Our approach, activities and achievements in climate research

Andrew W. Robertson
and IRI Climate Group

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Approach

- Use-inspired climate forecasting and climate science research
- Collaborative climate and interdisciplinary research
- Participatory capacity building research

What we mean by "Use-inspired climate forecasting and climate science research"

➡ R&D needed to produce salient & credible climate information for better real-world management of climate related risks/climate change adaptation

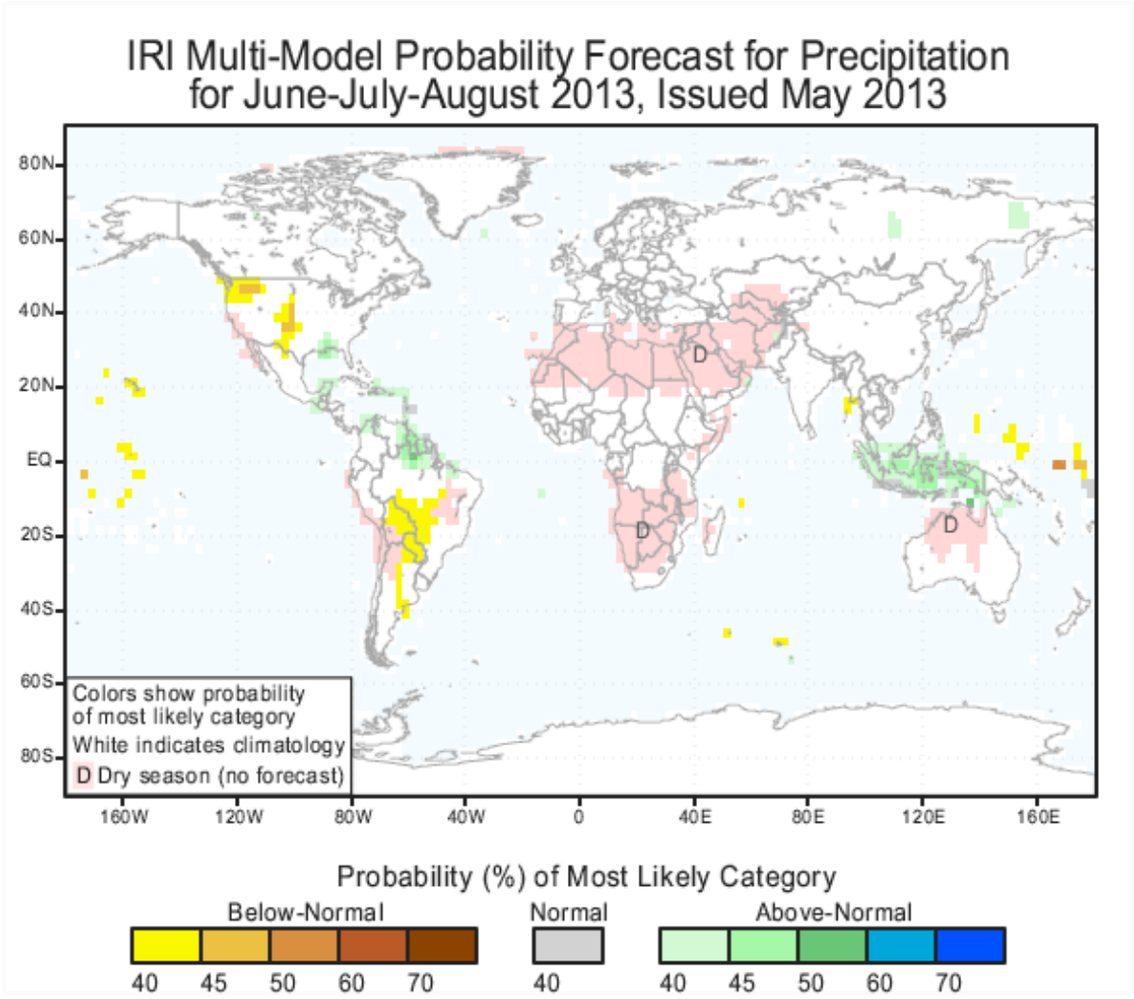
(counter examples: deterministic seasonal forecasts and raw downscaled CMIP projections)

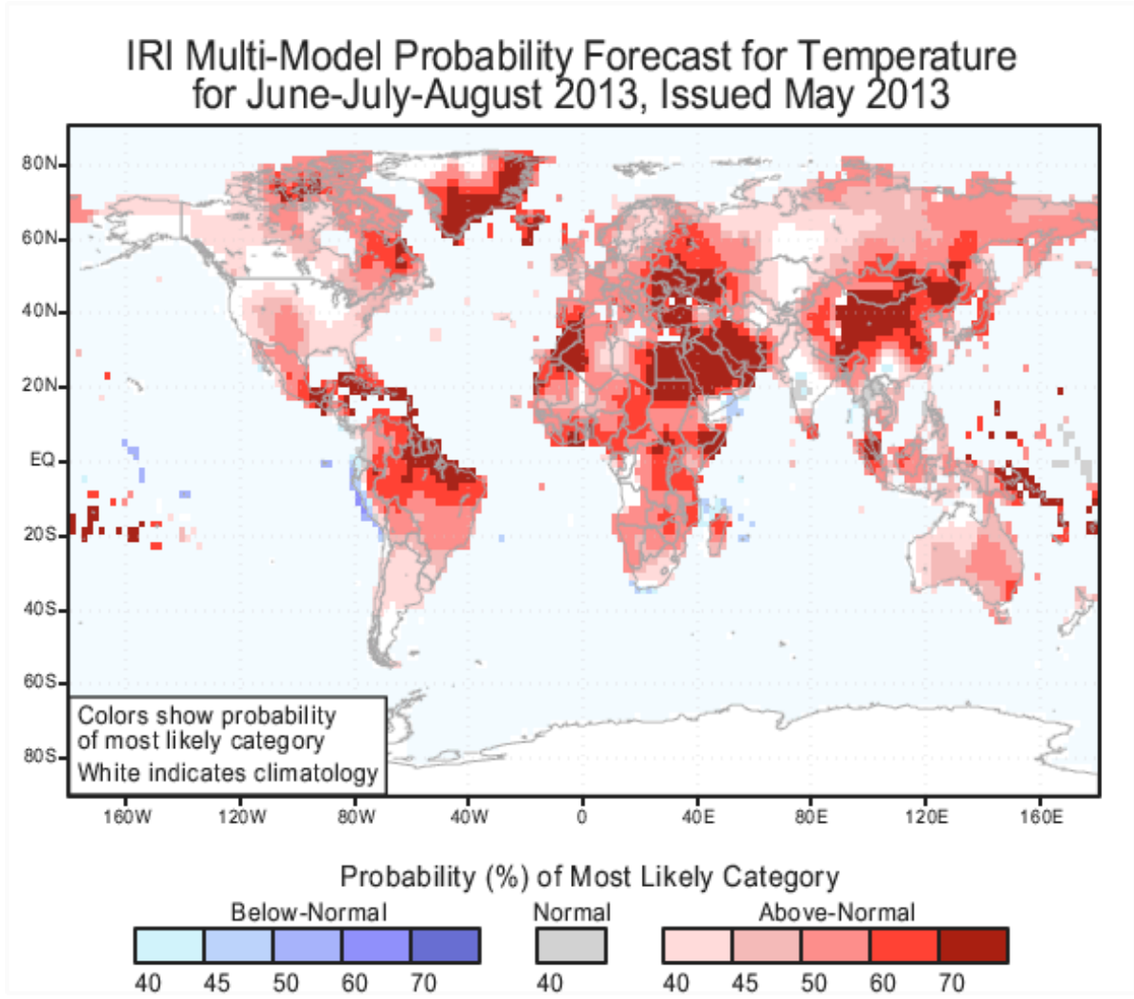
Examples

Operational Products:
Net Assessment & ENSO Outlook

- Multi-institutional 2-tier seasonal forecasting system since late 1990s
- Currently 2 AGCMs run in house, 4 outside, plus CFSv2
- Parametric multimodel combination/ calibration
- Large set of additional GCM products run each month for research & partner use

Seasonal forecast
"Net Assessments"





Is this the extent of reliable seasonal forecast information?

Net assessments were visited 52,000 times in 2012 - "Global Public Good"

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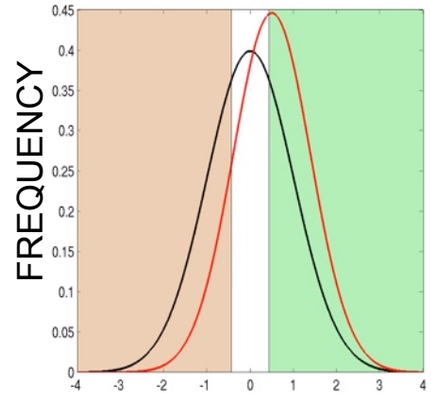
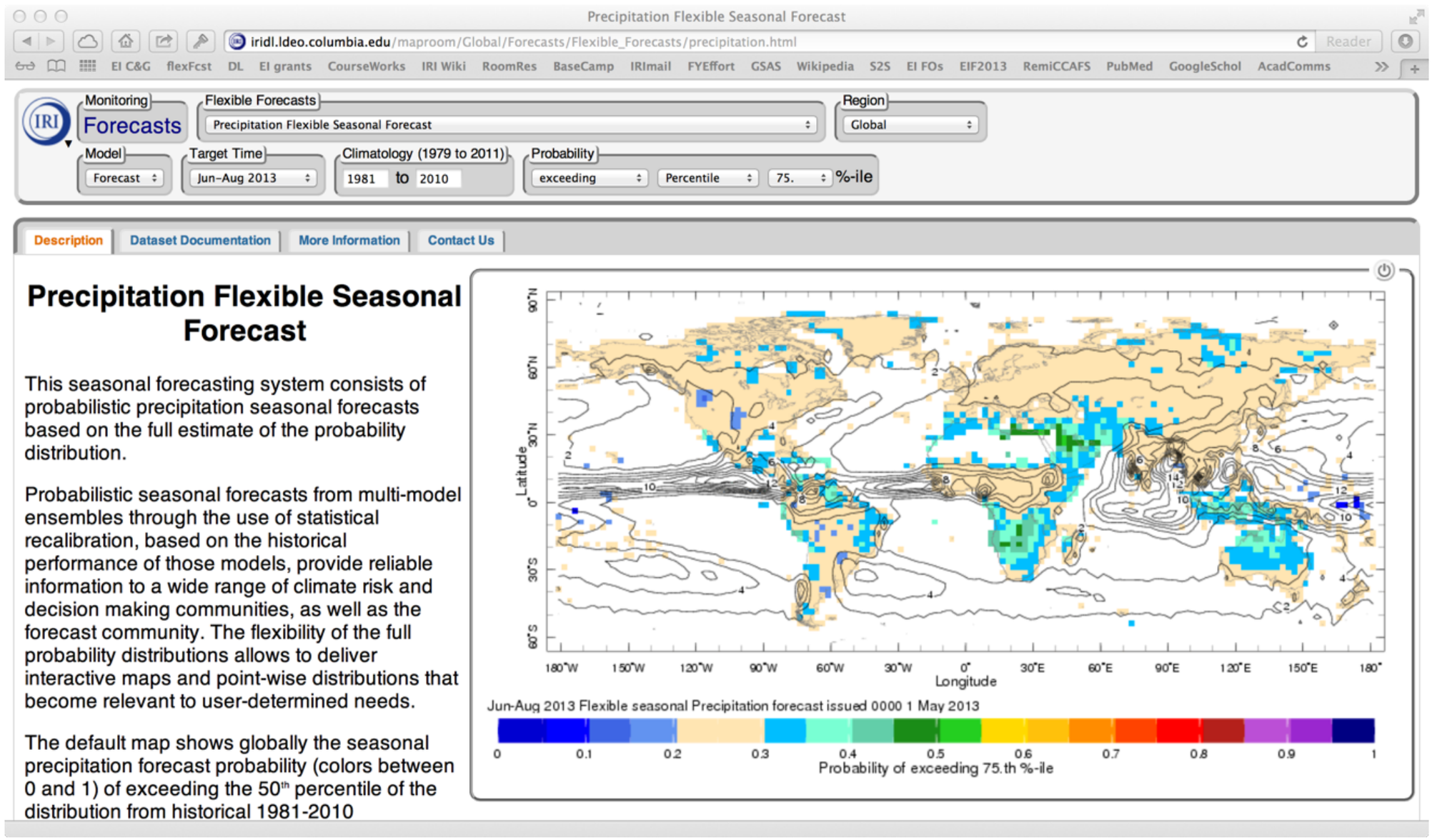
Forecasting the full distribution: "Flexible" Forecasts Maprooms





IRI DYNAMICAL CLIMATE FORECAST SYSTEM

2-tiered

OCEAN **ATMOSPHERE**

PERSISTED GLOBAL SST ANOMALY

FORECAST SST SCENARIOS

TROP. PACIFIC: THREE

(multi-models, dynamical and statistical)
TROP. ATL and INDIAN

(2 and 3 multi-models)
EXTRATROPICAL

(damped persistence)

GLOBAL ATMOSPHERIC MODELS

COAPS(FSU)

ECHAM4.5(MPI)

CCM3.6(NCAR)

GMAO(NASA)

COLA2

GFDL

10
24
24
10

Persisted SST Ensembles 3 Mo. lead

12
24
24
12
30
30

Forecast SST Ensembles 3/6 Mo. lead

POST PROCESSING

MULTIMODEL ENSEMBLING
model weighting

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Verification of IRI's Seasonal Climate Forecast

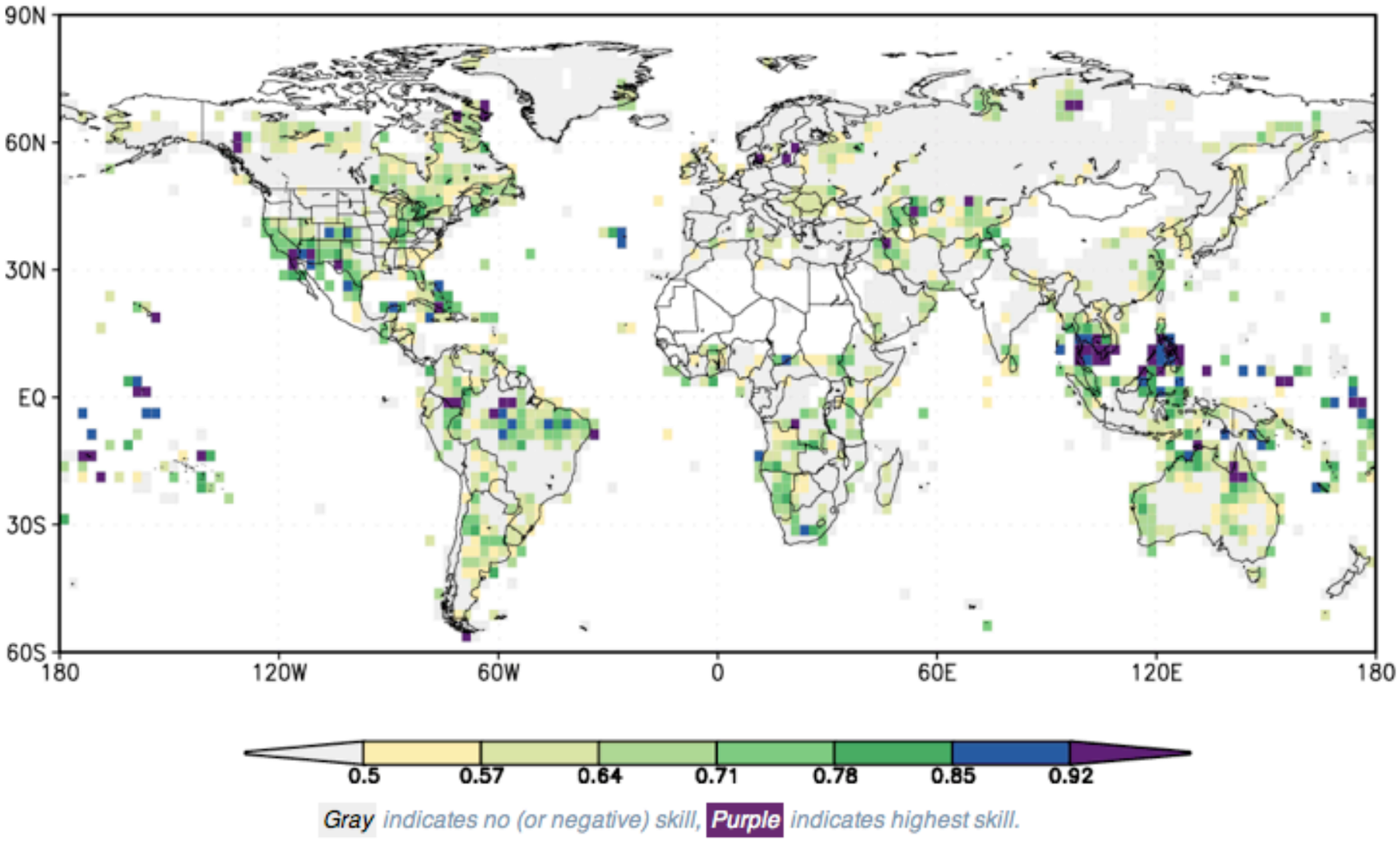
Skill Category: Measures of Discrimination
Score: GROC
Variable: Precipitation Season: Feb-Mar-Apr Lead: 0.5 month Lead

Description of Score

The generalized ROC score (GROC), like the ROC, shows the degree of correct probabilistic forecast discrimination, even if the forecasts have biases or calibration problems. However, unlike ROC, GROC is generalized to encompass all forecast categories (below, near, and above normal) collectively, rather than being specific to a single category.

For more information download the Full Score Descriptions File: Score Descriptions Document

Generalized ROC (GROC): Lead 0.5 months, Precipitation Forecast Skill: FMA



Gray indicates no (or negative) skill, Purple indicates highest skill.

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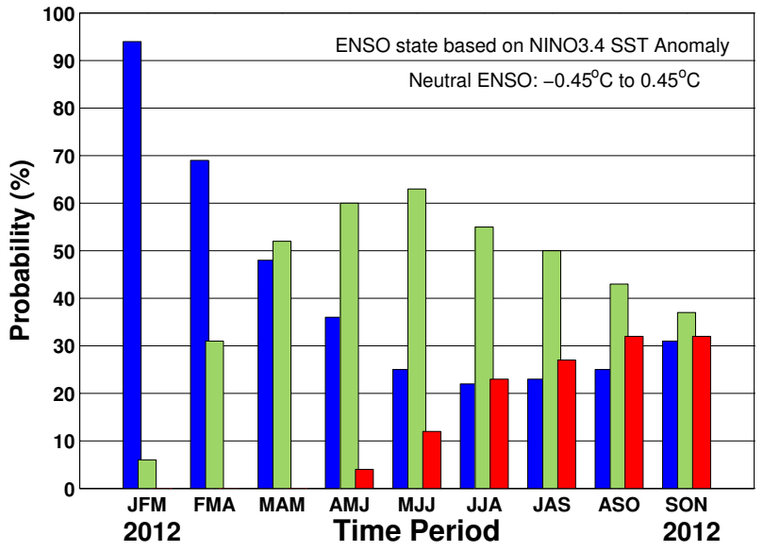
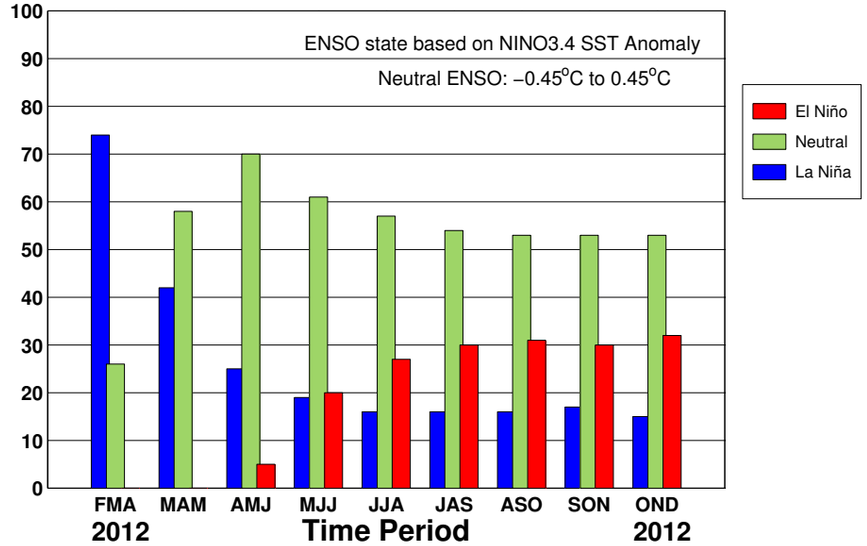
ENSO *QUICK LOOK* **February 16, 2012** **A monthly summary of the status of El Niño, La Niña and the Southern Oscillation, or "ENSO",** based on NINO3.4 index (120-170W, 5S-5N)

A majority of the ENSO prediction models call for weak La Niña conditions during the February-March period, transitioning to neutral conditions during the March-May period with the most likely time of dissipation occurring in early April.

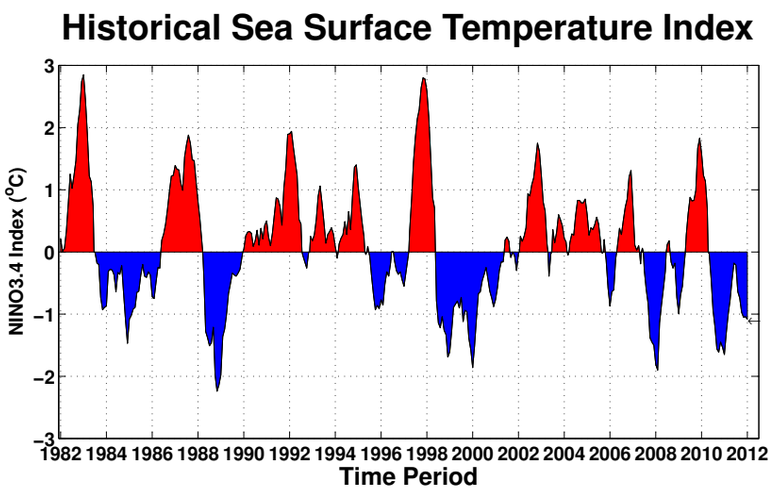
Official Early-Feb CPC/IRI Consensus Forecast[1]



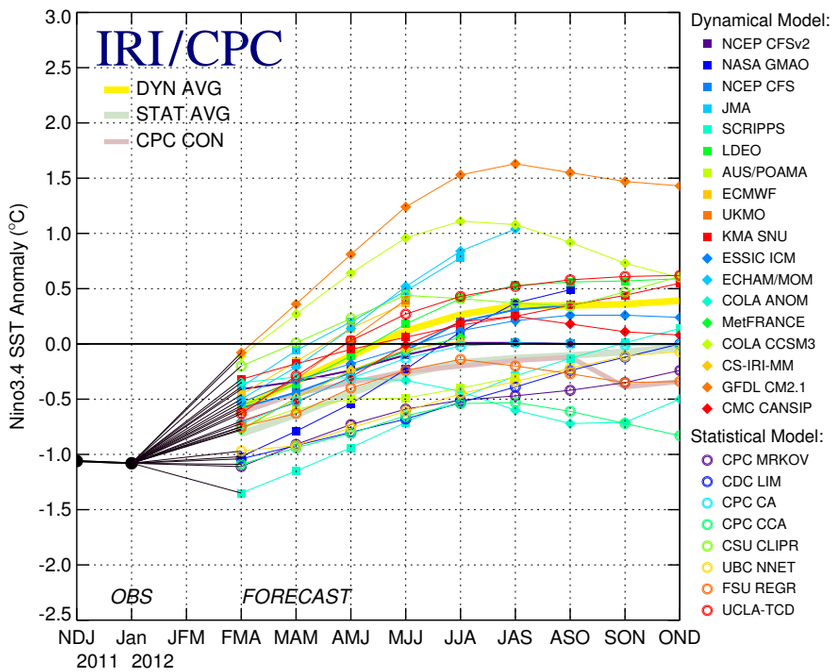
Mid-Feb IRI/CPC Plume-Based Forecast[2]



ENSO pages were visited 99,000 times in 2012



Mid-Feb 2012 Plume of Model ENSO Predictions



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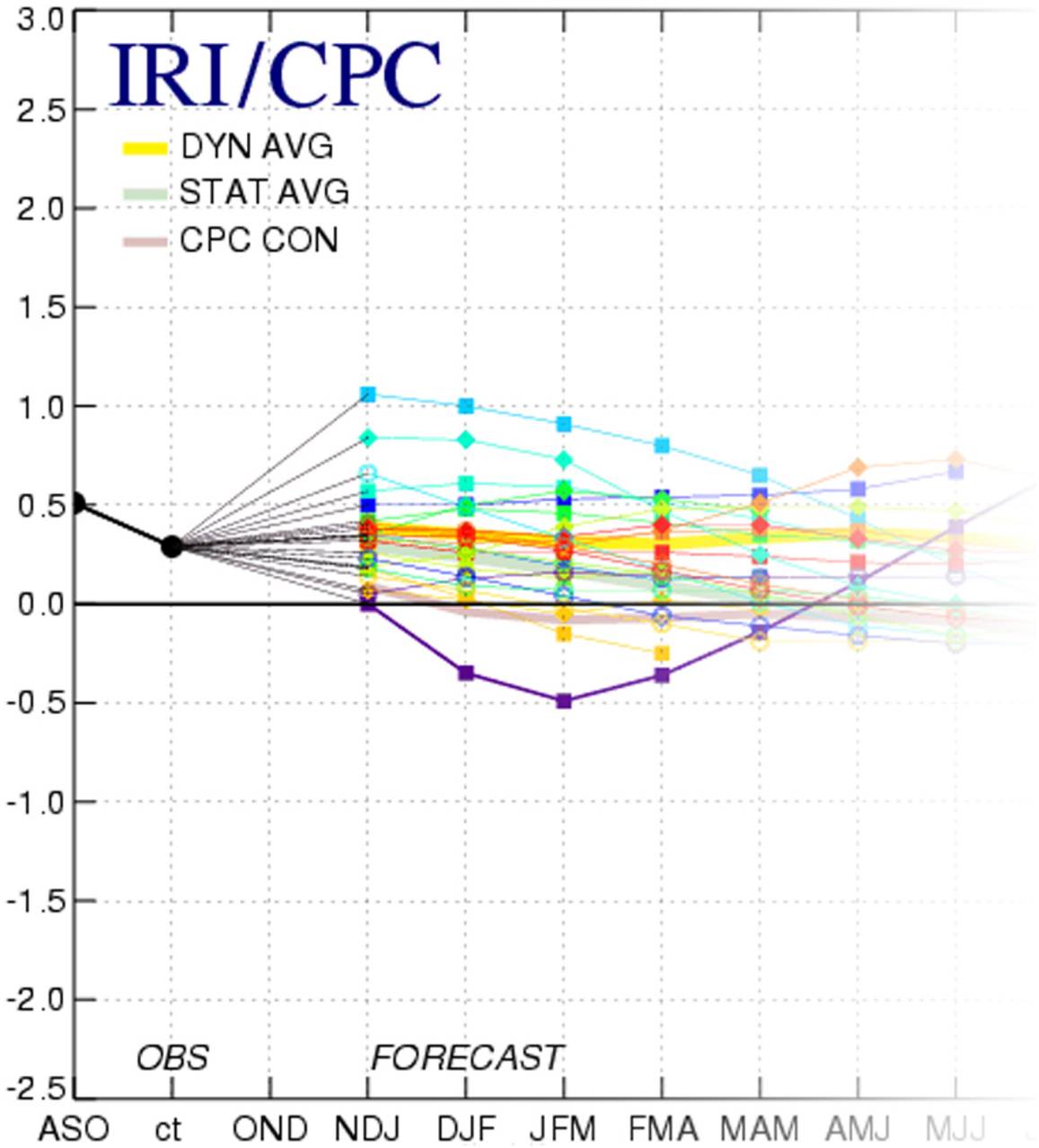
New IRI/CPC Joint ENSO Forecasts



IRI recently began working with CPC to issue a joint ENSO forecast.

Benefits to CPC

- Expanded forecast lead time
- Co-branding on IRI/CPC ENSO plume
- Having a partner in drafting the monthly ENSO Diagnostic Discussion

Areas of Future

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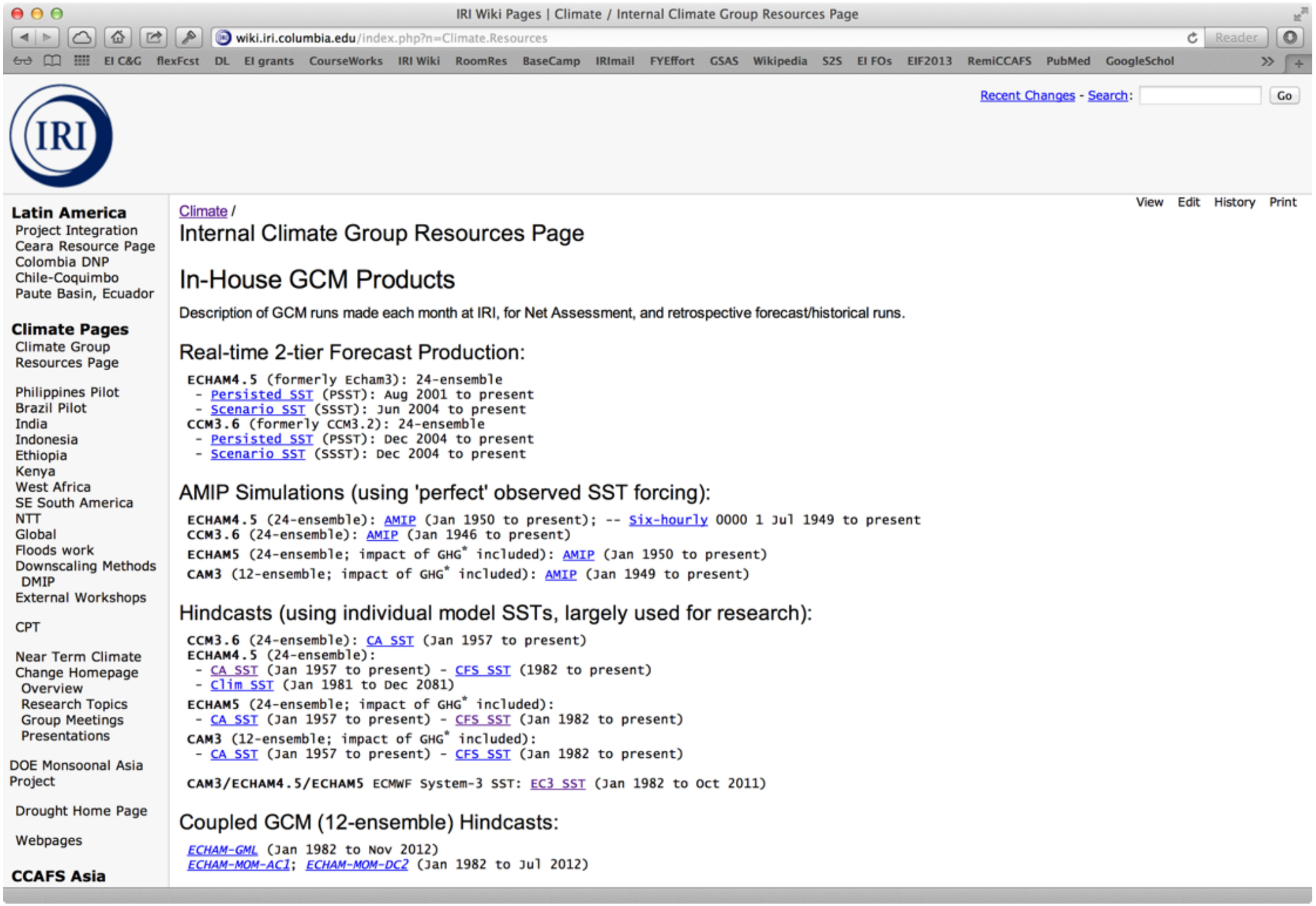
GCM Products made at IRI



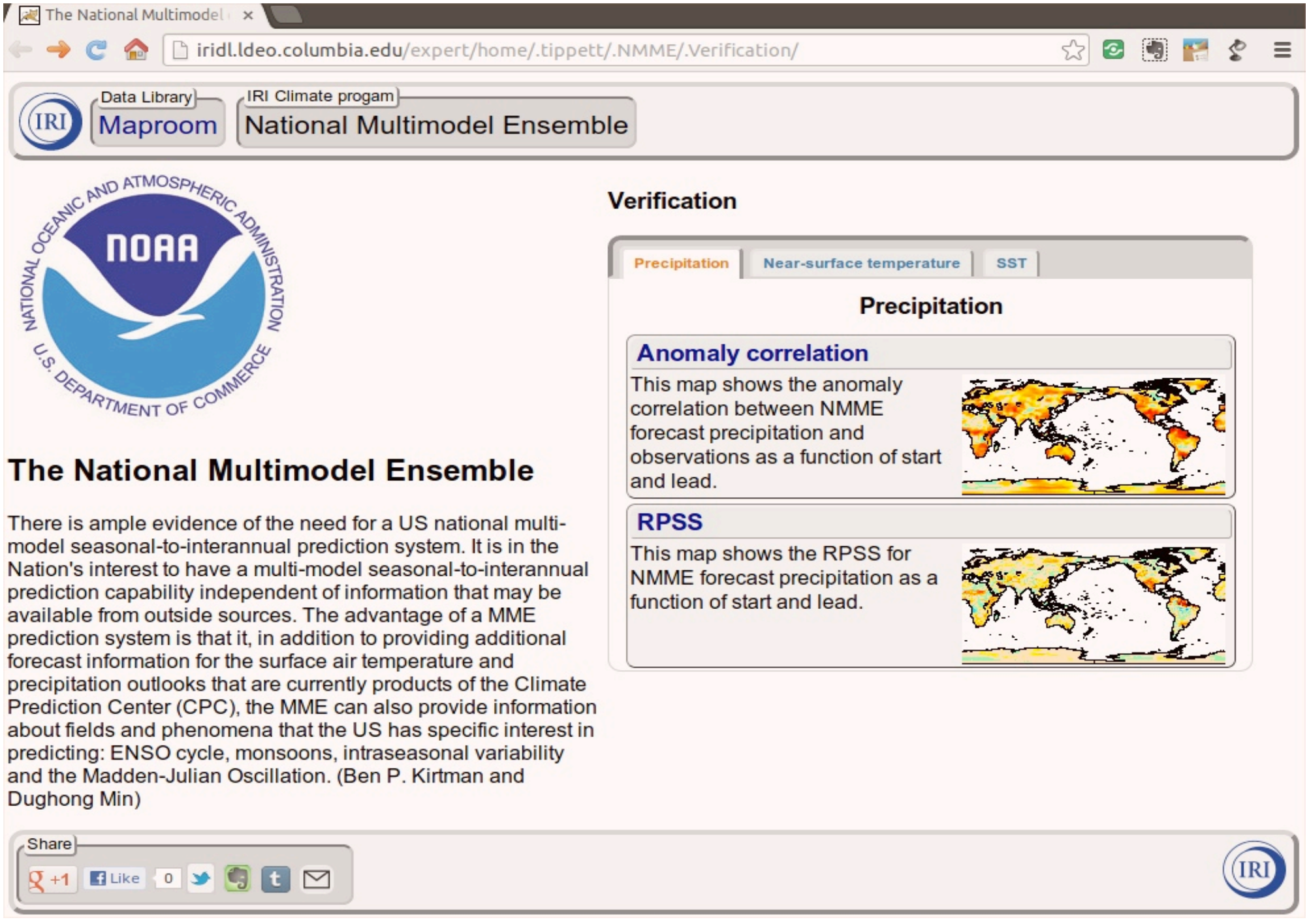
Forecast Development

+

Diagnostics & Modeling

- New US NMME and coupled model collaborations
- Forecast calibration/MME methodologies
- Verification metrics development
- Downscaling and forecast tailoring

NMME Data Services

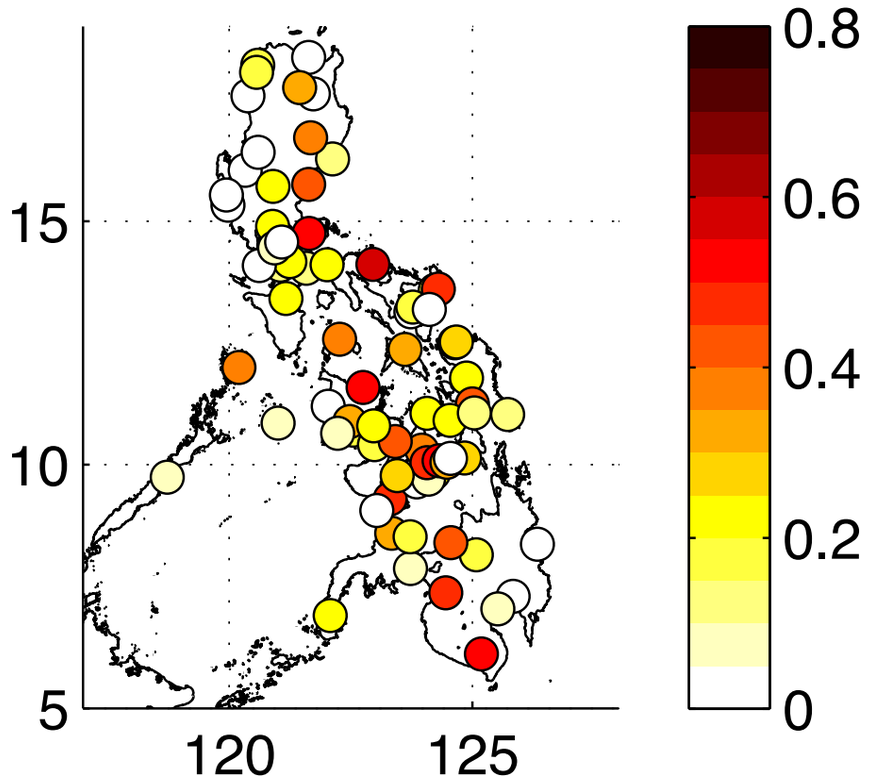


Coupled GCMs in IRIDL Real-time + Hindcasts

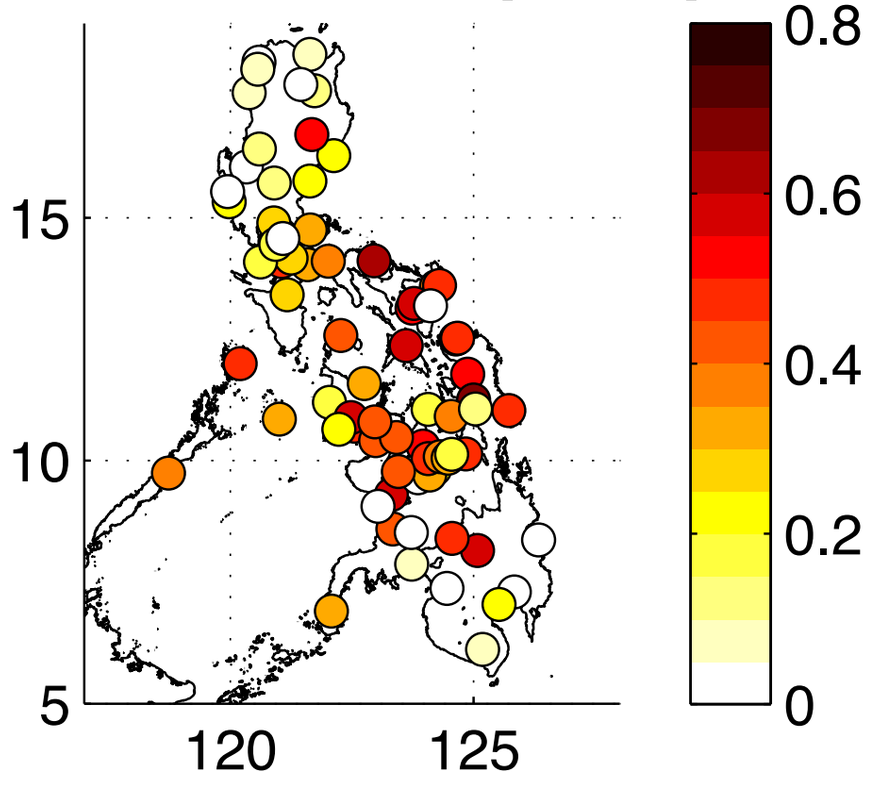
- NMME (CFSv2, CCSM3, GFDL, NSIPP, Env-Canada)
- UKMO-GloSea5
- POAMA (Australian BoM)
- ECMWF (SST)

Downscaling:
Dynamical or Statistical?

Dynamical (RCM, 50km)



Statistical (MOS)



Anomaly correlation skill for April–June season

GCM T42 simulations w/obs SST, 1977–2004

Robertson et al. (2013, MWR)

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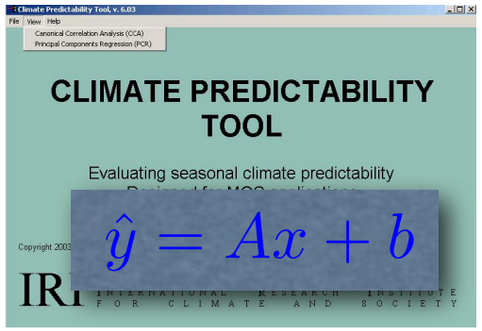
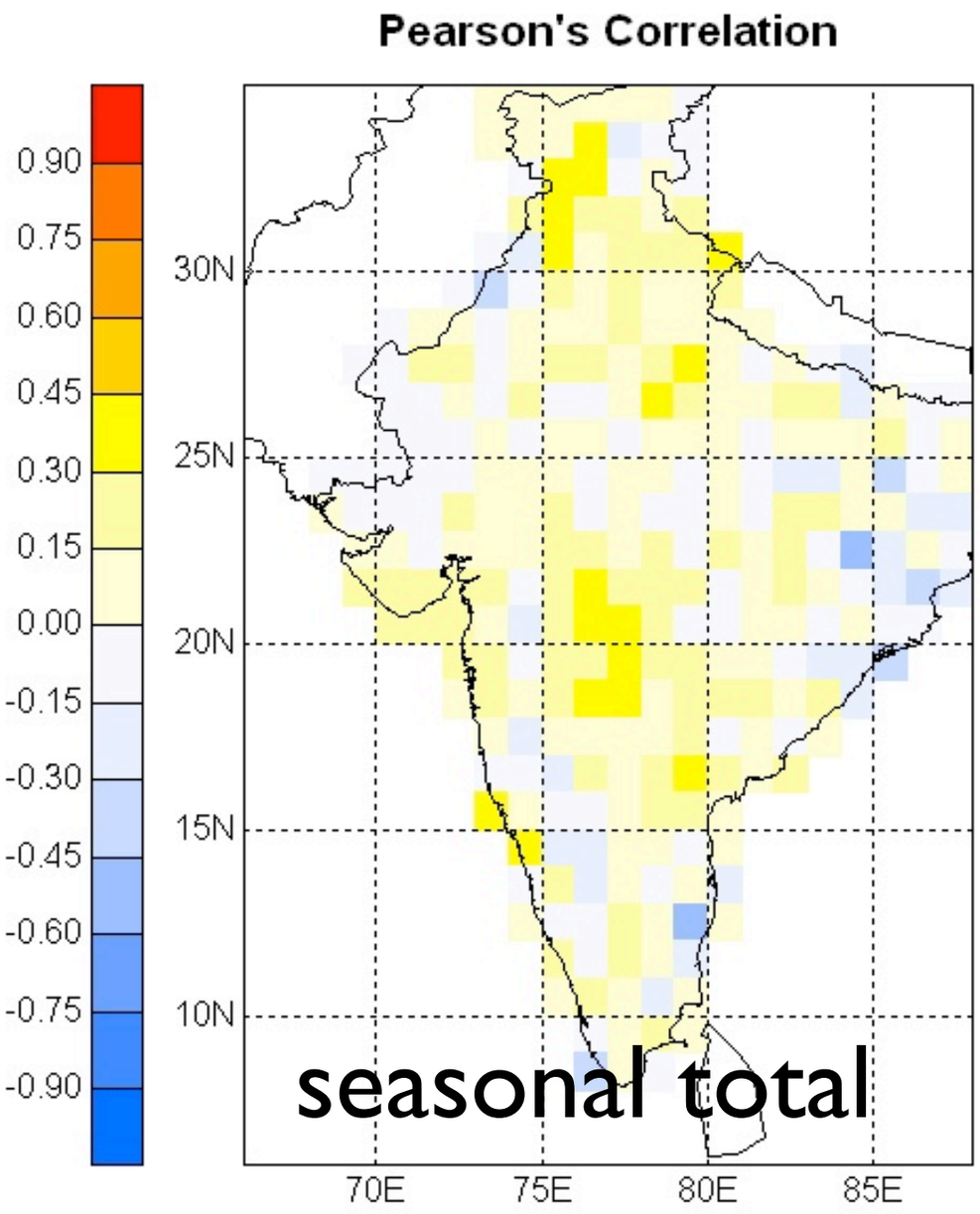
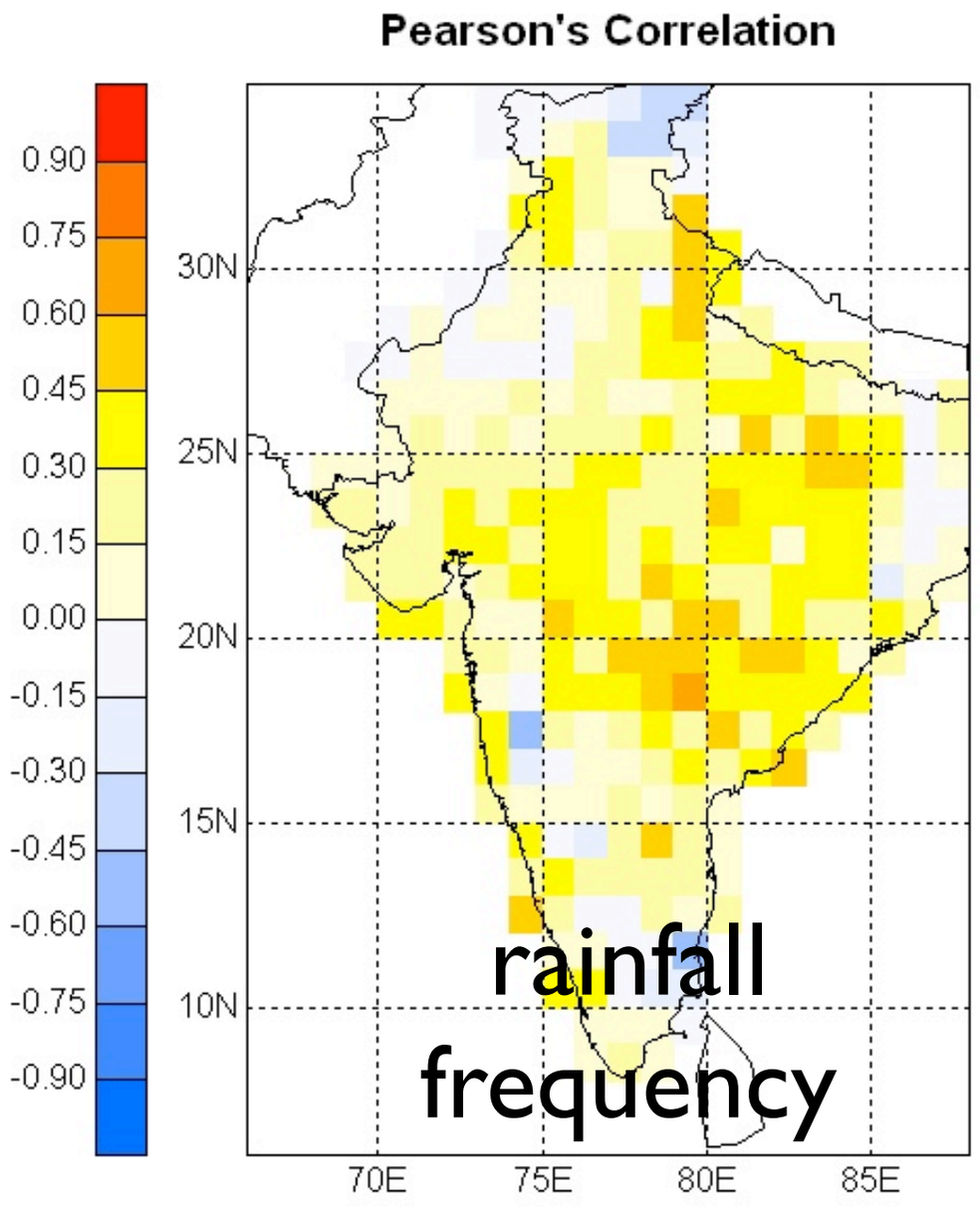
Predictability of "Weather within Climate"

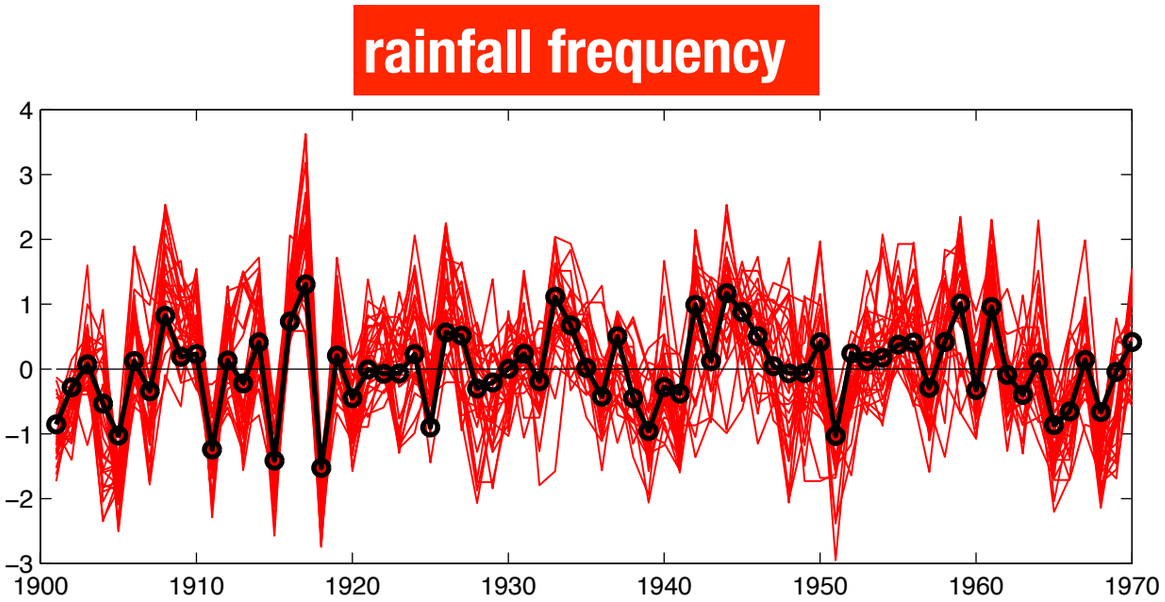


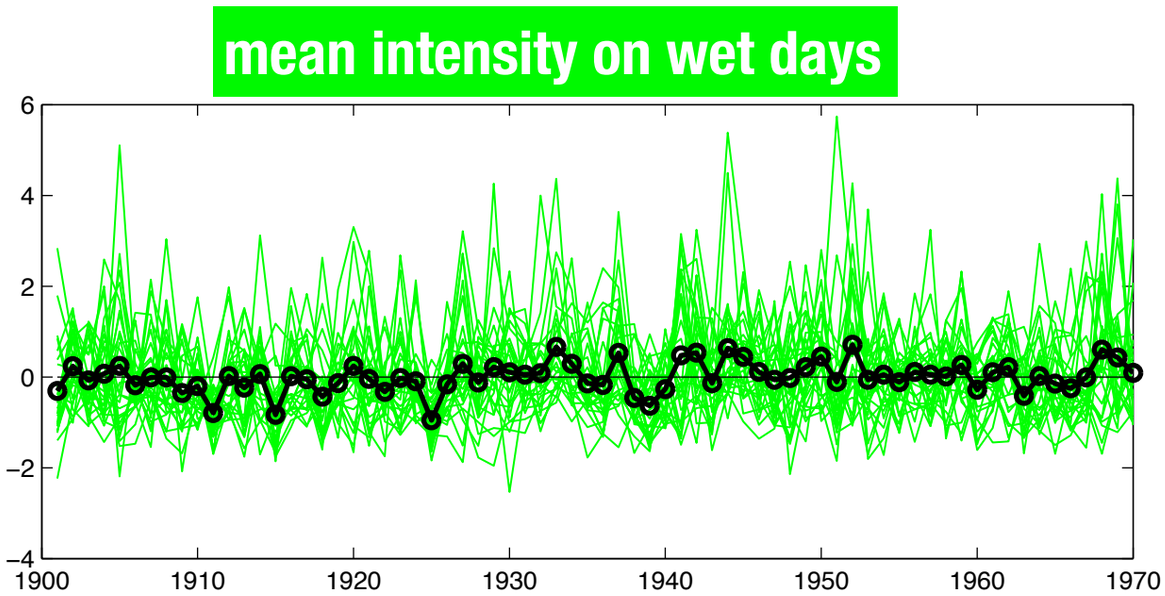




JJAS rainfall correlation skill (ECHAM4-CA: made from June 1)

Why is frequency more predictable than intensity?





Rainfall at individual stations and station-average (NW India)

Rainfall occurrence frequency is more spatially coherent than intensity.

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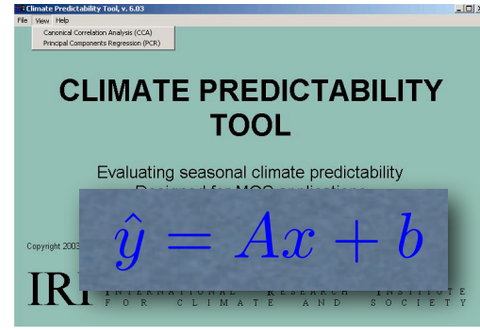
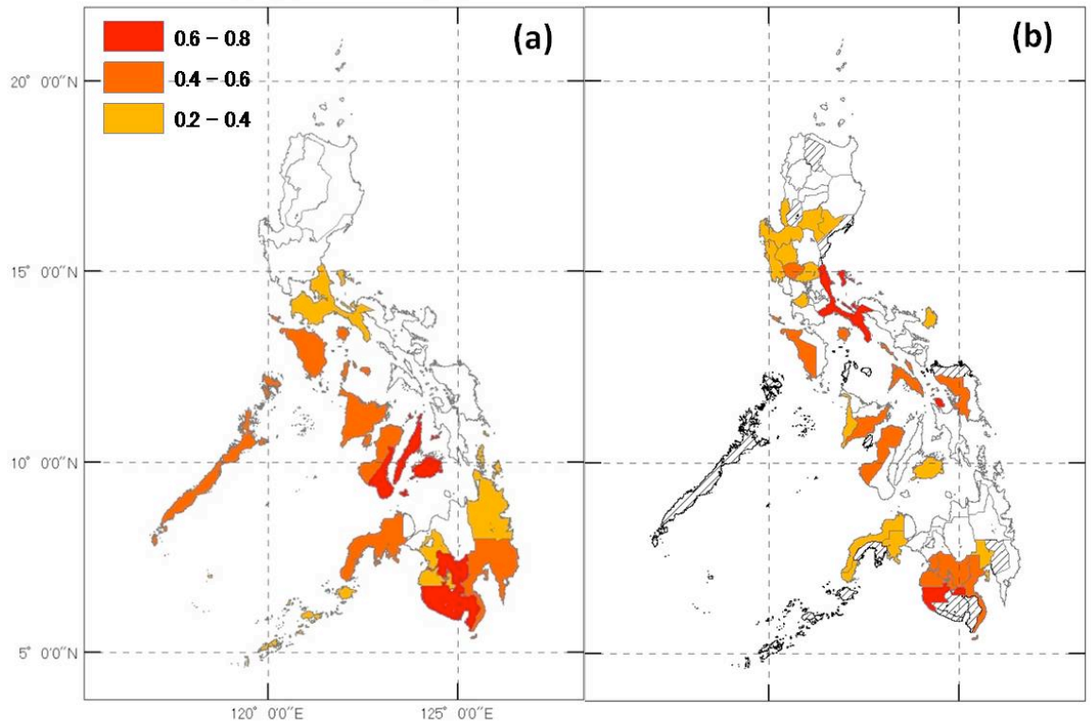
Moron et al. (2007, JCL)

Predictability of Philippines Rice Production Based on CGCM hindcasts

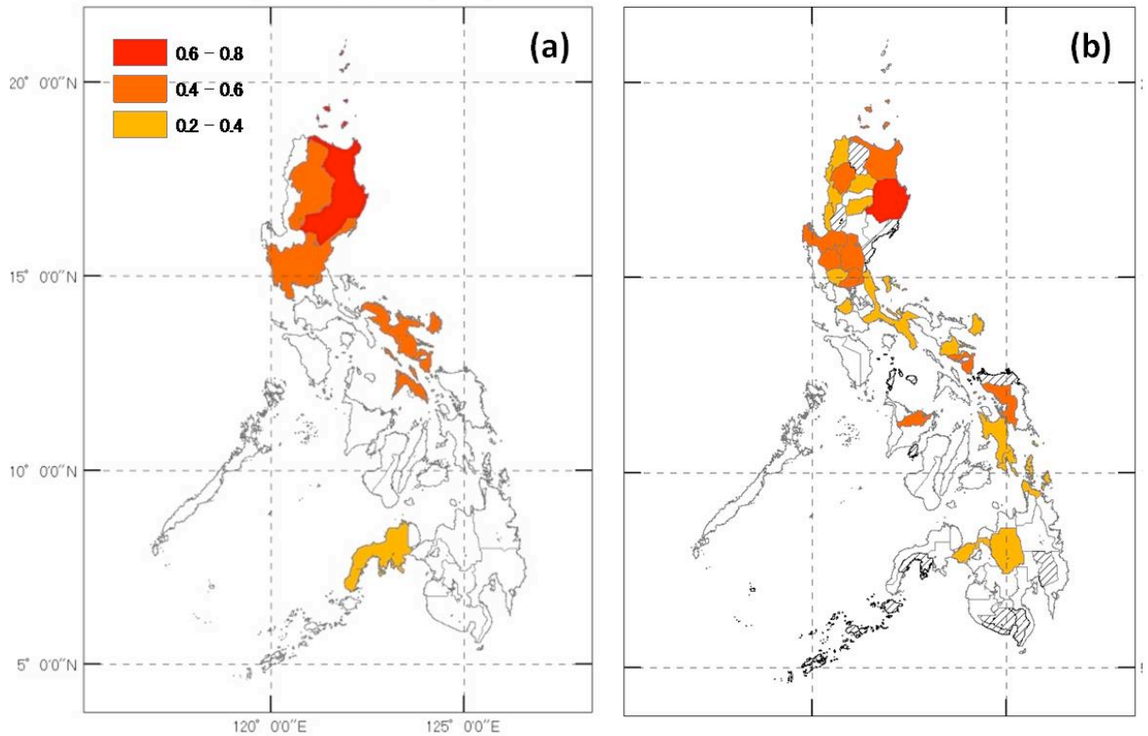


Jan–Jun
(Dry Season)
from prev. Jun 1

Koide et al. (2013, JAMC)



ACC Skill of (a) Regional & (b) Provincial Production

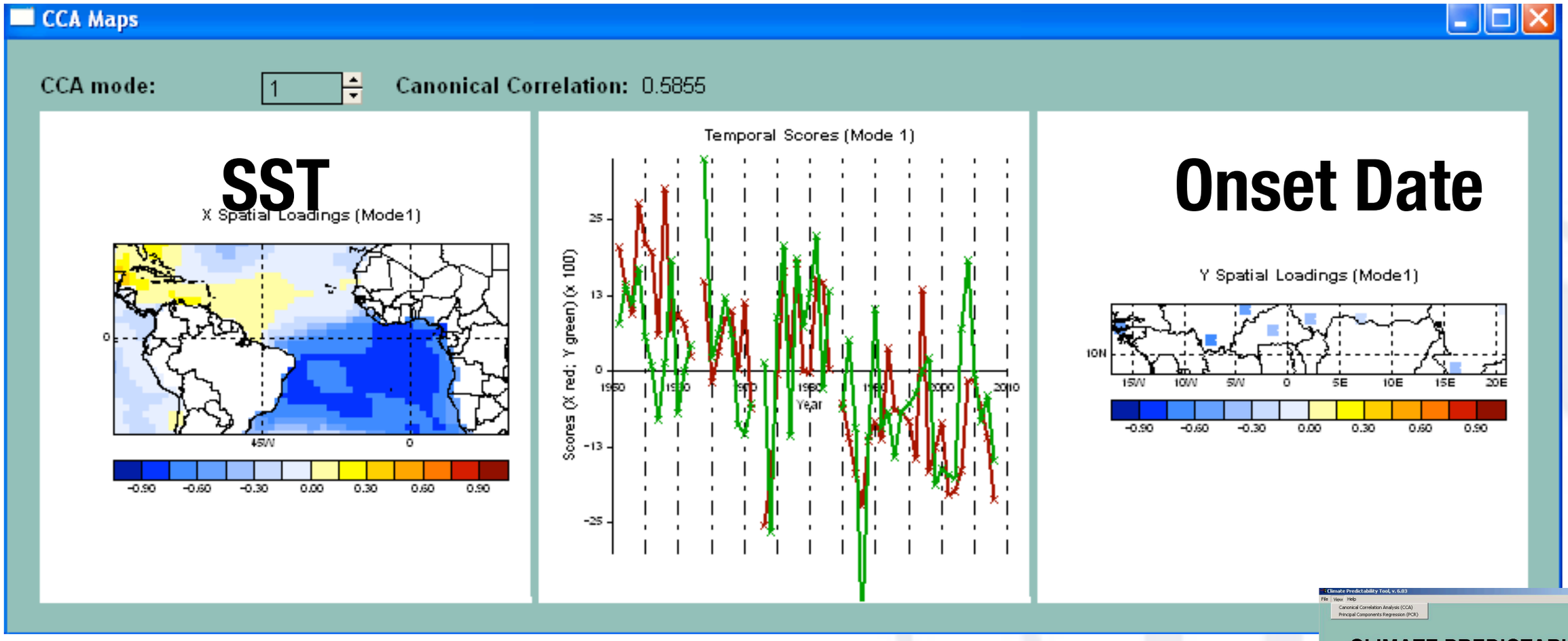


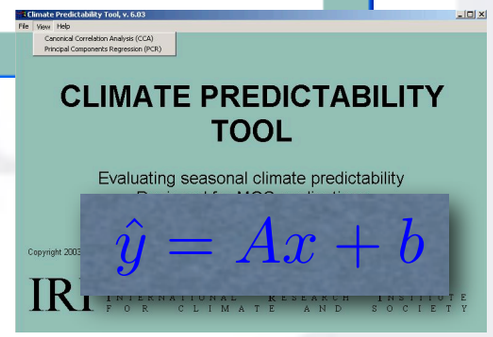
Jul–Dec
(Rainy Season)
from prev. Mar 1

1980–2007

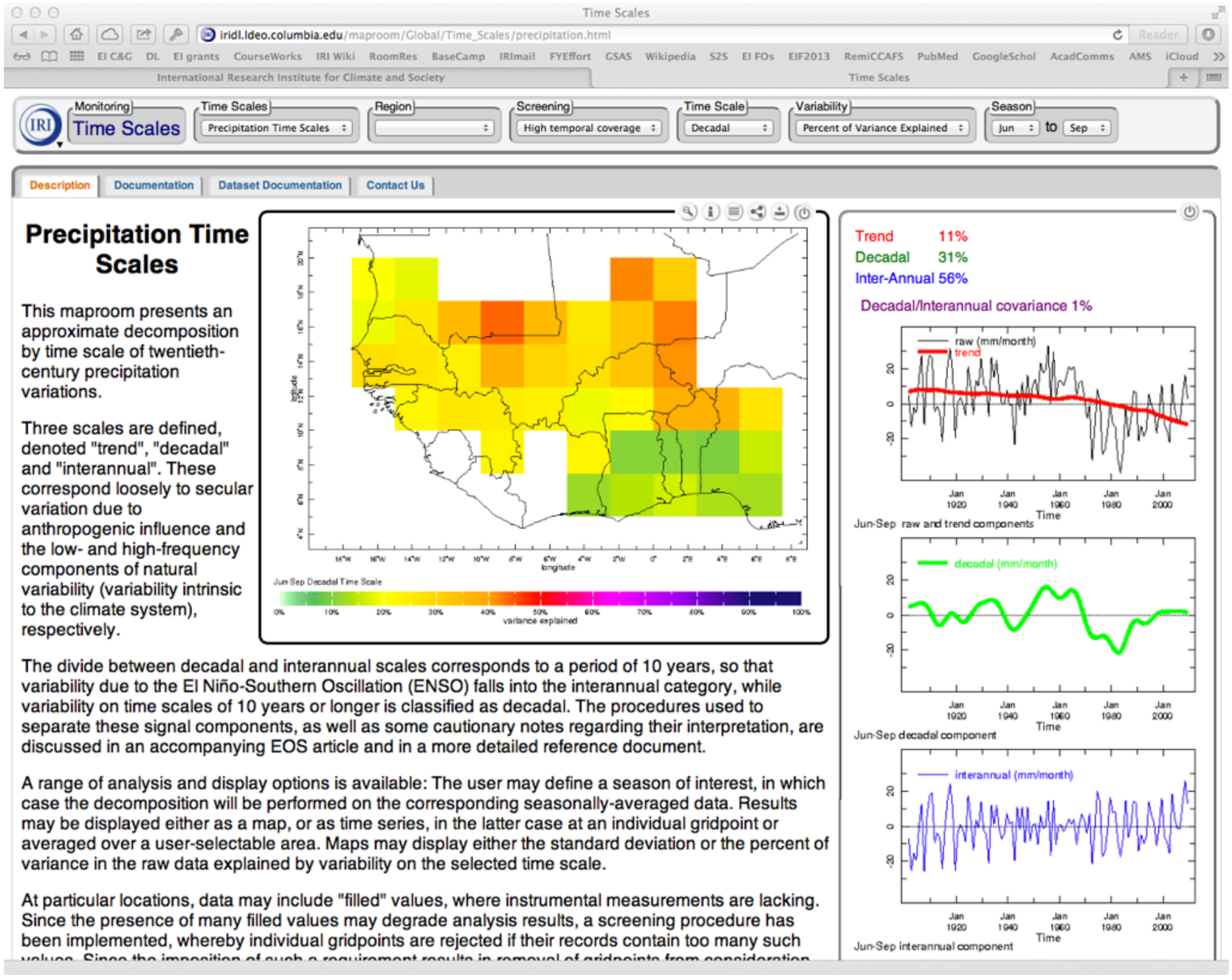
AGRHYMET Training (2012) on predictability of agroclimate and hydrological quantities (incl. monsoon onset dates & river discharge)

Map of covariability between May SST and Rainfall Onset Dates





Timescales decomposition



Greene, Goddard & Cousin (2010, EOS)

Research: Models say that IF the subtropical North Atlantic warms up more than the global tropics, then the Sahel could get wetter…

Future:

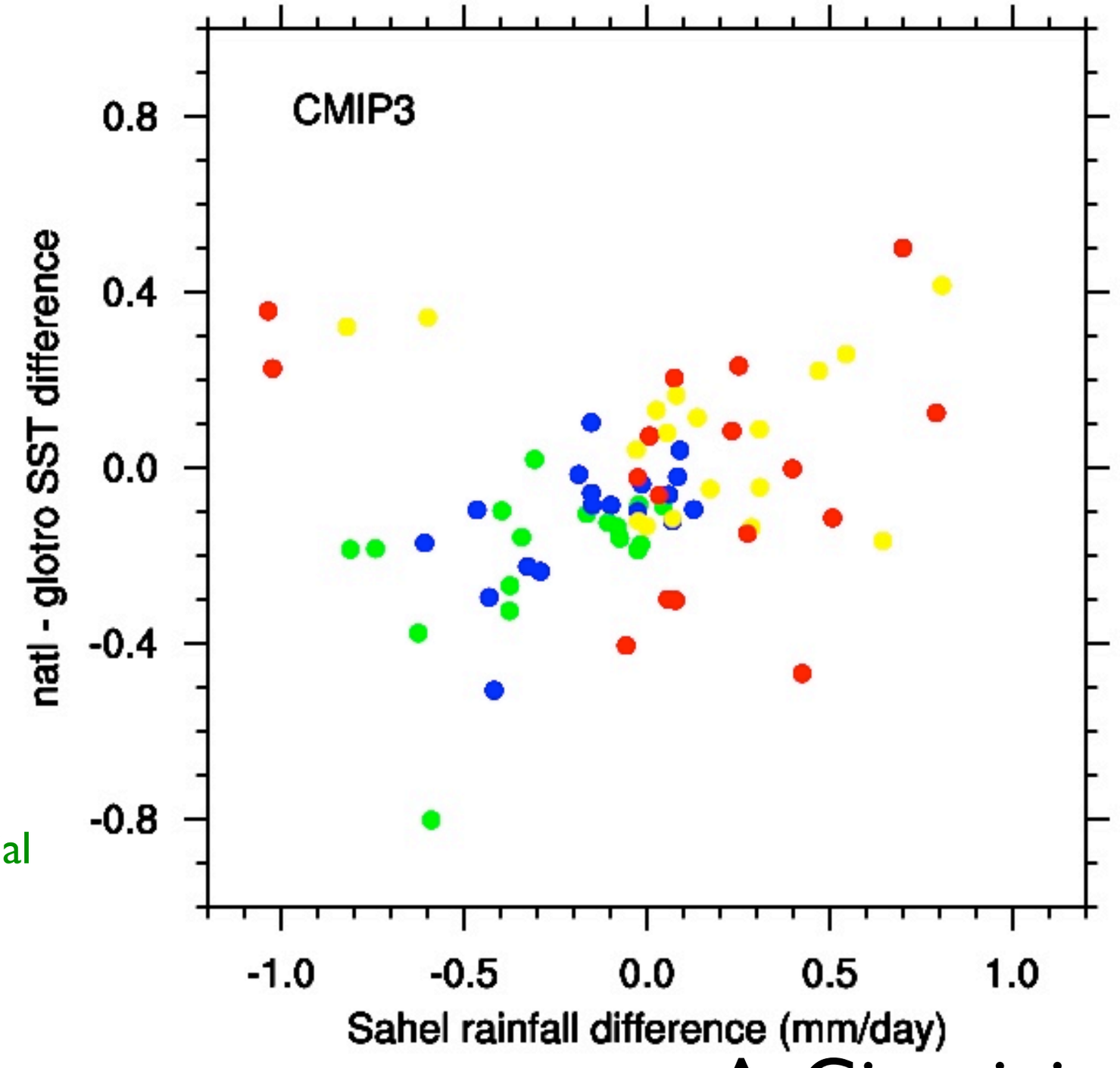
Yellow: mid-21st (A1B) – end 20th

Red: end 21st – end 20th

Past

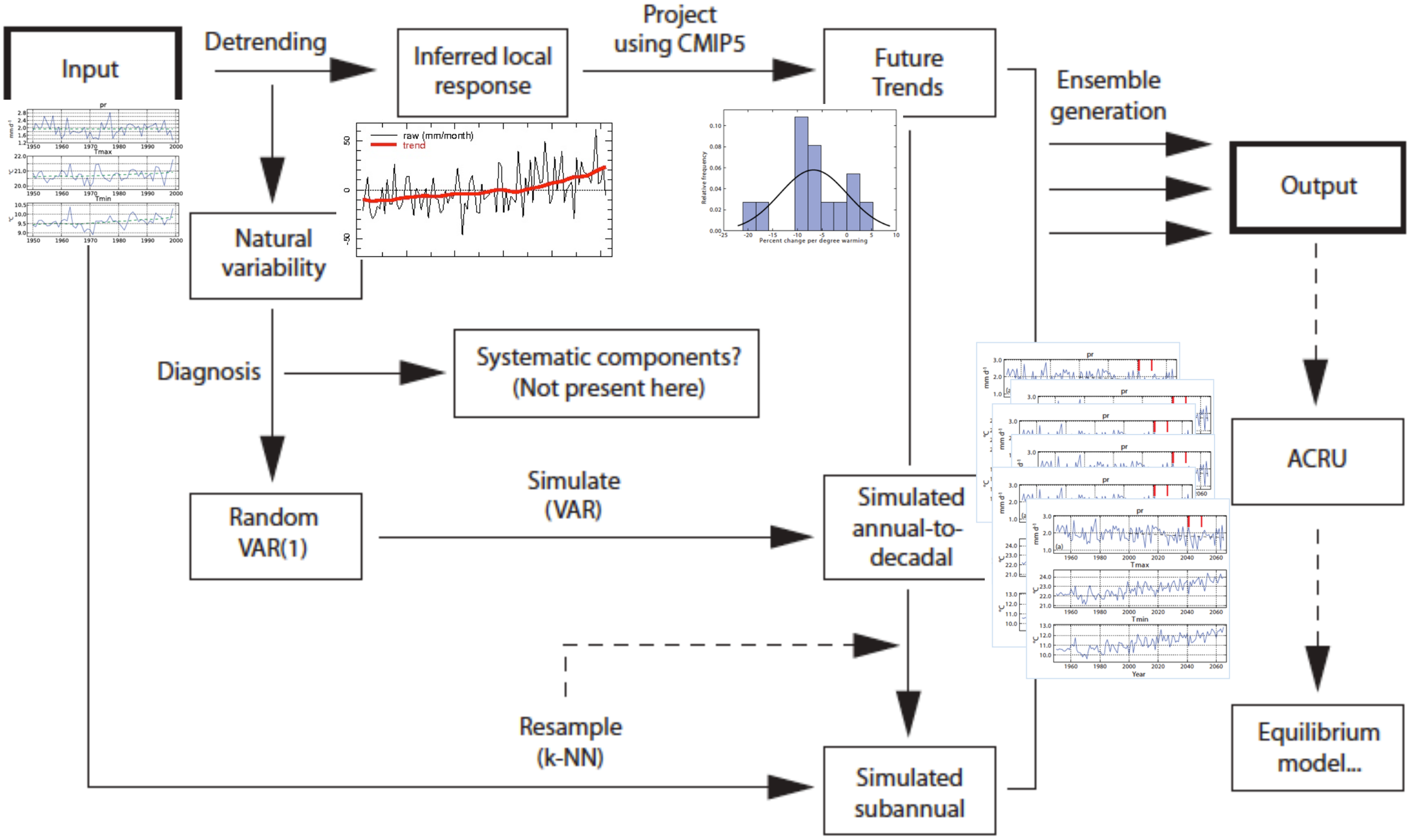
Green: end 20th century – pre-Industrial

Blue: end – beginning 20th century



A. Giannini

Stochastic Simulation Framework



(Greene, et al. 2012, WRR)

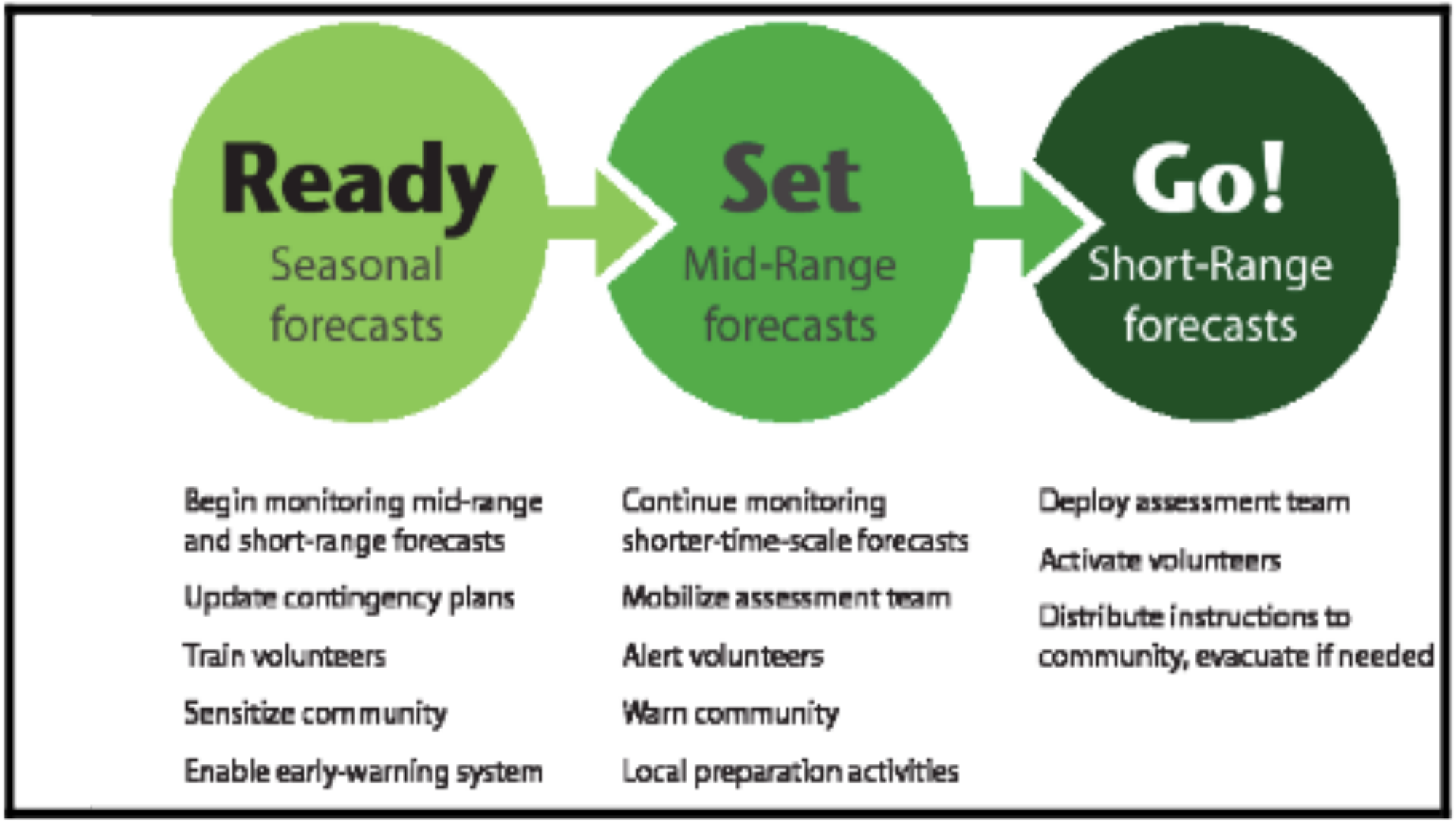
Funding and research partners

- Federal science agencies – individual PI'd grants (NOAA, NASA, NSF, DOE, ONR)
- Cooperative Agreements with NOAA and USAID
- Climate service/development projects

Linkages

- CLIVAR/US-CLIVAR
  - Scientific Steering Group, Co-Chair (L. Goddard)
  - Process Studies and Model Improvement panel (US) (A. Giannini)
  - Predictability, Prediction and Applications Interface panel (US)(A. Barnston)
  - Variability of the African Climate System (S. Mason)
- WCRP
  - Working Group on Regional Climate (S. Mason)
  - Working Group on Seasonal to Interannual Prediction (A. Robertson)
  - WCRP-WWRP/THORPEX Subseasonal to Seasonal Prediction Project planning group, Co-Chair (A. Robertson)
- WMO
  - Expert Team on Climate Services Information System (CCI), Chair (S. Mason)
  - Joint Working Group on Forecast Verification Research (S. Mason)
- NOAA Modeling, Analysis, Prediction & Projection (MAPP) Task Force
  - L. Goddard, A. Barnston, B. Lyon, S. Mason, M. Tippett,

Opportunity to use information on *multiple* time scales



Red Cross - IRI example

What's next?

- New flexible seasonal forecast MME Net Assessment based on partnerships with climate modeling centers in US and internationally
- Pan-timescale climate forecast information from sub-seasonal to decadal
- Robust in-house climate research (forecasting, diagnostic, modeling) in collaboration with LDEO, CU, NOAA, universities, regional centers, NMHSs ...
- Tailored product development, esp. using IRIDL

Thank You!

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