

# Acclimations

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



## Policy Implications of Scientific Assessment

By Daniel Reifsnyder, U.S. Department of State

Having spent the past decade on the negotiating front, I can say with confidence that nations are passionately interested in their vulnerability to climate change and in their options for adaptation. This passion runs highest among the developing countries -- many have contributed (and will contribute) little to the build-up in atmospheric concentrations of greenhouse gases, but they know they may suffer. They worry too that they won't have the resources to adapt.

Why is the U.S. National Assessment so important? Because it is the most comprehensive such effort ever undertaken, because it may serve as a model for other countries, and because it will be a major contribution by the United States to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), scheduled for completion in 2001.

Arguably the most significant article of the U.N. Framework Convention on Climate Change, and its most lasting achievement, is Article 2. That article contains the Convention's ultimate objective: to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human interference with the climate system. The objective also provides that such a level should be achieved in a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in an equitable manner.

Even before the negotiations that led to the Kyoto Protocol, there was strong interest in what this level should be. In October 1994, the IPCC held a workshop in Fortaleza, Brazil, to discuss the objective's scientific and technical aspects. As IPCC Chair Bert Bolin said at the time, "It is not an IPCC task to define how terms such as 'dangerous,' 'threaten,' and so on are interpreted. Still scientific informa-

tion is of basic importance to resolve issues of this kind. When the word 'level' is mentioned, we should present several alternatives, describe the differences, and thereby illustrate the sensitivity. When adaptation is at stake, we need to present information that permits an analysis of what is critical for determination of 'rates of change.' "

Coming to grips with the objective of the Convention will be the most critical and most difficult task for the foreseeable future. Therein lie all the concerns about preserving our environment while maintaining economic prosperity. To date, it has not been possible to say with certainty what climate change may be avoided by stabilizing atmospheric concentrations at a particular level. Even more important, it has not been possible to say precisely how life as we know it would be affected if we attain or avoid a particular level. Much depends on the 'rates of change' Professor Bolin mentioned. But if science can assess these consequences and present them clearly, the task persuading people to act will be much easier.

The IPCC is now fully engaged in preparing its Third Assessment Report. The United States is well placed to contribute significantly to that effort. In addition to legions of U.S. scientists giving freely of their time to serve as lead authors and reviewers, Dr. Robert Watson chairs

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## Stakeholder-Led Assessment of Climate Change Impacts: The UK Climate Impacts Programme



By Merylyn McKenzie Hedger, UK Climate Impacts Programme

The UK Climate Impacts Programme (UKCIP) is a Government sponsored but stakeholder-led program initiated in 1997. The program is part of the ongoing research strategy on climate change of the Department of Environment Transport, and the Regions (DETR) which has the lead within Government on the issue. While the focus of the work of DETR is mitigation through the reduction of greenhouse gas emissions, the EU stabilization target of 550 ppm of CO<sub>2</sub> implies that 2-3° C of climate change will occur. Thus, Government support for the program recognizes that climate change has to be tackled.

### UK CIP Structure and Approach

The program is advised by a Steering

Committee comprised of representatives of key Government departments, public agencies, the private sector and NGOs. A Science Panel oversees the integrity of the work and a User Panel will enable stakeholders to interact directly. There are also now a number of steering committees for projects operating within the program.

The program currently has no direct funds of its own to undertake research, so has been working largely in a 'bottom-up' mode, supporting organizations to initiate studies which assess their own vulnerability and work out their responses with the "stakeholders". It has become a new link between users and researchers and helps make connections between partners to stimulate a broad-based approach to the study of climate change impacts. In order

to generate momentum it has been opportunistic and responsive to enquiries wherever they have arisen. The conceptual framework is of modular studies, which can be used to prepare an integrated national assessment. Integration will be achieved principally through:

- The common use of core data sets and scenarios.
- Development of networks of funders and researchers.
- Developing and applying specific methodologies.

The program office tries to promote the identity of UKCIP through the organization of workshops, newsletters, a website, *continued on page 3*



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the IPCC, and Dr. James McCarthy co-chairs its Working Group II on Impacts and Adaptation.

U.S. interest in Working Group II was not fortuitous. Many in the USGCRP recognized that holding this position internationally would complement the enormous domestic effort we are undertaking in the U.S. National Assessment. By assessing the potential consequences of climate variability and change in the organized, methodical manner in which the

National Assessment is being undertaken, words such as "dangerous" and "threaten" may come more clearly into focus.

In Fortaleza, Professor Bolin asked, "How can we present scientific information in a way that is relevant for policy-makers?" He suggested that this could be done by:

- Elaborating and explaining the types, sources and consequences of uncertainties.

- Pointing out the role of natural climate variability, in interaction with limited knowledge, in contributing to uncertainties.
- Highlighting the importance of extreme events when assessing damages (and not simply changes in mean conditions).
- Underscoring the importance of extreme, unexpected events in heightening peoples' awareness, in social change, and in human responses.
- Developing improved definitions of critical 'loads,' 'levels,' or 'changes'.
- Improving our understanding of 'irreversibility,' and the processes and time scales needed for restoration of ecosystems".

The importance of scientific assessment to the policy debate cannot be over-estimated. It was the IPCC First Assessment Report in 1990 that led to the Convention. It was the IPCC Second Assessment Report in 1995 that led to the Kyoto Protocol. In Buenos Aires last November, several nations, including the United States, sought to link further reviews of the "adequacy" of commitments to the scientific assessment cycle of the IPCC. Scientific assessment will continue to drive the negotiations, as it has consistently over the past decade. Let me assure those involved in the U.S. National Assessment, you are most assuredly not working in a vacuum. We in the policy community welcome and applaud your efforts.

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and by daily work with stakeholders. It has overall responsibility for preparing a major report on integrated assessment, and in March 2000 a report is due on the first stage projects underway. Underpinning products for the program in the form of Technical Reports are separately funded by DETR:

- Report on climate change scenarios, *Climate Change Scenarios for the United Kingdom*, launched in October 1998. The scenarios were based on the series of climate modelling experiments performed by the Hadley Centre with their HadCM2 model over the period 1995 to 1997. A CD-ROM has been made available for studies within the program. A Summary Report that explains the use climate scenarios in an accessible way has been widely distributed in the UK.
- Socio-economic scenarios - a study intended to provide baseline socio-economic scenarios for the UK has been underway. Next steps are also under consideration.
- Risk, uncertainty and decision-making – this work will shortly start and is intended to provide guidance to policy-makers as to how they can plan for climate change without complete information.
- Costing the impacts of climate change (at planning stage).

### UKCIP studies underway

Studies within the program fall into two broad groups: sub-UK/ regional and sectoral studies.

Sub-UK/ regional:

- Scotland- draft finished of scoping study (covering mitigation and impacts assessment), to be launched by the new Government for Scotland, funded by The Scottish Office;
- A scoping study for Wales is about to start, funded by The Welsh Office;
- A scoping study for North West England was completed in December 1998, funded by an in-region consortium of local governments, the regional Government Office, NGOs, and the EA;
- A scoping study for South East England is underway, funded by an in-region consortium of local governments, the regional Government Office, NGOs, the EA and a major up-market magazine;
- A major conference for South West England is planned for October 1999 to look at the economic impacts of climate change on the region. It is funded by in-

region universities, local business, local government, NGOs, the Duchy of Cornwall (HRH Prince of Wales' land holdings) and the regional Government Office. Reports from the Conference and other outputs will steer next stage work.

UKCIP sectoral studies:

- A scoping study of health impacts - led by Department of Health
- In biodiversity- two studies are underway: one scoping study relying on a literature review and expert judgement has been funded by two Government departments, another quantitative modelling exercise is led by specialised agencies and NGOs;
- Built environment- so far work directly within the program has been focussed on developing a project with the Association of British Insurers on subsidence; issues on data confidentiality have eventually been overcome. Other studies on the impacts of climate change on buildings had already been commissioned by central government.
- One of the priority studies identified by the original scoping study for UKCIP was the need for integrated assessments of impacts of climate change on the water sector. To develop methodologies a major study (REGIS) has been funded for 2 years looking at four related sectors (water, land use, biodiversity and coasts) in two regions (East Anglia and Northwest England; funds \$500,000).

### UKCIP funding 1997-2000

The bulk of the funds come from central government where UKCIP has proved to be an effective vehicle to lever involvement from a wider range of departments. Private industry's involvement so far is limited largely to the water and insurance sectors. The sums needed for involvement in scoping studies need not be large. For example, in the Southeast study, contributions of \$3000 to \$8,500 led to a total of \$75,000 being raised, including \$5000 from a major magazine that is tracking the study monthly in its publication. More difficulties arise in raising funds for fundamental research. The budget for the Core Program Office is \$1.4mn over the 1997-2000 period and so far \$1.3 million has been raised for projects, including \$250,000 from private industry and \$250,000 non-central Government.

### Differences between UK CIP and US National Assessment

While there are many similarities between the US and UK programs, a number of important differences can be identified and these are listed below:

- In the UK, there is no interagency structure equivalent to the USGCRP, so this has meant the program itself is helping to develop linkages within Government.
- The program is led by one Government department and based at one university so efforts are needed all the time to diversify ownership.
- There is a greater diversity of funding within UKCIP.
- The UKCIP98 climate scenarios have provided intellectual leadership for the program.
- There is competitive bidding for contracts so this can mean there is some reluctance to share contacts/ results between contracting teams, and that can be a problem in the undertaking of a series of ongoing overlapping studies in a small country.
- Stakeholder control makes coordination is more difficult, it is not practical to think of a common template for reports for example. But the results will immediately be plugged into decision-making frame works of stakeholders.
- Human induced climate change is accepted scientifically as a basis for action by the research community and business, as well as by the Government.
- Identification of impacts is used by Government as a rationale/ driver for its well-developed mitigation program.

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## The Canada Country Study: Climate Impacts and Adaptation

By Roger Street, Atmospheric Environment Service, Canada

Canada has responded to the need for a better understanding of the impacts of climate change and potential adaptive response by undertaking a national assessment - The Canada Country Study: Climate Impacts and Adaptation (completed in 1998) - and a focused national effort on identifying impacts and adaptation options - the establishment and administration of the Science, Impacts and Adaptation component of the Climate Change Action Fund (to be completed by March 2001).

The Canada Country Study (CCS): Climate Impacts and Adaptation was the first Canadian assessment of the potential impacts of climate change and variability, including consideration of existing and potential adaptive responses. This assessment focused on reviewing existing scientific and technical literature through a series of commissioned studies and regional workshops. The result of this initial work is state-of-the-art information for Canada on the sensitivities and vulnerabilities of Canada's economic sectors, social well-being, and ecological systems to projected changes in climate (see web site <http://www.ec.gc.ca/climate/ccs>).

The results of this initial assessment are published in eight CCS volumes - six regional volumes (Arctic, Atlantic, Ontario, Pacific and Yukon, Prairies, and Québec), a national sectoral volume consisting of twelve papers (agriculture, built environment, energy, fisheries, forestry, human health, insurance, recreation and tourism, transportation, unmanaged ecosystems, water resources, and wetlands) and a cross-

cutting issues volume consisting of eight papers (changing landscapes, costs, domestic trade and commerce, extra-territorial issues, extreme events, integrated air issues, sustainability, and two economies). The results are also summarized in seven plain language documents, one for each region and one at the national level.

The Canada Country Study results were based on a review of existing scientific and technical literature, the nature of which is two-fold. First, this literature includes studies of the sensitivity to and observed impacts of past and current climate. Secondly, it includes impact analyses based on scenarios of future climate change, mainly those projected by general circulation models of the atmosphere on the basis of a doubling of atmospheric carbon dioxide and assumptions reflecting the current understanding of the global climate system. As such, the identified impacts should not be seen as predictions but, rather, as indications of sensitivities and vulnerabilities associated with the projected change in climate. The diversity of these impacts and viable adaptation options, in addition to reflecting projected change in climate, reflect the geographic breadth and the environmental, economic and social diversity of Canada.

Some general conclusions resulting from this assessment are:

- Responding to the impacts of projected climate change in Canada will be significantly complicated by the consequences for Canada arising from those impacts projected for the international community, particularly our trading partners and competitors.
- The environmental, economic, and social costs associated with the impacts of and adaptation to current climate in Canada (including, for example, over a billion dollars annually in the water sector alone) are large, and projected changes in climate are expected to increase those costs.

- As Canada's prosperity and well-being is strongly linked to that of its natural ecosystems and water resources, the responses of these to projected climate change will be critical in determining the environmental, economic and social costs and benefits of climate change for Canada.

- The location, structure and functioning of terrestrial and aquatic ecosystems would be altered as a result of expected changes in relative season length, species distribution, population, habitat, and competition between species, and their capacity to adapt would be tested by the fast, possibly irregular rate of warming.

- In addition to natural environmental influences, all socio-economic sectors would be impacted through additional stresses on physical and social infrastructure, ranging from altered building and construction practices to adjustments in health care to changes in subsistence lifestyles with their reliance on local knowledge.

- Harvest levels in the agriculture, forestry and fisheries sectors are sensitive to climate. Sustaining viable production levels will depend on the capacity of these sectors to cope with the projected rate of warming and changes in climate variability, as well as their ability to counter projected decreases in water availability and increased threats of competition, disease and other disturbances (e.g., fire).

- Adaptive capacity to climate conditions has historically been strong in such sectors as energy, transportation, and recreation and tourism, but the rate of projected warming and the prospects of future climate surprises would present serious challenges to that capacity.

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- Considering Canada's vulnerability to extreme events, projected changes in their occurrence and severity would have serious ramifications for the security and integrity of our natural resources, social systems, and infrastructure with subsequent implications for the insurance industry and supporting public sectors.
- In some cases projected climate change would have positive impacts (e.g., longer growing season and lower heating demand), which could provide adaptive opportunities or could alleviate the pressures caused by other stresses (e.g., population change, other air issues, land-use alterations).
- Increased emphasis in climate impacts and adaptation research on integrated assessment, on linking with sustainable development research, and on involving stakeholders directly in research is essential for addressing gaps in our current level of understanding.

Through the Canada Country Study and its review of the existing scientific literature, two points became clear. We have a limited understanding of the range and extent of impacts of climate change on Canada and, as such, there is considerable work required to refine that understanding and to develop workable adaptation approaches. This work is necessary in defining a portfolio of responses to climate change that includes both adaptation and mitigation.

In 1998 the federal government established a multi-stakeholder process to develop a national implementation strategy to respond to the challenge of climate change. The strategy will address mitigation (emission reduction), adaptation and foundation work in climate science. A three-year C\$150 million fund was established to support the strategy development process and to facilitate early action on climate change.

Activities under the CCAF (see web site [www.climatechange.gc.ca](http://www.climatechange.gc.ca) for more details) have been divided into four components:

- Foundation Analysis (Issue Tables) - The development of a national

implementation strategy via a multi-stakeholder consultation process.

- Science, Impacts and Adaptation - Targeted research to better understand climate processes and to assess the impact of climate change on the regions of Canada and the options for adaptation.
- Technology Early Action Measures- Cost-shared support for the development and deployment of emission-reducing technologies
- Public Outreach- Public education and outreach activities directed at informing Canadians about climate change and encouraging them to take action.

The need to spur Canadian research required to fill the gaps identified in the Canada Country Study and other assessments has been recognized. Funds in the Impacts and Adaptation component of the CCAF support targeted research to better understand the impacts of climate change on regions and sectors of Canada, and to study the options for adaptation to changes in climate. Specific activities included as part of this component are:

- Research on the impacts of climate change on Canada - to provide an improved and useable understanding of the sensitivities and range and extent of the impacts of climate change on Canada and Canadians as a basis for the identification of various adaptive measures;
- Development of adaptation strategies - identification of the range of options available to address certain climate change impacts issues, collection of critical baseline information and, where applicable, the completion of case studies;
- Implementation of adaptation strategies - determining the socio-economic and environmental consequences of implementing various adaptation strategies that will have national implications and assessing the utility of various domestic instruments and policies for implementation;

- Report - to facilitate compliance and, through knowledge, implementation of adaptive measures; and
- Identification of economic opportunities made possible by development of adaptive strategies and potential technologies.

Local scale case studies that include assessments of impacts as well as the development of adaptation options are also being considered. It is expected that the impacts research will address the gaps in such a manner as to provide useful information for those who will use it in the development of adaptation options or strategies for particular sectors, communities or regions. A consistent set of climate scenarios as the basis for impacts and adaptation research in Canada is also being supported through this component of the CCAF. All research is to be completed by March 31, 2001.

Through the work of the Canada Country Study and the research being conducted under the Impacts and Adaptation component of the CCAF, it is becoming clear that we will have come a long way in identifying sensitivities and vulnerabilities to climate change in Canada. Yet, it is also apparent that there is more to do towards understanding the range and extent of impacts of climate change on Canada. Considerable research will be required to improve that understanding and to develop workable ways of adapting.

It is not enough, however, to solely improve our understanding of how climate will affect us, or to assess ways of adjusting to the inevitable. We also need to increase public awareness, to work with decision makers, to involve all stakeholders particularly at the regional and local levels - governments, scientists, researchers and citizens - in a shared learning and assessment experience.

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## The Global Environmental-Assessment Project: Learning from Efforts to Link Science and Policy in an Interdependent World

By William Clark and Nancy Dickson, Belfer Center for Science and International Affairs, Harvard University

The Global Environmental Assessment (GEA) Project is an interdisciplinary, international effort to better understand the role of assessment as a bridge between science and policy in matters of large scale environmental change. Over that period, a group of scholars drawn from the natural and social sciences have conducted research on the nature and effectiveness of a wide range of global environmental assessments covering issues of climate change, stratospheric ozone depletion, acid and other tropospheric air pollutants, desertification and biodiversity. Through this process, we have attempted to advance a common understanding of what it might mean to say that one assessment is more "effective" than another, not only from the perspective of national decision makers in the world's wealthier "core," but also from the position of leaders in countries at regional and local scales, and the scientists who give their time and energy to assessment efforts. We have sought to learn which factors have been systematically responsible for failures of assessment, and which have contributed to at least partial success.

The Project is based at Harvard University, but includes core faculty from a number of other institutions within and beyond the United States. We have tried to keep our efforts grounded in reality through a series of workshops that have engaged practitioners, users, and scholars of assessment in an off-the-record dialog that lets them compare insights and experiences. To date, the GEA Project has produced more than 30 working papers, the earliest of which have now begun to appear in the peer-reviewed academic literature. In addition, the Project and its workshops have provided ongoing practical input to efforts as diverse as the IPCC, the National Science Board's report on Environmental Science and

Engineering for the 21st Century, the US Global Change Research Program, the National Assessment of the Potential Consequences of Climate Variability and Change, and a number of national government agency planning efforts in the US and abroad.

Our studies have suggested that much about what makes some assessments more effective than others seems to be tied up with the process by which they are developed, rather than just the product itself. In particular, we have increasingly found it helpful to view assessments as a social process through which scientists, decision makers, and advocates interact to define relevant questions (while leaving others unasked), mobilize certain kinds of experts and expertise (while leaving others out), and interpret findings in particular ways. Such assessment processes can affect the social response to global environmental challenges in a number of ways. The effectiveness of an assessment should therefore be evaluated not only through its ultimate impacts on the environment (e.g., bringing about a decrease in damage due to acid deposition), but also through its influence on:

- the behavior of key actors (e.g., bringing about a decrease in emissions);
- the strategies of key actors (e.g., inducing active promotion of an international agreement to change emissions);
- issue frames and agendas (e.g., precipitating a decision to pay attention to an ENSO forecast, or to view the climate issue as one of poor peoples' vulnerability rather than rich peoples' emissions; raising concern for the acidification problem);
- the terms of the debate (e.g., introducing non-CO2 greenhouse gases to the climate debate; introducing liming to set of options considered in the acid rain debate);

- the perception of knowledge needs (e.g., identifying a critical need for research on heterogeneous chemistry in the stratosphere).

The list is not exhaustive or unambiguous. Its importance is merely in stressing that assessments can and do exert their immediate impacts – if any – in a variety of ways. The particular paths of influence are a matter for empirical investigation rather than theorizing or assumption. Our research suggests the not surprising result that assessments exert their immediate impact on the policy process through the lower end of the list more often than they do through the higher.

Learning what distinguishes more from less effective assessments is one of the principal purposes, and deepest challenges, of our research program. We have therefore approached it stepwise, first identifying characteristics of assessments that seem to be differentially associated with high or low impact, and then working backwards to identify the underlying design choices that contribute to those characteristics. At this point in our investigations, three characteristics seem to be most important in distinguishing effective assessments: we have called them "saliency," "credibility," and "legitimacy." "Saliency," as we use it, is meant to capture the perceived relevance or value of the assessment to particular groups who might employ it to promote any of the effects noted above. "Credibility," as we use it, is meant to capture the perceived authoritativeness or believability of the technical dimensions of the assessment process to particular constituencies, largely in the scientific community. "Legitimacy," as we use it, is meant to capture the perceived fairness and openness of

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## IPCC Prepares Third Assessment Report

By Kasey Shewey White, IPCC

The Intergovernmental Panel on Climate Change (IPCC) is in the midst of preparing its Third Assessment Report (TAR), which will be completed in 2001. The report will be a comprehensive assessment of the scientific, technical, and socio-economic dimensions of climate change. Like all IPCC reports, the TAR is being written by multidisciplinary teams of authors from around the world, chosen for their scientific and technical expertise in topics relevant to the report.

### Intergovernmental Panel on Climate Change

The IPCC was formed in 1988 by the United Nations Environmental Programme and World Meteorological Organization to gain a better understanding of global climate change. The IPCC examines, evaluates, synthesizes, and reports information from peer-reviewed published literature, but does not conduct new research. IPCC reports are used worldwide, most notably by parties to the United Nations Framework Convention on Climate Change, as a credible and comprehensive source of information on climate change, its potential consequences, and options to adapt to or mitigate climate change.

The IPCC is organized into three working groups. Working Group I assesses the science of climate change; Working Group II focuses on the impacts and adaptations to climate change; and Working Group III reviews options for climate change mitigation. Each Working Group has a Technical Support Unit (TSU) to help direct the production of reports and a Bureau to oversee the process. The Working Group II TSU is housed in Washington DC and the others are located overseas.

### Third Assessment Report

The IPCC published its first assessment report in 1990 and completed its second assessment report in 1995. The TAR seeks to build on the knowledge base of these reports, as well as other special reports prepared by the IPCC. Each working group will produce a volume of the TAR on their respective topic in a parallel manner. The working groups will also each produce a Summary for Policymakers, a non-technical highlight of the key scientific findings of the report. In addition, a Synthesis Report that focuses on policy-relevant questions using information from

all three volumes of the report will be produced.

Work on the TAR began last year, after approval of the mandates for the three working group volumes by the Panel in late 1997. Working Group II authors recently completed the first draft of their volume and began the lengthy review process. The first draft has been sent for review to several hundred experts in various scientific and technical fields. After their comments are received and analyzed, a second draft of the report will be prepared and distributed for review by governments as well as experts that participated in the first review. A final draft will then be prepared and presented to the IPCC for acceptance in mid-2001.

### Special Reports

In addition to the TAR, the IPCC is currently producing several special reports that will be completed in 2000. Special Report on Methodological and Technological Issues in Technology Transfer, Special Report on Emissions Scenarios, and the Special Report on Land Use, Land Use Change, and Forestry are underway and will follow a similar review process to the TAR.

Two special reports were completed recently and are publicly available. The Regional Impacts of Climate Change: An Assessment of Vulnerability, published in 1998, reviews state-of-the-art information on potential impacts of climate change for ecological systems, water supply, food production, coastal infrastructure, human health, and other resources for ten global regions. The Special Report on Aviation and the Global Atmosphere, completed in May 1999, assesses what is known about the effects of aviation on the Earth's climate and atmospheric ozone, both in the recent past and for the future. In addition, the report examines scientific, technological, social, and economic issues associated with options to mitigate these aviation effects.

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the assessment process to particular constituencies, largely in the political community.

Saliency, credibility, and legitimacy are not independent properties of assessments. Sometimes they overlap, as when an effort to achieve political legitimacy through greater sensitivity to the views of previously excluded stakeholders results in an increase in saliency of the resulting assessment to those groups. At other times, they seem to compete, as when an effort to increase political legitimacy through inclusion of multiple perspectives results in what many perceive to be a lowering of the scientific credibility of the result. Similarly, efforts to maximize the scientific credibility of assessments often drive them away from addressing the sorts of questions that would make them more salient to decision makers. It is such tensions and complementarities in the development of effective assessments that we hope to untangle or make sense of through our research and workshops.

If assessments become effective by being salient, credible, and legitimate, what imbues an assessment with these characteristics? These are the ultimate questions that drive our project. Current work is focusing on three sets of factors that we have found exert a substantial influence on the effectiveness of global environmental assessments: historical context (When in the evolution of an issue are different sorts of assessment most effective?), characteristics of the assessment user or audience (What sort of capacity does it take to be able to use an assessment?), and characteristics of the assessment itself (How does the institutionalization and process management of an assessment matter?). Studies of these and related questions are ongoing, with preliminary findings reported in our workshop proceedings and working papers. Those interested in commenting on or contributing to our studies, or in joining the GEA network, are invited to consult the project web site or contact us for further information.

### For more information:

The GEA Project, its participants, and its research products are described in detail on the Project's web page: <http://environment.harvard.edu/gea>. Further information is available from the authors at [William\\_Clark@harvard.edu](mailto:William_Clark@harvard.edu) and [Nancy\\_Dickson@harvard.edu](mailto:Nancy_Dickson@harvard.edu).



## Impacts of Climate Change and Climate Variability in Mexico

By Cecilia Conde, Ciudad Universitaria, Mexico; and Carlos Gay, Instituto Nacional de Ecología, México



Within Phase I of the "Country Study: Mexico" (1994 - 1996), the vulnerability of Mexico was studied under climate change conditions considering seven research areas: Forestry, Desertification and Drought, Human Settlements, Energy and Industry, Agriculture, Hydrology and Coastal Zones.

Except for the Coastal Zones study, climate change scenarios were constructed using arbitrary incremental and temperature/precipitation anomalies obtained from two General Circulation Models: CCCM and GFDL. Regional climate change scenarios were also generated for Mexico based on statistical downscaling techniques applied to GCM output from 2' CO<sub>2</sub> experiments. Results indicate that Mexico will experience less or normal summer precipitation and increased precipitation during winter.

General results of the vulnerability studies pointed to the following regions as being the most vulnerable:

- Central and Lerma-Chapala-Santiago Basin: According to the results of the Hydrology study, the current critical conditions observed in the base scenarios for these regions may be aggravated. The predicted increase in temperature coupled with a decrease in rainfall could result in severe water supply shortages in these regions, exacerbated by the growth in population and industries predicted by the Human Settlements research.
- Northern areas and regions with large populations, especially in Central Mexico, are most vulnerable to droughts and desertification, since erosion and drought severity will increase with higher temperatures and rainfall variations in these arid and semi arid regions.

- The Tabasco State Coast will be most vulnerable to sea level changes. Approximately 40 to 50 km of inland sea penetration is predicted by the Coastal Zones studies, using the trends observed in 50 years of aerial photograph data, and with 0.5 meters per decade as a change scenario.
- Northern and Central regions are most vulnerable in the agricultural sector, according to application of a crop simulation model (CERES maize), and calculation of the possible changes in the aptitude for maize optimal production, given different temperature and precipitation changes.
- Forests in temperate climates will be the most vulnerable ecosystems, particularly those located on the Eje Neovolcanico (Neovolcanic Axis mountain range) and Northern regions of the country, (dependent of altitude).

- The maximum vulnerability is anticipated in the Central regions of the country, according to the Human Settlements studies, which show major increases in population growth, density, morbidity, and decrease in water supply.
- Energy and Industry studies found that the most vulnerable regions in this sector will be the Central and Northern regions of the country and the Tabasco Coasts.

Given these results, the three Mexican regions most vulnerable to climate change are, in order of importance: Central, Northern and Tabasco Coast. In a second phase of the Mexican assessment, two states were taken as Case Studies: Tlaxcala (central region) and Sonora (northern region). For those states, vulnerability and adaptation

strategies are being analyzed, considering also the historic impacts under El Niño and La Niña conditions.

The Tlaxcala Case Study is being developed in the project entitled On the use of climate forecasts for agricultural activities in the State of Tlaxcala, México. The economy of this state is highly dependent on rain-fed corn production. Population growth, erosion and drought are also acute problems in this state. Producers and state managers are participating in this project.

For the Sonora studies, the project entitled Climate Variability and Its Potential Impact on Transboundary Freshwater Resources in North America was developed, in cooperation with the University of Arizona.

Various studies have shown that the El Niño/Southern Oscillation phenomenon mainly affects precipitation and moisture conditions over Mexico. The ENSO signal may explain up to 25% of the variability in monthly precipitation in some parts of Mexico, particularly along the northern Mexican states. The ENSO impacts are summarized in Table 1.

During some El Niño years, winter precipitation may be so great that stream-flow and water levels in dams may exceed those observed during summer. In contrast, summer droughts during these events can lead to serious deficits in reservoir levels and in rain-fed maize production. In Mexico during 1997, the estimated costs of climate anomalies associated with El Niño were around 8 billion pesos (900 million US dollars), particularly in agricultural activities, when 2 million hectares were affected by a severe drought.

*continued on page 11*



## Calendar

### NATIONAL ASSESSMENT SPONSORED MEETINGS:

**Pacific Northwest Water Resources workshop**  
TBA  
September 1999

**Pacific Northwest Climate Workshop**  
TBA  
September 1999

**Sector Assessment Team Meeting--Agriculture Sector**  
TBA  
October 1999

**International City/County Management Association - Annual Conference**  
Portland, OR  
September 26-29, 1999  
(Contact: ICMA at 202-289-4262).

**Second Annual Climate Change and Ozone Protection Conference**  
Washington, D.C.  
September 27-29, 1999  
(Contact: Erika Fischer, tel: 703-807-4052; <http://www.earthforum.com>).

**Environmental Council of the States - Annual Meeting**  
Jackson Hole, WY  
October 3-6, 1999  
(Contact: ECOS at 202-624-3660).

### RELATED MEETINGS:

**Fourth International Conference On Modeling Of Global Climate Change And Variability**  
Hamburg, Germany  
September 13-17, 1999  
(Contact: L. Dümenil, Max-Planck-Institut für Meteorologie, Bundesstr. 55, 20146 Hamburg, Germany. Tel: +49 40 411 73 310; E-mail: [mpi-conference@dkrz.de](mailto:mpi-conference@dkrz.de) ).

**National Association of State Energy Officials - Annual Meeting**  
Indianapolis, IN  
September 19-22  
(Contact: NASEO at 703-299-8800).

**Food & Forestry: Global Change and Global Challenges**  
Reading, England, United Kingdom  
September 20-23, 1999  
(Contact: <http://www.elsevier.nl:80/homepage/sag/gcte99/> ).

**Desert Technology V: Deserts in Changing Climates**  
Reno, NV  
October 3-8, 1999  
(Contact: Engineering Foundation Conferences, Three Park Avenue, 27th Floor, New York, NY, 10016-5902; tel: 212-591-7836; e-mail: [engfnd@aol.com](mailto:engfnd@aol.com); [www.engfnd.org](http://www.engfnd.org) ).

**Global Environmental Change Education Workshops for Secondary and Post-secondary Educators**  
Monona, WI  
October 23, 1999  
(Contact: <http://www.seagrant.wisc.edu/advisory/GEC/workshops.htm> ).

**AWRA's Annual Water Resources Conference**  
Seattle, WA  
December 5-9, 1999  
(Contact: e-mail: [awrahq@aol.com](mailto:awrahq@aol.com) or tel: 703-904-1225).

## Climate Change Bibliography Available

The Pacific Institute has compiled a comprehensive bibliography of the peer-reviewed literature dealing with climate change and its effects on water resources and water systems of the United States. Over 750 citations have been included to date. The searchable bibliography can be found at: <http://www.pacinst.org/CCBib.html>.

A second bibliography focusing on climate change impacts on biodiversity and individual flora and fauna species will

also be available shortly. If you wish to be informed when new resources are posted on our site, sign up for our announcement list at: [www.pacinst.org](http://www.pacinst.org)

### For more information, contact:

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## Synthesis Team News

The National Assessment Synthesis Team held two short sessions in June and July and has most recently finished a 10-day summer study at the National Academy of Sciences facility in Woods Hole, Massachusetts. The Team is preparing its two documents: the ~200 page Foundation Document and its companion, the ~75 page Overview Document. Both will enter review stages later in the year.

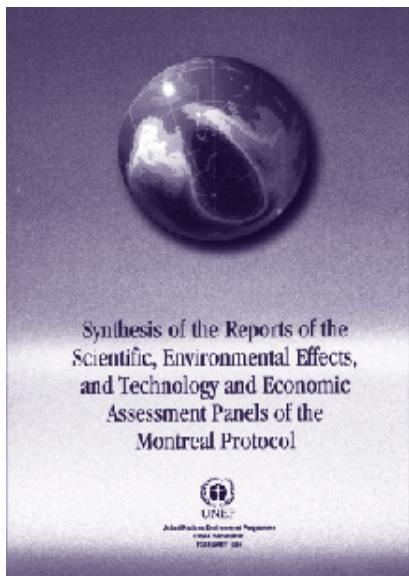
A Blue Ribbon Panel is overseeing the preparation of the report and the design of the review process. The Panel has now met twice to provide insight into the readability of the documents, their methodology, balance and treatment of uncertainties. In addition, the Blue Ribbon Panel is designing the multi-stage review process and helping to select reviewers. Although the Woods Hole meeting was planned as the last working session of the Synthesis Team, an additional short meeting is planned tentatively for December to collectively evaluate responses to review comments and revise the documents.



## Assessment of the State of Understanding of the Ozone Layer: A Decade of Information for the U.N. Montreal Protocol

By Dan Albritton, NOAA Aeronomy Laboratory

The United Nations Montreal Protocol on Substances that Deplete the Ozone Layer was signed in September, 1987. It entered into force in January, 1989, thereby beginning a decade of decision making associated with protection of the Earth's ultraviolet-radiation shield and thereby creating the need for sound, independent, and regular information upon which to base those decisions.



Specifically, the Montreal Protocol established three Assessment Panels, with the following foci: (i) the science of the ozone layer, (ii) the environmental impacts of ozone depletion, and (iii) the mitigative technologies and associated economics. These Panels have provided the Protocol with a series of four major assessments: 1989, 1991, 1994, and 1998. The assessment process is as follows. The Panel Chairs participate in the meetings of the Parties to the Protocol, which are also attended by industry, environmental groups, and other relevant organizations. Thereby, the Chairs are able to construct a picture of the evolving information needs of the stakeholders associated with the Protocol. Periodically (about every 3 to 4 years), the Panels organize a two-year

process of assessing the current state of understanding, namely, defining the information needs, organizing the drafting and peer review of an updated status report prepared by the relevant communities, and summarizing the resulting major points to the Parties in decision-relevant terms.

### The 1998 State-of-Understanding Assessments

An example of a tangible "product" of the most recent assessment process is the Scientific Assessment of Ozone Depletion: 1998 (UNEP/WMO, 1999), which has been distributed to governments, industry, the professional communities, and interested members of the general public. The sections of the report address the major four questions about the ozone layer issue: "What's happening?", "Why?", "So what?", and "What's next?" Examples of answers include the following findings:

- The total abundance of ozone-depleting gases in the lower atmosphere peaked in 1994 and is now (slowly) starting downward, giving direct evidence that the Montreal Protocol is working.
- The springtime Antarctic ozone "hole" continues unabated, with the overall extent of loss being essentially unchanged since the early 1990s.
- In the Arctic, six of the past nine winters have been cold and protracted, which, as predicted, have caused lower-than-usual (25-30%) ozone levels.
- Over the midlatitudes of both hemispheres, the decadal downward trend of ozone has slowed since about 1991.
- The abundance of ozone-depleting gases in the stratosphere is expected to peak before the year 2000, and the ozone layer will then be in its most vulnerable state for the next decade or two.

- Detection of the recovery of the ozone layer as a result of the Montreal Protocol may not be possible for perhaps another 20 years, due to the superimposed natural variation of ozone, changing atmospheric composition, possible volcanic activity, the coupling of ozone change and climate change, and other potential human impacts on the ozone layer.

The Executive Summary of the Ozone Assessment has been separately published. This booklet also contains a section called "Frequently Asked Questions About Ozone", as well as a full list of the hundreds of international participants who contributed to the preparation and review of the Assessment. The purpose of the Summary is, of course, to give the 1998 "bottom lines" in a user-friendly format. The "Frequently Asked Questions" have been updated. It still has the questions and



answers that were formulated in the 1994 assessment (e.g., "If CFCs are heavier than air, how can they get to the stratosphere?"), but it also includes ones that the public is now posing ("Is the ozone layer expected to recover? If so, when?"). Because the answers are written for the general reader, but are based upon the science embodied in the 1998 assessment, these booklets have proven useful in communicating with the public on a complex topic.

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In the State of Tlaxcala, various climatic regimes are found, in relation to complex topography and major differences in land use from one place to another. On an interannual basis, the climate of Tlaxcala is essentially regulated by large-scale atmospheric circulation, such as those observed during El Niño events. This variability strongly affects maize production.

During the Tlaxcala regional study, the coop-

eration of producers (organized in the PRO-DUCE A.C. Foundation) and state government officials was crucial. Through periodic discussions, climate products were delivered as useful information to plan agricultural activities and this was also a way to analyze adaptation strategies. The CERES maize model, which included information obtained from farmers, was also used to examine impacts and adaptation to drought in the Tlaxcala region. The positive experience with the use of seasonal climate forecasts in 1998

convinced producers in the state to repeat the analysis in 1999.

**For more information, contact:**

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Table 1. El Niño and La Niña impacts, for winter and summer		
	SUMMER	WINTER
El Niño (eastern Pacific sea surface temperature anomalies > 0 C)	Precipitation below normal	Precipitation above normal (in most cases)
La Niña (eastern Pacific sea surface temperature anomalies < 0 C)	Precipitation above normal	Precipitation below normal

continued from page 10

In addition to their three individual reports (UNEP/WMO, 1999; UNEP, 1999a; UNEP, 1999b), the co-chairs of the three Assessment Panels have prepared a Synthesis Report (UNEP, 1999c), which integrates the major points of their full reports. As such, it is "one-stop shopping" for the Parties regarding the overall 1998 understanding of the ozone depletion issue.

Lastly, the year 1999 marks the 10th anniversary of the formation of the Assessment Panels by the Montreal Protocol. It also ends the first decade of the Panel's providing assessed information to the world governments about the ozone layer and related topics. Therefore, the main body of the 1998 report takes this 10-year perspective in synthesizing the work of the Panels and the communities represented.

**The Assessment Process: What Have We Learned?**

The Parties to the Montreal Protocol have found the assessments to be essential input to decision making. Amendments and adjustments to that historic international agreement have occurred in lock-step with the major assessments in 1989, 1991, and 1994. Others have noted their value and style. For example, the American Library Association recognized the 1991 scientific assessment report as the Best Government Publication of that year. More importantly, features of the Montreal Protocol

assessments have been adopted by the Intergovernmental Panel on Climate Change (IPCC) when it set up its assessment process, which issued its first report in 1990.

It is no accident that such assessment features have "caught on", since several aspects of the assessments have proven to be highly useful:

- They are the integrated perspective of the (vast) majority of the expert communities involved, which is in contrast to the more-limited utility of the viewpoint of a particular scientist, technologist, or economist.
- They are the status of understanding of the information-producing communities, but that information is described in the context of the information needs of the stakeholding "customers".
- They are the perspective of the global communities on a global issue, which is in contrast to a particular national or single-sector viewpoint.
- They are an end-to-end picture of the issue (causes -> effects -> options), which is in contrast to a study of a single aspect of a phenomenon/issue.
- Lastly, the Protocol recognized that knowledge improves over time and

hence that the assessment process must necessarily be a sequential one.

**The Past is Prologue to the Future**

In the last section of the Synthesis Report, the Montreal Protocol Assessment Panels paused to describe "the world that was avoided"; namely, to give a forecast of what would have occurred had there been no Montreal Protocol. The nature of that world – for example, the impacts of ultraviolet radiation on humans – underscores the high value of the efforts of so many people worldwide who are wrestling with the series of challenging decisions and actions that are associated with the complex ozone depletion issue. In this case, the independent, professional, and regular assessments have been, by design, useful "touchstones" for society's decision making process.

**References for further information**

(and <http://www.unep.org/ozone>):  
 UNEP/WMO, 1999. *Scientific Assessment of Ozone Depletion: 1998*, pp. 732.  
 UNEP, 1999a. *Environmental Effects of Ozone Depletion: 1998 Assessment*, pp. 191.  
 UNEP, 1999b. *1998 Report of the Technology and Economic Assessment Panel*, pp. 286.  
 UNEP, 1999c. *Synthesis Report of the Scientific, Environmental Effects, and Technology and Economic Assessment Panels of the Montreal Protocol, A Decade of Assessments for Decision Makers Regarding the Protection of the Ozone Layer: 1988 - 1999*, pp. 161.

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