

Acclimations

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



Sectors in the National Assessment Process

By Anthony C. Janetos, NAST Co-Chair, NASA Headquarters

The National Assessment process on which we have collectively embarked depends on both outreach to a variety of national and regional stakeholders for the identification of important issues, and on the ability of the scientific community to analyze those issues, and suggest where vulnerabilities and opportunities may lie. In order to make this aspect of the process work, the assessment must have a component that investigates issues that are truly national in their importance, either because of the magnitude of the potential consequences or because the issues transcend regional boundaries.

It is no surprise that the regional workshops initially suggested a large number of issues that have either or both of these characteristics. At the time of last year's Climate Forum, the list of national issues for possible investigation was very long, and the prospects of investigating all of the issues of concern were correspondingly daunting. One of the early challenges of the National Assessment was deciding which of the many possible issues to address from a national perspective in this first round of analysis, so that we could be sure to do a few things really well.

important. Nevertheless, it was felt that these five provided a critical minimum number to investigate that would illuminate some of the potential consequences of climate variability and change from a national perspective. For each, there is an existing body of scientific literature on which to draw, and strong analytical capabilities within the scientific community. The federal agencies also showed a strong commitment to supporting analytical studies through the end of this first phase of the assessment process. A consensus quickly developed that these five issues, while not a complete story by themselves, would nonetheless present information critical to continue the national debate about what we do and do not know, what options are available for adaptation, and where both vulnerabilities and opportunities may exist in the future.

Although we have used the word "sector" as shorthand, we have not defined these issues from the traditional economic perspective that is implied by that term. Rather, we have encouraged as comprehensive an investigation as possible for each area of interest, from the perspective of the physical and biological sciences, to economics and social sciences, to understanding what coping strategies or opportunities might exist. The analyses will draw on the available scientific literature, but are also expected in most cases to draw on new modeling studies using consistent climate scenarios to investigate the potential responses of the systems of interest. We have also encouraged each team to reach out very broadly into its own research and user community to incorporate their expert insights. Such analyses are intended to go well beyond what has been possible previously, and begin to provide a more integrated national picture of the potential consequences of climate variability and change, albeit a picture with regional texture.

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This issue of *Acclimations* focuses on the sectoral component of the National Assessment. The decision to focus on five national issues: water, agriculture, forests, coastal areas, and health, was taken with the full knowledge that there were many others that might have been interesting and will ultimately also prove to be

Next Issue

La Nina Predictions
 Climate Scenarios for the Assessment
 Central Great Plains Climate Changes
 Assessment Socioeconomic Framework



Agriculture

By John Reilly, U.S. Department of Agriculture

Agriculture is one of our nation's most vital and economically important industries and also one of the most sensitive to climate change. Agriculture sector co-chairs John Reilly (MIT) and Jeff Graham (U.S. Department of Agriculture (USDA) Natural Resource Conservation Service have finalized the membership of the sector assessment team which will contain members of regional assessment teams, ongoing agricultural assessment activities at the national level, and government agencies.

Several ongoing assessment-related research efforts will be tapped in preparing the sector assessment. For example, the Department of Energy funded National Institute for Global Environmental Change, which is sponsoring a series of crop modeling studies to assess what is known about climate change impacts on agriculture. This study is updating and reapplying a methodology employed by the Environmental Protection Agency in the late 1980s during the first effort to assess climate change impacts on the U.S. The sector assessment will utilize modeling work currently being conducted at Pacific Northwest National Laboratory as part of its integrated global change assessment effort. Texas A&M University researchers have also used an agricultural economic model to show how climate change would affect agricultural income, consumers, exports, and regional production in the U.S. In addition, researchers at the Economic Research Service of USDA have capabilities that will be drawn upon for the agriculture assessment. They model impacts of climate change on agriculture production across the world, and are able to study how differential impacts on the U.S. and its foreign competitors might affect U.S. producers and consumers. Gaining insights

from all of these efforts will provide the information needed to estimate possible impacts of climate change on the U.S. agricultural economy under the climate and socioeconomic scenarios being used for the assessment.

The agriculture sector team will also develop at least three case studies that will focus on particular aspects of agricultural impacts that are not captured well in existing models, including:

Variability: Impacts on agriculture and responses by farmers to climate variability and changes in variability. Climate variability has the potential to significantly impact food production efficiency. For example, drought, floods, extreme heat, and storms can all cause severe losses. The sector team will therefore work closely with climatologists to develop meaningful agricultural impacts from potential shifts in climate variability.

Indirect Impacts: The off-site impacts of possible changes in climate on the environment. Not all impacts connected to agriculture will be directly related to food production. For example, more intense rainfall is predicted as a likely result of a warmer world. If true, then soil erosion and run-off of animal waste into streams, lakes, estuaries, and coastal areas may become more difficult to control and impacts may occur far from the original sources.

Uncertainty: Adaptation and response of farmers to climate change, and dealing with uncertainty in climate predictions. Climate may be changing but it is difficult over short periods to clearly separate the signal from the noise of normal variability. This



case study will try to shed some light on what farmers can do that makes sense under these conditions.

The agriculture assessment team recently held its first planning meeting and will conduct their work over the next year with a follow-up review meeting planned for late August of 1999. Based on this schedule and with review, final editing and publication time requirements, a report is planned for publication in January of 2000. A significant effort will be made throughout the assessment process to encourage public comment and stakeholder involvement. To that end, the sector team will assemble a steering committee to provide guidance on the overall assessment effort. In addition, principal sessions of the planning and review meetings will be open to the public, and representatives of stakeholder groups, regional assessments, and other sectors will be invited to meetings and kept informed of progress. Finally, the report will be reviewed widely both for its technical quality and its relevance to stakeholder questions.

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The World's Water

Peter H. Gleick, President of the Pacific Institute for Studies in Development, Environment and Security, and co-chair of the water resources sector, has just published a book entitled "The World's Water: The Biennial Report on Freshwater Resources". The book summarizes a wealth of data on freshwater resources, and how they may be affected by global climatic

changes as well as impacts to agriculture and human health. Gleick also discusses sustainable approaches to water management, new technologies in maintaining fresh water resources, and international conflicts over water resources. The book is available for \$29.95 from Island Press; phone: (800) 828-1302; fax: (707) 983-6414.



Coastal Areas and Marine Resources

By Donald Boesch, University of Maryland Center for Environmental Science; and Donald Scavia, National Oceanic and Atmospheric Administration

Recent experiences, from disastrous hurricanes to storms and other distant consequences of the El Niño, have heightened public awareness of the effects of climate variability on coastal environments and marine resources. Not only are these environments and resources dramatically affected by climate variations, but they may be highly susceptible to long term climate change.

Most attention in climate change assessments has been focused on the consequences of sea level rise for islands, shorelines, wetlands, and coastal communities. To varying degrees, sea level is rising in many parts of the world due both to sinking of coastal lands and thermal expansion of the ocean. If this is coupled with the possibility of increased ocean volume in a warming world due to glacial melting, sea level rise would have even more substantial consequences. The coastal areas and marine resources sector team will not only examine scenarios related specifically to sea level rise, but will also examine more broadly the myriad of known and potential consequences of climate variability and change on the coastal zone, the coastal ocean, and the marine resources of the nation.

Coastal environments and marine resources are affected in significant ways by storms, freshwater inputs from land and rainfall, water temperature, currents, winds and solar radiance, as well as by sea level. All of these vary with the climate, and could potentially change in major ways as a result of climate change. The assessment team will evaluate the effects of these climatic forces on the ecosystem goods and services provided by coastal environments, wetlands, estuaries, coral reefs, and ocean margin environments. The team will also examine the socio-economic consequences of the climate-related variation and change in these systems.

The coastal areas and marine resources sector assessment will emphasize case studies. The examples chosen will provide specific examples and illustrate the complex set of interac-

tions between the effects of these climate (i.e. variability and long-term change) and human activities (e.g. flood protection, navigation, pollution, and conservation).

Anticipated case studies include:

Bering Sea - affected by reductions in sea ice coverage and alterations to the food chains supporting fisheries.

Northeastern Pacific Ocean - characterized by regime shifts in the Alaska and California currents which cause profound effects on associated ecosystems and their productivity.

San Francisco Bay Delta - affected by freshwater inflows, El Niño-related events, sea level rise, and the need to maintain urban and maritime infrastructure.

Mississippi Delta - where low-lying communities are increasingly at risk to hurricanes and coastal wetlands are already being rapidly lost as a result of relative sea level rise due to land subsidence; and where climate impacts the delivery of freshwater, sediments, and nutrients by the river.

South Florida - where changes in sea level and freshwater inputs affect the Everglades and Florida Bay, and where coral reefs are influenced by climate factors.

Mid-Atlantic estuaries such as the Chesapeake Bay - where variations and changes in freshwater inputs and sea level rise complicate efforts to restore ecosystems degraded by eutrophication and habitat loss.

The coastal and marine sector assessment team has been formed and has had its first organizational meeting. It is currently assembling retrospective data and analyses and future model projections of such factors as temperature, freshwater runoff, storm frequency and intensity, sea level, sea ice, human population and development, wetlands, fisheries, shoreline erosion rates, and salinity. The team is co-chaired by Donald Boesch of the University of Maryland Center for Environmental Science in Cambridge,

Synthesis Team News

The third official meeting of the U.S. National Assessment Synthesis Team (NAST) took place November 16-17 at the National Science Foundation in Arlington, Virginia. The meeting was chaired by Jerry Melillo and Tony Janetos.

The objective for the meeting was to make additional progress in developing the Synthesis Report outline based on comments that had been received on the Woods Hole draft. In addition, the next steps in drafting the Synthesis Report were outlined, including writing assignments and a timeline for the completion of the work.

The Synthesis Team Outline provided the framework for the meeting. Following the Woods Hole meeting in August, the outline was distributed broadly to National Assessment participants. Comments were then collated and redistributed to the Synthesis Team. These comments provided the basis for revising and further developing the outline.

Significant thought was given to interactions with the regional and sectoral teams. It was concluded that a NAST member should serve as liaison with each of the 6 "mega-regions" identified in the Synthesis Report and with each of the 6 cross-cutting issues (the five sectors conducting assessments as well as Native Peoples/Native Homelands). This liaison will work with the regional and sectoral teams in developing the sections over the next few months to ensure that each was cohesive and fairly represented the issues and major impacts for the regions.

The next meeting of the National Assessment Synthesis Team is scheduled for April 12-14, 1999, in Annapolis, Maryland.

MD and Donald Scavia of the National Oceanic and Atmospheric Administration.

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Forests

By Steven McNulty, U.S. Department of Agriculture, Forest Service

Environmental factors controlling forest distribution and growth vary across the nation (Figure 1). Precipitation, minimum and maximum air temperature, or soil conditions can dominate ecosystem structure and function, depending on geographic location. During the past decade, field observation and experimentation have been combined with forest process models to examine the impacts of changing precipitation, air temperature, ozone, and carbon dioxide on forest structure and function. This research suggests that the impacts of climate change will not be uniform across all forests types.

Tree species that currently exist within a narrow range of soil or climate conditions

are particularly vulnerable. For example, spruce-fir forests are often located across a narrow elevational range in mountainous areas where climate and soil conditions provide them with a competitive advantage over other tree species. In warmer areas below this elevational range, hardwood forests dominate. In colder areas above the elevational range of spruce-fir, climate and soil conditions restrict vegetative growth. Under a warmer environment, hardwood forests will move to higher elevations; however, spruce-fir forests will be limited from also moving to higher elevations due to poor soil conditions in those areas. Therefore, spruce-fir forests could be replaced with hardwood stands across much of the country. Similarly, the competitive advantage that other forest types have developed to survive in very dry or wet environments may also be disrupted by climate change. The rate of potential climate change that forests are subjected to may be faster than the rates at which they can adapt. This could result in specific forests being displaced or in species extinction. Therefore, the degree of climate change, geographic location, and forest species composition will all contribute to the positive or negative impacts of climate change across the country.



Figure 1. Forested areas of the continental United States (USGS).

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carbon dioxide. Relatively young forests that are strong carbon sinks cover much of the U.S, providing an important link to changes in atmospheric carbon dioxide concentrations. For the national forest sector assessment, discussion of climate change impacts on the forest sector will be compiled from the twenty regional workshops. Other components of the forest sector, including recreation, wildlife diversity, population size, and water use and yield, may also be impacted by climate change. To examine these components, the forest sector

The ecological and economic importance of forests varies across the nation. For example, in the southern U.S., much of the forested land is intensively managed for lumber production, while mid-west forests serve more of a recreational purpose. In addition to ecological and economic considerations, forests and soils may be important sinks of atmospheric



assessment team has formed a committee to compile, review and present the available information from many published sources including the United States Resource Planning Assessment Report and the Vegetation/Ecosystem Modeling and Analysis Project. The forest sector committee is co-chaired by Dr. John Aber of the University of New Hampshire IN Durham, NH and Dr. Steven McNulty of the USDA Forest Service IN Raleigh, North Carolina. The sector team will develop alternate impact projections and mitigation strategies based upon the scenarios supplied to the sectors. Working drafts of the assessment will be posted to the sector web site to solicit public comments. For the latest status and information on the forest sector assessment, see the sector web site at <http://www.sgcp.ncsu.edu/forestsector.html> (under construction).

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Human Health

The health sector will focus on what is known about the relationship between climate and health, and on the possible effects climate change and variability might have on human health in the United States. The assessment will factor in anticipated changes in the American population and way of life as a result of aging, urbanization, immigration patterns, population growth, economic development, and other factors. It will also evaluate the extent to which the nation can potentially adapt to or mitigate the health effects of climate change and variability, and identify other current and possible future health priorities for the country that might compete for the nation's attention and resources.

The project is co-chaired by Jonathan Patz, Director of the Program on the Health Effects of Global Environmental Change at Johns Hopkins University School of Public Health, and Michael McGeehin, Chief of the Centers for Disease Control (CDC) Health Studies Branch, and is directed Susan Bernard, also at Johns Hopkins. A group of eight lead authors has been assembled from a range of government, academic, and private institutions.

The literature on the topic of the possible health effects of climate change and variability in the United States identifies a number of potential outcomes, mostly adverse. For example, if the summer heat waves become more frequent or last longer, heat-related morbidity and mortality, particularly among the urban and elderly poor, could

increase. Because higher temperatures have been shown to exacerbate air pollution, longer, hotter summers may lead to increased respiratory illness in our cities. The habitats of disease vectors may change as regional climates become more or less hospitable to them. Changes in the hydrological cycle may result in increased severity and frequency of storm events like those driven by El Niño. As we have learned from the recent series of El Niño events, extreme weather events can result in injury, illness, emotional distress, and even death. Additionally, storm events can result in exposure of people to water and food-borne diseases as a result of contaminated storm water runoff and flooding.

The health sector assessment will address four key questions (with sub-questions):

- What is the current status of the nation's health, and what are current stresses on our health?
- How might climate change affect the country's health and existing or predicted stresses on health?
- What is the country's capacity to adapt to climate change, for example, through modifications to the health infrastructure or by adopting specific coping mechanisms? What are the negative health impacts, if any, of adapting? What are the co-benefits, if any? What are the economic and social costs/benefits?

- What essential knowledge gaps must be filled?

These questions can be answered, to the extent an answer is currently possible, through comprehensive research in a range of sources, including scientific literature; government reports and information; ongoing and unpublished research; and some computer modeling, using climate change and socioeconomic scenarios developed by the NAST. The health sector assessment team is currently seeking the involvement of members of the public health community and of other participants in the national assessment process in defining the scope of their investigation and in identifying public health concerns, priorities, and research needs with respect to climate change and variability. Copies of the relevant documents may be obtained by emailing healthfx@jhsph.edu or by calling Susan Bernard at (410) 955-4074. Comments should be submitted in writing, so that they can be disseminated to the assessment authors for consideration and response. (Email is fine for briefer comments. Longer comments should be mailed to Susan Bernard at the address listed below.)

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Wetlands and Climate Change Workshop

The Institute for Wetland Science and Public Policy of the Association of State Wetland Managers is organizing a workshop entitled *Wetlands and Climate Change: Scientific Knowledge and Management Options*. The workshop will be held February 3-4, 1999, in the U.S. Fish and Wildlife Service Patuxent Research Refuge at the National Wildlife Visitor Center in Laurel, Maryland. It is being sponsored by the U.S. Geological Survey and the U.S. Environmental Protection Agency.

Goals of the workshop include:

- Identification of wetland systems at greatest risk
- Dissemination of information on wetlands impacts caused by global change and other stresses
- Discussion of coping strategies to deal with climate

change impacts

- Identification of research priorities and information needs

National Assessment participants are closely involved in the planning of the workshop. It is anticipated that the workshop will benefit from the work of the National Assessment, and will provide important information to the regional and sectoral teams. In particular, strong synergies are anticipated with the water and coastal sectors.

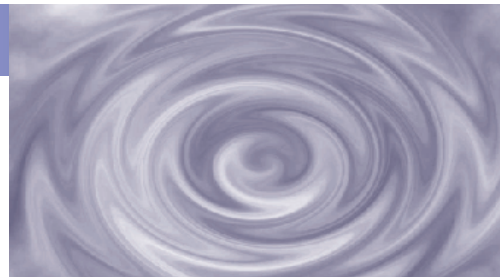
For more information, contact:

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Water Resources

By D. Briane Adams, U.S. Geological Survey



Water resources are integral to every region and sector included in the National Assessment. The scope of the sector includes everything from water availability and quality to almost every aspect of societal needs and dependence on water resources. Topics for the assessment thus range from water quantity to the economic impacts resulting from the potential consequences of climate variability and change, including possible responses of water managers and planners.

The water resources sector of the National Assessment has been organized with nationally recognized team members from federal and state governments, academia, and the private sector. They represent a wide variety of technical, management, and legal disciplines and stakeholders. The sector team is being sponsored by the U.S. Geological Survey (USGS), and is co-chaired by D. Briane Adams (USGS) and Peter Gleick (Pacific Institute). Sector Assessment Team (SAT) members have been identified to serve as the principal authors of the assessment report and of journal papers in their area of expertise, and to guide any additional work to be done

during the assessment. In addition to the SAT, an advisory committee (ADCOM) has been formed that complements the expertise of the SAT. The USGS Water Resources Division has also provided a core of researchers (ATEAM) that will provide analytical support for the assessment. The sector is also making plans to work with various water-related organizations at the national and international level, including the American Water Works Association, the American Water Resources Association, the American Geophysical Union, the International Water Resources Association, the American Association for the Advancement of Science, and many others. One member of the SAT is an education and outreach professional and is developing plans for a public education process that will include focus groups to interpret needs and to design processes for effective outreach.

The water resources sector work began on July 2, 1998, with a meeting of the SAT and other National Assessment participants. The SAT identified required work areas, and made initial assignments to members. A workshop was held from September 14-

16, 1998, in West Palm Beach, Florida. This meeting invited participation from all the team members, water resources representatives from the twenty regions, and other sector representatives. The workshop summarized and prioritized water resources issues from the regions and other sectors in the assessment (see Regional Water Issues sidebar).

The products of ongoing water sector research activities will be presented publicly at an American Water Resources Association (AWRA) symposium held in Atlanta, Georgia, May 10-12, 1999. Proceedings of this meeting will provide an opportunity for wider professional, policy and public comment. Significant papers will be selected for further development and will be published in the October 1999 issue of the Journal of the American Water Resources Association.

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Assessment News

Synthesis Team:

A Meeting of the Synthesis Team took place November 16-17. The team made further progress in developing the Synthesis Report outline and to develop a timeline and assignments for next steps (see Synthesis Team News).

Scenarios:

A Synthesis Team sub-group distributed a revised guidance document on socio-economic frameworks to regions and sectors October 16th.

NPAData Services, Inc. distributed two CD-ROM disks containing the middle (baseline) growth scenarios for the period 1997-2025. Due to limited supply, one set was sent to each region and each sector. The next mailouts will contain the high and low growth projections for 1997-2025 (mid-December) and the high, middle and low growth projections for the period 2025-2050 (January).

Sectors:

Leaders for each of the sectors participated in a conference call with Tony Janetos in early November to discuss progress and ask questions of the Synthesis Team co-chair.

The water sector held a meeting in West Palm Beach, FL September 14-16 inviting representatives of all regions and all other sectors.

Regions:

The nineteenth regional scoping workshop, the Native Peoples/Native Homelands, took place October 28-November 1 in Albuquerque, NM.

Many regions held major follow-up workshops or meetings including Alaska (workshop October 29-30), Metropolitan East Coast (assessment meeting November 6), Central Great Plains (steering committee September 9-10), Mid-Atlantic (stakeholder meeting October), Pacific Northwest (water resources meetings), Rocky Mountains (climatology-hydrology focus group), and SW/Colorado River (urban water and ranching October 22-23).

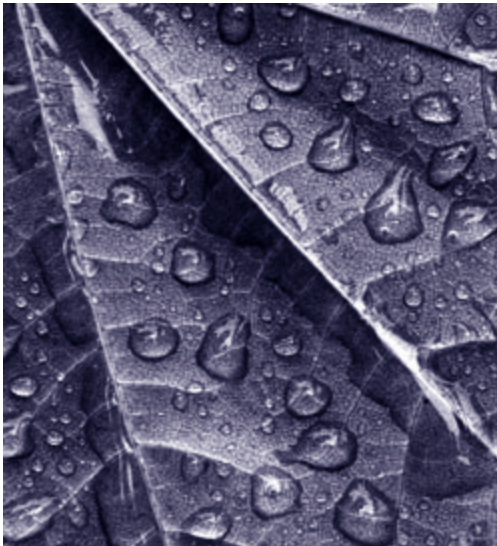
Other:

NASA announced the winners of the Regional Earth Science Application Centers (RESACs), including George Seielstad, the PI of the Northern Great Plains region. Other awardees closely involved in the National Assessment include Roger Bales of the University of Arizona.



Regional Water Issues

The first workshop of the water resources sector was held from September 14-16, 1998, in West Palm Beach, Florida. The workshop summarized and prioritized water resources issues from the regions and other sectors in the assessment. Regional issues identified at the workshop included:



Central Great Plains: The Central Great Plains rely on water imported to the region. The main transbasin water diversions are the tunnels drilled through the Rockies to bring supplies of water from the Colorado River to the Great Plains. Irrigated agriculture is a main end use in this region, and this demand is increasing (although there are some shifts underway from agriculture to urban development). The biggest regional issue is the lack of surplus capacity in regional water supplies. For example, water from the Arkansas River serves multiple uses as it passes through the different states. The resulting conflicts over allocation of limited groundwater and surface water supplies have led to a number of lawsuits in the region.

Eastern Midwest: The eastern Midwest includes some of the largest river systems in the nation, and this region is also strongly affected by drought and flood. Drought brings on low flow and depletion of groundwater. Flooding causes crop and property damage, erosion, and sedimentation. In addition, agricultural runoff from the region is causing hypoxia (a reduction in aquatic oxygen concentration to levels where life cannot be sustained) within the Gulf of Mexico. On the bright side, floods increase the fish population. Generally, the region has

plenty of water, but the effectiveness of the distribution systems varies, resulting in water shortages during droughts.

Great Lakes: The Great Lakes, while making up 95% of the fresh surface water in the United States, are a shared resource with Canada. The potential for degradation in water quantity, quality, associated ecosystems, and coastline is a concern for both nations. Anticipated impacts associated with climate change and variability include increased air temperatures, changes in precipitation, increased evaporation from lakes, increased evapotranspiration from plants, decreased tributary flows, decreased net water supplies, and lower lake levels. Seasonal and interannual changes are also projected to lead to a factor of three increase in the normal variability of water level in the lakes. Regional needs include a serious consideration of sustainability, the development of a robust water-management plan including groundwater supplies, and an assessment of water-quality and ecosystem impacts on the 121 watersheds around the Great Lakes.

Metropolitan East Coast: Although many communities in this region have their own water supply systems, they are generally small compared to that for New York City. Water supply here is a complex issue which is linked to many others. Climate change would occur on top of these other dynamics with unknown effects to the water supply. A rise in sea level could also cause a major impact because it would result in saltwater intrusion into the long island aquifer, causing increased strain on the New York City system. New institutional forms and changes will be needed, as will new infrastructure systems. The quality of effluent waters has improved significantly; water quality will not be affected to a large extent by climate change unless large increases occur in upstate precipitation or there is a large sea-level rise.

Mid-Atlantic: The Middle Atlantic region is an area with significant climate variability and large vulnerabilities. During the past few decades, the region has experienced both severe drought and flooding produced by winter storms and summer hurricanes. The region includes several metropolitan areas which rely on water systems that are highly sensitive to climate variation. A large portion of the population obtains water from private wells which are potentially impacted by cli-

mate variability. As a result, water management in dry periods is a major issue here.

Pacific Islands: The Pacific Islands cover a vast expanse of ocean but have a relatively small population and vulnerable economic and ecological systems. Water-resource systems are made up of (1) low-lying atolls with no groundwater, and (2) high islands with the runoff from mountains being collected for subsequent use. The extant models of these systems are relatively weak, and limited historical climate data exist for the area. Research and information that are needed include: reinstatement of streamflow monitoring, better understanding of climate-system processes, information and education campaigns, and involvement of the industrial sector in overall water use planning.

Pacific Northwest: As temperatures go up, snowpacks in the mountains go down, and those snowpacks supply most of water resources to the area east of the Cascades. Late fall snow turns into flood-producing rains under warmer climate scenarios, leaving less snowpack to augment water flows during the summer. Because the Columbia River watershed has already experienced demands on too little water, a potential decrease in water availability is a major concern. Another regional issue is the length of time required for fish to travel downriver with all the reservoirs in place and related degradation in fish habitat.

Rio Grande: Water shortage is a concern for the entire region, yet at the same time the region is experiencing rapid urban and population growth. With the population doubling every 20 years, aquifers are being depleted rapidly. Conflicts are arising between Indian tribes and the rest of the community, resulting in legal battles in many cases. Border river water is being allocated to agriculture, yet no drought-management plan is in place. With in-stream flows as low as 20% of historical levels, the ecology of the region is also threatened. One potential answer to supply problems is increased efficiency of agricultural water use.

South Atlantic Coast and Caribbean: Some parts of the region (such as the southeastern states) have abundant water; but others (such as the Caribbean Islands) have no groundwater. Water management policy is critical

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The End of Tomatoes

By Robert Gerard

I planted 300 tomato plants this year with great expectations. I worked hard to get the soil ready for them, laying down drip hoses, getting the seeds started and cared for till they were large enough to transplant. I watered the growing plants throughout the season, watching their progress with great attention and taking the needed action when a problem arose.

Tomatoes as a crop can be so good or so bad. They are sensitive to environmental phenomena and can react in mysterious ways to the world around them. They are often beset with plagues of insects and diseases and nutrient problems. And then there are the endless "I don't know's" which usually result in shaken heads, shrugged shoulders, speculations - but no real straight answers.

For the second year in a row the tomato plants grew into beautiful plants that produced a harvest. Harvests that were only enough to favor customers happy. Not enough, not a profit.

But I am not alone. No one got a good harvest. Speculations fly about the lack of flower and fruit set. The general observations of the growers, however, have concentrated on the climate. Most agree that the weather has just been too hot for good tomatoes. And they also agree that it is not so much the daytime temperatures that have caused the problem but the lack of cool nighttime temperatures. They surmise that the higher than usual humidity is a big reason why the nights have stayed so warm - there has not been that dry-night heat loss as usual. I should probably explain at this point that tomatoes are particular about temperature. They will not set flowers or fruit well when the temperatures are over 92F daytime or over 70F nighttime.

Well, the growers have been disappointed as have the consumers. There have not been many home grown tomatoes this year. "Maybe next year", is the cry most commonly heard from the vegetable farmers.

My uncle wonders why I bother with tomatoes. He is from the old school and believes that horse sense should always prevail. He questions why I gamble with such a sensitive crop as tomatoes when I could turn my concentration over to garlic, which is almost too easy to grow.

For me and some others there will be no next year for tomatoes. It is a bit sad for me because tomatoes are a truly satisfying crop to sell. Customers oooh and aaah, they compliment the grower for producing such fine tasting tomatoes and crack open their

wallets with glee. But practically speaking, this satisfaction does not keep a farm afloat. It doesn't pay for the water bills and lost time when harvests are poor.



...s' eyes, tell them that
...next year. I tell them
...problem with warm
...idity. I am not alone
...and tomatoes. Other
...s are telling the same
...and many of them
...ive been at this pro-
...fession much longer
...than I. They've said
...that back in the 60's
...and the 70's the
...nights were cooler,
...hovering below
...70F, and the
...humidity would
...average around 10
...or 15% - much
...lower than the 30%
...humidity that we get
...ow.

I ask these old timers what is the cause of this climate change? What is going on? "Oh Bobby", they respond, "it is mostly to do with El Paso, it has gotten so big and all that concrete holds the heat into the night and warms up the desert all around. It also doesn't help that all them swamp coolers and lawns have bucked-up the humidity up as well. And then there is that global warming."

Interestingly these old fellows are remarkably open to talk of global climate change; they believe in it strongly and have believed in it long before it became a hot topic. It is the younger fellows that stubbornly contend that nothing has changed. These younger men have less history on this planet than their older compatriots and perhaps believe as they do because of inexperience with weather. They may also be resistant climate change talk because they feel threatened by it.

After all, their stake both timewise and in relation to climate is larger than the older fellows and oftentimes negative talk makes them feel as if their backs are against the wall.

Anyhow, I will breathe a sigh of relief when the first freeze signals the end of tomato season. The farm is on its way to becoming a total garlic operation. Garlic is a wonderful crop that grows through our mild winters without pest problems or any major hassles. It stores well so it doesn't have to be marketed quickly and sells with ease.

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Calendar

National Assessment Sponsored Meetings:

Southwest Colorado River Regional Assessment Team and Steering Committee Meeting

Tucson, AZ

December 18, 1998 (Contact: Todd Hinkley, thinkley@usgs.gov)

National Assessment Meeting of Regions and Sectors

Annapolis, Maryland

April 10-12, 1999 (Contact: Melissa Taylor, mtaylor@usgcrp.gov)

National Assessment Synthesis Team

Annapolis, Maryland

April 12-14, 1999 (Contact: Melissa Taylor, mtaylor@usgcrp.gov)

Southern Great Plains Workshops

Texas

Early 1999 (Contact: Robert Harriss, harriss@tamu.edu)

Related Meetings:

Committee on Human Dimensions and Global Change of the National Research Council

Washington, D.C.

Dec. 11-12, 1998 (Contact: Heather Schofield, (202) 334-3731; hschofie@nas.edu)

IPCC Third Assessment Report; Third Lead Authors Meeting

Geneva, Switzerland

5-8 January 1999 (Contact: webmaster@ipcc.ch)

American Meteorological Society 11th Conference on Applied Climatology; 10th Symposium on Global Change Studies

Dallas, Texas

January 10-15, 1999

(Contact: see web site at http://www.ametsoc.org/AMS/meet/meet_79page.html or Evelyn Mazur, (617) 227-2426, ext. 204; emazur@ametsoc.org)

IPCC Meeting of Chapter Team on Detection

College Station, Texas

January 15-16, 1999 (Contact: webmaster@ipcc.ch)

American Association for the Advancement of Science (AAAS)

Anaheim, California

January 21-26, 1999 (Contact: see web site at

<http://www.aaas.org/meetings/scope/> or Ryan Strowger, (202) 326-6736; rstrowge@aaas.org)

Wetlands and Climate Change Workshop

Laurel, Maryland

February 3-4, 1999 (Contact: Jon Kusler, (518)872-1804; aswmi@aol.com)

AWRA: Potential Consequences of Climate Variability and Change to Water Resources of the United States

Atlanta, Georgia

May 10-12, 1999 (Contact: American Water Resources Association, (703) 904-1225; awrahq@aol.com)

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The loss of my and other growers' tomatoes is probably not important in the whole scheme of things. As climate change goes it is rather a small loss that can perhaps be overlooked. People can continue to live without fresh tomatoes; they can go to their jobs, buy their groceries, and drive their cars. But I can not say with certainty that the loss of fresh tomatoes is insignificant. A good fresh tomato brings joy into peoples' lives. It adds to their existences, making them fuller, albeit by a small degree - giving them nutrition and flavor. And perhaps this is the major lesson of these tomatoes and climate change: that everything to do with our changing weather does not have to be catastrophic to be important. Waves should not need to destroy houses nor winds blow down bridges to get our attention. There are little losses that don't threaten us but are significant in that they chip away at the things we enjoy. That deserve notice because they reduce the quality of our lives.

Robert Gerard studied agriculture at New Mexico State University. After he received his degree, Robert spent the next 10 years working as an Extension Agent in various Latin American countries. Since 1990, he has worked as a Market Gardener in Chaparral, New Mexico. He is the author of the book "Gardening the Arid Land" which is a technical book on dryland gardening. It may be ordered from Robert Gerard for \$8.95 PPD at 441 Paseo Real, Chaparral, NM 88021

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because of the strong pressure for further development in the region. Demographic IMPACTS also play an important role in water management and use in this area because of the high population densities along the coast and because of large seasonal swings in population. In addition, some health hazards are also associated with water resources.

Southeast: The Southeast regional workshop identified agriculture, forestry, and ecological systems as the main areas of concern, especially with respect to water quality and availability. To assess how climate change and variability might affect those resources, institutions and agencies are performing climate-model simulations and biophysical-response models relating to water resources for agriculture, forests, and land use.

- D. Briane Adams, USGS

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

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