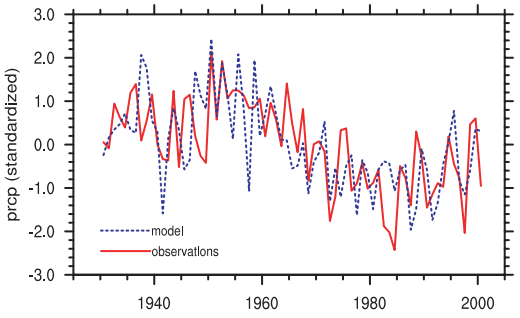
CLIMATE CHANGE

Warming Indian Ocean Wringing Moisture From the Sahel

When drought hit the 5000-kilometer-long strip of marginally habitable land along the southern edge of the Sahara in the 1970s and '80s, the people of the Sahel suffered greatly. Soon some researchers were hypothesizing that intensive use of the land might have altered the surface of the Sahel enough to dry it out. The locals, although they have clearly used the land heavily, have since been absolved of fooling with the climate (*Science*, 31 July 1998, p. 633). Now researchers are pointing to another culprit—the warming Indian Ocean—but humans may still be to blame.

The indictment of the Indian Ocean comes from two new climate-modeling studies that investigate the effects of the recent warming of tropical oceans. In a paper published online by *Science* this week (www.sciencemag.org/cgi/content/abstract/1089357), climate dynamicist Alessandra Giannini of the International Research Institute for Climate Prediction in Palisades, New York, and her colleagues report results from the first climate model to simulate accurately the history of Sahel rainfall. Earlier models simulating particular years of drought versus wet years had highlighted unusual warmth in tropical oceans—the Atlantic, the Indian, and even the Pacific. But Giannini and her colleagues took a more demanding approach. They simulated Sahel rainfall in their global model year by year from 1930 to 2000 while mimicking the way sea surface temperatures changed over that time.



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Dry, dry, dry. A climate model driven largely by growing Indian Ocean warmth can now simulate the Sahel drought of the 1970s and '80s.

In their model, the Indian Ocean's warming over the decades was the dominant driver of the drying of the Sahel, Giannini and her colleagues found. The model's greenhouse gas amounts were not changed over the 70 years, nor was the vegetation or any other surface property in or around the Sahel. Yet the model faithfully produced the long-term trend in Sahel rainfall: a slight dip around 1940, a rise to a peak in the early 1950s, a long decline into the 1980s, and a still-incomplete recovery in the 1990s. Run with no change in sea surface temperature, the model produced no trend at all. Tropical Pacific temperatures—the relatively rapid El Niño–La Niña cycle—accounted for much of the year-to-year variability of Sahel rain but not much of the long-term trend. The warming of the tropical Atlantic did play some role in long-term drying, but it was the Indian Ocean—which has warmed more than any other ocean basin—that drove most of the drying in the model. Because the model climate—even without any long-term land-surface changes—looks so much like the actual drought, Giannini says, the Indian Ocean appears to be the primary cause.

Giannini's results "seem to show it's ocean sea surface temperatures that give a [Sahel rain] signal very close to nature," says modeler Max Suarez of NASA's Goddard Space Flight Center in Greenbelt, Maryland. His group developed the model that Giannini used. Although "it's just one model," he says, it seems to have been particularly successful because it realistically responds to an initial drying with additional drying.

Now another model adds support to Giannini's conclusions. In a study recently submitted for publication, "we found that the Indian Ocean is probably the most important agent in driving decadal changes in Sahel rainfall," says climate dynamicist Mojib Latif of the University of Kiel, Germany. Using a model developed at the Max Planck Institute for Meteorology in Hamburg, Jürgen Bader of the University of Cologne and Latif found that their model Sahel dried more when tropical seas were warmer during the past half-century than when they were cooler. When they changed sea surface temperatures one ▶

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SCIENTIFIC PUBLISHING

U.S. License Needed to Edit Iranian Papers

The U.S. Department of Treasury has ruled that scientific journals based in the United States cannot edit papers submitted by authors from Iran unless they have the government's permission. The policy, described in a letter sent last week to the Institute of Electrical and Electronics Engineers (IEEE), stems from rules prohibiting U.S. organizations from engaging in trade with Iran. Although the trade embargo has been in place since 1997, the 1 October letter is the first time Treasury has spelled out how it would affect publishers.

Editing is a "service" that requires a special license, notes the department's Office of Foreign Assets Control, which enforces trade sanctions. No license is needed for reviewing submissions, the letter states, or for publishing them if no revisions are made.

IEEE officials, who plan to apply at once for a license, say they pursued the issue to clarify the matter for all publishers. "Once our license is granted, other scientific societies will have much less to do," says Michael Adler, president of IEEE. But some societies are less than pleased with the outcome, which they see as based on a "nonsensical" view of editing. "The ruling shows a clear misunderstanding of scientific publishing," says Irving Lerch, director of international affairs at the American Physical Society. "The central value of a technical paper lies in its content. The correction of syntax and grammar is of little consequence."

IEEE stripped its 1700 members in Iran of several benefits in January 2002 after deciding that providing these services could be illegal. Adler says the association plans to restore electronic access to its journals, which is exempt under the regulations, once it separates journal access from other Web-based membership services. The association's Iranian membership has dwindled to under 400.

–YUDHIJIT BHATTACHARJEE

ocean basin at a time, it was the Indian Ocean that dominated. "The Bader and Latif experiments confirm the interpretation of Giannini that the Indian Ocean is indeed driving a Sahel drying," says climate dynamicist Martin Hoerling of the U.S. National Oceanic and Atmospheric Administration's Climate Diagnostics Center in Boulder, Colorado.

The link between the Indian Ocean and Sahel rainfall is only the latest ocean-drought connection. Earlier this year, a years-long drought across North America, southern Europe, and central-southwest Asia was linked to a temperature pattern in the tropical Pacific that was warm in the west and cold in the east (*Science*, 31 January, p. 636). In both cases, researchers have suggested that changes in sea surface temperature induced changes overhead in the energy released by tropical rain. That change in turn reached out across "atmospheric bridges" to shift distant atmospheric circulation, much the way El Niño does. The departure of the cold La Niña destroyed the warm-cold pattern in the Pacific, ending much of the globe-girdling drought, but the 50-year warming of the Indian Ocean may not be ending anytime soon. "People have put out the idea that it could be global warming" brought on by humankind, says Giannini, "but it's not at all tested. It's just an hypothesis." But it's one that climate modelers no doubt will soon be testing. **–Richard A. Kerr**

BIOTECHNOLOGY

The Ultimate Gene Gizmo: Humanity on a Chip

Commercial genomics reached a landmark last week, and several companies are jostling to share the limelight. Affymetrix Inc. of Santa Clara, California, announced that it is now selling the first research device that contains a complete set of 50,000 candidate genes covering the entire human genome. The GeneChip, as this microarray is called, can be used to measure the activity of all known human genes in a biological sample. Meanwhile, another California company, Agilent Technologies Inc. of Palo Alto, has begun distributing its own human genome array as an experimental prototype, and since June NimbleGen Systems Inc. of Madison, Wisconsin, has been using yet another whole-genome setup to support a DNA-scanning service at a lab in Iceland.

These arraymakers use a variety of techniques to attach minuscule dots of DNA onto glass slides, silicon wafers, or nylon membranes. When exposed to a mix of RNAs from a biological sample, each DNA latches onto the RNA that matches its sequence. The RNA carries a fluorescent tag, marking the place where it attaches. Based on the location and intensity of the signal, researchers can tell which gene is the source and how active it is.

Affymetrix has adapted a form of semiconductor photolithography to create arrays that are similar to electronic chips; NimbleGen incorporates photochemistry and digital mirror technology; and Agilent uses ink-jet machines. All have been shrinking the DNA-containing dots on their devices, thereby squeezing in more dots per array. For example, Affymetrix's first chips contained just a few thousand genes. More recently, the company developed a two-chip set covering most of the known human genes. The new version compresses the two chips into one and includes 6500 more genes. According to Stan Rose of NimbleGen, that company's array now covers 38,109 gene candidates. Agilent says its array will have more than 36,000.

These achievements "will reduce the [amount of] time and effort required to do an experiment, reduce the expense, … and make the data more uniform," says Joseph Ecker, a plant scientist at the Salk Institute for Biological Studies in La Jolla, California, who has helped pioneer whole-genome chips for *Arabidopsis tumefaciens*. Needing less RNA for an experiment can be critical, he adds, because sometimes researchers can isolate only tiny amounts of it.

Whole-genome chips exist already for four other organisms: the yeast *Saccharomyces cerevisiae*, the nematode *Caenorhabditis elegans*, the fruit fly *Drosophila melanogaster*, and the gut bacterium *Escherichia coli*. They have made possible wholesale scans that turn up new gene modifications and variations, says Ecker. The same should prove true for the new human gene arrays. In short, says Ernest Kawasaki, a molecular biologist who runs the microarray unit of the National Cancer Institute in Gaithersburg, Maryland, "we've come a long way."

–Elizabeth Pennisi

At a glance. Microarrays, such as Affymetrix's GeneChip (above), now include all known human genes.

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ScienceScope

Warming Up to "One HHS"

A Senate panel is expected to pull a provision from a spending bill that would have blocked a merger of human resources offices at the Department Health and Human Services (HHS). The move comes after the National Institutes of Health (NIH) reversed its opposition to a plan that would give HHS final authority over NIH hiring decisions. The centralization—from 40 offices to four—is part of HHS chief Tommy Thompson's "One HHS" effort to unify his department.

On 30 September NIH Director Elias Zerhouni and nine other HHS agency heads sent a letter to Senator Arlen Specter (R–PA), asking him to delete language in HHS's 2004 appropriations bill that called for a study of the issue. The agency chiefs wrote that they had worked out their concerns with HHS and found a way to preserve their agencies' "personal touch and direct involvement" in hiring scientific staff.

A Senate staffer said the request came as a "surprise. We thought this was what NIH wanted." **–Jocelyn Kaiser**

Iraqi Marsh Muddle

House Republicans have cut out a proposed U.S. contribution to restoring southern Iraq's ancient marshes, part of the White House's request for emergency funding to rebuild the country. The marshes are the traditional home of the Ma'dan people, a flyway for migratory birds, and a refuge for endangered species. They also have been a center of antigovernment activity, explaining why Saddam Hussein mounted a massive effort that drained 90% of the water.

This week, the chair of the House appropriations committee, Representative Bill Young (R–FL), announced that his committee had "scrubbed … and made some improvements in" the president's $20.3 billion request for restoration and relief, cutting $1.7 billion destined for Iraq but adding $413 million to repair damage done by Hurricane Isabel in the United States. The plan cuts more than $250 million from Iraqi water and dam projects, zeroing out an estimated $100 million for marsh restoration.

–Eliot Marshall

Nobels Next Week

This year's Nobel Prizes were announced as *Science* was going to press. Look for daily stories on *Science*NOW (www.sciencenow.org) and complete coverage in the next issue.