreme events such as droughts and floods. Farmers could decide whether to invest in fertilizers and improved seeds or switch crops altogether, if they had access to seasonal forecasts and understood how to interpret them. Forecasts could also help food-security agencies determine if, when, and where to preposition food aid in anticipation of a crisis. Some crop failures may not be avoidable, but every famine is. In the water sector, engineers using good quality decade-scale climate information can optimize the design of dams. For existing reservoirs, they can use the information to make better decisions on how to

allocate the water, or better quantify the chances that extremely low or extremely high reservoir levels will occur.

> *"Communities are left exposed to a great deal of climate-related risk. This happens despite the increased interest in climate, evidenced by the resources invested in climate-related science, unprecedented discussions on climate policy and increasing support for disaster-risk reduction and climate-smart development"*

Once we've identified the best technologies and practices, the fourth and final step is finding the "real world" arrangements that enable their implementation. Using the example of an early-warning system for food crises, we can ask: What are the actual mechanisms to have in place for hunger relief? Who are the key decision makers to identify? What specific types of climate information do they need in order to take action and who will supply it? How do we make this sustainable?

The fact that climate risk management can be effective doesn't make it easy. Because the process is inherently interdisciplinary, it requires a detailed understanding of complex, context-specific interactions between physical, natural and social systems. It also involves collaboration among experts who must work together on cross-disciplinary problems. Although developing the proper strategies is a complicated task, climate risk management can be applied to agricultural, water, health or any other sector, on spatial scales that range from local to global, and on time scales from near- to long-term.

While the science of climate risk management is still in its infancy, strategies already exist for every sector. For instance, an effort to address deepening drought in Western Australia created a constructive engagement between water managers and climate scientists that improved practice in both fields and contributed to better policy (see relevant links below). In the realm of public health, a group of partners developed an integrated malaria epidemic early warning and response system that is being implemented in conjunction with the Roll Back Malaria campaign. The system includes seasonal forecasts, climate monitoring, vulnerability assessments, case surveillance and response planning.

"Communities are left exposed to a great deal of climate-related risk. This happens despite the increased interest in climate, evidenced by the resources invested in climate-related science, unprecedented discussions on climate policy and increasing support for disaster-risk reduction and climate-smart development. "

Similarly, an IRI project in the Southern Cone of South America manages agriculture related climate risk through a series of technological and policy interventions. It also works to reduce the uncertainty associated with the impacts of climate variability on agriculture. Our project partners are currently developing information and decision support systems that include long-term climate and agricultural impact information, continuous monitoring of climate and vegetation, and seasonal climate forecasts.

We've also been involved on innovative weather-risk transfer solutions such as index insurance, which provides a way to minimize the livelihood impacts of 'bad years' associated with extreme events. This has the benefit of setting people free to invest in production during good years. In the future, it may be possible to combine index insurance with climate forecast information, providing insurance against the uncertainty of the forecast. At the same time, drought index insurance allows relief agencies to respond quickly as droughts unfold, thus avoiding catastrophes that may otherwise destroy livelihoods and force farmers into poverty traps.

## Obstacles to effective climate risk management

The practice of climate risk management as described above is rare throughout the world today. Communities are therefore left exposed to a great deal of climate-related risk. This happens despite the increased interest in climate, evidenced by the resources invested in climate-related science, unprecedented discussions on climate policy and increasing support for disaster-risk reduction and climate-smart development.

Very few development organizations use climate knowledge, information products, or related management strategies as part of their overall toolkit. Practitioner communities in health, water, agriculture, finance and other key sectors have not yet begun to incorporate climate risk management into their day-to-day programs. Many climate service providers do not provide information on scales that are relevant to policy and management decisions, or that can be easily incorporated into their decision-making process.

A recent study by the IRI characterized the current situation as one of market atrophy - negligible demand coupled with inadequate supply of climate services for development decisions. In this sense, the main obstacle to the widespread implementation of climate risk management is the lack of engagement and communication between communities, and the lack of investment to foster these critical interactions. Climate researcher and service communities develop knowledge and related information products from a disciplinary research perspective - often uninformed about stakeholder needs. Meanwhile stakeholders in development, policy and planning are not capable of assimilating relevant climate information that is available. As a result, research is not being taken up, while stakeholders increasingly worry about climate but remain largely at a loss about what to do in practice.

The solution to this dilemma requires a focus at the nexus of these communities. It also requires the cooperation of relevant communities on global and local scales. The extent to which we can meet this challenge will, in large measure, determine the benefit that can be realized from major ongoing investments in research, observations, assessments, international policy and climate-sensitive development programs in years to come.

In the next and final installment, I'll provide a path forward for the improvement and uptake of climate risk management practices.

A version of this essay appeared in "Climate Sense".

Permalink for this story:
***http://iri.columbia.edu/features/2010/what_is_climate_risk_management.html***

Permalink for the first part:
***http://iri.columbia.edu/features/2010/managing_risk_in_a_changing_climate_making_the_case.html***

*Stephen Zebiak is director-general of the International Research Institute for Climate and Society at Columbia University, which uses a science-based approach to enhance society's ability to understand, anticipate and manage climate risk to improve human welfare. He leads an interdisciplinary team of more than 40 scientists specializing in climate prediction, agriculture, health, water, economics and development policy. Dr. Zebiak has worked in the area of ocean-atmosphere interaction and climate variability since completing his Ph.D. at the Massachusetts Institute of Technology. He and Mark Cane authored the first dynamical model used to predict El Niño successfully.* ■

# Managing Risk in a Changing Climate: Making the Case *7.9.2010*

Pétionville camp for displaced Haitians. Eric Holthaus/IRI

***by Steve Zebiak***

We live in a time of rapidly escalating concern about climate change. Although scientific evidence on climate change has been steadily building over many years, only recently has the consensus concerning observed impacts and future scenarios reached a level to capture the world's attention. Increasingly, the question of whether or not climate change is happening is being replaced with the question of what we can and should do about the problem. The response will require concerted efforts not only to control atmospheric greenhouse gas emissions, but to adapt to and manage the effects of climate change as well.

Climate shocks in the form of droughts, floods, cyclones, and related problems such as epidemics, food insecurity and infrastructure loss have been playing out throughout recorded history, but with increasing severity as populations become increasingly vulnerable. A growing body of evidence, much of it captured in the 2007-2008 Human Development Report by the United Nations, points to the direct effects of climate on economic and human development, particularly in low-income countries. Scan the headlines of recent weeks, and you'll undoubtedly come across stories about the ongoing food crisis in Niger caused by irregular rainfall, which threatens the lives and well being of at least seven million people. You'll see pictures from the extremely harsh winter in Mongolia, which wiped out nearly 20% of the country's livestock, leading to food shortages and loss of livelihood for tens of thousands of families. You'll read about how hundreds of thousands of earthquake survivors in Haiti are still living in relief camps and other temporary structures, under threat of a hurricane season forecasted to be unusually active. The ability to cope better with climate is thus a paramount issue of the present, and a potentially even greater issue in the foreseeable future. We need 'win-win' approaches to better manage current climate risks and to build capability to cope with the climate of the future.

Many of the world's leading development institutions – including the United Nations Development Programme, the World Bank and major foundations – recognize that efforts to meet development goals, in particular the Millennium Development Goals, are threatened by climate risk. As a result, they have begun reviewing their programs from the perspective of climate-related risk assessment and risk management. Similarly, national governments and decision makers at the local and regional levels are now asking how they can better manage climate-related risk.

There is a great deal of relevant information now available to assist these efforts. Under the United Nations Framework Convention on Climate Change, and particularly through the work on the Intergovernmental Panel on Climate

Change (IPCC), authoritative assessments of the current climate and possible future climate scenarios are readily accessible. In addition, routine monitoring information and seasonal-to-interannual climate forecasts are available in several centers, including the IRI. In practice, however, it is difficult to cast this information in terms that can inform decisions and policies in key socioeconomic sectors. As a result, little uptake has been achieved and livelihoods and economies remain vulnerable to climate risk.

> *"It has been difficult to cast climate information in terms that can inform decisions and policies in key sectors. As a result, little uptake has been achieved and livelihoods and economies remain vulnerable to climate risks."*

The work needed to provide problem-specific information and to advance innovations in the use of such information is the science of climate risk management practice. Put simply, climate risk management is the process of climate-informed decision-making. It involves the use of strategies that reduce uncertainty through the systematic use of climate information. This work is especially challenging because it involves a complex interplay between physical, natural, and social systems and requires that practitioners engage with good science, good policy, and good practice. At present there are some organizations working to connect these disparate disciplines – but while their work has provided examples of practical ways to manage climate risk, the demand for useable knowledge and information far outstrips what can be provided.

If the global community is to become serious about managing climate risks, it must close the gap between knowledge and practice. In addition to major programs in climate assessment, international policy, and development assistance, the global community must also provide a mechanism to advance climate risk management practice.

In the next installment, I'll discuss in detail what we mean by climate risk management and what the current challenges are to its implementation.

A version of this essay appeared in "Climate Sense". *Stephen Zebiak is director-general of the International Research Institute for Climate and Society at Columbia University, which uses a science-based approach to enhance society's ability to understand, anticipate and manage climate risk to improve human welfare. He leads an interdisciplinary team of more than 40 scientists specializing in climate prediction, agriculture, health, water, economics and development policy. Dr. Zebiak has worked in the area of ocean-atmosphere interaction and climate variability since completing his Ph.D. at the Massachusetts Institute of Technology. He and Mark Cane authored the first dynamical model used to predict El Niño successfully.*

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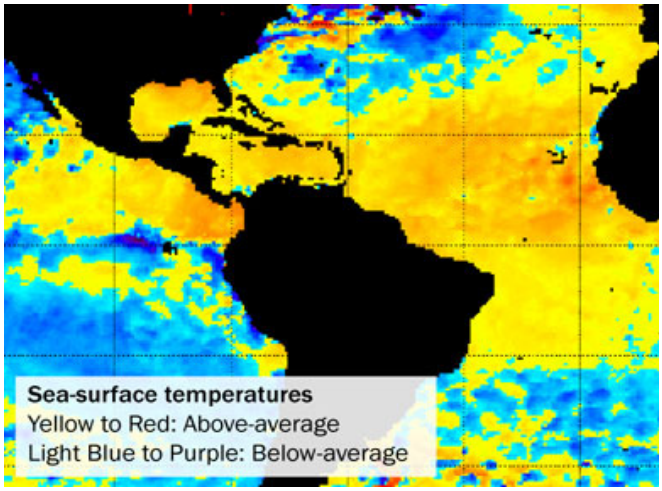
# An Active Hurricane Season Predicted *6.2.2010*




Above-normal temperatures in the North Atlantic are strongly influencing recent forecasts that call for a robust 2010 hurricane season. Map courtesy of NOAA.

***by Eric Holthaus***

The Atlantic hurricane season has officially started, and the International Research Institute for Climate and Society has issued its updated seasonal hurricane forecast for the region. The results continue to indicate that an above-normal season is very likely. This could spell trouble for highly vulnerable Caribbean nations such as Haiti, still reeling from the effects of a 7.0 magnitude earthquake on January 12, 2010. On top of this, other forecasts point to increased thunderstorm activity for the region as well.

The IRI's hurricane forecast probabilities are the strongest the institution has ever issued at this point in the season, eclipsed only by a late-season forecast during record-setting 2005. The latest numbers call for a 50% chance of above-normal activity, 35% chance of near-normal activity and a 15% chance for below-normal activity. Put in simpler terms, this means that the chance of having an above-normal year is more than three times the chance of having a below-normal one.

The hurricane forecast issued last week by the National Oceanic and Atmospheric Administration is even stronger, calling for an 85% chance of an above-normal season.

Although the forecast calls for an active season, this doesn't guarantee that devastation will occur. The seasonal forecasts don't tell us where, when or if the hurricanes will hit land. They just tell us that we'll likely see more of them this season, increasing the odds that some inhabited areas will get hit.

Because of the potentially destructive nature of hurricanes and tropical storms, the higher odds are a cause for concern. "Hurricanes can devastate the economies of the Caribbean and Central America," says Walter Baethgen, who runs IRI's regional program for Latin America and the Caribbean. "Our hope is that seasonal forecasts and other types of climate information will feed into emergency networks and early-warning systems currently operating in the region."

To facilitate this, the IRI helped develop a website focused on supplying government staff, relief workers and development agents located in Haiti with the most up-to-date weather and climate forecasts for the country. By making this information available through its ongoing partnerships with the United Nations Office for the Coordination of Humanitarian Affairs and the International Federation of Red Cross and Red Crescent Societies, the IRI hopes to alleviate some of these elevated storm risks for Haiti and ultimately help save lives this hurricane season.

Maarten van Aalst, the associate director of the Red Cross/Red Crescent Climate Centre, says that his organization has alerted its network in Haiti and across Latin America. "The Red Cross/Red Crescent is used to mobilizing quickly around short lead-time forecasts for specific hurricane events, but now also has early-warning information to prepare in advance for what may be a particularly active hurricane season," he says.

## Record Ocean Temperatures

The forecast for above-normal hurricane activity has remained high in part because of the dissipation of the 2009-10 El Niño and increased likelihood for La Niña conditions starting in the fall of 2010. In general, La Niña conditions tend to increase the chances for hurricanes in the Atlantic, while El Niño conditions tend to suppress them.

## Haiti Weather and Climate Risks website.

"But the strongest influence on the forecast has to do with what's going on in the surface waters of the Atlantic," says Suzana Camargo, who, along with Tony Barnston, developed IRI's seasonal hurricane forecasts and have been issuing them since 2003. During April, the surface temperatures in the Atlantic, where the majority of hurricanes develop, rose to nearly 1.5 degrees Celsius above the 30-year average--the highest levels ever recorded. "In fact, April marks the third consecutive month that temperatures in this region of the Atlantic broke long term records," Camargo says. "This is important because, in general, hurricanes use warm-water temperatures as fuel to grow and get stronger."

> *"Our hope is that seasonal forecasts and other types of climate information will feed into emergency networks and early warning systems currently operating in the region."*

Barnston, IRI's chief forecaster, says these abnormally high-sea surface temperatures do not bode well for a quiet start to the hurricane season. "Taken in combination with the increased likelihood for a developing La Niña during the latter stages of hurricane season, the entire season may be lengthened this year," he says.

La Niña conditions, should they develop, would also tend to increase the number and intensity of "regular" Caribbean rainshowers and thunderstorms, which in turn could lead to higher chances of flooding and mudslides.

"La Niña conditions give rain-making clouds a greater chance to turn into the tall, dense cumulonimbus clouds associated with thunderstorms. This is the same mechanism that makes hurricane development more likely," says Barnston.

The next updated IRI seasonal hurricane forecast will be issued in mid-June.

*Eric Holthaus is a staff researcher at the IRI. He works primarily in Latin America and Africa on strategies for managing drought, hurricanes and other climate related disasters.*

Permalink for this story:
***http://iri.columbia.edu/features/2010/an_active_hurricane_season_predicted.html*** ■

# Climate and Health Communities Training Together *5.20.2010*

The facilitators and participants of the 2010 Summer Institute. Francesco Fiondella/IRI

For the third year in a row, public-health professionals and climate scientists from around the world are visiting Columbia University's Lamont campus, where the International Research Institute for Climate and Society is based, to learn how to use climate information to make better decisions for health-care planning and disease prevention. They're taking part in the third Summer Institute on Climate Information for Public Health, organized by IRI, in partnership with the Center for International Earth Science Information Network (CIESIN) and Columbia's Mailman School of Public Health.

World leaders have grown increasingly concerned with finding ways to adapt to climate change and climate variability, which threatens the stability of many facets of life, such as energy, food, and water. Climate also affects the fundamental requirements for good health. The public health community recognizes the need to better understand climate's role as a driver of infectious diseases such as malaria and meningitis, as well as its potential to change the geographic distribution of disease.

"Droughts, floods, changing rainfall and temperature patterns-these all can have severe impacts on public health, especially in developing countries," says senior research scientist Madeleine Thomson. "They also often disrupt food production and limit access to safe drinking water, which in turn can make people sick and undernourished," she says.

By understanding climate, its associated impacts and its potential predictability, decision makers can start responding proactively. "The IRI has its roots in strong climate science, with a goal to enhance society's ability to understand and manage climate-related risks. That's why we're excited to again host a summer institute, bringing together a talented group of participants and our expert staff to explore the most effective ways to use climate information in decision making," Thomson says.

The 13 participants this year come from ten countries, including Ethiopia, India and China. They include heads of meteorological offices, laboratories and institutes, medical epidemiologists and researchers, program officers and medical advisors (see map for complete biographies). For two intense weeks, they will sit in on lectures and exercise sessions to introduce them to computational tools that integrate epidemiological data with available climate, population and environmental data. Download an agenda to see a full list of activities.

One of the organizers is Patrick L. Kinney, Mailman School of Public Health professor of Environmental Health Sciences and director of the Climate and Health Program at the Mailman School. Kinney will be lecturing on

the current impacts and future risks of climate change on health, as well as participating in a panel discussion on creating a "climate smart" global health community.

> *"The professionals attending the Summer Institute strive each day to improve the health care and health outcomes of people around the world."*
>
> *-- Mark Becker, CIESIN*

In addition to lectures, the participants will also attend numerous hands-on, practical training sessions, including one on IRI's powerful Data Library, a free tool that allows users to manipulate, view and download more than 300 data sets through a standard web browser.

Another practical session will be on how to use the global positioning system (GPS), geographic information systems (GIS) and Google Maps for public health, led by Mark Becker, associate director of CIESIN's geospatial applications division. "The professionals attending the Summer Institute strive each day to improve the health care and health outcomes of people around the world," Becker says. "Many of the issues they deal with have an inherent spatial component-for example, health care planning and understanding how climatic factors may contribute to disease. The course presents a unique opportunity to learn spatial analysis techniques to address these issues, and mapping skills to better communicate their message."

Exposure to these and other advanced techniques will hopefully provide the participants with a better understanding of how the climate and public-health fields can be integrated, says Gilma Mantilla, the Summer Institute's general coordinator.

"We've already seen an increase in demand for this type of training," says Mantilla. "We received 134 applicants for the 2010 course, and in the last year, we've helped organize summer institutes in Madagascar and Ethiopia. More are planned in every country where there are alumni."

Mantilla, who is the former deputy manager for Colombia's Public Health Surveillance and Control unit, believes the training course is a valuable platform for creating a global network of practitioners focused on policy and practice in public health and climate issues.

Permalink for this story:
***http://iri.columbia.edu/features/2010/climate_and_health_communities_training_together.html***

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# Climate Information Helps Prepare for Disasters *5.7.2010*

Members of the climate and humanitarian communities team up to improve disaster readiness and response. IRI

***by Cathy Vaughan***

Climate-related disasters can have a devastating impact on human life and development. Globally, climate events including floods, droughts, cyclones, heat waves and mudslides contribute to tens of thousands of deaths, hundreds of thousands of injuries and billions of dollars in economic losses each year. In recent years, it's become clear that such losses can be greatly reduced when climate information is used for early warning and preparedness. It's also increasingly clear that climate information is most effective when the climate and humanitarian communities work together.

To help bridge the gap between these two communities,the International Research Institute for Climate and Society has teamed up with the UN Office for the Coordination of Humanitarian Affairs (OCHA),the International Federation of the Red Cross and Red Crescent Societies (IFRC) and the Red Cross/Red Crescent Climate Centre. The team recently wrapped up its first activity: a two-day workshop in Nairobi, Kenya designed to give humanitarian actors in East Africa a better sense of the kinds of climate information tools available and provide concrete examples of how these tools can be used to inform disaster risk management.

With support from the IFRC, RC/RC Climate Centre, OCHA and the IRI, Meaghan Daly travelled to Nairobi to organize and run the workshop. A recent graduate of Columbia University's Climate and Society master's program, Daly currently serves as a technical advisor on climate-related issues. Her mission is to help members of the humanitarian community understand how climate information, properly used, can reduce the impacts of disasters on people's lives and livelihoods.

"There has to be an ongoing conversation between the humanitarian community and the climate community so that humanitarian agencies can learn what's available in terms of climate information products, and the climate scientists can determine what's actually needed," Daly says.

The workshop brought together staff from a number of nongovernmental and United Nations organizations (for a complete list, please download the workshop report). Representatives from the climate community, including the Kenya Meteorological Department and the IGAD Climate Prediction and Applications Centre, were also on hand to answer questions, give presentations and gain a better understanding of the needs of the humanitarian community.

This was critical because in order to be successful, communication between the climate and

humanitarian communities must go both ways. According to Daly, "One of the most important outcomes of the process was that we were able to summarize our workshop proceedings for the Greater Horn of Africa Climate Outlook Forum (GHACOF), essentially giving the humanitarian community an opportunity to speak directly to the climate community"

The forum, which currently occurs twice a year, convenes the Greater Horn climate community to formulate consensus forecasts for the region's March-to-May and September-to-December rainy seasons. Government representatives, including those from climate-sensitive sectors such as agriculture, health and water also attend the conference in order to gain a better sense of how the forecasts could help with their decision-making.

"Humanitarian actors have a clear interest in using top-notch climate and climate change science to help save lives and livelihoods, but it isn't always clear to nonspecialists how to do that," says Jenty Kirsch-Wood, a humanitarian affairs officer at OCHA.

As for the workshop, Kirsch-Wood says that "OCHA is interested in making sure we can use projects like this to inform our own policies and action, but also to increase the access of the wider humanitarian community to information that can help us collectively prepare and respond to hazard-related disasters"

To help humanitarian actors get comfortable using climate information, the workshop speakers highlighted several new forecast products and outlined ways in which they could be incorporated into planning. Workshop discussions also explored factors that prevent humanitarian organizations from making better use of the products already available.

Importantly, the workshop marks the first step toward the next issue of IRI's Climate and Society publication. The lessons learned from the workshop will be folded into the upcoming publication, A Better Climate for Disaster Risk Management, to be published in partnership with the IFRC, RC/RC Climate Centre, OCHA, the World Food Programme and the US National Oceanic and Atmospheric Administration early in 2011.

"The long-term goal, really, is for the humanitarian community to be better able to prepare for and respond to climate-related disasters. This requires sustainable, active partnerships between the local humanitarian and climate communities so that they can work effectively together in practice. We hope the workshop, the partnership and the publication all contribute to that," explains IRI's Molly Hellmuth, who oversees the Climate and Society publication.

> *"Humanitarian actors have a clear interest in using top-notch climate and climate change science to help save lives and livelihoods, but it isn't always clear to nonspecialists how to do that."*
>
> *-- Jenty Kirsch-Wood, UN OCHA*

The lessons learned will also be incorporated by the conference partners. Over the next few years, IRI, IFRC, and OCHA will work together to develop new climate information products for East Africa, including a regional online map room and near-term climate change projections.

"We are trying to address the problem of climate information that is currently available but may be very difficult to use," explains IRI's chief climate scientist Simon Mason. "The key is to provide forecasts of what the users care about rather than what the forecasters care about"

As for Meaghan Daly, her efforts to make sure climate information is used for humanitarian decision-making will now take her to South Africa and parts of Southeast Asia. "The key is to engage local actors in constructive dialogue. What really matters is communication. When the humanitarian and climate science communities start interacting, the result is improved information that leads to action"

*Cathy Vaughan is a program coordinator at the IRI. She is a member of the Climate and Society Secretariat and a frequent contributor to the Earth Institute's Climate Matters@Columbia blog.*

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# Creating More Useful Forecasts *4.15.2010*

Simon Mason describes the theory behind CPT.
Ashley Curtis/IRI

***By Ashley Curtis***

Seasonal forecasts can be effective tools for agricultural planners, water resources managers and other decision makers. For example, after torrential rains and floods wreaked havoc in the West African nation of Ghana in 2007, displacing some 400,000 people there, the regional office of the International Federation of Red Cross and Red Crescent Societies started using seasonal rainfall forecasts as part of its planning operations. When similar flooding occurred in 2008, the office was well-prepared and was able to save lives and livelihoods, as well as reduce the costs of providing relief to those affected.

Despite major advances in seasonal forecasting capabilities, the use of these forecasts is still fairly limited, especially in developing countries, where climate scientists often lack the resources or expertise to customize forecasts for specific needs. To address this issue, the IRI and its partners have led training workshops for professionals around the world for the last eight years. One recently took place in Beijing, China.

Twenty five experts from meteorological and climate agencies in 17 countries took part in the two-week workshop, which was sponsored by the IRI and the World Meteorological Organization and hosted by the Beijing Climate Center. The participants learned how to use statistical approaches to seasonal forecasting and how to "downscale"– which is the process of teasing out regional and local details from the coarse resolution of global climate models. Just as importantly, the participants learned how to more effectively communicate forecasts and forecast quality to users such as health and agriculture planners back home.

"This workshop was our most important one to date," says Simon Mason, who runs IRI's Climate Program. "With the support of the WMO, we've aimed to develop experts around the world who could lead or assist in subsequent training activities, and who could provide technical support to colleagues in their region."

Central to the training was the Climate Predictability Tool (CPT), IRI's free downloadable application for making tailored seasonal climate forecasts (see earlier story). Mason and Michael Tippett created the CPT in 2002 specifically for meteorologists and other forecasters in developing countries who don't have access to powerful computers and other resources. The tool allows them to make usable, customized forecasts, complete with maps and charts, in a matter of minutes. It has been downloaded more than 1,200 times last year alone and has a strong global user community.

Mason and the other trainers encouraged the forecasters to think about how they could present

forecasts in a way that was most beneficial to their users. "National meteorological services in many countries could greatly improve their effectiveness by focusing more directly on the questions users ask of them rather than expecting the users to understand the default forecast formats," he says.

The participants in Beijing were treated to a new version of the CPT that included many enhancements requested by users around the world. In fact, Mason says most of the changes made to the program since its creation have come from the user community. "The CPT is designed for operational forecasters, who often have to make regular predictions with limited resources and minimal time. We pay close attention to their suggestions so that the software provides them with the outputs they need," he says.

> *"National meteorological services in many countries could greatly improve their effectiveness by focusing more directly on the questions users ask of them rather than expecting the users to understand the default forecast formats.""*
>
> *-- Simon Mason*

Close attention indeed: during the workshop, one of the participants, Philip Aming'o Omondi from Kenya, thought it would be useful if he could compare forecasts to conditions that occurred in definable 'base' years. Within a couple of days, Mason had rolled this feature into the software. He also tweaked the program so that it was more compatible with Spanish and Portuguese versions of the Windows operating system. Thanks to Omondi's suggestion and Mason's quick response, another participant, Juan Jose Nieto, was able to generate a forecast for his native Ecuador that showed how conditions in the upcoming rainy season compared to those experienced in 2007 and 2008. This feature was so useful that Nieto, who works at International Research Centre on El Niño (CIIFEN), was able to convince national meteorological services in the region to begin issuing some of their forecasts in this manner-something which was easy to implement because many of them are already using CPT to produce their operational seasonal forecasts.

The recent IRI-WMO Workshop participants now join a set of worldwide trainers and regional experts in producing high quality, tailored forecasts in user-friendly formats. Like Nieto and Omondi, they're passing this knowledge on to their colleagues. These are vital steps in strengthening the communication of climate information to climate-sensitive sectors such as public health, and agriculture, ultimately enabling more effective climate-related risk management practices.

*Ashley Curtis is a Staff Associate at IRI. She coordinates the Climate Program and contributes to research, education and outreach efforts.*

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## New Program Aims to Mitigate Climate Threats to Food Security *3.23.2010*

Simon Mason describes the theory behind CPT.
Ashley Curtis/IRI

A new multimillion dollar research program by the Consultative Group on International Agricultural Research aims to alleviate climate-related threats to the food security, livelihoods and environment of people living in the developing world. One of the key intellectual forces behind this initiative has been the International Research Institute for Climate and Society's Jim Hansen. He'll be leading efforts within the program to look at how managing current climate risks will help farming communities adapt to longer term climate change.

The CGIAR-- a network of agricultural research centers that supports thousands of scientists in more than 100 countries-- considers climate change an "immediate and unprecedented threat" to the food security of hundreds of millions of people who depend on small-scale agriculture and natural resource management. To address this threat, it has created a ten-year Challenge Program on Climate Change, Agriculture and Food Security (CCAFS) [pronounced SEE-cafs] to explore new ways of helping vulnerable communities adjust to global changes in climate as they relate to food security. The program's annual budget is expected to ramp up to $25 million by its fifth year.

Hansen, an expert on climate risk management for agriculture, sees the new program as a way to foster collaboration between people concerned with climate change adapatation and those concerned with development.

"Climate-related risk is a major contributor to poverty and food insecurity, and an impediment to agricultural development efforts, particularly in rain-fed farming systems in the dryer tropics," he says. "Well-designed, well-targeted research, in the context of an international development strategy, can have a huge impact." And with CCAFS, he will have an opportunity to shape a program of high-impact research.

He is leading a research theme called Adaptation pathways based on managing current climate risk (see accompanying box), one of six themes under CCAFS. Three of the themes seek to understand the ways in which climate change threatens food security; the other three, including Hansen's, will try to develop ways to address these threats.

The theme leaders come from a number of influential global centers of research, such as the International Food Policy Research Institute (IFPRI), the International Livestock Research Institute (ILRI) and the International Centre for Tropical Agriculture (CIAT).

"CCAFS is about tackling two of the major global problems humanity faces at the moment," says the program's director, Bruce Campbell. "One is food security and the other is climate change."

This involves bringing together two very different communities of researchers under a common set of goals, Campbell says.

> *"In the agriculture world, the Consultative Group is the actor, and having the IRI engaged at this level is a dream come true. Our science now has the potential to inform millions of people."*
>
> *-- Walter Baethgen*

"The climate science community has tended to focus on what's going to happen in 2050 or 2100, but with respect to food security issues, that [time scale] is almost useless," he says. "We really have to focus on the near term, and that's why IRI was part of the equation in terms of putting CCAFS together. It's one of the few places where there's a focus on near-term prediction."

Hansen's high-level role within CCAFS represents a milestone for IRI, says Walter Baethgen, who runs IRI's Latin America and Caribbean program. "In the agriculture world, the Consultative Group is the actor, and having the IRI engaged at this level is a dream come true. Our science now has the potential to inform millions of people," says Baethgen, who also served on the CGIAR's Science Council created to provide guidance to the group's overall strategy.

Hansen expects to build on the kind of research IRI has already undertaken. "For example, we've worked for years to connect climate information services and products to rural communities in places such as India, Kenya and Zambia." he says. "We've learned much about the challenges to using information to manage agriculture better, as well as the opportunities to overcome those challenges."

This new role for Hansen builds on a 14-year career that has focused on issues important to the rural poor. During his first year in college, he developed a passion for trying to reduce suffering from poverty and hunger in rural areas. This continues to be the underlying motivation for his work.

As do many in his field, Hansen points to Norman Borlaug as a key source of inspiration. Borlaug, who died last September, is known as the "father" of the Green Revolution.


"He was a superhero in our profession, attributed with saving more lives than any other individual in history. People credit him with saving a billion lives by catalyzing the Green Revolution, which tripled global food production in a period when the planet's population roughly doubled," he says. The CGIAR was a significant driver of the Green Revolution.

While the Green Revolution had a huge impact in the irrigated areas of Latin America and Asia, Hansen points out that it has been less effective in the more marginal, rainfed areas, particularly in sub-Saharan Africa and parts of South Asia. "I think this is where the exciting targets are for intervention now. A lot of people see food security, especially in Africa and elsewhere in the tropics as the challenge of climate change in the coming decades."

> *"A lot of people see food security, especially in Africa and elsewhere in the tropics, as the challenge of climate change in the coming decades."*
>
> *-- James Hansen*

To this end, the CCAFS program will target three regions for initial research South Asia's Indo-Gangetic Plains, Eastern Africa and Western Africa but the aim is to find solutions that go beyond specific locations. "The strategy is to address knowledge gaps and to develop international public goods that can be implemented and applied elsewhere in world," Hansen says.

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# Climate Risks in Haiti *2.10.2010*

Citée Renault camp for displaced people at the edge of Port-au-Prince. Joe Lowry/IFRC

In this Q+A, IRI staffers discuss some of the climate-related risks that could affect Haitians over the next year as they struggle to rebuild their country after a devastating earthquake in January. Currently, about 1.2 million Haitians are without proper shelter, and an additional 470,000 have been displaced from their homes, according to the U.N. Office for the Coordination of Humanitarian Affairs (latest updates). This situation leaves them vulnerable to storms and extreme weather events in the coming months.

**Q: What is Haiti's climate like?**

Tony Barnston: Haiti is a tropical island with daily temperatures that range, on average, from 19°C to 28°C (67°-83°F) in winter, to 23°C to 33°C (73°-92°F) in summer, in lowland areas. Average annual rainfall varies, from almost none in some areas to more than 127 centimeters (50 inches) in Port-au-Prince. The two rainy seasons that Port-au-Prince experiences are from April to June and from August to mid-November. The dry season runs from December to April. The country is subject to periodic droughts and floods, which are made worse by deforestation. Hurricanes also periodically threaten the country.

**Q: We're currently in an El Niño period. Is this expected to change the climate outlook for Haitians?**

Tony Barnston: Haiti's rainy season is long. As I mentioned above, it actually has two peaks, with a brief period in July that has relatively lower rainfall. We expect the current El Niño to persist through at least March, and possibly through May. During times of El Niño, the region around Port-au-Prince tends to get above-normal rainfall from late winter to around May. But we can't be sure the El Niño will still exist in May. We'll have a better idea in the coming months.

Alessandra Giannini: Let's remember that we are talking about the impact of the El Niño-Southern Oscillation (ENSO) in its weakening phase, which is different from that in its growing phase. Right now, El Niño's impact on Haiti is mostly indirect, resulting from warming in the tropical North Atlantic over the past six months. That's why we also need to consider North Atlantic atmospheric circulation, captured in something called the North Atlantic Oscillation. The NAO was in its negative phase in December 2009, meaning that trade winds were weakened. This situation contributed to ocean warming, because there was less evaporation happening on the surface waters. So if the NAO lasts in its negative state from December to March, it will favor the continuation of these warm conditions, which are the basis for the above-normal rainfall predictions that Tony mentioned above.

**Q: And what about the second half of the rainy season~ after July?**

Tony Barnston: The rainfall expectation for the second half of Haiti's rainy season will depend in part on the direction of the ENSO state this summer~ will it be toward another El Niño, La Niña or neutral? At this time of year we currently have poor predictability for ENSO beyond about May or June. An unfavorable scenario for Haiti would be for the development of La Niña during the summer. It would not only imply a wet second half of its rainy season, but also the chances for a tropical hurricane in the vicinity, or even a hurricane hit. As these maps show, La Niña conditions tend to not only increase the total number of hurricanes in the Atlantic, but also increase the number that cut across the Caribbean. In 2008, Tropical Storm Fay, Hurricane Gustav, Hurricane Hanna and Hurricane Ike pounded Haiti, leaving widespread destruction and displacing hundreds of thousands of people.

**Q: So climate conditions could give Haitians more problems in a few months, but it's still too early to tell?**

Tony Barnston: That's right, we'll have better information in forecasts we issue over the next few months.

**Q. How will having this information ahead of time help reduce Haiti's climate risks?**

Walter Baethgen: Information and forecasts are most useful when they can be added to existing practices or methods. Information may not help if there isn't a mechanism in place that can use it to improve preparedness and response, or if it reaches a population that is extremely vulnerable, as in Haiti's case. Haiti is an example where much work is needed in vulnerability reduction at many levels. Unless these vulnerabilities are reduced, climate information isn't going to do much good.

Before we get too far, it's very important we define what we mean by "risk". Simply put, risk has two components: hazards and vulnerability. Hazards are the things that threaten: hurricanes, heavy rains, earthquakes, etc. Vulnerability is how susceptible a society is to damage, loss of life, epidemics and other possible consequences of those hazards. Poor building codes, widespread malnutrition, poor sanitation, are all elements that can make a society more vulnerable. We can think of risk then as the likelihood that a society will suffer damages from hazards based on its overall vulnerability.

**Q: How do you reduce risks then?**

Walter Baethgen: Reducing risks could be achieved by reducing the hazards, but in the case of climate this usually isn't possible~one can't reduce the chances of having El Niño or a hurricane. Another way is work on reducing the vulnerability, for example, reducing the number of people who live on steep slopes, in flood plains and other areas sensitive to storms. We can also reduce vulnerability by having structures like early-warning and early-response systems and institutions that are well prepared and react fast in the event of a disaster.

Molly Hellmuth: The other thing about risks is that they vary by hazard, which means the way to reduce vulnerability of the population at risk also varies. An effective risk reduction strategy for Haiti must consider all the multiple hazards, stressors and risks that threaten the country.

**Q. What do you mean by 'stressors'?**

Molly Hellmuth: Stressors such as endemic poverty, ineffective governance and institutions, limited access to capital, ecosystem degradation and conflicts. They all combine to exacerbate vulnerability to hazards. IRI's next Climate and Society publication will be about disaster risk management and how we can better inform disaster preparedness and response through improved understanding of climate information across time scales.

**Q: IRI and other institutions will be putting out forecasts and other types of information relevant to Haiti in the coming months. What are some of the most effective ways for this information to be used in the short term, given that restoration and rebuilding efforts will be far from complete in 2010?**

Walter Baethgen: Well, the information needs to be useful across time scales. For rebuilding, there's a need to consider the multiple hazards and risks that Molly mentioned. In the immediate future, the information should feed into the emergency and early warning/response systems that are available now in Haiti. It will be useful to the International Federation of Red Cross and Red Crescent Societies and other humanitarian organizations, for example. They need to be aware that as desperate as the conditions are right now, new hazards and socioeconomic damage are possibilities in the near future due to adverse weather and climate conditions that may affect food production, health conditions and water supplies. Going back to the concept of risk that we discussed before, any new hazard in the near future will find Haiti in a situation that is even more vulnerable than usual, given the devastating effects of the earthquake, and therefore the risks are huge.

**Tony Barnston** is IRI's lead forecaster and an expert on ENSO variability.

**Alessandra Giannini** has researched the impact of ENSO on tropical Atlantic variability, working on regions particularly vulnerable to climate variability, including the Caribbean islands.

**Walter Baethgen** is the director of IRI's Latin America and the Caribbean Program.

**Molly Hellmuth** is the director of the Climate and Society Publication Secretariat.

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# Climate Information and Humanitarian Assistance *12.13.2009*

Citée Renault camp for displaced people at the edge of Port-au-Prince. Joe Lowry/IFRC

The International Research Institute for Climate and Society, the International Federation of Red Cross and Red Crescent Societies and the Red Cross/Red Crescent Climate Centre produced a short video for COP 15 called Using Climate and Weather Forecasts to Improve Humanitarian Decision Making. In the video, staff from the three organizations detail how they have been working together to incorporate seasonal forecasts and other climate information into the IFRC's humanitarian-preparedness and response operations. They also discuss a specific example of when a seasonal forecast was used for early action on flood preparedness in West Africa in 2008.

The video looped on the iSeeT @ Climate Change Kiosk in the Bella Center, December 14 & 15. Watch it here now, or share it with your colleagues and friends via the IRI multimedia page.

To read more about the collaboration between the IRI and IFRC, see here and here. To learn more about the IFRC's Early Warning, Early Action strategy visit here.

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*Selected Features* . November 2009 - October 2010

## Climate and Meningitis in Africa A Google Earth Tour *12.7.2009*


A still from Google Earth's Climate & Health in Africa video narrated by IRI's Judy Omumbo.

The International Research Institute for Climate and Society and Google are offering a guided tour of Africa to teach you about the relationship between climate and deadly meningitis outbreaks there. No need to pack your bags, though: it's a virtual tour, one you can run on Google Earth from your living room.

The climate and meningitis tour is one of a number that Google has launched for the Conference Of the Parties in Copenhagen, Denmark, known as COP15. Al Gore gives the introductory tour, called "Confronting Climate Change". Google.org will be also hosting a briefing about the tours at the Climate Change Kiosk in Copenhagen's Bella Center on December 10, 11 a.m.

Through the Google Earth application, users can explore the potential impacts of climate change and some the solutions for managing it.

"The IRI tour integrates real climate data, beautiful imagery and the collaborative narration of a host of climate and health experts," says Kiersten Jennings Chou, who worked with IRI staff and Google to create the tour. "It is a powerful tool to allow people around the world to visualize the impact of this devastating disease," she says. Jennings Chou is a former eighth-grade science teacher and recent graduate of Columbia University's Masters Program in Climate and Society.

Users can download the Google Earth application here (please check system requirements). Then they can download the IRI tour file and play it from within Google Earth. Narrated by IRI scientist Judy Omumbo, the IRI tour takes users across Africa, discussing the impacts of meningitis outbreaks and the role that climate plays in their occurrence. Users will be able to pause the tour at any time, turn on a variety of layers such as roads and placemarks, and zoom in on any spot along the way.

Alternatively, users can watch a recorded video of the tour embedded on this page or on YouTube without having to install Google Earth, but will lose the interactivity.

Meningitis outbreaks occur yearly in 25 countries in sub-Saharan Africa, primarily in the 'Meningitis Belt', which stretches from Senegal to Ethiopia. They place undue strain on the overtaxed health systems of these countries. Every few years, the outbreaks rise to epidemic proportions that have a devastating impact, especially on impoverished communities. In 2009, for example, there have been more than 55,000 cases in northern Nigeria and nearly 14,000 in neighboring Niger, according to the World Health Organization.

The epidemic form of the disease is caused by bacteria that attack the membranes surrounding

the brain and spinal cord. Meningitis kills approximately one in ten of its victims, and leaves many survivors with lifelong disabilities. Despite these tragic statistics, the mechanisms that drive the dynamics of this dry-season disease are still not completely understood. Meningitis can be prevented through vaccination, but in order for the vaccine to be effective, it must be given before outbreaks occur. Researchers at IRI are using their expertise in health and climate forecasting and modeling to try to help decision-makers stay one step ahead of the outbreaks. They are providing scientific and practical support to the Meningitis Environmental Risk Information Technologies (MERIT) project.

"Bacterial meningitis is a devastating climate-sensitive disease, and the climate community has something to contribute toward its control," says Madeleine Thomson, who is the chair of IRI's Africa Program and who sits on the MERIT steering committee. "MERIT is a collaborative effort between the health and climate community designed to serve decision-makers at the local level. The collaboration brings together a wide range of scientific and operational expertise and is supported by many institutions besides the IRI." These include the World Health Organization, the World Meteorological Organization,Group on Earth Observations, the Health and Climate Foundation, the International Federation of Red Cross and Red Crescent Societies and, most significantly, the Meningitis Vaccine Project. The third international MERIT meeting recently took place in Niger, hosted by the African Centre for Meteorological Applications in Development and the Centre de Recherche Médicale et Sanitaire. Please visit the MERIT home page for the latest information.

The Google Earth tour references some of this important work. It also pulls in climate data from the IRI's Climate Data Library, a powerful and freely accessible collection of online tools which allows users to view, analyze and download more than 400 climate-related data sets through a standard web browser.

"Connecting Google Earth to the Data Library provides users with seamless access to climate data," says Data Library manager, Benno Blumenthal, "Users can request portions of a dataset or perform analyses with the data, and have those results transferred to Google Earth with a simple click."

The tour is the latest in a number of collaborations between the IRI and both Google and its philanthropic arm, Google.org. One project is improving the use of forecasts, rainfall data and other climate information in East Africa, and building stronger connections between weather, climate and health specialists so they can better predict and prevent outbreaks of infectious diseases. Another project, led by the University Corporation for Atmospheric Research, aims to use weather forecasting to predict delays in the end of the meningitis season in West Africa and thereby help identify populations in most need of vaccination.

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# Selected Abstracts

The following pages present selected abstracts of work keyed to the topic and region icons shown below. Abstracts are organized with efforts that relate to climate and forecasting topics followed by work that relates climate analyses with specific problems in regions. These merge into work that utilizes remote sensing and/or environmentally monitored data to supplement climate information as needed to address climate-sensitive problems in regions with observational data paucity. Work involving the forecasting of societal or sector outcomes follows, with learning also translated into work to develop or improve educational materials, tools, data resources, and training opportunities. The section concludes with summaries of significant collaborative work with partners and/or in regions. Throughout, the contributions link by at least one key word icon.

## Key Word Icon Legend

 Agriculture & Food Security

 Climate

Climate & Society Publication

 Data Library & Maprooms

 Economics & Livelihoods

 Education & Training

 Remote Sensing & Environmental Monitoring

 Fire Management

 Forecasting

 Public Health

 Book Publication

 Water Management

 Asia Region

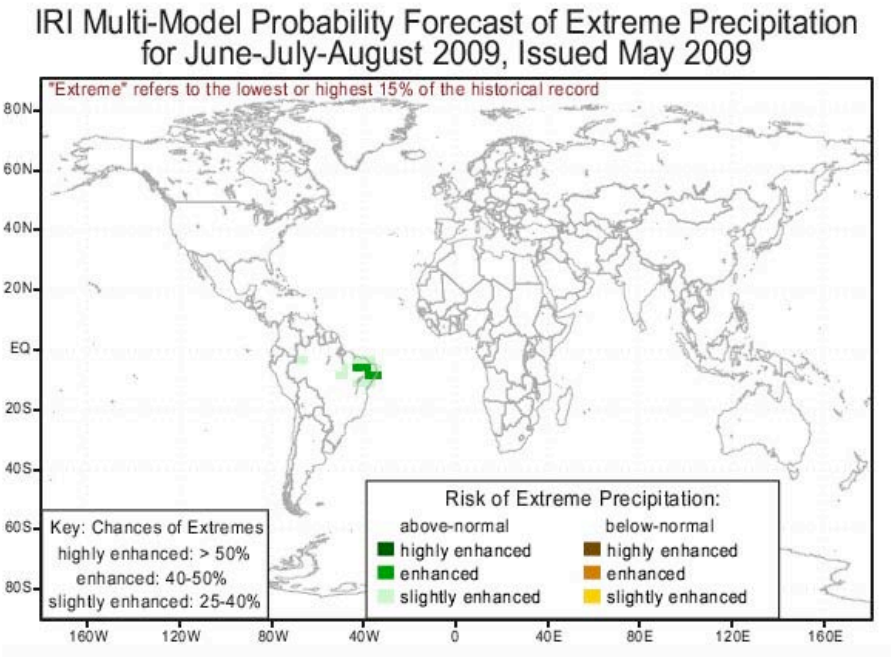
 Latin America Region

 Africa Region

# Evaluation of IRI's Seasonal Climate Forecasts for the Extreme 15% Tails

In addition to IRI's tercile-based probabilistic seasonal forecasts of near-global precipitation and temperature beginning in October 1997 (Mason et al. 1999), forecasts for events falling into the lower or upper 15 percentiles of the climatological distribution began being issued in 1998. Based on the same model output as the standard forecasts, forecasts for the 15% tails are issued only for the season having the shortest lead-time. These forecasts are provided for users particularly sensitive to climate events farther away from the climatic average than can be specifically represented by the tercile-based categories.

Three gradations of probability enhancement above the 15% climatological level are defined for the 15% tail forecasts: "slightly enhanced" (defined by probabilities of 25-40%), "enhanced" (40-50%), and "greatly enhanced" (≥50%). Together with the climatological neutral default, this forecast format was chosen to make the forecasts more easily understood by users, and because of the greater uncertainty associated with forecast probabilities in the outer portions of the climatological distribution.

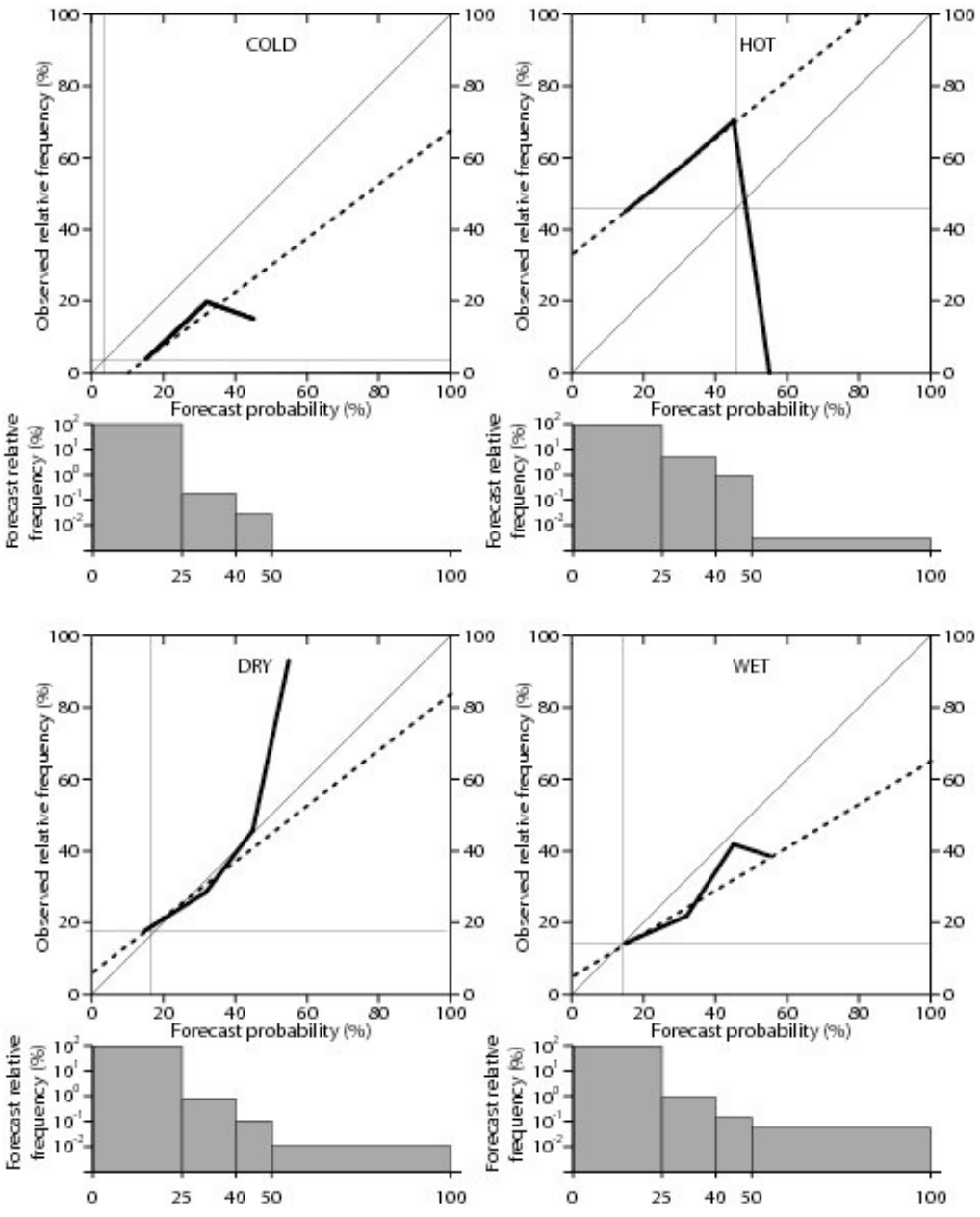



Example of a forecast for the 15% precipitation extremes, issued in May 2009 for June-July-August 2009. An area of enhanced (40-50%) probability for above-normal rainfall is indicated in part of northeast Brazil, surrounded by some area of slightly enhanced (25-40%) probability.

An example of a forecast map for the extreme 15% tails for precipitation is shown in the above figure. Forecasts for the 15% extremes were issued conservatively, resulting in spatial coverage averaging less than 5% for both precipitation and temperature, with largest coverage in the tropics. Hence, many occurrences of upper and lower 15% of precipitation and temperature were not forecast. However, within the set of extremes forecasts that *were* issued, largely satisfactory resolution and favorable calibration are shown by a reliability analysis (see figure below). Nonetheless, two notable weaknesses are that forecasts for extreme above-normal precipitation were somewhat overconfident, and that 15% above normal temperature extremes were substantially underforecast. This second finding has been noted also in IRI's standard tercile probability forecasts (Goddard et al. 2003; Barnston et al. 2010), and can be attributed in part to

the use of fixed (and outdated) $CO_2$ concentrations in the atmospheric general circulation models.

Improvements currently being implemented in IRI's forecast system are expected to benefit the forecasts for the 15% extremes. The new system performs multivariate rather than only local calibration of individual model forecast outputs prior to multi-model combination. Additionally, single-tiered (coupled) models are being introduced. Expected increases in forecast sharpness are resulting in larger coverage of areas of enhanced probabilities for the 15% tails.



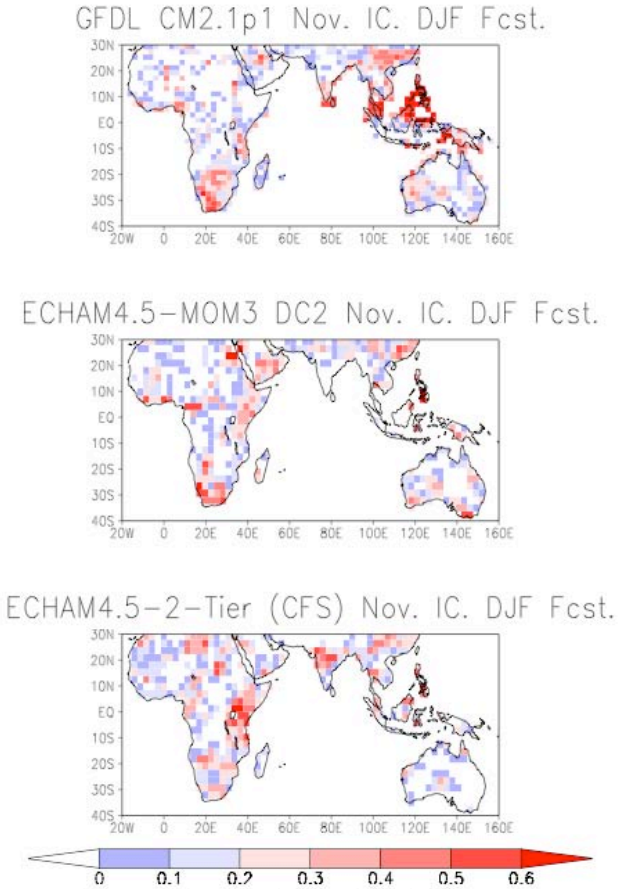

Reliability plots for forecasts of temperature (top) and precipitation (bottom) extremes in the tropics (25ºN–25ºS). The straight 45º line represents ideal reliability. The dashed line is the least-squares linear regression fit to the points forming the reliability curve, weighted by the sample sizes represented by each point. Horizontal and vertical lines are drawn at the observed relative frequency for the study period. Forecast probabilities are plotted at the midpoints of their respective probability intervals, except "neutral default" is plotted at 15% and "extremely enhanced" at 55% because values greater than 60% were never indicated. Sub-panels below each chart show the percentage frequencies with which the four forecast probability categories were forecast, with a logarithmic scale.

*Contributed by **T. Barnston** and **S.J. Mason***

# Development of a Seasonal Forecast System Based on the GFDL CM2.1p1 CGCM

IRI is developing a coupled-atmosphere-ocean general circulation model (CGCM) seasonal forecast system based on the Geophysical Fluid Dynamics Laboratory (GFDL) generalized vertical coordinate Coupled Model Version 2.1 (CM2.1p1; Delworth et al., 2006; Griffies, 2009). Work so far has concentrated on examination of different initialization strategies and testing of physical parameterizations. The goal of this work is to optimize the forecast skill for the global Tropics, both in terms of sea surface temperature (SST) and near-surface air temperature and precipitation. Initialization strategies explored so far include coupled initialization (as done for example by Keenlyside et al., 2005; and Luo et al., 2005), nudging of sub-surface temperature and salinity from the GFDL Ensemble Kalman Filter Assimilation System (Zhang et al., 2007), and ocean initialization using surface fluxes from the NCEP Re-analysis2 (Kanamitsu et al., 2002) data sets. Currently, nudging of sub-surface temperature and salinity from the NCEP ocean re-analyses products (Behringer et al., 1998; Saha et al., 2010) is being tested. Ocean physical parameterizations tested include the ocean vertical mixing, horizontal viscosity and horizontal neutral mixing. The parameter spaces being used for these parameterizations have been obtained from other researchers currently using MOM4 (including from GFDL and NCEP).

The IRI employs a multi-model ensemble (MME) seasonal forecast system which benefits from models having non-homogeneous skill among models. Currently, IRI runs a 2-tier (uncoupled) and a 1-tier (coupled) MME forecast systems. Work is currently being performed to merge these 2 forecast systems into a combined MME forecast system. The seasonal forecasts from the final configuration chosen for the CM2.1p1 will first be included in the 1-tier MME and then in the combined MME forecast systems. Forecast skill for 2 models currently being used for real-time forecasts at IRI are compared with those from the CM2.1p1 utilizing the simple coupled initialization strategy in the figure at right. The other models are: 1. An updated version of the directly coupled CGCM




Anomaly correlation coefficients (ACC) for December-January-February (DJF) forecasts starting from November initial conditions for years 1982-2007. Top panel: GFDLCM2.1p1. Middle panel: ECHAM4.5-MOM3 DC2. Bottom Panel: ECHAM4.5-2-Tier (CFS). Shading values are given in the color bar.

described in DeWitt (2005) which couples the Max Planck Institute for Meteorology (MPI) ECHAM4.5 (Roeckner et al., 1996) atmospheric general circulation model (AGCM) and the GFDL Modular Ocean Model Version 3 (MOM3; Pacanowski and Griffies, 1998) ocean model, denoted ECHAM-MOM3 DC2; 2. A 2-tiered forecast system based on the ECHAM4.5 AGCM forced with SST forecasts from the NCEP CFS (Saha et al., 2006), denoted ECHAM4.5-2-Tier (CFS). Shown in the figure is the anomaly correlation coefficient (ACC) for December-January-February (DJF) precipitation forecasts initialized from November 1 initial conditions (IC). It is clear from the figure that each of the models possesses a region of useful skill (here defined as an ACC > 0.3) not found for the other models. For example, the CM2.1p1 has skillful forecasts over the Maritime Continent and southern India which are unique. The ECHAM-MOM3 DC2 has a skillful region in Southern Africa including the coastal regions, while the ECHAM4.5-2-Tier (CFS) has skillful regions over central and northern India and eastern Africa.

*Contributed by **D.G. DeWitt***

## The Generalized Discrimination Score for Ensemble Forecasts

Mason and Weigel (2009) introduced a Generalized Discrimination Score, D, which is based on a two-alternative forced choice test, for use in the verification of forecasts. D quantifies whether a set of observed outcomes can be correctly discriminated by the corresponding forecasts, i.e. it is a measure of the skill attribute of discrimination. Discrimination is one of the most fundamental attributes of prediction skill in that it measures whether forecasts differ when their corresponding observations differ. While forecasts with high discriminative power may still be subject to systematic errors (e.g. bias, overconfidence) and may require (re-) calibration to become useful, forecasts lacking discrimination are useless by principle. Discrimination can therefore be considered as a necessary, but not sufficient, attribute of prediction skill. It does not tell us how good a set of forecasts is if taken at face value, but rather how useful a set of forecasts can potentially be after appropriate calibration and post-processing.

Due to its generic definition, D can be adapted to essentially all relevant verification contexts, ranging from simple yes-no forecasts of binary outcomes to probabilistic forecasts of continuous variables. For most of these cases, Mason and Weigel (2009) derived expressions for D, many of which have turned out to be equivalent to scores that are already known under different names. However, no guidance was provided on how to calculate D for ensemble forecasts. This gap is aggravated by the fact that so far hardly any other measures of discrimination exist that could be directly applied to ensemble forecasts without requiring that probabilities be derived from the ensemble members prior to verification. We address this gap by proposing a definition of how ensemble forecasts can be ranked; the ranks of the ensemble forecasts can then be used as a basis for attempting to discriminate between corresponding observations (Weigel and Mason, 2010). Given this definition, formulations of D are derived which are directly applicable to ensemble forecasts. With these formulations of D, it is possible to calculate discrimination for a set of ensemble forecasts without requiring that the ensemble members are transformed into

probabilistic forecasts prior to verification. This has the advantage that the skill values obtained are not shadowed by potentially inappropriate assumptions concerning probabilistic ensemble interpretation.

*Contributed by A.P. Weigel and* ***S.J. Mason***

## Diagnosing Errors of the Upper Indian Ocean Temperature Forecasts with NCEP-CFS

Errors in the Indian Ocean SST forecasts with the National Centers for Environmental Prediction Climate Forecast System (NCEP-CFS; Saha et al., 2006) are investigated. It is found that biases in the surface heat flux, vertical velocity and stratification are the major sources of the forecast errors.

The forecasts of upper ocean temperature from the NCEP-CFS in the eastern Tropical Indian Ocean (ETIO) are compared with the Global Ocean Data Assimilation System (GODAS; D. Behringer et al., 2005, unpublished manuscript) which is assumed to represent a realistic estimate of the observed state. An analysis of each term in the thermodynamic energy equation is carried out to investigate the upper ocean heat balance. This is written as:

$$\rho c_p \int_{-d}^{0} h \left[ \frac{\partial T}{\partial t} = -u\frac{\partial T}{\partial x} - v\frac{\partial T}{\partial y} - w\frac{\partial T}{\partial z} \right] dz + \left( Q_{net} + R \right) \qquad eq.1$$

$$(g) \qquad (a) \qquad (b) \qquad (c) \qquad\qquad (f)$$

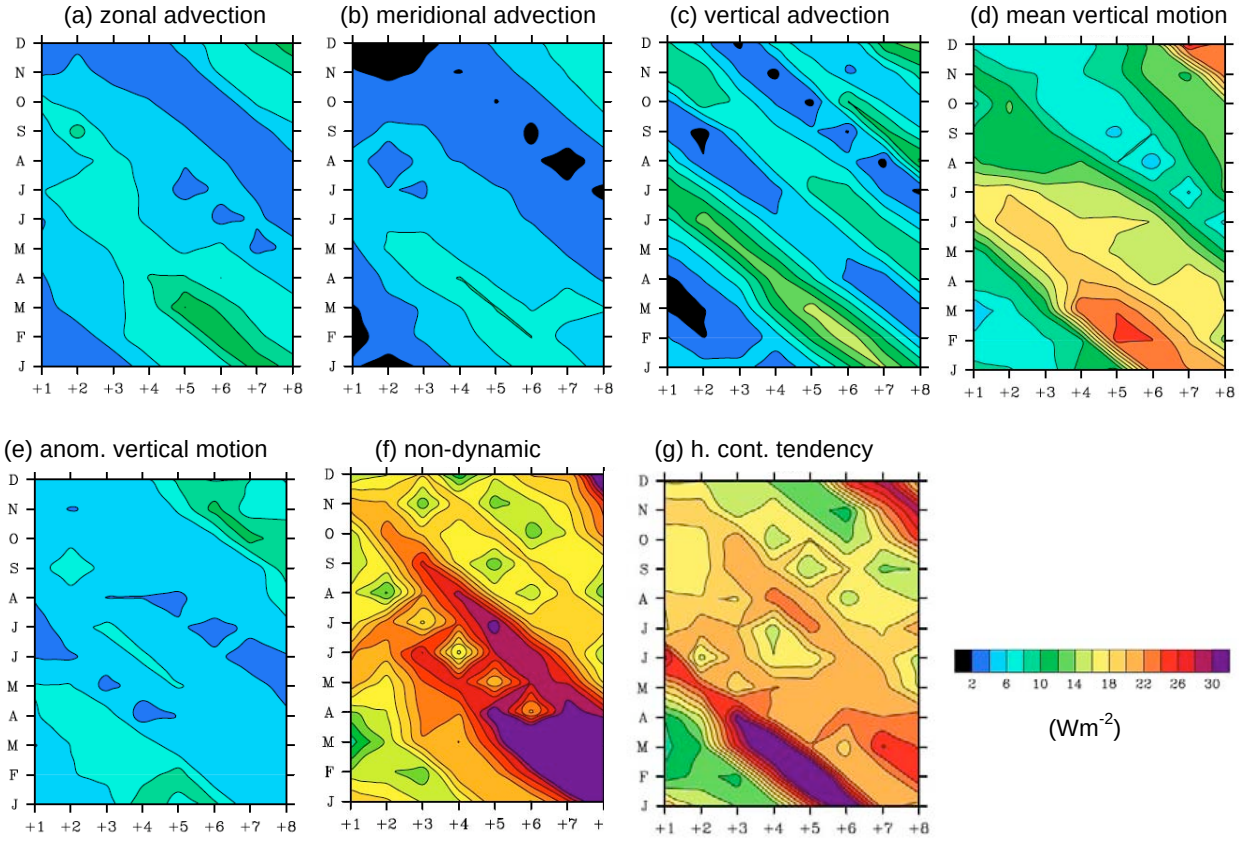
, where d indicates the bottom of the mixed layer, and h is the vertical thickness of each grid box. ϱ is the density of sea water, $c_p$ is the specific heat, T is temperature, u is zonal velocity, v is meridional velocity, w is vertical velocity, $Q_{net}$ is the net surface heat flux, and R is the residual which consists of missing physical parameterizations and errors in the calculation due to use of monthly mean data. The letter in the parentheses below each term in Eq. 1 corresponds with the panels in the figure below. For each initial condition month from January to December, the local tendency of the mixed layer heat content anomaly (see panel (g) of figure) consists of 3 dimensional ocean dynamics (panels (a), (b) and (c)), and non-dynamical processes (panel (f)), which is the sum of the net surface heat flux and residual terms. For this region it has been verified that the dominant error for the non-dynamical processes is the surface heat flux (not shown).

The largest error after the heat-flux is found to be the vertical advection (panel (c)). In the boreal spring, when the forecasts tendency of mixed layer heat content has the largest error, the vertical advection has the largest contribution to the error. Meanwhile, the error in boreal autumn is found to be dominated by the heat flux. Linear decomposition of the vertical heat advection term is carried out as follows:

$$\rho c_p \int_{-d}^{0} h \left[ -w\frac{\partial T}{\partial z} = -\overline{w}\frac{\partial T'}{\partial z} - w'\frac{\partial \overline{T}}{\partial z} - w'\frac{\partial T'}{\partial z} \right] dz \qquad eq.2$$

$$(c) \qquad (d) \qquad (e)$$

, where the overbar indicates climatological monthly mean, the prime indicates the deviation from the monthly mean. The last term, which represents nonlinear advection, is omitted for it explains less than 10% on average of the error in the total vertical advection.



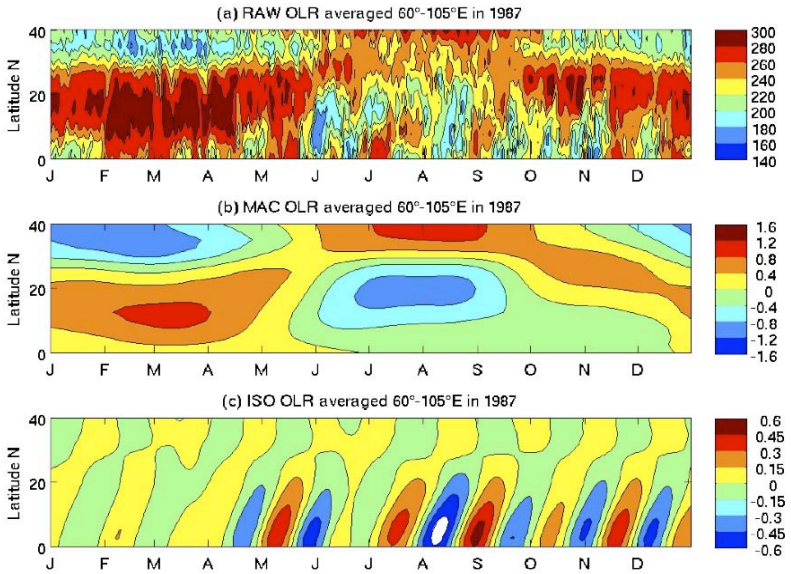

Root-mean-squared-errors of the tendency of mixed layer heat content anomalies (Wm-2), in (a) zonal advection, (b) meridional advection, (c) vertical advection, (d) anomalous heat advection by the mean vertical motion, (e) vertical heat advection by anomalous vertical motion, (f) non-dynamic term including surface heat flux and residual terms and (g) the total tendency. Y axis indicates each initial condition month, from January to December upward. X axis indicates the lead time in month. Averaged in the Eastern Tropical Indian Ocean area (12°S~0, 88°E~110°E).

The linear decomposition reveals that the larger part of the vertical advection error for most initial condition months and leads is due to the error in the vertical temperature stratification (panel (d)) but the error in the vertical motion (panel (e)) makes a significant contribution during those times when the vertical advection error is largest. Further work is being conducted to better understand these errors.

*Contributed by **D.E.Lee** and **D.G. DeWitt***

# Modulated Seasonal and Intraseasonal Cycles of Indian Summer Monsoon and their Connections with Rainfall Variability

Variability of the Indian summer monsoon is decomposed in terms on an interannually-modulated annual cycle (MAC), together with a northward-propagating intraseasonal (30–60-day) oscillation (ISO), by means of multichannel Singular Spectrum Analysis (MSSA) applied to daily fields of outgoing long-wave radiation (OLR) and low-level winds over the Indian domain. An example of this decomposition is shown in the figure at right for the year of 1987. The impact of these components on rainfall is then analyzed using a 1-degree gridded daily dataset.




Decomposition of OLR daily variability over India during 1987, in terms of its leading spectral components. Shown are time evolutions in the meridional plane of zonally averaged [60E–105E] OLR anomalies (panel a: W/m$^2$), with the modulated annual cycle component (MAC, panel b, in standard deviations), and intraseasonal oscillation component (ISO, panel c, in standard deviations).

Active and break phases of monsoon rainfall variability are found to be well characterized by the linear superposition of the MAC and ISO components, while the relatively weak ISO component alone cannot account for them. Monsoon onset is shown to be sensitive to the phase of the ISO, except when the latter is delayed in which case the phase of the ISO is found to be much less relevant. The phase of MAC onset is shown to be highly correlated with a large-scale pattern of SST over the Pacific that resembles the Pacific Decadal Oscillation (PDO).

This study departs from previous work on the relationships between seasonal-mean rainfall anomalies and intraseasonal variability by expressing the former in terms of a seasonal cycle that is modulated from year to year; this framework clarifies their relative roles in accounting for intraseasonal rainfall variability.

*Contributed by **V. Moron** and **A.W. Robertson***

# Analysis of Intraseasonal and Interannual Variability of the Asian Summer Monsoon using a Hidden Markov Model

Intraseasonal and interannual variability of Asian summer monsoon rainfall in pentad precipitation data is examined using a Hidden Markov Model (HMM). The spatial patterns of discrete rainfall states derived with the HMM and the associated transition probabilities between the states are shown to represent well the principal Asian summer monsoon ISO, propagating eastward and northward with a period of 40–50 days. Stochastic simulations made with the HMM reasonably reproduce the canonical ISO propagation and its observed statistics such as the frequency of ISO events.

The interannual modulation of the ISO associated with El Niño-Southern Oscillation (ENSO) is assessed by employing a nonhomogeneous HMM (NHMM) with summer-mean NINO3.4 index prescribed as an input variable. ENSO influence on the ISO is found to manifest as preferences toward particular ISO phases depending on the ENSO condition, thus adding an asymmetry to the ISO. In the presence of seasonal mean anomalies, the El Niño seasonal mean rainfall anomaly pattern is identified by the HMM as a distinct state, in addition to the ISO states, whereas the La Niña seasonal mean rainfall anomaly pattern does not appear distinct from the ISO states (see also Yoo et al., 2010).

*Contributed by J.H. Yoo, **A.W. Robertson**, and I.-S. Kang*

# The Effect of Grid Spacing and Domain Size on the Quality of Ensemble Regional Climate Downscaling over South Asia during the Northeasterly Monsoon

We evaluated the performance of an ensemble-based dynamical regional climate downscaling over Southern Asia in a northeast monsoon season for choices in grid resolution and domain extent. We used a seven-member ensemble of the ECHAM4.5 global atmospheric general circulation model at a resolution of about 300 km (2.8125 degree) and the International Center for Theoretical Physics (ICTP) Regional Climate Model 3 (RegCM3) with grid resolutions of 100km, 50km, 25km and 20km, respectively. Unlike the rest of South Asia that garners most of its annual rainfall in the boreal summer, the southern most Indian states and Sri Lanka obtain a large fraction of its annual rainfall during the October to December season. We report in detail on the performance in Sri Lanka.

The size of Sri Lanka (about 432x224 km) is slightly larger than a gridbox of ECHAM and has mountain ranges that reach up to 2532 meters in altitude. Two sets of regional model runs were undertaken to assess the effect of grid resolution and model domain size on the downscaling

performance. We evaluated the skill in simulating the spatial distribution of precipitation and seasonal evolution. Our simulations show that the RegCM3 with 100km grid ('large-domain'), which estimates the peak of the mountains at less than 200m, is too coarse to capture orographic influences on the monsoon rainfall. The RegCM3 simulation with grid size from 20km to 50km ('small-domain') captures fine scale details resulted from the topographic effect on monsoon rainfall associated with the uplift condensation on the windward side. While the small-domain runs (where only the forcings for the region immediately around Sri Lanka - 4N-11N and 76E to 85E - were used) are computationally more efficient, the results are overly controlled by the lateral boundary driving of the ECHAM4.5 due to insufficient space for spinning up fine scales. As a result, the topographic precipitation is displaced compared to the observed precipitation.

The large-domain simulation used a domain comprising both land and ocean (approximately 4S-22N and 65E-96E). The large-domain group of simulations produced reasonable spatial distribution of precipitation over both land and ocean regions. Moreover, the uncertainties, represented by the ensemble spread among the seven realizations, are reduced in the large-domain high-resolution runs. Therefore, fine enough grid resolution (25 km or less) and sufficiently large domain size are both needed to simulate the essential features of precipitation in this tropical and monsoonal region.

*Contributed by **J.-H. Qian** and **L. Zubair***

## Downscaling of Seasonal Rainfall over the Philippines: Dynamical vs. Statistical Approaches

A longstanding yet very important question concerns the additional value derived from labor intensive regional climate models (RCMs) nested within GCM seasonal forecast models, over and above simple statistical methods of downscaling. In a collaborative study with the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and the European Center for Research and Education in Environmental Geoscience (CEREGE), we compare the two types of downscaling of precipitation 'hindcasts' over the data-rich region of the Philippines, using observed data from 77 raingauges for the April-June monsoon onset season. Spatial interpolation of RCM and GCM grid box values to station locations is compared with cross-validated regression-based techniques such as canonical correlation analysis. The GCM hindcasts are formed from an ensemble of simulations from the ECHAM4.5 model at T42 resolution made with observed SSTs prescribed, over the 1977 – 2004 period. The RegCM3 with 25km resolution is nested within each of a 10-member GCM ensemble over the Philippines. To first order, we find that anomaly correlation skill at the station scale for simulations of seasonal total rainfall and monsoon onset date is quite similar using all the techniques considered, including simple spatial interpolation of the GCM values. The RCM has significantly smaller RMS error than the 'raw' interpolated GCM, although statistical correction can greatly improve the latter.

*Contributed by **A.W. Robertson**, **J.-H. Qian**, **V. Moron**, **M. Tippett** and A. Lucero*

# Mechanisms for the East-West Dipole of Rainfall Variability Associated with ENSO in the Boreal Winter Season over Borneo Island

Using the Global Precipitation Climatology Centre (GPCC) gridded rain gauge observation, Climate Predictability Center Morphing technique (CMORPH) satellite estimates of precipitation, the NASA Quick Scatterometer (QuikSCAT) sea winds, and the National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) reanalysis data, we studied the opposite sign of interannual variability of precipitation between West and East Kalimantan over Borneo Island in Southeast Asia. Besides the well-known anomalous dry conditions that characterize the boreal fall season (September to November) during an El Niño year, analysis of rain gauge data show a dipolar structure of wet west versus dry east in precipitation anomalies associated with El Niño over Borneo Island during the boreal winter season (December to February).

Composite analyses of the 108-year GPCC data confirm the ENSO-related dipole pattern of anomalous rainfall over Borneo. By using the high-resolution (0.25 degree of longitude and latitude) and high-frequency (3-hourly) CMORPH satellite estimates of precipitation, it is found that rainfall over Borneo is strongly affected by the diurnal cycle of land-sea breezes. The spatial distribution of rainfall over Borneo also depends on the horizontal propagation of the diurnal rainfall maxima following the direction of synoptic winds. Weather typing analysis results indicate that this dipolar structure of rainfall anomalies associated with ENSO is caused by the variability in the frequency of occurrence of different weather types. Multi-scale processes of ENSO, large-scale monsoonal winds and local diurnal cycle of land-sea breezes are analyzed to understand the mechanisms for this heterogeneity of rainfall variability. Rainfall reaches diurnal maxima in late afternoon and then propagates downstream in the direction of synoptic-scale low-level winds.

In the December-February of El Niño years, the northwesterly Austral summer monsoon is weaker than normal in the Maritime Continent and easterly winds are more frequent than normal over Borneo, enhancing westward propagation of daily maximum rainfall over the island. On the other hand, the strong westerly monsoon weather types are less frequent than normal in El Niño years, which means that in the less number of days the maximum daily rainfall propagates from the central region toward east Borneo. This parity of rainfall propagation by different weather types explains why there is a wet west versus dry east in the rainfall anomaly pattern over Borneo Island in El Niño years.

*Contributed* ***by J.-H. Qian****,* ***A.W. Robertson*** *and* ***V. Moron***

# Interactions between ENSO, Monsoon and Diurnal Cycle in Rainfall Variability over Java, Indonesia

Using a high-resolution regional climate model RegCM3, station and satellite observations, we have studied the spatial heterogeneity of climate variability over Java Island, Indonesia. Besides the well-known anomalous dry conditions that characterize the dry and transition seasons during an El Niño year, analysis of regional model output reveals a wet mountainous south versus dry northern plains in precipitation anomalies associated with El Niño over Java during the peak rainy season. Modeling experiments indicate that this mountains-plains contrast is caused by the interaction of the El Niño-induced monsoonal wind anomalies and the island/mountain-induced local diurnal cycle of winds and precipitation. During the wet season of El Niño years, anomalous southeasterly winds over the Indonesian region oppose the climatological northwesterly monsoon, thus reducing the strength of the monsoon winds over Java. This weakening is found to amplify the local diurnal cycle of land-sea breezes and mountain-valley winds, producing more rainfall over the mountains, which are located closer to the south coast than to the north coast. Therefore, the variability of the diurnal cycle associated with this local spatial asymmetry of topography is the underlying cause for the heterogeneous pattern of wet south/dry north rainfall anomalies in El Niño years. It is further shown that the mean southeasterly wind anomalies in December to February of El Niño years result from more frequent occurrence of a quiescent monsoon weather type, during which the strengthened sea-breeze and valley-breeze convergence leads to above normal rainfall over the mountains.

*Contributed by **J.-H. Qian**, **A.W. Robertson** and **V. Moron***

# Oscillatory Climate Modes in the Eastern Mediterranean and Their Synchronization with the North Atlantic Oscillation

Oscillatory climatic modes over the North Atlantic, Ethiopian Plateau, and eastern Mediterranean were examined in instrumental and proxy records from these regions. Aside from the well-known North Atlantic Oscillation (NAO) index and the Nile River water-level records, the authors study for the first time an instrumental rainfall record from Jerusalem and a tree-ring record from the Golan Heights. The teleconnections between the regions were studied in terms of synchronization of chaotic oscillators. Standard methods for studying synchronization among such oscillators are modified by combining them with advanced spectral methods, including singular spectrum analysis. The resulting cross-spectral analysis quantifies the strength of the

coupling together with the degree of synchronization. A prominent oscillatory mode with a 7–8-yr period is present in all the climatic indices studied here and is completely synchronized with the NAO. An energy analysis of the synchronization raises the possibility that this mode originates in the North Atlantic. Evidence is discussed for this mode being induced by the 7–8-yr oscillation in the position of the Gulf Stream front. A mechanism for the teleconnections between the North Atlantic, Ethiopian Plateau, and eastern Mediterranean is proposed, and implications for interannual-to-decadal climate prediction are discussed (see also Feliks et al., 2010a).

*Contributed by Y. Feliks, M. Ghil and **A.W. Robertson***

## The Atmospheric Circulation over the North Atlantic as Induced by the SST Field

Spectral analyses of the SST in the Simple Ocean Data Analysis (SODA) reanalysis for the past half-century identify prominent and statistically significant interannual oscillations in two regions along the Gulf Stream front over the North Atlantic. A model of the atmospheric marine boundary layer coupled to a baroclinic quasi-geostrophic model of the free atmosphere is then forced with the SST history from the SODA reanalysis.

Two extreme states are found in the atmospheric simulations: they consist of (1) an eastward extension of the westerly jet associated with the front, which occurs mainly during boreal winter; and (2) a quiescent state of very weak flow found predominantly in the summer. This vacillation of the oceanic-front–induced jet in the model is found to exhibit periodicities similar to those identified in the observed Gulf Stream SST front itself. In addition, a close correspondence is found between interannual spectral peaks in the observed NAO index, and the SODA-induced oscillations in the atmospheric model.

In particular, significant oscillatory modes with periods of 8.5, 4.2 and 2.8 years are found in both the observed and simulated indices, and shown to be highly synchronized and of similar energy in both time series. These oscillatory modes in the simulations are shown to be suppressed when either (a) the Gulf Stream front or (b) its interannual oscillations are omitted from the SST field (see also (Feliks et al., 2010b). Moreover, these modes also disappear when (c) the SST front is spatially smoothed, thus confirming that they are indeed induced by the oceanic front.

*Contributed by Y. Feliks, M. Ghil and **A.W. Robertson***

# Tropical Oceanic Causes of Interannual to Multidecadal Variability in Precipitation in Southeast South America over the Past Century

Observations, atmosphere models forced by historical SSTs and idealized simulations are used to determine the causes and mechanisms of interannual to multidecadal precipitation anomalies over southeast South America (SESA) since 1901. About 40% of SESA precipitation variability over this period can be accounted for by global SST forcing. Both the tropical Pacific and Atlantic Oceans share the driving of SESA precipitation with the latter contributing the most on multidecadal timescales and explaining a wetting trend from the early mid-century until the end of the last century. Cold tropical Atlantic SST anomalies are shown to drive wet conditions in SESA. The dynamics that link SESA precipitation to tropical Atlantic SST anomalies is explored.

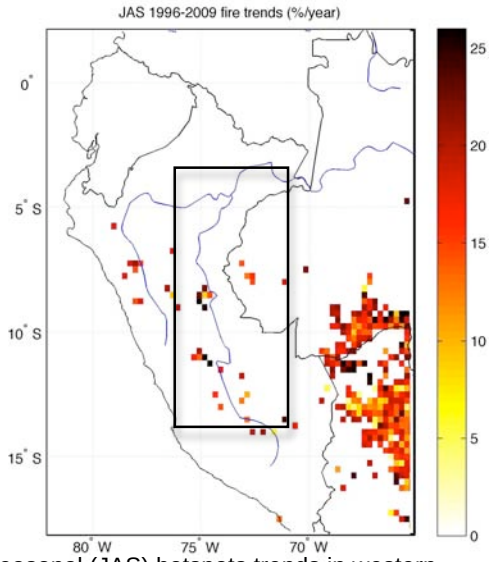
Cold tropical Atlantic SST anomalies force equatorward flowing upper tropospheric flow to the southeast of the tropical heating anomaly and the vorticity advection by this flow is balanced by vortex stretching and ascent which drives the increased precipitation. The 1930s Pampas Dust Bowl drought occurs via this mechanism, in response to warm tropical Atlantic SST anomalies. The atmospheric response to cold tropical Pacific SSTs also contributed. The tropical Atlantic SST anomalies linked to SESA precipitation are the tropical components of the Atlantic Multidecadal Oscillation.

There is little evidence that the large trends over past decades are related to anthropogenic radiative forcing although models project that this will cause a modest wetting of the climate of SESA. As such, and if the Atlantic Multidecadal Oscillation has shifted towards a warm phase, it should not be assumed that the long term wetting trend in SESA will continue (see also Seager et al., 2010). Any reversal to a drier climate more typical of earlier decades would have clear consequences for regional agriculture and water resources.

*Contributed by R. Seager, N. Naik,* ***W.E. Baethgen****,* ***A.W. Robertson****,*
*Y. Kushnir, J. Nakamura and S. Jurburg*

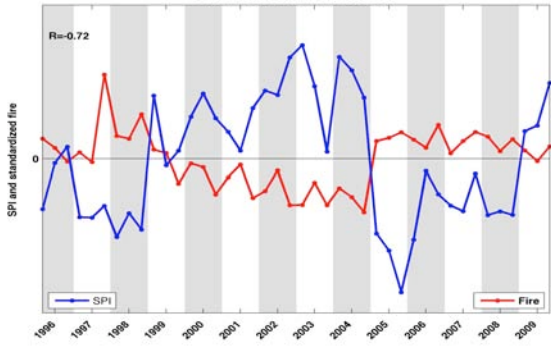
# Incorporating Climate Variability and Change into Fire Potential Assessments in the Ucayali Region

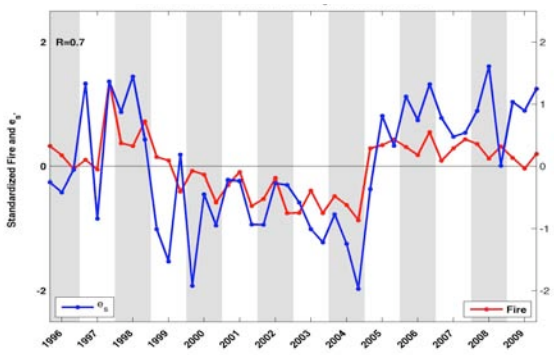
In Amazonia, fire is the least expensive tool used for clearing agriculture fields, pastures and industrial scale plantations. Although fire has been traditionally used for centuries, escaped fires from burning fields have become increasingly common in the Ucayali region of western Amazonia, ravaging forests, farms, and settlements. While the pattern of land uses and circular rural-urban migration patterns may affect fire use and spread, our focus is to determine the most relevant climate variables to fire occurrence and whether climate variability and trends can explain the increased fire severity in Western Amazonia. The World Fire Atlas from the European Space Agency fire data and Peru's Servicio Nacional de Meteorologia y Hydrologia (SENAMHI) meteorological stations data are used in our analysis. Positive trends in hotspots count are found in western Amazon for July, August and September (JAS) 1996-2009 as seen in the figure at right.




Seasonal (JAS) hotspots trends in western Amazon in percentage of increase per year for the period 1996-2009. Inset box depicts approximate domain over which fire and climate variables were averaged.

In a domain defined by coordinates 76.5W-71W and 13S-4S (see box inset in figure) and altitude below 800m, 3 months Standardized Precipitation Index (SPI) drought index and saturation vapor pressure ($e_s$) show 99% statistically significant correlation with fire anomalies in western Amazon (see figures below). An anomalously active fire season responds to both a persistent deficit in precipitation (negative SPI; see left figure below) and higher potential for evapotranspiration (positive $e_s$; see right figure below).




A linear regression model using SPI (left) and $e_s$ (right) as predictors can explain 65% of hotspots count variance in JAS in the domain of study, indicating encouraging potential for fire season predictability in western Amazon.

*Contributed by* ***K. Fernandes, W.E. Baethgen*** *and* ***L. Goddard***

# Monitoring Air and Land Surface Temperatures from Remotely Sensed Data for Climate - Human Health - Agriculture Applications

Climate change affects air and land surface temperatures with implications for climate sensitive human and animal diseases and crop production around the world. Monitoring changes in land surface and air temperature is therefore important to assess and forecast risks in vector-borne disease distribution and crop yields. There is a need expressed by the scientific and user communities to access high spatial resolution and real-time temperature data for developing models and taking actions to mitigate impacts of temperature changes. The objectives of this study are to: Develop a new method to retrieve minimum and maximum air temperature based on satellite measurements; create minimum and maximum air temperature maps; validate the new minimum and maximum air temperature maps with field measurements over specific areas in Africa (Botswana, Eritrea, Ethiopia, Madagascar); and, provide minimum and maximum air temperature maps to researchers for studying the relationship between changes in air temperature and various diseases such as malaria and meningitis (Africa).

This research demonstrates that the Moderate Resolution Imaging Spectroradiometer (MODIS) nighttime Land Surface Temperature products provide a good estimation of minimum air temperature over different ecosystems (Vancutsem et al., 2010). We find that the MODIS daytime Land Surface Temperature (Ts) varies from the maximum air temperature (Ta) according to the seasonality, the ecosystems, the solar radiation, and cloud-cover. Two factors proposed in the literature to retrieve Ta from Ts (the Normalized Difference Vegetation Index (NDVI) and the Solar Zenith Angle (SZA)), were analyzed. No strong relationship between ($\Delta$Ts−Ta) and NDVI or ($\Delta$Ts−Ta) and SZA was observed, therefore requiring further research on robust methods to retrieve maximum air temperature.

However, we do find that it is possible to infer maximum air temperature using observations from MODIS through the extrapolation of the minimum temperature derived from Ts nighttime images and the diurnal cycle. The diurnal cycle parameters (*i.e.* phase and amplitude) which are used to estimate the maximum air temperature are determined locally using data from the WORDCLIM database. The proposed approach was applied over four different areas in Africa (Eritrea, Ethiopia, Botswana and Madagascar) based on measurements collected in 28 different stations over the period 2002-2008. An acceptable agreement between maximum air temperature estimated and observed temperatures was noticed. This finding was presented at the 2010 IEEE International Geoscience and Remote Sensing Symposium in Honolulu, Hawaii.

*Contributed by **P. Ceccato**, C. Vancutsem, **T. Dinku**, M. Temimi, and **S.J. Connor***

# Integrating Climate Information into Surveillance Systems for Infectious Diseases: New Opportunities for Improved Public Health Outcomes in a Changing Climate.

Many infectious diseases are climate-sensitive: climate acting as an important driver of spatial and seasonal patterns, year-to-year variations (including epidemics), and longer-term trends. Although climate is only one of the many drivers of infectious diseases, public health policy makers and practitioners are increasingly concerned about the potential impact of climate change on the health of populations. Noticeable changes in average climate are already being observed (and are therefore likely to affect the spatial distribution of some diseases, such as malaria). It is also expected that extreme events that can have devastating socioeconomic, environmental, and health impacts (e.g., floods, droughts, and heatwaves) are more likely to occur.

The global health system is in a period of rapid change, with global health surveillance receiving increasing recognition as a primary source of protection from newly emerging and re-emerging threats: infectious diseases, new cycles of pandemics, bioterrorism, as well as climate change. There is growing awareness of the need to incorporate climate information into routine epidemiological surveillance systems for climate-sensitive diseases.

From our experiences, as well as our commitment to improved uses of climate information in public health settings, we have identified key messages and actions pertaining to improved public health outcomes in a changing climate. Needed outcomes we perceive include strengthened data management and sharing; informed development of climate services; increased intersectoral collaboration as required by specific problem settings; improved access to appropriate training and capacity building; and further fostering of enabling policy environments.

Specific recommendations for the epidemiological surveillance community are to: (1) Establish collaborative partnerships with climate and environmental research and service communities to overcome policy and institutional barriers and identify opportunities for the effective use of climate information in health policy and decision-making; (2) Build the capacity of health professionals to understand, use and demand appropriate climate and/or environmental information through creation of nested training opportunities in epidemiology and related professional training; (3) Support the research and development of appropriate evidence-based climate/environment products and services for use in health policy and decision-making; and (4) Support national and global investments in routine observation of climate, environmental and health phenomena pertinent to decision-making for climate-sensitive diseases.

*Contributed by **M.C. Thomson** and **G.C. Mantilla***

# Simulating Malaria Transmission Dynamics in the Pilot Sites of the Colombian Integrated National Adaptation Plan: Steps Toward an Integrated Surveillance and Control System

Changes in climatic conditions are likely to alter malaria incidence and spatial distribution in Colombia. As part of the Integrated National Adaptation Plan, the Colombian Institute of Health is working on the implementation of a proactive, collaborative, multidisciplinary, integrated surveillance and control system (ISCS). The aim of this initiative is to improve risk assessments of malaria transmission in order to facilitate effective allocation of health resources and more cost-effective preventive responses.

One of its key components is an Early Warning System Framework, in which we are proposing several dynamical and statistical models. Dynamical models, in particular, are being used to integrate climatic variables with non-climatic factors in order to simulate malaria transmission dynamics. Twelve process-based models were studied and included in a single multi-model ensemble. Five tools were initially applied in the pilot sites where the ISCS is being implemented. Activities included the characterization of local eco-epidemiological settings and numerical simulations. Characteristics such as general profile (population at risk, natural resources, economic activities), climatic conditions (climatology, long-term trends), entomology (primary and secondary vectors, breeding sites, feeding frequencies, preferences), malaria situation (annual cycles of malaria incidence, stability conditions), and non-climatic factors (including control campaigns) were analyzed to assess local conditions. Simulations included retrospective experiments (base scenarios, changes in initial conditions, local settings, sensitivity analyses, and uncertainties) of at least 8-year simulation periods, as well as short-, medium- and long-term future changing scenarios. Complementary activities included the study of local spatial patterns of vectorial capacity, descriptions of the vulnerability of populations at risk, and a conceptual framework for the analysis of non-climatic drivers. Outreach activities included the design of interactive and online platforms as well as the documentation of our experiences.

Dynamical models have improved our understanding of malaria complexity, allowed us to estimate previous malaria outbreaks in the selected pilot sites, and helped us to investigate decision-making processes. All these activities constitute steps forward in the implementation of the Colombian ISCS.

*Contributed by **D. Ruiz Carrascal**, A.M. Molina, V. Cerón, P. Gutiérrez, M.L. Quiñónes, M.M. Jiménez, **M. Thomson**, **S. Connor**, M.E. Gutiérrez, P.A. Zapata, C. López, **R. Cousin**, S. Osorio and **G.C. Mantilla***

# Priority Earth Observation Needs for Environmental Change Parameters that Affect Human Health

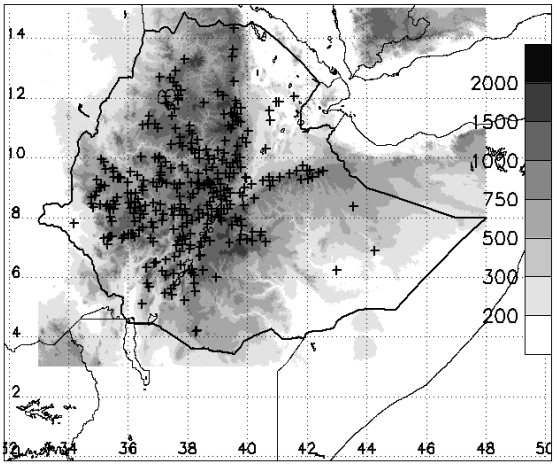
Sponsored by the Group on Earth Observations (GEO), the project team lead by Pietro Ceccato worked to identify and develop a report describing critical Earth observation priorities in Human Health Infectious Diseases (one of the nine GEO social benefit areas) to assist GEO in determining investment priorities. The project team served as expert analysts to the Eastern Research Group (ERG) and identified priority user needs regarding the use of Earth observations to monitor physical, chemical, and biological parameters relevant to understanding the connection between environmental change (e.g., ecosystem disruption, climate, deforestation, biodiversity decline) and terrestrial disease emergence or risk.

Results were presented to the GEO User Interface Committee (UIC) at the GEO Plenary VI session in Washington, DC in November 2009. A final report gathering the information on "who are the users" for which "applications" with which "requirements" has been produced (Ceccato, 2010).

*Contributed by **P. Ceccato***

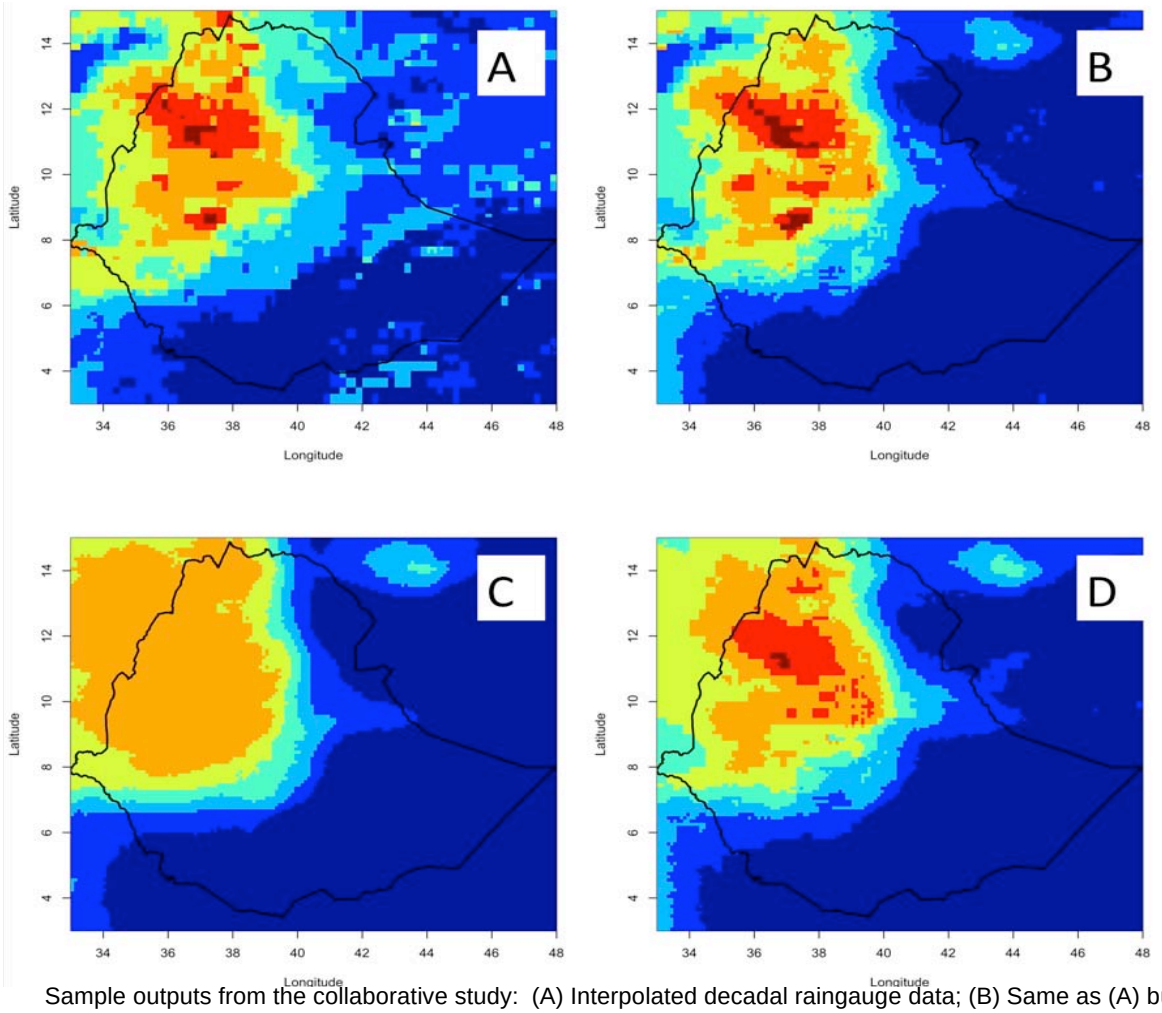
# Blending Satellite Rainfall Estimates and National Raingauge Observations to Produce Long -Term Rainfall Time Series over Ethiopia

Long-term, temporally homogeneous time series of rainfall data with good spatial coverage are of great importance in a number of applications. The conventional source of climate data is weather stations. However, reliable climate information, particularly throughout rural Ethiopia, is very limited. The available stations are unevenly distributed. The density of stations is relatively good over the central highlands, while there are very few stations over the lowland areas (see figure at right). Almost all stations are located in cities and towns along main roads. The number of stations with longer time series is even much less. This imposes severe limitations to availability of climate data on the farms and rangelands, where the data are




Distribution of raingauge stations with 20 or more years of data between 1981 and 2005. Shading is elevation in meters. Station locations from NMA.

needed most. Data available in the cities and towns also suffer from short time series and severe data gaps. The alternative has been satellite rainfall estimates. The main advantage of the satellite products is the excellent spatial coveage. However, satellite rainfall estimates also suffer from a number of critical shortcomings that include heterogeneous time series, short time period, and poor accuracy particularly at higher temporal and spatial resolutions. Thus, it makes a lot of sense to combine the point accuracy of the raingauge measurements with the better spatial coverage of the satellite estimates. A project underway at the National Meteorological Agency (NMA) in Ethiopia, in collaboration with the IRI, is an implementation of this appraoch. It involves rigorous quality check, gridding the station data to regular grids and blending station data with satellite estimates. The outputs would be 30-year time series of high-resolution (10 km and ten-daily) gridded data sets that can be used to characterize observed recent climate variability and trends and that could be routinely updated to provide real-time monitoring and verification. The gridded products (see below figure for examples) will be in a format that is easier to import into GIS software and could easily be combined with other data of interest.



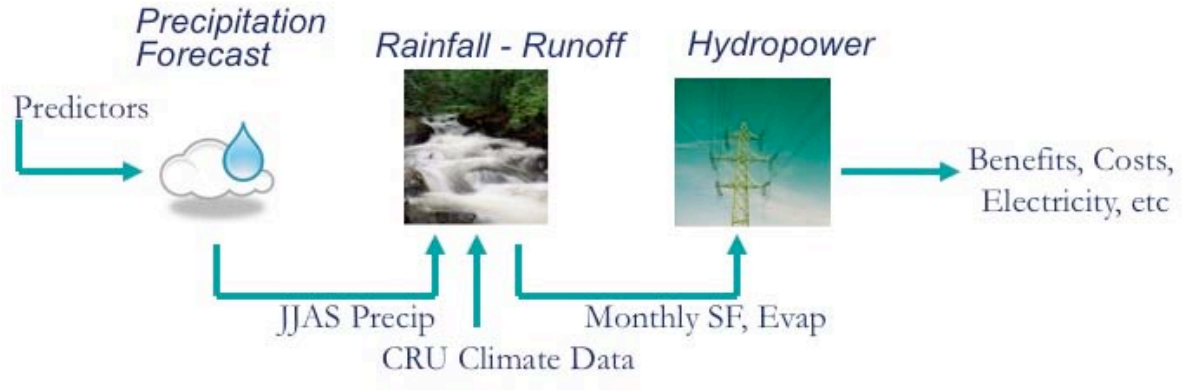

Sample outputs from the collaborative study: (A) Interpolated decadal raingauge data; (B) Same as (A) but satellite estimate used as background filed; (C) Satellite rainfall estimate for the same dekad; and (D) Bias-adjusted satellite estimates using raingauge data.

*Contributed by **T. Dinku**, **S.J. Connor**, D. Grimes, K. Hailemariam, R. Maidement and E. Tarnavsky.*

# Statistical and Dynamical Climate Predictions to Guide Water Resources in Ethiopia

Climate predictions with lead times of one season or more often provide prospects for exploiting climate-related risks and opportunities for sectoral application. This motivates the evaluation of precipitation prediction techniques to potentially augment current prediction skill over the Blue Nile basin in Ethiopia. Previous work demonstrated skill using a statistical precipitation prediction model over the basin; here, precipitation predictions from a dynamical model, specifically the Climate Forecast System from NOAA, are also evaluated – both independently and in combination with the statistical approach (forming a multi-model.) Further, this work considers to what degree greater skill or reliability in a particular prediction technique translates through hydropower management models given their nonlinear response.

One hundred precipitation series from the period 1981-2000 are generated to compare prediction techniques. The linked multi-model ensemble climate forecast – hydropower system proves superior to the statistical and dynamical prediction technique linked systems across a range of metrics; an increase in annual benefits by $2-5 million dollars on average, while surpassing a predefined minimum energy threshold with equivalent or greater frequency, is also evident. The climate forecast – hydropower system is sufficiently flexible to allow water managers to attain an optimal balance between benefits and the dependability of energy delivery, by varying exceedance probability and target energy thresholds, with the added benefit of forecast guidance. Ideally this provides decision-makers with incentives to integrate improved prediction techniques into sectoral management models, and further justifies expanding efforts into climate forecast improvement.

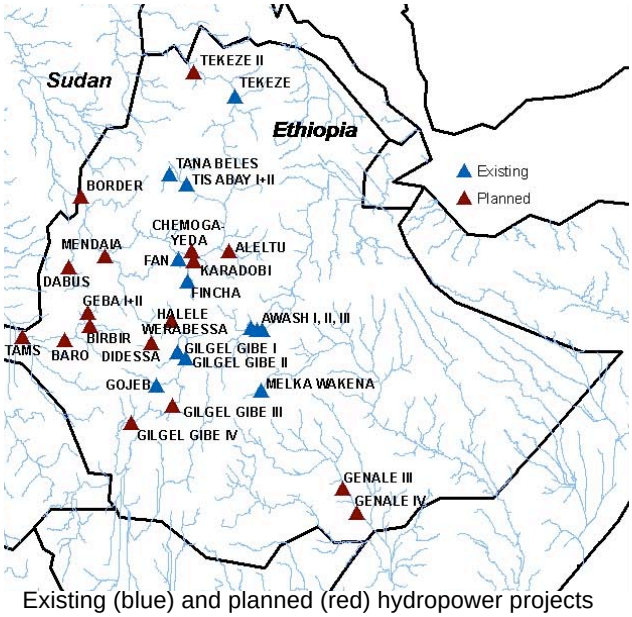



Linked model system components, inputs, and outputs for the upper Blue Nile Basin, Ethiopia. Precipitation forecast component includes statistical, dynamical, and combination approaches.

*Contributed by* ***P. Block*** *and* ***L. Goddard***

# Analysis of the Economics of Adaptation to Climate Change for the Agriculture and Energy Sectors within Ethiopia

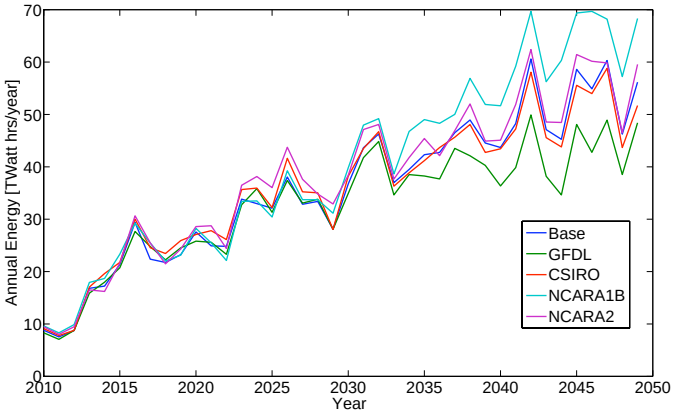
The focus of this project is to undertake disaggregated economic modeling, including analysis of climate change impacts and adaptation, for Ethiopia, one of the African EACC case study countries. The project brings together climate science, economics, and agricultural and water resources to paint a broad picture of how climate may influence baseline and adaptation strategies. The ultimate goal is to provide guidance toward tailored adaptation funding and relevant decision-making by nations and funders.



Existing (blue) and planned (red) hydropower projects being considered within Ethiopia

Two specific themes are addressed in this work. The first utilizes GCM projections, coupled with existing and planned national energy projects, to evaluate potential energy production for comparison with a no climate change simulation (current and planned hydropower infrastructure shown above). Costs and timing of infrastructure development for adaptation are also evaluated. Subsequently, outputs are fed into a computable general equilibrium (CGE) model for further assessment.

The second is an economic and social assessment through a sub-model abstracted from a larger multi-market agriculture-economic model (see also figure below). The model is country-wide based on administrative zones, is indirectly driven by precipitation variability, and produces projected outputs (crop area, grain production, etc.) based on investment strategies (e.g. irrigation.) As with energy, potential agricultural production from climate change simulations are evaluated and compared with a no climate change simulation. Costs and types of adaptation are also evaluated.



Annual energy production for Base (no climate change) and four climate change scenarios under one development strategy.

The primary recommendation surfacing from this analysis is to continue development as planned. Ethiopia is embarking on an ambitious development trajectory, for both energy production and

irrigation development. This development is desperately needed, independent of future climate change trends, and will require significant investment and capacity, with the hope of appreciably reducing vulnerability to variability.

Future phases on this work will focus on moving from a predominantly deterministic evaluation to a stochastic approach, capturing model and climate uncertainty, as well as tradeoffs between sectors (energy, agriculture, urban use) for a finite water resource. Development and adaptation costs do not currently account for the true value of water nor promote economic efficiency.

*Contributed by **P. Block** and **B. Lyon***

## The Impacts of Thresholds on Risk Behavior: What's Wrong with Index Insurance?

Index insurance is a relatively new tool being explored for implementation in developing countries. Since it remains to be established if index insurance is scalable or effective in helping to address development problems, it is important that critiques and evaluations of index insurance interventions appropriately identify and address the basic features of the index insurance and low-income households. An index insurance contract is one that provides its holder with a payout based on the measurement of an index that is correlated with the holder's income. For example, a farmer, whose annual income varies according to his crop's yield, may wish to buy an index insurance contract that pays its holder some amount of money in the event of low rainfall - which is typically associated with lower than average crop yields. A well-designed contract of this type can significantly reduce the variance of the farmer's annual income, which, in turn, can induce a desirable change in the distribution of his long-term wealth and his chance of avoiding a poverty trap (Barnett, Barrett, and Skees, 2008).

One of the most common types of index insurance currently in use is weather-based index insurance for farmers (Hellmuth et al 2009). These contracts are sometimes referred to in the literature as weather derivatives, area-yield insurance contracts, catastrophe bonds or catastrophe options, or index-based risk transfer products (Miranda, 1991; Skees, Black, and Barnett, 1997; Barnett, Barrett, and Skees, 2008). Almost universally, implementers of index insurance for low-income households recommend that index insurance be embedded with other interventions to improve productivity. The insurance is used almost entirely to make the other interventions possible instead of being risk reducing per se (Hellmuth et al, 2009). A common example is to use the insurance to allow farmers to have access to loans by reducing the probability of weather related defaults. Because of the threat of large-scale defaults due to droughts, microfinance institutions are unable to manage the risk of massive simultaneous defaults, leaving farmers without access to credit. By providing index insurance to the lender or the farmer, the risk of drought-driven defaults is lowered, enabling access to credit for productive inputs. In the projects with relatively high-income farmers for which banks can easily enforce repayment, insurance is purchased directly by the banks, and loans are forgiven during drought years. For very low-

income farmers, limited liability problems make repayment enforcement problematic (Banerjee and Newman, 2003). For these projects, loans are insured through contracts sold directly to the farmer, and the farmer is required to repay in full in all years, using the insurance as payment when necessary.

An example of such a program exists for groundnuts in Malawi. The goal of the insurance package was to increase productivity (as opposed to reducing the variance of income). The index insurance was bundled as part of a package to provide farmers with high yielding ground- nuts, using drought insurance contracts purchased directly by smallholder farmers to enable access to loans (Hellmuth et al., 2007). Instead of designing the insurance as a tool to reduce variance in income, the contracts were designed solely to target the drought related loan repayment risks that alternate risk management strategies could not effectively address (Osgood et al., 2007). Implementation partners included the National Association of Smallholder Farmers (NASFAM), the Malawi Rural Finance Corporation (MRFC), Opportunity Inter- national Banking Malawi (OIBM), the Insurance Association of Malawi (IAM), the Malawi Meteorological Agency, and the World Bank Commodity Risk Management Group (CRMG). Technical assistance for contract design was provided by the International Research Institute for Climate and Society at Columbia University (IRI). The key challenge to this program was that the overwhelming farmer take-up rate outpaced the growth capacity of the groundnut supply chain, leading to a shift to other crops with stronger supply chains in the third year of the project (Hellmuth et al., 2009).

Testing the assumptions behind the bundled design of the pilot, in the second year of the project's implementation, Gine and Yang (2009) offered two versions of the contract in a randomized experiment. It is important to note that this study was an analysis of the insurance bundling issue, not an evaluation of the impacts of the insurance-driven development project. The first product was the combined insurance/loan bundle offered outside the experiment. In the other version, the researchers offered the loan without requiring the farmer to purchase insurance. They found that take-up rates of the package that required insurance were substantially lower than those of the package that did not require insurance. These perhaps surprising findings were that the farmers were more interested in the purely production-improving package than the one that included insurance-based risk reduction. The authors attribute the lack of interest in the insurance to the implicit insurance due to the limited liability of the low-income farmers. These findings support the assumptions of the implementation project, that index insurance for low income farmers should be used not as risk reduction per se, but instead to enable productivity-increasing activities.

From this experience it appears that these farmers whose livelihoods are severely threatened by weather variability place relatively little value on reduction of variance as compared to increases in productivity. If low-income farmers are highly risk averse, why do they place so little value on risk reducing insurance once their access to productive inputs is secured? In general, what could justify the assumption of index insurance implementers targeting the lowest income households that insurance should be used as a tool to increase productivity instead of using it to reduce variance? In the project reports of implementers, poverty traps are mentioned, however a model explaining how poverty traps lead to a preference for productivity over variance reduction is missing.

We explore the optimal design of an insurance contract for farmers who are living in great poverty, and find another reason for farmers to be less risk averse than they would be in a mean-variance utility framework. This reason is that less risk aversion results in a greater probability of avoiding a poverty trap. In fact, the closer a farmer is to a poverty trap threshold, the less willing he is to give up some of his expected income in exchange for a reduction in income variance. The focus of our work is the optimal design of index insurance contracts, with applications to weather-based index insurance for farmers. We consider contract design as it relates to two goals: (1) reducing the variance of a farmer's annual income, and (2) helping a farmer avoid a poverty trap. We set-up the problem by introducing a simple form for the payout function, using a known joint probability distribution to describe the relationship between the index and the yield. We then design optimal contracts in a mean-variance utility maximization framework. That is, we create a framework for a poverty trap and design contracts that are optimal in the sense that they minimize a farmer's probability of falling into a poverty trap.

*Contributed by **D.E. Osgood** and K.E. Shirley*

## Rising Temperatures over the Kericho Tea Estates: Revisiting the Facts in the East African Highlands Malaria Debate

The distribution of malaria in sub-Saharan Africa is determined largely by climatic influences and so malaria is considered a climate-sensitive disease. The development of both the parasite *Plasmodium falciparum* that causes malaria and the Anopheline mosquito that transmits it, are particularly sensitive to temperature. The availability of suitable climatic conditions for the development of Anopheles mosquitoes and *Plasmodium falciparum* is largely responsible for the geographical distribution of malaria today.

A study in 1998 by Lindsay and Martens suggested that increasing global warming could result in the geographic spread of malaria transmission into previously malaria–free highland areas. Since then the research community has been divided over the validity of this statement resulting in a highly polarized debate reported in multiple peer-reviewed publications; more than 10 years later, researchers are unable to concur. Studies on temperature impacts on malaria have centered on analyses conducted in the East African highlands in Kericho, a district that lies at 1600 to 3000 meters above sea level in the western highlands of Kenya. Laboratory-confirmed malaria incidence data are available from the Brooke Bond tea estate health facilities from a period where confounding effects such as those brought about by demographic influences, interventions against malaria and marked environmental changes are constrained (Malakooti et al. 1998).

The malaria data from Kericho are a significant resource for modeling climatic and other drivers of malaria epidemics given the paucity of long time series of high quality data. Researchers have generally paid inadequate attention to the quality and relevance of the climate data used in the analysis of temperature and malaria. The result of this is that the findings from many studies are largely confounded by the poor quality and inappropriate use of climate data. Research to date

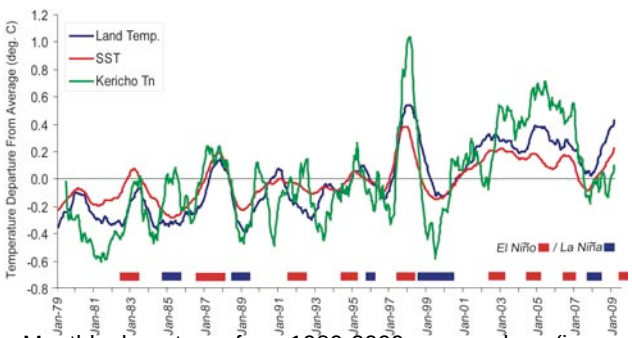
Partial view of a large tea estate in Kericho, Kenya

has focused on answering four key questions: (1) Is malaria increasing or re-emerging in the East African highlands; (2) Are temperatures increasing in the East African highlands; (3) If there is a warming trend in the highlands, is it related to global climate change; and, (4) If there is a warming trend, is there a causal relationship between this trend and trends in malaria incidence?

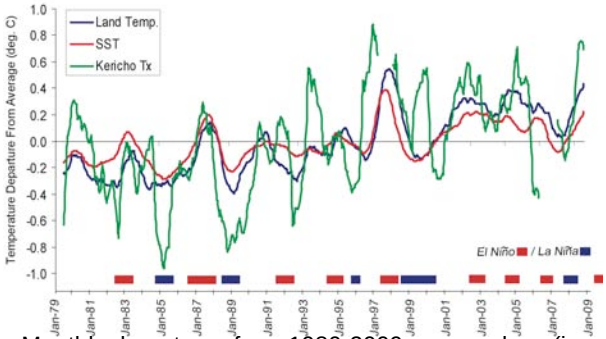
This study uses 31 years (Jan.1979 to Dec. 2009) of quality controlled (97% complete) daily observations of maximum and minimum temperature from Kericho meteorological stations sited in a tea-growing area of Kenya's western highlands. These 'Gold Standard' meteorological observations are compared with gridded temperature datasets that have been used extensively to investigate climate trends in Kericho. The relationship of local climate processes (at Kericho) with larger climate variations (SST, ENSO), is also assessed.

An upward trend of 0.2$^{O}$C/decade was observed in both temperature variables ($P<0.01$) after adjusting the time series for temporal inconsistencies. Temperature variations in Kericho were associated with large-scale climate variations including tropical Sea Surface Temperatures ($r= 0.61$; $p<0.05$). A comparison with two versions of a gridded temperature data set showed markedly different trends when compared with each other and with the Kericho station observations.

This study presents conclusive evidence of a warming trend of ~ 0.2$^{o}$C per decade in observed minimum (below left) and maximum (below right) temperatures at Kericho during the period 1979 to 2009. The findings also show strong connections to global climate processes including El Niño and La Niña, as well as longer-term trends.




Monthly departures from 1980-2009 mean values (in degrees C with 11 month moving average applied) for Kericho Tmin (green), global tropical SST (red), and tropical land area temperature (blue). Bars at base show occurrence of ENSO events.




Monthly departures from 1980-2009 mean values (in degrees C with 11 month moving average applied) for Kericho Tmax (green), global tropical SST (red), and tropical land area temperature (blue). Bars at base show occurrence of ENSO events.

Global climate services, relevant to the achievement of the Millennium Development Goals and the analysis of infectious disease in the context of climate change are being developed and the malaria community could avail themselves of this new opportunity through partnership with national meteorological agencies and climate scientists.

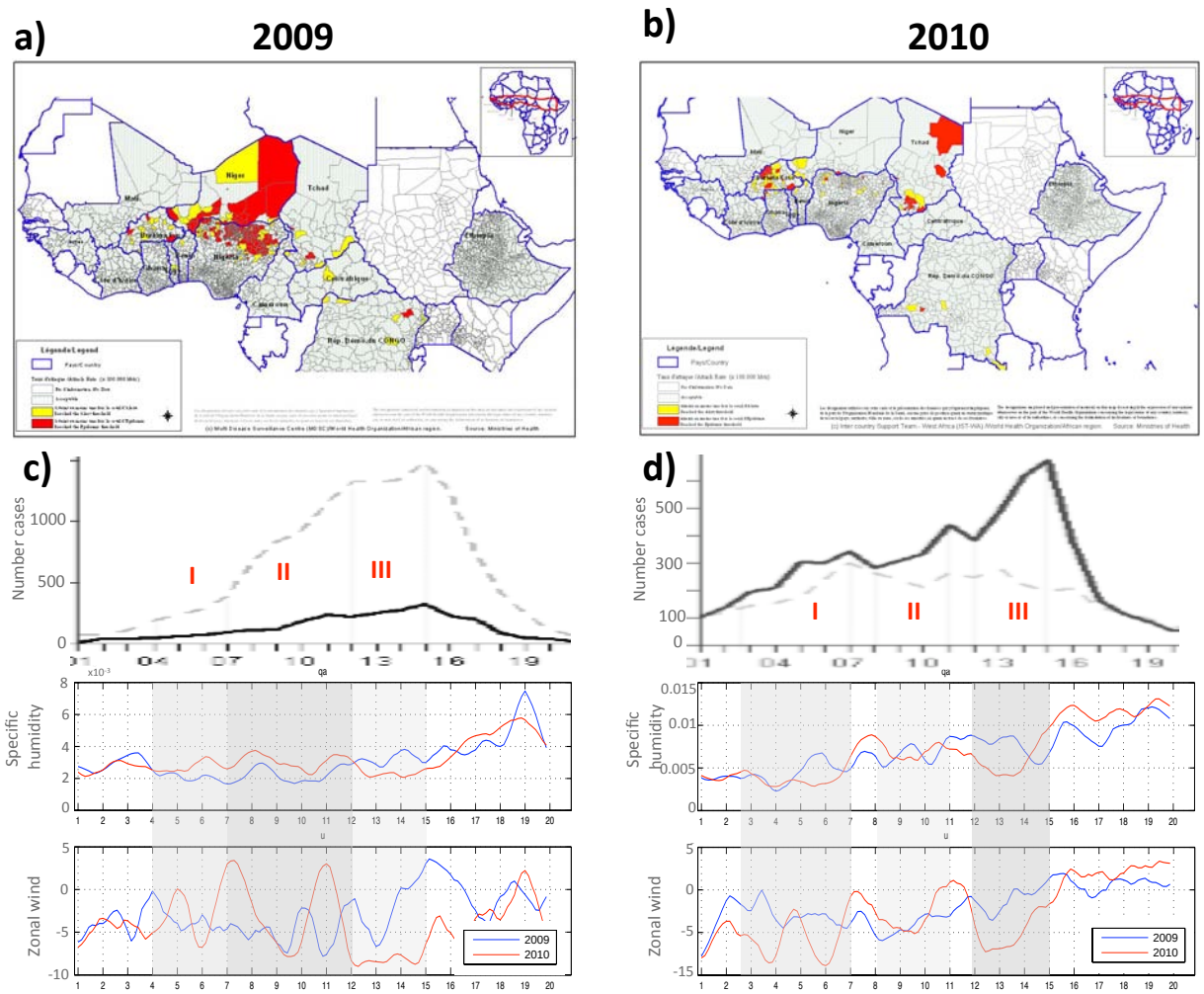
*Contributed by **J. Omumbo** and **B. Lyon***

## The Role of Intraseasonal Atmospheric Variability in Meningitis Outbreaks in the Sahel – 2010 vs. 2009 Case Study

Meningococcal meningitis (MM), a potentially lethal bacterial infection of the meninges, occurs worldwide but attack rates in the Sahel are one order of magnitude higher than anywhere else. There, MM affects close to 400 million people in 25 countries. Annual incidence rates can reach 1,000 cases per 100,000 people. MM occurs every year and reaches epidemic levels every few years. The largest recorded outbreak, in1996, caused 250,000 cases and almost 25,000 deaths. At least 50,000 persons suffered permanent disability. Although mechanisms that trigger the infection are not well established, potential risk factors include: age, immune defects, crowding, smoking, upper respiratory tract infections, new strain, waning herd immunity, population movements and environment (dry, hot and dusty conditions). MM is extremely seasonal, occurring at the heart of the dry season in the Sahel and the role of environmental conditions was identified in 1963 (Lapeyssonie, 1963). Several studies have attempted to model/predict meningitis outbreak risks based on environmental factors (Molesworth et al. 2003, Sultan et al. 2005, Yaka et al. 2008) but they do not provide the spatio-temporal distribution of risk at the resolution useful for operational decisions - at district and weekly scale.

Years 2010 and 2009 experienced very different meningitis patterns (see maps a and b, below) with a larger number of districts reaching epidemic level in 2009 (as defined by WHO - weekly incidence of 10 cases/100,000 pop) and the epidemic regions confined to Burkina Faso and Tchad in 2010. While demographic and immunological factors, such as increased herd immunity in the regions affected by outbreaks in 2009, cannot be ruled out we have analyzed the climatic conditions that prevailed in Jan-Feb-March 2009 and 2010, focusing on low level humidity and wind patterns, as the humidity has been shown to be a limiting factor for meningitis outbreaks (Cheesbrough et al. 1995).

The differences between the 2010 and 2009 seasonal JFM patterns (not shown) did not show characteristics matching observed differences in spatial patterns of epidemics. However, the analysis of daily NCEP Reanalysis data (Kalnay et al. 1996) showed a stronger subseasonal variability of low level humidity and winds in 2010 than in 2009. This difference is illustrated in figure panels c) and d) using values of 925hPa specific humidity and zonal winds averaged over two of the regions (indicated as green boxes on the maps) that experienced different meningitis conditions in 2009 and 2010: Northern Niger was affected in 2009 but not in 2010, Burkina Faso was more strongly affected in 2010 than 2009. Specific humidity in Northern Niger (c) was



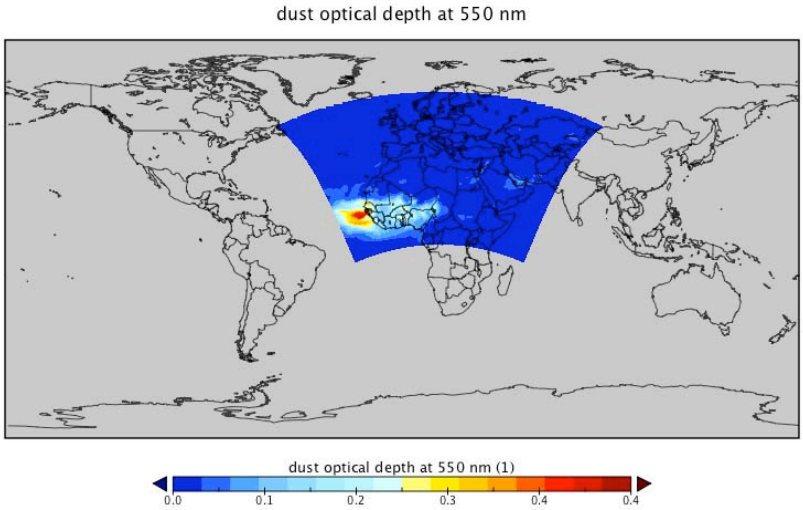

Maps a) and b) show districts that crossed alert (yellow) or epidemic (red) level during 2009 and 2010 respectively, published by WHO in the Weekly Epidemic Reports in Sept. 2009 and 2010; c) and d) upper panels – show the number of cases recorded weekly in Niger (c) and Burkina Faso (d) in 2009 (dashed line) and 2010 (solid line); middle panels - 5-day averages of NCEP reanalysis daily specific humidity at 925 hPa averaged over Northern Niger and Burkina Faso respectively (areas indicated as green boxes on the maps, time series for 2009 in blue, 2010 in red); lower panels – same as middle panels except for zonal wind. Shading on the time-series corresponds to periods I, II and III from the case time-series, where moderate to strong increase in the number of cases were observed during epidemic years 2009 for Niger (c) and 2010 for Burkina Faso (d).

generally lower in 2009 during strong case number increases than in corresponding periods in 2010. Higher humidity values in 2010 were clearly related to bursts of westerly wind, advecting dust-free and moist air into the region; no such wind bursts were observed in 2009. The higher wind variability in 2010 appeared to favor meningitis in Burkina Faso with stronger easterly wind bursts and associated low humidity as compared to 2009. Similar subseasonal characteristics have been observed in Southern Niger and Northern Nigeria where 2009 (2010) were epidemic (non-epidemic) years. However, in Niger, low humidity in phase III of 2010, linked to exceptionally strong easterly winds was not associated with a substantial increase in cases. These preliminary results will be used to establish a testable hypothesis on the role and predictability of humidity and wind in meningitis outbreaks in the Sahel. The analysis will be extended to a larger number of years for which weekly data at district level are available for Niger, Burkina Faso and Mali.

*Contributed by:* ***S. Trzaska***, ***C. Perez*** *and* ***M. Thomson***

# Atmosphere and Dust Regional Reanalysis for North Africa and the Sahel: Model Description and Application to the Study of Meningococcal Meningitis Epidemics

The mechanism by which climate modulates meningococcal meningitis epidemics in the Sahel remains unclear (Cheesbrough et al., 1995). Several studies in the meningitis belt have shown that there is little change in the level of meningococcal carriage or the rate of acquisition of nasopharyngeal colonization with season (e.g. Blakebrough et al., 1982), suggesting that the dry and dusty climate during the dry season primarily influences co-factors, such as mucus desiccation or upper respiratory tract infection, which might facilitate the progression of colonization to invasive disease. The low resolution of current atmospheric reanalysis data, the lack of a dense meteorological network in the region and the limitations of satellite and other estimates of dust hamper the spatio-temporal analysis of the role of climate and dust on the occurrence of epidemics (Thomson et al., 2006).

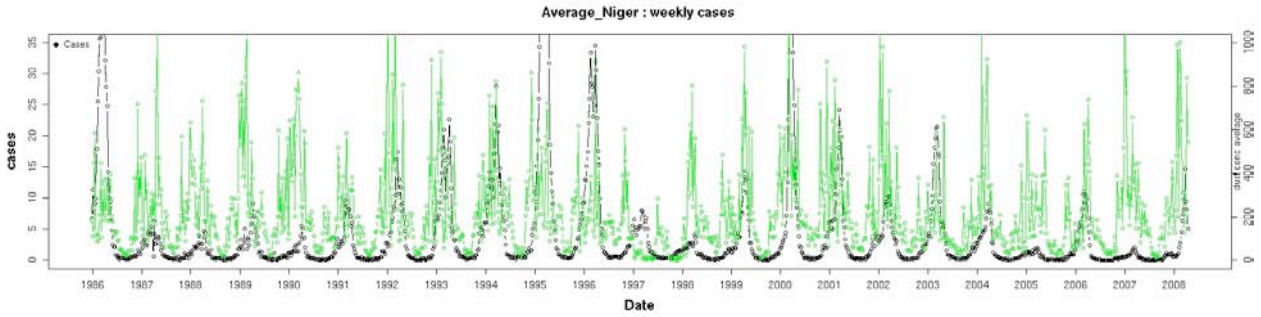


Regional domain used depicting simulated dust optical depth on 12.14.1979.

In order to improve our understanding on the role of climate and dust on meningitis epidemics dynamics we have performed a 30-year simulation (February 1979-March 2010) with the NMMB-BSC-Dust model within a domain that covers (but is not limited to) North Africa and the Sahel (see figure at right). The NMMB-BSC-Dust model is a new dust aerosol cycle model embedded online within the new NOAA/NCEP Non-hydrostatic Multiscale Model (NMMB). The NMMB has been developed within the Earth System Modeling Framework (ESMF) at the National Centers for Environmental Prediction (NOAA/NCEP) following the general modeling philosophy of the NCEP regional WRF Non-hydrostatic Mesoscale Model (NMM) (Janjic et al., 2001; Janjic, 2003) which is operationally used at NCEP as the regional North American Mesoscale (NAM) model. The NMMB-BSC-Dust model is intended to provide weather and dust forecasts from regional to global scales and has been developed as a collaboration among NOAA/NCEP, the Barcelona Supercomputing Center, the NASA Goddard Institute for Space Studies and the IRI.

The resolution of the model was set to 0.5 x 0.5 and 40 hybrid sigma-pressure model layers. The simulation was reinitialized every 24 hours with NCEP Reanalysis-2 pressure level data and the Global Land Data Assimilation System (GLDAS) for soil moisture and temperature with a spin-up of 12 hours each day. Only dust is re-cycled from one day to the next. The dataset has been

included in the IRI data library. As an example, the below figure depicts the temporal evolution of weekly meningitis cases per district in Niger compared to the average dust surface concentration simulated by the model. Despite the complex behavior of epidemics, mathematical models combining, among other factors, accurate climate information, population density and herd immunity estimates will facilitate the understanding of the relative role of the different risk factors in the onset of epidemics, their non-linear interaction and eventually serve as predictive tools of the timing and location of epidemics at appropriate scales of intervention.




Temporal evolution of average weekly meningitis cases per district (black) in Niger and simulated weekly average dust surface concentration (mg/m3) in Niger (green) from 1986 to 2008.

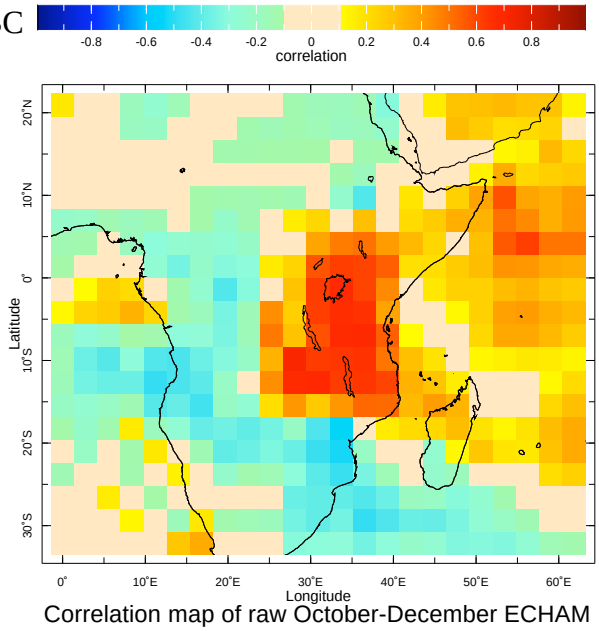
*Contributed by **C. Perez Garcia-Pando, M.C. Thomson, S. Trzaska**, R. L. Miller, J. Perlwitz, K. Haustein, Z. Janjic, O. Jorba, J.M. Baldasano, T. Black, and S. Basart*

## Enhancing the Utility of Daily GCM Rainfall for Crop Yield Prediction

Global climate models (GCMs) are promising for crop yield predictions because of their ability to simulate seasonal climate in advance of the growing season. However, their utility is limited by unrealistic time structure of daily rainfall and biases in rainfall frequency and intensity distributions. Crop growth is very sensitive to daily variations of rainfall; thus any mismatch in daily rainfall statistics could impact crop yield simulations. Here, we present an improved methodology to correct GCM rainfall biases and time structure mismatches for maize yield prediction in Katumani, Kenya. This includes GCM bias correction (BC), to correct over- or under-predictions of rainfall frequency and intensity, and nesting corrected GCM information with a stochastic weather generator, to generate daily rainfall realizations conditioned on a given monthly target.

Bias-corrected daily GCM rainfall and generated rainfall realizations were used to evaluate crop response. Results showed that corrections of GCM rainfall frequency and intensity could improve crop yield prediction but yields remain under-predicted (see also Ines et al., 2010). This is strongly attributed to the time structure mismatch in daily GCM rainfall leading to excessively long dry spells. To address this, we tested several ways of improving daily structure of GCM

rainfall. First, we tested calibrating thresholds in BC but these were found not very effective for improving dry spell lengths. Second, we tested BC-stochastic disaggregation (BC-DisAg) and appeared to simulate more realistic dry spell lengths using bias-corrected GCM rainfall information (e.g., frequency, totals) as monthly targets. Using rainfall frequency alone to condition the weather generator removed biases in dry spell lengths, improved predicted yields, but under-predicted yield variability. Combining rainfall frequency and totals, however, not only produced more realistic yield variability but also corrected under-prediction of yields. The skill of the GCM (e.g., see figure at right) is still the final determinant for the overall success of the approach. We envisaged that the presented method would enhance the utility of daily GCM rainfall in crop yield prediction.



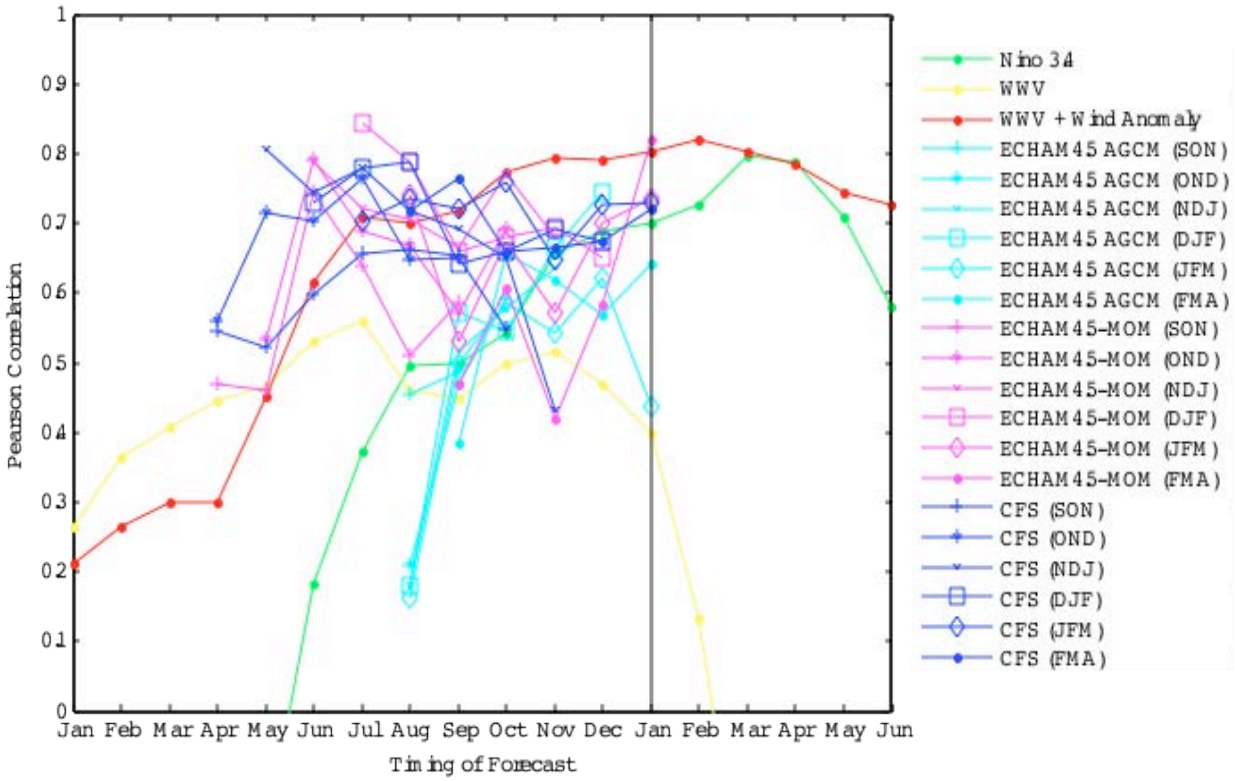

Correlation map of raw October-December ECHAM v4.5 rainfall and maize yield simulated by observed weather at Katumani Dryland Research Center.

*Contributed by **A.V.M. Ines**, **J.W. Hansen** and **A.W. Robertson***

## Predictability of Rice Production in the Philippines with Seasonal Climate Forecasts

The El Niño Southern Oscillation (ENSO) is the most influential factor on interannual variability of the Philippines climate, and the impacts of ENSO on the Philippine rice production have been documented in previously documented. In this study, predictive empirical models for rice production and yield are constructed and tested based on coupled and uncoupled general circulation models (GCMs) currently used for seasonal climate forecasts , as well statistical predictors comprising Niño 3.4 SSTAs and warm water volume (WWV) in the equatorial Pacific Ocean, using multiple linear regression (MLR), principal component regression (PCR), and canonical correlation analysis (CCA).

A summary of results for nationally-aggregated crop data is shown in the figure below. The two coupled GCMs are shown to have high predictive skills (r~0.8) for dry-season national rice production (both irrigation and rainfed systems) with lead time of half a year (six months before the beginning of the harvest). It is found that purely empirical models based on WWV and zonal wind anomalies over the equatorial west Pacific attain similar predictive skills to those of the coupled GCMs, whereas the skill of the uncoupled GCM is somewhat lower. Predictive skills at regional levels are generally lower than those for the Philippines as a whole, with higher predictive skills located in southwest of Mindanao and the central Philippines.




Cross validation correlation skills of dry-season rice production of all ecosystems of the Philippines. Nino 3.4, WWV, and WWV plus zonal wind anomalies over the west equatorial Pacific (1980-2007) were used as predictors of multiple liner regression (MLR). Seasonal precipitation anomalies over 0N-25N, 110E-130E forecasted with ECHAM 4.5(1980-2006), ECHAM4.5-MOM (1982-2007), and NOAA CFS(1981-2007) were used as predictors of principle component regression (PCR).

Rainy season rice national production is found to be correlated with rainfall in a more complex manner. The national area harvested in the Philippines correlates positively with rainfall during the preceding dry season, while national-level yield in the rainy season exhibits positive and negative correlations with rainfall in JAS and in OND respectively. We found that WWV plus zonal wind anomalies over the equatorial west Pacific have high predictive skills (r~0.7) with a few months lead time from the beginning of the harvest. Only regions in Luzon showed high predictability while the other regions do not. Such a spatial difference in predictability of rainy season rice production might be due to difference in impacts of climate such as flood and tropical cyclones on the yield.

The results show high potential of climate information for prediction of rice production in the Philippines, and encourage efforts to evaluate the potential value of this climate information for prediction of rice production.

*Contributed by N. Koide, **A.W. Robertson**, **A.V.M. Ines** and **J.-H. Qian***

# Seasonal and Longer - Range Forecasts: A New Chapter

A second edition of the standard and widely cited text book *Forecast Verification: A Practitioner's Guide in Atmospheric Science* (Wiley& Chichester, 2nd edition) is planned for publication in 2011. The new edition will include a new chapter on the verification of seasonal and longer-range forecasts. This chapter begins with the premise that there is no inherent reason why forecasts of different timescales (seasonal, decadal, and longer-term climate change projections) should be verified in different ways, except to the extent to which the forecasts are presented in different ways. Verification procedures should be defined according to what one wants to know about the quality of forecasts, and it is only the extent to which the nature and availability of forecasts at different timescales limit the extent to which one can meaningfully address these questions of forecast quality that verification procedures should be timescale specific. That said, there are a few criteria that do impose restrictions on the choice of verification procedures when analyzing the quality of seasonal and longer-range forecasts, which necessarily shape how these forecasts are best verified. These criteria are: the limited availability of historical predictions, which severely limits sample size; and the often-weak levels of skill largely because of inherently low predictability.

The sample size issue is often addressed by generating a set of back-forecasts, but the chapter demonstrates that it can be very difficult to generate these in a way that does not result in biased estimates of forecast skill, especially in the context of statistical models (the problem is less severe, but not completely unavoidable, for dynamical model predictions). This problem has important implications for the design of cross-validation experiments, for example, that are rarely adhered to in practice. A related issue to that of the limited sample size is that there is often interest in verifying individual forecasts, most notably for seasonal forecasts where there is a desire to know how "good" the forecast was for the last season. At shorter timescales similar questions may be asked, but will usually focus on only those occasions in which some kind of extreme event occurred, and the question then relates to how well the event was pre-visioned. The subsequent analysis will then generally include an evaluation of the deterministic forecasts available, and a detailed diagnostic analysis. For seasonal forecasts, the question is asked regardless of the outcome, usually every season, and there is a fixation on obtaining a single score. The problem would be reasonably simple if seasonal forecasts were deterministic, but given that they are almost invariably probabilistic the appropriate way to verify a forecast is not so obvious. Mason argues that to verify a single probabilistic interpretation one must acknowledge that there is a different set of attributes that define how good that forecast is compared to the attributes of a good set of probabilistic forecasts. Specifically, the attribute of reliability is appropriate only to the set of forecasts, but not to the individual forecast because of the spatial dependence of forecasts and verifications in a single forecast. Once one is able to focus on the attributes of interest, it is possible to identify meaningful verification procedures.

The second criterion - the often-weak levels of skill - means that there is a heavy focus on demonstrating whether forecasts are potentially useful. In practice this objective translates into the calculation of a suite of skill scores against a reference strategy such as climatology. Mason demonstrates that this practice often results in overly pessimistic estimates of forecast quality

since the most commonly used skill scores for probabilistic forecasts are both biased, and have an arbitrary weighting of different attributes. He argues that the preferred solution is to focus on measuring individual attributes for more easily interpretable results. Specifically, calculating the resolution or discrimination skill of the forecasts is recommended if the interest is to identify whether the forecasts have any potentially usable information.

*Contributed by **S.J. Mason***

## Updates to the Climate Predictability Tool

With a rapidly increasing demand for the Climate Predictability Tool (CPT) both within the operational activities of national meteorological services, and in research environments, the IRI continues to invest in upgrading the software. These upgrades add new functionality as requested by users, and promote the adoption of innovative methods for improving the communication of forecasts to user communities. Over the last approximately 12 months, two major upgrades of CPT have been developed. Version 10 was released in October 2009 with a new simpler to use interface. For the first time allowed different predictors to be used at the same time. This feature, allows, for example, multiple model predictions - model outputs from more than one Global Producing Centre can be used - as well as allowing the simultaneous use of different variables from the same model such as geopotential heights at different atmospheric levels.

Given that the deterministic predictions from CPT are sometimes used as inputs to applications models, an option to generate an ensemble of deterministic predictions was introduced in version 10. The ensemble is generated by sampling evenly from the forecast distribution that is calculated to generate the probabilistic predictions, and is based on the prediction error variance. The user can specify the size of the ensemble. Other improvements to the way in which the forecasts are presented include the calculation of odds and relative odds, and the definition of "above-normal" and "below-normal" in terms of analogue years. This latter option makes it possible to address questions such as "What is the probability that this year will be wetter than last year?" or "What is the probability that this year will be hotter than 2003?" This option was introduced in direct response to a request at a 2010 CPT training course in Beijing co-sponsored by the WMO. Similarly, in response to user requests at a 2010 CPT training workshop in Buenos Aires, an option to select predictor and predictand domains using an interactive map was introduced. Another noteworthy enhancement is the inclusion of so-called "weather roulette" verification procedures for retroactive forecasts. These procedures are based on the ignorance score, and essentially provide an indication of expected returns if a user were to invest on the forecasts assuming a model of fair returns. The weather roulette idea has proven to be very popular in teaching forecasters and users about the potential value of seasonal forecasts, and a separate game has been developed and used effectively in a wide range of workshops.

The next major upgrade, version 11, is to be released shortly. Its main development involves the translation of the user interface into French, Portuguese and Spanish. CPT attempts to detect the preferred language automatically depending upon settings in the Windows Operating System, but

the user is able to select the preferred language manually. A second major enhancement is the inclusion of a new option to allow a gridbox-by-gridbox based prediction rather than a spatial MOS correction. This new option compares the observed data at each station only with the GCM gridbox in which it is located or, optionally, to interpolate the GCM output to the station location. There are options to correct for mean and variance biases and historical skill as desired. This option will be valuable to assess whether the MOS correction can improve on the raw GCM output, and, if so, to what extent. It will also allow CPT to be used as a basic GCM verification tool. This new functionality is further improved by the inclusion of various probabilistic verification metrics for retroactive forecasts.

*Contributed by **S.J. Mason** and **A.E. Curtis***

## Development of Global Climate Maps and Data Layers for Climate Change

The World Bank is developing a Climate Change Data Portal for development practitioners and policy makers, an online tool on the World Bank website that is meant to serve as a readily-available source of global and country-level information related to climate, climate change, and development. The World Bank tool consists of a map interface that includes elements such as information on climate change-related World Bank projects, country-based socio-economic information, climatological data, projections from models used in the IPCC Fourth Assessment and possible related crop impacts. At the request of the World Bank, the IRI provided two additional components, based upon the functionality of the IRI Data Library, that have been incorporated into the World Bank Data Portal, including a map layer displaying the Climatic Suitability for Malaria Transmission in Africa and a tool that allows a user to investigate the historical variability of 20$^{th}$ century seasonal precipitation and temperature at interannual and decadal timescales, and the observed linear trend over the century.

The Climatic Suitability for Malaria Transmission (CSMT) map overlay for Africa included in the World Bank Climate Change Data Portal has the same functionality as the CSMT tool found in the IRI Health Maproom. The map shows the number of months of the year in which climatological precipitation, temperature, and humidity conditions are conducive to the transmission of malaria. Clicking on the map displays bar graphs of the fraction of years in which historical monthly precipitation, temperature, and humidity conditions (separately and combined) met thresholds favorable for malaria transmission.

The second component developed by the IRI allows a user to specify a season of interest and station data completeness criteria, and click on a global map of available Global Historic Climatology Network (GHCN) temperature or precipitation stations to display time series of interannual and decadal variability and the long-term trend for the chosen variable and season of interest (from both the station data set and a gridded data set, for comparison) over the course of the 20$^{th}$ century. This tool was accompanied by a guidance document on the interpretation of its

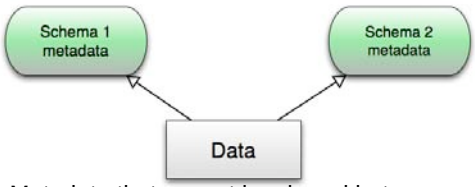
graphical output for the expected audience of development and policy professionals. The main objective of this simple tool was to call the attention of World Bank staff and other users of their Data Portal to the limitations of focusing their climate change activities exclusively on projected linear trends. Thus, the tool uses a very simple approach to show that in many regions of the world the magnitude of the observed variability at "near decadal" time scales can be larger than that corresponding to the linear trend. Furthermore, the tool also helps to compare the magnitude of the interannual climate variability which is usually much larger than that corresponding to the linear trend and the decadal variability.

*Contributed by **W.E. Baethgen**, **M.A. Bell**, **A.M. Greene** and **M. B. Blumenthal***

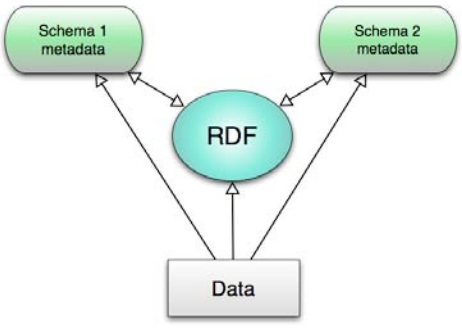
## A Semantic Framework for Metadata in the IRI Climate Data Library

Often in a research community there are several different metadata standards used to describe the same type of objects. We are using an RDF/XML (Resource Description Framework) framework to address this issue, and create a flexible, reusable solution that can adapt to new metadata standards. We created a semantic framework (e.g., see figure below) that contains multiple metadata views of the objects that we wish to describe. The framework is established by creating ontologies for each metadata representation of these objects, and rule-based crosswalks between them so that each object is expressed in all representations, thus all objects can be viewed in multiple systems.

For a case study, we chose bibliographic references, presenting the results in a paper entitled "A Bi-directional Semantic Framework for Bibliographic Metadata" at the 2010 IEEE International Conference on Semantic Computing. We applied the same semantic technology to metadata for the contents of the IRI Climate Data Library. We had explored both national and international standards for geoscience metadata, finding a diverse set of incomplete standards. We use Semantic Technology to bridge those standards together into a more complete framework. Semantic technology is being used today by two national data portals, www.data.gov in the United States, and www.data.gov.uk in the United Kingdom. Because of our investment in semantic technology, we have developed and continue to improve a multi-faceted search interface for the contents of the IRI Climate Data



Metadata that cannot be shared between schemas.



Resource Description Framework (RDF) to enable metadata to be expressed and shared with multiple schemas.

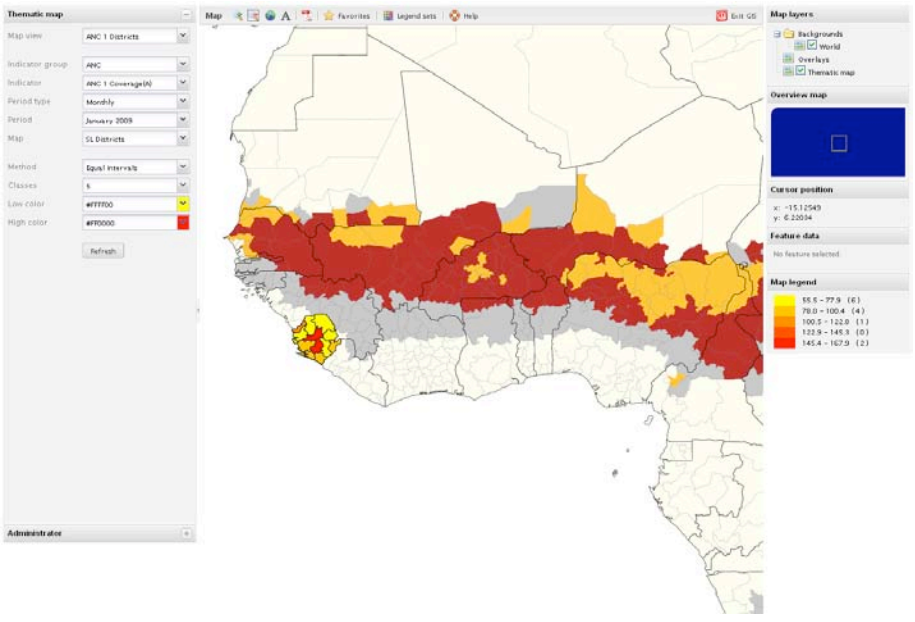
Library. We have begun discussions with the University of Dublin to expose our semantic database as a web-accessible query access point for machine generated queries. We are using well-accepted World Wide Web Consortium (W3C) standards to express the metadata and to make it available to the outside world. Our goal is to create access service points that are available to any client that follows any one of a number of standards.

*Contributed by **J. del Corral** and **M.B. Blumenthal***

## Enabling Technology Transfer to Partners in Africa

The IRI Climate Data Library has been working with the World Health Organization (WHO) Geographic Information System's (GIS) group to integrate climate/environmental data maps with WHO's newest mapping and analysis platforms that are part of the WHO OpenHealth Program. These platforms are the OpenHealthMapper and the EMS Interactive Map Viewer. The IRI Climate Data maps are made available through a Web Map Service (WMS) maintained by the Climate Data Library. This integration enables WHO to view climate/environmental maps with health information maps (e.g., see map below). Different layers (or maps) can be selected individually from the Climate Data Library or from a catalog of WMS layers created by the Climate Data Library.

In June 2010, a stakeholders workshop was held in Addis Ababa, Ethiopia, to discuss how to integrate Climate and Public Health data for Ethiopia, and make it available to Ethiopia's national and regional offices. Participants from the Climate and Health Working Group, the Ethiopia Ministry of Health, the Ethiopia NMA, WHO, WMO, and the IRI met to discuss the issues, and propose a technical solution. WHO's OpenHealthMapper was proposed for use in Ethiopia as the platform to integrate Health and Climate information. The data sources for this platform would be the




Screen shot of maproom served by the WMS showing the IRI Meningitis Probability Map with an example of health statistics from Sierra Leone.

local National agencies as well as WHO and IRI. Data would come from the IRI as a WMS service of map layers of Climate information.

In late summer 2010, the Ethiopia NMA requested help in redesigning its website to improve the visibility and accessibility of Climate data. In September 2010, the IRI performed an assessment of the NMA's website, and conducted interviews with the Head of Data Management and the Web Manager. Three days were spent on site in Addis Ababa to map out specific goals to be achieved in the coming year. Based on its experience with the IRI Climate Data Library, the IRI was able to guide the NMA in incorporating technology, techniques, and styles in the redesigned website. The IRI provided comprehensive Terms of Reference, and developed schematic diagrams for every section of the redesigned website. These will be used by the NMA to hire a local consulting firm to do the work. The IRI will continue to monitor progress on this project and provide expert guidance until the new website is up and running.

*Contributed by **J. del Corral** and **M.B. Blumenthal***

## Expanding the Reach of Data Portals with a Portable IRI Climate Data Library

For the last 10 years, the IRI Climate Data Library has been delivering climate data and analyses to the greater scientific community via the internet. In the past year, new efforts have been made to expand the use of the Climate Data Library in areas where there is little or no internet and to sectors where use of climate information has become a priority.

The Climate Data Library can be used as a teaching tool for explaining how to analyze climate data and to correlate it with sectoral data such as health data, agricultural data, and water resource data. This technology has been encapsulated in two forms to extend its application to far corners of the world. One encapsulated form is the pure standalone Climate Data Library, which runs on a laptop, or bootable hard drive. This has been used in Africa for training courses in climate data analysis techniques for local professionals where internet access to the IRI Climate Data Library is slow or non-existent. The second encapsulated form is a Climate Data Library mirror portal built on a local computer using the IRI Climate Data Library software. This form is being set up in India (ERFS)

Training participants study the relationship between land surface temperature derived from satellite imagery and minimum/maximum air temperatures.

and Indonesia (CCROM) to give local professionals full access to the IRI Climate Data over the internet, and the ability to add their own local data to the mirror portal. If they choose to share their data with the IRI, that data will appear as a catalog entry on the central IRI Climate Data Library. There has recently been interest in establishing a mirror site in South America (CIIFEN). With this interest, there is a desire and willingness on the part of CIIFEN to translate relevant web pages of the Climate Data Library into Spanish. This will extend the effective reach of the Climate Data Library to those that primarily speak Spanish.

*Contributed by **J. del Corral** and **M.B. Blumenthal***

## WMO-IRI Hydrological Outlooks: The Training of Trainers at IRI

In September of 2010 the IRI and the World Meteorological Organization (WMO) co-sponsored a workshop to train scientists to develop and undertake hydrologic outlook trainings appropriate to their region. A specific aim was to enable the establishment of hydrological seasonal outlooks for the hydrological services of six countries in western South America (Chile, Peru, Bolivia, Colombia, Ecuador, Venezuela). The workshop explored different techniques for constructing probabilistic seasonal hydrologic outlooks, including the direct statistical downscaling of precipitation to streamflow and the disaggregation of seasonal precipitation forecasts into daily time series for input into hydrological models. The workshop broadly followed the approach of Verbist et al. (2010), in which predictive downscaling models were built with the Climate Predictability Tool and conditioned on Global Climate Models with the Non-Homogeneous Hidden Markov Model. K-nearest neighbor sampling was also implemented as a complimentary approach for disaggregation to daily data. The workshop was proposed at an international workshop held at the International Center for the Investigation of El Nino (CIIFEN), in Ecuador, in early 2010. Participants included representatives from CIIFEN and from Colombia's Institute for the Study of Hydrology, Meteorology, and the Environment (IDEAM), Peru's National Meteorological and Hydrological Service (SENAMHI), and India's National Water Academy (NWA).

Paul Block assists a workshop participant in the exploration of seasonal hydrologic outlook products.

*Contributed by **A.W. Robertson** and **P. Block***

# Building Capacity to Produce and Use Climate and Environmental Information for Improving Health in East Africa

This three-year project, funded by Google.org, has entered its final year with a continued investment focus on Ethiopia. The project seeks, however, to broaden its impact to other Africa countries as low-cost opportunities allow. The successful outcome of this project requires significant effort in awareness-raising, greater dialogue on climate and health issues as well as research and capacity building among the agencies that support the main players, i.e. the National Ministries of Health (MoHs) and National Meteorological and Hydrological Services (NMHSs). Awareness and network-building is being achieved, in part, through the establishment of multi-agency Climate and Health Working Groups (CHWGs), typically chaired by the MoH and co-chaired by the NMHS. Research foci are being identified through the resulting dialogue. Capacity building is being achieved through the development of appropriate cross-disciplinary training mechanisms.

The CHWGs established in Ethiopia (Ghebreyesus et al. 2009), Madagascar and Kenya are increasingly recognized as national resources in this highly topical area of interest and, as a consequence, they are increasingly engaged and supported by many other partner organizations, including WHO, UNICEF, WMO and their own national governmental agencies. This is a desirable consequence of the awareness raising and institutional capacity building in this arena.

Girmaw Gezahegne, Vice-Chair of the Ethiopian Climate and Health Working Group and representative from the NMA, presents to the Kenyan and Malagasy CHWGs at the 5th MIM Pan-African Malaria Conference in Nairobi, November 2009.

The project is designed for delivery through four outcome areas:

Outcome 1: Capacity built to provide information about climate as it impacts on public health
Outcome 2: Capacity built to use and request climate information
Outcome 3: Global dissemination of products, tools, and knowledge
Outcome 4: Project coordination, implementation, assessment and reporting

In the reporting period of this report, the project has seen several important deliverables realized that have leveraged critical core institutional support from NOAA. These include:

*The development of a satellite-station climatology for Ethiopia*, leveraging the METEOSAT TIR archive in partnership with the University of Reading to provide a 30-year time series of gridded rainfall data.

*The joint meeting of the Ethiopian, Kenyan and Malagasy CHWGs* and side symposium at the 5th multilateral initiative on Malaria (MIM) Pan-African Malaria Conference on "Building Capacity to Use Climate and Environmental Information for Improving Health Outcomes" in Nairobi in November 2009.

Participants of the Ethiopian, Kenyan and Malagasy CHWGs at the 5th MIM Pan-African Malaria Conference in Nairobi, November 4 2009.

*The training of health professionals* on climate and health, hosted by the Ethiopian CHWG and held in Addis Ababa in late November and early December 2009.

*The NMA training course for use of CPT for Seasonal Forecast Verification* held in Addis Ababa in August 2010.

*Collaborative investments to improve the online delivery of products and climate information* through the NMA website (see also Selected Abstract entitled 'Engaging technology transfer to partners in Africa').

*The training of partner personnel in the use of climate information for public health* at the Summer Institute on Climate Information for Public Health held at IRI in New York in May 2010.

*Baseline surveys of the NMA and Public Health communities* completed in the spring/summer 2010.

*The integration of the Data Library with WHO's Open-Health-Mapper*, used to display both health and climate/environmental information on the same Open-Source platform (see also Selected Abstract entitled 'Enabling technology transfer to partners in Africa'). The IRI WMS server has also been used successfully with Open-Health-Mapper and is now being tested with a prototype WHO interactive map display product that renders maps that are compatible with Google-Maps.

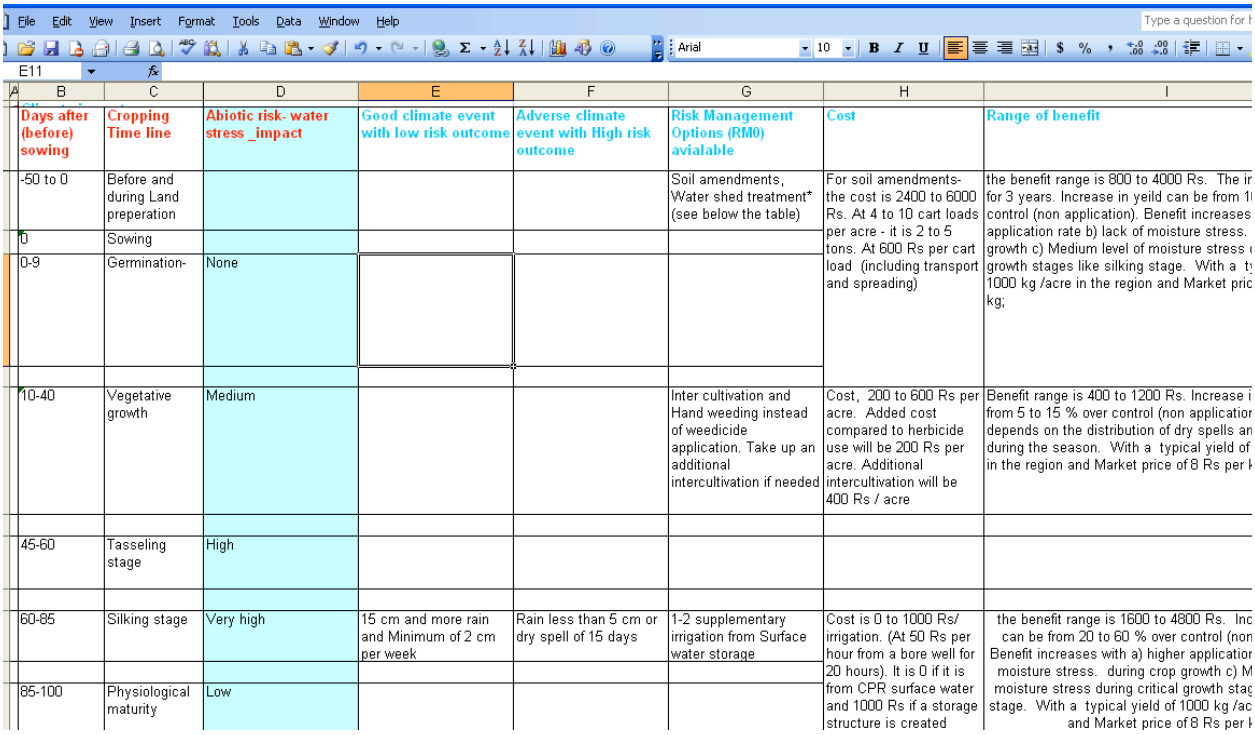
*Contributed by **S.J. Connor**, **M.C. Thomson** and **S. Mason***

# The Extended Range Forecast System for Climate Risk Management in Agriculture

In 2009, the Government of India launched the Extended Range Forecast System for Climate Risk Management in Agriculture (ERFS) with funds from Government of India's Ministry of Agriculture, with IRI serving as the lead international agency. The Indian Institute of Technology Delhi (IITD) serves as the project secretariat and the primary partners are the India Meteorological Department (IMD), the National Center for Medium-Range Weather Forecasting (NCMRWF), the Indian Agricultural Research Institute (IARI), and state agriculture universities in the project's nine demonstration states: Andhra Pradesh, Gujarat, Maharashtra, Madhya Pradesh, Orissa, Himachal Pradesh, Rajasthan, Tamil Nadu, and Uttarkhand. The project's primary objective is to enhance climate resiliency of agriculture in India at the farm, village and district levels. The effort involves the generation and use of quality climate forecasts for weather and/or climate risk-resilient decision-making and to develop and test risk management tools for farmers and district level decision makers in anticipating and responding to weather and climate-related agricultural risks. Here, we provide an overview of the activities and accomplishments achieved in the second year of the project's implementation.

*Enhanced forecast methodologies in India* - Research to improve forecasting of the summer monsoon continued into the second year of activities with the six month visit (July-December 2009) of four Indian scientists from IITD to the IRI campus in New York. During this period, IRI and IITD scientists collaborated on signal-to-noise maximizing techniques to enhance forecast skill, developed stochastic rainfall downscaling models to link the forecast with crop-simulation models, and integrated station data into an India-based Data Library and online maproom. The IRI Data Library is a powerful tool for decision makers because it allows for the analysis of wet and dry spell patterns using historical rainfall data and enhances access to information to provide better-informed risk management. Maprooms were created for 0.5-degree daily IMD rainfall, 1-degree daily IMD temperature data, as well as Global Daily Climatology Network daily station rainfall data.

*Agriculture risk management and decision-making research* - IRI has coordinated with the national stakeholders in developing a methodology for analyzing climate risks and identifying risk management options at the plot and farm levels for specific crops. The research in partnership with Dr. D.R. Reddy's group at the Acharya Ranga Reddy Agricultural University focused on maize in the Mahabubnagar district. Here, working with farmers, we have identified the key weather and climate risks and potential management options for low and high clay content soil across the pre-sowing, vegetative growth, reproductive, and harvest stages. Findings of this research have been consolidated into a decision support matrix that identifies biotic and abiotic climate risks as they are expressed in soils with both low and high clay content. An example of a preliminary version of the matrix is provided in the below screenshot.

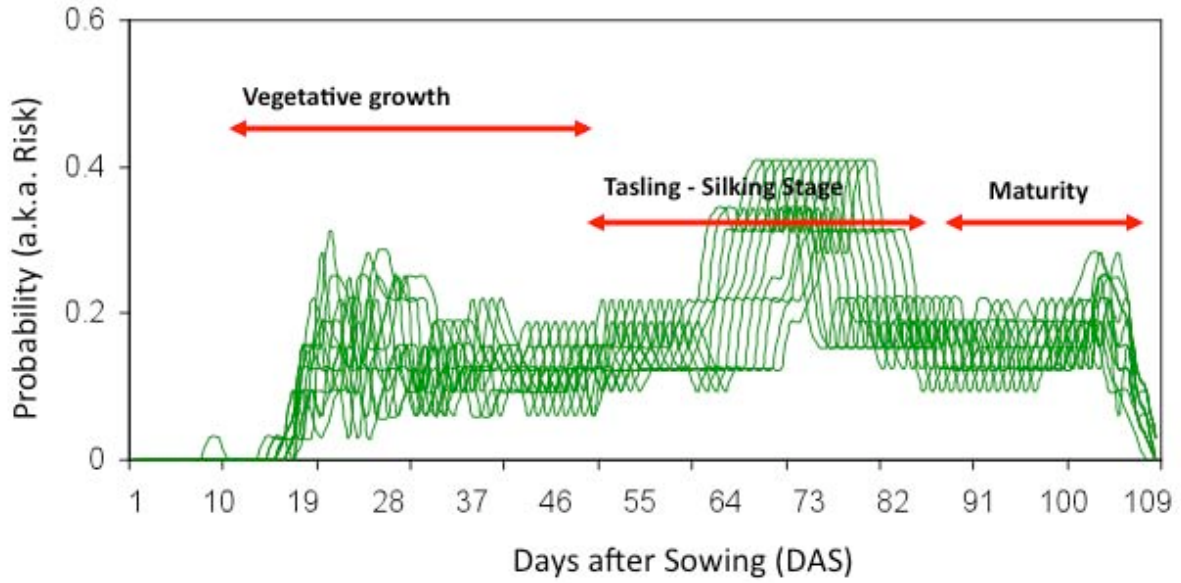


| Days after (before) sowing | Cropping Time line | Abiotic risk- water stress _impact | Good climate event with low risk outcome | Adverse climate event with High risk outcome | Risk Management Options (RM0) avialable | Cost | Range of benefit |
|---|---|---|---|---|---|---|---|
| -50 to 0 | Before and during Land preperation | | | | Soil amendments, Water shed treatment* (see below the table) | For soil amendments- the cost is 2400 to 6000 Rs. At 4 to 10 cart loads per acre - it is 2 to 5 tons. At 600 Rs per cart load (including transport and spreading) | the benefit range is 800 to 4000 Rs. The ir for 3 years. Increase in yeild can be from 1 control (non application). Benefit increases application rate b) lack of moisture stress. growth c) Medium level of moisture stress growth stages like silking stage. With a t 1000 kg /acre in the region and Market pric kg; |
| 0 | Sowing | | | | | | |
| 0-9 | Germination- | None | | | | | |
| 10-40 | Vegetative growth | Medium | | | Inter cultivation and Hand weeding instead of weedicide application. Take up an additional intercultivation if needed | Cost, 200 to 600 Rs per acre. Added cost compared to herbicide use will be 200 Rs per acre. Additional intercultivation will be 400 Rs / acre | Benefit range is 400 to 1200 Rs. Increase i from 5 to 15 % over control (non applicatior depends on the distribution of dry spells an during the season. With a typical yield of in the region and Market price of 8 Rs per k |
| 45-60 | Tasseling stage | High | | | | | |
| 60-85 | Silking stage | Very high | 15 cm and more rain and Minimum of 2 cm per week | Rain less than 5 cm or dry spell of 15 days | 1-2 supplementary irrigation from Surface water storage | Cost is 0 to 1000 Rs/ irrigation. (At 50 Rs per hour from a bore well for 20 hours). It is 0 if it is from CPR surface water and 1000 Rs if a storage structure is created | the benefit range is 1600 to 4800 Rs. Inc can be from 20 to 60 % over control (non Benefit increases with a) higher applicatior moisture stress. during crop growth c) M moisture stress during critical growth stag stage. With a typical yield of 1000 kg /ac and Market price of 8 Rs per k |
| 85-100 | Physiological maturity | Low | | | | | |

Matrix of climate risks and risk management options for maize in Mahabubnagar district (light soils).

In developing this matrix, IRI has also worked with agricultural stakeholders in the Srirangapura and Ippallapally villages of Mahabubnagar district to identify opportunities in existing institutional and decision-making contexts to enhance the use of climate information in managing agricultural risks. Decisions related to climate risks are influenced by factors such as credit and water availability, farm gate price, and the role of the government agencies at district and state levels in specific government programs that support agricultural production. While initial research has focused on Mahabubnagar district, the next phase of activities will scale-up these activities in the other demonstration sites in partnership with the other demonstration site partners.

*Quantitative analysis of climate risk in agriculture using crop models* - Using the information from the risk matrix above, we set up a crop model to simulate maize responses to climate in light soil conditions in Mahabubnagar. This enabled estimation of the optimal planting window for maize (across the nominal three sowing periods), and to develop a risk-index for guiding decisions on the best time for sowing and implementing risk interventions (e.g. supplementary irrigation to minimize crop loss due to water stress under a given weather/climate condition). Using 30 years of weather data, the crop model was run for multiple sowing dates and documented the responses of the crop under rain-fed condition. The below figure shows a sample risk profile (water stress) for maize crop planted in the sowing window between June 20 – July 2. For this sowing period, most of the stress occurs at the later silking stage, and for the sowing windows investigated, promises maximum crop yield.




Sample risk profile for maize planted between June 20 – July 2, Mahabubnagar district.

We also developed a model-based index for estimating thresholds of accumulated rainfall for estimating the need for applying supplementary irrigation at a particular crop stage. In addition, several stand-alone tools were developed to calculate dry spell lengths, probabilities of having dry spells in a standard week, etc.

*Capacity building* - IRI scientists and Indian climate and agriculture experts met for a five-day workshop in Bhubaneshwar, India from April 12-17, 2010. The workshop was hosted by the Orissa University for Agriculture and Technology and brought together project scientists from the state agriculture universities in the demonstration sites, in addition to experts from IIT-Delhi and the IMD. During this event, climate and agricultural scientists worked together on practical approaches to systematically assess climate risks to specific crops in the context of each demonstration site. Participants engaged in practical exercises for analyzing specific crop risks throughout the growing season, promising interventions to manage these risks, and costs and benefits associated with each. IRI scientists also led sessions on statistical methods for crop and rainfall data analysis. Finally, workshop participants presented and discussed the use of climate forecasts for crop planning in the nine demonstration sites across India.

This improved understanding of climate-related agricultural risks and potential risk management strategies will help guide climate analysis and forecasting components of the ERFS project. The Bhubaneshwar workshop built upon the prior Hyderabad workshop (held in April 2009) at which a workplan was developed to guide efforts in the nine district-level demonstration sites. Outcomes of the Bhubaneshwar workshop include a call for all demonstration efforts to undertake the approach to analyzing risks to selected crops in each demonstration district, and recommendations for organizing and disseminating climate research and forecasting outputs at the demonstration level.

*Contributed by* ***S. Someshwar***, ***E. Allis***, ***A.V.M. Ines***, *and* ***A.W. Robertson***

# IRI Collaborating Institute in Southeast Asia: Continued Efforts to Build Regional Capacity to Manage Climate Risks

In 2008 the Institut Pertanian Bogor (IPB) in Indonesia, with support from IRI, established the Center for Climate Risk and Opportunity Management for Southeast Asia and the Pacific (CCROM). As IRI's first Collaborating Institute, CCROM builds from over six years of collaborative research between IRI, IPB, government agencies, research institutes and NGOs in Indonesia and Southeast Asia on climate risk management in sectors such as water, agriculture, food security and fire management. This abstract summarizes the collaborative activities undertaken by IRI and CCROM for the period of this report (November 2009 – October 2010).

*Capacity Enhancement* - In January 2010, IRI hosted two senior researchers from CCROM at the IRI campus in New York for a weeklong capacity enhancing event. As part of this event, IRI scientists provided participants with an overview of recent advances in climate forecasting methodologies and reviewed the data requirements for developing a high-quality forecasting model for Indonesia. The researchers discussed future collaboration between IRI and CCROM in developing a regional climate model to support climate application activities in the region. Furthermore, IRI scientists began collaborative work with the visiting researchers to develop a Data Library and online maproom. The Data Library is viewed as a powerful tool for decision makers because it allows for the analysis of wet and dry spell patterns using historical rainfall data and enhances access to information to provide for better-informed risk management policies. Since the January 2010 meeting, a prototype Data Library has been installed at CCROM that 'mirrors' the main IRI Data Library, and to which datasets can be added locally in future work. Working with a visiting intern student from the French Ecole Polytechnique, a prototype seasonal forecast virtual maproom for Indonesia has been set up at IRI, which we plan to develop further for tailored seasonal forecasts over the region, and to transfer to CCROM.

*Internship Exchange* - NOAA and IRI supported three Climate and Society Masters students to intern at CCROM from June-July 2010. The three interns assisted in research on agricultural climate risks and assessed the potential to introduce index insurance in specific districts in West and East Java. Their work contributed to the climate change aspects of a World Bank-supported project of the Government of Indonesia, as well as to advance the joint research of IRI and CCROM to help launch index insurance in Indonesia. The interns made field visits to specific districts (Pacitan and Indramayu) and met with agriculture officers, farming households and local stakeholders regarding the climate risks in agriculture. Using local agriculture and climate data, they worked with CCROM staff to conduct specific analyses to quantify risks and identify specific opportunities for the use of insurance.

The internship program provided dual benefit to both CCROM and IRI. Following the 2010 summer internship exchange, CCROM's director, Rizaldi Boer, has indicated strong interest to host interns in future years. In particular, he felt the interns helped expose Indonesian students/staff at CCROM to new tools, methods, and techniques for climate risk management and provided them with the opportunity to work in English and gain experience in international

collaborations. Dr. Rizaldi reported these outcomes as being extremely valuable for building the capacity of students and staff at CCROM. In addition to providing an exceptional opportunity for the interns to gain on-the-ground experience in a developing country context, the internships have also been helpful for IRI in advancing the institute's work on index insurance, and in supporting capacity development at CCROM as an IRI Collaborating Institute.

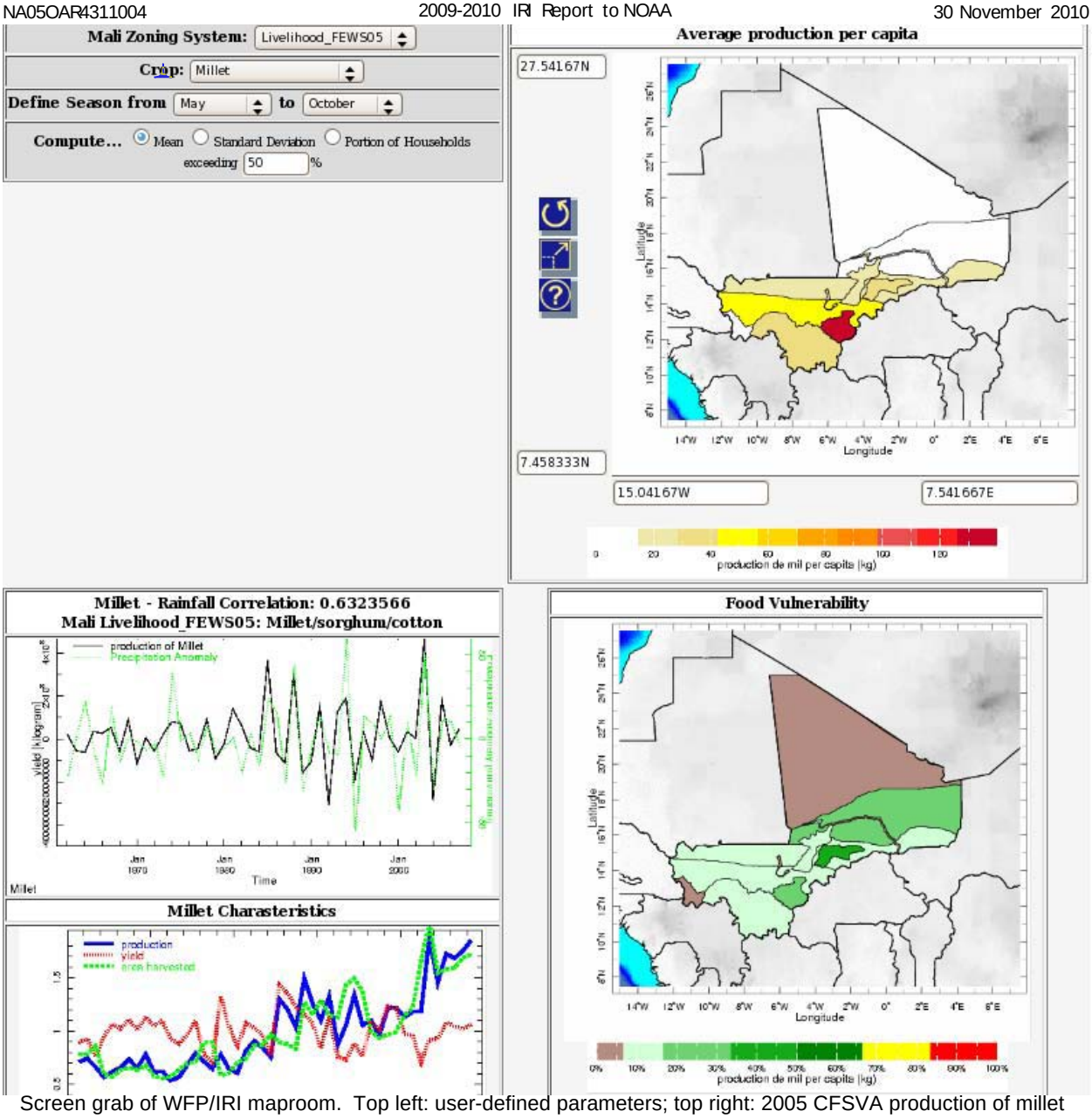
*Contributed by **S. Someshwar**, **E. Allis**, and **A.W. Robertson***

## Climate Change and Food Security in West Africa


The UN World Food Programme (WFP) and the IRI have commenced collaborations aimed to assess the impact of climate change on food security in West Africa. The project was initiated with the secondment of two IRI staff for a period of three months each at WFP headquarters for the Climate Change Disaster Risk Reduction Unit in Rome. There, priority outputs and activities were defined collaboratively. These included an analysis of the relationship between WFP Vulnerability, Analysis and Mapping (VAM) unit's Comprehensive Food Security Vulnerability Analysis (CFSVA) data, the UN Food and Agriculture Organization Statistics Division (FAOSTAT) crop production data, and available climate data in a pilot country chosen to be Mali. The results of this analysis feed an online WFP/IRI maproom that has been customized to allow WFP operational staff to explore the results in a manner that best suits their needs (e.g., see figure below). Related ongoing outputs and activities include: an assessment of this relationship at a regional level; publications in the Climate and Society Publication; the design of an analytical framework to allow the reproduction of the analysis in other countries or regions; and outreach and training materials to inform and educate about climate change and variability at different levels of WFP's organization.

Rainfall climatology spatial pattern matches well the US Agency for International Development (USAID) Famine Early Warning Systems Network (FEWSNET) defined livelihood zones of Mali, which are a zoning/mapping of a country according to its population activities, going from pastoralism in the North to millet-dominated agriculture in the South. This simple super-imposition suggests a prominent role of rainfall in crop production which is confirmed by time series analysis of year-to-year differences of FAOSTAT crop production and year-to-year differences of May-to-October seasonal rainfall average over Mali (e.g., see figure below). However good this correlation can be for the four major crops (millet, sorghum, maize and rice) studied at the inter-annual time scale, the trend in crop production since 1984 suggests that rainfall is not the only driver of crop production on longer time-scales, and that societal adaptation plays an important role yet to be identified.

Given the strong relationship between crop production and rainfall anomalies, it makes sense to put this information together with the CFSVA data. The CFSVA is field-survey data at household level that takes a snapshot of a country's food vulnerability in near-normal conditions. It represents thousands of variables at household level describing households' demography, migration, habitat, agricultural and livestock breeding activities, income, spending, food




Screen grab of WFP/IRI maproom. Top left: user-defined parameters; top right: 2005 CFSVA production of millet per capita averaged over FEWSnet livelihood zones; bottom left: millet production correlated to rainfall (top) and millet production (blue), yield (red) and area harvested (green) trends (bottom); bottom right: indicator of the portion of households' income relying on millet production.

consumption, exposure to shocks (e.g., economical, environmental, etc.) and strategies to cope with them. In light of the correlation between rainfall anomaly and, say, millet production, it is possible to map, from the CFSVA data, an indicator of how much households' income in different FEWSNET livelihoods zones rely on millet production (see also figure).

The operational WFP/IRI maproom was built to allow the exploration of such results. The continuation of the collaboration implies: improvement of the analysis; refinement of the tools to better inform the needs of potential WFP staff in a range of possible uses; and the introduction of forecasts and/or projections in the analysis. It also opens the door to further collaboration between the food security and the climate communities.

*Contributed by* ***R. Cousin*** *and* ***A. Giannini***

# Adaptation through Managing Current Climate Risk

The Consultative Group on International Agricultural Research (CGIAR) program on Climate Change, Agriculture, and Food Security (CCAFS) unites the complementary strengths of the CGIAR system and the Earth System Science Partnership (ESSP), and their respective partners, to address the challenges that a changing climate poses on attaining food security, enhancing livelihoods and improving environmental management. The CCAFS strategy is structured around six Research Themes: (1) diagnosing vulnerability, (2) macro-level policies, (3) linking knowledge to action, (4) adaptation through managing current climate risk, (5) adaptation to progressive climate change, and (6) pro-poor mitigation strategies. Initial focus regions are East and West Africa, and the Indo-Gangetic Plains.

The IRI contributed to the design of CCAFS. The Theme on adaptation through managing current climate risk, led by IRI Research Scientist James Hansen, will develop and evaluate promising innovations in climate risk management at a local (farming community and rural value chain) level, and at the level of food delivery, trade and crisis response systems. It will also support risk management at both scales through enhanced prediction of climate impacts on agriculture, and enhanced climate services for agriculture and food security.

Since its official launch in May 2010, CCAFS held agenda-setting and partnership-building workshops in its three focal regions; initiated a range of research, partnership and capacity-development activities; and initiated household- and village-level baseline surveys in eleven countries. The Theme the IRI leads has commissioned research on historic rainfall data reconstruction and crop yield forecasting, and scoping studies on climate information services and delivery mechanism, pests and disease early warning, and climate-informed food security management. Results from the workshops, surveys and scoping papers will guide the research agenda as CCAFS moves forward.

Although CCAFS was developed as a time-bound ‘Challenge Program,’ the CGIAR recently approved its transition into one of the ‘Consortium Research Programs’ that will serve as the framework for funding and managing CGIAR research-for-development into the future.

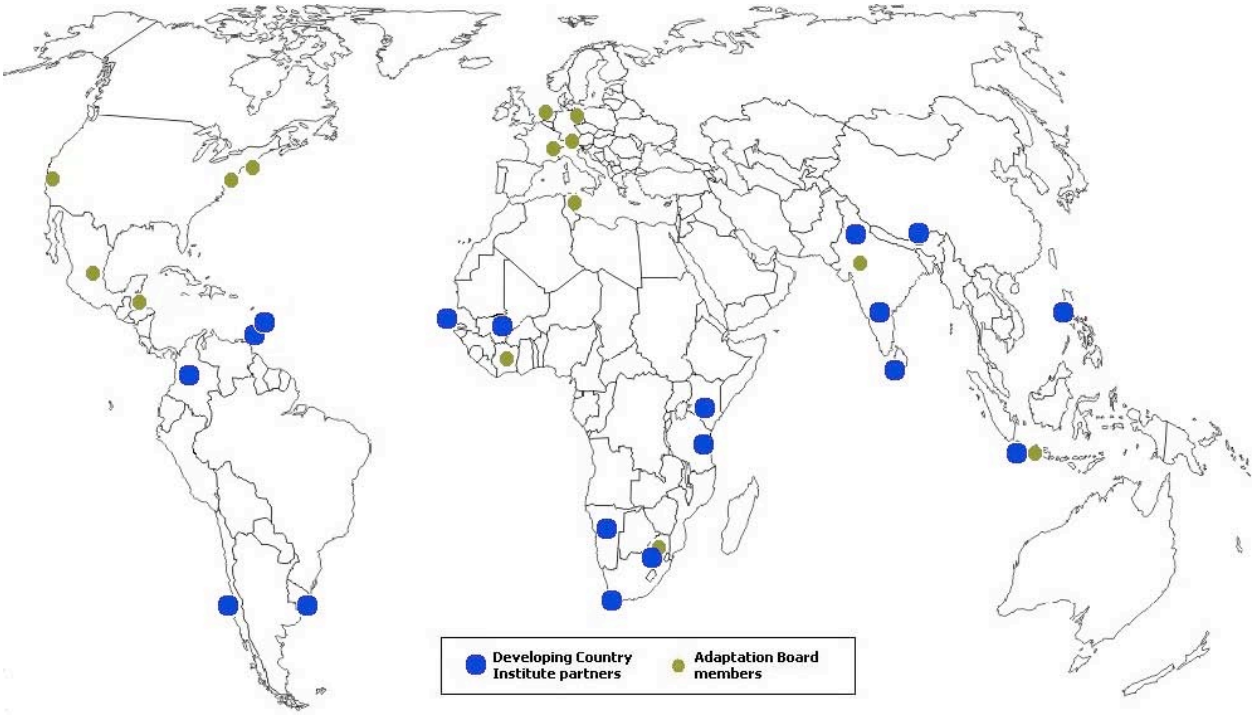
CCAFS represents a breakthrough for IRI’s agriculture work. As the globally-coordinated mechanism for bringing science-based solutions to the challenges of rural poverty and food security, the 15 International Agricultural Research Centers that comprise the CGIAR have been a high-priority partner for the IRI for more than a decade. The IRI’s leadership role in CCAFS provides a mechanism to partner with the CGIAR system, and an opportunity to shape the climate adaptation strategy of the CGIAR under its new structure.

*Contributed by **K. Coffey** and **J.W. Hansen***

# IRI Leads the Adaptation Program of the Global Network for Climate Solutions

In June 2010, the Earth Institute at Columbia University launched the Global Network for Climate Solutions (GNCS) to influence international climate negotiations and activities by grounding them in shared research and consensus focused on concrete solutions and action. The initiative seeks to create a low-cost, open architecture, on-line network of research centers and institutes around the world, addressing both mitigation and adaptation. The goal is to facilitate the design of action plans for climate mitigation and adaptation. These plans will inform the COP 16 and future negotiations, as well as help leverage funding to implement science-based actions. The launch of the GNCS has been made possible with support from the Skoll Foundation and the Planet Heritage Foundation.

Dr. Jeffrey Sachs, Director of the Earth Institute, oversees the entire effort. The Network comprises two components, with Dr. Shiv Someshwar of the IRI directing the Adaptation Program and Dr. Scott Barrett of Columbia's School of International and Public Affairs directing the Mitigation Program. Two independent boards of global leaders in the respective fields guide these programs. The Adaptation Program is supported by a coordinator and four research support staff. IRI staff also plays a key role in providing expert advice for the global adaptation effort on a range of climate and sectoral issues.




GNCS - Adaptation Program Developing Country Institute Partners and Adaptation Board Members as of October 18, 2010. The GNCS Adaptation Program is led by IRI's Shiv Someshwar.

The GNCS Adaptation Program is interacting with a range of Developing Country Institutes (DCIs) to help formulate concrete, solution-oriented Adaptation Plans. The process aims to
(1) advance practical, science-based methodologies for assessing adaptation options to address current and future climate risks;
(2) identify critical technologies, practices and institutional arrangements required for the practice of adaptation;
(3) create a basis for comparing and assessing costs of diverse adaptation efforts; and
(4) improve capacity of DCIs to contribute to adaptation planning and practice.

To facilitate collaboration and knowledge exchange, a robust, interactive website is being developed and involves a searchable online resource library and "knowledge modules" that capture expert insight on critical topics identified by DCIs. As of October, over 20 DCIs have joined the Network, and it is continuing to expand at an impressive rate (see also map, above).

*Contributed by **S. Someshwar** and **K.M. Baroang***

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# Selected Projects, 2009 - 2010

**TOPIC AND REGION ICONS**


Agriculture and Food Security


Climate


Data Library and Map Rooms


Economics and Livelihoods


Education and Training


Environmental Monitoring and Remote Sensing


Fire Management


Forecasting


Hazards


Public Health


Water Management


Africa


Asia & the Pacific


Latin America & the Caribbean

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
| | Agribusiness Climate Legal and Institutional Reform (AgCLIR) Project *Completed* | Provided technical expertise, guidance and support on the aspect of climate change for the USAID's AgCLIR assessment, an in-depth analysis of four dimensions of the business environment (legal, implementing and supporting institutions, and social dynamics) that affect Tanzania's agribusiness environment. | | Zebiak, S. Perez, C. |
| | Analyzing Tradeoffs Among Provisioning And Regulating Ecosystem Services and Biodiversity in Agricultural Landscapes in East Africa *Completed* | Developed an interdisciplinary land-use decision tool for rural East Africa based on spatially explicit modeling that enables the analysis of potential tradeoffs between agricultural development, biodiversity and ecosystem services. | Columbia University Lamont-Doherty Earth Observatory<br>Columbia University The Earth Institute<br>Columbia University Center for Environmental Research and Conservation | Smukler, S./ Ceccato, P. |
| | Assessment of the Changes in Water Productivity under Different Climate Scenarios in the Southern Cone | Define plausible scenarios of climate variability and near-term climate change and integrate them into information and decision support systems for improving water management in South America's Southern Cone. | Instituto Nacional de Investigacion Agropecuaria (Uruguay)<br>Instituto Nacional de Tecnología Agropecuaria (Argentina)<br>Instituto Nacional de Investigaciones Agropecuarias (Chile)<br>Empresa Brasileira de Pesquisa Agropecuária (Brazil)<br>Universidad Mayor de San Andres (Bolivia)<br>Fondo Regional de Tecnologia Agropecuaria (Inter-American Development Bank)<br>International Center for Agricultural Research in the Dry Areas (ICARDA, CGIAR)<br>Inter-American Institute for Cooperation in Agriculture (IICA)<br>Programa Cooperativo para el Desarrollo Tecnologico Agroalimentario y Agroindustrial del Cono Sur (PROCISUR-IICA) | Baethgen, W. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Atmospheric Aerosol Impacts on Health in Sub-Saharan Africa | Towards increased understanding of related health impacts in sub-Saharan African through the investigation of near-surface dust characteristics specific to the Sahel during the dry season. | NASA Goddard Institute for Space Studies<br>Columbia University Department of Ecology, Evolution and Environmental Biology<br>Columbia University Mailman School of Public Health<br>Columbia University Lamont-Doherty Earth Observatory<br>Columbia University Tropical Agriculture Program of the Earth Institute | Perez Garcia-Pando, C. Trzaska, S. |
|  | Building Capacity to Produce and Use Climate and Environmental Information for Improving Health in East Africa | Building capacity in the climate and health community (working with both individuals and institutions) to produce and use climate knowledge and information in routine health decision-making. | Ethiopia Ministry of Health<br>Liverpool School of Tropical Medicine<br>Ethiopia National Meteorological Agency<br>IGAD Climate Prediction Centre<br>Ethiopia Anti-Malaria Association<br>University of Reading, Department of Meteorology (UK)<br>World Health Organization Eastern and Southern African Malaria Control<br>Climate and Health Working Group, Ethiopia<br>Climate and Health Working Group, Kenya<br>Climate and Health Working Group, Madagascar<br>Meningitis Environmental Risk Information Technologies<br>Health and Climate Foundation | Connor, S. |
|  | CAREER: Characterizing the Uncertainty in Projections of Climate Change in the Semi-Arid Tropics Based on the Moist Static Energy Framework | Advancing climate change research through increased understanding of the physical processes that cause uncertainty in climate model projections, and improving communication of its results to the broader community. | Columbia University School of International and Public Affairs<br>Columbia University Department of Earth and Environmental Sciences<br>Columbia University Institute of African Studies | Giannini, A. |
|  | CIESIN/LDEO-Data Development and Improvement for the 2009 Global Risk Update: Earthquakes, Drought, and Population Exposure *Completed* | IRI collaborated with the Center for International Earth Science Information Network and the Center for Hazards and Risk Research in support of the effort to improve the evidence base for disaster risk assessment. | Center for Hazards and Risk Research<br>Columbia University Center for International Earth Science Information Network | Lerner-Lam, A. / Lyon, B. |
|  | Challenge Program on Climate Change, Agriculture and Food Security (CCAFS) - Theme 4: Adaptation pathways based on managing current climate risk | Conducting and leading strategic and theme research activities that bring promising innovations in climate risk management to bear on the challenge of protecting and enhancing food security and rural livelihoods in the face of a variable and changing climate. | | Hansen, J. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Climate Change and Variability in the Expansion of Agricultural Frontier in the Southern Cone: Technological and Policy Strategies to Reduce Vulnerabilities | Identifying the vulnerabilities of the expansion of agriculture to climate change and variability in the Southern Cone and exploring technological alternatives and policy interventions to improve adaptability. | Instituto Nacional de Investigacion Agropecuaria (Uruguay)<br>Instituto Nacional de Tecnologia Agropecuaria (Argentina)<br>Instituto Nacional de Investigaciones Agropecuarias (Chile)<br>Ministerio de Ganaderia y Agricultura (Paraguay)<br>Centro Internacional de Mejoramiento de Maiz y Trigo (CMMYT, CGIAR)<br>Inter-American Institute for Cooperation in Agriculture (IICA)<br>Programa Cooperative para el Desarrollo Tecnologico Agroalimentario y Agroindustrial de Cono Sur (PROCISUR-IICA)<br>Inter-American Development Bank (Sustainable Energy and Climate Change Initiative) | Baethgen, W. |
|  | Climate Information for Public Health Action | Providing public health professionals with knowledge, methodologies, tools, and data to better manage climate sensitive diseases toward improving health outcomes. | Columbia University Center for International Earth Science Information Network<br>Columbia University Mailman School of Public Health | Thomson, M. |
|  | Climate Predictability Tool Training | Fostering a network of expertise for improved understanding of climate predictability. | World Meteorological Organization | Mason, S. |
|  | Climate Predictability of Extreme Floods in the United States | Developing a statistically-based inference and modeling system for the conditional simulation of floods given climate attributes. | | Lall, U.<br>Robertson, A. |
|  | Climate Variability and Change in High-Mountain Watersheds, Case Study: Claro River High Mountain Basin, Los Nevados Natural Park, Andean Central Mountain Range, Colombia *Completed* | Analyzed the integrity and function of Andean high-altitude ecosystems and their associated watersheds, considered among the most vulnerable environments to changes in climate. | World Bank<br>Escuela de Ingenieria de Antioquia | Ruiz Carrascal, D. |
|  | Climate-Related Risk Assessment and Risk Management in the Agricultural and Forestry Sectors of Uruguay | Assessinh the impact of climate variability at different temporal scales (from seasonal/interannual, through decadal, to climate change) on food crops, livestock and forest production. | Instituto Nacional de Investigacion Agropecuaria (Uruguay)<br>Universidad de la Republica | Baethgen, W. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Collaborative Research: Regional climate-change projections through next-generation empirical and dynamical models | The development of a twin approach of non-homogeneous hidden Markov models and coupled ocean-atmosphere, intermediate-complexity models to identify the potentially predictable modes of climate variability and to investigate their impacts on the regional scale. | University of California, Irvine<br>National Oceanic and Atmospheric Administration<br>University of California, Los Angeles<br>University of Wisconsin Milwaukee | Robertson, A. |
|  | Collaborative Research: Separating Forced and Unforced Decadal Predictability in Models and Observations | We propose a methodology to identify unforced predictable components on decadal time scales in models and observations, distinguish these components from forced predictable components, and assess the reliability of model predictions of these components. The methodology will be applied to the decadal hindcasts generated by the CMIP5 project to assess the reliability of model projections. The question of whether anthropogenic forcing changes decadal predictability, or gives rise to new forms of decadal predictability will also be investigated. | George Mason University | DelSole, T. / Tippett, M. |
|  | Contributing to an OPeNDAP/OCG Gateway to Support Regional IOOS Interoperability<br>*Completed* | Contributed to overall design of OPeNDAP/OCG Gateway to Support Regional IOOS Interoperability, with particular focus on semantic mapping necessary to translate data through different interfaces, and the designing of a framework that allows semantic mapping without interfering with or changing the data transport. | Open-source Project for a Network Data Access Protocol | Blumenthal, M. B. |
|  | Data Library Operations | Facilitate data exchange by providing an online data library that provides multi-disciplinary access to data needed to study short-term climate change and its impact. | Thematic Realtime Environmental Distributed Data Services<br>OPeNDAP Distributed Ocean Data Sets | Blumenthal, M. B. |
|  | Decentralization and Local Public Goods: How does allocation of decision-making authority affect provision? | Determine under what conditions community participation in projects designed to raise living standards in the community improves project outcomes. | NGO Forum for Drinking Water Supply & Sanitation | Madajewicz, M. |
|  | Decision Support System for Irrigated and Rainfed Conditions in the Coquimbo Region of Chile | Improving preparedness and response to droughts in rainfed areas of Chile's Coquimbo region by collaborating with local partners to establish a drought early warning system and to improve water use efficiency. | Centro del Agua para Zonas Aridas y Semi Aridas de America Latina y El Caribe<br>Centro de Estudios Avanzados en Zonas Aridas (Chile)<br>Junta de Vigilancia del Rio Elqui<br>Gobierno Regional de Coquimbo, Chile<br>Direccion General de Aquas (Chile)<br>University of Gent (Belgium) | Baethgen, W. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Development of Coupled Model Products | This project explores improvements to real-time coupled model forecasts, including provision of diagnostics of coupled models provided by collaborating partners, who will aid implementation of operational coupled seasonal forecasting in Africa. | Center for Ocean-Land-Atmosphere Studies<br>European Centre for Medium-Range Weather Forecasts<br>National Centers for Environmental Prediction | DeWitt, D. |
|  | Development of Global Climate Maps and Data Layers for Climate Change | Developing tools that enhance project support decision-making by helping to answer questions about the relative importance of historical climate variations on different time scales. | | Baethgen, W.<br>Bell, M.<br>Greene, A. |
|  | Development of Model Systems for Prediction and Predictability Studies | Improve predictive skill and understanding of predictability limits by improving some aspect of global models, including numerics, physics, or boundary conditions. | | Sun, L. |
|  | Development of Report on Priority Earth Observation Needs for Environmental Change Parameters that Affect Human Health<br>*Completed* | Reporting on the environmental change and human health social benefit area (SBA) for Eastern Research Group, as part of a task sponsored by the Group on Earth Observations (GEO). | | Ceccato, P. |
|  | Development of a Monitoring and Forecasting System of Crop and Pasture Production for Managing Climate Risks | Incorporating climate-related information into decision support tools to enhance monitoring and forecasting crop and pasture production in Uruguay. | Instituto Nacional de Investigacion Agropecuaria (Uruguay) | Baethgen, W. |
|  | Diagnosing Decadal-Scale Climate Variability in Current Generation Coupled Models for Informing Near-Term Climate Change Impacts | Examining and documenting characteristics of decadal-scale variability in current generation coupled models, particularly in the context of initialized predictions, to prepare for the work in experimental decadal predictions emerging from modeling centers. | Geophysical Fluid Dynamics Laboratory<br>The National Center for Atmospheric Research<br>Hadley Centre | Goddard, L.<br>Greene, A. |
|  | ENSEMBLE-based predictions of climate changes and their impacts<br>*Completed* | The ENSEMBLES project was supported by the European Commission's 6th Framework Programme as a 5 year Integrated Project from 2004-2009 under the Thematic Sub-Priority 'Global Change and Ecosystems.' IRI, a no-cost partner, contributed to the assessment of the value of tailored products for end user communities, in this example, the infectious disease community. | Liverpool School of Tropical Medicine | Thomson, M. |
|  | Economics of Adaptation to Climate Change (EACC): Analysis of the Economics of Adaptation to Climate Change for Agriculture, Transportation and Energy Sectors in Ethiopia<br>*Completed* | Economic analysis of climate-related adaptation strategies for Ethiopia, assisting the World Bank's multi-country Economics of Adaptation to Climate Change study. | Massachusetts Institute of Technology<br>University of Colorado<br>Ethiopian Electric Power Corporation<br>Ministry of Water and Energy, Ethiopia<br>Ministry of Agriculture, Ethiopia | Block, P. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Elucidating Near-Term Climate Change Information to Guide Water Resources Decisions and Foster Sustainability | Identifying the linkages and feedbacks between near-term climate change projections and decadal decisions to lay the groundwork for a water management decision system in Chile's Elqui River Basin. | Junta de Vigilancia del Rio Elqui<br>Columbia University Center for Research on Environmental Decisions<br>Columbia University Tree Ring Lab<br>Universidad de la Serena<br>Columbia Water Center | Block, P. |
|  | Enhancing Malaria Early Warning System (MEWS) with Earth Observation and Modeling Results *Completed* | We tested satellite-derived rainfall estimation and temperature estimation products against ground observations to inform the development of integrated vectorial capacity maps. | United States Geological Survey<br>National Aeronautics and Space Administration<br>Pan American Health Organization<br>World Health Organization | Connor, S. |
|  | Environmental factors and population dynamics as determinants of meningococcal meningitis epidemics in the Sahel: an investigation of NASA and NOAA products | Exploring the potential of satellite observations and model outputs combined with available epidemiological and demographic information for meningitis risk mapping with a focus on Niger. | NASA Jet Propulsion Laboratory<br>Columbia University Center for International Earth Science Information Network | Trzaska, S. |
|  | Establishing an Information and Decision Support System (IDSS) for the Agricultural Sector of Chile *Completed* | Building on IRI's experiences and lessons learned in the work on IDSS in Uruguay and Paraguay, we helped to establish a similar system for Chile in collaboration with the Ministry of Agriculture. | Instituto Nacional de Investigaciones Agropecuarias (Chile) | Baethgen, W. |
|  | Evaluating Impacts of Sustainable Development Projects | Designing innovative methods to evaluate impacts of the projects we undertake towards sustainable development. | Columbia University Tropical Agriculture Program of the Earth Institute<br>Columbia University Applied Statistics Center<br>Columbia University Department of Mechanical Engineering<br>Columbia University Center for International Earth Science Information Network | Madajewicz, M. |
|  | Experimental Crop Disease Outlooks for SE South America | Testing the ability of ENSO and seasonal climate forecasts to establish outlooks of the incidence of two important crop diseases (fusarium in wheat and rust in soybeans) in southern Brazil. | Centro de Previsão de Tempo e Estudos Climáticos<br>Empresa Brasileira de Pesquisa Agropecuária<br>Instituto Agronomico do Parana(Brazil) | Baethgen, W. /<br>Del Ponte, E. |
|  | Extended Range Forecasting and Agriculture Risk Management, India (ERFS) | Integrating risk management and climate science research to improve forecasting capacity and the understanding of climate risks in the context of rural livelihoods. | Indian Institute of Technology Delhi<br>Government of India Ministry of Agriculture<br>India Meteorological Department<br>National Centre for Medium Range Weather Forecasting<br>Indian Council of Agriculture Research | Someshwar, S.<br>Robertson, A. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Fires in Western Amazonia: Understanding and Modeling the Roles of Climatic, Social, Demographic, and Land Use Change | Columbia University's Center for Environmental Research Conservation takes the lead in this collaboration with IRI, and the Department of Ecology, Evolution, and Environmental Biology (E3B) to investigate the relevant processes of change in land use, migration, urbanization, and climate in Western Amazonia, and links to the probability of changes in the incidence, size and severity of escaped fires. | Columbia University Center for Environmental Research and Conservation<br>Columbia University Department of Ecology, Evolution and Environmental Biology | Pinedo-Vazquez, M. / Baethgen, W. |
|  | IRI CSL Computing Project: Development & Application of Seasonal Climate Predictions | We utilize CSL computational resources to investigate the potential to predict extreme seasonal and sub-seasonal climate variability. The results of this work contribute to better estimates of the skill realizable by real-time forecasts of climate, and in improvements to sector forecasts that incorporate climate factors. | Max Planck Institute for Meteorology<br>The National Center for Atmospheric Research | DeWitt, D. |
|  | IRI MIEL (monitoring, impact evaluation and learning) Planning and Technical Support for HARITA Micro-Insurance Pilot<br>*Completed* | Planning and technical support in the expansion of Oxfam America's climate change resiliency pilot in Adi Ha, Tigray, Ethiopia, providing a holistic package that combines risk reduction, drought insurance and credit for food insecure households. | | Osgood, D. |
|  | IRI-IFRC partnership to save lives<br>*Completed* | A partnership with IFRC in the use of climate information to enhance IFRC's national and regional offices' capacity in effective early warning-early action to minimize the effects of weather- and climate-related natural disasters. | International Federation of Red Cross and Red Crescent Societies | Mason, S. |
|  | IRI-SCG Developing User Requirements Registry, Concepts and Approaches for Cross-Cutting Analyses Between Nine Societal Benefits Areas for Identifying User Needs in terms of Earth Observation Priorities from the 2009 US-09-01A Primary Reports | Providing analyses and consultation on cross-cutting issues to set the observational priorities for the health components of the Group on Earth Observations (GEO) System of Systems (GEOSS). | | Ceccato, P. |
|  | IRI-WFP Collaboration on Climate Change | IRI and the UN World Food Programme collaborate to identify practice areas in food security risk to which climate information, tailored for policy and planning can beneficially be incorporated. | World Food Program | Zebiak, S. |
|  | Impact of Increased Model Resolution on Predictive Skill in Tier-2 Integrations Using Prescribed Sea Surface Temperature | Assess the impact of increased model resolution on seasonal forecast skill, and evaluate the potential benefit to the IRI real-time forecast system from increasing resolution. | Max Planck Institute for Meteorology<br>The National Center for Atmospheric Research | Goddard, L. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Implementation of New or Improved Systems, Tools, Software and Products | Implementation of new or improved components into the forecast operations for the production of the global "net assessment" forecasts is considered an essential step in the completion of a successful research activity on forecast combination and / or recalibration. The transition into "real-time" forecasting products and tools is an integral component of predictability research at the IRI. | Max Planck Institute for Meteorology<br>NASA/Goddard Space Flight Center<br>Center for Ocean-Land-Atmosphere Studies<br>Geophysical Fluid Dynamics Laboratory<br>Climate Prediction Center<br>Environmental Modeling Center<br>National Centers for Environmental Prediction<br>Experimental Climate Prediction Center<br>Queensland Climate Change Centre of Excellence | Barnston, A. |
|  | Improved SST Prediction | Provide the most accurate and reliable predictions possible of global SSTs and of ENSO probabilities | European Centre for Medium-Range Weather Forecasts<br>National Centers for Environmental Prediction | Tippett, M. |
|  | Incorporating Scale and Predictability Information in Multi-model Ensemble Climate Predictions | Developing a state-of-the-art multi-model ensemble prediction system informed by the best available prior information using a mathematically rigorous procedure. | National Centers for Environmental Prediction<br>George Mason University | DelSole, T. / Tippett, M. |
|  | International Internships for Climate and Society | Working with IFRC to provide opportunities for students in the Climate & Society MA Program to work on climate risk management in Asia, Africa and Latin America. | NOAA Climate Program Office<br>International Federation of Red Cross and Red Crescent Societies<br>Red Cross/Red Crescent Climate Centre | Zebiak, S. |
|  | LDEO: The American Midsummer Drought: Casual Mechanisms and Seasonal-to-Interannual Predictability | We seek to understand more fully the "mid-summer drought" (MSD), which is unique to Central America and southern Mexico. We propose to focus on analysis of observations, using approaches that will allow us to identify what features of the atmospheric circulation are critical to predicting inter-American hydro-climate. | Columbia University Lamont-Doherty Earth Observatory<br>Woods Hole Oceanographic Institution | Seager, R. / Giannini, A. |
|  | Linking Seasonal Forecasts into RiskView to Enhance Food Security Contingency Planning<br>*Completed* | Equipping a water requirement satisfaction index tool for crops with climate forecast information to generate probabilistic estimates of emerging or current food production risks across Africa. | | Hansen, J.<br>Tippett, M. |
|  | Malaria Early Warning System: Building on Botswana Work and Scaling Up to Other Epidemic-Prone Countries in Africa<br>*Completed* | Provide evidence for the role of climate in disease dynamics in African countries and to assess the value of such evidence to improving epidemic prevention and control. | World Health Organization<br>La Recherche Agronomique au Service des Pays du Sud | Thomson, M. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Map Rooms - Capability Enhancements | Enhance society's ability to understand climate variability and its synergistic relationships with other environmental factors for applications in various sectors and decision systems. | World Meteorological Organization<br>United States Geological Survey<br>Columbia University Center for International Earth Science Information Network<br>Center for Climate Risk and Opportunity Management (CCROM) | Blumenthal, M. B. |
|  | Mapping Institutions and Policy Responses | Develop and pilot methodologies to map institutions and policy processes to manage climate-related problems, initially in the context of diverse demonstration sites in Southeast Asia. | Institute of Strategic Planning and Policy Studies<br>Center of Agricultural and Rural Development Studies<br>Udayana University | Someshwar, S. |
|  | Monitoring Air and Land Surface Temperature using Satellite Derived Products | An analysis of the air and surface temperature derived from satellite images to monitor temperature conditions favorable to vector-borne disease transmissions. | | Ceccato, P. |
|  | Monitoring Air and Land Surface Temperatures from Remotely-Sensed Data for Climate-Human Health-Agriculture Applications *Completed* | The objective of this project is to provide minimum and maximum air temperature maps to researchers studying the relationships between changes in air temperature and certain diseases affected by climate. | National Oceanic and Atmospheric Administration<br>Columbia University Mailman School of Public Health | Ceccato, P. |
|  | Near Term Climate Change (NTCC) | This project aims to develop methods and products for guidance on near term climate change (NTCC). | Geophysical Fluid Dynamics Laboratory<br>Centro de Previsão de Tempo e Estudos Climáticos<br>Columbia University Lamont-Doherty Earth Observatory<br>Bureau of Meteorology and Geophysics, Indonesia | Goddard, L. |
|  | New Tools for North American Drought Prediction | The work will develop and test best new tools for drought prediction based on empirical-dynamical forecasting approaches. The goal is to enhance real-time, seasonal drought assessment and prediction capabilities for the U.S. and Mexico. | Universidad Nacional Autonoma de Mexico | Lyon, B.<br>Bell, M. |
|  | A Prototype Earth-Gauging System Integrating Weather and Health Data to Manage Meningitis | Identifying global partnerships and related research opportunities to link understanding of the meningitis-related environmental risks with action for the improved management of meningitis. | The University Corporation for Atmospheric Research<br>North Carolina State University | Thomson, M. |
|  | Real-Time Dynamically Based Climate Diagnostics of Observations and Forecasts | Improve understanding and attribution of real-time observed and forecasted climate anomalies via use of dynamical techniques. | Center for Ocean-Land-Atmosphere Studies<br>Columbia University Lamont-Doherty Earth Observatory | DeWitt, D. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
| | Recalibrating and Combining Ensemble Predictions | Developing and evaluating a seasonal forecasting system that takes advantage of the latest innovations in multi-model combination, pattern correction and recalibration of forecast distributions. | Climate Prediction Center<br>National Centers for Environmental Prediction | Goddard, L.<br>Tippett, M.<br>Mason, S. |
| | Regional Climate Outlook Forums (SE S Am, Western S Am, NE Brazil, Central Am) | Provide climate information (model runs, data library, IRI forecasts); train researchers on the use of the Climate Predictability Tool; and present educational material to stakeholders on probabilistic climate forecasts and their applications in decision making. | World Meteorological Organization<br>Centro de Previsão de Tempo e Estudos Climáticos (CPTEC, Brazil)<br>International Center for Research on El Nino (CIIFEN)<br>Comité Regional de Recursos Hidráulicos del Istmo Centroamericano (CRRH/SICA) | Baethgen, W. |
| | Research and Capacity Building Partnership between IRI and the Earth Observation, Department of Geography & Geology, University of Copenhagen, Denmark | This project aims to develop a long-term research and capacity building partnership between IRI and the Earth Observation, Department of Geography & Geology, University of Copenhagen, Denmark. | University of Copenhagen | Ceccato, P. |
| | Retrospective Forecasts Made Using Using Retrospectively Forecast SST | Estimate real-time forecast skill from two of the operational IRI forecast models using hindcasted SST | Max Planck Institute for Meteorology<br>The National Center for Atmospheric Research | Goddard, L. |
| | The role of airborne dust and climate in meningococcal meningitis outbreaks in the Sahel | A pilot study on the influence of seasonal and spatial climate variability on dust concentrations and composition specific to the "meningitis belt" of sub-Saharan Africa, to further the understanding on the quantitative relationships between these climatic and environmental factors and high transmission and incidence rates and epidemic outbreaks of meningococcal meningitis. | Columbia University Lamont-Doherty Earth Observatory<br>Columbia University Mailman School of Public Health | Trzaska, S. |
| | Routine Forecasts | Routine monthly production of climate and SST forecast products | Max Planck Institute for Meteorology<br>NASA/Goddard Space Flight Center<br>Center for Ocean-Land-Atmosphere Studies<br>Geophysical Fluid Dynamics Laboratory<br>Climate Prediction Center<br>Environmental Modeling Center<br>Experimental Climate Prediction Center<br>Queensland Climate Change Centre of Excellence | Barnston, A. |
| | Supporting Colombia's National Integrated Dengue and Malaria Surveillance and Control System | Supporting Colombia's national integrated dengue and malaria surveillance and control system by providing the evidence of the role of climate in disease dynamics, the use of climate information and development of tools for disease prevention and control. | Instituto Nacional de Salud de Colombia<br>Instituto de Hidrología, Meteorología y Estudios Ambientales<br>Conservacion Internacional Colombia | Baethgen, W. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | Sustainable development in the Sahel - learning from the recent greening | Laying the groundwork for quantifying the relative roles of physical and societal factors in the recent "re-greening" of the Sahel, and for assessing the potential for sustainable practices to combat land degradation in adapting to climate change. | University of California, Irvine<br>Columbia University Lamont-Doherty Earth Observatory<br>Columbia University Center for International Earth Science Information Network | Giannini, A. / Adamo, S. |
|  | Swiss Proposal for an Insurance Pillar under the UNFCCC | Providing the climate framework to inform the analysis of the needs and capabilities of various stakeholders, such as private sector, individuals, public institutions on the national and sub-national level, and the role of index insurance providers and users in developing countries. | Swiss Reinsurance Company<br>INFRAS Forschung und Beratung<br>Center for Climate Risk and Opportunity Management (CCROM) | Osgood, D. |
|  | Tailored forecast and monitoring products | This project focuses on the provision of real-time forecasts tailored to specific climate risk management approaches. | Climate Prediction Center<br>Centro de Previsão de Tempo e Estudos Climáticos<br>European Centre for Medium-Range Weather Forecasts<br>Centre Europeen de Recherche et d'Ensignement des Geosciences d l'Environment | Robertson, A. |
|  | Towards improved control of meningitis outbreaks in sub-Saharan Africa | Fostering research on epidemiological, environmental, demographic and socio-economic determinants of meningococcal meningitis outbreaks in sub-Saharan Africa. | NASA/Goddard Space Flight Center<br>Columbia University Center for International Earth Science Information Network<br>Columbia University Mailman School of Public Health | Trzaska, S. |
|  | UFS-Managing climate risk for agriculture and water resources development in south-western South Africa: Quantifying the costs, benefits and risks associated with planning and management alternatives | A Climate Change Adaptation in Africa project collaboration with three South African universities and the UNEP-Risoe Center to engage government (water and agricultural departments) and private sector stakeholders to identify and test the feasibility of alternative management options in light of development and climate change in the Western Cape, South Africa. | Climate Systems Analysis Group<br>University of the Free State<br>UNEP Risoe Centre on Energy, Climate and Sustainable Development<br>University of KwaZulu Natal, School of Bioresources Engineering and Environmental Hydrology | Louw, D. / Hellmuth, M. |
|  | Validation of Satellite and Other Climate Data Sets | This project compares the performance of various satellite-derived and other climate data sets over different parts of the world, with more of a focus on Africa. | | Dinku, T. |
|  | Verification of Seasonal Climate Predictions | This project aims to set and implement standards for the verification of real-time seasonal climate forecasts. | African Center of Meteorological Applications for Development<br>Intergovernmental Authority on Development Climate Prediction and Applications Centre<br>Drought Monitoring Centre<br>MeteoSwiss - Federal Office of Meteorology and Climatology | Mason, S. |

| Topic / Region | Project Title | Description | Partners | Project / IRI Lead |
|---|---|---|---|---|
|  | The World Food Programme in Egypt and the IRI | Collaborating with the World Food Programme in Egypt and its partners, by providing the technical support and focus on vulnerability and food security mapping in light of climate change. | | Hellmuth, M. |
|  | Weather Risk Transfer for Climate Impacts-Millennium Villages Project *Completed* | A SwissRe, Millennium Promise and IRI collaboration to support research in financial instruments and decision-making for climate risk management with specific applications in the Millennium Villages. | | Ward, N. Zebiak, S. |

# Technical Training Summary

| *Date / Place*<br>Contributors | Event<br>Description of efforts, participants, collaborators |
|---|---|
| *9 - 13 Nov 2009*<br>*Addis Ababa, Ethiopia*<br>P. Block | Nile Basin Initiative (NBI) Training<br>Technical training on a water balance model for the White Nile River considering climate variability for decision-making (upstream allocation, downstream effects, etc.) for the NBI decision-support team |
| *23 - 26 Nov 2009*<br>*Panama City, Panama*<br>A. Barnston | Training in Seasonal Climate Prediction and Review of Use of Climate Predictability Tool<br>Follow-up on November 2007 training, held in El Salvador, on seasonal forecasting and use of CPT, sponsored by Comite Regional de Recursos Hidricos and Sistema de la Integracion Centroamerica (for Central America met and hydro organizations) |
| *30 Nov - 5 Dec 2009*<br>*Addis Ababa, Ethiopia*<br>A. Barnston<br>R. Cousin<br>T. Dinku<br>G. Mantilla<br>O. Ndiaye | Training of Professionals on Climate and Health<br>Six-day course under the Google.org project, "Building capacity to produce and use climate and environmental information for improving health in East Africa," to provide health professionals with the fundamental concepts on climate and public health, using a curriculum based on the Summer Institute (SI) 2009 course, and further tailored to local conditions with inputs from Ethiopian SI alumni and professionals from the National Meteorological Agency (NMA), Addis Ababa University, World Health Organization, UN Economic Commission for Africa, and members of the Climate and Health Working Group Ethiopia. Lectures were delivered by:<br>• A. Barnston: Making Sense of Associations; Practical Sessions on: Seasonal Forecasting of Malaria in Botswana, and Rainfall vs. Malaria Statistical Forecast Exercise<br>• R. Cousin: Cluster Analysis; Practical Sessions on: Overview of the IRI Data Library, Summary Statistical Analysis of Climate and Health Data, and Remote Sensing Tools in the Health Map Room<br>• R. Cousin/G. Mantilla: Practical Session on Malaria Climate Suitability Map<br>• T. Dinku: Introduction to Remote Sensing<br>• G. Mantilla: Climate Risk Management in Health<br>• O. Ndiaye: Introduction to Climate and Weather (delivered by R. Cousin); Understanding Predictions and Projections in Climate; Practical Session on Probabilistic Seasonal Forecasting and Its Applications<br>*See IRI Technical Report 10-01 at http://iri.columbia.edu/publications/id=981* |

| *Date / Place*<br>Contributors | Event<br>Description of efforts, participants, collaborators |
|---|---|
| *30 Nov - 4 Dec 2009*<br>*Addis Ababa, Ethiopia*<br>A. Barnston<br>T. Dinku<br>O. Ndiaye | Climate Predictability Tool Training at the Ethiopia National Meteorological Agency (NMA)<br>A Google.org project activity conducted for Ethiopia's NMA–with 25 participants representing the country's 12 regions–in collaboration with training facilitators: NMA's K. Fekadu (Seasonal Forecasting) and A. Sisay (Computing Support), and T. Melese (Ethiopia Civil Service Reform Office). The climate predictability tool was explored as a means for understanding:<br>• principles of seasonal prediction,<br>• the statistical techniques that can be used in seasonal prediction,<br>• the preparation of seasonal forecasts, and<br>• the verification methods which measure forecast skill<br>Each participant focused on the application of CPT exercises to the cluster of meteorological stations in their respective regions. |
| *7 - 11 Dec 2009*<br>*Addis Ababa, Ethiopia*<br>T. Dinku | Training on Satellite Rainfall Estimation, Raingauge Data Quality Control and Gridding, and Merging Raingauge Measurement and Satellite Rainfall Estimates<br>In this Google.org project activity, the plan to train two NMA staff members at the University of Reading was changed (due to visa complications) to bring training to the NMA, resulting in training of more staff, and enabling the use of rainfall data that would have not been available outside the NMA. Contributors included: University of Reading's Dr. David Grimes and two of his Ph.D. students, Helen Greatrex and Ross Maidement. Ten trainees and two organizers came from the NMA. Local expenses were also covered by NMA.<br>General course objective: To enhance NMA's capacity to investigate rainfall climate trends and variability over the last 30 years and to measure rainfall in real time over the whole of Ethiopia.<br>Specific objectives: (1) To ensure participants understand the strengths and limitations of satellite rainfall estimation, in particular the TAMSAT method based on Meteosat TIR imagery; (2) To enable participants to calibrate the TAMSAT algorithm using available raingauge data; (3) To instruct participants in running the TAMSAT TRES3 software for real time generation of rainfall estimates; (4) To instruct participants in the procedures for generating a 30 year time series of dekadal rainfall. |

| *Date / Place*<br>Contributors | Event<br>Description of efforts, participants, collaborators |
|---|---|
| *2 - 4 Feb 2010*<br>*Addis Ababa, Ethiopia*<br>P. Ceccato<br>T. Dinku | IRI-NMA Training on Land Surface Temperatures Retrieval from Satellite and Interpolation of Station Temperature Observations<br>Three-day training activity for 11 NMA staff persons, part of the Google.org project to enhance staff capacity to provide improved climate data. The goal was for participants to gain an understanding of the strengths and limitations of (1) satellite temperature retrievals; and (2) different temperature interpolation techniques. Training was provided on: (1) the use of MODIS images to monitor Land Surface Temperature; (2) extracting time series of minimum and maximum Land Surface Temperature; (3) comparing the data with station measurements and gridded products. The methodology involved lectures on satellite temperature retrieval and gridding techniques with time for practical exercises. Local expenses for the activity were covered by Ethiopia's NMA. |
| *1- 5 March 2010*<br>*Virtual global*<br>C. Perez Garcia-Pando | EUMETSAT-WMO Virtual Lab: Dust Training Week<br>Contributed session on "The WMO SDS-WAS programme, dust forecasting models and verification methods. Participants included meteorological service professionals in Europe, Africa, Asia and the Americas. |
| *18 - 28 March 2010*<br>*Antananarivo, Madagascar*<br>L. Cibrelus<br>R. Cousin | Malagasy's 2nd Climate Information for Public Health (CIPH) Workshop, "Learning Through Doing Project: Cross-Training Workshop for the National Meteorological and Hydrological Service (MetSer) and Ministry of Health (MoH) Staff in the Use of Meteorological, Climate and Health Data<br>A 5-day workshop, made possible by a partnership among Malagasy's Climate and Health Working Group (CHWG), its MetSer and MoH, WMO, WHO, and the Pasteur Institute, with support from WMO. There were 15 participants from the following fields: climate, climate variability, weather forecast, hydrology, human health (in particular, Malaria, Rift Valley Fever and plague surveillance, environmental health, crises management, and communication).<br>Objectives for participants of the first and second "Learning Through Doing" project were to: (1) understand the fundamental concepts of climate and public health; (2) analyze the relationship between climate and public health data in space and time using basic statistics; (3) use new tools for accessing,analyzing and mapping climate and epidemiological data; (4) synthesize and apply the course material to the participants' own area of interest; (5) identify the benefits that may arise from enhanced climate and public health collaboration in Madagascar; and (6) identify the means and needs to achieve this cross-discipline cooperation locally and with partner institutions. In particular, some sessions of the second workshop was aimed to lead the CHWG towards |

| *Date / Place*<br>Contributors | Event<br>Description of efforts, participants, collaborators |
|---|---|
| | scientific and financial autonomy.<br>*For more detail, see the IRI Technical Report 10-12 at http://iri.columbia.edu/publications/id=1034.* |
| *17 - 28 May 2010*<br>*Palisades, NY*<br>W. Baethgen<br>A. Barnston<br>M. Bell<br>P. Ceccato<br>L. Cibrelus<br>S. Connor<br>R. Cousin<br>A. Curtis<br>J. del Corral<br>F. Fiondella<br>B. Lyon<br>O. Ndiaye<br>G. Mantilla<br>S. Mason<br>J. Omumbo<br>C. Perez<br>A. Robertson<br>D. Ruiz<br>M. Thomson<br>S. Trzaska<br>S. Zebiak | 2010 Summer Institute on Climate Information for Public Health<br>A 2-week course offering public health decision makers the opportunity to learn practical methods for integrating climate knowledge into decision making processes through expert lectures, special seminars, focused discussions and practical exercises.<br>Thirteen participants from Burkina Faso, China Ethiopia, India, Kenya, Niger, Tunisia, Uganda and from NOAA.<br>Co-organizers/contributors: M. Becker (CIESIN) and P. Kinney (Mailman School of Public Health).<br>Partners/contributors: E. Bertherat, WHO; M. Bouma, LSHTM; U. Confalonieri, Oswaldo Cruz Foundation; P. Diggle, Lancaster School of Health and Medicine; D. El Naiem, University of Maryland; W. Elliot, UK Meteorological Office; P. Graves, the Carter Center; K. Knowlton, MSPH and NRDC; R. Luce, CDC; S. Morse, MSPH and USAID; S. Marx, CRED; W. M. Thomas, American Meteorological Society; P. Yaka, Burkina Faso Meteorological Office<br>Sponsors: Spanish Meteorological Office (AEMET), Google.org, CDC Uganda, CDC Kenya, GTZ Tunisia, Nigerian Meteorological Office, USAID Ethiopia, Malaria Research Institute India, NOAA's West Coast Center for Oceans and Human Health<br>*See the IRI Technical Report 10-11 at http://iri.columbia.edu/publications/id=1011 for complete details.* |
| *27 - 28 May 2010*<br>*Niamey, Niger*<br>O. Ndiaye | 13th Regional Climate Outlook Forum (RCOF) for West Africa, Cameroon and Chad - PRESAO 13: “Seasonal Climate Prediction: Coping with Climate Change Impacts” and in support to the Global Framework for Climate Services (GFCS)<br>Provided training to COF participants in the use of the climate predictability tool (CPT), to help prepare the consensual 2010 JAS forecast including preparation of CPT input files; topics presented:<br>▪ CPT development and applications (statistical models for countries, including new predictors)<br>▪ Evaluation of 2009 Forecast & Building national forecast with PRESAO-SG<br>▪ Statistical methods for tailoring a seasonal forecast<br>▪ Hindcast and CPT |

| *Date / Place*<br>Contributors | Event<br>Description of efforts, participants, collaborators |
|---|---|
| *27 July - 4 Aug 2010*<br>*Alanya, Turkey*<br>L. Sun | International Training Workshop on Climate Variability and Predictions for the Mediterranean Basin<br>Sponsored by NOAA, USAID, WMO and the Turkish State Meteorological Service, for 16 participants from 10 countries, with lecturers from CPC, KMA, ICTP, IRI, USAID, WMO, and universities in Turkey and Tunisia.<br>L. Sun led training on climate downscaling on week 2 (3 days), with lectures on:<br>1) Introduction to climate downscaling<br>2) Regional climate modeling: a review<br>3) Climate prediction and projection using RCMs<br>Hands-on practice:<br>1) RSM configuration<br>2) RSM simulation over the Mediterranean basin<br>3) Seasonal climate prediction using the RSM data over Northeast Brazil |
| *2 - 13 Aug 2010*<br>*Buenos Aires, Argentina*<br>W. Baethgen<br>L. Goddard<br>G. Mantilla<br>S. Mason | IAI Training Institute on the Use of Seasonal Climate Predictions for Applications in Latin America<br>For 25 participants from the IAI member countries (Argentina, Brazil, Bolivia, Canada, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Jamaica, Mexico, Panama, Paraguay, Peru, Uruguay, USA, and Venezuela)<br>To build local and regional capacity on the use of seasonal prediction tailored to needs of various Latin American socio-economic sectors such as agriculture, health, and water resources<br>• W. Baethgen: organizing committee member; presented "Climate Information to Aid in Decision-Making"<br>• L. Goddard presented "Verification Issues in Seasonal Prediction<br>• G. Mantilla presented "Climate Change Impacts on Public Health" and "The Use of Climate Information in Public Health"<br>• S. Mason demonstrated a verification game, "Weather Roulette" (with L. Goddard) and conducted climate predictability tool training |
| *2 - 13 Aug 2010*<br>*Trieste, Italy*<br>A. Barnston<br>M. Tippett | ICTP Targeted Training Activity: Statistical Methods in Seasonal Prediction<br>For 49 participants from 23 countries.<br>Contributed lectures to: provide better understanding of statistical properties of climate system and state-of-the-art knowledge in statistical methods; highlight limitations/cautions in the use of statistical methods in short-term climate prediction; and review current seasonal forecast methods of participating countries:<br>• Tippett: Predictor Selection; PCR, CCA, and other Pattern Based |

| *Date / Place*<br>Contributors | Event<br>Description of efforts, participants, collaborators |
|---|---|
| | Regression Techniques; Pitfalls of Linear Regression; Constructing Probability Forecasts<br>• A. Barnston: Lessons in Statistical Prediction; Verification Measures; Interpretation of Canonical Correlation Analysis Results; Seasonal Prediction at IRI |
| *9 - 13 Aug 2010*<br>*Hokkaido University, Sapporo, Japan*<br>S. Barone<br>L. Sun | 10th International Regional Spectral Modeling (RSM) Workshop<br>For 42 participants from 12 countries<br>To understand the current status of RSM and RSM research in progress, encourage model development and improvement as a community effort, promote greater interaction among its users, provide training, and set future targets<br>L. Sun delivered:<br>• Talks: Verification of downscaling forecasts" and "Rainfall trends over Northeastern Brazil<br>• Lecture: "Introduction to climate change downscaling"<br>• Lead trainer for two-day course which capped the workshop<br>S. Barone provided analyst support for participants. |
| *22 - 29 Aug 2010*<br>*Addis Ababa, Ethiopia*<br>B. Lyon<br>O. Ndiaye | Forecast methodology and verification workshop for the National Meteorological Agency (NMA) of Ethiopia<br>A Google.org training activity for 15 regional NMA representatives with the goal of enhancing knowledge of CPT acquired from previous year's training and to verify the seasonal forecast from 1999 to 2009. Workshop activities included:<br>• discussions on the current forecast for JJAS 2010,<br>• introduction to GCMs outputs as predictors (CFS, ECHAM and ECHAM using CFS_SST),<br>• identifying the best GCM predictor fields using the MOS approach (i.e., CPT),<br>• introduction to the verification of probabilistic forecasts (excel spreadsheet exercises),<br>• examining the different possible outcomes of a probabilistic forecast with respect to observation,<br>• calculating and interpreting the bias and the hit rate, and<br>• presentation of results at the NMA headquarter to an audience which included national experts. |

| *Date / Place*<br>Contributors | Event<br>Description of efforts, participants, collaborators |
|---|---|
| *30 Aug - 2 Sept 2010*<br>*Addis Ababa, Ethiopia*<br>T. Dinku<br>B. Lyon | Data quality and analysis workshop for Ethiopia's NMA<br>For 7 NMA staff members, with support from the project, Challenge Program on Climate Change, Agriculture and Food Security (CCAFS) - Theme 4: Adaptation pathways based on managing current climate risk<br>To enhance NMA capacity to conduct quality control of surface station data across the country. Activities included:<br>• introducing approaches to enhance data quality of surface observations, primarily maximum and minimum temperature and precipitation (obtaining metadata for stations, use of reference stations, identifying and adjusting for breakpoints in a time series, and<br>• introducing several statistical tests to evaluate statistical significance of changes in mean and variance in time series. |
| *13 Sept 2010*<br>*Mekele, Ethiopia*<br>E. Holthaus<br>D. Osgood<br>J. Sharoff | Regional Workshop on the Weather Index Insurance<br>Oxfam America, the Relief Society of Tigray and IRI collaborated to bring together 57 participants (representing local insurance companies, government offices, researchers, academic experts) to share knowledge and experience acquired from the weather index insurance pilot project. This is the first of a series of workshop/training activities involving core partners of the HARITA project who will be led through the development, implementation and review of actual product implementation. |
| *14 - 22 Sept 2010*<br>*Dar es Salaam, Tanzania*<br>B. Lyon | Training Workshop on Seasonal Weather Forecasting Tailored to Disaster Risk Management<br>CPT training on seasonal forecasting of within-season rainfall extremes, (with support from the IFRC) for 8 participants from the national meteorological services of Botswana, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe<br>Topics/activities included:<br>• Review of statistical downscaling, model output statistics and the Climate Predictability Tool (CPT) software.<br>• Generating probabilistic, seasonal forecasts of rainfall for stations in the countries of the trainees<br>• Tailoring seasonal forecasts (changing forecast categories, using absolute thresholds, probability of exceedance)<br>• Developing station-based, daily rainfall indices that measure the frequency of occurrence of rainfall intensity above various thresholds<br>• Generating probabilistic forecast of the daily rainfall indices described above<br>• Comparing forecast skill when using sea surface temperatures (SST) versus general circulation model (GCM) fields as predictors |

| *Date / Place*<br>Contributors | Event<br>Description of efforts, participants, collaborators |
|---|---|
| *20 Sept - 1 Oct 2010*<br>*Palisades, NY*<br>W. Baethgen<br>M. Bell<br>P. Block<br>O. Ndiaye<br>A. Robertson | WMO-IRI Hydrological Outlooks Training for Trainers Workshop<br>Two-week training on methodologies for developing hydrologic seasonal outlooks primarily targeted on western South America, presented to 4 scientists who, in turn, will conduct training in regional workshops on these methodologies for the meteorological and hydrological services of Bolivia, Chile, Peru, Colombia, Ecuador and Venezuela<br>The foci of activities by week:<br>• Week 1: Streamflow downscaling using seasonal averages via CPT<br>• Week 2: Streamflow downscaling using stochastic daily rainfall sequences via NHMM<br>*See the training wiki at http://wiki.iri.columbia.edu/index.php?n=Climate.Downscaling-HydrologicalOutlooks* |
| *5 - 6 Oct 2010*<br>*Brazzaville, Republic of Congo*<br>O. Ndiaye | CPT Training at the 4th Climate Outlook Forum in Central Africa (PRESAC)<br>Training for participants from Congo, Cameroon, Democratic Republic of the Congo, Gabon and Sao Tome and Principe on the climate predictability tool and topics to enhance knowledge on statistical forecasting approaches, specifically:<br>▪ discussing issues related to building seasonal forecasting model : fishing, over fitting;<br>▪ introducing GCMs outputs as predictors (ECHAM and ECHAM using CFS_SST);<br>▪ identifying the best GCM predictor fields using the MOS approach (i.e., CPT);<br>▪ discussing “why are we doing what we are doing” and the added value of the seasonal product and outreach to users.<br>Results from the training were presented at the Ministry of Finance in front of national experts and users |
| *8 - 15 Oct 2010*<br>*Addis Ababa, Ethiopia*<br>O. Ndiaye | Participation in pre-forum of the African Development Forum-VII: Getting it Right: Reporting climate change for sustainable development in Africa” (Africa Media Training Workshop)<br>Presented "Climate Risk Management" and "Uncertainties in Climate Change Models" to 25 participants from the African region |

# Academic Courses designed and taught by IRI staff

Earth and Environmental Engineering 4010 - Remote Sensing and Environmental Change
Instructors: Pietro Ceccato and Michael Bell
This is a practically oriented course designed to teach students how to apply remote sensing techniques to identify and monitor environmental changes. Students will experience hands-on the capabilities of remote sensing data for analyzing environmental problems. This includes designing and applying spectral indices for assessment and monitoring of environmental changes, time series analysis of remote sensing data, and a range of classification procedures. This course is designed for students having research interests that include the analysis of remote sensing data supported by the IRI data library.

Earth and Environmental Science 4400 - Dynamics of Climate Variability and Change
Instructor: Lisa Goddard
This is the comprehensive climate science course in the Climate and Society program. Students learn how the climate system works, primarily on large scales of time and space. It is these large-scale features and processes that dominate variability of the regional and local climate immediately relevant to social and individual decision making.

Earth and Environmental Science 4401 – Quantitative Models of Climate-Sensitive Natural and Human Systems
Instructor: Tony Barnston
Quantitative models are used routinely to evaluate impacts of climate variability and climate change. In their subsequent careers, students will be called upon to interpret and evaluate the results of both statistical and dynamical models. This course is intended to equip students with an understanding of how climate-societal and intra-societal relationships can be evaluated and quantified using relevant data sets, statistical tools, and decision models. In addition to experimenting with statistical techniques, students have an opportunity to do some simple decision model experiments and evaluate the results.

Earth and Environmental Science 4403 - Managing Climate Variability and Adapting to Climate Change
Instructors: Shiv Someshwar (S2009) and Ben Orlove (F2010)
This fall semester course provides students with social science concepts and methods to examine human behavior related to climate; it includes both behavior related to greenhouse gas sources and sinks, and behavior related to climate variability and change on a variety of temporal scales. In order to integrate learning, the course is structured around three levels of interaction: individuals, organizations and networks of organizations. The readings and discussions draw on examples from developed and developing countries and from a variety of sectors (water, agriculture, fisheries, health, hazards, urban infrastructure, etc.) Individual and group projects are designed to help integrate learning and to provide professional development.

Earth and Environmental Science 4404 - Regional Dynamics, Climate, and Climate Impacts
Instructor: M. Neil Ward
The dynamics of environment and society interact with climate and can be modified through use of modern climate information. To arrive at the best use of climate information, there is a need to see climate in a balanced way, amongst the myriad of factors at play. Equally, there is a need to appreciate the range of climate information available and to grasp its underlying basis and the reasons for varying levels of certainty. Many decisions in society are at more local scales, and regional climate information considered at appropriate scales and in appropriate forms (e.g., transformed into vegetation stress) is key. Building a sufficient understanding of the science behind the information, and providing examples of how the information can and is being used, mean this course seeks to contribute toward the holistic understanding needed for wise use of climate information.

Earth and Environmental Policy U6260 - Climate change in Africa
Instructor: Alessandra Giannini
This course enables students in their appreciation for the complexity of the climate system, and provides a basic understanding of baseline observational features and physical arguments related to climate change in Africa. Students learn how to discern which questions it is reasonable to expect that science can answer, and which it is not. Students become familiar with an interdisciplinary approach to climate change adaptation that encourages the investigation of complementary perspectives in the search for solutions to real-world problems. This includes local, regional and global scales; consideration of perspectives derived from theory or practice; the synthesis of knowledge from different fields of inquiry; and contributions from the physical sciences as well as from the humanities.

| Students engaged in Internships or other project work, November 2009 - October 2010 | | | |
|---|---|---|---|
| Student Name | IRI Supervisor | Project Name/Description | Time Period |
| Akhavan, Tala, Columbia College, Columbia University | Sylwia Trzaska | Migration Patterns in Sub-Saharan Africa and its potential contribution to meningococcal meningitis outbreaks. | October - December 2010 |
| Alhenc-Gelas, Vincent, École Polytechnique | Andrew Robertson & Pietro Ceccato | Contribute research on climate related to forecasting fire activity in Indonesia's Central Kalimantan province. | March - May 2010 |
| Basche, Andrea, DEES C&S MA 2010, Columbia University | Esther Conrad & Rizaldi Boer | IRI & The Center for Climate Risk and Opportunity Management (CCROM) - Complete the preliminary research to help establish a weather insurance program for the farmers in the Indramayu and Pacitan Districts of Central Java. | June - August 2010 |
| Bhattacharjee, Arindam, DEES C&S MA 2011, Columbia University | Shiv Someshwar & Andrew Robertson | Develop web-based tools to harness and downscale seasonal climate forecasts for use in climate risk management in agriculture in India. | October 2010 - May 2011 |
| Chatikavanij, Vansa, DEES C&S MA 2011, Columbia University | Shiv Someshwar | IRI & the Global Network for Climate Solutions (GNCS) - Research and develop knowledge modules for adaptation-related sectors and themes and Utilizing the IRI Data Library and other resources to produce comprehensive climate profiles for countries and regions, in support of the GNCS adaptation program. | October 2010 - May 2011 |
| Cordray, Michelle, DEES C&S MA 2010, Columbia University | Rise Fullon & Francesco Fiondella; | Project database and communications contributions. | September - December 2009 |
| | Paul Blick & Molly Hellmuth | Create video coverage of Uganda Red Cross Society's disaster risk reduction projects; impacts of climate change, deforestation, and wetlands encroachment in Uganda; what farmers are doing to adapt to climate change. | June - August 2010 |
| Coughlan,Erin, DEES C&S MA 2011, Columbia University | Shiv Someshwar | IRI & GNCS - Research and develop knowledge modules for adaptation-related sectors and themes and Utilizing the IRI Data Library and other resources to produce comprehensive climate profiles for countries and region, in support of the GNS adaptation program. | October 2010 - May 2011 |
| Flemming, Megan, DEES C&S MA 2011, Columbia University | Paul Block | IRI & The Center for Research on Environmental Decision (CRED) - Elucidate near-term climate change information to guide water resources decisions and foster sustainability in Chile. | October 2010 - May 2011 |
| Hansen, Lars Boye, PhD, Department of Geography & Geology, U. Copenhagen | Pietro Ceccato & Tufa Dinku | Downscale satellite rainfall estimates using vegetation, NDVI, and other information. | March - June 2010 |
| Huber, Daniel, DEES C&S MA 2010, Columbia University | Esther Conrad & Rizaldi Boer | IRI & CCROM - Conduct background research, field visits, and data collection and analysis to lay the groundwork for developing pilot index insurance efforts in Indramayu or Pacitan district. | June - August 2010 |
| Jankowski, Krista, DEES C&S MA 2010, Columbia University | Ashley Curtis and Francesco Fiondella | IRI & IFRC - work with the disaster management unit of the Southeast Asia Regional Delegation office in Bangkok, Thailand to develop a two-week field session on disaster risk reduction, climate risk reduction, and the Vulnerability and Capacity Assessment (VCA) process. | June - August 2010 |
| Jeannin, Thomas, École Polytechnique | Arthur Greene & Lisa Goddard | Undertake verification and testing of statistical decadal forecasts. | March - May 2010 |
| Jensen, Sean, DEES C&S MA 2011, Columbia University | Amor Ines | Estimate effective soil hydraulic properties from remote sensing. | October 2010 - May 2011 |

| Student Name | IRI Supervisor | Project Name/Description | Time Period |
|---|---|---|---|
| Kinfe, Yosef, DEES C&S MA 2011, Columbia University | Dan Osgood | Contribute to the Index Insurance initiative underway in Ethiopia, in support of an IRI project supported by Oxfam. | October 2010 - May 2011 |
| Kirk,Jeanie, DEES C&S MA 2010, Columbia University | Esther Conrad | IRI & The Energy and Resources Institute (TERI) - Assess climate change vulnerability and adaptation strategies for Maharashtra State and Coastal vulnerability assessment and strategies for better preparedness towards impacts of climate change and sea level rise along the West Bengal coast. | June - August 2010 |
| Koide, Naohisa, ISERP QMSS, Columbia University | Andrew Robertson | Masters Thesis: Assessment of Predictability of Rice Production in the Philippines with Seasonal Climate Forecast | January - September 2010 |
| Lafferty, Amy, Hertford College, Oxford University | Simon Mason | Assist in developing and testing Excel spreadsheets for use in verification training workshops; will also conduct comparative studies of Africa Regional Climate Outlook Forum forecasts with objetively generated re-forcasts made using CPT. | July - August, 2010 |
| Liu, Harry, SEAS, Columbia University | Amor Inez, Walter Baethgen & James Hansen | IRI & The Tropical Agriculture Program - Estimate effective soil hydraulic properties from remote sensing. | October - December 2010 |
| Lochard, Anna, l'Ecoles des Mines de Paris | Lareef Zubair & Upmanu Lall | IRI & The Columbia Water Center - Research on renewable energy, water resources and climate. | January - June 2010 |
| Mendiola, Luciana, DEES C&S MA 2011, Columbia University | Gilma Mantilla | Assist with IRI Summer institute on Climate Information for Public Health. | May-10 |
| Moy, Bryan, MPH Epidemiology, Mailman School, Columbia University | Madeleine Thomson, Steve Connor & Gilma Mantilla | Evaluation of malaria interventions in Botswana. | October 2010 - February 2011 |
| Omiyale, Abimbola, DEES C&S MA 2011, Columbia University | Shiv Someshwar | IRI & GNCS - Research and develop knowledge modules for adaptation-related sectors and themes and Utilizing the IRI Data Library and other resources to produce comprehensive climate profiles for countries and regions, in support of the GNCS adaptation program. | October 2010 - May 2011 |
| Podgorska, Anna, DEES C&S MA 2010, Columbia University | Shiv Someshwar | IRI & GNCS - In support of the development of the GNCS adaptation program, engage with participating research centers in developing countries, and contribute to development of outreach materials. | June - August 2010 |
| Robbins ,Patrick, DEES C&S MA 2011, Columbia University | Madeleine Thomson | Assist in the compilation of material for, and writing of, a synthesis and integration chapter for a book on natural disasters and adaptation to climate change | October 2010 - May 2011 |
| Rosen, Jessica, DEES C&S MA 2010, Columbia University | Esther Conrad & Rizaldi Boer | IRI & CCROM - Gather information on approaches and technologies currently used by farmers to manage climate risks. Literature review and data analysis to summarize current approaches of farmers and advance climate modeling and risk management research agendas relating to food security in Indonesia. | June - August 2010 |
| Sousa, Frank, DEES C&S MA 2010, Columbia University | Ashley Curtis and Simon Mason | IRI & IFRC - assisted in the writing of background documents for the Preparedness for Climate Change Programme of the Middle East North Africa Zone in Amman and developed a Powerpoint presentation on climate change for the region. Delivered this and two other presentations for 12 National Societies at the Disaster Risk Reduction and Climate Change Adaptation workshop held in Amman this August. | June - August 2010 |

| Student Name | IRI Supervisor | Project Name/Description | Time Period |
|---|---|---|---|
| Stiffle, Sarah, Edinburgh University | Dan Osgood | Participate in work to understand the role that insurance plays in climate risk management for smallholder farmers, with a focus on Ethiopia. | June - July 2010 |
| Stypa, Amy, DEES C&S MA 2010, Columbia University | Megan Sheremata | Contribute to the development of the IRI Water Resources Management Manual | September 2009 - May 2010 |
| | Liqiang Sun | In Mongolia, assist with completion of the National Society's PfCC2 background document, developed a climate change project proposal, gave input on development of climate change communications materials, and delivered a workshop presentation on climate change. In China, worked in the Fujian province helping with preparations for a workshop designed to build partnerships and shared visions for collaborative efforts on climate change adaptation and disaster risk reduction. | June - August 2010 |
| Talati, Shuchi, DEES C&S MA 2010, Columbia University | Shiv Someshwar | Support the development of the Adaptation component of the Network, engage with participating research centers in developing countries, and contribute to development of outreach materials. | June - August 2010 |
| Verjee,Neelam, SIPA, Columbia Univeristy | Shiv Someshwar | Support the development of the Adaptation component of the Network, engage with participating research centers in developing countries, and contribute to development of outreach materials. | June - August 2010 |
| Weltman-Fahs, Maya, DEES C&S MA 2010, Columbia University | John del Corral | Contribute to GIS and Data Library organization; assist with data location. | September 2009 - May 2010 |
| Wong, Anjela, Barnard College, Columbia University | Paul Block | Senior Thesis: Understand the interactions of climate extremes, food security, and available water; mapping policy and economic aspects. | September 2009 - August 2010 |
| Wood, Scott, DEES C&S MA 2010, Columbia University | Gilma Mantilla | Contributing to the IRI Climate Information for Public Health Summer Institute 2010, reviewed literature for a journal database and maintaining the Climate Information for Public Health Action network contacts database; | September 2009 - May 2010 |
| | Simon Mason | Worked with both the Tanzania Red Cross Society (TRCS) and the Tanzania Meteorological Authority (TMA) facilitated processes to help the TRCS identify and articulate their needs for climate and weather information so that the TMA could improve and tailor their products and support to user needs. The TRCS now receives 12 hour forecast updates from the TMA daily, and advances have been made to develop an MoU together. | June - August 2010 |
| Wu, Gavin, DEES C&S MA 2011, Columbia University | Gilma Mantilla | Provide research and logistical support for all -related activities on the development of the Climate Information for Public Health Action Network (CIPHAN). | October 2010 - May 2011 |
| Zhou, Yufang, DEES C&S MA 2011, Columbia | Amor Ines | Estimate effective soil hydraulic properties from remote sensing. | October 2010 - May 2011 |

# Governance at a glance

**Board of Overseers**

| | |
|---|---|
| Dr. R.K. Pachauri, Chair | Director-General, TERI<br>Chairman, Intergovernmental Panel on Climate Change (IPCC) |
| Prof. Michael McElroy | Gilbert Butler Professor of Environmental Studies, Harvard University |
| Hon. Kazuo Aichi | Former Member, House of Representatives, Japanese Diet |
| Mr. Jan Egeland | Director, Norwegian Institute of International Affairs |
| Mr. Chiang-Lin Hsin | Director General, Central Weather Bureau, Taiwan (Retired) |
| Prof. Nay Htun | Professor, Stonybrook University |
| Dr. Chester J. Koblinsky | Director, NOAA Climate Program Office |
| Prof. Jeffrey Sachs | Director, Earth Institute, Columbia University |
| Sir Crispin Tickell, GCMG KCVO | Director, Policy Foresight Programme, James Martin Institute for Science and Civilization, Oxford University |
| Dr. Ching-Yen Tsay | Chair Professor, Chung-Hua Institution for Economic Research, National Central University |
| Rt. Hon. Simon Upton | Chair, Round Table on Sustainable Development OECD |
| Dr. Stephen E. Zebiak | Director-General, IRI |

**International Science and Technical Advisory Committee**

| | |
|---|---|
| Prof. Ed Sarachik (Chair) | Emeritus Professor of Atmospheric Science, University of Washington |
| Dr. Mark Cane | G. Unger Vetlesen Professor of Earth and Climate Sciences; Director, Climate and Society Masters Program, Columbia University |
| Dr. Shubham Chaudhuri | Senior Economist, World Bank |
| Dr. Ulisses Confalonieri | Professor, National School of Public Health, FIOCRUZ (Oswaldo Cruz Foundation) |
| Prof. Sulochana Gadgil | Professor, Center for Atmospheric and Oceanic Sciences, Indian Institute of Science |
| Prof. Graeme Hammer | Professorial Research Fellow, University of Queensland |
| Professor James W. Jones | Distinguished Professor, University of Florida |
| Dr. Francisco de Assis de Souza Filho | Former President, FUNCEME; Adjunct Research Scientist, IRI |
| Dr. R. Wayne Higgins | Director, NOAA Climate Prediction Center |

# Personnel at a Glance

## Office of the Director-General

| | |
|---|---|
| Stephen E. Zebiak | Director-General, Senior Research Scientist |
| Haresh Bhojwani | Institutional Development Officer |
| Ann K. Binder | Manager, Staff and Operations |
| Molly Hellmuth | Director, Climate and Society Publication Secretariat, Associate Research Scientist |
| Carolyn Z. Mutter | Assistant Director for Science Management |
| Arezou Paksima | Assistant Director, Climate and Society Masters Program |
| Carlos Perez | Senior Analyst |
| Maria Salgado | Executive Assistant to the Director-General |

## Program Leaders

| | |
|---|---|
| Walter Baethgen | Director, Latin America and Caribbean Program, Research Scientist |
| Stephen Connor | Program Leader, Environmental Monitoring Research; Director, PAHO/WHO Collaborating Centre on early warning systems for malaria and other climate sensitive diseases; Senior Research Scientist |
| David DeWitt | Program Leader, Climate; Research Scientist |
| Bradfield Lyon | Interim Chair, Africa Regional Program Committee (2010 -); Research Scientist |
| Simon Mason | Climate Program Chief Scientist; Research Scientist |
| Shiv Someshwar | Director, Asia and Pacific Regional Program; Director, Institution and Policy Systems Research; Research Scientist |
| Madeleine Thomson | Chair, Africa Regional Program Committee (-2010); Senior Research Scientist |
| M. Neil Ward | Director, Decision Systems Research |

## Senior Research, Information Technology, and Data Library Staff

| | |
|---|---|
| Anthony Barnston | Lead Forecaster |
| M. Benno Blumenthal | Data Library Manager |
| Remi Cousin | Staff Associate |
| Lisa Goddard | Research Scientist, Adjunct Professor, DEES |
| James Hansen | Research Scientist |
| Upmanu Lall | Senior Research Scientist, Professor, DEEE |
| Bin Li | Senior Analyst/Programmer |
| Ben Orlove | Senior Research Scientist, Professor, SIPA |
| Leo Ostwald | Manager, IRI Computing |
| Andrew Robertson | Research Scientist |
| Adam Sobel | Professor, DEES/APAM |
| Liqiang Sun | Research Scientist |
| Michael Tippett | Research Scientist |
| Jeff Turmelle | Senior Systems and Network Analyst/Program Manager |
| Jian-Hua (Joshua) Qian | Research Scientist |

## Research Staff

| | |
|---|---|
| Erica Allis | Staff Associate |
| Julie Arrighi | Staff Associate |
| Kye Mesa Baroang | Senior Research Staff Assistant |
| Michael Bell | Senior Staff Associate |
| Paul Block | Associate Research Scientist |
| Daniel Ruiz Carrascal | Graduate Research Student |
| Pietro Ceccato | Associate Research Scientist |
| Chao Chen | Postdoctoral Research Fellow, EI |
| Laurence Cibrelus | Staff Associate |

Research Staff, continued

| | |
|---|---|
| Kevin Coffey | Senior Staff Associate |
| Esther Conrad | Senior Staff Associate |
| Ashley Curtis | Staff Associate |
| John del Corral | Senior Staff Associate |
| Tufa Dinku | Associate Research Scientist |
| Katia Fernandes | Postdoctoral Research Scientist |
| Alessandra Giannini | Research Scientist |
| Paula Gonzalez | Postdoctoral Research Scientist |
| Arthur Greene | Associate Research Scientist |
| Eric Holthaus | Staff Associate |
| Amor Ines | Associate Research Scientist |
| Dong Eun (Donna) Lee | Staff Associate |
| Shuhua Li | Senior Staff Associate |
| Haibo Liu | Staff Associate |
| Malgosia Madajewicz | Associate Research Scientist |
| Gilma Mantilla | Senior Staff Associate |
| Ousmane Ndiaye | Postdoctoral Research Scientist |
| Michael Norton | Staff Associate |
| Judith Omumbo | Associate Research Scientist |
| Daniel Osgood | Associate Research Scientist |
| Indrani Pal | Postdoctoral Research Scientist, EI |
| Carlos Perez Garcia-Pando | Postdoctoral Research Fellow, EI |
| Jessica Sharoff | Senior Research Staff Assistant |
| Shaky Sharpa | Intern |
| Christelle Vancutsem | Senior Staff Associate |
| Tara Troy | Postdoctoral Research Fellow, EI |
| Sylwia Trzaska | Associate Research Scientist |
| Lareef Zubair | Associate Research Scientist |

## Adjunct Research Staff

| | |
|---|---|
| Sankar Arumugam | Adjunct Associate Research Scientist, North Carolina University |
| Rizaldi Boer | Adjunct Research Scientist, Department of Geophysics and Meteorology, Bogor Agricultural University, Indonesia |
| Kenneth Broad | Adjunct Research Scientist, University of Miami |
| Casey Brown | Adjunct Associate Research Scientist, University of Massachusetts |
| Delcon Conway | Adjunct Research Scientist, University of East Anglia, United Kingdom |
| Francisco de Assis de Souza Filho | Adjunct Senior Research Scientist, Universidade Federal do Caerá, Fortaleza Brazil |
| Peter Diggle | Adjunct Senior Research Scientist, University of Lancaster, United Kingdom |
| Patricia Graves | Adjunct Research Scientist, Carter Center, Centers for Disease Control and Prevention, Atlanta, GA |
| Hugo Oliveros | Adjunct Research Scientist, Banco Republica, Colombian Central Bank (Retired) |
| Vincent Moron | Adjunct Senior Research Scientist, CEREGE, UMR 6635 CNRS and Université d'Aix-Marseille, France |
| Maartin van Aalst | Adjunct Research Scientist, International Federation of Red Cross and Red Crescent Societies |

## Affiliates

| | |
|---|---|
| Mohammed Boulahya | Senior Advisor (Africa) |
| Lisette Braman | Staff Associate, International Federation of Red Cross and Red Crescent Societies |
| Suzana Camargo | Associate Research Scientist, Lamont Doherty Earth Observatory |

## Affiliates, continued

| | |
|---|---|
| Mark Cane | Vetlesen Professor, Columbia University, Earth and Environmental Sciences, Applied Physics/Applied Math |
| Roberto Lenton | World Bank, Washington DC |
| Sabine Marx | Associate Research Scholar, Columbia University, Center for Research on Environmental Decisions (CRED) |
| Cheryl Palm | Senior Research Scientist, Tropical Agriculture Program, Columbia University |
| Pedro Sanchez | Director, Tropical Agriculture Program, Columbia University |
| Jim Williams | Consultant, European partnerships and mobilization |

## Visiting Research Scientists

| | |
|---|---|
| Kinfer Hailemariam Beyene | National Meteorological Agency, Addis Ababa, Ethiopia |
| Kripan Ghosh | Indian Meteorological Department, Pune, India |
| Lars Hansen | Department of Gegraphy and Geology, University of Copenhagen |
| Marakand Kulkarni | Centre for Atmospheric Sciences, Indian Institute of Technology, Delhi, India |
| Haiqin Li | School of Geography, Beijing National University, Beijing, China |
| Vincent Moron | CEREGE, UMR 6635 CNRS & Université d'Aix-Marseille |
| Jean-François Pekel | Researcher, Environmetry and geomatic unit, Université Catholique de Louvain, Belgium |
| Palash Sinha | Centre for Atmospheric Sciences, Indian Institute of Technology, Delhi, India |
| O.P. Sreejith | Indian Meteorological Department, Pune, India |

## Institutional Support

*Office of the Director General*

| | |
|---|---|
| Esteban Andrade | Latin American & Caribbean Program Coordinator |
| Francesco Fiondella | Communications Officer |
| Maria Risë Fullon | Project Coordinator |
| Althea Murillo | Administrative Assistant |
| Barbara Platzer | Africa Program Coordinator |
| Jason Rodriguez | Draftsman 1 |
| Lori Scally | Project Finance Manager |
| Megan Sheremata | Education Coordinator |
| Catherine Vaughan Green | Project Coordinator |
| Sandra Vitelli | Administrative Assistant |
| Maria (Christie) Walkuski | Senior Research Staff Assistant |

*Computer Systems*

| | |
|---|---|
| Baaba Baiden | Web Manager |
| Sara Barone | Analyst/Programmer |
| Mike Dervin | Analyst/Programmer |
| Chi-Huei Liu | Junior Web Developer |
| Lulin Song | Analyst/Programmer |

*Part-Time Research Assistants*

Timothy Murphy
Mary Mildred Stith
Cynthia Thomson

# Selected Publications

## Peer-Reviewed

Aggarwal, P. K., **W. E. Baethgen**, P. Cooper, R. Gommes, B. Lee, H. Meinke, L. S. Rathore, and M. V. K. Sivakumar, 2010: Managing Climatic Risks to Combat Land Degradation and Enhance Food Security: Key Information Needs. *Procedia Environmental Sciences*, **1**, 305-312, doi: 10.1016/j.proenv.2010.09.019.

Anderson, E. P., J. Marengo, R. Villalba, S. Halloy, B. E. Young, D. Cordero, F. Gast, E. Jaimes, and **D. Ruiz**, 2010: Consequences of climate change for ecosystems and ecosystem services in the Tropical Andes. In *Climate change effects on the biodiversity of the tropical Andes: an assessment of the status of scientific knowledge*, Herzog, S. K., R. Martinez, P. M. Jorgensen, and H. Tiessen, Eds., Inter-American Institute of Global Change Research (IAI) and Scientific Committee on Problems of the Environment (SCOPE), in press.

**Baethgen, W. E.**, 2010: Climate Risk Management for Adaptation to Climate Variability and Change. *Crop Sci*, **50,** S-70-76, doi: 10.2135/cropsci2009.09.0526. [Available online at https://www.crops.org/publications/cs/articles/50/Supplement_1/S-70]

Bark, R. H., **D. E. Osgood**, B. G. Colby, G. Katz, and J. Stromberg, 2009: Habitat preservation and restoration: Do homebuyers have preferences for quality habitat? *Ecological Economics*, **68,** 1465-1475, doi: 10.1016/j.ecolecon.2008.10.005.

**Barnston, A. G.**, **S. Li**, **S. J. Mason**, **D. G. DeWitt**, **L. Goddard**, and X. Gong, 2010: Verification of the First 11 Years of IRI's Seasonal Climate Forecasts. *Journal of Applied Meteorology and Climatology*, **49,** 493-520, doi: 10.1175%2F2009JAMC2325.1.

**Block, P.**, 2010: Tailoring seasonal climate forecasts for hydropower operations in Ethiopia's upper Blue Nile basin. *Hydrology and Earth System Sciences Discussions*, **7,** 3765-3802, doi: 10.5194/hessd-7-3765-2010.

**Block, P.**, and K. Strzepek, 2010: Economic Analysis of Large-Scale Upstream River Basin Development on the Blue Nile in Ethiopia Considering Transient Conditions, Climate Variability, and Climate Change. *Journal of Water Resources Planning and Management*, **136,** 156-166, doi: 10.1061/(ASCE)WR.1943-5452.0000022.

**Brown, C.**, and **K. M. Baroang**, 2010: Risk Assessment, Risk Management and Communication: Methods for climate variability and change. In *Treatise on Water Science*, Elsevier, in press.

Chowdhury, M. R., **A. G. Barnston**, C. Guard, S. Duncan, T. A. Schroeder, and P. S. Chu, 2010: Sea-level variability and change in the US-affiliated Pacific Islands: understanding the high sea levels during 2006–2008. *Weather*, **65,** 263-268, doi: 10.1002/wea.468.

**Connor, S. J.**, **J. Omumbo**, **C. Green**, J. DaSilva, **G. Mantilla**, C. Delacollette, S. Hales, D. Rogers, and **M. Thomson**, 2010: Health and Climate - Needs. *Procedia Environmental Sciences*, **1**, 27-36, doi: 10.1016/j.proenv.2010.09.004.

Daly, M., N. Balfour, **M. Hellmuth**, **S. Mason**, J. Kirsch-Wood, and **M. van Aalst**, 2010: Findings of the East Africa Humanitarian Climate Risk Management Workshop. *IRI Technical Report 10-05*, International Research Institute for Climate and Society, Palisades, NY, 56 pp. [Available online at http://iri.columbia.edu/publications/id=994]

Peer-Reviewed, cont.

Del Ponte, E., A. d. Maia, T. dos Santos, E. Martins, and **W. Baethgen**, 2010: Early-season warning of soybean rust regional epidemics using El Niño Southern/Oscillation information. *International Journal of Biometeorology*, (Online First)**,** doi: 10.1007/s00484-010-0365-6.

**Dinku, T.**, 2010: The Need for National Centers for Climate and Development in Africa. *Climate and Development*, **2,** 9-13, doi: 10.3763/cdev.2010.0029.

**Dinku, T.**, F. Ruiz, **S. J. Connor**, and **P. Ceccato**, 2010: Validation and Intercomparison of Satellite Rainfall Estimates over Colombia. *Journal of Applied Meteorology and Climatology*, **49,** 1004-1014, doi: 10.1175/2009JAMC2260.1.

**Dinku, T.**, **P. Ceccato**, K. Cressman, and **S. J. Connor**, 2010: Evaluating Detection Skills of Satellite Rainfall Estimates over Desert Locust Recession Regions. *Journal of Applied Meteorology & Climatology*, **49,** 1322-1332, doi: 10.1175/2010JAMC2281.1.

Ericksen, P., B. Stewart, S. Eriksen, P. Tschakert, R. Sabates-Wheeler, **J. Hansen**, and P. Thornton, 2010: Adapting Food Systems. In *Global Environmental Change and Food Security*, Ingram, J. S. I., P. J. Ericksen, and D. M. Liverman, Eds., Earthscan, 115-143, in press.

Feliks, Y., M. Ghil, and **A. W. Robertson**, 2010: Oscillatory Climate Modes in the Eastern Mediterranean and Their Synchronization with the North Atlantic Oscillation. *Journal of Climate*, **23,** 4060-4079, doi: 10.1175/2010JCLI3181.1.

**Giannini, A.**, 2010: Mechanisms of Climate Change in the Semiarid African Sahel: The Local View. *J. Climate*, **23**, 743–756, doi: 10.1175/2009JCLI3123.1.

**Goddard, L.**, Y. Aitchellouche, **W. Baethgen**, M. Dettinger, R. Graham, P. Hayman, M. Kadi, R. Martínez, and H. Meinke, 2010: Providing Seasonal-to-Interannual Climate Information for Risk Management and Decision-making. *Procedia Environmental Sciences*, **1**, 81-101, doi: 10.1016/j.proenv.2010.09.007.

**Graves, P. M.**, F. O. Richards, J. Ngondi, P. M. Emerson, E. B. Shargie, T. Endeshaw, **P. Ceccato**, Y. Ejigsemahu, A. W. Mosher, A. Hailemariam, M. Zerihun, T. Teferi, B. Ayele, A. Mesele, G. Yohannes, A. Tilahun, and T. Gebre, 2009: Individual, household and environmental risk factors for malaria infection in Amhara, Oromia and SNNP regions of Ethiopia. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **103**, 12, 1211-1220, doi: 10.1016/j.trstmh.2008.11.016.

**Greene, A. M.**, 2009: Review of "Darkening Peaks: Glacier Retreat, Science and Society," **Orlove, B.**, E. Wegandt, and B. H. Luckman, eds. *Bull Am Meteor Soc***, 91**, 497-498.

**Hansen, J. W.**, **S. Mason**, **L. Sun**, and A. Tall, 2010: Review of seasonal climate forecasting for agriculture in sub-Saharan Africa. *Experimental Agriculture*, in press.

**Ines, A. V. M.**, **J. W. Hansen**, and **A. W. Robertson**, 2010: Enhancing the utility of daily GCM rainfall for crop yield prediction. *International Journal of Climatology*, Early View**,** doi: 10.1002/joc.2223.

Li, P.-H., H.-H. Kwon, **L. Sun**, **U. Lall**, and J.-J. Kao, 2010: A modified support vector machine based prediction model on streamflow at the Shihmen reservoir, Taiwan. *International Journal of Climatology*, **30,** 1256–1268, doi: 10.1002/joc.1954.

Peer-Reviewed, cont.

**Lyon, B.**, 2009: Southern Africa Summer Drought and Heat Waves: Observations and Coupled Model Behavior. *Journal of Climate*, **22**, 22, 6033-6046, doi: 10.1175/2009JCLI3101.1.

Martinez, R., B. J. Garanganga, A. Kamga, Y. Luo, **S. Mason**, J. Pahalad, and M. Rummukainen, 2010: Regional Climate Information for Risk Management: Capabilities. *Procedia Environmental Sciences*, **1**, 354-368, doi: 10.1016/j.proenv.2010.09.023.

**Moron, V.**, A. Lucero, F. Hilario, **B. Lyon**, **A. Robertson**, and **D. DeWitt**, 2009: Spatio-temporal variability and predictability of summer monsoon onset over the Philippines. Climate Dynamics, 33, 7, 1159-1177, doi: 10.1007/s00382-008-0520-5.

Mutter, J. C., and **K. M. Barnard**, 2010: Climate change, evolution of disasters and inequality. In *Human Rights and Climate Change*, Humphreys, S. and M. Robinson, Eds., Cambridge University Press, 272-296.

Pekel, J. F., **P. Ceccato**, **C. Vancutsem**, K. Cressman, E. Vanbogaert, and P. Defourny, 2010: Development and Application of Multi-Temporal Colorimetric Transformation to Monitor Vegetation in the Desert Locust Habitat. *Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of*, **PP**, 99, 1-9.

**Qian, J.-H.**, **A. W. Robertson**, and **V. Moron**, 2010: Interactions between ENSO, Monsoon and Diurnal Cycle in Rainfall Variability over Java, Indonesia. *Journal of the Atmospheric Sciences*, in press, doi: 10.1175/2010JAS3348.1.

**Qian, J.-H.**, and **L. Zubair**, 2010: The Effect of Grid Spacing and Domain Size on the Quality of Ensemble Regional Climate Downscaling over South Asia during the Northeasterly Monsoon. *Monthly Weather Review*, **138,** 2780-2802, doi: 10.1175/2010MWR3191.1.

**Robertson, A. W.**, V. Moron, **J.-H. Qian**, C.-P. Chang, F. Tangang, E. Aldrian, T. Y. Koh, and L. Juneng, 2010: The Maritime Continent Monsoon. In *The Global Monsoon System: Research and Forecast*, 2nd ed. Chang, C.-P., Ed., World Scientific/WMO, in press.

Rogers, D. P., M. A. Shapiro, G. Brunet, J. C. Cohen, **S. J. Connor**, A. A. Diallo, W. Elliott, K. Haidong, S. Hales, D. Hemming, I. Jeanne, M. Lafaye, Z. Mumba, N. Raholijao, F. Rakotomanana, H. Teka, J. Trtanj, and P. Y. Whung, 2010: Health and climate - opportunities. *Procedia Environmental Sciences*, **1**, 37-54, doi: 10.1016/j.proenv.2010.09.005.

**Ruiz, D.**, 2010: Indo-Pacific and Tropical Atlantic EOF modes: contributions to the analyses of cloud cover conditions in the Los Nevados Natural Park, Colombian Central Mountain Range. *Revista Escuela de Ingenieria de Antioquia*, **in press**.

**Ruiz, D.**, A.M. Molina, M.E. Gutierrez, P.A. Zapata, C. Lopez, M.L. Quinones, M.M. Jimenez, **M. Thomson**, and **S. Connor**, 2010: Simulating malaria transmission dynamics in the pilot areas of the Colombian Integrated National Adaptation Pilot project - First part: Malaria transmission models, 57 pages.

**Ruiz, D.**, M. P. Arroyave, M. E. Gutierrez, and P. A. Zapata, 2010: Increased climatic stress on high-Andean ecosystems in the Cordillera Central of Colombia. In *Climate change effects on the biodiversity of the tropical Andes: an assessment of the status of scientific knowledge*, Herzog, S. K., R. Martínez, P. M. Jørgensen, and H. Tiessen, Eds., Inter-American Institute of Global Change Research (IAI) and Scientific Committee on Problems of the Environment (SCOPE), in press.

Peer-Reviewed, cont.

Sahoo, D., P. K. Smith, and **A. V. M. Ines**, 2010: Autocalibration of HSPF for Simulation of Streamflow Using a Genetic Algorithm. *Transactions of the ASABE*, **53,** 75-86,

Seager, R., N. Naik, **W. Baethgen**, **A. Robertson**, Y. Kushnir, J. Nakamura, and S. Jurburg, 2010: Tropical oceanic causes of interannual to multidecadal precipitation variability in southeast South America over the past century. *Journal of Climate*, **23**, 5517–5539, doi: 10.1175/2010JCLI3578.1.

Shargie, E. B., J. Ngondi, **P. M. Graves**, A. Getachew, J. Hwang, T. Gebre, A. W. Mosher, **P. Ceccato**, T. Endeshaw, D. Jima, Z. Tadesse, E. Tenaw, R. Reithinger, P. M. Emerson, F. O. Richards, and T. A. Ghebreyesus, 2010: Rapid Increase in Ownership and Use of Long-Lasting Insecticidal Nets and Decrease in Prevalence of Malaria in Three Regional States of Ethiopia (2006-2007). *Journal of Tropical Medicine*, **2010,** doi: 10.1155/2010/750978.

Sheriff, G., and **D. Osgood**, 2010: Disease Forecasts and Livestock Health Disclosure: a Shepherd's Dilemma. *American Journal of Agricultural Economics***,** (online), doi: 10.1093/ajae/aap042.

Stockdale, T. N., O. Alves, G. Boer, M. Deque, Y. Ding, A. Kumar, K. Kumar, W. Landman, **S. Mason**, P. Nobre, A. Scaife, O. Tomoaki, and W. T. Yun, 2010: Understanding and Predicting Seasonal-to-Interannual Climate Variability - The Producer Perspective. *Procedia Environmental Sciences*, **1**, 55-80, doi: 10.1016/j.proenv.2010.09.006.

**Tippett, M. K.**, **A. G. Barnston**, and T. DelSole, 2010: Comments on "Finite Samples and Uncertainty Estimates for Skill Measures for Seasonal Prediction". *Monthly Weather Review*, **138,** 1487-1493, doi: 10.1175/2009MWR3214.1.

**Vancutsem, C.**, **P. Ceccato**, **T. Dinku**, and **S. J. Connor**, 2010: Evaluation of MODIS land surface temperature data to estimate air temperature in different ecosystems over Africa. *Remote Sensing of Environment*, **114**, 449-465, doi: 10.1016/j.rse.2009.10.002.

Vera, C., M. Barange, O. P. Dube, **L. Goddard**, D. Griggs, N. Kobysheva, E. Odada, S. Parey, J. Polovina, G. Poveda, B. Seguin, and K. Trenberth, 2010: Needs Assessment for Climate Information on Decadal Timescales and Longer. *Procedia Environmental Sciences*, **1**, 275-286, doi: 10.1016/j.proenv.2010.09.017.

Verbist, K., **A. W. Robertson**, W. M. Cornelis, and D. Gabriels, 2010: Seasonal predictability of daily rainfall characteristics in central-northern Chile for dry-land management. *Journal of Applied Meteorology and Climatology*, **in press**, doi: 10.1175/2010JAMC2372.1.

Yoo, J. H., **A. W. Robertson**, and I.-S. Kang, 2010: Analysis of Intraseasonal and Interannual variability of the Asian summer monsoon using a Hidden Markov Model. *Journal of Climate*, **23**, 5498–5516, doi: 10.1175/2010JCLI3473.1.

Zheng, F., C. Miao, X. Zhang, and **L. Sun**, 2009 (in Chinese): Short-range climate prediction with nested regional spectral model for Wenzhou. *Meteorological Science and Technology*, **37,** 9-11.

Zheng, F., X. Zhang, C. Miao, and **L. Sun**, 2009 (in Chinese): Climate characteristics in the nested regional spectral model. *Journal of Anhui Agricultural Sciences*, **37,** 21-30.

## Other Reports and Conference Proceedings

**Baroang, K. M.**, **M. Hellmuth**, and **P. Block**, 2009: Identifying Uncertainty and Defining Risk in the Context of the 4th World Water Development Report. Discussion Paper, *WWDR-4 Issues Workshop*, Perugia, Italy, 33 pp. [Available online at http://www.unesco.org/water/wwap/wwdr/wwdr4/pdf/WWDR4_Risk_and_Uncertainty_Paper.pdf]

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**Ceccato, P.**, and **T. Dinku**, 2010: Introduction to Remote Sensing for Monitoring Rainfall, Temperature, Vegetation and Water Bodies. *IRI Technical Report 10-04*, International Research Institute for Climate and Society, Palisades, NY, 10 pp. [Available online at http://iri.columbia.edu/publications/id=986]

Chen, J., **T. Dinku**, **E. Holthaus**, **B. Lyon**, **M. Madajewicz**, C. Mullaly, **M. Norton**, **D. Osgood**, A. Pascualini, S. Pant, N. Peterson, R. Saavedra, **J. Sharoff**, K. E. Shirley, C. Small, S. Stiffel, and T.-L. Teh, 2010: HARITA IRI Report to Oxfam America - Final Report for IRI MIEL Planning & Technical Support for HARITA - Micro-Insurance Pilot USA 536 /09 - June 2010. *IRI Technical Report 10-08*, International Research Institute for Climate and Society, Palisades, NY, 44 pp. [Available online at http://iri.columbia.edu/publications/id=1002]

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# Visitors To The IRI

## 2009

4 Nov Jeff Shaman *College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR*
IRI Seminar: Absolute humidity and the transmission and seasonality of influenza

16 - 24 Nov Kinfe Hailemariam *Ethiopia National Meteorological Agency, Addis Ababa, Ethiopia*
Development of December 2009 and Jan-Feb 2010 Ethiopia rainfall and temperature training program, including performing trend analysis; and familiarization with Data Library and other tools

17 Nov Stephen Ngigi *Water specialist, Tropical Agriculture, LDEO, Palisades, NY*
Meetings with M. Hellmuth and J. Hansen

17 Nov Francisco Mendonca *Professor, Federal University of Parana, Brazil*
Presentation and discussion on his work on dengue fever in relation to environmental factors

18 Nov Ronghua Zhang *Earth System Science Interdisciplinary Center, University of Maryland, Baltimore, MD*
IRI Seminar: The effects of freshwater flux forcing on interannual climate variability in the tropical Pacific"

23 Nov Maryam Golnaraghi *Chief, Disaster Risk Reduction Programme, World Meteorological Organization*
IRI and Climate & Society Masters Program Seminar: Managing Meteorological, Hydrological and Climate-related Disaster Risks in a Changing Climate - From International Agreements to Local Action

3 - 15 Dec Alexandre Araujo Costa *FUNCEME and Ceara State University, Fortaleza, Ceara, Brazil*
- Collaboration with L. Sun: Update the IRI/FUNCEME downscaling forecast system over Nordeste Brazil, and discuss forecast verification project over Nordeste
- 9 Dec presentation: Latest development of climate downscaling over NE Brazil, and use of the downscaling forecasts for hydrology and agriculture applications

8 Dec Julie Arrighi *Climate & Society Masters Program student*
Discussion on past internship in Uganda with American Red Cross and give a talk: Integrating climate information into disaster risk reduction strategies in Uganda

## 2010

3 - 4 Jan J. B. Williams, S. Flasse *Kent, UK*
Collaborative planning on early warning systems

11 Jan Chet Ropelewski *NOAA Program Manager*

11 - 12 Jan Rizaldi Boer *Director, Center for Climate Risk and Opportunity Management in Southeast Asia and the Pacific (CCROM), Bogor Agriculture University, Insitut Pertanian Bogor, Indonesia)*
IRI-CCROM collaboration and joint research

11 - 15 Jan Agus Buono and Akhmad Faqih *CCROM*
Working with IRI's climate research staff on climate modeling techniques, and with IRI's Data Library staff to develop a version of the Data Library for CCROM

22 Jan Adama Alhassane Diallo *Director General, ACMAD, Niamey, Niger* and John Jones *ACMAD International Development and Advocacy Committee Chair*

## 2010, cont.

29 Jan Xuejie Gao *Chief Scientist, National Climate Center, China Meteorological Administration, Beijing, China*
IRI Seminar: Application of RegCM3 in Regional Climate and Climate Change over China

3 Feb Paula Gonzalez *Centro de Investigaciones del Mar y de la Atmosfera (CONICET/UBA) Departamento de Ciencias de la Atmosfera y los Oceanos (UBA) Buenos Aires, Argentina*
IRI Seminar: Different Aspects of Climate Variability and Change over South America

24 - 26 Feb Pablo Chilibroste *Industrial Engineer; Faculty, Universidad de la Republica-Uruguay's Agronomy Department (Research Station "Dr. Mario A. Cassinoni"); President, National Institute of Agricultural Research (INIA, Uruguay); and member, Uruguay's Innovation Intergovernmental Operative Team*
Working with M. Madajewicz to: (1) examine the climate risks that the dairy industry in Uruguay faces, (2) potentially develop climate information tools for use in the dairy industry, (3) conditional on progress on number 2, evaluate the impacts of climate information on performance and livelihoods in the dairy industry.

1 - 12 Mar Abdou Ali *Hydrology expert, AGRHYMET, Niamey, Niger*
- 1 Mar IRI Seminar: The AGRHYMET Center: Role and activities in West Africa
- Program of activities to learn more about IRI

5 Mar David Rogers *President and Chairman of the Board, Health and Climate Foundation, Marchissy, Switzerland*
Discussions about MERIT and Weather Information for All (WIFA) projects

8 - 9 Mar Paulo Nobre *CPTEC/INPE, Brazil*
- Collaborative visit to explore seasonal to interannual prediction work
- 9 Mar IRI Seminar: Current efforts in climate modeling at CPTEC/INPE Brazil

11 Mar Michael J. Puma *Postdoctoral Research Scientist. NASA/Goddard Institute for Space Studies, Columbia University / Center for Climate Systems Research*
IRI Seminar: Effects of irrigation on global climate during the 20th century

12 - 23 Mar Angel Muñoz *University of Zulia (LUZ), Venezuela*
- Exploring collaboration on the predictability of malaria in the northwestern region of South America and review the Andean Observatory's forecasting methodologies
- 23 Mar IRI Seminar: The Andean Observatory and Malaria Predictability Experiment in Northwestern South America Effects

22 - 26 Mar Yves Tourre *Former IRI Director of Training*
- Meetings to highlight the lessons learned, capacity built and emerging risks and opportunities since the Bamako 1999 workshop on Climate and Health in Africa
- 23 Mar IRI Seminar: Low-frequency natural climate variability in the Atlantic during the 20th century

12 Apr Joshua Sperling *IGERT Fellow at the Sustainable Urban Infrastructure Program, University of Colorado Denver*
IRI Seminar: Down to the Wire in Reinventing Our Common Future: New Strategies for Climate Change, Poverty, and the Upcoming Ecological Era

14 Apr Tom Guilarte, Joe Graziano, Patrick Kinney, Darby Jack *Mailman School of Public Health, Department of Environmental Health Sciences, new Chair, outgoing Chair, Professor, Assistant Professor, respectively*
Meeting with S. Zebiak, M. Cane, S. Connor, B. Platzer

## 2010, cont.

16 Apr Visit of the China Meteorological Administration delegation
- Jiao Meiyan *Deputy Administrator and Beijing Climate Center delegation Beijing, China*
- Xiao Ziniu *Director-General*
- Zhang Zuqiang *Deputy Director-General*
- Li Weijing *Chief Scientist*
- Yan Yuping *Director, Operation and Scientific Division*
- Li Qingquan *Director, Climate Prediction Division*
- Zhang Peiqun *Director, Climate Application and Service Division*
- Wu Tongwen *Director, Climate System Modeling Division*
- Wang Lanning *Deputy Director, Climate System Modeling Division*

20 - 21 Apr Speakers and panelists for Workshop on Impact Evaluation of Projects Addressing Global Environmental Change
- Fred Carden *International Development Research Center's Evaluation Unit*
- Osvaldo Feinstein *Madrid Complutense University*
- Alan Fox *United Nations Development Programme Evaluation Office*
- John Gerring *Boston University*
- Macartan Humphreys *Harvard University*
- Uma Lele *World Bank Operations Evaluation Department (retired)*
- Carla Roncoli *Emory University*
- Maximo Torrero *Market, Trade and Institutions Division at International Food Policy Research Institute*
- Aaron Zazueta *Global Environment Facility (GEF) Evaluation Office*

21 - 23 Apr Daroonwan Kamthonkiat *Department of Geography, Faculty of Liberal Arts, Thammasat University*, and Kanchana Nakhapakorn *Faculty of Environment and Resource Studies, Mahidol University, Thailand*
- D. Kamthonkiat seminar: Remote Sensing for Agricultural and Disaster Applications
- K. Nakhapakorn seminar: Remote Sensing and GIS Applications on Urban Heat, Climate and Health

22 Apr M. Daly *Environmental Studies Program, University of Colorado, Boulder, CO*
IRI Seminar: From Prediction to Practice: Connecting Climate and Humanitarian Communities for Improved Climate Risk Management in East Africa

22 Apr M. Leone *Senior Program Officer, Urban Poverty and Environment at the International Development Research Center (IDRC)*
Meetings to discuss Adaptation to Climate Change, Water and Renewable Energies and possible IRI/IDRC exploratory study

3 May Leah VanWey *Department of Sociology, Brown University, Providence, RI*
Meeting to discuss activities in Ethiopia and opportunities for student involvement (with P. Block and others)

12 May Michael Williams *External Relations Manager, Group on Earth Observations (GEO), Geneva, Switzerland*
Meeting to discuss GEO-IPCC workshop and other GEO efforts

14 - 19 May Ulisses Confalonieri *Professor, FIOCRUZ and Federal University, Rio de Janeiro, Brazil; and ISTAC member*
2010 Summer Institute and ISTAC visit

17 - 20 May Mactar Ndiaye *Director General, Senegalese National Weather Service*
Attend O. Ndiaye thesis defense; collaborative meetings

## 2010, cont.

23 - 25 May • Jean-Francois Jusot *CERMES* • *Peter Diggle and Michelle Stanton Lancaster University* • Eric Bertherat, Stephane Hugonnet, Emily Firth *WHO*
Mini MERIT modeling meeting

24 May - 11 June Vincent Moron *IRI Adjunct Senior Research Scientist and Professor, CEREGE & the University of Aix-Marseille, France*

- Work on seasonal predictability over India and fire-climate relationships over Indonesia with A. Robertson
- 9 June IRI Seminar: Which elements of the Indian summer monsoon are predictable at seasonal scale?

27 - 28 May Francisco (Paco) Doblas-Reyes *Catalan Institute for Climate Sciences (IC3), Barcelona, Spain*

- Discussion of issues related to probabilistic climate prediction (sharing past experience as an ECMWF researcher, and currently as leader of new center in Spain)
- Participate in Summer Institute and interact with participants

28 May Maarten van Aalst and Pablo Suarez *Red Cross/Red Crescent Climate Centre*
IRI-IFRC partnership meeting: Taking stock and moving forward

3 June Chie Ihara *Lamont-Doherty Earth Observatory*
IRI Seminar: The state of climate over India and Indian Ocean

10 June Casey Brown *University of Massachusetts Amherst, IRI Adjunct*
IRI Seminar: Decision-scaling: A Decision Analytic Approach to Using Climate Information

15 June Helen Greatrex *University of Reading PhD candidate*
IRI Seminar Series: (1) An ensemble approach to estimation of uncertainty on satellite-based rainfall estimates, and (2) Application of seasonal rainfall forecasting and satellite rainfall observations to crop yield forecasting for Africa

16 June Daniel Rodriguez *Principal Scientist and Focus Team Leader, Agricultural Systems Modeling, Agricultural Production Systems Research Unit, Toowoomba, Queensland, Australia*
IRI Seminar: Farming business design for planned adaptation

18 June Lars Boye Hansen *PhD Fellow, Department of Geography and Geology, University of Copenhagen*
IRI Seminar: Remote Sensing of Precipitation - Use of MSG Data in a Semi-deterministic Downscaling of Existing Products

23 June Tegan Blaine *Climate Change Advisor, USAID Africa Bureau; Aurelia Micko (formerly NOAA, climate change programs in Asia)*
Meeting with IRI staff

24 June Vicky Pope *Head of Climate Change Advice, Wayne Elliott Head of Health Forecasting, UK Met Office, Exeter, Devon, UK*
Meeting with IRI staff to discuss potential areas for collaboration in Global Climate Services

24 June Sonali Shukla *Department of Earth and Environmental Sciences, Columbia University; NASA/Goddard Institute for Space Studies*
IRI Seminar: Characterizing the Indian Ocean Atmospheric Circulation in a Warmer Climate - The Impact of Altered Sea Surface Temperature Gradients

25 June Vincent Alhenc and Thomas Jeannin *Ecole Polytechnique, Palaiseau, France*

- Alhenc, V: Developing real-time tailored seasonal rainfall forecasts for Indonesia and analysis of fire-rainfall relationships
- Jeannin, T: Experimental statistical forecasts at decadal time scales

## 2010, cont.

26 - 27 July Agr. Tabare Aguerre *Uruguay Minister of Agriculture, Montevideo, Uruguay*
Meeting to discuss IRI-Uruguay Ministry of Agriculture collaborations

12 Aug Andreas Schaffer and Prof. Kerry Sieh *Earth Observatory of Singapore*
Discuss tropical climate science and sustainability issues

15 - 28 Aug • John Mac Callaway *UNEP Risoe Centre on Energy, Climate and Sustainable Development Denmark* • Trevor Lumsden *University of KwaZulu-Natal, South Africa* • Daan Luow *University of the Free State, South Africa*
Climate Change in Africa project discussions

15 - 19 Aug Roland Schulze *Professor Emeritus and Senior Research Associate at the University of KwaZulu-Natal, South Africa*
- Climate Change in Africa project discussions
- 15 Aug IRI Seminar: On climate, climate change and adaptation: A South African water practitioner's perspective

9 - 10 Sept John Furlow, Jennifer Frankel-Reed, John Garrison *USAID Climate Change Team*
Discuss possible collaborative efforts on the Data Library, index insurance and West Africa climate services

15 Sept Herve Bisseleua *MDG Centre West and Central Africa*
Discuss concept for a workshop on "Adaptation/coping strategies for climatic vulnerability and change in the Sahel" (with H. Bhojwani, B. Platzer, M. Thomson, S. Trzaska)

16 Sept Belay Begashaw *Director, MDG Centre, Nairobi, Kenya*
Discuss potential IRI contributions to the MDG Centre's Drylands Initiative

20 Sept - 1 Oct Steve Charles *CSIRO Land and Water, Perth, Australia*
- Work with A. Robertson on stochastic models for climate downscaling for hydrology
- 30 Sept IRI Seminar: Downscaling for hydrological applications using a non-homogeneous hidden Markov model

21 - 23 Sept Scientists participating in the WMO-IRI Hydrological Outlooks Training of Trainers Workshop (held at IRI, Palisades, NY)
- Claudia Contreras *Sistema de Información Ambiental de Colombia (IDEAM), Bogota, Colombia*
- Dr Waldo Lavado *Peruvian National Service of Meteorology and Hydrology (SENAMHI)*
- Juan José Nieto *Centro Internacional para la Investigación del Fenómeno de El Niño (CIIFEN), Ecuador*
- Dr R.N. Sankhua *National Water Academy, India*

22 Sept Amy Luers *Project Manager, Google.org*
Discuss: IRI-Google project; opportunities to build on Google's investments in climate data and services in Africa

24 Sept Inge Sandholt *Professor, Institute of Geography, University of Copenhagen, Denmark*
Meeting with P. Ceccato to discuss: CALM project (retrieval of land surface moisture in Africa), and collaboration with IRI on capacity building

27 Sept - 6 Oct Steve Charles *CSIRO Land and Water, Perth, Australia*
- Work with A. Robertson on stochastic models for climate downscaling for hydrology
- 30 Sept IRI Seminar: Downscaling for hydrological applications using a non-homogeneous hidden Markov model

30 Sept - 1 Oct Sergey Kirshner *Department of Statistics, Purdue University, West Lafayette, IN*
DOE project meeting

## 2010, cont.

4 Oct Norman Barth *Regional Environmental Officer, U.S. Embassy, Suva, Fiji Islands*
Discussions to enhance IRI collaboration in initiatives in the Pacific Islands; and IRI Seminar: A Pacific Climate Change Primer; Organizations, Players and Opportunities in the Region

7 Oct Naresh Devineni *PDRS, Columbia Water Center*
IRI Seminar: Improved Prediction of Winter Precipitation and Temperature over the continental United States: Role of ENSO State in Developing Multimodel Combinations

18 - 20 Oct Rahel Legesse *Micro Insurance Project Officer, Oxfam-America Horn of Africa Regional Office, Addis Ababa, Ethiopia*

18 - 22 Oct Professor Sulochana Gadgil *Indian Institute of Science, Bangalore, India; IRI ISTAC member*
ISTAC member visit and (19 Oct) IRI Seminar: Challenge of predicting the Indian summer monsoon rainfall

21 Oct Elin Enfors *Coordinator for the research project "Human dimensions behind the re-greening in Sahel", Stockholm Resilience Centre, Sweden*
Meeting with P. Ceccato to discuss research on monitoring re-greening of the Sahel

25 Oct Andres Baeza *Ann Arbor, MI*
Meeting with P. Ceccato on new vegetation products derived from remotely-sensed data, analysis to understand the relationship between environmental factors and malaria in Gujarat and Rajasthan, India

# Representing The IRI Around The World

## Africa

### 2009

2 - 6 Nov S. Connor, B. Lyon, J. Omumbo, B. Platzer *Nairobi, Kenya*
Fifth Multilateral Initiative on Malaria (MIM) Pan-African Malaria Conference, and International Research Institute for Climate and Society Symposium on the theme "Building Capacity to Use Climate and Environmental Information for Improving Health Outcomes," chaired by J. Omumbo; presentations:

- Stephen Connor: The Climate for Malaria Control
- Asefaw Getachew (Malaria Control and Evaluation Partnership in Africa/PATH-Ethiopia): Mapping Requirements from a User Perspective
- Joaquim Da Silva (WHO AFRO): Malaria: Current and Potential for Climate Informed Control
- Bradfield Lyon: The Recent Drying Trend in East Africa and the Current El Niño

9 - 11 Nov L. Cibrelus, C. Perez, M. Thomson, S. Trzaska *Niamey, Niger*
3rd MERIT Technical Meeting and National Workshop; participation in the MERIT steering committee meeting; presentations:

- M Thomson: Outcomes from the 3rd World Climate Conference meeting
- S. Trzaska et al: Climatic influences on meningitis epidemics
- L. Cibrelus et al: MERIT Niger case study – predicting meningitis outbreak in Niger

Posters:

- S. Trzaska et al: Environmental factors and population dynamics as determinants of meningococcal meningitis epidemics in the Sahel: an investigation of NASA and NOAA products – a joint project between CIESIN, IRI, NASA-GISS and NASA-JPL
- L. Cibrelus et al: Building capacity through training: experience from the 1st Malagasy workshop on climate information for public health
- C. Perez et al: Atmospheric dust modeling within MERIT: models and plans

9 - 21 Nov P. Block *Addis Ababa, Ethiopia*
Nile Basin Initiative training and Economics of Adaptation to Climate Change workshop

28 Nov - 5 Dec A. Barnston, R. Cousin, T. Dinku, G. Mantilla, O. Ndiaye *Addis Ababa, Ethiopia*
Lecturers/facilitators at Ethiopia: Training of Professionals on Climate and Health held at UNECA; presentations:

- A. Barnston: Making Sense of Associations; Practical Sessions on: Seasonal Forecasting of Malaria in Botswana, and Rainfall vs. Malaria Statistical Forecast Exercise
- R. Cousin: Cluster Analysis; Practical Sessions on: Overview of the IRI Data Library, Summary Statistical Analysis of Climate and Health Data, and Remote Sensing Tools in the Health Map Room
- R. Cousin/G. Mantilla: Practical Session on Malaria Climate Suitability Map
- T. Dinku: Introduction to Remote Sensing
- G. Mantilla: Climate Risk Management in Health
- O. Ndiaye: Introduction to Climate and Weather (delivered by R. Cousin); Understanding Predictions and Projections in Climate; Practical Session on Probabilistic Seasonal Forecasting and Its Applications

28 Nov - 5 Dec M. Hellmuth *Johannesburg and Pietermaritzburg, South Africa*
- Meeting with UN Office for the Coordination of Humanitarian Affairs
- Meetings at the University of Kwazulu-Natal for the project, Managing Climate Risk to Agriculture and Water Resources in South Africa

30 Nov - 4 Dec A. Barnston, T. Dinku, O. Ndiaye *Addis Ababa, Ethiopia*
Climate Predictability Tool Training at the Ethiopia National Meteorology Agency (NMA)

4 - 18 Dec E. Holthaus *Mekele, Ethiopia*
Oxfam America HARITA project support: training, field research for 5 expansion villages, including focus groups and collection of rainfall and yield data

7 - 11 Dec T. Dinku *Addis Ababa, Ethiopia*
Satellite and Rainfall Estimation for Long-Term Rainfall Time Series for Ethiopia, technical training conducted with three University of Reading scientists from the TAMSAT (Tropical Applications of Meteorology using SATellite and other data) group of the Department of Meteorology for Ethiopia's National Meteorological Agency (NMA) (9 NMA participants)

## 2010

6 - 23 Jan A. Giannini *Dakar, Senegal; Niamey, Niger*
Meetings with CILSS institutions, MDG research center and universities to discuss "Regreening of the Sahel" project as an adaptation to climate change strategy

12 - 22 Jan P. Block *Addis Ababa and Koraro, Ethiopia*
- 12 - 15 Jan, Addis Ababa: 2010 Conference on Water Resources in Ethiopia; presented: Tailoring seasonal climate forecasts for hydropower operations in Ethiopia's Blue Nile Basin
- 18 - 22 Jan, Koraro: Field visit, U. Lall Pulitzer project

16 - 27 Jan E. Holthaus *Tigray, Ethiopia*
HARITA drought microinsurance field visit

17 Jan - 2 Feb C. Perez *Dar-Es-Salaam and Arusha, Tanzania*
Climate adaptation in agriculture, AgCLIR Assessment, Booz, Allen and Hamilton

20 - 23 Jan S. Trzaska *Addis Ababa, Ethiopia*
African Meningococcal Carriage Consortium (MenAfriCar) meeting

2 - 4 Feb P. Ceccato, T. Dinku *Addis Ababa, Ethiopia*
Provide training at the National Meteorological Agency (Ethiopia) on the use of MODIS images to monitor air temperature

3 - 5 Feb S. Mason *Banjul, The Gambia*
Conference of Directors of Western Africa National Meteorological and Hydrological Services; presented: IRI's Africa Program Engagement in Climate and Health

4 Feb - 1 Mar T. Dinku *Addis Ababa, Ethiopia*
- Work with NMA staff on: (1) calibration of satellite rainfall estimation algorithm (2) data quality control for rainfall and temperature; (3) gridding rainfall and temperature data; (4) merging raingauge measurements with satellite rainfall estimates
- Meetings with partners

23 - 24 Feb M. Hellmuth, S. Mason *Nairobi, Kenya*
Humanitarian Climate Risk Management Workshop; S. Mason presented "Predicting Extremes;" served as panel member for a session on climate science questions; coordinated ice breaker using the "weather roulette" forecast verification game

25 - 26 Feb M. Hellmuth, S. Mason *Nairobi, Kenya*
25th Greater Horn of Africa Climate Outlook Forum (GHACOF25); S. Mason presented "Current State of the Global Climate System"

12 - 25 Mar E. Holthaus, D. Osgood *Mekele, Ethiopia*
Oxfam America HARITA project support: insurance index negotiations, data gathering and field visits, long-term planning

14 - 18 Mar D. DeWitt *Pretoria, South Africa*
Represent IRI at the South African Weather Service (SAWS) Climate Change Conference; and meet with global model collaborators

15 - 18 Mar A. Giannini *Accra, Ghana*
ECOWAS Specialized Technical Committee Meeting to Adopt the Sub-Regional Action Programme to Reduce Vulnerability of West Africa to Climate Change

18 - 28 Mar L. Cibrelus, R. Cousin *Antananarivo, Madagascar*
Facilitators for Malagasy's second Climate Information for Public Health (CIPH) Workshop, "Learning Through Doing Project: Cross-Training Workshop for the National Meteorological and Hydrological Service and Ministry of Health Staff in the Use of Meteorological, Climate and Health Data

24 - 25 Mar S. Mason *Addis Ababa, Ethiopia*
Vigilance Systems and Integrated Climate Risk Management in Africa (ViGIRisC Afrique) Project kick-off meeting; presented: Case study on early-warning systems: climate and health

29 Mar - 13 Apr E. Holthaus *Mekele, Ethiopia*
Oxfam America HARITA project support: data gathering and field visits, preparation for product rollout and delivery of rain gauges

12 - 16 Apr S. Mason *Nairobi, Kenya*
The First Conference of Ministers Responsible for Meteorology in Africa
- 12 - 14 Apr, Expert Meeting; discussant for the Disaster Risk Reduction session
- 15 - 16 Apr, Ministerial Conference

25 Apr - 5 May M. Norton *Mekele, Ethiopia*
Index insurance contract experiments

27 Apr - 19 May S. Mason *Pretoria, South Africa*
South Africa Weather Service/Council for Scientific and Industrial Research (CSIR) consultancy

4 - 7 May J. Hansen *Nairobi, Kenya*
CCAFS Launch Conference, and CCAFS Launch Planning Workshop

26, 27 - 28 May O. Ndiaye *Niamey, Niger*
- Presented to AGRHYMET staff, "Forecasting the Onset of the Rainy Season Over Senegal," hosted by Dr. Seydou Traore
- 13th training and Regional Climate Outlook Forum (PRESAO-13): Seasonal Climate Prediction: Coping with Climate Change Impacts; provided training in the use of the Climate Predictability Tool (CPT) as a means toward enhancement of better seasonal climate predictions practices.

1 - 10 June O. Ndiaye *Dakar, Senegal and Bamako, Mali*

- 1 June, IFRC Dakar meeting with Yousef Aitchellouche to discuss onset research and possible IFRC decision-making applications
- 3 June, Visit Senegal's national weather service (ANAMS) hosted by Dr. Aida Diongue, Head of Research and Development; presentations made to staff and regional aviation agency weather (ASECNA) forecaster: (1) Revisiting the JAS 2009 Seasonal Forecast: what did happen?; (2) On Forecasting the Onset of the Rainy Season Over Senegal; and discussion of interest in the use of these products
- 5 June, ICRISAT, Bamako, Mali visit hosted by Dr. Pierre Sibiry Traore to explore, from onset research, development of an applied product for crop development at different stages and forecasting planting date
- 10 June, Presentation and discussions at ASECNA training unit (CELICA Meteo Dakar), hosted by Mme Sokhna Wane (Coordinator) and with experienced forecasters on, "Characteristics of a False Start of Rainy Season"
- 10 June, Visit and presentation at the Laboratory of Atmospheric and Ocean Physic (LPAOSF), University of Cheikh Anta Diop, hosted by LPAOSF Lab head, Dr. Amadou Gaye, to present "The Predictability of the Sahelian Climate : Seasonal Sahel Rainfall and Onset over Senegal," to share PhD results to LPAOSF researchers, masters and PhD students

13 - 26 June H. Bhojwani, S. Mason *Niamey, Niger*

IRI-ACMAD collaboration discussions on ViGiRisC and AfriClimServ

28 - 29 June J. del Corral, T. Dinku *Addis Ababa, Ethiopia*

- Represent the IRI at the Korea International Cooperation Agency (KOICA)-funded "Weather and Climate Impact on Community Health and Public Health Services" workshop hosted by the Ethiopian Climate and Health Working Group in collaboration with WMO and WHO; presentations/demonstrations made on the IRI Data Library
- Meetings with Ethiopia's National Meteorological Agency (NMA) on improvements to NMA web content and delivery

5 - 9, 12 - 13 July T. Dinku *Addis Ababa, Ethiopia*

- 5 - 6 July, FAO-sponsored Climate Change Forum Ethiopia (CCF-E) workshop Strengthening Capacity for Climate Change Adaptation in the Agriculture Sector; presented on IRI, our CRM approach, and our work in Ethiopia; and meeting with Mr. Gebru Jember, CCF-E scientific officer (and Ethiopia National Meteorological Agency)
- 6 July, Meeting (and ongoing discussions) with the Ethiopian Institute of Agricultural Research
- 6 - 9 July, UN-SPIDER Workshop on Building upon Regional Space-based Solutions for Disaster Management and Emergency Response for Africa (a workshop for the mapping and remote sensing community); presented: on the IRI-DL, some of the relevant Map Rooms, and IRI project with NMA during a session on " Information Management Including Spatial Data Infrastructure"
- 12 July, Meeting with OXFAM America on areas for collaboration
- 12 - 13 July, Meeting with Abere Mihrete (Anti Malaria Association), Adugna Woyessa (Ethiopian Health and Nutrition Research Institute), and Abnet Girma (CHWG coordinator) to discuss the implementation of the baseline survey for the Google project
- 16 July, Meeting on the Seventh African Development Forum, with J. Williams and M. Boulahya

19 - 26 July H. Bhojwani *Niamey, Niger*

ACMAD Board Meeting

2 Aug T. Dinku *Addis Ababa, Ethiopia*

Meetings at Addis Ababa University with Dr. Semu Moges, Civil Engineering Department and Dr. Gizaw Mengistu, Physics Department

10 Aug - 2 Sept M. Norton *Maputo, Mozambique*
African Development Bank micro-insurance consulting

20 - 28 Aug J. del Corral *Addis Ababa, Ethiopia*
Collaborate with Ethiopia NMA on their current and future website and climate atlas

22 - 29 Aug B. Lyon, O. Ndiaye *Addis Ababa, Ethiopia*
Forecast methodology and verification workshop for the National Meteorological Agency (NMA) of Ethiopia

23 - 27 Aug K. Coffey *Nairobi, Kenya*
CCAFS Scenarios Workshop

27 Aug - 2 Sept S. Connor, B. Platzer *Addis Ababa, Ethiopia*
Meet with Google project partners, including the Ethiopian MoH, NMA and the CHWG Secretariat; visits to: CDC Ethiopia office-EFELTP, WHO country office, Addis Ababa University's School of Public Health; and, meeting to discuss ADF-VII with M. Boulahya

30 Aug - 2 Sept T. Dinku, B. Lyon *Addis Ababa, Ethiopia*
Data quality and analysis workshop for Ethiopia's NMA

2 - 3 Sept J. Sharoff *Kisumu, Kenya*
26th Climate Outlook Forum for the Greater Horn of Africa and Food Security Outlook

6 - 11 Sept J. Sharoff *Nairobi, Kenya*
Climate and Society Publication (CSP) case study research and CCAFS scoping

10 - 23 Sept E. Holthaus, D. Osgood, J. Sharoff *Mekele, Ethiopia*
HARITA stakeholder meeting and field training

11 - 22 Sept J. Sharoff *Addis Ababa, Ethiopia*
- 11 - 18 Sept, HARITA project
- 19 - 22 Sept, CCAFS scoping

14 - 22 Sept B. Lyon *Dar es Salaam, Tanzania*
Conducted workshop, "Tailoring Seasonal Forecasts for Disaster Risk Management," hosted by the Tanzania Meteorological Agency, for participants from the national met agencies of Botswana, Malawi, Mozambique, Zambia, Zimbabwe and Tanzania; IFRC funding through the IRI-IFRC Partnership to Save Lives Project, with additional funding from WMO.

23 Sept - 16 Oct J. Sharoff *Nairobi, Kenya*
CCAFS scoping and CSP case study

28 - 30 Sept J. Hansen, O. Ndiaye *Dakar, Senegal*
CCAFS West Africa Stakeholder Workshop

2, 5 - 6 Oct O. Ndiaye *Brazzaville, Republic of Congo*

- 2 Oct, Meeting with Drs. Magaran and Manga, WHO-AFRO, on planning for the "Climate and Public Health: 10 Years On" project, an IRI initiative
- 5 Oct, Presentation on seasonal rainfall and onset research at University Marien Ngouabi, and discussions on collaboration and application of approach in Central Africa
- 5 - 6 Oct, 4th Climate Outlook Forum in Central Africa; provided training in CPT and topics to enhance knowledge on statistical forecasting approaches, specifically:
  - discussing issues related to building seasonal forecasting model : fishing, over fitting;
  - introducing GCMs outputs as predictors (ECHAM and ECHAM using CFS_SST);
  - identifying the best GCM predictor fields using the MOS approach (i.e., CPT);
  - discussing “why are we doing what we are doing” and the added value of the seasonal product and outreach to users.

  Participants came from Congo, Cameroon, Democratic Republic of the Congo, Gabon and Sao Tome and Principe. COF results were presented at the Ministry of Finance in front of national experts and users

8 - 15 Oct S. Zebiak, H. Bhojwani, O. Ndiaye *Addis Ababa, Ethiopia*

Participation in pre-forum and African Development Forum-VII

- 8 - 10 Oct, O. Ndiaye: Pre-forum, Getting it Right: Reporting climate change for sustainable development in Africa” (Africa Media Training Workshop); presented "Climate Risk Management" and "Uncertainties in Climate Change Models" to 25 participants from the African region
- 10 - 15 Oct, S. Zebiak: Delivered keynote presentation for ADF-VII session on "Climate risk management: Monitoring, Assessment, Early Warning and Disaster Risk Reduction"

20 Oct O. Ndiaye *Dakar, Senegal*

Presentation on "The Predictability of the Sahelian Climate: Seasonal Sahel Rainfall and Onset over Senegal" at Universite Gaston Berger's Department of Applied Sciences and Technology

23 - 30 Oct M. Norton *Tunis, Tunisia*

African Development Bank presentation on "Mozambique: Pre-Feasibility Study On Weather Index Microinsurance for Rural Livelihoods Protection"

## Europe

### 2009

1 - 14 Nov T. Dinku *Reading, UK*

IRI-Google project partner activities at University of Reading, including assessing the progress in satellite data processing, gaining an understanding of the TAMSAT software for rainfall estimation, planning for the December 2009 satellite rainfall estimation training workshop to be held at NMA/Ethiopia

2 Dec S. Connor *Geneva Switzerland*

WHO PHE follow up discussion on WCC3 MEWS meeting

3 - 4 Dec S. Connor *Geneva, Switzerland*
Chair, Informal Expert Consultation "Effects of Environmental and Climate Change on Major Disease Vectors and Vector-Borne Diseases: Current Evidence and Research Priorities," convened by the UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (S. Connor's blog on the meeting: Climate change and health: new impetus for better understanding of the linkages between climate variability and disease outcomes is at http://blog.tropika.net/copenhagen2009/2009/12/11/climate-change-and-health-new-impetus-for-better-understanding-of-the-linkages-between-climate-variability-and-disease-outcomes/)

7 - 17 Dec S. Zebiak, W. Baethgen, H. Bhojwani, J. Hansen, M. Hellmuth, S. Mason, D. Osgood *Copenhagen, Denmark*
15th United Nations Climate Change Conference (COP15)

9 - 13 Dec J. Hansen *Copenhagen, Denmark*
- CGIAR's Climate Change, Agriculture and Food Security (CCAFS) Leadership Meeting
- 11 Dec, COP 15 side event: "Climate robust water supply, agriculture and nature" speaker: "Designing Climate-Robust Agriculture" (co-author, H. Meinke)
- 12 Dec, Agriculture and Rural Development Day, co-hosts: CGIAR CCAFS, Global Donor Platform for Rural Development, University of Copenhagen's Faculty of Life Sciences

## 2010

8 - 14 Mar A. Giannini *Amsterdam, Netherlands*
Meetings with potential Regreening of the Sahel Project collaborators at Free University Amsterdam and Stockholm Resilience Center

25 - 27 Mar J. Hansen *Montpellier, France*
Climate Change, Agriculture and Food Security (CCAFS) management team meeting

29 Mar J. Hansen *Montpellier, France*
CCAFS expert brainstorming meeting with CIRAD

30 Mar S. Mason *King's College, London, UK*
Humanitarian Futures Programme seminar: An exchange between climate scientists and humanitarian and development policy makers; S. Mason and M. van Aalst presented: "Practical application of climate science: examples of successful applications of climate science, developing science-policy partnerships, and remaining gaps"

26 - 29 Apr L. Braman, S. Mason *Driebergen, The Netherlands*
Red Cross/Red Crescent Climate Centre Retreat

6 - 8 May M. Thomson *Louvain-la-Neuve, Belgium*
Invited seminar: Climate information for public health in developing countries external examiner for V. Obsomer's PhD public defense

31 May - 11 June J. Qian *Trieste, Italy*
5th ICTP Workshop on The Theory and Use of Regional Climate Models; invited lecture: Multiscale climate processes of ENSO, monsoon and diurnal cycle in rainfall variability over the Maritime Continent of Southeast Asia

3 - 7 June D. Osgood *Bonn, Germany*
UNFCCC meetings in Swiss Party and MCII Sessions

7 - 9 June A. Giannini *Diessenhofen, Switzerland*
Weather and Climate Extremes During the Past 100 Years Workshop; presented: Late 20th century drought in the Sahel: causes, characteristics and attribution

14 - 16 June S. Zebiak *Lille, France*
WCRP Regional Climate Workshop: Facilitating the production of climate information and its use in impact and adaptation work; presented: Climate data and user demands, bridging the gap: Experience from seasonal forecasting

29 - 30 June M. Thomson *London, UK*
Wellcome Trust Frontiers Meeting: Research to Strengthen the Public Health Response in Disasters and Humanitarian Emergencies

12 - 16 July A. Greene *Edinburgh, Scotland*
11th International Meeting on Statistical Climatology; presented: Downscaling Climate Change Projections of Indian Summer Monsoon Rainfall Using a Nonhomogeneous Hidden Markov Model

19 July - 18 Oct R. Cousin *Rome, Italy*
3-month secondment for technical scoping on IRI-WFP Collaboration for Climate Change

22 July - 4 Aug S. Connor *Reading, Norwich, Liverpool, UK*
Collaborative discussions at Universities of Reading, Liverpool, and East Anglia

27 July A. Greene *Saclay, France*
Laboratoire des Sciences du Climat et l'Environnement (LSCE), presented: Downscaling climate change projections of Indian summer monsoon rainfall using a nonhomogeneous hidden Markov model

2 - 13 Aug A. Barnston, M. Tippett *Trieste, Italy*
ICTP Targeted Training Activity: Statistical Methods in Seasonal Prediction; lectures:
- 3 Aug, Tippett: Predictor Selection
- 4 Aug, Tippett: PCR, CCA, and Other Pattern Based Regression Techniques
- 5 Aug, Tippett: Pitfalls of Linear Regression; Constructing Probability Forecasts
- 9 Aug, Barnston: Lessons in Statistical Prediction; Verification Measures
- 11 Aug, Barnston: Interpretation of Canonical Correlation Analysis Results; Seasonal Prediction at IRI

7 - 15 Aug M. Thomson *Geneva, Switzerland*
Visit WHO Tropical Disease Research Unit to establish climate research agenda

9 - 13 Aug K. Coffey, J. Hansen *Aberdeen, UK*
CCAFS Management Team Meeting

18 - 20 Aug L. Zubair *London, UK*
2010 Ecohealth Conference - Global Ecohealth Challenges; Multiple Perspectives (sponsored by the London School of Hygiene and Tropical Medicine); presented: Climate justice in relation to adaptation and ecohealth in Southern South Asia (with Z. Yahiya)

20 - 24 Aug M. Hellmuth *Rome, Italy*
WFP project work planning

31 Aug - 24 Sept S. Mason *Geneva, Switzerland*
- 31 Aug - 2 Sept, Task Team on Meteorological Services for Improved Humanitarian Planning and Response; presented: Climate Services for the Humanitarian Community
- 3 Sept, IFRC Partnership discussions
- 3 - 24 Sept, Global Framework for Climate Services report writing

1 Sept - 1 Dec A. Giannini *Rome, Italy*
World Food Programme secondment for WFP-IRI partnership

6 - 9 Sept A. Giannini *Reading, UK*
ECMWF 2010 Annual Seminar: Seminar on Predictability in the European and Atlantic Regions from Days to Years; invited presentation: The impact of sea surface temperatures on African climate

16 - 17 Sept P. Ceccato, J. Hansen *Ispra, Italy*
2-day workshop: Food security monitoring, basis for collaboration between the EC Joint Research Centre and the IRI

20 - 24 Sept T. Dinku *Cordoba, Spain*
2010 EUMETSAT Meteorological Satellite Conference; presented on climatology work in Ethiopia; presented: Blending METEOSAT Rainfall Estimates and National Raingauge Observations to Produce High-resolution 30-year Time Series over Ethiopia

11 - 15 Oct T. Dinku *Hamburg, Germany*
Fifth Workshop of the International Precipitation Working Group; presented: Historical Time Series of Merged Raingauge-Satellite Rainfall Data for Climate Risk Management Applications in Ethiopia (with K. Hailemariam, D.F. Grimes)

11- 22 Oct S. Mason *Geneva, Switzerland*
- 11 Oct, Global Framework for Climate Services report writing
- 12 - 14 Oct, CCI/CBS Intercommission Expert Meeting on Scoping Global Seasonal Climate Updates
- 22 Oct, IFRC Disaster Relief Emergency Fund (DREF) Donor Meeting

13 Oct A. Giannini *Rome, Italy*
Invited seminar, "Impact of sea surface temperatures on African climate," given at ENEA's (Italian national agency for new technologies, energy and sustainable economic development) Casaccia Research Center

22 Oct A. Giannini *Bologna, Italy*
Invited seminar, "Climate change in the Sahel: past, present and future," given at the Center for Euro-Mediterranean Climate Change, Istituto Nazionale di Geofisica e Vulcanologia

22 Oct S. Someshwar *Athens, Greece*
Launch of Mediterranean Climate Change Initiative

25 - 27 Oct S. Mason *Bonn, Germany*
GFCS High-Level Task Force Meeting

## Australia, Asia and the Pacific Islands

### 2009

2 Nov O. Ndiaye *Honolulu, HI*
- University of Hawaii-Manoa Joint Institute for Marine and Atmospheric Research to conduct a seminar: Predictability of Seasonal Sahel rainfall Using GCMs and Lead-Time Improvements Using a Coupled Model
- Scientific discussions with Rashed Chowdhury, Principal Research Scientist

13 - 18 Nov E. Conrad, S. Someshwar *Delhi, India*
- Meetings with the Indian Planning Commission, TERI, and World Ban
- ERFS project meetings with IMD and IIT Delhi

16 - 20 Nov A. Robertson *Bogor, Indonesia*

- 17-19 Nov, International Workshop on Achieving Resilient Agriculture to Climate Change through the Development of a CRM-Based Scheme
- 16, 20 Nov, Centre for Climate Risk and Opportunity Management meetings
- 20 Nov, BMKG (Indonesian Bureau of Meteorology, Climatology & Geophysics) visit

26-27 Nov S. Someshwar *Delhi, India*

- • Meeting with Minister of Environment
- • ERFS project meeting with IMD

11 - 18 Dec L. Zubair *Kandy/Colombo, Sri Lanka*

- University of Peradeniya collaboration on curriculum development and practical placement for Masters in Development Practice
- Central Region Anti-Malaria Campaign (AMC) and AMC HQ on discussion of proposals to Global Fund to Fight AIDS, Tuberculosis and Malaria/International Development Research Centre
- Discussion on Developing Crop Early Warning Systems with Director General, Agriculture, Department of Meteorology and UNDP, Sri Lanka

## 2010

23 - 28 Jan L. Sun *Tsukuba, Japan*

Workshop on Dynamical Downscaling Over Japan; presented: Climate prediction and climate risk management using regional climate models

3 - 13 Feb E. Conrad, S. Someshwar *Delhi, India*

- Delhi Sustainable Development Summit 2010
- Day-long CRM training, South Asian Network for Development and Environmental Economics at TERI University
- Meetings with TERI, Swiss Development Corporation, Development Alternatives

15 - 19 Feb S. Mason *Antalya, Turkey*

Technical Conference on Changing Climate and Demands for Climate Services for Sustainable Development, with a Special Joint Session of CCl experts with the Joint Scientific Committee (JSC) of the World Climate Research Programme (WCRP); presented: Enhancing Linkages between Climate Service Providers and Users to Facilitate Climate Adaptation and Climate Risk Management

4 - 23 Mar A. Ines *Quezon City, Philippines*

Conduct Department of Science and Technology Balik Scientist Program II: PAGASA capacity building on crop field forecasting

26 March, 1 April L. Zubair *Kandy, Sri Lanka*

University of Peradeniya meetings on progress of Masters in Development Practice program and workshop for curriculum development; discussions with the Institute of Fundamental Studies on NSF opportunity

5 - 7 Apr A. Ines *Ahmedabad, India*

Visit to Anand Agriculture University for ERFS demonstration site research on agriculture risks

5 - 9 Apr A. Robertson *Delhi, India*

ERFS project research and meetings at IIT Delhi and IMD, and Asia project meetings at TERI

6 - 12 Apr L. Sun *Beijing, China*

- 6 - 8 Apr, Invited speaker to the Sixth Session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Asia (FOCRAII);
  - Presentations: Regional climate modeling: an update; IRI seasonal forecasts for summer 2010
  - Chaired climate prediction system and modeling session
- 9 Apr, Conducted seminar, China Academy of Science: A new nesting scheme for the regional climate model
- 10 Apr, Nanjing University of Information, Science and Technology visit, and discussed collaboration on East Asian monsoon prediction
- 12 Apr, Conducted seminar at Beijing Normal University: Regional climate modeling for climate diagnosis and prediction

8 - 9 Apr A. Ines *Pune, India*

Visit to IMD Pune Office for ERFS project research discussions

12 - 14 Apr A. Robertson *Bhubaneshwar, India*

Led sessions in: "Climate Risks in Agriculture: ERFS Project Training/ Workshop," Orissa University for Agriculture and Technology.

12 - 16 Apr A. Ines *Bhubaneshwar, India*

Led training sessions in: "Climate Risks in Agriculture: ERFS Project Training/Workshop" Orissa University for Agriculture and Technology

13 - 15 Apr M. Tippett *Pune, India*

First session of the South Asian Climate Outlook Forum (SASCOF-1); presented: Tailoring Seasonal Forecasts; Predictions of IRI

8 - 13 June E. Conrad, S. Someshwar *New Delhi and Hyderabad, India*

- " Extended Range Forecasting and Agriculture Risk Management, India (ERFS) project meetings
- " ERFS demonstration site visits/research

14 – 18 June E. Conrad, S. Someshwar *Thimphu, Bhutan*

Visit hosted by Ministry of Agriculture and Forests to explore collaboration on climate risk management for agriculture/natural resources in Bhutan

22 - 25 June M. Tippett *Taipei, Taiwan*

2010 Western Pacific Geophysics Meeting; presentations:

- Invited: Predictability and predictions of Indian summer monsoon rainfall using dynamical models (with A. Robertson, M. Kulkarni, O. Sreejith, P. Sinha, K. Ghosh, D. Dewitt, D. Lee)
- Development and applications of an index for tropical cyclone genesis (with S. J. Camargo, A. Sobel, G. Vecchi, M. Zhao)

31 July - 5 Aug L. Sun *Alanya, Turkey*

International Training Workshop on Climate Variability and Predictions for the Mediterranean Basin (sponsors: WMO, NOAA, USAID, and Turkish State Meteorological Service, held at the WMO Regional Training Center); led training on climate downscaling and prediction

9 - 13 Aug S. Barone, L. Sun *Hokkaido University, Sapporo, Japan*
The 10th International RSM Workshop, hosted by Hokkaido University's IFES-GCOE Program , Japan's Ministry of the Environment, Japan's Meteorological Research Institute, IRI, NOAA, and the Experimental Climate Prediction Center (ECPC) (G-RSM)

- L. Sun gave two talks on "Verification of downscaling forecasts" and "Rainfall trends over Northern Brazil," and a lecture, "Introduction to climate change downscaling;" leader of the two-day training course on (1) the latest RSM version, and (2) climate change downscaling using the RSM
- S. Barone provided analyst support for the participants

12 - 20 Oct S. Someshwar *Bangalore, Hyderabad, and Delhi, India*
ERFS project meetings and donor discussions

17-20 Oct H. Bhojwani *Delhi, India*
Meetings with: the US Embassy Chief of Environment, Scientist and Technology, the Director, Earth Science and Climate Change Division of The Energy Resources Institute (TERI)

18 - 22 Oct D. DeWitt *Tokyo, Japan*
26th Working Group on Numerical Experimentation (WGNE) and the 12th session of the GEWEX Modelling and Prediction Panel (GMPP)

25 - 28 Oct S. Connor *Taipei, Taiwan*
2010 Taiwan Health Forum: Asia Perspective; invited panelist on climate change and health; and presenter: Climate Risk Management for Disease Prevention and Control

## North America

### 2009

2 Nov S. Mason *New York, NY*
Panelist, IPI Policy Forum on Monitoring Disaster Displacement in the Context of Climate Change

9 - 14 Nov D. Osgood *Washington, DC*
Institutional presentations: to NOAA on IRI activities to address poverty using NOAA products; to the World Bank Development Marketplace on index insurance innovations for Indonesia

12 - 13 Nov P. Ceccato *Washington, DC*
Co-organizer, session moderator for the IEEE GEOSS Workshop XXXI – Using Earth Observation for Health; a workshop of the GEO Health and the Environment Community of Practice

18 Nov C. Perez *Washington, DC*
Air Quality and GEOSS Meeting; presented: The WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS): A Global Consortium Helping Society Reduce Risk Through Research, Assessments and Forecasts

18 - 22 Nov S. Connor, M. Thomson *Washington, DC*
American Society of Tropical Medicine and Hygiene; presentations:

- For the NASA-sponsored symposium, Progress Towards Predicting and Preventing Outbreaks of Vector-borne Disease Utilizing Satellite Remote Sensing Technology and Models; S. Connor: Enhancing Malaria Early Warning Systems (MEWS) with earth observation and modeling results
- For the NCAR-sponsored symposium, Changing the Climate: A data-driven discussion about climate
  - S. Connor: Climate Informed Early Warning for Malaria
  - M. Thomson: Climate Information for the Control of Meningitis: The Evidence to Date

19 Nov M. Thomson *Washington, DC*
GEO-IGOS Symposium: The Need for Earth Observations: Yesterday, Today and Tomorrow; invited presentation: The Health Community of Practice (including presentation of draft Google Earth Tour)

19 - 20 Nov L. Goddard *Washington, DC*
Fall Meeting of the National Academies' Climate Research Committee

2 Dec H. Bhojwani *Washington, DC*
NOAA Next Generation Strategic Plan National Stakeholder Forum

14 - 15 Dec E. Conrad, S. Someshwar *Washington, DC*
Meetings to discuss collaborative projects at World Bank, Conservation International, World Resources Institute

14 - 18 Dec P. Block, A. Giannini, L. Goddard, A. Ines, J. Qian, A. Robertson *San Francisco, CA*
2009 American Geophysical Union Fall Meeting; presentations:
- P. Block: Tailoring seasonal climate forecasts for hydropower operations in Ethiopia's upper Blue Nile basin (P. J. Block)
- L. Goddard: Does Uncertainty in the Pattern of Tropical SST Changes Underlie Uncertainty Tropical Precipitation Trends? (L. Goddard and C. Coelho)
- J. Qian: Role of multi-scale physical processes in the spatial and temporal variability of rainfall over the Maritime Continent (J. -H. Qian, A. W. Robertson, and V. Moron)
- A. Robertson: Climate change projections of daily rainfall statistics over India: Downscaling using a hidden Markov model (A. W. Robertson, A. M. Greene, P. J. Smyth, and S. Triglia)

Posters:
- Integrating interannual climate variability forecasts into weather-indexed crop insurance. The case of Malawi, Kenya and Tanzania (M. Vicarelli, A. Giannini, and D. Osgood)
- Mechanisms of Climate Change in the Semi-Arid Sahel (A. Giannini)

## 2010

11 - 14, 15 Jan L. Goddard, D. Osgood *Miami, FL*
- 11 - 14 Jan, Predicting the Climate of the Coming Decades Workshop; presentations:
  - " L. Goddard, Keynote Lecture: Decadal-scale Climate Information
  - " D. Osgood: Trends, Decadal Processes, and Rainfall Insurance for Farmers in Ethiopia; Tropical Cyclone Decision Support Tool for IFRC operations in Latin America and the Caribbean
- 15 Jan, L. Goddard, co-chair, US CLIVAR Decadal Predictability Working Group meeting

16 Jan M. Thomson *Atlanta, GA*
Invited contributor, National Weather Service International Session "Cooperation between National HydroMet and Public Health Services" convened for the 90th American Meteorological Society Annual Meeting

17 - 20 Jan M. Bell, L. Cibrelus, T. Dinku, B. Lyon, G. Mantilla, A. W. Robertson, M. Thomson, N. Ward *Atlanta, GA*
The 90th American Meteorological Society Annual Meeting; presentations:
- T. Dinku: Validation of Satellite Rainfall Products over Africa and S. America; Bridging the Climate and Health Community through Climate and Health Working Groups: An example from Ethiopia
- B. Lyon: Assessing sources of skill in forecasts of meteorological drought on seasonal to interannual time scales (with M. Bell)
- A. W. Robertson: Statistical downscaling daily rainfall statistics from seasonal forecasts using canonical correlation analysis or a hidden Markov model? (with K. Verbist); Toward regional climate-change downscaling of weather statistics using a hidden Markov model (with A. M. Greene, P. Smyth, and S. Triglia)
- M. Thomson: Meningitis Environmental Risk Information Technologies (MERIT) program

19 Jan W. Baethgen *Washington, DC*
Invited speaker, Annual Forum of the Sustainable Development Network (SDN) of the World Bank

27 - 29 Jan D. Osgood *Athens, GA*
Planning meeting for Northeast Brazil climate risk and financial mechanisms

1 - 3 Feb A. Ines *Colorado Springs, CO*
NASA Earth Observing Missions Applications Workshop; co-leader, Agriculture break-up group

8 - 10 Feb L. Goddard *Washington, DC*
5th Meeting of the NAS Committee on the Assessment of Intraseasonal to Interannual Climate Prediction and Predictability

22 - 26 Feb D. Lee *Portland, OR*
2010 AGU Ocean Sciences Meeting; presented: Diagnosing the Development and Termination of Sea Surface Temperature Anomalies in the Tropical Pacific

23 Feb P. Ceccato *Arlington, MD*
Analyst workshop for the GEO User Committee on "Critical Earth Observation Priorities"

24 - 25 Feb P. Block *Gainesville, FL*
2nd University of Florida Water Institute Symposium; presented: Tailoring seasonal climate forecasts for hydropower operations in Ethiopia's upper Blue Nile basin

2 Mar M. Thomson *New York, NY*
New York Academy of Sciences Conference: "Climate Change and Emerging Infectious Diseases;" featured speaker on "Climate Information for Public Health: Challenges and Opportunities"

3 Mar G. Mantilla, B. Platzer, M. Thomson *New York, NY*
M. Thomson presentation on IRI's work in climate and health to the Doris Duke Charitable Foundation; and meeting to learn more about the foundation's initiatives

3-5 Mar J. Hansen *Washington, DC*
- CCAFS Global Scenarios Workshop at IFPRI
- CCAFS donor visits
- CCAFS Management Team Meeting

11 Mar W. Baethgen *Columbia University, New York, NY*
Lecture on "Agriculture and Climate Change" in Glenn Denning's course, Global Food Systems, part of Columbia's Public Administration in Development Practice Masters Program

12 Mar J. Hansen *Cornell University, Ithaca, NY*
- CCAFS Theme 4 expert brainstorming meeting
- Seminar: The CGIAR Climate Change, Agriculture and Food Security Challenge Program: Adaptation Pathways Based on Managing Current Climate Risk

15 - 16 Mar L. Goddard *Seattle, WA*
NOAA Climate and Global Change Postdoctoral Fellowship Program - Steering Committee Meeting

29 Mar A. Robertson *Washington, DC*
Consultation Session on Asia Regional Center of Excellence on Climate Change, USAID

29 Mar - 2 Apr A. Greene, A. Robertson *Gaithersburg, MD*
DOE Integrated Climate Change Modeling Science Team Meeting
- A. Greene presented "Dynamical and Non-dynamical influences on Indian monsoon rainfall: Projections using a nonhomogeneous hidden Markov model," with A. Robertson, P. Smyth and S. Triglia
- A. Robertson presented "Collaborative Research: Regional climate-change projections through next-generation empirical and dynamical models," with co-authors A. Greene, M. Ghil, D. Kondrashov, M. Chekroun, S. Kravtsov, M. Wyatt, P. Smyth, S. Triglia

1 - 2 Apr M. Hellmuth *Boulder, CO*
Keynote speaker at University of Colorado's Fifth Annual Hydrological Sciences Student Research Symposium "Water in a Changing Climate;" presented: Adapting the Water Paradigm to a Changing World

2, 5 Apr P. Block *Washington, DC*
World Bank meetings to discuss future work on Economics of Adaptation for Climate Change and on Near-Term Climate Change for the Nile Basin Initiative

12 - 14 Apr A. Binder *Silver Spring, MD*
NOAA Financial Management Workshop

14 - 18 Apr D. Ruiz *Washington, DC*
2010 Association of American Geographers Annual Meeting; presented: Increased Climatic Stress on High Altitude Ecosystems of the Colombian Central Mountain Range

19 - 20 Apr S. Someshwar *Fort Collins, CO*
Launch workshop: Consilience Among the Social Sciences in the Face of Global Climate Change; Working group co-chair: Consilience and the science-policy-practice interface-Social science policy making and the private sector interface

21 Apr J. Omumbo *Syracuse, NY*
Invited speaker on "Climate Variability and Global Health" for SUNY Upstate Medical University's Global Health Seminar Series

25 Apr B. Lyon *Palisades, NY*
Panelist, LDEO's Spring 2010 Public Lecture: Rockland County's Water Resources

27 - 29 Apr F. Fiondella *Asheville, NC*
NOAA Climate Services Portal Workshop

27 - 28 Apr L. Goddard *Washington, DC*
NAS Climate Research Committee Spring Meeting

28 Apr M. Thomson *New York, NY*
Invited speaker on "Climate Information for Public Health" for the Earth Institute visit of Mariama Khan (Secretary General and Head of the Civil Service), Mamadou Tangara (Minister of Higher Education, Research, Science and Technology), Muhammadou Kah (Vice Chancellor, University of The Gambia)

28 - 29 Apr M. Thomson *Washington, DC*
Participation in an Interagency Climate Change Adaptation Task Force led by the White House Council on Environmental Quality (CEQ), Office of Science and Technology Policy (OSTP) and NOAA to develop recommendations towards a US strategy for adapting to climate change

29 Apr S. Zebiak *West Point, NY*
Invited panelist on "Climate Change and Africa: Thinking Beyond Copenhagen" for the 2010 International Peace Institute Seminar: African Institutions in a Changing Regional and Global Security Environment

6 - 7 May L. Goddard, D. Osgood *New York, NY*
Center for Research on Environmental Decisions (CRED) advisory group planning meetings for CRED-2 (institution's new phase, funding for which begins October 2010)

17 - 20 May L. Goddard *Boulder, CO*
17th Session of the CLIVAR Scientific Steering Group

17 May D. Osgood *Philadelphia, PA*
Invited participant, Wharton Index Insurance and Climate planning session for potential collaborative activities involving IRI, CRED, Wharton and the London School of Economics

20 May H. Bhojwani, B. Blumenthal *Washington, DC*
Discussion of Climate 1-Stop project and other potential areas of collaboration with USAID and NASA

21 May A. Giannini *Woods Hole, MA*
Invited seminar at Woods Hole Oceanographic Institution (WHOI), Geology and Geophysics Department; presented: "Climate change in the Sahel - past, present and future"

24 - 25 May D. DeWitt *Silver Springs, MD*
Represent IRI at NOAA

26 - 27 May P. Ceccato *Washington, DC*
EPA-sponsored analyst workshop on GEOSS to discuss user requirement registry development and testing

2 - 4 June P. Block *Wilkes-Barre, PA*
NOAA's National Weather Service Eastern Region Flash Flood Conference

2 - 4 June B. Blumenthal *Greenbelt, MD*
NASA Global Change Master Directory (GCMD) Science User Working Group meeting

7 June G. Mantilla *Washington, DC*
NOAA and WHO Collaboration Discussion

8 - 10 June S. Mason *Boulder, CO*
Invited speaker, 2010 Advanced Study Program (ASP) Summer Colloquium: Forecast Verification in the Atmospheric Sciences and Beyond; presented:
- Meta-verification
- Verification of seasonal forecasts

28 - 29 June D. Osgood *Washington, DC*
NASA and Center for Disease Dynamics, Economics and Policy workshop: The Value of Information: Methodological Frontiers and New Applications; invited presentation: The Value of Information in Index Insurance for Farmers in Africa

28 June F. Fiondella *Palisades, NY*
Presentation to MPA in Environmental Science and Policy students: An Introduction to IRI

7 - 8 July L. Goddard, L. Sun *Denver, CO*
U.S. CLIVAR Summit 2010
- L. Goddard: Scientific Steering Committee Chair
- L. Sun: PPAI Panel Member

11 - 15 July L. Goddard *Steamboat Springs, CO*
Participant, as Creator and Oversight Committee Chair of PACE (Postdocs Applying Climate Expertise), 9th Summer Institute: NOAA Climate and Global Change Postdoctoral Fellowship Program; presented: Climate Information for Risk Management and Decision Making

12 July A. Giannini *Montreal, Canada*
Invited participant, meeting with Environment Canada colleagues to discuss potential collaboration on "FACE - Faire-face Aux Changements Ensemble," a proposal framed by a host of Canadian research and development institutes for submission to the International Research Initiative on Adaptation to Climate Change (IRIACC) program, following approved of LOI to which IRI contributed a letter of support; presented: Drought and climate change in the Sahel: causes, attribution and adaptation

25 - 27 July M. Norton, D. Osgood *Denver, CO*
2010 Agriculture and Applied Economics Conference; presented:
- Norton: Weather Index Insurance and the Pricing of Spatial Basis Risk
- Osgood (with K. E. Shirley): The impacts of thresholds on risk behavior: What's the matter with index insurance?

27 - 29 July W. Baethgen *Washington, DC*
Delegation member for the World Bank visit of Uruguay's Minister of Agriculture to discuss ongoing project, potential capacity building activities and project with climate change adaptation component for the country's agricultural sector

2 - 6 Aug A. Robertson *Los Angeles, CA*
Department of Energy project collaborative working meetings

9 - 12 Aug D. Osgood *San Francisco, CA*
2nd International Remote Sensing Index-Based Crop Insurance Working Group; presented: The IRI experience with Remote Sensing in index insurance in Africa

11 - 13 Aug F. Fiondella *Silver Spring, MD*
NOAA ClimateWatch Storytellers Workshop; presentations:
- 12 Aug, Building institutional video and multimedia capacity
- 13 Aug, Storytelling with Google Earth

11 Aug S. Someshwar *Washington, DC*
USG-Government of India meetings on Agriculture and Climate Bilateral Program

17 - 18 Aug B. Lyon *Broomfield, CO*
NOAA and the Joint Office for Science Support - Climate Attribution Workshop

22 - 30 Aug C. Perez *Minneapolis, MN*
McKnight's Agriculture and Nutrition Conference

25 - 28 Aug S. Someshwar *New Orleans, LA*
Fighting for Survival: The Vulnerability of America's Gulf Coast and the Caribbean Basin (conference organized by UNDP, Columbia University`s National Center for Disaster Preparedness, the Earth Institute and the Mayor of New Orleans)

9 Sept P. Ceccato, F. Fiondella *Palisades, NY*
Earth Institute Fellows Orientation; presentations:
- P. Ceccato: Activities at the IRI for Monitoring and Forecasting Agriculture, Human Health and Disasters
- F. Fiondella: An Overview of the International Research Institute for Climate and Society

10 Sept L. Zubair *New York, NY*
Columbia Water Center Seminar speaker on: Improving River Basin Management Using Climate Information - Retrospective of Projects in Sri Lanka

17 - 18 Sept T. Dinku *New Haven, CT*
2nd UNITAR/Yale Conference on Environmental Governance and Democracy: Strengthening Institutions to Address Climate Change and Advance a Green Economy
- Presentation: Mainstreaming Climate Change Adaptation in Africa Through National Centers for Climate and Development
- Panelist on national governance for the session, "Regional, National, Sub-National and Local Level Governance to Address Climate Change and Advance a Green Economy"

20 Sept D. Osgood, S. Someshwar, S. Zebiak *New York, NY*
Risk and Resiliency: Risk Transfer and Adaptation Developing Economies, a Panel Discussion hosted by Swiss Re and The Climate Group

20 - 23 Sept D. DeWitt, L. Goddard, P. Gonzalez *Boulder, CO*
CLIVAR Working Group on Ocean Model Development-GSOP Workshop on Decadal Variability, Predictability, and Prediction: Understanding the Role of the Ocean; talk:
- L. Goddard: A Metrics Framework To Assess And Validate Decadal Climate Predictions And Simulations (given on behalf of the US CLIVAR Decadal Predictability Working Group)

22 - 25 Sept J. del Corral *Pittsburgh, PA*
Fourth IEEE International Conference on Semantic Computing; presented: A Bi-directional Semantic Framework for Bibliographic Metadata (with B. Blumenthal)

27 - 28 Sept S. Zebiak, W. Baethgen, H. Bhojwani, S. Mason, M. Thomson *Washington, DC*
NOAA International Climate Services Workshop and Review Activity: Understanding and Responding to the Needs of Decision Makers

27 - 28 Sept J. Omumbo *New York, NY*
- Cross-MDG Roundtable on Addressing Long-term, Multi-sectoral Development Challenges within the MDGs: A Dialogue among the HIV, Gender Equality and Environmental Movements (co-hosted by UNDP's HIV Practice, Gender Group and Environment & Energy Group); invited participant
- IRI-UNDP Africa Adaptation Programme Meeting

27 - 29 Sept S. Trzaska *San Antonio, TX*
Public Health Program Review; presented: Environmental factors and population dynamics as determinants of meningococcal meningitis epidemics in the Sahel: an investigation of NASA and NOAA products

29 - 30 Sept S. Zebiak, W. Baethgen, H. Bhojwani, L. Goddard, M. Thomson *Washington, DC*
Fall Meeting of RISA Principal Investigators: Revisiting What RISAs Do

1 Oct S. Someshwar *New York, NY*
Cities and Eco-Crises (sponsored by Columbia University's Committee on Global Thought), invited presenter on "Adapting to Climate Risks: Comparing Approaches"

4 - 7 Oct D. DeWitt *Raleigh, NC*
35th Climate Diagnostics and Prediction Workshop Presentations

7 - 8 Oct P. Ceccato *Washington, DC*
Analyst workshop on GEOSS to discuss user requirements and testing

11 Oct S. Someshwar *New York, NY*
The Climate Change Challenge: Revitalizing the Debate (co-organized by sponsored by Consulate General of Denmark in New York and the Earth Institute); invited panelist to the discussion, "Adapting to Climate Change: The Water Challenge"

12 - 13 Oct S. Trzaska *Boulder, CO*
Meningitis Weather Project Team Meeting

13 - 15 Oct L. Goddard *Las Vegas, NV*
MDA EarthSat Weather's 9th Annual EarthSat Conference for Weather Analysts; invited, presentation: IRI seasonal forecast

15 Oct L. Zubair *Palisades, NY*
Columbia University Division of Ocean and Climate Physics seminar series speaker: Does tropical climate adaptation need advanced climate science?

17 - 20 Oct M. Thomson *Warrenton, VA*
Institute on Science for Global Policy conference on "Emerging and Persistent Infectious Diseases: Focus on Surveillance;" presented: Thomson, and Mantilla, 2010: Integrating climate information into surveillance systems for infectious diseases: new opportunities for improved public health outcomes in a changing climate

22 Oct A. Robertson *New York, NY*
Pakistan Floods: Prevention and Preparedness to Guide Humanitarian Action in Future Crises (forum sponsored by the Mailman School of Public Health's Program on Forced Migration and Health); invited speaker on: Climatic Context of 2010 Flooding Events Over Pakistan

26 - 29 Oct L. Goddard *Washington, DC*
- 26 Oct, Meeting with InterAgency Group (national funding agencies) for US CLIVAR, as US CLIVAR Scientific Steering Committee Chair
- 27 - 29 Oct, Office of Climate Observations Annual System Review, as member of Climate Observations System Council

28 - 30 Oct J. Hansen, A. Ines *Long Beach, CA*
Agricultural Model Intercomparison and Improvement Project (AgMIP) Kickoff Workshop (organized by Goddard Institute for Space Studies through funding from USDA); A. Ines was an invited expert to help facilitate and inform workshop discussions

## Central America, South America and the Caribbean

### 2009

4 - 6 Nov W. Baethgen *São José dos Campos, Brazil*
Meeting on "Impact, Adaptation and Vulnerability (IAV) on Global Change," at the Brazilian Institute for Space Research (INPE)

16 - 20 Nov G. Mantilla *Havana, Cuba*
Global Forum for Health Research; presented: New Methodologies and Tools in Public Health-Climate

23 - 27 Nov A. Barnston *Panama City, Panama*
Conducted a workshop on the use of CPT to members of the Central America Climate Outlook Forum

### 2010

9 - 16 Jan C. Perez *Florianapolis, Brazil*
McKnight Foundation Annual Collaborative Crop Research Program (CCRP) Leadership Meeting

25 - 28 Jan W. Baethgen *Guayaquil, Ecuador*
Regional Workshop on Integration of Seasonal Forecasts and Hydrological Information for the Water Sector of WCSA (organized by CIIFEN and WMO); presented: Experience of IRI on Hydrological Outlooks

22 Feb - 5 Mar D. Ruiz, C. Vaughan Green *Medellin and Bogota, Colombia*
Research activities at the Escuela Ingeneria de Antioquia, on research impacts of climate on high altitude ecosystems; meetings with the Colombia Red Cross and with the National Department of Planning

5 Mar W. Baethgen *Montevideo, Uruguay*
Meeting with Uruguay's newly-appointed Minister of Agriculture to discuss possible areas where IRI can assist the Ministry, particularly in coordinating efforts to link the existing INIA Information and Decision Support System with an information system that the Ministry is developing for the agricultural sector, and introducing CRM in the Ministry's national plan for an agricultural sector that adapts to climate change

8 Mar W. Baethgen *Castelar, Argentina*
Invited presentation on "Methods to introduce Near Term Climate Change" for the IDB (FONTAGRO) project: Assessment of the Changes in Water Productivity under Different Climate Scenarios in the Southern Cone

9 Mar W. Baethgen *Montevideo, Uruguay*
Invited presentation to Uruguay's House of Representatives on "Adaptation to Climate Change in the Agricultural Sector"

12 - 16 Mar K. Fernandes *Pucallpa and Lima, Peru*
Fires in Western Amazonia: Understanding and Modeling the Roles of Climatic, Social, Demographic, and Land Use Change Project

- Field work to identify the land uses and fires practices in sites around Pucallpa in the Ucayali Region of Peru
- Presentations and panel discussion aiming to foster collaboration with local researchers and institutions at the Servicio Nacional de Meterologia y Hidrologia de Peru (SENAMHI), Lima, (together with Columbia's Ecology, Evolution and Environmental Biology (E3B) investigators: Miguel Pinedo-Vasquez, Maria Uriarte, Ruth DeFries, Christine Padoch and Victor Gutierrez). SENAMHI's scientific director, Dr. Elizabeth Silvestre Espinoza, was the meeting moderator.

20 - 26 Mar L. Goddard *University of Buenos Aires, Argentina*
The 2010 Southwestern Hemisphere Workshop Series on Climate Change: CO2, The Biosphere and Climate (sponsored by ICTP); invited lecturer: The Quality of Climate Prediction

12 - 14 Apr W. Baethgen *San Jose, Costa Rica*
Invited lecturer on "Climate Change, Climate Risk Assessment and Management: Informing Decisions and Policy," for "Knowledge Innovation at the Science- Policy Interface," an international colloquium organized by the Inter-American Institute (IAI) and NCAR Advanced Study Program (ASP)

18 - 23 Apr B. Lyon *Mexico City, Mexico*
Meetings at Universidad Nacional Autónoma de México (UNAM) and the Mexican Institute of Water Technology (IMTA) on collaboration

22 Apr - 2 May C. Perez *Cochabamba and La Paz, Bolivia*
Cochabamba World People's Conference on Climate Change and the Rights of Mother Earth; La Paz McKnight Foundation grantees climate change subgroup meeting to plan August 2010 climate change and adaptation workshop in Cochabamba

1 May D. Ruiz *University of Medellin, Colombia*
2010 Water Network Science Colloquium - Interinstitutional Water Network; presented: Climatic stress in high-altitude ecosystems of the Colombian Central Cordillera: potential impacts on biodiversity and surface water supply'

2 May D. Ruiz *Bogota, Colombia*
Global Knowledge Exchange on Adaptation to Climate Impacts in High Mountains, held at IDEAM; presented: Six-tiered approach to understand the impacts of changes in climatic conditions on the integrity of high-altitude ecosystems - Case study: Los Nevados Natural Park, Andean Central Mountain Range, Colombia

2 - 7 May C. Perez *Cusco, Peru*
- Meeting with Institute for Alternative Agriculture (IAA) staff for potential IAA-McKnight collaboration development learning
- Meeting to plan annual gathering of McKnight Foundation grantees scheduled for July in Lima, Peru

7 May B. Lyon *Hermosillo, Mexico*
4th Binational Workshop on Water and Climate Change in the Arizona-Sonora Border Region - Urban Water Management, Climate Change, and Adaptive Strategies for the Arizona-Sonora Region

7 - 11 June E. Holthaus *San Juan, Puerto Rico*
Keynote speaker, WAS*IS (Weather and Society*Integrated Studies) Carribean Workshop; presented: Caribbean Hurricane Preparedness–Red Cross and Others

21 - 23 June W. Baethgen, L. Goddard, E. Holthaus *Bridgetown, Barbados*
Caribbean Regional Climate Outlook Forum; presented:
- Baethgen: Climate Risk Management at the IRI
- Goddard: Seasonal-to-Interannual Climate Forecasts and Climate Outlook For a
- Holthaus: Translating Climate Information into Actionable Knowledge

5 - 24 July E. Holthaus *Port au Prince, Haiti*
Case study research for: Climate & Society Publications 3 and Global Framework for Climate Services (GFCS); and research for: Red Cross Haiti web and IRI/IFRC hurricane decision tool

12 - 16 July W. Baethgen, G. Mantilla, H. Oliveros *Bogota, Colombia*
Invited participants to the Colombia National Institute of Health (INS)-sponsored International Conference on Health, Environment and Climate; presented:
- W. Baethgen: Climate Risk Management in the Public Health Sector
- G. Mantilla: Public Health Decision-Making Under Uncertainty
- G. Mantilla: Use of Climate Information in Public Health
- H. Oliveros: Statistical Models for the Health Sector

12 - 14 July J. Hansen *Belo Horizonte, Brazil*
Invited participant, WMO-sponsored International Workshop on Addressing the Livelihood Crisis of Framers: Weather and Climate Services, presented: Seasonal to Inter-Annual Climate Forecasts and their Applications in Agriculture

13 - 15 July S. Mason *Bogota, Colombia*
1st National Climate Congress; presented: Climate Variability and Human Health

13 - 16 July G. Mantilla *Bogota, Colombia*
Invited lectures at the National University's International School on Environment and Health delivered to 25 graduate students:
- Basic Concepts: Climate and Public Health
- Impacts of Climate Change on Public Health
- Use of Climate Information in Public Health

29 - 31 July L. Goddard *Buenos Aires, Argentina*
13th Session of the VAMOS Panel (VPM13); presented: Outreach and Capacity Building in VAMOS

2 - 13 Aug W. Baethgen, L. Goddard, G. Mantilla, S. Mason *Buenos Aires, Argentina*
IAI Training Institute on the Use of Seasonal Climate Predictions for Applications in Latin America Buenos Aires, Argentina
- W. Baethgen: organizing committee member; presented: Climate Information to Aid in Decision-Making
- L. Goddard presented: Verification Issues in Seasonal Prediction
- G. Mantilla presented "Climate Change Impacts on Public Health" and "The Use of Climate Information in Public Health"
- S. Mason demonstrated a verification game, "Weather Roulette" (with L. Goddard) and conducted climate predictability tool training

8 - 12 Aug K. Fernandes *Foz do Iguacu, Brazil*
2010 American Geophysical Union (AGU) Meeting of the Americas, presented: Incorporating Climate Variability and Change into Fire Potential Assessments in the Ucayali Region (with W. Baethgen, R. S. DeFries, L. M. Goddard, M. Uriarte, C. Padoch, M. Pinedo-Vasquez)

13 - 14 Aug G. Mantilla *Montevideo, Uruguay*
Meeting with Carmen Ciganda, Head, Environmental Health Department, Ministry of Public Health

16 - 20 Aug W. Baethgen, H. Bhojwani, C. Green *Fortaleza, Ceara, Brazil*
2nd International Conference: Climate, Sustainability and Development in Semi-arid Regions; W. Baethgen, invited speaker: Climate and Society: Bridging the Gap between Science and Applications

26 Aug - 14 Sept G. Mantilla *Bogota, Colombia*
Explore new opportunities for climate and health work in Colombia

31 Aug P. Ceccato *Buenos Aires, Argentina*
EMBC 2010 Workshop on Global Health Information, part of the 32nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society "Merging Medical Humanism and Technology;" invited speaker: Human Health Infectious Diseases Early Warning Systems

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Credits: Cover graphics, by J. Rodriguez & F. Fiondella, depict a few of the diverse work environments of the IRI (clockwise: HQ at the Monell Building in New York (USA), Colombia, Ethiopia). This report benefited by contributions from the entire IRI staff. Additional contributions from A. Binder, F. Fiondella, A. Paksima, B. Platzer, J. Rodriguez, M. Salgado, L.Scally, J. Turmelle and S. Zebiak were greatly appreciated. R. Fullon contributed major sections, aggregating information also reported to staff in the concise yet informative monthly staff newsletter 'IRI Update' that she creates and distributes. C. Mutter compiled and edited the report. Comments should be directed to czm@iri.columbia.edu.

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