

Acclimations

Newsletter of the U. S. National Assessment of Climate Variability and Change



Partnership and Progress

By Paul Dresler, Chair, National Assessment Working Group

It was not the Global Change Research Act of 1990, but Thomas Jefferson in 1800 who first called for a national assessment of global change. He was adamant in his interest in climate effects on the people of the United States and the effects of people on the climate. Inspired by Benjamin Franklin, Jefferson advised his correspondents to keep weather diaries. He wrote that one day it would be established that "clearing and culture" could change the climate, and he believed that climate and longevity were intimately linked.

Now, less than 200 years later, the national assessment is in full swing. Whether this is slow progress or rapid progress depends, I suppose, on your perspective. Geologists tend to be most sympathetic, pointing out that it was 600 million years ago that insects and plants first appeared and 200 million years ago that dinosaurs ruled during the Jurassic Period. It's becoming difficult to even remember the Cretaceous Period, which began only 143 million years ago. On the other hand, social scientists may tell us that Jefferson and his colleagues were socially and intellectually ahead of their time, and that ideas are implemented when society is ready. But within less than two years of launching our national assessment, we have made indisputable progress - in part because it was an idea whose time had come. We have mobilized people and institutions at a speed that is astonishing - although to us who have been involved on a day to day basis the pace has sometimes seemed much less awe-inspiring. We are Carl Lewis

running the 100, although we have felt more like Babe Ruth trying to beat out a bunt.

Most astonishing is that we have transformed thinking about the nature of assessment and the interaction between scientists and users. Many who in the summer of 1997 were skeptical about stakeholder involvement today could not imagine proceeding in any other way. What makes this assessment so worthy of the investment is its ability to infuse and refine the federal research agenda with questions relevant to those who ultimately use the information; to build communities of informed individuals across the country; to partner research programs so that there is a more effective leveraging of resources; and ultimately to inform decisionmaking - not by offering answers, but by conveying our best understanding of the risks and opportunities faced by society.

How appropriate that Jefferson believed that educating the people of the United States would lead them to the best possible decisions, even if we cannot ever say or know that decisions are the right ones, at least they will be informed ones. It is my pleasure to introduce this second edition of our newsletter, which again demonstrates the extraordinary commitment to this effort. The theme of this edition is partnership and progress, which is demonstrated throughout in the updates, case studies, articles, and plans for future work. We have indeed come a long way.

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A Farmers Perspective on Climate Change



The New England Regional Assessment Process

By Barry Rock, University of New Hampshire

The New England regional scoping workshop was held at the University of New Hampshire (UNH) on September 3-5, 1997. Of the 122 participants, 57 represented non-academic, non-agency stakeholders from the six New England states (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont), as well as upstate New York. For workshop discussions, these stakeholders were grouped into seven sectoral groups, including Business and Industry, Energy and Utilities, local Government and Resource Management, Human Health, Information Transfer and Public Awareness, Natural Resources, and Recreation and Tourism.

Stakeholder interest in the workshop was high, and participation was maintained during the workshop by engaging participants in an open, two-way dialogue. Participants were treated not only as listeners, but as important sources of

information and perspective. Three key issues identified by the stakeholders as important to citizens of the New England region were:

- climate change information and educational materials written in "plain English" - stakeholders want information to be readily accessible to assist in understanding of the issues;
- a regional integrated assessment of climate change impacts for New England - such as an assessment as needed for developing sector-based coping strategies;
- regionally-specific examples of climate change impacts - specific examples are needed to make the concept of climate change relevant and important to the general public.

The New England Regional Assessment process following up on the workshop will focus on addressing these

stakeholder needs.

This process will begin by assembling a stakeholder-based Regional Assessment team to include representatives of the seven sectoral areas. Since the September 1997 workshop, a strong region-wide network has been established between members of the regional steering committee, university and agency research scientists, and the stakeholders. Through the network, key stakeholders will be selected to convene and run seven, sector-based, one-day workshops designed to identify major sectoral needs and concerns likely to be impacted by regional climate change.

The climatic data sets made available by the National Assessment Synthesis Team (NAST) will be used to generate climate scenarios, which will be presented to each sector for evaluation

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New England: Skiing Impacts

Scientists predict that the ski season in New England may be adversely impacted as a result of climate change. The ski industry in the northeast is, of course, extremely climate-dependent, and has a narrow cost/profit margin of economic viability such that success or failure can depend on the difference of several days or weeks of favorable weather. Climate models predicts that warming will be greater in northern latitudes than the projected global average, and will mostly occur in late autumn and winter, with more of the warming occurring at night. Potential impacts of these climate trends to the ski industry include:

Potential mid-season rain and significantly more freeze-thaw cycles could result in more icy, granular conditions that are unfavorable for skiing. Mid-season rain would necessitate additional snowmaking to restore conditions. Combined with the potential that warming will be more pronounced during winter nighttime, snowmaking may be more difficult and costly. To cover one acre of ski trails with one foot of snow takes

150,000 to 180,000 gallons of water. Water supply will be an issue, as will be environmental impacts from such large water withdrawals.

Total ski spending in New Hampshire, including indirect spending such as meals and overnight accommodations, totals \$420.7 million. Projected losses of 10 to 20 percent of ski season days represents a loss of \$42 million to \$84 million in direct and indirect spending in New Hampshire alone.

Participants at last year's New England regional scoping workshop discussed mitigating and coping options, such as: Development and use of new technologies that induce freezing of water at higher temperatures and/or increase the efficiency of snowmaking per volume of water.

Use of alternative energy sources and increased energy efficiency of snowmaking and other ski industry activities. Increasing the size of specially built ponds to support snowmaking activities.





The Media Breakfast, held prior to the opening of the New England Regional Climate Change Impacts Workshop, provided the opportunity for members of the local, regional, and national media to question workshop presenters.

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and integration into sector-specific examples of possible climate variability and impacts to the region. Modeled historical data will be compared against recorded and proxy data for region over the past 300-400 years, assembled as part of the New England climate initiative organized by the Climate Change Research Center at UNH.

In addition to the socioeconomic data provided for the National Assessment,

regional economic impacts of climate change will be modeled using an off-the-shelf impact assessment model as part of each sector-based assessment activity. The sectoral components of the Regional Assessment Report will be written by stakeholders and collectively integrated into the regional report. The Regional Assessment Team will act as a review panel for evaluating and producing the final version of the report.

A parallel activity within the assessment process will be the development of innovative educational and outreach materials. Existing hands-on science outreach programs such as Forest Watch and GLOBE (Global Learning and Observations to Benefit the Environment), currently available in hundreds of classrooms throughout New England and upstate New York, will be used to introduce teachers and their students to model products and supplemental educational materials on regional climate change issues, as well as to engage students in the process of "doing science" and contributing valuable data of use in the documentation of climate impact to the region. In addition, interactive displays and information kiosks dealing with climate change issues will be developed in conjunction with regional science museums (Talcott Mountain Science Museum in Hartford, CT, and the Boston Museum of Science, in Boston MA).

For more information, contact:

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Native Peoples, Native Homelands Climate Change Workshop

The Native Peoples, Native Homelands Climate Change Workshop will be held October 28-November 1 1998, in Albuquerque, New Mexico. This workshop is designed by Native Peoples to examine the impacts of climate change and extreme weather variability on the people and their homelands from an indigenous culture and spiritual perspective and to develop recommendations as well as future response actions. Native Peoples, with their spiritual traditions and long community histories of change, adaptation, and survival in specific regions, can provide an invaluable contribution to the assessment and understanding of climate change as well as to the development of sustainable economies in this country.

Native communities are repositories of valuable human and natural resources with significant implications for addressing climate change issues. Like island nations, the land bases contained within Indian reservations represent significant land holdings often in relatively undisturbed tracts embracing a variety of microenvironments and containing a wide

range of indigenous plant and animal species. Many of these species can serve as key indicators to monitor and document climate change.

Reservation communities are composed of multigenerations of Indian families who have resided in relatively fixed federal reservations. These communities have first-hand, detailed familiarity with the environment and its history over long periods of time and through various types of economic development. Most Indian cultures continue to rely upon strong oral traditions and pass on community knowledge about specific locations and past climatic variability.

Tribal concerns naturally span many generations, and strategic thinking is inclined for the long-term, not just short-term survival. The Tribal cultural world view envisions and accepts the natural relationship between the human and natural world. Basic cultural assumptions hold that all things in creation are related and each has effects upon the other.

The Native Peoples, Native Homelands Climate Change Workshop will be an opportunity for Native Peoples to inform the U.S. National Assessment on the impact of global climate change on Native Homelands and Peoples and to participate in the development of the national policy and research agenda. Areas of impact which will be considered in the workshop will include agriculture, energy, natural resources, vegetation, fish and wildlife, economy, tourism, disaster planning, water resources, culture, health and human populations. Participants will help develop position papers and policy recommendations. Invitations are going primarily to interested Native Communities, Tribal organizations, educational institutions, including Tribal leaders, natural resource managers, and Tribal college staff and students.

For more information, contact:

Mrs. Verna Teller, Director, Workshop Project Office, 700 4th St. SW, Albuquerque, NM 87102; (505) 242-3351; vernat@swcp.com

Stakeholder Interactions in the Northern Great Plains Region

By George A. Seielstad, University of North Dakota

The Northern Great Plains regional scoping workshop was held November 5-7, 1997 at the University of North Dakota, and was attended by 100 stakeholders from throughout the region. The workshop proceedings (available at <http://www.umac.org/Climate/>) have already been distributed to approximately 1000 people.

The scoping workshop identified stakeholder concerns. But the real challenge has been following up on the ideas, con-

cerns, and enthusiasm generated by the workshop. To assist with this, the Upper Midwest Aerospace Consortium (UMAC) has conducted two other workshops at Montana State University in February 1998. The first workshop brought educators and Geographic Information System experts together for hands-on training in use of geospatial technologies in classrooms for grades 8-12.

The second workshop focused on farming, ranching, and forestry. The aim was

to develop applications of remotely sensed data to improve the economic competitiveness of these sectors and simultaneously minimize adverse effects on the environment. At the heart of these applications is the notion of precision agriculture, defined as an information management practice that applies inputs only where needed, in the amounts needed, and when needed. These inputs are often chemicals, used as pesticides, herbicides, and fertilizers. By mapping where those inputs will be most

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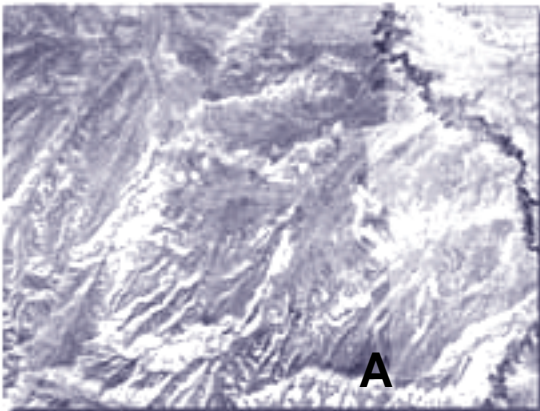


Figure 1



Figure 2

Figure 1 is an AVHRR satellite image, in which a line between darker and lighter areas can be clearly seen towards the right side of the image. This line is a result of grazing on the right side of the fence line shown in the photograph in Figure 2, which was taken at Point A in Figure 1.

Northern Great Plains: Rebuilding After the Flood

The April 1997 flood of the Red River washed out homes and businesses that had been in Grand Forks, North Dakota, and East Grand Forks, Minnesota, for generations. The disaster was expected to occur, at least on the average, only once every 500 years.

Since the flood, Mayors Pat Owens of Grand Forks and Lynn Stauss of East Grand Forks have led major rebuilding efforts. Their cities are now on the mend. But a new uncertainty haunts them and the area's residents. Will floods of this

magnitude occur more frequently in the future? If so, what level of protection must be provided? Can dikes or diversion channels be built to withstand even greater floods? No one is quite certain how severe or how frequent future floods--or droughts--will be. But the climate change that is already underway could alter the pattern of storms and spring melts in this region. The historical pattern of seasonal river flows might change as well.

For Mayors Owens and Stauss, climate

change is an important issue on their agendas. Displaced people and businesses need decisions now on how close to the river they can build and what level of protection will need to be provided. These decisions are imminent, but making them has not been easy because future generations are affected as well. To protect lives, property, and livelihoods for residents both today and tomorrow, the two mayors need the best possible information about future climates.

- George Seielstad



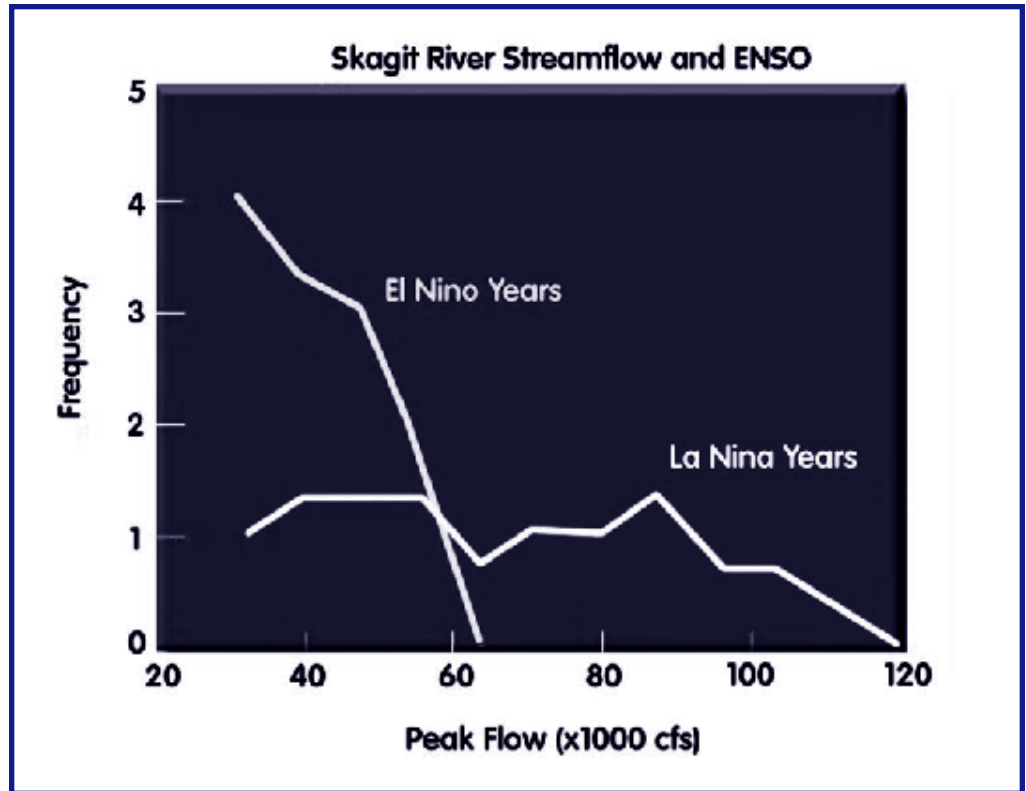
Climate Impacts Group Shares Pacific Northwest Research Results

By Phillip Mote, University of Washington

Members of the Climate Impacts Group (CIG) at the University of Washington in Seattle have been actively engaged in research on climate variability, climate change, and impacts on the Pacific Northwest region. Studies focus on climate-sensitive sectors like water supply, salmon populations, forest health, and coastal development. This research will provide an important contribution to the region's assessment.

At its annual meeting last June, the CIG presented research results before an audience that included both stakeholders and scientists. Results concentrated on past climate variability in the Pacific Northwest, its relationship to two cyclical "climate drivers" (ENSO, the El Niño-Southern Oscillation, and PDO, the Pacific Decadal Oscillation), and its impacts on biological and hydrological systems. The PDO, like ENSO, is a natural variation of sea surface temperature in the Pacific, but unlike ENSO it characterizes variations in sea surface temperature in the North (as opposed to equatorial) Pacific. The PDO also has a much longer time scale, with positive (warmer) phases from 1925 to 1945 and after 1977, and negative (cooler) phases from 1900 to 1925 and from 1945 to 1977. The CIG research results included the following:

- Analysis of tree ring data shows that 1925-1945 (a positive phase of the PDO) was the warmest and driest period in the last 250 years.
- Rivers flood more commonly during the cold phase of ENSO and the negative phase of the PDO.
- Juvenile coho salmon (at least those entering the ocean along the outer coast of the PNW) survive better in colder water, conditions more common in the negative phases of ENSO and PDO.
- Using past associations between Columbia River flow and different phases of ENSO and PDO, it may be possible to predict Columbia River flow for an entire water year, from



October to September.

- Analysis of Columbia River flow indicates that the phase of PDO may have changed recently from positive to negative. Wet years like 1996-97 are very unusual in a positive PDO. (The PDO has been in its positive phase since 1977.)
- Area burned by forest fires (in the years before fire suppression efforts became widespread) was greatest in the positive phase of PDO.
- Even extremely accurate forecasts of the number of salmon returning may have little economic value in part because of the flexibility of annual quota-setting procedures and in part because of the spatial and temporal scales on which forecasts would be needed by decision-makers.

As the CIG heads into its fourth year, it is developing formal links with a group at Washington State University, which will study potential effects of climate change on soils and crops; with forest hydrologists at Oregon State University; and possibly with other research groups. Informal links have also been developed with a regional modeling and impact-assessment group in Sweden, where the climate and the economic base are similar to the Pacific Northwest.

For more information, contact:
 Phillip Mote, University of Washington,
 Box 354235; Seattle, WA, 98195; (206) 616-5346; phlip@atmos.washington.edu; or see the CIG web site at <http://tao.atmos.washington.edu/PNWimpacts>.

Calendar

Water Resources Sector Workshop

September 14-16, 1998; West Palm Beach, FL

For more information, contact: D.Briane Adams, US Geological Survey; 3850 Holcomb Bridge Rd., Suite 160, Norcross, GA 30092; (770) 409-7708; dadams@usgs.gov

49th Arctic Science Conference

October 25-28; Fairbanks, AK

For more information, contact: Gunter Weller, University of Alaska Fairbanks; Fairbanks, AK 99775; (907) 474-7371; gunter@gi.alaska.edu

Alaska Regional Assessment Workshop

October 29-31, 1998; Fairbanks, AK

For more information, contact: Gunter Weller, University of Alaska Fairbanks; Fairbanks, AK 99775; (907) 474-7371; gunter@gi.alaska.edu

Native Peoples/Native Homelands Workshop

October 29-November 1, 1998; Albuquerque, NM

For more information, contact: Verna Teller, Workshop Project Office; 700 4th St. SW Albuquerque, NM 87102; (505) 242-3351; vernat@swcp.com

Southern Great Plains Regional Scoping Workshop

Date TBD; Austin, TX

For more information, contact: Gerald North, Texas A&M University; College Station, TX; (409) 845-8083; northead@ariel.met.tamu.edu; or Bob Harriss, Texas A&M University; College Station, TX; (409) 862-6301; harriss@tamu.edu

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efficient is a win-win scenario for the farmer, rancher, and forester, and for the global environment - saving money and protecting the environment. Examples of problems UMAC is developing applications to address include:

- **Determination of Wheat Protein Content.** When dryland wheat farmers apply only a light application of fertilizer at the beginning of the growing season, they could supplement it midseason in years the weather seems likely to produce a high yield. The midseason application increases the protein content, driving up the wheat's market price.
- **Weed Detection.** Satellite and aerial mapping of weed

distributions enable farmers to apply an herbicide only where weeds exist, rather than the older practice of uniform herbicide application.

- **Rangeland Carrying Capacity.** The goal is to measure the biomass of feed for livestock so that the number of grazers can be calculated. An illustration of the ability of satellites to measure range conditions is shown in Figures 1 and 2.
- **Drought Index.** Vegetation stressed because its water supply is inadequate for the temperatures in which it grows is being identified as a useful index of fire danger in forests.
- **Soil Moisture.** No concern about climate change is

more worrisome than possible changes in the availability of water at the right time for various crops. UMAC is a satellite technique for assessing soil moisture.

Continued participation in the National Assessment will allow UMAC, in conjunction with other Northern Great Plains groups and stakeholders, to build an environmental information network. This network can use workshops and other tools to add to the number of people who teach and learn about climate and the environment.

For more information, contact:
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Q & A

Q. What is the relationship between the regional scoping workshops and the regional analyses?

A. The regional scoping workshops are the first step in each region. They are meant to identify key questions, issues, and concerns which can then be further analyzed and pursued. This may involve applying quantitative methods and models, and it may involve further outreach activities, such as additional workshops with stakeholder groups. The three major components of the post-workshop phase include (a) quantitative analysis of a few key issues, (b) continuous cultivation and engagement of regional stakeholder networks, and (c) publication of a report in a common format.

Q. What products will come out of the regions?

A. Each regional scoping workshop begins with a scoping paper meant to generate discussion among participants. Following each workshop, organizers prepare a workshop report to reflect discussions; often this is a revision of the scoping paper. For the next (post-workshop) phase, each region will prepare a report with some commonality of issues. Regions are also encouraged to develop other products that might be useful, although these would be published as regional documents, and not as part of the national volumes.

Q. Will the National Assessment synthesize existing literature or conduct new research?

A. Primarily the former. Analysis will be based on extant scientific literature and from new studies done specifically in support of the national assessment process. The national assessment process will be guided by a short list of questions such as the following:

- What are the current environmental stresses and issues for the United States that will form a backdrop for potential additional impacts of climate change?
- How might climate variability and change exacerbate or ameliorate existing problems?
- What are the priority research and information needs that can better prepare policy makers to reach wise decisions related to climate variability and change?
- What research is most important to complete over the short term? Over the long term?
- What coping options exist that can build resilience to current environmental stresses, and also possibly lessen the impacts of climate change?

Q. What timeframe will the National Assessment address?

A. The National Assessment will emphasize the potential consequences over the next 25-30 years, and also over the next 100 years. Analyses of potential consequences over the next 100 years will need to consider the potential for significant secular changes in climate, potentially accompanied by changes in climate variability and the frequency of extreme events, as well as the projected large changes in atmospheric carbon dioxide concentrations. Over this time frame, coping technologies and practices can also be expected to change, so some provision must be made in the analyses for these considerations. Analyses of potential consequences over the next 25-30 years will need to consider that atmospheric carbon dioxide concentrations will certainly continue to rise, and there may be modest, but observable, trends in climate. Potential consequences over both short and long time frames will need to consider the possibility of non-linear and threshold responses.

Q. What is the timeframe for the completion of the National Assessment?

A. The Synthesis Team will finalize a report by January 2000 to present to the Congress and to provide input into the Third Assessment Report of the Intergovernmental Panel on Climate Change. However, the work of the regions and sectors will be ongoing, punctuated by the periodic publication of reports.

Q. What are key deadlines for regions and sectors?

A. In terms of the Synthesis Report, regions and sectors have opportunities to formally submit interim findings to the Synthesis Team at three specific times: August 1998, February 1999 and April 1999. However, they are encouraged to provide input and submit information continuously through the process. In terms of individual regional assessments, those volumes that will be published in a common format will need to be final in November-December 1999 for printing; therefore, the fall of 1999 is being planned for reviews and revisions.

Ask GCRIO

Common Questions about Climate Change, produced by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), addresses ten frequently-asked questions about climate change. This document and others, such as the White House Office of Science and Technology Policy's Climate Change: State of Knowledge and the US Global Change Research Program's Our Changing Planet, are among the dozens of publications that can be obtained free of charge either in hard copy or on-line on the World Wide Web from the US Global Change Research Information Office (GCRIO).

In 1990, Congress passed and the President signed Public Law 101-606, the Global Change Research Act of 1990. The Act required that a US Global Change Research Information Office be established. The GCRIO mission was to provide access to data and information on global change research, adaptation/mitigation strategies and technologies, and educational resources on behalf of the US Global Change Research Program (USGCRP) and its participating Federal Agencies.

To accomplish this mission, GCRIO acts as a clearing-house for selected key documents and reports that are either generated or sponsored by the US Government or by

specific Federal Agencies. GCRIO generates abstracts of these documents and places them into an on-line searchable bibliographic data base. Links to other relevant bibliographic systems are also maintained. GCRIO can respond to requests for copies of these documents either directly or indirectly by forwarding the request to the proper Agency contact. Selected documents are available on-line in their entirety.

The GCRIO Home Page (<http://www.gcrio.org>) provides access to selected bibliographic databases; web sites at the participating Federal Agencies; relevant environmental data, catalogs, and library systems; the 'Ask Dr. Global Change' column; and a special section that deals with environmental education. Brochures describing GCRIO's products and services are available in English, French, Russian, Spanish, Arabic, and Chinese.

GCRIO is operated by the Center for International Earth Science Information Network (CIESIN) at Columbia University. For more information, contact GCRIO User Services, P.O. Box 1000, 61 Route 9W, Palisades, New York 10964 USA; help@gcrio.org; telephone - (914) 365-8930; FAX - (914) 365-8922
- **Bob Worrest, CIESIN**

Synthesis Team News

The second official meeting of the U.S. National Assessment Synthesis Team (NAST) took place August 23-28 at the J. Eric Jonsson Center in Woods Hole, Massachusetts. The meeting was chaired by Jerry Melillo and Tony Janetos, the co-chairs of the NAST.

The objective for the meeting was to develop a first-order draft of the Synthesis Report outline. The draft outline developed throughout the course of the meeting contains an Executive Summary, and sections covering introductory materials, past and future conditions in the U.S. (including discussion and description of scenarios used), regions (both summary information and "examples"), sectors (both summary information and "examples"), and synthesis (combining regions and sectors, and exploring cross-cutting issues). Primers are also proposed to cover climate change science, the climate policy domain, and possi-

bly other key areas. The Synthesis Report outline developed in Woods Hole has been circulated to National Assessment participant teams for comments and additional development leading to a working draft; this new draft and further revisions will be discussed at the next Synthesis Team meeting to be held November 16-17 in Washington DC.

In addition, meeting participants worked to develop a strategy for drafting the Synthesis Report making optimal use of the various parallel assessment efforts by regions and sectors, and assuring that the key information from these efforts is integrated into the Report. Other topics discussed at the Woods Hole meeting included development and use of climate and socio-economic scenarios in the National Assessment, plans for post-2000, and formation of a review panel.



Regional Notes

Alaska

The assessment will be both qualitative and quantitative, focusing on fisheries, transportation, forestry, subsistence, and wildlife. Transportation affects virtually all aspects of life in Alaska. Impacts of climate change and variability on wildlife will affect subsistence, tourism, recreation, and the environment. These key issues may have implications for the Alaskan economy. The assessment team has constructed climate scenarios from a combination of GCM models and observed data trends. They will focus especially on socioeconomic impacts and on outreach, particularly to native communities.

Appalachians-Central and Southern

Through a broad survey of the interests of government, NGOs, and businesses, this assessment team will define key areas to assess. Currently, the team is focusing on forests, water, and energy. In the context of these issues, the assessment team will also examine commerce, ecosystems, human health, air quality, and tourism as well as the impact of policies which are targeted at climate related phenomena.

California

The assessment team plans to identify key sectors through the engagement of the Steering Committee members. Team members envision a long-term assessment effort which will involve model integration and business participation. The team is focusing on water, health, forests, agriculture, coastal, and urban areas and has identified four priority research areas: integrated regional impacts modeling project, ecological systems impacts assessment, communities and infrastructure impacts assessment, and business and economic impacts.

Eastern Midwest

One of the main areas of focus for this assessment team is the effect of climate change on agriculture in the region and how agriculture can adapt to these changes. They have divided their region into twelve sub-sections in order to more thoroughly examine this issue. They are using the Century 4.0 as a crop produc-

tion model and the Purdue Crop Livestock Linear Program (PC/LP) model for the analysis of farm level decisions. The team would also like to address direct impacts and the impacts of adjustment policies and intend to engage stakeholders from a wide range of sectors.

Great Lakes

Using the overlay approach for most sectors, the assessment team has divided the assessment into two levels. In level I, information will be compiled from recently completed studies. In level II of the assessment, they will use GCM output, other climate change scenario information and the information compiled in level I to assess the impacts of regional climate change. Impact model simulations for corn, soybeans, and dairy will be performed. Data from climate change scenarios will be used to input into the GLERL Great Lakes Advanced Hydrologic Prediction Suite of models to assess the impacts of climate change on the Great Lakes.

Great Plains --Central

The assessment team will conduct a quantitative assessment in which stakeholders will be meaningfully engaged. The analysis will cover the Great Basin region and the north, south, and central Great Plains, thus providing data to other National Assessment regions. The team will focus on water agricultural modeling, agricultural land use/adaptation, ranching and rangeland production systems, and conservation areas. Using scenarios and analog studies, an evaluation of ecosystem and agronomic responses to climate changes will be conducted. A steering committee will form which will include stakeholders from many sectors.

Great Plains-Northern

This assessment team intends to motivate actions to reduce the consequences and seize the opportunities of climate change. In order to achieve this goal, the assessment team will next take steps to compile more detailed regional scenario information. The team is focusing on agriculture, forestry, grasslands, education: K-12 and informal, water, extreme weather events, teacher training, information creation and

distribution. They would like to hold annual workshops for the next three years to maintain stakeholder involvement. Information which results from these workshops would be passed on to the extensive network of stakeholders that is developing.

Great Plains-Southern

Emphasizing a long-term perspective on broadly based issues, workshop coordinators intend to focus on the impacts of climate variability and change on water, agriculture, and energy. The workshop will focus on three hydrologic systems: the Rio Grande, the Texas-Gulf drainage, and the Arkansas-White-Red drainage basin. They would like to assess the impacts of drought and water abundance on an array of economic sectors and land uses. In the context of assessing these impacts, they will be looking at urban and community issues. The use of the historical record and other data will be important to the region; however, acquisition of data may be difficult due to the sparse data locations. The workshop will be held by the end of 1998.

Gulf Coast

The assessment team plans to focus on wetland ecosystems, bottomland forests, fisheries, health, water and air quality, and urban problems. The team will expand outreach to stakeholders through extensive media, organization of town meetings, a focus on educational programs, and the maintenance of an active web site. The key experts will be designated to lead the assessment of each sector and to develop sectoral teams.

Metropolitan East Coast

Focusing on the interaction between knowledge, knowledge production, and policy making, the assessment team will develop an action plan for the region. Through the iteration between the production of impact scenarios and stakeholder review, they will refine the assessment, time frames and action plans. The team will concentrate on water resources, air resources, land use, coastal marine, human health, ecosystem services, urban environments, and infrastructure. They also intend to develop a regional climate impacts network.

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Middle-Atlantic

The assessment will be structured as an open process which encourages stakeholder and researcher involvement. The Center for Integrated Regional Assessment (CIRA) framework will be used as an assessment approach. The assessment will focus on five sectors: water, coasts, health, forests, and agriculture as well as cross-cutting issues such as biophysical (ecosystem) impacts and human impacts (socio-economic), with a qualitative overview and a quantitative assessment. Case studies focusing on different locations and types will be used to illustrate the potential impacts of climate change on the region.

Native Peoples, Native Homelands

The assessment team plans to provide a framework for the articulation of the concerns of native peoples. The team intends to view the Earth holistically as a living system, focusing on the impacts of climate change and variability on water, human health, ecosystem/wilderness, sovereignty/cultural integrity, subsistence, and emergency response. The workshop is scheduled to be held October 29-November 1 in Albuquerque, New Mexico.

New England

The assessment team would like to facilitate the development of a dynamic partnership among regional research, service, industry, and end-user communities that apply research methods and technologies. To foster this partnership, they will develop an effective outreach program to address important regional climate change and variability issues and concerns and promote information transfer and public awareness. The assessment team will reach out to business and industry leaders from the recreation and tourist industries as well as leaders in agriculture and the energy and utilities industries. They will also focus on government resource management, human health, and natural resources.

Pacific Islands

Water availability and quality are important issues in this region as islands are more limited in sources of water than other areas. The impacts of extreme events

and the impacts of other climate-related coastal hazards are particularly important to assess because of the implications for community planning, economic development and public safety. Changes in terrestrial/coastal and marine ecosystems also produce a wide array of implications and hence will be another focus of the assessment team. The team will form critical partnerships to develop, communicate, and use enhanced information to understand and respond to climate variability and change.

Pacific Northwest

The assessment team is looking at the impacts of variability and change on how natural systems and human systems interact. They are using a sophisticated regional model driven by GCM and will base their approach to the assessment upon climate dynamics. Their previous work has focused more on variability, but they are now placing more emphasis on the study of change and thresholds. They are specifically interested in the effects of the El Niño-Southern Oscillation on seasonal-interannual timescales and the Pacific Decadal Oscillation on inter-decadal timescales on region. The assessment team has done in-depth study of forestry, water, agriculture, marine ecosystems, and coastal issues. The team will continue studying these issues as well as begin to assess the impacts on health and energy.

Rocky Mountains and Great Basin

The assessment team will work with focus groups to study water resources, climatology, and other sectors to develop probability scenarios. The focus groups will hold workshops which will produce scenarios and position papers. Ecological modeling will be conducted jointly with the Great Plains. Emphasizing the importance of montane snowpacks in the region, the team will assess the effects of water availability and timing on cultivated agriculture and ranching, skiing and tourism, natural ecosystems, and urban and industrial use.

South Atlantic and Caribbean

The workshop coordinators emphasize that education can be used as a method of transforming research findings into practical knowledge. They will draw on rich cumulative experience in vulnerability analysis, hazard assessment, hazard mitigation, and emergency management. They will also focus on lessons learned during

the response and recovery phases of several disasters to include empirical knowledge in the socio-economic aspects of climate scenarios. In an area which is highly vulnerable to coastal hazards and known for a high level of coastal development, coastal impacts and impacts on the tourism industry have emerged as important issues as well as the impacts of climate change and variability on urban areas.

Southeast

Using linked ecophysiological, hydrologic, and economic models along with climate change scenarios, the assessment team is conducting quantitative assessments on both agriculture and forestry which will be coordinated with other regions to ensure coverage of the entire southeastern U.S. The effects of climate variability and change on ground-level ozone production, air quality, and non-attainment as well as on stream flow, runoff, and water quality compliance will be assessed using historical and climate scenarios. The team will examine the cross-cutting effects of water and extreme climate events on these sectors.

Southwest-Colorado River Basin

Water, health, and urbanization have emerged as key issues in the region. Utilizing tree-ring analyses, team members will examine the consequences of extreme events and climate variation over the past 500 years in an attempt to evaluate what the effects of these events would be if they were to occur today. The team will continue outreach to stakeholders through their web site and on-line discussion group. They will coordinate with ongoing regional research activities to expand the scope of their assessment. For example, in collaboration with the Institute for Study of Planet Earth at the University of Arizona, they will analyze the contemporary climate impacts in parts of New Mexico and Arizona.

Southwest-Rio Grande River Basin

The assessment team will collaborate closely with the Southern Great Plains region and work to identify the areas of greatest vulnerability in the region, especially those which may affect the health and water sectors. They will use climate scenarios to assess the impacts of climate change on surface water availability and the implications that the availability may have for urban and agricultural interests.



Sector Notes

Agriculture

The agriculture sector is primarily focused on issues associated with national and regional agricultural production and economic implications. The assessment team will consider the financial vulnerability of farmers and farming regions, coping strategies that may be utilized to manage the impact of climate change, and possible impacts of climate change on environmental factors. Some of these potential changes that will be examined are soil erosion, wildlife habitat, livestock waste, and agricultural chemicals. Finally, the assessment will examine the impact of the international agricultural market in the context of climate change.

Coastal Areas and Marine Resources

The assessment team is focusing on potential climate impacts within the broad coastal zone. These include: sea-level rise and impacts such as coastline erosion or infrastructure damage; changes in freshwater delivery, including the impacts on salinity and nutrient loading; the intensity and frequency of coastal storms; ocean currents; and ocean temperatures. Models will be used to project sea-level changes and other coastal phenomena. Logical inferences and case-studies based on observations of climatic

variability impacts may be used when climate models do not effectively address important variables. Outside input will be sought through regional interactions, review activities, and through brochures to interested parties.

Forests

The forests sector will concentrate on potential physical and chemical atmospheric changes and the related impacts of socio-economic shifts on forest structure and function. Specifically, this sector will look at forest productivity, forest tree diversity, forest carbon sequestration, and forest hydrologic change. Experimental literature, derived data, and model simulations will be incorporated into the analysis. The assessment team will develop alternate impact projections and adaptation strategies. Continental-scale models will be used as the basis for the assessment. When more detailed regional models of forest response exist, comparisons between regional and continental predictions will be conducted. Drafts will be placed on the web site for comments.

Human Health

The assessment team is concerned with identifying at-risk populations. As such, this sector is focusing on the possible implications of climate change on health, the provision of health care, and health-

related services. The specific vulnerabilities due to heat stress, respiratory disease, vector-borne disease, and water-borne/water-mediated diseases will be the target of the analysis. The assessment team will apply scientific literature, agency reports/contacts, ongoing research, and limited models to assess the potential vulnerabilities in human health. A general analysis and regional case studies will be completed.

Water Resources

The water resources sector is focusing on water quality and human health, extreme events, ecosystem function and health, water management and socio-economic impacts, water use/quantity/resources. All of these issues will be analyzed in the context of how potential climate change impacts may be related to other stresses. The assessment process is being incorporated with professional review through the auspices of a special symposium and journal issue of the American Water Resources Association. Stakeholders from the regions and other sectors attended a Water Workshop in Palm Beach, Florida from September 14-16 where they identified cross-cutting issues and developed assessment priorities.

For more information
(including contacts for each sector and region)
please see the USGCRP web site at
<http://www.nacc.usgcrp.gov>

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Newsletter of the U.S. National Assessment of the Potential Consequences of Climate Variability and Change

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