REPORT
OF THE
INTERNATIONAL NETWORKSHOP

Climate-Related Impacts
March 14-17, 1989 - Boulder, CO

The Networkshop was funded by the World Climate Impacts Programme of the United Nations Environment Programme and the Environmental and Societal Impacts Group (ESIG) of the National Center for Atmospheric Research.* The meeting was organized by Michael Glantz (ESIG) and Maria Krenz (ESIG). Martin Price and Steven Rhodes, both of ESIG, served as rapporteurs.

*The National Center for Atmospheric Research is sponsored by the US National Science Foundation.
An international workshop, sponsored by the World Climate Impacts Programme of the United Nations Environment Programme (UNEP) and the Environmental and Societal Impacts Group (ESIG) of the National Center for Atmospheric Research, was convened 14–17 March 1989 to assess the value of, and constraints to, 1) establishing national networks of individuals, groups, and institutions interested in climate-related impacts research and 2) linking such networks within an international framework. Eleven nations were represented at the workshop (see list of participants at the end of the report).

I. Introduction: 14 March

The workshop was opened by Michael Glantz, Head of ESIG, who welcomed everyone and sketched a brief history of the North American network started in 1985 following a similar workshop.

Peter Usher, Senior Program Officer of UNEP, also welcomed the participants and outlined the history of UNEP’s World Climate Impact Programme (WCIP). The direction of the WCIP since the 1985 meeting on the international assessment of climate impacts related to a global warming (Villach, Austria) has been to 1) provide climate-related information to the public through radio, television, the press, and an array of special publications; 2) encourage dialogue between the scientific and decisionmaking communities, cosponsoring a variety of workshops and conferences to this end; 3) improve the understanding of regional climate changes and their impacts, through support of regional impacts studies; and 4) identify policy response options to climate change.

Public concern and policymakers’ interest in climate-related issues is at an all-time high worldwide. UNEP does not presently have the internal resources for a truly worldwide
climate impacts program, but wants to build on the interests and activities of governments, institutions, and individual scientists. UNEP's mandate is to coordinate and catalyze. It is particularly important that national climate programs and national climate impacts activities be encouraged and facilitated, not only in developed countries, but also in developing countries, and that international support for and linkage of these activities be provided. UNEP is looking for ways to facilitate cooperation and avoid duplication of effort and waste of resources, as well as ways to meet the needs of developing countries to understand climate-related issues, initiate their own programs, and identify appropriate outside expertise when necessary.

The World Climate Programme entered into a new phase when UNEP and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC) in late 1988. UNEP is seeking guidance on other coordinated activities which will benefit both national and regional programs on climate-related impacts. This networkshop (workshop to create a network) to explore and facilitate the creation of networks is a step in that direction.

Michael Glantz observed that much recent interest in climate impacts has been generated by the prospects of potential climate change some decades in the future. He noted that the impacts community must not lose sight of the importance of the impacts that climate variability and of extreme meteorological events have on society and the environment; these are present regardless of climate change. The current interest in climate change can be used to increase our understanding about climate variability and its
implications. Climate change and climate variability are best understood when considered together.

Glantz also discussed the utility of the North American Climate Impacts Network Newsletter. When it was initiated after the 1985 workshop, there were 43 people in the network and the newsletter was six pages long. Recently, 850 subscribers received the latest 16-page newsletter. To date, ESIG has absorbed the cost of producing and mailing the newsletter. About one-fifth of the subscribers are from outside North America. Each issue brings additional subscribers. Thus, a newsletter appears to be an efficient means of increasing awareness of climate/society interactions and of expanding the awareness of those in the impacts area about the activities of other researchers in this field.

Glantz noted that a distinction must be made between climate-related impacts networks and national climate programs (NCPs). NCPs are concerned with all aspects of the World Climate Program (research, data, application and impacts). NCPs in different countries have varying levels of commitment to impacts studies. Thus, autonomous impacts networks are not in competition with NCPs and may in fact complement their activities.

II. Recent climate-related research activities: 14 March.

In this session presentations were made by workshop participants representing Hungary, Brazil, the USA, Ethiopia, and Japan. Presentations centered on climate impacts activities in each of these countries. Recent global change research activities were also included. Each presentation was followed by open discussion.
1. Hungary - Tibor Faragó (Hungarian Meteorological Service, Budapest)

Since the early 1970s, increasing attention has been paid to global environmental problems, especially when their impacts are felt at a national or sub-national level. Research on climate-related impacts has become internationalized because: 1) climate anomalies are now recognized at levels beyond the national level (e.g., ENSO [El Niño-Southern Oscillation] events); 2) transboundary atmospheric pollution requires international efforts for effective solutions; and 3) ways of thinking about climate-related problems in some regions can be used as regional analogs of how to detect, study, or cope with such problems in other regions.

An ongoing Hungary/U.S. project (HMS/ESIG) considers extreme meteorological events and their impacts, focusing on drought, severe winters, and frost. Such events are specific features (outlying events) within the normal climatic state, and their impacts can be considered in this context. Such extremes may also be signs of climatic change, and their frequency may change as climate changes. These events may have positive or negative socioeconomic and environmental impacts, and can be viewed as warnings to society that climate is a varying system, not a stable one; we have to be prepared to adjust to those variations. This project has led to an increased understanding of these issues and to improved methodologies for the detection of extremes; and it has shown that analysis of extreme meteorological events and their impacts, whether in Hungary or analogous areas, helps to develop policies for coping with future events.
2. Brazil - Antonio Magalhães (Secretariat of Planning, State of Ceará)

Climate change has only recently emerged as a research and political issue in Brazil. However, since 1988, international attention on deforestation in the Amazon has led policymakers, who had previously concentrated on issues of more immediate concern (e.g., external debt), to consider other environmental problems that affect Brazil. A set of regional studies, supported by UNEP since mid-1987, is near completion. The objectives are to improve understanding of climate impacts in order to mitigate adverse impacts on people and their activities; to promote the dissemination and use of climate information (mainly relating to climate variability) for human activities; and to identify government responses to climate variability and possible climate change. Because of limited experience with climate impact assessment in Brazil, it was initially difficult to identify relevant researchers. Of the 13 case studies selected, 8 focus on drought while the others consider floods and frost.

These studies have shown that climate variability can have severe impacts on the economy, society, and the environment and that impacts vary between regions, especially in relation to regional levels of development. The main policy recommendations are as follows: to promote sustainable development in order to increase economic productivity and improve social and inter-generational equity; to realize that public participation is essential in designing and executing responses to climate variability; and to accept that the planning of responses must be continuous, not just ad hoc responses to emergencies. These recommendations will be presented to Brazilian policymaking and scientific communities at a workshop this summer. A final workshop report will be submitted to UNEP. As climate becomes a more important consideration, there will be increasing opportunities to increase
research on, and awareness of, climate variability and change and to develop an institutional framework for this purpose. Another stimulus to such institutional development should be the IPCC.


In 1986, the U.S. Congress requested that the Environmental Protection Agency (EPA) assess the implications of, and policy options for, climate change in various geographic regions and economic sectors of the United States. One approach to the research was to use the output from General Circulation Models (GCMs). This information was used as a basis for assessing potential impacts in economic sectors and in the Southeast, California, the Great Lakes region and the Great Plains. However, to date, GCMs can provide little reliable regionally-specific information.

A second approach – forecasting by analogy – was coordinated by ESIG for the EPA. The objective was to assess the ability of decisionmakers (from local to federal to international levels) to cope with future climate-related problems by analyzing their responses to recent significant climate-related events or to analogous situations. Ten case studies were undertaken: rises in the levels of the Great Lakes and Great Salt Lake, sea-level rise in Louisiana and Charleston, South Carolina, the Mississippi River navigation system, flows in the Colorado and Sacramento river basins, depletion of the Ogallala aquifer, urban water management in northern Virginia, and recurrent freezes in citrus-growing areas of Florida. These studies underlined the need for greater flexibility in climate-related environmental management since climate is an inherently variable phenomenon.

Climate impact assessment projects, supported by SIDA (Sweden) and the Ethiopian Ministry of Science and Technology, have been underway since 1987. The objectives of these projects are to identify the past occurrence of drought in Ethiopia, to assess the impacts of drought on human activities, and to design improved drought forecasting and monitoring systems.

In 1988, UNEP sponsored a National Meteorological Service Agency (NMSA) project to strengthen the country's existing drought early warning system. Initially, a consultant worked with users to assess their information needs. A national workshop then brought producers and users of information together to decide what information was needed for practical use. There were also participants from other African countries and international organizations concerned with food security issues. Workshop recommendations included: 1) improve the technical capability of the meteorological system; 2) establish an interdisciplinary committee to advise the government on monitoring and coping with drought (already implemented); 3) develop a National Climate Program (this will be incorporated in the next 5-year plan); 4) train potential users in using meteorological information; and 5) establish and promote contact within the region for drought monitoring.

5. Japan - Masatoshi Yoshino (University of Tsukuba)

The first meeting of the Japanese Study Group for the WCIP and World Climate Applications Programme (WCAP) was held in October 1983. Since 1985, the group has participated in Japan's NCP. There are now approximately 250 active members in the group, which meets twice a year and publishes an annual newsletter. A wide range of natural and
social science fields is represented. Support for research, from both government and industry, is increasing.

Group members' research activities can be divided into five major fields: 1) Changes in agricultural practices due to climate change and secondary effects (e.g., water for irrigation, soil fertility, pests and disease, extreme events) to be used in land use planning. 2) Changes in living marine resources related to climate change. 3) Changes in availability of water resources due to climate change (e.g., snowfall, floods), and their impacts on agriculture and urbanization. Research is also being undertaken on deforestation and desertification outside Japan. 4) Climate change and variability in the historical period, and resultant socioeconomic impacts. 5) Potential future climate change and variability, and resultant economic impacts. Much of this research has already been published (in Japanese) in monographs and review papers.

6. **Developing social science/policy programs relating to climate/global change** - Martin Price (ESIG/NCAR, Boulder, CO)

The only long-term program in this field is the WCIP, managed by UNEP, and related to the WMO's WCP. Other groups with interests in this field include the UNEP/WMO Advisory Group on Greenhouse Gases and Coordinating Council on the Ozone Layer, and the European Science Foundation. The major initiative at present is the UNEP/WMO Intergovernmental Panel on Climate Change (IPCC). The IPCC first met in November 1988, and will present its report to the 2nd World Climate Conference in November 1990. It has three working groups to: 1) review the state and knowledge of the science of climate and climate change; 2) review programs and conduct studies of social and economic impacts; and
3) develop and evaluate possible policy responses by governments to delay or mitigate the impacts of adverse climate change.

The ICSU (International Council of Scientific Unions) International Geosphere-Biosphere Program (IGBP), which should be implemented in the 1990s, will principally consider physical biogeochemical systems. During the planning process of the IGBP, until recently, human activities have mainly been considered as a cause of perturbation in these systems. However, at recent meetings there have been increasing calls for the integration of social science in the program, recognizing the central place of humankind in the Earth’s systems. Such research may be carried out as an integral part of IGBP, or as a separate program, as been suggested at meetings of the developing Human Dimensions of Global Change Program, supported by the International Federation of Institutes for Advanced Study (IFIAS), the International Social Science Council (ISSC), and the United Nations University (UNU).

III. Climate impacts in individual countries: March 15

Climate & fisheries organizations.

1. Australia - Andris Auliciems (University of Queensland)

Australia is the driest continent. More than 60% of the population lives in five large coastal cities. The economy is highly reliant on high-risk exports (e.g., wool, wheat, beef) that are vulnerable to climate variability. Two main groups of climate-related hazards exist: those associated with ENSO events - droughts, wind erosion, bushfires; and those related to anti-ENSO events - heavy rains, floods, water erosion, high winds. While impacts are mainly financial, because Australia is a developed country, they are huge in relation to the size of its
population. However, government relief can always be relied on, and national pride means that hazardous areas are not easily abandoned.

Australian government agencies conduct little research on climate impacts, and there is no NCP. University scientists are underfunded and rarely meet; however, the Australia-New Zealand Climate Forum, an informal group initiated by individuals from several university geography departments and joined by interested parties from the National Climate Centre (Bureau of Meteorology) and the Commonwealth Scientific and Industrial Research Organization (CSIRO), has met four times. In 1987, CSIRO and the Commission for the Future funded a conference on the greenhouse effect. The generally-accepted Villach scenario (suggesting semi-permanent ENSO conditions) was ignored in favor of a scenario proposed by Pittock (CSIRO). This suggested that, because of semi-permanent anti-ENSO conditions, western Australia would dry out, the east would become wetter, and tropical cyclones would move southwards to reach the low-lying coastal cities of Sydney and Brisbane. This scenario now appears to be accepted as an accurate prediction, on which basis government policies are being developed. However, there are other equally plausible scenarios. Focusing on one scenario could be misleading at this early stage in the process of understanding regional responses to climate change. As a result of the focus of attention on the climate change issue, there continues to be little consideration of existing climate variability and its substantial impacts.
2. Brazil - Antonio Magalhães (Secretariat of Planning, State of Ceará)

The major environmental problems in Brazil are the overuse of natural resources, leading to decreased food production and poverty, and the external debt. The two most important climate impacts are droughts and floods.

Droughts in the northeast (Nordeste) can last for four years, and are critical because of the region’s low level of economic development. While droughts have been a policy issue since the late 1800s, the strength of response has varied depending on the recentness of drought. Responses have been to: 1) provide short-term relief; 2) accumulate water; 3) develop drought-resistant crops; and 4) promote rural development (e.g., irrigation, small industrialization). Drought is now coming to be integrated as a variable in the development process, with the intention to raise incomes so as to increase the resilience of “nordestinos” to drought. In the southern and central regions, droughts occur, but are not of critical importance because of the considerably higher level of economic development; impacts are mainly economic.

Floods occur all over Brazil, even in drought-prone areas. One significant recent example was the flooding of Rio de Janeiro in February 1988, caused by rainfall 3 to 5 times the average. The city’s development (both planned and informal) had not properly considered its environmental setting. Total losses were estimated at about $1 billion, mainly due to lost productivity and physical damage. About 15,000 people became homeless, 800 were injured, and 290 died. The policy response from the State government (with some federal support) has been to develop an integrated program for flood damage reconstruction and prevention relating to highways and drainage and sanitation systems.
Canada has a wide range of climates, from arctic to mediterranean. Economic activities vary correspondingly and include agriculture, hydropower generation, forestry, fisheries, and minerals and energy-source exploration and extraction. The long Canadian winter seasons restrict, for example, agriculture, tree growth and exploration, and affect energy demand. Recurrent drought in the Prairies can limit agricultural production and create the preconditions for possible forest fires. Severe weather events can also have significant economic effects.

Canada's global warming concerns focus on three primary areas. 1) Water resources: there may be shifts in supply, affecting viability of delivery systems. Side effects may develop on agriculture, energy production, fisheries, transport, and water quality. 2) Forests: there may be significant effects on species at their ecological margins; patterns of pests, diseases, and fire outbreaks may change. Side effects on water resources, wildlife, and parks may develop. 3) Arctic areas: changing thermal regimes may affect permafrost (and hence energy development and infrastructure) and ecosystems (and hence wildlife). Secondary adverse effects on native cultures are likely. With shorter winters and less sea ice, defense and national security issues may become more important. Areas of concern related to secondary impacts include infrastructure, agriculture, natural ecosystems, sea-level rise and policy considerations. There are likely to be great regional variations in the effects of global warming, and much research is presently in progress to determine the extent of possible regional impacts of global changes.

Major climatic hazards and their societal impacts in Ethiopia today are directly related to food shortages and indirectly to famines (e.g., drought, locusts, heavy rains, hail, and frost) and loss of life and property. Droughts are the major problem, and have been recorded for over two millenia. They affect most of the eastern lowlands and adjacent areas, part of the north, and the Rift Valley. Their effects on human nutrition and health, livestock and agricultural production are significant.

Policy responses to drought by the Ethiopian government may be divided into three types: 1) resettlement to areas with fertile land and lower population density; 2) soil and water conservation and afforestation; and 3) identification, of and decreases in, the irrational use of resources. An interministerial committee is using agro-climatic zoning to develop appropriate land-use policies and to define the best use of available resources. A national conference will be convened to review and endorse the resulting plan. Drought mitigation measures include the development of an early warning system for food production, and 10-day and monthly weather bulletins. An experimental seasonal forecasting system has operated successfully for the past four crop seasons. High level government officials use the information to prepare agricultural strategies which are then disseminated to farmers for implementation.

5. **Hungary - Tibor Faragó (Hungarian Meteorological Service, Budapest)**

Climate variability has a major effect on the Hungarian economy. The most sensitive sector is agriculture. Moisture is frequently limiting, and there are large interannual fluctuations, leading to large variations in yields from one year to the next and between
regions. A recent impact assessment of droughts in the eastern Hungarian Great Plain showed that: 1) it is unreasonable to use only the best recent years for planning and forecasting crop yields; 2) while irrigation is essential to ensure wheat and corn production in drought years, few irrigation projects have been undertaken because of planners' short-term horizons; and 3) an extensive research program on relationships between agriculture and meteorology is necessary to reduce the vulnerability of the agricultural sector to meteorological factors.

Energy production and consumption are also very climate-sensitive. Space heating accounts for 30% of energy consumption. In recent decades, energy demand increased greatly in spite of mild winters. A series of very cold winters (1984–7) led to severe problems in energy supply and in other economic sectors. These events and assessments of their impacts have reinforced the need for reserve generation capacity and have led to long-term energy planning.

S. Italy - Guido Visconti (Università Degli Studi dell'Aquila)

In the Mediterranean region, interannual climatic variability is comparable to annual mean variation. Moisture deficits are already a problem in most of the country: desertification and soil erosion are increasing in Sardinia and Sicily. GCM outputs suggest that climate change will lead to increased temperatures in all seasons; but the outputs from different models do not agree on the location or degree of changes in precipitation. If soil moisture does decrease, water management problems will increase. Increased irrigation could lead to increased salinization, most likely in areas where it does not occur now. Adverse societal impacts could result from sea-level rise, especially along the Adriatic coast. Global
warming could also cause changes in circulation, affecting the spatial distribution of acid
deposition in Europe. Further research is needed on meteorological prediction, especially of
atmospheric blocking episodes, which are related to Italian droughts. To assess the regional
impacts of climate change, regional models will need to be integrated with GCMs. Climate
impact assessment methodologies also need to be developed.

7. Japan - Masatoshi Yoshino (University of Tsukuba)

Winter monsoons, the early summer rainy season (Bai-u), and typhoons are the climatic
events that are of major concern to Japan. Each of these events tends to have local or
regional, rather than national impacts. For example, the winter monsoon is typified by
heavy snowfall in western Japan, often having significant impacts on agriculture, forestry,
transportation, property and tourism. In eastern Japan dry winds contribute to soil erosion
and increased fire potential. Rainfall during the Bai-u varies greatly between years. A long or
cool Bai-u can result in lower wheat, vegetable and rice yields. However, farmers continue to
grow rice because its value is much higher than millet or sorghum.

During ENSO years there are fewer but stronger typhoons than in anti-ENSO years.
This information is used for seasonal forecasting. On average, three typhoons hit Japan each
year, in late summer. These can lead to storm surges, strong winds and heavy rains, causing
flooding and landslides, resulting in property damage and deaths. However, the rain adds
significantly to the regional water balance, and can end droughts.
8.1 Thailand - Ruangdej Srivardhana (Kasetsart University, Bangkok)

Thailand's climate is marked by two monsoons, one in late winter and the other in summer. In the dry season between these, there can be substantial failure of the rice crop. Irrigation has been developed over 20% of the drought-susceptible area, but government relief and seed supply are often necessary. During the monsoons, flash floods can lead to severe damage to crops and property, resulting in many deaths. Upstream erosion, combined with downstream sedimentation, is creating conflicts between highland and lowland inhabitants.

8.2 Thailand - Sangsant Panich (Office of the National Environment Board, Bangkok) and Suwanna Panturat (Srinakharinwirot University, Bangkok)

Concern about climate change focuses attention on changes that might adversely affect rice production and sea level. Thailand is a major rice exporter, and 60% of its population are rice farmers. Research based on GCM outputs has shown that increased precipitation variance will increase risks to farmers in rice production. These risks can be limited by increasing irrigation, especially of upland rice, and by changes in traditional agricultural land-use practices. Increased variability in precipitation will also affect hydroelectric power generation.

Sea-level rise is likely to have serious negative impacts on Bangkok (flooding), water supplies (through salinization), shrimp and fish resources, tourism if resorts are flooded, and mangrove forests.
9. United Kingdom - Martin Parry (University of Birmingham)

Until mid-1988, the "official" attitude toward climate change and variability could have been described as neutral or "positive obstructionism." Without detailed regional information about the impacts of climate change, policy responses to climate change were seen as inappropriate. This attitude has changed only recently as a result of 1) review studies by the Department of Environment; 2) a meeting on climate impacts attended by people from all economic sectors which suggested that climate change will include changes in variability; and 3) a fear of lagging behind other countries. It is now likely that national review groups, mirroring those in the IPCC, will be formed, reporting to the Minister of Environment.

Industries are very sensitive to weather. The total cost of the impacts of climate anomalies in the UK is estimated at about US$3.5 billion/year. A quarter of this might be saved by optimal use of available meteorological information. There is great uncertainty as to the degree and effects of climate change. The primary economic impacts would probably result from increased precipitation and increased frequency and intensity of winds.

10.1 U.S.A. - Donald Wilhite (University of Nebraska-Lincoln)

Until recently, federal and state planning in the United States in relation to droughts has been reactive, rather than proactive. In fact, droughts in the 1970s found few states with drought plans. A review by the US General Accounting Office showed that relief measures in response to the 1976–7 drought were inefficient and unsuccessful, and recommended that a national drought plan be formulated. This has not yet been implemented. In the 1980s, however, many state and regional drought plans were developed, primarily in response to a series of severe droughts. Presently, about 20 states have formal
drought plans and approximately 10 are developing these plans. Such drought plans usually have three components: monitoring (early warning), impact assessment, and response. The state plans differ greatly in detail, because of the differences in the mixture of local economic activities. For example, plans in South Dakota and Nebraska focus principally on alleviating the impacts of agricultural drought, while plans in New York and Kentucky focus primarily on municipal water supplies during periods of water shortage. In other states, such as Colorado and California, plans concentrate on a much more diverse set of economic impacts (e.g., agricultural, municipal, industrial, recreational). Overall, drought contingency planning by state governments in the US has progressed rapidly during the 1980s. There are currently some signs that the federal government may have a renewed interest in drought planning as a result of the 1988–89 drought.

10.2 U.S.A - Margaret Davidson (South Carolina Sea Grant Consortium, Charleston, SC)

By the year 2000, 70% of the U.S. population is likely to live within 50 miles of a coast. Many cities, especially along the east and southeast coasts, are located in areas of vulnerable topography (i.e., low-lying, protected by islands which may be lost to sea-level rise). In many cases the infrastructure of the cities (e.g., wastewater management, stormwater drainage system) is old and inadequate. It needs replacement due to decay and population growth. Stormwater runoff is a particular problem; current engineering approaches tend not to consider the potential for increased rainfall that may result from climate change within the lifetimes of structures. Construction of coastal protection structures is one solution to the loss of coastal property, but interferes with outflow from coastal wetlands, on which 90% of marine fisheries depend for nutrients during certain stages of their life cycle.
11. Vietnam - Nguyen Huu Ninh (University of Hanoi)

Vietnam is geographically a very diverse country. Climate information is critical for economic development, but little climate impact assessment research has been conducted. Most development activities are in coastal areas and in the Red and Mekong River basins and deltas. Recent research at the Center for Resources and the Environment has focused on El Niño–Southern Oscillation events. Scientific research over the past 20 years shows that in ENSO years, fewer typhoons occur and, as a result, crop damage decreases. However, summer temperatures tend to be lower. Winters and springs after ENSO years tend to be colder than usual, which can affect the development of the rice crop. ENSO forecasting for Vietnam, as well as for other countries in the region, is important for selecting crop varieties and planting times.

IV. Creating, administering, maintaining and disseminating the output of networks: March 15

The session began with a discussion of defining a network. Michael Glantz defined it as "a community of interests somehow tied together." Margaret Davidson underlined that the purpose, message, and audience must be defined, so that members know what information to disseminate and why. Andris Auliciems identified a potential continuum of networks distinguished from one another by degrees or levels of formality and informality. Each point along this continuum has positive and negative aspects; researchers in each country have to choose an appropriate approach to networking depending on cultural and institutional contexts.

Maria Krenz (ESIG) mentioned two reasons for the success of the relatively informal North American network: it brings together people who are interested in climate-related
impacts, and it provides a means of exchanging information relevant to climate impact assessment. Tibor Faragó noted that members must have a willingness to be informed, pursue new ideas and share experience. It is critical that people from different disciplines communicate. A very formal approach could lead to a loss of multidisciplinarity. Masatoshi Yoshino said that one of the keys to developing the rather formal Japanese network was that initial meetings were held at “neutral” locations, so that one discipline would not be perceived (or become) dominant.

Michael Glantz stressed that, to start a network, a core individual or group is essential. In some countries, the initiative may come from a government which recognizes the need for climate-related impact activities because of political pressure or because of the societal impacts of a “climate shock.” Often, a single institution will provide the administrative center. Once a core group is established, it can identify people working in related fields and bring them into the network, providing a greater pool of resources for government and other funding agencies and decision-makers. This can enhance research, for example, by showing that policies must consider both natural factors (e.g., climate variability) as well as societal factors (e.g., impacts and politics). All governments should be concerned about climate impacts and not only within their own borders but in other countries as well. For example, climate variability in one country can affect its harvests, thereby impacting the global commodity market for some crops and, in turn, affecting activities of other countries dependent on those crops.

Workineh Degefu provided a list of purposes for newsletters. These include: providing information about who is doing what, what meetings are scheduled or have occurred,
the status of ongoing research projects, and on other sources of information (e.g., the existence of other newsletters); sharing views and developing consensus on such topics as climate change; creating awareness of policy issues; generating new research projects and themes; and identifying new sources of funding for both the network and network members' activities. He noted that, with all the positive benefits of a network, there are important financial implications such as the costs associated with the ongoing production of a newsletter. Before a network is developed, the organizers have to know what commitments they will have to make. Martin Parry pointed out that each potential networking activity (meetings, newsletters, other publications) implies different levels and types of commitment. Antonio Magalhães reminded us that collecting information to aid policymaking also requires investment. Masatoshi Yoshino stated that support for the activities of the Japanese network comes mainly from within members' institutions. However, this may be one reason that some disciplines are very poorly represented or not represented at all.

Andris Auliciems stated that, in some countries, a critical stimulus for creating a national network can be international direction provided by an agency such as UNEP, possibly through an international contact to which national networks would to report back. Glantz noted that many international topical networks (e.g., for drought) already exist and contain many potential members for starting national climate impacts networks. Peter Usher pointed out that this international networkshop was conceived largely in response to the decisions of the UNEP Governing Council in 1985. These decisions emphasized the importance of building links between and within the climate research communities, including impacts, at national and international levels. He identified networking as one of the most
fruitful approaches for encouraging such activities, particularly to attract countries presently uninvolved in climate impact assessment. UNEP may be able to provide seed money to initiate networks in countries with limited resources.

Guido Visconti reminded workshop participants that UNEP is obliged to use national Foreign Ministries as the intermediary for communications to and from countries. Consequently, information from UNEP often does not reach the most appropriate target audiences in a timely manner or at all. He suggested that UNEP should consider new ways to communicate directly with representatives of national scientific communities. Peter Usher acknowledged the problem and suggested that the WCP newsletter might be an appropriate medium in the future. He concluded the discussion by stating that one of the purposes of the workshop was to identify the best ways for UNEP to help develop national networks. He also accepted the idea that an international framework for national networks was necessary for their success.

V. National Climate Programs: 16 March.

1. Canada - Al Malinauskas (Canadian Climate Centre, Toronto, Ont.)

The Canadian Climate Centre (CCC) has developed in parallel with the WCP since 1979, and contains the same components. It is mainly coordinated by the Atmospheric Environment Service (AES), with some input from other federal agencies. Lack of rivalry between agencies is crucial. The CCC Board provides direction and advice. It is composed of 6-7 senior officials of federal agencies (a critical ingredient), with 2 participants each from provincial governments, academia, and industry. A committee of Assistant Deputy Ministers meets as required to agree on co-fundable activities; funding from other agencies
is increasing. Advising the CCC Board are the National Advisory Committee and a Research Committee, mainly involved with climate modelling.

AES accounts for about 25% of the total Environment Canada budget and manpower. About 7% of this goes to climate programs; about half of this ($9M in FY 1988/9) to the CCC. This funds most climate impact research, undertaken by academics and consultants. Eleven studies completed since 1984 have been summarized in the Climate Change Digest reports. The significant media coverage these have received has been successful in raising public and government awareness of issues related to climate impacts. Ten more reports are in preparation and other studies are planned.

2. Hungary - János Zákonyi (Ministry for the Environment and Water Management, Budapest)

A program related to climate impacts is just beginning in Hungary, prompted by political and economic issues, and is evolving quickly. Many ministries and universities will be involved; NGOs should also be included. At present, policy development tends to be based on political considerations; greater understanding of climate/society interactions by the public and policymakers is needed. A conceptual change may be required. The first steps are the inventory of available data and the coordination of researchers (especially social scientists) and methodologies. Priority areas for research are to analyze past climate trends, to develop monitoring systems suitable for future needs, to involve all sectors in research, and to interact with international groups. Hungary has participated in some international initiatives, but is proceeding cautiously. Language differences and funding are major constraints.
3. Italy - Guido Visconti (Universita Degli Studi dell'Aquila)

The Italian NCP was established in 1985, but has not yet been implemented. It will form part of the 2nd National Environmental Program, which will start in 1990. Its emphasis will be on applied (physical climatology) research through National Dedicated Plans, in each of which research at universities and national research labs is coordinated by one institution. Most of the funding will come from federal agencies, with some financial support from industry. Climate research is not a high national priority. In addition, meteorology falls within the purview of the Italian Air Force. One of the six proposed projects in the NCP (with the lowest projected funding level) will consider the impacts of climate change, based on climate model outputs and information from paleoclimate reconstruction. There is little Italian experience in these areas, particularly with regard to Italy; most work has been done in other countries.

4.1. Japan - Shuzo Nishioka (Japan Environment Agency, Tsukuba)

Japan, like other industrialized countries, contributes significantly to climate change through its carbon dioxide emissions and imports of timber and other materials. The impacts are primarily indirect because of the country's economic dependence on imports (e.g., energy, food, timber). National responses to climate change may be described as: 1) Watch - promote research and participate in the IPCC; 2) Prepare - develop adaptive and preventive technologies, and build international cooperation; and 3) Delay - start undertaking low-cost preventive measures.

Many federal agencies and their associated research institutes are involved in the NCP. Since 1988, climate change has become a high priority, with increased funding and
the organization of many committees within government agencies. However, coordination among agencies needs to be improved in order to enhance Japanese participation in the IPCC. The National Institute for Environmental Studies is developing a number of studies on the mechanisms, trends and impacts of climate change. These studies are intended to complement those being undertaken by the study group referred to by Dr. Yoshino (see II.5).

4.2 Japan - Tsuneharu Yonetani (National Center for Disaster Prevention, Tokyo)

Japan's Science and Technology Agency will start two projects relating to climate and climate impacts in 1989. One will analyze the processes of desertification (in cooperation with the People's Republic of China). The second one will assess the mechanism of the Asian monsoon, to improve forecasting of abnormal weather events in Asia (e.g., droughts, heavy rain). The National Center for Disaster Prevention has also carried out studies of the impact of severe rainfall events, which showed that knowledge of variability should be built into planning. The Center is building a data base on severe weather events and their impacts.

5. U.S.A. - Garth Paltridge (U.S. National Climate Program Office, Washington, DC)

The National Climate Program Office (NCPO) was created by legislation in 1978. Its responsibilities are to prepare an annual report and budget, develop and monitor the NCP, and coordinate climate-related work by federal agencies. Most departments of the federal government are involved in the NCP. The NCPO funds regional climate centers; by the end of 1989, these will cover the entire nation. It has also worked closely with Canadian agencies to assess the impacts of climate change in the Great Lakes Basin. The NCPO now
produces a newsletter which will report on the activities of the IPCC. In the IPCC the U.S.
has responsibility for policy.

The three primary areas of concern to the NCP are to monitor climate, to model and
predict climate change, and to assess climate impacts and develop response strategies. The
U.S. is heavily involved with all areas of the IPCC, which is acting as a stimulus to the NCP.
Many government agencies are exerting pressure on the NCP to provide information useful
for policy development related to climate.

VI. Global change: 16 March.

A special session was held to discuss various aspects of global change programs and
activities currently being developed as part of an international decade-long global change
research program. This session built on the presentation made by Martin Price on the first
day of the workshop (see II.6). Brief presentations were made by selected participants and
were followed by open discussion.

1. A *modeling perspective on global warming*
   Guido Visconti (Università Degli Studi dell'Aquila)

   Improved assessment of the impacts of climate change on the European continent
and elsewhere will be dependent on the development of “limited area models” (i.e., with
spatial resolutions on the order of 60 km²) to be used in conjunction with existing global
climate models (GCMs). On this improved spatial scale, climate change impacts to regional
precipitation and soil conditions could be better predicted than is currently the case with the
coarse-resolution GCMs.
2. Societal dimensions of global change -
Edward Parson (Institute for Research on Public Policy, Ottawa, Ont.)

Many international research programs are devoted to the issues of climate change
and global change. The Canadian Institute for Research on Public Policy's "Program on
Environment and Sustainable Development" research effort, entitled "The Social Challenge
of Global Change," is designed to focus public policy-related research efforts on the general
concept of global change. The project's four principal tasks are: 1) survey existing literature
on global change; 2) identify Canadian researchers and research centers involved in global
change matters; 3) develop a conceptual framework for understanding how public policy can
address global change; and 4) identify themes for a global change research program.

The conceptual framework developed for this research effort is composed of four
elements: two micro-elements—"preferences, values, and perceptions"—which together
determine what is desired in societal terms, and "technology" (including wealth and
knowledge), which determine what is possible; and two forms of aggregation—"economy"—
which involves decentralized decisionmaking in market settings, and "governance," which
involves centralized societal decisionmaking.

The research themes for this project are as follows:

1) Institutions and decision processes (including international legal and diplomatic
frameworks to identify possible precedents and analogies applicable to policies on global
change; defining information needs for sustainability; scales of process and management;
and accountability and responsibility);

2) cultural/ethical roots of economic/environmental behavior (including cross-cultural
studies of environmental ethics; native value systems and environmental exploitation;
feminist perspectives on the ethic of exploitation; and communication and symbols in
public values);
3) relationships between impacts research and policy research;
4) types of environmental policy, such as “anticipate and prevent,” “react and cure,” and
“anticipate, wait, and adapt.”

3. Ethical implications of global change -
   Dale Jamieson (University of Colorado, Boulder)

   Societal responses to climate change, if any, will involve “winners” and “losers.” For example, in order for developed countries to remain “winners” by preserving today’s climate, developing countries may have to be “losers” in the sense that their tropical rainforests must not be commercially exploited. As another example, even within nations, choosing to combat global warming might involve a reduction of dependence on fossil fuels as well as a renewed commitment to nuclear power.

   Another ethical issue is that of intergenerational equity: is it ethical for past and present generations to bestow on future generations a changed global climate, or to leave a degraded environment for future generations to repair? Precisely what is our responsibility to future generations regarding the global environment?

   A third ethical issue is that of the destruction and extinction of animal and plant species through, for example, deforestation in developing countries: is it ethical stewardship of the Earth to knowingly extinguish life forms which can never be reestablished?

   One can be skeptical about society’s ability to think of the global environment in ethical terms for the following reasons:
1) Globally, society is not inclined to devote resources to understand the impacts of global change, let alone devote resources to determining how to respond to such change.

2) The moral and legal systems in many societies evolved in settings where harms were immediate, both temporally and spatially. Under global warming and climate change, temporal and spatial harms may not be identifiable for many years, thereby clouding the establishment of guilt, blame, or responsibility for damages.

3) Assigning blame for global warming and climate change is virtually impossible, even with today's knowledge of the Northern Hemisphere's overwhelming consumption of fossil fuels, compared to much lower consumption levels in the Southern Hemisphere. Assigning responsibility for solving problems related to global warming will also be difficult.

4. Impacts of sea level rise  
   Margaret Davidson (South Carolina Sea Grant Consortium)

   Global sea-level rise is more than just a physical science issue; it is institutional and social as well. For example, what will be the impacts of sea-level rise on human activities and on society and what will be the human responses? The impacts of sea-level rise will not be simply physical (e.g., coastal erosion, wetlands inundation, saltwater intrusion), but broader, as economic and other human patterns of interaction are disrupted. If we expect institutional and governmental awareness as well as consideration of the possible impacts of sea-level rise, we must present impacts research down to the community level and be able to demonstrate direct economic consequences in local contexts.
5. Societal impacts of climate variability and climate change -
Tibor Faragó (Hungarian Meteorological Service, Budapest)

A critical issue in assessing climate impacts involves the question of separating climatic
variability and extremes from evidence of climate change. In the present climate condition,
climatic variability resembles a random walk around a definition of climate. With climate
change, a different state of climate variability (with new extremes) would be established.
Thus, to understand the consequences of climate change, one must also recognize the
significance of new meteorological extremes as well as new climatic means (e.g., for
temperature and precipitation).

VII. Concluding Session: 17 March.

As part of the last session of the workshop, Amory Lovins, of the Rocky Mountain
Institute, presented a lecture on the potential for more efficient use of fossil fuel energy.

Following Lovins’ lecture and a discussion, the session began with a discussion of
the problems and prospects of multidisciplinary research. Margaret Davidson noted that
much lip-service is given to multidisciplinary research, but that the reward structure in
universities rarely fosters it. The development of peer-groups is one way to strengthen such
research activities. Meetings and networks which involve the interaction of many disciplinary
perspectives allow such perspectives to evolve. Michael Glantz referred to a meeting held at
NCAR in 1977 on multidisciplinary research related to the atmospheric sciences which was an
early attempt to bring physical and social scientists together. Don Wilhite mentioned that,
in spite of problems in bringing social sciences into the agricultural research community,
many centers with this purpose are developing, sometimes outside the university setting.
University administrators as well as department faculty have to be educated about the value of multidisciplinary research.

Tibor Faragó mentioned that a major problem with multidisciplinary research is funding - it often falls outside the obvious competence of any particular agency. He suggested that when one agency funds such research, this often leads to oversimplification by emphasizing one discipline's approach. Climate-related impacts research, however, needs to include, be interpreted from, different viewpoints.

Andris Auliciems identified another constraint to multidisciplinary research; that it is largely undertaken by non-traditional minorities within disciplines. A question was raised whether multidisciplinary research should develop through the immediate integration of research of people representing several disciplines or through feedback and interaction between researchers of different disciplines. Antonio Magalhães reminded us that life is interdisciplinary; the challenge to science is to develop concepts to understand the different parts and then to combine these into a whole.

Discussion then focused on the development of climate-related impacts networks. Michael Glantz stressed that one purpose of UNEP-funded studies should be to ensure that human capital remains in countries after UNEP funding for such activities stops. The education of policymakers is important to ensure both long-term funding and the use of climate-related information for policymaking. János Zákonyi proposed that, while governments should play a major funding role, climate impacts researchers should not wait until all of their needs are recognized by governments. Scientists have to learn how to "sell" their knowledge. Tibor Faragó noted that it is often easier for impacts researchers to gain
a reputation and have an influence outside their own countries. Martin Parry suggested that an international framework would greatly help in getting national networks established, especially in countries which tend to approach such topics formally (e.g., the U.K.).

Peter Usher noted that, even in UNEP, networking on climate-related issues is not easy: departments tend to be compartmentalized. However, an interdepartmental task force has now been formed, as UNEP recognizes climate as an important global issue that has to be tackled holistically. This is also the viewpoint of the Governing Council that sets UNEP priorities. UNEP will continue to develop international mechanisms for developing and disseminating climate-related information. This includes both the development of an infrastructure within UNEP and the encouragement of the development and maintenance of national networks. Such networks should be developed within all UN countries. National networks should involve national agencies, in order to facilitate communication with UNEP. However, other channels of communication to the scientific community are also important.

Usher also indicated that UNEP’s World Climate Impacts Program might be able to provide $1–2,000 to developing countries to encourage the development of national networks. In addition, funds should also be used to stimulate and develop an international network in order to provide encouragement as well as a focal point for national networks. This development needs to be defined, but should be a major direction of the WCIP in the future. These proposals must be presented to the Governing Council for approval.

The workshop activities concluded with the drafting of the following recommendations:
1. **Main Recommendations:**

   i. There is a need to establish national climate-related impact networks. Each national network may take a different form because of the differences that exist between national settings.

   ii. There is a strong need for the development of an international network devoted to climate-related impact assessment in all its dimensions, including multidisciplinary research. UNEP’s World Climate Impacts Programme could serve as the focal point of this network. An important activity of this network should be to publish and disseminate an international newsletter.

   iii. Interaction should be encouraged between national networks on topics of mutual concern. (For example, Ethiopia, Vietnam and Japan could collaborate on the use of ENSO information for seasonal forecasting purposes.)

   iv. There is a strong need for international support for the establishment of networks. UNEP should urgently develop a project with sufficient resources, both human and financial, to promote the creation and maintenance of networks and to ensure the implementation of the recommendations of this networkshop.

   v. A follow-up international networkshop should be convened in 1991 under the auspices of UNEP and WMO (possibly in Japan), to review progress in the development and operation of national and international climate-related impact networks and national climate programs.
2. Recommendations for National Networks:

a. There is a need to identify core groups to take the initiative in establishing each national network. [U. of Cairo]

b. As part of the national and international networking process, existing research activities on climate-related impacts could be assessed for their potential in providing the initial actors and activities for establishing that network.

c. There is a need to identify, at the national level, organizations, institutions, and researchers whose activities may be related to climate impacts, even though they may not yet consider their activities to be a part of the climate impacts area.

d. A national network newsletter can serve as one approach to defining and establishing a national network for those interested in climate-related impacts. Another approach might include the convening of multidisciplinary conferences.

3. Recommendations for National Climate Programs:

a. The development of national climate programs should be encouraged where they do not now exist. Existing national climate programs should ensure that sufficient attention is paid to climate-related impacts within such programs. Such national climate programs could encourage the creation of networks or the strengthening of existing ones.

b. UNEP and WMO should stimulate cooperation among national climate programs and between them and the World Climate Programme.
INTERNATIONAL NETWORKSHOP
National Center for Atmospheric Research
Boulder, Colorado
Main Seminar Room, 14–17 March 1989

Monday, 13 March
7:30 p.m. Reception at Golden Buff Motel

Tuesday, 14 March
9:00 a.m. Opening
    UNEP, Peter Usher
    ESIG, Michael Glantz
    Brief introduction by participants about themselves
10:15 a.m. Break
10:45 a.m. General discussion about purpose
    Discussion of goals and objectives
    Adoption of agenda
12:00 noon Lunch
1:30 p.m. Examples of recent climate-related research activities
    Hungary Regional Scenarios (T. Faragó)
    Brazil Regional Scenarios (A. Magalhães)
    USA Regional Scenarios - EPA (M. Glantz)
    Ethiopia Famine Early Warning (W. Degefu)
3:00 p.m. Break
3:15 p.m. Continuation of examples of climate-related research activities
    Japanese Study Group (M. Yoshino)
    Global Change and the Social Sciences (M. Price)
4:30 p.m. Redefine/restate goals of international networkshop
5:00 p.m. Adjourn
    Free evening
Wednesday, 15 March

8:30 a.m.  Presentation by a representative of each country of the two most important impacts of climate with which it is concerned (15 minutes each).

10:00 a.m. Break/Reception to meet NCAR scientists

10:30 a.m. Continuation of country presentations

12:00 noon  Lunch

1:30 p.m. Discussion of problems with creating, administering, maintaining, disseminating output of networks.

3:00 p.m. Break

3:30 p.m. Continuation of discussion

4:30 p.m. Adjourn

6:30 p.m. Group dinner

Thursday, 16 March

8:00 a.m. National Climate Program Office presentations:
            Canada (A. Malinauskas)
            Hungary (J. Zákonyi)
            Italy (G. Visconti)
            Japan (S. Nishioka and T. Yonetani)
            United States (G. Paltridge)

10:00 a.m. Open

7:00 p.m. Dinner

8:15 p.m. Global change session at the Golden Buff Motel:
            scientific panel followed by open discussion
            A modeling perspective on global warming (G. Visconti)
            Social dimensions of global change (T. Parson)
            Ethical implications of global change (D. Jamieson)
            Impacts of sea level rise (M. Davidson)
            Climate variability and climate change (T. Faragó)
Friday, 17 March

8:00 a.m.  Continuation of discussion of global change

9:15 a.m.  Seminar by Amory Lovins, "Is saving three-quarters of our fossil fuels cheaper than burning it?"

10:30 a.m.  Break

11:00 a.m.  Problems and prospects for multidisciplinary research on climate related issues

12:30 p.m.  Lunch

1:30 p.m.  Recommendations to UNEP

3:00 p.m.  Workshop adjourned

Evening:  Open House at Michael Glantz's home
List of Participants
INTERNATIONAL NETWORKSHOP
14–17 March 1989

Andris Auliciems
Director, Applied Climate Research Unit
Department of Geographical Sciences
University of Queensland
St. Lucia, Queensland 4067
Australia

Dale Jamieson
Department of Philosophy
University of Colorado
Boulder, CO 80302

Antonio Magalhães
Secretaria de Planejamento
Centro Administrativo do Estado
Sitio Cambeba
60000 Fortaleza, Ceará
Brazil

Stewart Cohen
Canadian Climate Centre
4905 Dufferin St.
Downsview, Ontario
Canada M3H 5T4

Al Malinauskas
Canadian Climate Program Office
Environment Canada
4905 Dufferin St.
Downsview, Ontario M3H 5T4
Canada

Margaret Davidson
South Carolina Sea Grant Consortium
287 Meeting St.
Charleston, SC 29401

Nguyen Huu Ninh
Resources & Environment Center
University of Hanoi
Vietnam

Workineh Degefū
Director, National Meteorological
Service Agency
P.O. Box 1090
Addis Ababa, Ethiopia

Shuzo Nishioka
System Analysis & Planning Division
National Institute for
Environmental Studies
Japan Environment Agency
Yatabe-mache
Tsukuba, Ibaraki 305
Japan

Tibor Faragó
Hungarian Meteorological Service
P.O. Box 38
H-1525 Budapest
Hungary

Garth Paltridge
National Climate Program Office
NOAA
11400 Rockville Pike
Rockville, MD 20852

Michael H. Glantz
Head, Environmental & Societal
Impacts Group
National Center for Atmospheric
Research
P.O. Box 3000
Boulder, CO 80307
Sangsant Panich  
Office of the National Environment Board  
SOI Piboonwatana 7  
Rama 6 Road  
Bangkok, Thailand 10400

Suwanna Panturat  
Srinakharinwirot University  
Sukhumvit 23  
Bangkok 10110  
Thailand

Martin Parry  
Department of Geography  
The University of Birmingham  
P.O. Box 363  
Birmingham B15 2TT  
United Kingdom

Edward Parson (Canada)  
c/o Kennedy School of Government  
Room G-27  
79 JFK Street  
Cambridge, MA 02178

Vo Quy  
Resources & Environment Center  
University of Hanoi  
Vietnam

Ruangdej Srivardhana  
Faculty of Economics and Business Administration  
Kasetsart University  
Bangkok, Thailand 10900

Peter Usher  
Program Officer  
World Climate Impacts Program  
U.N. Environment Programme  
P.O. Box 30552  
Nairobi, Kenya

Guido Visconti  
Dipartimento di Fisica  
Universita’ Degli Studi dell’Aquila  
67100 L’Aquila, I  
P.za dell’Annunziata, 1  
Italy

Donald Wilhite  
Center for Agricultural Meteorology  
University of Nebraska  
241 Chase Hall  
Lincoln, NB 68483-0728

Tsuneharu Yonetani  
National Center for Disaster Prevention  
Tokyo, Japan

Masatoshi Yoshino  
Institute of Geoscience  
The University of Tsukuba  
Ibaraki, 305  
Japan

János Zákonyi  
Deputy Director General  
Department of International Relations  
Ministry for Environment and Water Management  
P.O. Box 351  
H-1394 Budapest  
Hungary

Secretariat:  
Maria E. Krenz, ESIG  
Martin F. Price, ESIG  
Steven L. Rhodes, ESIG