Proposal for a
Climate Affairs Program
and Center

DRAFT
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Executive Summary

Faculty interest in climate change activities at the university level does exist. However, this interest is often fragmented and lacks coherence. A structured approach to engage faculty in climate change research and education is needed to build a cohesive climate change program at the university.

The document outlines the following steps to achieve this goal:

1. **Climate Change Awareness**: Faculty should be aware of the environmental and social implications of climate change. This awareness can be enhanced through education and training programs.

2. **Faculty Engagement**: Engage faculty members in climate change-related research and education activities. This can be achieved through collaborative projects and interdisciplinary initiatives.

3. **Student Involvement**: Encourage student involvement in climate change initiatives. This can be done through internships, research projects, and community service.

4. **Policy Development**: Faculty should be involved in developing policies that address climate change. This includes both internal and external policies.

5. **Community Engagement**: Engage the community in climate change initiatives. This can be done through outreach programs and public education campaigns.

The document concludes with a call to action for the university to take a leadership role in addressing climate change, both on campus and in the broader community.
It serves to catalyze multidisciplinary interactions within the university system, as well as elsewhere, on a range of climate-related aspects of common concern.

It provides researchers in various departments, centers, and programs with the expertise to operate and maintain a Climate Affairs Program.

It can serve as a theme for the development of a network of universities worldwide that have a growing interest in climate-related education in a wide range of disciplines.

It is as applicable to undergraduate education and training as it is to graduates and professionals.

The creation of a focal point on campus, within an organization or region for climate affairs, a Climate Affairs Center, is of primary importance: to oversee the Climate Affairs Program development; to foster awareness of climate and climate-related issues among university students, administrators and faculty; to encourage multidisciplinary interactions (teaching, research) on climate and climate-related issues; to develop and maintain a proactive website.

The Center would serve as a potential catalyst and a hub to the creation of other such programs on a regional and global basis, given the interest expressed thus far by educators, students and researchers from around the world.

Resources at levels appropriate to achieve the long-term goals would need to be made available.

A mix would be developed of new, existing and modified existing educational and research resources.

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It is my impression that no one really likes the new. We are afraid of it. It is not only as Dostoevsky put it that "taking a new step, uttering a new word, is what people fear most." Even in slight things the experience of the new is rarely without some stirring of foreboding.

Back in 1956 I spent a good part of the year picking peas. I started out early in January in the Imperial Valley and drifted northward, picking peas as they opened, until I picked the last peas of the season, in June, around Tracy. Then I hopped all the way to Lake County, where for the first time I was going to pick string beans. And I still remember how sudden I was that first morning as I was about to address myself to the string bean vines. Would I be able to pick string beans? Even the change from peas to string beans had its elements of fear.

In case of drastic change the uneasiness is of course deeper and more lasting.

(Eric Hoffer, On the Ordeal of Change, 1952, p.3)

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I. Introduction

The overarching goal of this paper is to present a feasibility study and develop a proposal for the development at a university or training center of a program and center for Climate Affairs. My approach has been to develop generic guidelines for developing a multidisciplinary Climate Affairs Program or course concentration, which can then be modified to meet the specific interests and expertise of the various faculty members, departments, institutes, centers, students, and schools and colleges of a university that might wish to help to develop and to be involved in such an activity. The range of courses encompassed by the notion of climate affairs includes the physical, biological and social...
sciences, and the humanities. This plan can easily be modified to meet the needs, goals, and requirements of undergraduate education.

**Objectives**

The general objectives behind the establishment of a Climate Affairs program and center are the following:

- Encourage and foster education and research on climate-related issues.
- Develop a climate affairs educational hub at a university.
- Understand how climate, environment, and human activities interact.
- Make climate information "usable" to decision makers from the local to the national level.
- Develop a network of climate affairs education and training centers and programs.

**Specific Objectives of a Feasibility Study is as follows:**

1. P2 To determine to the extent possible in a preliminary activity the degree of on-campus faculty, center, and institute interest (actual and potential) in broadening faculty and student involvement in teaching and research on climate and climate-related issues. Climate Affairs has two aspects: (1) courses for which the threat of climate runs through it from end to end; and (2) courses in which climate issues are noted for a number of weeks or only in a number (not all) of topics. Make this distinction: this means that for (2) we would have to contact professors/ institutions about the possibility of talking about climate in their courses.

- To suggest the type(s) of academic program(s) that might be developed at a university or training facility for a climate affairs activity (a Master's program, a one-year professional Master's, a course concentration, a certificate program, minor, etc.).

- To develop a multi-year plan for a Climate Affairs center and for a Climate Affairs program.
- To assist interested and potentially interested faculty in identifying materials, contacts, activities, and topics in the climate-related area of education -- teaching, professional development, and research.
- To develop a prototype introductory course on climate affairs.
- (P2) To develop a prototype capstone seminar on climate affairs.
- To prepare a mission statement for a Climate Affairs Center and Program.
- (P2) To identify an on-campus, an off-campus (national as well as international), and a New York metropolitan network of individuals, groups, and organizations presently and potentially interested in networking with Columbia on climate and climate-related issues.
- To suggest and provide, when possible, linkages for faculty to make contact with international and other counterparts interested in climate and climate-related issues. (P2) To assist faculty and institutes in the identification of potential funding sources for climate-related research proposals and climate-related activities such as workshops and conferences.
- To design a prototype site for a Climate Affairs Center and Program.

Separate out Phase 2 (P2) actions and expand Phase 2.
II. Defining Climate Affairs

Climate Affairs Program Focus: Why Now?

Climate and climate-related issues such as food security, water resources, energy production and consumption, public health and public safety have become increasingly important to governments, corporations, individuals and the general public in the 1990s. One could surmise that this sharp increase in interest in climate issues and weather has been, at least in part, a result of the end of the Cold War in the early 1990s. In the same time period various weather and climate anomalies have been labeled as the “storm of the century”, the “worst” hurricane, the “most costly” drought, the “longest El Niño,” the deadliest flood in history, and so forth. Some observers have linked this spate of weather and climate episodes to human-induced global warming of the atmosphere, while others have argued that these are random extreme occurrences under normal global climate conditions. The perception about the global climate regime is that climate anomalies have become more frequent, more costly and more deadly. Since the late 1980s scientific and government interest in global warming has increased steadily and to new heights, leading up to serious international negotiations to control the production of greenhouse gases. The potential for adverse impacts on food, water, energy, ecological and human health and public safety of a human-induced global warming appears to be quite high for the 21st century. Meanwhile, poor and often disenfranchised communities and countries remain chronically vulnerable to the vagaries of the climate system. Assessing climate-society-environment interactions and acting on those assessments can reduce societal vulnerability while enhancing societal resilience to climate-related hazards.

What Constitutes the Notion of Climate Affairs?

For more than a hundred years, climate has been described as “average weather,” but in reality it is much more than that. In fact, one could argue that because people see climate and weather as different, they respond to them differently. For our purposes, climate encompasses the following: variability from season to season and from year to year, fluctuations on the order of decades, change on the order of centuries and beyond, extreme meteorological events and seasonality. By including all five aspects of climate in a climate affairs program, a realistic balance in teaching and research of climate on various time scales can be developed. (See pp. 43–47 of this report for more information on these aspects of climate.)

Climate-related: a definition

I often refer to climate and climate-related. There is a distinction that needs to be made, although I tend to use these concepts interchangeably. Climate anomalies refer to the direct impacts of atmospheric processes on ecosystems and societies. These include more or less precipitation, more or less outgoing long-wave radiation, changes in temperature, changes in relative humidity, cloud cover, etc. Climate-related is used to capture many of the second and third order effects of those anomalies on societies and ecosystems. These include, as examples, agricultural and hydrologic drought, floods, soil erosion, changes in seasonality that can affect human activities and ecological processes. While I try to keep these concepts separate in this publication, when I use climate anomalies I am referring to both the meteorological aspects of the atmosphere and their direct and indirect impacts. It is hoped that the contextual use of these terms will clarify what is intended by their specific use in a given place.

In order for a Climate Affairs Master’s Program to be complete (as defined in this report) it must contain educational and professional training and research aspects related to the following areas: Climate Science, Climate Impacts on Ecosystems and Societies, Climate Policy & Law, Climate Politics, Climate Economics and Climate Ethics. Each of these areas is discussed in the following section.

Climate Science

The objective of a climate science section of Climate Affairs program is threefold:

- To understand the climate system

- To understand the climate system

- To understand the climate system
To understand its components and their interactions and recognize society as an integral component, it is important for climate affairs students, educators and professionals to understand the workings of the climate system and the interactions of its components. Briefly, incoming solar radiation is intercepted by clouds and by the Earth’s terrestrial and oceanic surfaces. The short wave radiation is reflected back to space as long wave radiation some of which is trapped within the Earth’s atmosphere. The atmosphere and the Earth’s surface warms as a result of this process. Ice reflects incoming radiation at a rate much higher than darker surfaces such as rainforests with the latter warming, as a result of having a lower albedo (reflectivity). As the Earth warms differentially the atmosphere responds accordingly. As moisture evaporates, clouds form and clouds act as a feedback way to cool down the atmosphere.

That system, which has numerous components, is, understandably, often characterized in a simple graphic. The following is such a graphic. It is an important graphic in the sense that it can educate those who review it, especially decision makers at all levels of society. It was produced in June 2000 as part of the report of the National Assessment of Climate Change Impacts in North America. Note the major components of the system: sea ice, forests, oceans, deserts, clouds, the sun, topography, rangelands, and wetlands. These components are synergistic and interact in a variety of ways to create climate at all spatial scales: local, national, regional and global.

A closer review of this graphic, however, exposes a major omission. Human activities are not represented. This is an important omission, because most scientists today would have to agree that each of the following human activities in the form of industrialization processes (the emission of greenhouse and other gases and particulates), land-surface modifications, tropical deforestation and urbanization has in its own way contributed to altered climate regimes on various space and time scales. This is a major oversight, because it suggests at worst a “backsliding” or at best an oversight by the scientific community that accepted the graphic as representative of the modeled climate system. Regardless of cause, it represents a step backward for multidisciplinary research and application related to climate issues, because other previous reports such as the 1995 IPCC report did contain graphics with human activities explicitly identified. Many new policy makers and researchers new to the IPCC process will likely be misleading by
viewing human activities as an insignificant aspect of the climate system despite considerable evidence to the contrary.

While the following IPCC graphic is less colorful than the one above, it more correctly portrays the climate system as it should be represented today. This is so, given the global community's heavy dependence on fossil fuel use, rapid and widespread rates of tropical deforestation and the dominant use of new chemicals in industrial and agricultural activities.

Thus, it is imperative that students, regardless of their disciplinary interest, or young professionals, regardless of their career goals, develop a broad multidisciplinary perspective of the climate system. Consideration of atmospheric processes and climate is too important to society to be left only to the climatologists.

Climate Impacts on Ecosystems and Societies

Climate variability, climate change, seasonality and their extremes have visible impacts on the environment and society with which all people are familiar. They also have subtle effects as the more initial and visible impacts ripple the environment and society. The type, location, duration and severity of those impacts, however, vary over time, depending on changes as well in ecosystems and societies. Impacts are as determined by the level of vulnerability and resilience of an ecosystem or a society as they are by the intensity of a weather- or climate-related anomaly.

The truth be told, drawing attention to the need to identify the direct and indirect, visible and hidden influence of weather and climate anomalies is easier said than done. Attributing an ecological or societal impact to a specific climate or climate-related cause is also not so easy, as there are often several factors operating at the same time that have to be taken into consideration. Often, the way attribution is done by the public is as follows: a major weather or climate anomaly occurs -- drought, flood, frost, fire, severe storm, cyclone -- and most visible adverse changes that happen to take place around the time of that anomaly are identified. Almost immediately, they are attributed to the anomaly. However, a more considered analysis is necessary, so that appropriate safeguards can be developed to enable a society to cope with similar climate and climate-related anomalies in the future. Wrongly attributing climate-related impacts to a specific cause can prove to be wasteful with regard to resources and can lead to false expectations about the level of protection that a society might have from climate and climate-related anomalies.

It is an important challenge to scientific organizations to the fact that at the onset of the 21st century human activities have become a notable forcing factor as far as atmospheric processes are concerned. For its part the social science community must only recognize the importance in a passive way of understanding the physical conditions (especially the global and regional climate settings) with which societies must cope.

Trenberth et al., 1996, p. 55.
- Climate impacts on ecosystems

Terrestrial

For the most part, the media concentrate their attention and coverage on highly visible, usually adverse, climate and climate-related impacts on land-based ecosystems, both managed ecosystems (irrigated, dryland, rangeland) and unmanaged ones (forests and other wilderness areas). Droughts and floods capture the most attention. Often, during prolonged dry spells premature concerns about drought often fill the airwaves and the printed media, only to have that concern evaporate when a timely rain saves a crop. For example, in the midst of a serious El Niño-related drought in 1997 in Australia, timely rains occurred over a few weeks and prevented a devastating on-farm production year, as suggested in the following figure.

The effects of drought on grasslands have been well documented, not only recently but over many decades. Continual production of annual crops in dry areas often leads to drops in productivity and lower yields over time and can leave the exposed soils subjected to wind and water erosion. There is also an increase in the likelihood of dust storms. For example, in the West African Sahel during good rainfall years crop production is favorable but in the dry years food shortages occur. Those who have livestock on the grasslands will take their livestock to the relatively better-watered areas to the south. This can lead to conflict between herders and cultivators as the cattle and goats graze in the agricultural areas destroying crops and trampling soil.

Also in West Africa many farmers cultivate the banks of rivers that had swollen during the rainy season. As the river water recedes in volume, farmers plant seeds in the moist exposed soils where there is enough moisture to support crops. However, in the event of a hydrological drought (a reduction in streamflow volume), those in flood recession farming are increasingly at high risk to crop failure.

As the global atmosphere warms, eco-zones will change. Tropical and sub-tropical climate will shift poleward. Vector-borne diseases will follow the warmth from the tropics into the mid-latitudes. Computer models and observations suggest that for each degree of warming in the mid-latitudes, there will be a 3-4 deg C warming in the polar regions.

Mention in a paragraph or two Biodiversity and Climate

The interactions between the ocean and the atmosphere are multifaceted. Moreover, the impacts of changes in the atmosphere (e.g., climate changes on various time scales) on marine ecosystems are highly complicated, as can be seen in the following chart. The variability and change of local to global climate can foreseeably affect each stage in the life span of living marine resources.

Climate impacts on marine ecosystems receive much less attention for a variety of reasons: fishing activities take place where most people do not live; the fishing sectors in most countries involve a relatively small number of workers; it is an economic problem in the industrialized countries for the most part, whereas it can be one of life and death in artisanal fisheries in developing countries; the relationship between the viability of living marine resources and variability in air-sea interactions in different parts of the world’s
oceans are much more difficult to study and are not well understood. There are notable examples, however, of climate-marine life interactions: the Peruvian anchoveta, Ecuadorian shrimp, Pacific Northwest salmon, Pacific sardine, among others.

As the global climate warms, so too do the oceans, suggesting that there will likely be a poleward shift of the area inhabited by the warm water and cold water species. These shifting locations of various living marine resources will have an obvious second-order (or downstream) impact on economics and communities dependent on their exploitation.

In this description of a climate affairs program there has been an unrealistic attempt to separate natural processes and human activities. However, these processes interact. So, in the marine environment, the living marine organisms are subject to variability and changes in the oceanic and atmospheric environments as well as to exploitation by insatiable predators, societies. The combination of such pressures on living marine resources is a determining factor in the potential for long term sustainability of those resources.

- Climate impacts on industrialized, agricultural and subsistence societies

For the most part the impacts of climate anomalies in industrialized countries are economic issues, for the most part, whereas in developing countries the impacts of anomalies on societies, in addition to causing serious economic problems, tend to create life-death situations for relatively large segments of their populations. In other words, rich countries have the economic (and therefore technological) resources to minimize and mitigate climate impacts on their populations.

Speculation abounds about whether rich countries or poor ones are more vulnerable to climate variability, change and extremes. While rich countries have the economic wherewithal to react if not pro-act to impacts, their citizens appear to have a lower level of tolerance for discomfort. For their part, the people in developing countries have more experience in having to cope, using scarce resources, with the adverse impacts of climate anomalies. Their social structures and cultural systems have developed various ways for those who had been unaffected to assist those who have been adversely affected by climate anomalies.

This particular issue of relative vulnerability and relative resilience of rich and poor countries remains an important research question yet to be addressed.

- Human impacts on the atmosphere (direct & indirect)

The public now knows that some human activities can affect atmospheric chemistry and atmospheric processes at all space scales from the local level (i.e., air pollution, urban heat island effect) to the regional level (i.e., tropical deforestation, desertification, Aral Sea desiccation and SO2 emissions), to the global level (i.e., ozone depletion as a result of CFC emissions and global warming as a result of greenhouse gas emissions). Research on human activities that can affect chemistry of the atmosphere and therefore atmospheric processes continues, in an attempt to reduce scientific uncertainties surrounding their affect on the atmosphere. Improved understanding of this interaction could provide a sound, non-controversial basis for societal actions to minimize human influences on the atmosphere at these various spatial levels.

- Quantitative & qualitative methods to assess impacts

Attempts to identify human impacts on the atmosphere and the impact of atmospheric processes on society depend on both qualitative and quantitative methods of assessment. It is likely that there will always be some level of scientific uncertainty that surrounds society-atmosphere interactions and, as new methods are developed, a refining of our understanding of those interactions will take place.

There have been several attempts in the past two decades to put together compendia of methods for impact assessment related to climate research (e.g., Kates, et al., 1985; Parry et al., 1987). It seems that the agencies that fund climate and climate-related research believe that there is a cookbook of methods that can be kept on the bookshelf waiting for the proper time of need for use by researchers in various
disciplines. Each new effort to compile such an “impacts handbook” fails to rely on the previously published impact methods handbooks. Almost all of the methods appearing in these books are quantitative.

However, there are also useful qualitative measures to identify how societies might be affected by climate variability, change and extremes. Even the use of anecdotal information can be instructive about climate impacts in certain societies (e.g., Watts, 1983). Historical accounts of impacts and responses to climate-related problems can be very instructive. One qualitative approach has been referred to as “Forecasting by analogy.” While the future impacts of a climate anomaly will not likely be a mirror image of a recent past anomaly, this approach can help decision makers identify the strengths and weaknesses in societal and especially in institutional responses. The strengths can be maintained or enhanced, and the weaknesses can be addressed.

Climate Policy & Law

Since the mid-1970s actions have been taken to reduce and, later, eliminate ozone-depleting chemicals from industrial use in industrialized and developing countries. The first concern about the health and sustainability of the stratospheric ozone layer centered on national plans by the US, France, Great Britain and the Soviet Union to develop national fleets of high-flying supersonic transports (e.g., CIAP, 1975). The US scientific fear was that these aircraft emissions of NOx into the stratosphere would attenuate the highly protective ozone shield (or as the British scientists referred to it, the ozone layer) (Brian Martin, 1979). That concern was followed immediately by concern that chlorofluorocarbons (CFCs), used in aerosol spray cans, refrigerators, air conditioners and as foam-blowing agents, were making their way as inert gases into the stratosphere. There, chlorine would be released from the CFC molecule and would destroy ozone. As an ozone-eater, each chlorine atom is capable of destroying 10,000 molecules of ozone.

The Montreal Protocol in 1987 (and later amended) has sharply reduced CFC emissions, but the Antarctic ozone thinning remains. These concerns led to national legislation in several countries that banned the use of CFCs in spray cans. In 1984 the Vienna Convention paved the pay for continued international discussion and action on ozone-depleting substances. In 1995 the discovery of the Antarctic ozone hole sparked rapid international action on banning CFC production and use in Montreal in 1997, where governments signed on to the Montreal Protocol. This protocol (later amended and strengthened) brought about a sharp reduction in CFC emissions and manufacturing, but CFCs have a long residence time in the atmosphere. As a result the ozone hole continued to grow.

Since the late 1980s, there have been several international conferences on global warming. The most noteworthy series of conferences resulted in setting up the IPCC process. Governments then signed on to the UN Framework Convention on Climate Change (UNFCCC) and the subsequent Kyoto Protocol. Various COPs (Conferences of Parties) have been held since Kyoto in late 1997 to develop protocol for the effective control of greenhouse gas emissions at the global level. The Kyoto Protocol was rejected by US President Bush in March 2001. Nevertheless, other governments, especially those in Europe, continued to hammer out aspects of the Kyoto Protocol in The Hague (late 2000), Bonn (mid 2001) and in Marrakech in November 2001.

Acid rain has also generated international discussions, conferences and regional agreements on the science and impacts. Transboundary acid rain concerns have led to a dilemma: the SO2 output of industrialization processes resulting from the burning of the suite of fossil fuels has been found to counteract the warming of the atmosphere regionally.

Recently, considerable renewed concern has focused on water issues and how those issues are or can be affected by climate variability, fluctuations, change and extremes (e.g., the World Water Forum in 2001 in Japan). The phrase that caught the attention of policy makers was “water wars.” Water has become contaminated or increasingly scarce in certain parts of the globe. There is a big question mark about how the quantity and quality of regional water resources will be affected by global warming. There are existing laws that deal with transboundary water quantity and quality issues. There are many examples of how climate information has been properly as well as
improperly used in the management of water resources within as well as between countries.

**Climate Politics**

Politics exist wherever issues arise. Climate politics center on issues in which climate and climate-related factors are involved. Climate politics refers to the give-and-take processes that occur as groups with differing views seek to have their perspectives on climate issues prevail. The results of climate politics are climate policies and laws at the local to global levels. There are many climate-related political issues in need of identification as well as resolution. For example, deforestation in the Brazilian Amazon is not just a political issue related to resource exploitation or to indigenous rights but is also one of climate variability and change. Why so? Because researchers have determined that fifty percent of the rain that falls in the basin is derived from evapo-transpiration and evaporation from vegetation and the soils. Remove the vegetation, reduce the rainfall. Politics related to climate issues occur at the local, national, regional and global levels. Some examples of climate-related politics are the following:

- **The White House Effect vs. the Greenhouse Effect**

  An article appeared in a conservative, influential Washington DC newspaper, the *Washington Times*, headlined “White House effect vs. greenhouse effect”. The message behind the article was a suggestion that the global warming issue was purely political, was part of the liberals’ environmental bias and was driven for the most part by the Clinton-Gore energy agenda, which was designed to shift America away from fossil fuel use to a greater dependence on renewable energy sources.

- **Greenpeace vs. Wise Use**

  “Wise Use” is conservative movement that calls for the “wise” but extensive use of natural resources. This would ideologically include a call to exploit the oil in the

ANWAR, giving little attention to the environmental risks associated with that exploitation. Their views can be juxtaposed with those of Greenpeace, an organization with a diametrically opposed view of how it would define the wise use of resources and the liberal meaning of environmental conservation.

- **Conservation vs. Exploitation**

  These terms represent two opposing perspectives on the environment and on the use of natural resources. They are in conflict with each other. Perhaps there is no better example of these two opposing view that the perspectives of the two US presidential candidates in the 2000 election. Vice President Gore represented for the most part conservationists. His policies sought a balance between resource use and conservation of the environment including the urban, regional and global atmosphere. His EPA would have sought tighter controls on urban pollution, acid rain and on the emission of carbon dioxide as a result of the burning of fossil fuels. Governor, now President, Bush on the other hand favors the use of natural resources in order to allow Americans to maintain their current lifestyle: Ease restrictions on urban air pollution; Pull out of the Kyoto Protocol negotiations, declaring them “dead” as far as the US is concerned; Open up wildlife reserves and public lands and coastal areas to oil and gas exploration and transport. In reaching binding policies and laws of the land, one can see that very difficult, sometimes intractable, political conflicts lie ahead.

  Fisheries management also reflects an aspect of climate politics. For example, when an El Niño event has been forecast it is known that there would be adverse impacts for certain fish populations, such as the surface dwelling (pelagic) species such as anchovy and sardine. Some people use the uncertainties surrounding the possible impacts of El Niño on fish populations to call for protection of the fish by reducing fishing activity. Others, however, use that scientific uncertainty to call for all out exploitation of the endangered fish population arguing that they would likely perish in the face of an El Niño. Catch them or lose them, they would argue. This conflict in what to do in the face of an El Niño event has as yet to be resolved.
Technophiles vs. Technophobes

Some people believe that American science and engineering will solve any obstacle to climate and climate-related problems that either currently exist or that might emerge in the future. They are the so-called technophiles. They believe that people as well as societies can dominate nature and that natural resources are there to be used. If environmental problems arise, scientists and engineers are expected by their governments and citizens alike to find ways to resolve if not by-pass those problems. Technophobes do not have such a blind faith in the American scientific establishment. They do not trust governments or corporations, believing that they, respectively, put political gains or profits ahead of public welfare or of environmental protection. Another aspect of this would be the conflict between those who favor “high tech” solutions to environmental problems and those who favor the use of “appropriate technologies” when dealing with the natural environment (e.g., Schumacher 1973; Hazel Henderson, 1979). An interesting collection of case studies of the impacts of various types of technologies on fragile environments was published by Farvar and Milton (1969).

Climate Economics

One of the most common desired measures for assessing climate’s impacts on a society has centered on economics. What was the cost of that storm? Or the cost of the drought, flood, frost? What was the cost of the severe unexpected ice storm in Quebec in January 1998? How costly was the 1997-98 El Niño event? And so forth. When people think of climate economics, this is most likely what they will think about — cost or benefit of a climate or climate-related impact. To do this properly however, researchers have to have a reliable understanding of “attribution”, that is, what impacts can legitimately be associated with or blamed on a specific weather or climate event.

A climate anomaly can affect a society that is also being affected at the same time by other factors, such as poverty, poor land management, inappropriate land use, conflict, trans-boundary air or water disputes, bureaucratic rivalries, domestic political rivalries, and so forth. Researchers must take great care in sorting out this situation, in order to identify the contribution of the climate anomaly. All too often, there has been a tendency to come up with a number that showed the most costliest impact. That number was often derived by a group seeking to make a political point or to attract attention for one reason or another. Climate researchers tend to believe that climate factors are usually the determining factors with respect to the severity of impact for any disaster in which a climate connection can be found. However, sometimes climate taken alone may not have been the most important factor but became important as a catalyst to other processes or when its influences manage to combine with some of these other processes.

Economic assessments are also called for in determining the societal value of a particular forecast, such as one for El Niño’s onset. Here, too, there are many factors to take into consideration when assessing the value of information in the decision making process. Forecast lead time, who gets the forecast and when, forecast uncertainty, track record of the forecasters, and so forth, each influences the use and, therefore, value of the information conveyed by that particular forecast. Today, the research community seeks to identify the value added to existing forecasts by supporting research to improve even marginally the accuracy of existing forecasts.

Financial loss or gain as the result of climate variability, change or extreme, in fact, is only one aspect of climate economics. Economic researchers are concerned about a wide range of climate aspects such as the following, when it comes to assessing climate-society-environment interactions;

- Risk analysis
- Discount rates
- Externalities — “Polluter Pays”
- Present vs. future generation welfare
- Forecast value
- Free market vs. government intervention
Climate Ethics

Of all the aspects of a Climate Affairs Program or activity, the most neglected has been that of climate ethics. This aspect encompasses a wide range of ethical and equity issues that are directly or indirectly affected by climate variability, change or extremes. Some elements of climate ethics are noted in the following paragraphs.

Inter- vs. Intra-generational Equity

Governments everywhere seem to have to face the same question in the face of a climate issue: Who to help in the event of climate or climate-related problems, present generations or future ones? Many people in the present generation do not believe that they owe anything to the future. One statement frequently cited is “What has the future ever done for me?” Given this perspective, there would be little reason to preserve natural resources for use by future generations. On the other hand, there is a desire also on the part of many to pass something of value on to future generations, who happen by the way to include our children, grandchildren and their progeny. They seek to manage resources (earth, water, air) with the needs of future generations in mind.

For example, should the Brazilian government preserve Brazil’s tropical rainforests for potential discovery of pharmaceuticals or cut them down to clear the land for cultivation and livestock and sell the timber (to Japan, for example)? What is the value of this forest to people [today or in the future] or to the earth’s environmental health? Many Brazilians are poor and are in search of land for farming to grow subsistence crops or raise livestock. The trees are also instrumental in pulling carbon dioxide out of the atmosphere and storing it in the forest. They are also instrumental in providing moisture in the Amazon Basin.

Environmental Justice

Why is it usually the poor people in a society who are most adversely affected by a drought or a flood? They are the ones whose living space has been relegated to precarious regions or areas: flood plains, steep slopes, arid lands, swamp land, short growing seasons, and so forth. Seldom are the upper classes in a society in harm’s way to the same extent as the poor. The rich in society have other options that the poor do not have available to avoid climate-related harm. When the torrential rains come, the shanty town is often washed away by rivers overflowing their banks or by mudslides. They have less access to medical facilities in the case of climate-related emergencies and are subjected to climate-induced diseases. Thus, there is a clear link between death and destruction resulting from natural disasters in general and from climate anomalies specifically and the level of poverty in a given country or region within that country.

North-South Cleavages and Climate Change

Today, there is considerable debate over responsibility for the global warming of the earth’s atmosphere. The developing countries argue forcefully and effectively that the industrialized countries were able to develop rapidly as a result of their burning of fossil fuels during their industrial revolution. As a result the rich countries have saturated the atmosphere with radiatively active greenhouse gases. They then argue that it is the responsibility of the developed countries to take the first steps — unconditionally — to reduce their greenhouse gas emissions.

The rich countries (along with the coal and oil countries) argue that the developing countries will be supplying the lion’s share of the greenhouse gases in future decades. It is they who are going to super-saturate the atmosphere and cause an enhancement through human activities of the naturally occurring greenhouse effect. The industrialized countries argue that all governments must sacrifice together to take steps to reduce greenhouse gas emissions in the 21st century in order to avoid the worst impacts of a heightened global warming. The developing country representatives believe that they
are being asked to forego economic development because of a problem caused by rich
countries and they are reluctant to do so. There are many ethical and equity issues
embedded in the North-South cleavage.

There are several sayings that relate to the ethical aspects of climate, broadly
defined. There is the “Polluter Pays Principle,” the “Precautionary Principle,” “Common
but differentiated responsibilities,” and “Nature’s Bank Analog.” Each of these notions
generates climate-related philosophical concerns about equity among competing groups
and ideologies. Climate ethics and equity must be made an integral part of a Climate
Affairs Program.

Climate and Weather Aspects of International Security

Interest in the influence of weather and climate on the course of history has
generated many case studies. Pizarro with his conquistadores invaded northern Peru in an
El Niño year (1531), which enabled them to survive their trek along Peru’s normally arid
coast in order to attack the Inca empire. The Spanish Armada, for example, was
destroyed in coastal storms that ended Spain’s invasion of England in 1588. Napoleon
ordered his army into Russia to the defeat that country in war but his forces were
decimated by an early harsh winter.

The following graph depicts the dynamics of Napoleon’s invasion of Russia.
Napoleon’s troops numbered more than four hundred thousand, when they began their
march on Moscow.

The map, based on the 1869 chart by Minard, graphically illustrates (both literally and figuratively) how
the size of the French army dwindled during the march into Russia and was reduced to almost nothing on
the wretched rout back into Poland. The map can be read in several ways. The size of the peach-colored bar
indicates the relative strength of the French army during the march on Moscow. The black bar shows the
dwindling French army during the retreat. In the lower portion of the map, the temperature in degrees
Celsius is shown, along with the dates of the retreat.

“Having waited until mid-October to depart [from Moscow], the exhausted French
army soon found itself in the midst of winter — in fact, in the midst of an unusually
early and especially cold winter”. (www.internalmedian.com/russia/russi05.htm)

The delay was in large measure responsible for the final destruction of his
invading army. Of the hundreds of thousand troops that left France, only tens thousand
were able to make it back to their point of origin five hundred miles away.

The reason for showing this chart is to highlight the often-hidden influence that
weather, climate and extreme events can have on national security both in a negative and
positive way. The march on and retreat from Moscow is but one such example. More
than a century later, Hitler’s armies also invaded Russia and suffered a similar defeat at
the hands of Russian partisans and their natural ally — Russian winters, among the
coldest in the twentieth century (Caviedes, 2001, 172–183). Contemporary examples of
the important of weather and climate to military operations include the following:
forecasting the weather for the Allied invasion of Normandy in 1944; the attempt by the
US military to free American hostages in Iran which had been thwarted by sand storms
that downed the rescue helicopters; most recently, El Niño-related heavy rainfall and
cloud cover along the Peru-Ecuador border was acknowledged as having thwarted the air
and ground war between these two countries engaged in a “hot” border war.

About 15 years ago in the midst of the Cold War, there was considerable
scientific and political discussion about the possible impact on the atmosphere of a
nuclear war. That entire activity has been labeled as nuclear winter and several scenarios
were produced that took into account varying levels of nuclear warhead explosions.
Concern centered around the potential rapid cooling of the Earth’s atmosphere as a result
of an increase in the opaqueness of the atmosphere and the likely inability of life-
supporting solar radiation to reach the Earth’s surface (e.g., Ehrlich et al., 1984;
Thompson et al., 1984).

During the war in Vietnam, the US military reported to cloud-seeding activities
along the Ho Chi Minh Trail, a supply route used by the North Vietnamese to support
their war effort and Viet Cong allies in South Vietnam. The science of cloud seeding
remains controversial; nevertheless, it was resorted to in an attempt to slow down the
shipment of supplies to South Vietnam. And before that, the US government supported a
cloud seeding effort referred to as Stormfury (Willoughby, 1985). However, political
opposition in Central America to cloud seeding of hurricanes in the Atlantic and in the
Caribbean Sea brought a halt to this “research” activity. They claimed that the operations
were for military purposes and also that the rainfall associated with the hurricane season
was needed each year for food production, water resources and hydropower throughout
the region (Howard et al., 1972). Thus, knowledge of seasonal variability as well as of
the natural flow of the seasons with which we are all familiar (depending on where we
happen to live) is also quite valuable. Researchers can easily demonstrate how there have
been changes in seasonality over decades (start of a season, its severity or mildness, its
precipitation time and space scales, etc.). As the impacts of global warming on the
existing flow of the seasons becomes more evident we will have to adjust many aspects
of life to mesh with such changes.

Today, one can find websites on the Internet produced by the US Navy and the
US Army about the influence of El Niño and La Niña events in the tropical Pacific and
on their ability to respond rapidly to a conflict situation. Thus, major powers have
acknowledged that weather and climate factors can enhance or impede military actions as
well as preparedness on both strategic as well as tactical levels.

* * *

The preceding pages on the aspects of climate (science, impacts, policy, ethics
and security), provide an overview of climate-environment-society interactions on a
variety of time scales of interest to the various socioeconomic and political sectors of
societies around the globe, whether industrialized or agricultural. The examples provided
are by no means exhaustive but are illustrative of the many ways societies and their
environments are or can be influenced by atmospheric processes that produce our global,
regional and local climates. Examples were also provided to suggest if not demonstrate
why we, as individuals, along with groups, corporations, the military and national
governments, need to know more about the workings and influences of the climate
system and subsystems and how they influence society and environment.
III. What Will a Climate Affairs Center and Program Do?

A Climate Affairs Program and Center are different activities and require different kinds of consideration. The Climate Affairs Program is designed to foster education, research and research application to meet societal needs that are climate-related and multidisciplinary. The Center is expected (and designed) to be a focal point for various activities related to climate affairs.

**Center**

The Center will serve as a hub of an international as well as national network for climate-related educational activities.

1. It will bring climate issues to the attention of the students, faculty and regional centers and institutes.
2. It will assist various groups in society (such as corporations) and government (such as disaster preparedness agencies) to understand the role that climate variability, change and extremes play in their operations.
3. It will seek to identify alternative ways of addressing societal issues that might be directly or indirectly related to climate.
4. It will work closely with other climate-related centers and programs at the college or university.
5. It will assist those faculty members interested in pursuing climate-related research in identifying potential funding sources.
6. It will assist students in finding internships; among other activities such as designing and maintaining an active website, and possibly publish a climate affairs newsletter.

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**Program**

A Climate Affairs Program encourages the following:

**Education** (faculty, grads, undergrads): Climate issues often require multidisciplinary interactions. Such interactions complement and in fact can strengthen traditional disciplinary perspectives and educational and research activities.

**Professional education** (one-year training, education and research activities on climate related issues for the career professionals around the globe).

**Research** (identify issues; identify research partners; identify potential funding sources; provide internships).

**Outreach** (broadly defined, this refers to networking on a university or college campus, in a nearby metropolitan area, in the US and globally). In the climate area, this educational institute could be the regional center for climate issues.

Not every course associated with a Climate Affairs Program, whether it is a Master's degree, a course concentration, or a certificate program, needs to have climate factors or issues explicitly spelled out in the course materials such as readings or in prepared lectures. In some courses climate will be an explicit factor such as in the core courses. In other courses, however, it would be the students who are interested in learning and writing about climate-related issues that are likely to bring climate concerns, issues and related information into a course and its supporting materials.

In order to identify the possible structure, content, and participants of a climate affairs program, I used as a prototype the brochure of one of Columbia's institutes (its Institute for Strategic Policy, ISP). The brochures of other institutes have been reviewed in order to identify useful elements required to develop a robust climate affairs program and center. Using a composite of relevant information in each of these brochures, we
sought to design a brochure for a prospective climate affairs Master's program and center.

Types of Master's Programs

A Climate Affairs Program can encompass one or a combination of the following dimensions:

- a Master's in Climate Affairs
- a professional one-year Master's Program
- a course concentration
- a certificate program
- a professional Master's certificate

Two-Year Master's

For some time I believed that climate affairs as a notion would not be able to support a Master's program in the traditional sense (two years). However, having looked at other Master's programs with concentrations on a variety of topics or geographic regions, I now believe it is possible to develop a Master's level two-year program. In addition, a focus on climate affairs could support a Master's in international affairs with a concentration in climate and a one-year professional Master's degree.

A two-year Climate Affairs Master’s program can be an academic program, meaning it is often more based in theory and the student has the option to enter a Ph.D. program. It can also be a professional (or “terminal”) Master’s, meaning that the course requirements are different from those for the regular academic program. It is focused toward the application of research findings to societal needs more than on theory. Its objective is to improve the climate-related knowledge base of professionals for career enhancement in their chosen field.

There is almost always a concentration, specialization or focus within a two-year Master's program, unless the program itself is very narrow in scope. Most two-year Master’s programs require a set of core courses, electives, and a research paper, project, or thesis. Internships are often required as part of the program.

- One-Year Master's

The one-year Master's varies from one university's program to another, and sometimes even within a program. It can be either an accelerated version of a 2-year Master's where the student has a certain background or prerequisites that allow him or her to skip certain requirements. Sometimes the 2-year Master’s can be completed by anyone (regardless of background) in one-year with the maximum amount of credits taken per semester and a summer term.

The one-year Master's can and often is a mid-career, professional development program. This can be specifically designed for people with a degree and/or years of experience in a profession. This can be very valuable to climate-related decision makers in a variety of fields in developing countries. As an example, Harvard’s Kennedy School of Government offers a one-year, Mid-Career Master’s in Public Administration for professionals with 7 years experience in their profession and a “demonstrated capacity for leadership.” The mid-career Master’s is sometimes called the Executive Master's when it is designed for high-level professionals with many years of experience in their field. Mid-career Master’s can be one year or longer. Sometimes a program with a similar set of requirements is a 2 or more year program with night and summer courses.

Another version of the one-year Master’s is referred to as the Accelerated Master's Program. This is where an undergraduate student can apply in his or her junior year and is able to complete a Master’s program a year after receiving the bachelor's degree. They begin to take some of the courses that are within the Master’s program in their senior year in tandem with their required course work.
• Master’s Concentration

The concentration is endogenous to a certain program or programs – it exists within that program and is chosen as a path or direction. There are often several such concentrations from which to choose. The concentration often guides and focuses a student’s course of study within a broader major, for example, Public Affairs with concentration in Environmental Policy and Natural Resource Management, such as is done at Indiana University. Another example would be a Master’s in International Affairs with a concentration in international security.

The student has to fulfill the requirements for the host program as well as the requirements for the concentration. Some courses can be counted for both the degree requirements and the concentration requirements. The concentration is much like a “minor” and is sometimes referred to as such. Concentrations often offer students much more flexibility in terms of the courses they can take because it is happening within the larger context of a formal program. However, a certificate program (discussed below) often requires specific training on a certain topic or set of skills. The concentration generally requires around the same number of, if not less, credits or courses than a certificate program (4-6 core courses in many programs).

In some cases, a concentration will have a specialization (or “track”) within it. This is especially true for the broader concentration such as Environmental Policy or Environmental Management (which is usually a concentration within an M.S., Master of Public Policy or Master of International Relations). In this case, the track may be “water science and management” or “environmental justice,” for example.

• Master’s Certificate Program

As opposed to the concentration, a certificate program is typically exogenous – it exists outside of a specific Master’s program (freestanding) and acts as a complement or additional training to the program or programs. Many graduate certificates are open to students in any program or a certain set of programs (for example to students in Political Science, Public Affairs, and Geography). They are sometimes even open to students not formally registered in any other university program such as: mid-career professionals, government employees, and interested citizens for reasons of personal or professional development. In some cases these outside students must meet certain requirements to enter the program, i.e., a bachelor’s degree, a Master’s degree, specific courses, certain types or level of courses, professional experience, etc.

Certificate programs usually require a small number, but specific set of courses that the student must take to receive the certificate, typically there are around 4-6 courses. The ratio of core versus elective courses varies depending on the program. For example, a certificate program might require 3 core courses with 1 elective (usually from a specific set of courses). A certificate program can usually be completed in a year to two years depending on the student’s other obligations.

Some certificate programs are a pared version of an established Master’s program. Others are for a specific topic or skills such as Certificate in Ecological Economics (University of Maryland), Conflict Management, or GIS certification (many environmental policy/management programs are now offering GIS as a separate certification). Sometimes a program is offered as either a concentration or a certificate with requirements varying slightly. Some programs offer certificate programs in other departments or schools of the university or at other nearby universities to give university students the skills and training they might desire but are unavailable within the program due to limited resources (GIS, for example).

• Professional Master's Certificate

The structure for this program for professions is based on courses taught at San José State, Northeastern University, the University of Canterbury (New Zealand) Antarctic Program, and at various universities that have programs focused on professional training. I have had the opportunity to discuss the value of this structure with those who designed it about 11 years ago at San José State University.
Climate Affairs at the Undergraduate Level

As part of the planning for climate affairs education and training programs, it was proposed that the focus be on graduate programs. However, it became clear during the planning activity that there HAD to be consideration given to an undergraduate program. In a recent article about promoting undergraduate research in science, Reginald Halaby (2001) suggested that “today’s student often feels bored or intimidated” (see also Morgan, 1991). Halaby went on to suggest that the undergraduate experience with science would be greatly enhanced if the student were to become engaged in a bona-fide faculty-directed research project. An undergraduate Climate Affairs Program could enable students to engage in such disciplinary, if not multidisciplinary, research activities working with faculty. The student can learn about the value of scientific research and the application of that research to address societal needs at home or abroad. Paraphrasing Halaby, “students who are engaged in climate affairs research (graduate or undergraduate) can integrate previous natural and social science courses that they have taken.” According to Hoopes (1993), undergraduate students provide a proverbial “mother lode” of potential next-generation science researchers. She suggested this, noting that “since undergraduates and frequently fearless and intrigued with the unusual, they are ready and willing to work ahead of current ideas and try to develop the next big area of research.” Climate affairs courses at the undergraduate level can serve to spark interest in climate and climate-related issues and can possibly provide career direction to undergraduate students. Thus, the undergraduate climate affairs concentration option is a valuable one for several reasons:

- Many undergraduates are searching for potential career options.
- They have more flexibility in elective course selections.
- They are risk takers with regard to course diversity.
- They provide a pool of potential graduate students for the graduate Climate Affairs Program.
- They provide more informed citizens to the workplace and to society at large.

The program would consist of 34 weeks of courses and 6 weeks for a follow-on research report by each student. This would be composed of 13 two-week sessions and 2 four-week sessions. The proposed syllabus would be as follows:

1. Two-week session: an introduction to climate in general that includes its interactions with societies.
2. Four-week session on climate science, using the Bretherton diagram to depict the climate system and all its components, including societal activities.
3. Two-week on impacts in general, raising the problems of attribution and introducing methods of assessment.
4. Two-week session on the ecological impacts of climate variability.
5. Two-week session on societal impacts of climate variability and extreme meteorological events.
6. Two-week session to prepare a report on climate and economic development in a specific geographic location or in general; climate and history; climate and energy; climate and food; climate and water; climate and health; climate and other issues (eg., mining, commodities, trade, pre-history).
7. Four-week session on the science and policy of global climate change and climate change impacts on societies (what we know, what we don’t know, what we need to know, scientific uncertainty).
8. Two-week session on climate law.
9. Two-week session on climate policy (eg., IPCC, stratospheric ozone depletion issues such as supersonic transport and spray can controversies).
10. Two-week session on domestic climate politics (eg., national policy making about the Kyoto Protocol or the Montreal Protocol).
11. Two-week session on international climate politics (eg., rich vs. poor nations, natural bank analogy, “sinks” issue, Debt-for-Nature swaps, CDMs).
12. Two-week session on climate forecasting.
13. Two-week session on climate ethics and equity issues.
14. Two-week session on climate issues and the media.
15. Two-week capstone seminar on climate affairs.
They would be peers to the graduate students who have chosen to focus on an academic concentration in climate affairs.

**Undergraduate-graduate linkage**

The administrative and academic linkage between the graduates and the undergraduates could be as follows:

- 4000-level graduate courses can be open to upper-division undergraduates who meet course requirements.
- Students can pursue the 5-year BA (or BA)/MA program in international affairs or some other program with a concentration in Climate Affairs, e.g., the International Affairs FIVE-YEAR PROGRAM at Columbia University offers students the opportunity to earn both the BA and MIA degrees in five years. Once admitted to the joint program, the student completes the senior program at Columbia College, but the bulk of the courses taken will be graduate level ones acceptable to SIPA. The student must receive the BA with a satisfactory grade point average.

As noted in other parts of the report, it would be important to design and convene an introductory multidisciplinary course on climate affairs as soon as possible, e.g., the spring semester 2002, if there is a good chance a climate affairs center and program will be pursued. At the least, students would have been exposed in one course to a wide range of climate-environment-societal issues from the perspective of various disciplines.

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**Center Description**

**Functions**

- It will reinforce multidisciplinary interactions on the University's campus, using climate issues as the common thread of concern;
- it will serve as a hub of an international as well as a national network for climate-related educational activities;
- it will seek to bring climate issues to the attention of the students, faculty and regional centers and institutes;
- it will identify emerging research topics and possible course materials from published (as well as unpublished) literature;
- it will assist various groups in society (such as corporations and government (such as disaster preparedness agencies) to understand the role that climate variability, change and extremes plays in their operations;
- it will flag new or emerging climate and climate-related issues;
- it will seek to identify alternative ways of addressing societal issues that might be directly or indirectly related to climate;
- it will work closely with other climate-related centers and programs at Columbia;
- it will assist those faculty interested in pursuing climate-related research in identifying potential funding sources;
- it will assist students in finding internships;
- it will develop a metro network, among other activities such as to design and maintain an active website, and possibly publish a climate affairs newsletter.
- It will provide visibility to Columbia's commitment to a broad range of climate issues under one central hub.
Structure

Staff and location

The Center would need a director, a deputy director, a secretary/administrator, a research associate, a part- to full-time web person, graduate assistant (s) and undergraduate and graduate interns. It would benefit from a visitor program and a distinguished visitor each semester. It would best be located on the Morningside campus. It would need encouragement and financial support for, and faculty involvement in, an initial all-university climate conference to launch the Center. The Center would administer the Climate Affairs Program and especially the core curriculum.

Advisors

A Climate Affairs Program and Center merit two kinds of advisory bodies: one advisory group from within the university community and the second an international panel.

- Advisory groups

University advisory group: Its members would be drawn primarily from various departments, centers, institutes disciplines and administration to oversee the operations of the center and to assure that it operates within its mandate. In addition, this panel of advisors would help to broaden the interest in climate issues and to assist in making contacts between those deeply involved in climate education and research and those who could be interested if they were to be made aware of the climate linkages to their own personal research and teaching agendas. This advisory group should include participation from NGOs, e.g., World Affairs Council, and corporate communities, such as a corporation that has known concern about climate issues (e.g., Goldman Sachs or an NGO such as the Council on Foreign Relations).

International advisory: This group would be operated by way of the Internet and e-mail and would be composed of people working on multidisciplinary climate and climate-related issues specifically, and on environmental issues in general. They would come from all parts of the globe. It may be necessary to supply a few of these advisors with a PC and an Internet connection fee to keep them actively as opposed to passively and belatedly in contact.

Fellowships and internships: It is very important that graduate and undergraduate students be directly involved in the workings of the Center. They will provide another vehicle for “getting the word out” about the climate affairs center and its goals. This can be done in many different ways and depends on funding.

International partners: In the course of discussing the notion of climate affairs, we have encountered several educators and professors in other countries who have expressed interest in participating in a network with other universities (especially with Columbia) involved in climate affairs. This is the start of a network that includes China, Fiji and the South Pacific, Southeast Asia (ADPC, Thailand), New Zealand, South Africa, Mozambique, Kenya, Ethiopia, Bangladesh, Peru, Cuba, Mexico, Ecuador, Northern Ireland, among several others. Some of these contacts could serve as members of a global advisory group.

In addition, various UN agencies and US government departments would be approached for involvement in a climate affairs network. I am already working closely with the United Nations University (Tokyo) on developing a program on climate affairs for developing countries. The WMO has expressed interest in climate affairs as a complementary activity to some of its World Climate Program activities. Within the US, NCAR at present is showing interest in involvement in a climate affairs network. I have been in discussion with NOAA’s National Climatic Data Center about the development of a project I proposed called an “ENSO info audit” for the Department of Commerce and other departments in the Executive Branch (DOI, DOE, etc). [El Niño Southern Oscillation, popularly referred to as El Niño].

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Website Concerns

The Center would encourage that the courses in a university’s catalogues be key-worded for actual climate information content as well as for indirect climate information content (with some discussions the climate component or aspects could be made explicit). Key-wording course descriptions will provide students searching for courses on a university’s website to identify more accurately those courses that have explicit and implicit climate in climate related aspects.

It would announce courses in a climate affairs concentration; lectures at Columbia about climate and climate related issues; identify professors involved or at least interested in climate and climate related issues; identify similar things at other nearby universities and colleges; produce a newsletter (or the climate network newsletter); and have links to some of the key websites for each of the aspects of climate affairs (science, impacts, policy & law, politics, economics, and ethics).

The website could identify sources of multidisciplinary funding and climate-related RFPs; the website would also identify jobs and internships related to climate issues; it could provide a listing of new books on climate related issues. We could seek outside support for the website for the discussion of key climate issues on a topic-a-month basis.

The climate affairs website is what I call an Internet CAFÉ (Climate Affairs Enterprise). The site’s front page can have a variety of links to various aspects of the structure and function of the Climate Affairs Center and Program and to related courses, departments, centers and institutes. The aspect that I have developed can be used not only for the climate affairs activities but possibly for the university’s catalogue.

STRUCTURE OF THE WEBSITE:
The website, as developed here, contains a set of categories: Climate characteristics (variability, change, extremes, etc.); regional cells (geographic regions, sub-regions, countries); societal sectors (food, water, energy, health, safety, etc., academic disciplines; climate hazards (droughts, floods, fire, severe storms, etc.); spatial scale (local to global); and time periods. These categories can in turn be divided into sub-categories (see Appendix).

FUNCTION OF THE SITE: The website user drags the category or sub-category to the shopping cart, along the lines of shopping cart on the Amazon.com website. This develops a profile of either reading material (bibliography) or university courses. Clicking on the “GO” button starts the search process. This could provide the user with a list of courses that directly or indirectly address or refer to climate issues or aspects in which the user is interested. It can also provide the user with references to reading material in which he or she has interest.

A cursory review of front pages of websites of various educational programs yielded the following headers on that page: mission, goals and objectives, advisory council, news & events, projects, education, publications, staff, resources, workshops, link & learn, feedback, student link, curriculum, resources & activities, student jobs and internships, partners & collaborators, international partners & collaborators, virtual overview (link to a PowerPoint overview of climate affairs), newsletter, among others. A closer survey of such websites will be undertaken to identify the best set of headers to link those who visit the website to appropriate and useful information related to climate affairs.
Networking from Local to Global

In-reach (internships, on-campus workshops, issue-oriented conferences, topical teach-ins, multidisciplinary sabbaticals, inter-departmental collaboration, university seminars). It refers to engaging faculty, graduate studies, and undergraduates and university staff in climate and climate-related educational and research activities. Facilitate multidisciplinary research and teaching.

Metro-reach (metro reach activities are those focused on active involvement of entities in larger metropolitan areas. This includes universities, colleges, corporations, non-governmental organizations, the media).

Using Columbia University as an example, there are at least the following two components to climate affairs activities in the metropolitan area. The first component (aspect) of metro-reach is to create a network of educational institutions in the NYC metropolitan area. This requires identifying those courses at various universities and colleges in the metro area (NYU, CUNY, CCNY, corporations, UN, Barnard, Bard, Rutgers, etc.) that could complement those courses that are climate and climate-related that are already taught at Columbia. In addition, there are numerous activities and groups in the United Nations headquarters that relate to climate issues. They too could be linked to a Climate Affairs Center and Program.

The second aspect of metro-reach is to identify corporate and other non-governmental organizations that are (or should be) involved in issues encompassed by climate affairs. A Climate Affairs Center could identify those organizations that would be interested in having managers' knowledge of climate and climate-related information to enhance the effectiveness of their decision-making processes. For example, I have been invited on two occasions by Vice Presidents at Goldman Sachs to lecture to its staff and major investors on El Niño and its global implications for energy, mining, and fisheries.

Out-reach

Considerable value will be added to a climate affairs program with the implementation of a network of academic and training institutions around the globe. The United Nations University ( UNU) and some of its specialized institutes in other countries has become a champion of the notion of climate affairs. We have developed as a part of this UN agency's activities a climate affairs capacity building activity into its long-term program. It sees climate affairs education and training in developing countries as a way to raise the level of awareness of a wide range of climate and climate-related issues and to use that awareness for development and for disaster prevention purposes.

Several educators at various university and training centers around the globe have already expressed interest in developing climate affairs programs and activities at their institution. They have also expressed strong interest in linking to or networking with other universities pursuing the same interest. Please refer to the email from Professor Hay (New Zealand) in the Appendix. It is an example of the inquiries I have received.

Some of these institutions are in the following countries: Bangladesh, Cuba, Vietnam, Thailand, Philippines, Mozambique, Fiji, New Zealand, Peru and Ecuador. Links would also be made with institutions in Europe and other regions.

The Network Newsletter has been produced in ESIG/NCAR for 16 years. The funds have always come from outside the organization (i.e., from UNEP and NOAA/OGP). It has cost about $25,000 per year to publish, and the lion's share of the funds have gone for postage, as many recipients do not have constant (or any, for that matter) access to the Internet. I would like to see the newsletter (3500 subscribers) become a publication of a Climate Affairs Center, if a Center and Program were to be established.

Although I have never prepared an Internet course or taken one, I believe that education and training by way of an Internet-based climate affairs component to a larger program would serve as an excellent way to foster climate-based education in the US as well as internationally. If a Climate Affairs Introduction 400-level course were approved, it would serve as a Climate Affairs Internet educational prototype. Internet courses would facilitate international linkages and interactions with foreign education and research universities involved in climate and climate-related issues.
International Interest in Climate Affairs

During the process of carrying out, as the PI, the UNEP-NCAR-UNU-WMO-ISDR El Niño comparative retrospective study in 16 countries around the tropics, I had the opportunity to interact with educators, researchers and professionals who are involved to varying degrees in climate and climate-related issues. When the notion of “climate affairs” was raised, almost to a person they expressed their interest in being involved in any future endeavor to establish a climate affairs activity. It had been put in terms of “an activity to educate the educators” in developing countries on the many ways that climate, broadly defined, can influence human activities and environments. The idea behind the notion was capacity building. By educating the educators about climate-society-environment interactions, two major tasks could be accomplished: (1) the educators would be in a position to advise people involved in climate-sensitive endeavors in their own countries on how to engage effectively in climate-related decision making processes; and (2) they would be better able to educate on climate-related issues their students, who are the next generation of the country’s decision makers in government, in industry, and in society.

Some of the international groups that expressed interest in linking to a climate affairs hub are the following:

The United Nations University (Tokyo, Japan)
Asia Disaster Preparedness Center (Bangkok)
University of the South Pacific (Fiji)
University of Hanoi (Vietnam)
University of Havana (Cuba)
ESPOL (Ecuador)
Eduardo Mondlane University (Mozambique)
International Institute for Disaster Risk Management (cited as IDRIM) (Philippines)
NETTLAP (an Asian-Pacific Environmental Education Network)
Witwatersrand University (South Africa)
University of Nairobi (Kenya)

WMO World Climate Programme (Geneva)
University of Latvia (Riga)
China (Peking University, Beijing Normal and Nanjing Agricultural University)
Moscow State University (Russia)
Monash University (Australia)
University of Costa Rica (Turrialba)
University of Toronto (Canada)
CATIE (Costa Rica)
University of Melbourne
Xinjiang University (China)
China Meteorological Administration

No commitments have been made, as there is no climate affairs hub as yet. However, if one were to develop, I am certain that these and many other universities, colleges and training centers would be interested in participating in an active way. It is important to note that not all faculty at a given university or college have expressed interest in participating in a Climate Affairs Center or including climate information in their courses. Many, however, would have some level of interest. Some faculty approached about climate affairs found climate issues interesting but felt that they needed assistance in seeing how climate and climate-related issues related to their own research and education interests.

A Climate Affairs Program and Center does not need the immediate participation of everyone on a campus. Some faculty and adjuncts will participate to some degree at the outset of creating a climate affairs activity; others will likely participate as it develops and attracts students. Some who should be interested may end up expressing little interest in the climate connection for a variety of personal or professional reasons. A Climate Affairs Program and Center can thrive at a university under such circumstances.
A prototype brochure for the CAMP/Climate Affairs programs is being developed. This will highlight important information about the nascent program. A draft version can be found in the Appendix.

What Needs to be Done First?

**Administrative Action**

- The recommended way to insert a climate affairs agenda into a university system would be to create a Climate Affairs Center. This would require a mission statement and staff and commitment of appropriate start-up funds.
- Establish an advisory group from the university community to guide the staff in a broad sense but not to micro-manage it. These advisors would assist the staff in working with the faculty, departments, centers, institutes, and programs to explain how a climate affairs center and program can add value to their research and course objectives.

**Academic Action**

- An introductory course for graduates, open with certain restrictions to upper division undergraduate students (who have relatively more flexibility to explore new courses).
  - (P2) Identify existing climate-affairs-applicable courses that exist today.
  - (P2) Make new courses (this could require some new hires and would require identifying courses at other campuses using the Internet) [find out about possible linkages to the London School of Economics and any climate-affairs-related courses taught there].
  - (P2) Seek and help to modify existing courses by working with professors to add climate affairs materials to their syllabi.

- The Climate Affairs Center staff would interact on a continual basis with student groups and individual students to explain the notion of climate affairs and how more knowledge of the climate system can add to their ability to make decisions, whether they work in government, industry, education or research.
• An introductory climate affairs course for graduate students, but open to undergraduates with certain restrictions, should be developed.
• Climate-related discussions with the faculty and departments and students would be an ongoing activity that could begin in a more concerted way.
• Specific faculty could be identified as possible participants in climate-related workshops, conferences and other meetings, whether or not they are already convinced of the importance of climatic factors in their course materials.
• A multi-week climate affairs summer course for early career professionals from developing countries could be organized in cooperation with another agency, preferably a foreign one, such as the United Nations University, or with a foreign developing country university or NGO.
• Climate affairs staff and advisors could assist faculty members who are interested in connecting their current interests to climate issues in the identification of relevant reading materials useful for their research and teaching activities.

Outreach Action

• Develop a robust website that lists activities that are actually in progress.
• There should be some organized, highly relevant, high-visibility climate-related activities each semester.
• The center's staff could produce a climate-related quarterly newsletter.
• Formal contact could begin with international groups, universities and training centers to develop an international climate affairs network. Informal contacts have already taken place with many institutions that have already expressed interest in and support for establishing such a network.
• Formal talks could also begin with program directors of US universities and colleges that have expressed interest in the notion of climate affairs. Special attention can be given to some HBCUs.
• Workshops, conferences and other activities could be identified or organized by the Climate Affairs Center staff for faculty participation.

How I Might Launch a Climate Affairs Program

I would establish a Climate Affairs Center with the near-term objective to develop the elements of the program in detail. That would mean identifying the core courses, electives, faculty affiliates and administrators of the center and the program. I would also begin the careful process of establishing advisory groups.

I would undertake a thorough assets review of the curricula at a university and its various centers, institutes, and programs. Those courses and activities that have a direct or and indirect linkage to climate and climate-related issues can be identified through such a review. From this pool of identified resources (courses, faculty, programs, centers and institutes), we can then construct the Climate Affairs Master's Program or an undergraduate certificate program.

A similar assets review can also be undertaken for the metropolitan New York area. This will help to identify potential partners in a climate network in the region by identifying corporations, colleges and universities, non-governmental organizations, and so forth with a potential if not yet realized interest in climate and climate-related issues.

A staff appropriate to the long-term objective of developing a Climate Affairs Program must be brought together. It would be THE first Climate Affairs Program in the world. That center staff should be of an appropriate size to carry out necessary tasks: course identification, course(s) development, provide academic (education and research) leadership to the notion of climate affairs, provide management of the center (e.g., identify, cultivate interest and work with interested faculty), website development, manage a networking publication(s) issued by the center, carry out networking on campus, in the metropolitan area and globally, seek funding opportunities, and so forth. I do not think that it would be beneficial at all to launch a Climate Affairs Program and Center with minimal staff (e.g., a director and a half-time web master). It would be better to launch them when adequate funds would be made available. Otherwise, it will be seen as just another start-up activity with little support from the university administration or faculty.
Funding will be required to "buy" the time of faculty members away from existing duties so they can devote their attention to climate affairs courses (mainly the multidisciplinary, required core courses). Many of the most likely electives already exist or could be developed with some modification to existing courses.

Retailing and Wholesaling Climate Affairs on Campus

Throughout the 1990s, the public and many decision makers became aware of the value of El Niño information. Even if they did not understand much about the physical aspects of El Niño, they were aware of its existence and possible impacts on things and activities that they cared about. The 1997–98 events was the catalyst to such widespread awareness. However, awareness of El Niño and forecasts about it do not by themselves translate into usable scientific information. There has to be an information broker between the producers of this information and its users. That is when I came to realize that a distinction needed to be made between the "wholesaling" of El Niño information, including forecasts, and the "retailing" of it.

By wholesaling I mean that people are being made aware of the phenomenon and its impacts in a general way. It is interesting information but in most cases it is not easily or directly usable by those who do not really understand its true implications for them, for their activities and for their societies. Thus, the idea of retailing emerged. It is still necessary to retail information about the various aspects of El Niño to the needs of the various prospective users. Retailing El Niño information refers to tailoring it to the needs of each user or group of users. The same can be said for the development of a Climate Affairs Program and Center at a university.

While climate and climate-related issues are making their way into courses and new institutes and centers are being developed to take climatic aspects into consideration, they are appearing slowly and in an opportunistic and eclectic way.

The added value for developing a sustainable Climate Affairs Program and Center is coalition building around these activities among the various actors on campus. Bringing the various disciplinary perspectives and regional institute perspectives together to work on a common theme of interest requires special efforts that are different from those needed for tailoring climate information to the information needs of these academic and professional users.

We need to tailor the climate affairs activity to the needs of these specific individuals and centers. This can be carried out in different ways: identifying materials for inclusion in a course, identifying important and urgent research topics, identifying
potential sources of research in teaching funding, assisting in the organization of workshops, conferences, brown bag discussion groups, seeking to identify or convene conferences to which faculty might be invited to share their expertise on non-climate considerations while they learn about the importance of an interest in climate issues at the conference. It is important to note that focusing on the setting up such a center to support this program to bring climate considerations into the classroom is not an attempt to reduce all of societal needs to climate factors.

Building a constituency and continued coalition building at the university require continued effort at all levels: wholesaling climate affairs information to generate awareness climate-related issues in retailing that information to those who have expressed interest. The constant and important activity, one that is analogous to house-to-house combat, is the need to discuss with the yet-undecided faculty why involvement, or at least interest, in climate in climate-related affairs can be value added to their research, educational and professional activities.

Identify groups and individuals on campus who are already involved with climate issues, parties that are interested but have asked to be assisted as they learn how climate affects their areas of interest, and parties who may not be interested at all in the climate ‘connection’ to their work or research.

As is likely on any academic campus, one can divide the faculty (and students for that matter) into three groups. The first group is already interested in climate and climate-related issues, and their interest is likely to be increased with the development of a Climate Affairs Center as well as their involvement in a multidisciplinary international network maintained by a Climate Affairs Center at the university.

A second group consists of faculty members who have expressed interest in the connection of climate to their research and teaching areas. They have expressed or shown a willingness to learn more about how climate issues might be used in their specialized research, education and training activities. This is not to say that all of those placed in this category will ultimately get more deeply involved in multidisciplinary activities on campus, but their stated interest is a positive first indicator of a potential deeper interest.

The third group is made up of people with various reasons for not taking any interest in climate and climate-related issues: their time has been committed to projects for the next few years, they do not feel that climate adds much to the issue they are addressing, they have enough external research funding that they do not need to be exposed to new sources of funds that might be interested in supporting their work if it were to be made somewhat more climate-related.

A new program and center on campus should focus on the second and the first groups – in that order. To convince those in the third group that climate and climate-related issues are important aspects of their educational and research activities will require a range of approaches that are geared to the interests of the individual. That is to say, that there is no need to “give up” on those in the third group, it will just take more effort and ingenuity.

Potential Obstacles to Setting Up a Climate Affairs Program and Center

It is useful to identify potential obstacles to the creation of a Climate Affairs Center and Program. This provides an opportunity to respond to the obstacles, some of which may prove difficult to surmount, while others can be overcome by pre-action. While some of the obstacles may be unique to climate affairs, others may be more generic and applicable to any multidisciplinary educational activity. Some potential obstacles are listed below.

- A belief that environmental studies can encompass consideration of all aspects of climate.
- “Retailing” climate information to potential users (especially faculty) is difficult, time-consuming and labor-intensive.
- Many people still see climate as a boundary constraint to a country’s rate and progress of economic development and, as a constraint, little can be done about it.
• Some people view the word “climate” as representing a need for a background in physical science and, therefore, it does not initially apply to them.

• Many of the faculty expressed interest in knowing more about climate affairs and climate issues specifically as they might relate to their particular area of research. However, there is a need for constant reinforcement of that curiosity about how climate might relate to their individual, often disciplinary or region-specific, interest in order to minimize “backsliding.”

• There are some faculty whose interest has not yet crossed into climate and is not likely to do so. They have developed established research interests and agenda and are not willing or eager to deviate from them.

• There is confusion among faculty not invested in climate and climate-related research about the climate change issue. Climate Affairs, however, is only devoted in part to climate change (i.e., global warming).

• Some observers believe that climate issues can easily and as effectively be dealt with through existing environmental science or other programs.

• Different perspectives exist on campus about how to make a Climate Affairs Program sustainable: not all approaches are compatible.

• There are some environment, climate or climate-related centers, activities, or hubs at a university, and they may feel that a new center or program would deflect attention from their activities.

• There may be concern about increased competition from the same funding sources for climate-related issues. (Also, there may be a competition for resources such as a space for a center, visiting professors, staff, etc.)

• Lack of rewards for engaging in multidisciplinary work.

• Communication difficulties among centers, programs, disciplines (for example, different disciplines use different jargon and have different physical locations).

• Challenge of application of societal research to societal problems.

• Keeping the advisory board engaged and participating and bringing in new people/new perspectives over time.

• Balancing the emphasis of different disciplines (scientific arrogance, i.e., the thinking that those from non-science disciplines don’t understand the issues as well, scientists thinking there needs to be more emphasis on science when really only a certain amount is necessary). Different ideas about what and how much is important for climate affairs students to know.

• Attracting a diverse population of students (ethnic, i.e., minority populations, gender, foreign students, different disciplines, etc.).

• Assessing and keeping up with employment opportunities and making sure students are competitive in the job market.

Niels West (1986, private communication) prepared an assessment of graduate education in Marine Affairs. Some of his concerns about constraints on multidisciplinary activities centered on Marine Affairs are noted in the following bullets. These issues are still valid and apply to Climate Affairs Programs as well.

**Obstacles to Marine Affairs Programs:**

• “floating programs” (programs that rely on other departments for courses and faculty) – absence of departmental status may lead to “disciplinary turf” problems, underutilized faculty, lack of desire of university administrators to financial commitment for development of a new program, weaker faculty constituencies.

• Uncertainty about the initial role or long-term participation of pioneer developer(s) of a program to provide guidance and direction to a new center and program.

• Faculty perception (erroneous) of limited opportunities for publishing in peer-reviewed professional journals.

• Full time vs. part time/associated faculty – “Associated faculty working in interdisciplinary programs have often had difficulty in being evaluated for their interdisciplinary contributions when considered for tenure and promotion. As a result, many have been reluctant to become involved in such efforts.”
• The diversity of marine affairs is reflected in the number of potential courses available to Marine Affairs students.

• Assuring enough flexibility can be built into the program to accommodate varying backgrounds and career goals of faculty and students.

• To what extent will interactions exist between faculty and administrators of academic programs and the public and private sectors?

• To what extent will increasing employment opportunities within the private sector influence the assessment of courses, course content, and methodology?

• Will the program and center be prepared to analyze what presently may be ill-defined private sector needs?

Some of these potential and real obstacles or constraints can be overcome by working closely with faculty and students on the “value-added” aspects created by the development of a program and center focused on climate and climate-related issues.

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**Water Affairs?**

The response by faculty, program and regional center administrators and students to the notion of climate affairs has been quite positive. Thus, the possible development of a climate affairs program and center at Columbia is clearly in the realm of possibility, given human and financial resources appropriate to the task.

While preparing the climate affairs report, I was invited to a planning meeting in Tokyo for the 3rd World Water Forum to be held in March 2003. The attendees from various parts of the water research and application communities appeared to be less organized than their counterparts in the climate research and application communities.

A question that can be raised is as follows: “If a Climate Affairs Program can be developed successfully, can a ‘Water Affairs’ Program and Center be far behind”? The following suggestions represent an outsider’s attempt to organize the issues in the water world, so that it becomes a water community with recognizable groups, concerns, and timelines. Water, like weather, is a very broad and all-encompassing concept to decision-makers and the public. There is a water problem occurring somewhere in the world every day, and all people, in rich and poor countries and in rural and urban areas, have been confronted by some kind of water problem (quantity, quality, change, timing). With industrialization processes expanding and with populations increasing and moving into urban and marginal areas, existing as well as new water problems of different kinds will appear in some places and worsen in others. The objective is to get ahead of the learning curve on existing and emerging water problems and for the purpose of enhanced community building between the water world and the climate community.

I think it might be useful to categorize water issues in the following way, as is done for climate issues: water variability, water fluctuations, water change, and water extremes.

*Water variability:* This refers to water and water-related issues on seasonal to interannual time scales. Examples of water variability include drought, reservoir management, irrigation management (especially in arid and semi-arid areas where...
inter-annual variability is high and skewed to dryness), urban drought and other water shortages, low snow pack, winter snow pack augmentation, and so forth.

*Water fluctuations:* Some good examples of stream flow changes across several decades occurred in the following: the Colorado River system (naturally occurring decline in flow, 1923 to present), the Amudarya and Syrdarya in Central Asia (human-induced decline in flow, 1960 to present), Russia’s Volga (natural and human-induced flow changes, 1930s to present), among other decadal-scale changes in stream flow or inland sea level (either rising or falling levels).

*Water change:* Examples of severe water balance changes over time would include the following: the Amudarya and Syrdarya deltas, the drying up of various inland water bodies such as Owen’s Lake and Mono Lake in California, Lopnor in Xinjiang province of China, rivers that no longer reach the sea or delta (water change in a river’s lower reaches), among other examples taken from around the globe. Water changes would also encompass climate change scenarios and their consequences for permanent changes in water management and resources as we presently know them.

*Water extremes:* There are many examples of water extremes, including the 1998 Yangtze flood, severe floods in Europe and in the Mississippi Basin in 1993 and in Europe in 1995 and again in the late 1990s, unexpected heavy rainfall events in southern Africa in 2000 and 2001, and so forth. And, as a most recent example, costly flooding in Houston, Texas in mid-June 2001. Each year there are incidents of water extremes in various parts of the globe.

Each of these – water variability, fluctuation, change and extremes – can be related to other subcategories: water quality and quantity, natural and anthropogenic changes, etc. As with the notion of Climate Affairs, a notion of “Water Affairs” would have various aspects: water science, water impacts on ecosystems, water impacts on society (i.e., variability, fluctuations, change and extremes), water policy and law, water politics, and water ethics.

Water cells (discussed in the Appendix) for different geographic regions could also be developed. A Water Affairs Program would likely energize a different set of actors at a university, although there would be a modest, healthy level of overlap with a Climate Affairs Program.

In Dec. 2004 I convened a workshop with WHO/ HYDRO/ Program Support (USD 30k) on Education and Training for Water Affairs. It was convened in Honolulu, Hawaii at the University of Hawaii, Department of Civil and Environmental Engineering. The workshop was a prototype training course for meteorologists and hydrologists. The report is at [www. cse. ucar. edu/waf]. The WHO wants to continue to expand WHO activities at JPII in Latin America.

The UNESCO office in Uruguay is seeking funds to host a similar meeting for Latin America.
IV. Rationale for Developing a Climate Affairs Program and Center

Why is Climate Affairs Important?

Climate in its various dimensions — variability, fluctuations, change, extremes, seasonal rhythm — is appearing more frequently at or near the top of lists of concern from individuals, corporations, and governments, when it comes to issues about local to global environmental and technological changes. One could argue that global change represents a version of a new Cold War; only this time the conflict is between societal activities and natural physical and biological processes, instead of between two nuclear superpowers.

Climate is a highly charged (politically and economically) aspect of the environment and of environmental change from local to global levels. Climate as a scientific concern is not only important to comprehend in its own right, but understanding it and its various aspects helps us to cope more effectively with other issues considered to be climate-sensitive (fisheries, health, history, war, economy, policy, disasters, institutional change, etc).

The idea behind the notion of a Climate Affairs and the potential for developing an academic and training program centered on it did not develop out of thin air. The idea was sparked by my visit to the School of Marine Affairs at the University of Washington. In 1998 the school held its 25th anniversary. Reflecting on the historical development of marine affairs, a multidisciplinary program related to the marine environment, it became clear that such a program was an outgrowth of the need for information by government negotiators about the marine environment and its management. In the decades-long negotiations of the "Law of the Sea," there was a societal need for economists, political scientists, lawyers, engineers, oceanographers, geographers, and so forth educated in multidisciplinary marine-related issues to assist negotiators. It was not until 1969 that the first formal Marine Affairs Program was established at the University of Rhode Island. Today there are about 40 similar programs and there is even a Marine Affairs and Policy Association (MAPA) (see the website at http://www.oce.orst.edu/mrm/mapa/about.html).

Today, governments are in the midst of negotiating the development of what could be called a "Law of the Atmosphere," through the IPCC (Intergovernmental Panel on Climate Change) process. Coupling together international agreements related to the atmosphere that have been developed over time, a body of laws related to the chemistry of the atmosphere and atmospheric processes is being accumulated: the Vienna Convention, the Montreal Protocol, the Convention on Long-Range Transboundary Air Pollution, and the UN Framework Convention on Climate Change and subsequent Kyoto Protocol and the entire set of Conference of Parties (COP) conferences. In the process of developing what will essentially become a Law of the Atmosphere, negotiators have had to seek assistance from experts in a variety of disciplines in the physical, biological, and social sciences. Thus, expertise on climate and climate-related issues has been emerging in various disciplines within educational, governmental and non-governmental institutions in the United States and elsewhere.

Prior Questions

During the process of carrying out this planning grant, three commonly asked questions emerged. They reflect some of the concerns raised by those on campus with whom discussions about climate affairs were held. They are "prior questions" in the sense that they require consideration before addressing the development of a Climate Affairs Program and Center.

1. "What are you working on?" This is a question I was frequently asked while visiting the Columbia University campuses. There are at least two ways to answer this question (Fast Company, 1999). The first way to respond is to rattle off a list of specific activities that I have been engaged in: people I have met for the purpose of discussing climate affairs; courses I am in the process of developing; identifying of institutions in the metro area, in the US and around the globe that could be part of the climate affairs network, with Columbia University as the educational hub, and so on. However, these are really tactical (short-term) activities that are geared toward achieving an unexpressed long-term strategic objective.
A second way to answer this question is to identify and discuss the long-term strategic objective(s) of the various specific climate affairs activities proposed to Columbia. Identifying the strategic objective(s) provides the raison d’être and an overarching focal point of seemingly disconnected activities in which I have been engaged in order to fulfill the obligations of the planning grant. From this perspective, the above-mentioned tactical activities have been designed to identify individuals, centers, institutes, and academic departments and programs at Columbia University that are now actively involved in climate affairs-related issues or could be encouraged to do so in the near future.

Thus, strategically speaking, I have been involved in discussions with faculty and some directors of institutes and centers to identify (1) the need for and sustainability of a Climate Affairs academic Program and Center, (2) the types of programs for climate affairs, (3) the development of a network based on in-reach (within the university community), out-reach (nationally and worldwide) and metro-reach. I have also been seeking to determine the ‘value-added’ aspects that might accrue from the development of a Climate Affairs Program and yet another center at the university. Such value-added aspects include but are not limited to the following: the generation of how climate issues might interplay with the research and teaching interest of faculty members, the encouragement of climate-related multidisciplinary research, teaching and interactions across discipline-based departments, centers and institutes in the physical, social and biological sciences and the humanities.

2. “Why bother creating a new distinct program focused on climate affairs?”

Why not just stick with environmental science or environmental affairs programs and include some climate issues along with other environmental concerns? This question was raised by most people early in a discussion of the notion of climate affairs; again, “why develop a new program on climate affairs and why not just pursue climate issues within the environmental sciences?” To me, the answer to this question is rather easy: we want to draw attention to the true importance of climate and climate-related issues.

Environment is a very broad concept and is viewed as all-encompassing. However, loosely defined, “environment” is so all-encompassing that one could legitimately ask a similar question to ecologists or biologists: Why not place ecology or biology under environmental science as well? Yet there are ecology and biology departments alongside environmental science programs. The “environment” is made up of many components, each of which has its own distinct identity and can stand alone as valid areas of academic pursuit (through education, training, research and research application).

Another related concern is the following: if one were to mention climate affairs as a subtopic within an environmental science or even a climate science program, there would likely be a strong resistance to get involved by those interested in social and ethical issues related to the climate system, as they would feel that the emphasis of the program would be on the physical science aspects of climate. If, however, one were to (for example) refer only to climate policy or climate ethics, there would be also a strong likelihood that those students or faculty interested in the physical or biological science aspects of climate and climate-related issues would be reluctant to participate in such an academic program, even though the content of the course or program would be truly multidisciplinary, covering issues of science and policy as well as issues related to ethics.

Yet another concern is that when it comes to academic programs, to look at climate issues as a subcategory of environmental affairs or of an environmental science and policy program would mean that relatively few courses would focus on the climate issue itself, because of the requirements for the student to take several broad all-encompassing courses related in some general way to the environment. It would also mean that climate-related research would become unnecessarily restricted. Hence, there is a need and an urgency to highlight the climatic aspects of the environment. From the perspective of 2004, it appears fairly certain that climate issues will be among the dominant political economic and social issues that will require well-informed decision-making at the local to national and international levels in the 21st century.

In sum, climate affairs can be an integrator of disciplinary interests in issues that are directly or indirectly affected by the behavior or perceptions of the behavior of and impacts on the environment and on society. It can stimulate new thinking in the various disciplines as well about traditional issues of policy; war; peace; conflict; political,
economic, and technological development; food; water; energy; health; instability; and so forth.

3. "Is it an education or research program?" A third question that has been asked with relative frequency but more toward the end of this planning activity is whether the proposed Climate Affairs Master’s Program is to be an educational or a research-oriented program. Obviously a distinction can be made between these activities. However, from my perspective, the climate affairs activity is primarily an educational one, but one that will lead to and foster research at all levels in the academic community (undergraduates, graduates, postgraduates, and faculty). From this perspective a rigid line need not be drawn between education and research activities related to climate affairs.

V. Background

Aspects of Climate

For more than a hundred years, climate has been described as "average weather," but in reality it is much more than that. In fact, one could argue that because people see climate and weather as different, they respond to them differently. For our purposes, climate encompasses the following: variability from season to season and from year to year, fluctuations on the order of decades, change on the order of centuries and beyond, extreme meteorological events, and seasonality. By including all five aspects of climate in a climate affairs program, a realistic balance in teaching and research of climate on various time scales (e.g., education as generally defined) can be developed.

1. Climate Variability: Although climate varies on several time scales from seasons to millennia, I believe that most people in many places are concerned about climate variability within a season, from one season to the next, and from one year to the next. These are the time scales that are perceived by people and societies to directly as well as indirectly affect them and the resources on which they depend – food, water, energy, and human and ecological health. People everywhere are aware of growing seasons, hunger seasons, rainy seasons, fire seasons, hurricane seasons, planting seasons, harvest time, and so on. In fact the notion of seasons pervades just about every aspect of our lives and in ways not just related to the climate: there is a baseball season, a fall clothing season, a fishing season, etc.

Forecasters are now focused on producing reliable seasonal forecasts well in advance of the season, as these forecasts are most useful to societies and individuals, affording them time to take strategic and, if necessary, evasive action. When the expected normal flow of the seasons is disrupted, social and economic problems arise for people and for governments. The El Niño-Southern Oscillation cycle of warm-neutral-cold episodes operates on an annual basis, with El Niño events recurring on the order of 2 to
10 years often interspersed with cold episodes. Year-to-year climate variability is also of major concern to many socio-economic sectors of society.

There is a major difference in societal and environmental impacts in the way annual climates are sequenced. By this, I mean the following: if a dry year is followed by a wet year, societal (and individual) responses will be different than if a dry year were followed by a second and a third dry year. The same problems arise with the sequencing of wet years. As an example, in an arid area, traditional societal coping strategies are designed to cope with one and perhaps two dry years but not a third. Poor farmers live from one growing season's harvest to the next. Following the harvest they fulfill their financial obligations by paying off their debts. They store surplus grains for planting the next growing season and for food. If for some reason there is no crop in a given year, they are put in a position of having to borrow money and food and seed to plant. They may even sell their labor to the richer farmers in the region. That means they are in debt before the start of the next season and they may not be able to get to farm their own land until after they took care of the land of their creditors. So, a drought that affects a growing season can keep poor people poor and rich people relatively better off.

2. Climate Fluctuations: Fluctuations refers to variability on the order of decades. For example, Prof. Gray and colleagues (1997) have shown that the frequency of hurricanes in the tropical Atlantic has changed over periods of decades: 1930 to 1960 was a very active period, whereas 1960 to 1995 was a relatively inactive one. Gray believes that we are entering a multi-decadal period with an increase in the frequency of tropical storms on the order of the earlier (1930–60) active hurricane period. As a matter of fact, the 1995–2000 hurricane season period has been the most active in the historical record.

As another example of decade-scale fluctuations, El Niño events were less frequent than La Niña events between 1950 and 1975, and have become more frequent in the last quarter of the twentieth century. This can be seen in the following chart.

Multivariate ENSO Index (MEI) is based on the six main observed variables over the tropical Pacific. These six variables are: sea-level pressure, zonal and meridional components of the surface wind, sea surface temperature, surface air temperature, and total cloudiness fraction of the sky (CNC, 2001).

Fish populations (and landings) also show variability in productivity from year to year as well as on longer time scales. Researchers have referred to such changes in
regional productivity in the marine environment as a regime shift. Such decades-long shifts in species domination in a given ecosystem can be seen in the anchovy-sardine populations off the coasts of California and Peru. The problem is that societies tend to focus on shorter time periods and policy makers seem to have relatively little interest in what happens to fish populations decades after the policy makers have left political office.

Societies should be more concerned and knowledgeable about decadal-scale fluctuations than they are at present. While this time scale is of interest to certain specialists dealing with long-range issues, such as engineers who deal with the planning of water resources and structures that have to last for many decades, they have been apparently of much less concern to most individuals and policy makers. From their perspective, policy makers are, generally speaking, more concerned about 2-, 4- or 6-year time scales, the periods when they are up for reelection.

3. Climate Change (a new global climate state): Today, the term climate change is a euphemism for global warming. The IPCC report strongly suggests that human activities such as the burning of fossil fuels, tropical deforestation and the emission of other greenhouse gases (methane, nitrous oxide, CFCs) are responsible for enhancing the naturally occurring greenhouse effect. Political leaders in many countries have become directly involved in and concerned about the global warming issue. It relates to international energy politics as well as domestic energy debates. The way the climate change issue has been handled by the scientific and political communities is what sparked interest in the first place in developing the notion of climate affairs. For example, one reason was to deal with the climate change issue in a balanced scientific way (as opposed to just advocacy). Another reason was to draw attention to other equally important aspects of climate such as variability, fluctuations, and extreme events. Furthermore, in order to prepare society to cope with the projected global and regional changes in climate, societies must evaluate how well they now cope with today's variability fluctuations and extremes.

4. Extreme Meteorological Events (EMEs): Societies everywhere have their concerns about particular extreme weather, climate and climate-related events such as floods and fires. Although each society faces its own set of such extremes – droughts, floods, cyclones, heat waves, etc. – they do not necessarily have to face the same set of extremes. While Floridians are concerned about hurricanes and fires, Californians are concerned about El Niño-related coastal storms and torrential rains in the southern part of the state. People in the Great Plains and in the Gulf states are concerned about tornadoes and severe weather to a much greater extent than states in other parts of the US. There are, however, similarities in the way that communities prepare for or cope with extreme events. Researchers concerned about climate variability and those concerned about climate change are interested in EMEs, but for different reasons: the former community wants to forecast their onset and prepare society for their impacts, whereas the latter community of researchers wants to identify changes in frequency, intensity, duration or location of such extremes. The following graphic highlights the billion
5. **Seasonality:** Seasonality is an important characteristic of regional and local climates. The natural annual rhythm of the seasons and occasional disruption by extreme climatic events are more related to the success or failure of human activities than is generally realized (e.g., Sahn, 1989). Perceptions and expectations about the natural flow of the seasons play a major role in determining individual behavior and societal activities. It is something to which every society has had to adjust its climate-related activities. In industrialized countries, shifts in the onset, duration and other aspects of seasonality can have a major impact on a regional economy if not on the national economy (for example, hard freezes in Florida has had major impacts on the Florida frozen concentrate of orange juice industry). For the most part though, it is an economic problem, and not a life-death issue. During the 1930s droughts in the US and Canadian Midwest, people migrated from the region in droves.

However, one should examine this seasonal rhythm and its implications for rural poverty in the Third World. To date, interest in climate impacts on societies, and more specifically on rural poverty, has focused on spectacular or unusual events such as droughts and floods. Yet, such events may only serve to distort so socio-economic relationships that were already established by the less spectacular but perhaps equally important natural rhythm of the seasons. This has been a neglected aspect of research in economic development, with only a few notable exceptions.

For example, Chambers et al. (1979, p. 3) summarized how seasonality relates to various aspects of rural poverty in the Third World. They noted that "besides climate, seasonal patterns are also found in labor demand in agriculture and pastoralism, in vital events, in migration, in energy balance, in nutrition, in tropical diseases, in the condition of women and children, in the economics of agriculture and in social relations, and in government interventions."

Not all people in a given area are adversely affected by seasonality. In fact some segments of society, such as rich peasants and grain merchants, benefit from seasonality at the expense of the larger number of rural poor. Amartya Sen (1981, p. 43), whose observations were based on case studies in India and the Sahelien zone of West Africa, noted that "it is by no means clear there has ever occurred a famine in which all groups in a country have suffered from starvation, since different groups typically do have very different commanding powers over food."

The seasonal rhythm tends to reinforce the social relationship between the local quote halves unquote and quote have-nots unquote, while extreme meteorological events such as drought tend to exacerbate an already distorted social relationship. Thus, understanding seasonality and the relationship of drought and seasonality on rural
poverty is essential for establishing an effective system for mitigating climate-related societal impacts.

Societal Concern about Climate Issues

1. Droughts

Droughts are occurring somewhere on the globe all year round. There are different kinds of drought: meteorological, agricultural, and hydrological and each has its own kinds of impacts on society and environment. Droughts have often affected the quantity and quality of food supply and therefore food security of a region or an entire country. As a result, it appears to the untrained observer that drought causes famine. However, closer scrutiny of a famine will in most cases uncover a multi-stressed environment in which the drought itself may have been only one of the stressors and not necessarily the most important one. Industrialized or rich country food insecurity can be an economic problem. In an developing or poor country a drought, especially an agricultural drought, can become a matter of life, death and a sharp increase in morbidity.

Interest in drought is at least as old as the existence human settlements. Records note that all societies have been plagued by water shortages at one time or another, regardless of their level of economic development. Academic articles note centuries-old concern about drought and famine in such places as Ethiopia, China, Brazil and India.

2. Floods

Floods are a highly visible impact of a variable climate system. Although they are of relative short duration, they can be very devastating to life and property. Like droughts, floods are occurring somewhere on the globe each year. With the globalization of news coverage, people around the globe with access to TV, radio or newspapers are bombarded with stories about devastating and costly floods from various locations around the globe (As I write this paragraph, flooding is reported in the U.S. (West Virginia, Iowa) and in Japan, Pakistan, Taiwan, Indonesia, and India among other locations. They capture media attention much more so than droughts do.

3. Tropical Storms

Hurricanes (cyclones and typhoons) are extremely destructive phenomena that cause considerable damage around the globe due to strong winds, heavy rains and tidal surges. Their frequency and intensity vary, producing adverse impacts wherever they make landfall. The Atlantic coast of the U.S and nations in and around the Caribbean suffer every year during the hurricane season. Island nations in the South and western Pacific are also adversely (or positively – bringing rainfall to water-short regions) affected by typhoons. Cyclones have been extremely destructive in the Bay of Bengal and its major national victim appears to have been Bangladesh.

There is concern about how global warming might affect the frequency, intensity, trajectory and location of landfall of tropical storms. As noted earlier, some researchers have shown statistically that there is a multi-decadal fluctuation in the frequency of tropical storms in the Atlantic–Caribbean region. Hurricanes Hugo, Andrew, and Floyd in the United States, Hurricane Georges in the Caribbean, and Hurricane Mitch in Central America have heightened concern about the possibility of increased damage of blockbuster hurricanes that make landfall. There has been a major growth of population along US coastal areas. Landfall of a storm of the same intensity and in the same location would have a much greater economic impact today than it would have had 50 years earlier.

4. Ice Storms & Frosts

Severe ice storms are not as frequent as many other weather-related extremes but when they occur they can be highly destructive. The most notable recent ice storm took place in the northeastern part of the North American continent. In January 1998, one of Canada's worst ice storms destroyed power lines, closed down businesses, disrupted
commerce, damaged infrastructure, and deprived thousands of people of heat in winter. Another devastating ice storm took place in the early 1990s. The central part of the US was plagued by a storm so severe that at that time it was called the ice storm of the century.

Frosts and freezes, too, can be costly. An early or untimely frost can have a negative effect on agricultural production activities. For example, in the 1980s, a series of unexpected frosts and hard freezes in central Florida had a major adverse impact on oranges and on the American frozen concentrate of orange juice (FCOJ) industry in that state. In response to these freezes in Florida, Brazilian entrepreneurs decided to export large quantities of FCOJ to the US market. This created a major source of foreign exchange for Brazil as well as a strong industry in the country (Miller and Glantz, 1988). However, in a poor developing country such as Papua New Guinea, a severe frost can create a life-or-death situation for those dependent on subsistence agriculture (Allen, 1993). A drought-induced frost in the early 1980s and then again in 1997 led to severe food shortages and even famine in the highlands. This was the only famine to have occurred during the 1997–98 El Niño (Barr, 2001).

5. Fires

Throughout the 1990s, several countries were plagued by wildfires (brush and forest) – the US, Mexico, Australia, Russia, and Indonesia. Fires are destructive to the natural and the human built environments in both rural and urban areas. Ever since the 1982-83 fires in Indonesia in which an estimated 3 million hectares were destroyed, people have known about the connection between El Niño events and rampant fires in Kalimantan. One of the most notable fire situations took place in Indonesia during the 1997–98 El Niño event. It has been estimated that about 9 million hectares of forest were burned during this event. However, fires are set each year to clear the residue in the cultivated fields following the harvests. Farmers believe that such fires put nutrients back into the soils. As it turned out, many of the fires that occurred during the 1997-98 El Niño were intentionally set and illegally commissioned by company executives seeking to circumvent the law that protected the country’s forested areas. Forests in Indonesia that by chance “happened to be” destroyed naturally by fire as a result of lightning strikes could be purchased by private companies to grow lucrative plantation crops. In this instance the fires produced considerable haze that affected the air quality not only in Indonesia, but also in various countries of Southeast Asia. The fires and resultant haze were blamed for two plane crashes, two ship collisions, and various human health and respiratory problems.

Locations of fires detected the night of 21 September 1997 in Indonesia and Malaysia (Borneo) using data from the U.S. Air Force Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS). The OLS has a unique capability to perform low-light imaging of the earth at night. Data processing by the National Oceanic and Atmospheric Administration’s Geophysical Data Center, Boulder, Colorado.

6. El Niño & La Niña

The 1997–98 El Niño event has been labeled as the “El Niño of the (twentieth) century,” replacing the 1982–83 event that previously held that title. It surprised researchers and forecasters when it developed rapidly after February 1997. It surprised
them again when it decayed in May 1998 as rapidly as it had developed. El Niño became a household word around the globe, because of the media coverage of the weather- and climate-related destruction that occurred in the same time period as the El Niño. Media coverage of the event helped to educate the public worldwide about the phenomenon and its destructive capabilities. When people now hear that an El Niño has been forecast, they will most likely think back to their country’s climate situation in 1997–98 to forecast its possible impacts by analogy. In many places that experience was bad, as lives were lost or property destroyed.

In mid-1998, there were numerous forecasts of an emerging La Niña episode issued that eventually proved correct. In some locations La Niña has been associated with the opposite climate anomalies to those that occur during El Niño. For example, the Philippines, Indonesia, Vietnam, and Australia, among others that are adversely affected by drought during El Niño are at risk of flooding during La Niña. The level of those impacts depends on the intensity of La Niña and on the level of societal vulnerability. The tropical Pacific is the field of action for the ENSO cycle. As a result, the countries around the Pacific Rim are among the most directly affected by the cycle’s extremes.

There is considerable scientific and other speculation about how global warming might affect the behavior and characteristics of the ENSO warm event/cold event cycle and its impacts on ecosystems and societies. However, the scientific underpinning of this relationship has not as yet been uncovered.

7. Infectious Diseases

Malaria, dengue fever, cholera, and hantavirus, among other infectious diseases, are associated with climate conditions. This has been a recent area of interest of climate-researchers, and it has been sparked by disease outbreaks during climate anomalies such as those occurring during El Niño events. For example, the cholera pandemic in Latin America has been associated with the 1991–92 El Niño event and its impacts along the Peruvian coast.

Cholera is still a major threat to Latin America and other impoverished regions of the world. This map traces the Latin American epidemic that began in Peru in 1991 (Hoff and Smith, 2000, p. 21).

Dengue fever outbreaks in Vietnam have also been associated with El Niño events. Malaria outbreaks have been recorded during El Niño events in Venezuela and in Colombia; a Rift Valley Fever epidemic occurred in 1997–98 in Kenya during heavy flooding; and so forth.

Another increasing concern about infectious diseases centers on global warming. If a warming of the atmosphere continues, tropical diseases will likely spread poleward, bringing tropical disease vectors to the mid-latitudes. Signs of this are already appearing [MICKEY PLEASE PROVIDE REF]. This realization in the early-1990s led to a sharp increase in research on the climate-health nexus since that time. Before 1990, the issue of climate-health interactions was kept on the back burner by the climate change research community as well as climate research funding agencies. For example, in paired comparisons between health and other climate-related issues, funding health-climate issues seemed to place behind funding of climate aspects of agriculture, water, and energy issues. Today, these relative positions have since been shifted to favor issues of health and climate.
8. Plant Pathogens (where the bugs are)

The agricultural sector is constantly doing battle with plant pathogens. These include all kinds of mites and bacteria that attack otherwise healthy crops, each of which has its own preferences for the types of plants it likes to feed on. Of course, it is often a zero-sum game in which there is only one winner – the farmer or the pathogen. This combat with mites, weasels, worms and the like is a constant one because pesticides developed by the chemical industry can eventually lead to pathogen immunities to them, as new harder pesticide-resistant strains evolve. As the climate changes, there is likely to be a shift in the location of many of these pathogens as well as changes in the location of specific crops, as they migrate poleward in synch with the temperature – moisture isolines to which they are accustomed.

Even in the aquatic environment, pathogens are constantly putting pressure on living marine resources and the human-built environment. The zebra mussel, for example, was “accidentally” introduced into the North American Great Lakes, most likely having been brought into the lake with bilge water from Europe. This invasive species has now spread to streams, rivers and bodies of water in the U.S. as the zebra mussel has been transferred from one ecological niche on one continent to another hospitable niche on another continent.

9. Global Warming

International concern has grown markedly since 1975 about the human contribution of greenhouse gases and land use to and impacts on the naturally occurring greenhouse effect. Since then, scientists have been brought together on numerous occasions to assess the state of the science of radiatively active greenhouse gases (Villach, 1979, 1983, 1985; IPCC, 2001, 1996, 1990). Governments are in the process of negotiating approaches for governments to reduce their nation’s contribution to global warming by reducing its greenhouse gas emissions. Governments have put together the UN Framework Convention on Climate Change (UNFCCC) and have convened several meetings referred to as the conference of parties (COPs). To date there have been seven of them (the latest one has been referred to as COP 6.5, convened in Bonn, Germany to try to resolve the unresolved items from COP 6, which had been held in the Hague at the end of 2000).

Considerable research funding has gone into attempts to model and better understand the greenhouse effect and how human activities might be contributing to it. Because fossil fuels and carbon dioxide emissions are at the center of the global warming debate and because economic progress in the industrialized countries has been based on the use of fossil fuels, global warming concerns have devolved into a debate about energy policy and environmentally friendly approaches to sustainable economic development.

10. Sea Level Rise

Concern about climate change centers on two key changes in the physical environment: global warming of the Earth’s atmosphere and a resultant rise in global sea level. Increases in sea level threaten island nations and communities and low-lying coastal areas around the globe. Perhaps the most active governmental organization focused on the sea level rise issue has been AOSIS (the Association of Small Island States). AOSIS membership is on the order of 37 countries had has actively supported political attempts focused on the reduction of greenhouse gas emissions by industrialized countries. Interestingly, several of the world’s major cities are located along the coast or estuaries and are equally threatened by sea level rise. Yet, no coalition has been considered, let alone emerged, between the low-lying coastal urban areas and AOSIS. The political influence of such a broadened coalition sharing a central objective – to avert threatening levels of sea level rise that has been linked to human induced global warming – might be able to increase considerably.

11. Urban Areas

People around the globe are migrating to urban areas. This process has been taking place for decades within rich industrialized countries as well as in countries with developing economies. Can these metropolitan areas cope with rapidly increasing
populations? Aside from the problems associated with the need for expanded physical and socioeconomic infrastructures, and aside from the traditional concerns about urban air pollution or the urban heat island effect, an emerging but neglected problem in urban areas is that of maintaining an urban water supply commensurate with the demands of an increasing population. Thus, it is highly likely that “urban drought” will become a prominent climate-related environmental and human health problem in many areas worldwide during the twenty-first century. The list of major urban droughts, even in industrialized countries—New York City, Los Angeles, Chicago, Tucson, Washington, DC—is growing. Drought in urban areas causes not only water quantity problems but water quality problems as well. As a result, there is a growing risk of climate-related health problems in urban areas as a result of reduced water quantity and quality.

In this book on “nine clues to the coming instability,” Linden (1998) noted the following: “In the poorer nations of the world, the latter part of this century has seen a massive, unprecedented migration to the cities ... Urban migration offers a possible soft-landing for these mounting pressures in the developing world. On the other hand, it could just as easily spur social, political, epidemiological, and environmental collapse ... Sometime in the next [21st] century, cities may have to deal with the consequences of climate change. Even if this threat proves to be a chimera, population pressures have raised the stakes of ordinary climate variations ... [In addition], should the world see more frequent and intense storms in coming years, hundreds of millions more stand to suffer, since thirty of the world’s fifty largest cities lie near coasts” (pp. 52, 60–1).

12. Population Movement at the Margins

Clearly, population issues are highly sensitive in international political circles. Nevertheless, population aspects of land use and greenhouse gas emissions are important when considering the interactions between climate and society. One key concern is population movements as population increases. Assuming that most of the best rain-fed agricultural land is already in production, people are moving into areas that are increasingly marginal for agricultural production, such as rainfall, soil quality, or altitudinal margins. People tend to use the same cultivation practices or rangeland stocking rates that they used in the less-marginal areas from which they came, but the environmental conditions are often much less favorable. Thus, there are more crop failures, which are often blamed on the climate regime rather than on the land-use practices that may be ill-suited to the local environmental and climate conditions.

13. Recreational Activities

Climate is not just a life-death or economic concern. At one time or another, everybody in the U.S., for example, thinks about the weather. Sometimes he or she thinks about it for reasons related to personal convenience: carry an umbrella, wear a raincoat or a ski parka, stay off the roads that have not yet been cleared of snow, park in the shade, make sure the kids are dressed properly for the expected weather conditions, and so forth. At other times, people are concerned about the weather for reasons related to recreational purposes. They plan vacations and weekend trips based on what they believe the weather condition will be at their chosen destinations. Owners of resorts for their part, select the locations for their facilities based on expected climate and weather conditions as much as on other factors. Ski resorts need natural snow conditions to lure prospective skiers. On occasion, they provide man-made snow. Some resorts in the U.S. Rocky Mountains have resorted to cloud seeding in the mountainous areas to improve both skiing conditions as well as water resources for use in summertime for domestic, industrial and agricultural activities. Tourists for their part select holiday sites based on their perceptions of favorable climate and conditions. Those who like to sail on lakes or in the ocean pay close attention to the marine meteorological forecasts (winds, wave heights, etc.). Those who fail to pay close attention have been known to do so at their own peril (e.g. Rob Mundie, Fatal Storm: The inside story of the tragic Sydney-Hobart Race, McGraw Hill, 1998).

Other Societal Areas of Concern

Aside from specific weather and climate phenomena that are of concern in their own right (to individuals, groups, corporations and governments in different regions
around the globe), there is a deep concern about what the adverse effects might be of those phenomena on human activities or on the resources on which societies depend. Looking at climate issues from the societal perspective (as opposed to a physical perspective), one can identify climate-sensitive sectors in society that merit immediate climate research and educational attention: food production and security, water resources, energy, public health, public safety, economy and environment. Issues of equity and ethics run through each of these categories and the ten problem areas presented in the preceding paragraph. Those in the humanities have a key and integral role in climate affairs.

Climate Anomalies and the Continents

Obviously, it would not be possible to capture in a few paragraphs all of the major climate anomalies that can or do affect a particular continent. Books have already been written on the climate of each of the continents. Yet, a few highlights of recent climate anomalies and their impacts on the various continents is instructive to the reader, and serve to underscore the fact that no part of the globe is immune to the vagaries of the global climate system. As time progresses, societies tend to lose sight of their constant struggle throughout the ages to predict the onset, manage the impacts, and identify the causes of climate anomalies that affect their lives. Although it is rarely done, societies need to remind each new generation about the ways that they had been affected by climate anomalies in the past. As a Chinese proverb suggests, "to know the road ahead ask those coming back."

North America

Droughts, floods, severe storms, hurricanes, freezes, blizzards and fires are responsible for many of the continent's notable climate-related problems. Just about all socio-economic sectors of society are subjected at one time or another to weather and climate anomalies. Some of them are seasonal. Others may be induced by the irregular occurrences on El Niño and La Niña events that originate in the central Pacific Ocean.

As examples, the Midwest US drought in 1988 has been labeled as the costliest climate-related economic disaster in US history estimated at $40 billion in losses; in 1992 Hurricane Andrew caused an estimated $20-30 billion in damage; and the ice storm in Quebec and in other parts of northeast North America in 1998 was estimated to have cost about $8 billion dollars.

Aside from the financial cost of a disaster, there is a misery factor to consider; displaced populations, lost personal possessions, adverse health impacts, and the like. Other often-overlooked aspects of climate impacts in North America are the opportunities for other countries to take advantage of climate problems elsewhere. Two examples come to mind: orange juice concentrates and soy bean exports from Brazil in response to...
anomalies in the USA. Both of these Brazilian industries were sparked by weather-related extremes in the US in 1962 and in 1973, respectively.

Canada’s image has been shaped by its climate. As noted on the Environment Canada website, “Canada’s climate often forms a big part of the perceptions that non-Canadians have when they think of Canada. When referring to Canada, people of many other nations think of a country full of big, cold, snowy expanses. In reality, we are a land of distinctive and diverse climatic regions”. The site goes on to say that “We are a land of seasons: spring, summer, fall, and winter flowing in a natural rhythm. The weather of our seasons can vary dramatically from region to region” [www.ec.gc.ca/climate/primer/sec-3.htm].

Europe

As in North America, Europe from west to east up to the Ural Mountains in Russia faces a variety of anomalous climate episodes in all four seasons. Winter storms, heavy snows, strong winds, droughts and floods have plagued various parts of Europe in the 1990s. More specifically, hurricane force winds hit England; strong winds destroyed trees throughout Paris; extremely cold winters had adverse effects in the European part of the Russian Federation; flooding in Poland, Germany, The Netherlands. The flooding in the Netherlands came, not from the North Sea but from the Rhine River; record setting heat waves in various cities. These extremes, among others, occurred during the 1990s, along with the collapse of the Soviet Union and its hegemony over Eastern European countries.

Latin America

Latin America from Mexico to Tierra del Fuego has been no stranger to climate impacts, especially droughts, floods and disease outbreaks. Most people at first will think of South America when they hear about El Niño; Peru is ground zero for El Niño’s impacts.

Central Americans have to face the hurricane season each year from June to November. In the 1990s, there were several devastating hurricanes in the Gulf of Mexico and the Caribbean Sea: Georges, Andrew and Mitch. Venezuela lost an estimated 50,000 inhabitants to mudslides sparked by heavy rainfall in December 1999. When El Niño is underway, several parts of this region are adversely affected: northern Peru and southern Ecuador suffer floods, Bolivia and southern Peru are affected by drought, northeast Brazil is drought prone while the southern part of the country is flood prone. Droughts occurred during the 1997-98 El Niño.

During La Niña events there are heavy rains in Paraguay, Uruguay, and northern Argentina. These extremes are often costly in terms of impacts on the economies of these countries and on livelihoods. They also have second order impacts. For example, during severe drought in the northeast of Brazil, people tend to migrate to major cities and into...
the Amazon where they tend to carve farmland out of parts of the tropical rainforest. During the 1991-92 El Niño a cholera outbreak in Peru led to a pandemic in several countries in Latin America (see map on p. 51, this report).

**Australia**

Australia is a land of extremes. It is a land affected by droughts, cyclones, floods, disease outbreaks, and bush fires. As an arid continent, people consider that they are "living in a sunburnt country". Australia, like Peru, could also be considered 'ground zero' for El Niño's impacts. It was plagued by what researchers there considered to have been a five-year El Niño event from 1991-95. That prolonged event was linked to a costly multi-year drought in the country. Agricultural production and ranching activities were most adversely affected.

Droughts recurred in the 1997-98 event as well, but the impacts were not as severe as earlier in the decade. There are studies that suggest that El Niño events are associated with the outbreak of Murray Valley Fever.

**Africa**

Climate variability from season to season and year to year has been a major problem for regions, countries and inhabitants in Africa. The West African Sahel is the region that has drawn attention to the extent of vulnerability to climate variability on the continent. This region is no stranger to severe extended drought. The most recent devastating drought occurred from 1968-73. Major droughts occurred during colonial times in the 1910s and again in the early 1940s. Many countries in Africa have been adversely affected by drought. The risk to drought is depicted in the following graphic.

Not even the traditional food-surplus producing countries of South Africa and Zimbabwe have had their share of major drought episodes about which books, articles, and government reports have been written.

Nigeria, the most populous country on the continent, too, has been devastated by drought conditions in various parts of the country. Mozambique suffered devastating floods in 2000 and in 2001, and usually but not always suffers from drought during El Niño episodes. Each country has its own climate and climate-related problems.

This is the existing climate situation. With the onset of global warming of the atmosphere the situation is likely to worsen. There have been several scenarios about changes in precipitation, seasonality (i.e., change in the characteristics of growing seasons), and even sea level rise. The good news is that many African researchers have become engaged in climate and climate-related research, a true example of capacity building. In addition to all of Africa's woes --- coups, corruption, conflict --- one must add climate variability, fluctuations, change, and extremes.

[Map showing mean annual rainfall and average departure over Africa.]

Left: climatological mean annual rainfall distribution over Africa. Right: The distribution of the average departure of rainfall in Africa from the long-term mean expressed as a percentage (WMO, 1984).
Asia

Asia encompasses a broad expanse of territory that is often divided into smaller geographically based regions: Western Asia, South Asia, East Asia and Southeast Asia. Most people are aware of the monsoon in Asia and the important life-sustaining rains (and devastating floods) that it brings to countries from Pakistan to China. Problems arise when the monsoon fails in some way as to adversely affect food production. In the old days, hunger and sometimes famines would occur (Davis, 2000). For the Indian sub-continent, droughts seemed to accompany El Niño events. However, in the past two decades that relationship has not occurred, much to the benefit of India.

Bangladesh is plagued by floods, droughts, and climate-related infectious-disease outbreaks. It is also hit by cyclones. For example, the 1970 cyclone was blamed for more than 300,000 deaths in that country.

Pakistan depends in large measure on irrigation water to produce food. It is presently the recipient of a major influx of Afghan refugees fleeing a multi-year drought and a totalitarian government in their country. This has created major problems for the Pakistan government because it has to provide for the needs of the displaced Afghans.

Indonesia, the Philippines and the countries in Indochina are affected by El Niño and La Niña induced droughts and floods, respectively. In addition, Indonesia and Malaysia suffer from widespread forest fires during El Niño episodes. These fires produce a severe regional haze problem, affecting Singapore, Malaysia, Brunei and other countries.

For over a century books and articles have been written about droughts and floods in China (Wang, 1981). The most recent Yangtze River basin flood in the summer of 1998 displaced an estimated one-fourth of the country's population. As bad as it was, it was not the worst climate-related disaster in China in the 20th century. There had been other more devastating floods and drought-producing famine events during the first half of that century.

Antarctica

There have been several research efforts in the past two decades that have focused on the Antarctic environment. First of all, one of the major greenhouse gases, chlorofluorocarbons, was implicated in the thinning of the stratospheric ozone layer in the early 1980s. Secondly, there was initial concern expressed in the mid-1970s that the West Antarctic ice sheet was unstable and could, with global warming, disintegrate. Doing so would mean that large segments of the ice sheet would fall into the ocean, rapidly raising sea level globally on the order of 8 meters. There have already been signs of disintegration as segment of the ice sheet the size of Delaware and Connecticut has already broken away. The following picture of an iceberg on the Ronne Ice Shelf, Antarctica, was seen to break up into several pieces, captured using optical imagery from the DMSP-OLS optical sensor and analyzed by the U.S. National Ice Center.
VI. Climate Affairs Courses

Some Ideas for a Climate Affairs Introductory Course

The following section presents an outline of what a climate affairs introductory course could look like. It divides climate issues into 15 components that would fill the weeks of a spring semester at most schools. It could easily be modified to mesh the general topics with the specialized interests of the instructor.

The following outline could also be used as a framework for a climate affairs master’s program with each topical unit or combination of units forming an entire course, as appropriately modified by the interests of the instructors.

Unit 1: (Mickey Glantz)

Why do we think it’s important for society to know about the intricacies involved in climate/society/environment interactions? What is “climate affairs”? Why do we think climate affairs is a notion whose time has come? We will briefly discuss the components of climate affairs. Why call it climate affairs? Why is it not simply another aspect of how we have come to study environmental affairs/science or a component of existing intellectual frameworks? Some of the key insights and discoveries into climate science will be identified and briefly discussed.

Unit 2: (Nicholls)

In the second unit we discuss the climate system, its physical and biological aspects. It is important for the students to develop a good understanding of the intricacies of the global climate system. Brief mention must be made here of the human input into the climate system, as we now know that human activities have become a climate forcing factor at local, regional and global scales. In later units we will discuss the human aspects of the climate system in more detail.
Unit 3: (Schimel)

In this unit we discuss climate impacts on ecosystems. For example, we discuss climate impacts on managed ecosystems (rangelands, irrigation) and on unmanaged ecosystems such as forests, coastal oceans and deserts. Biodiversity, as affected by climate regimes and changes, will be noted. If this unit is expanded into two sessions, one could focus on agriculture, on fisheries or on biodiversity (e.g., it could focus on the topic of interest to the lecturer or the course participants.

Unit 4: (Mickey Glantz – Social Impacts)

We discuss climate impacts on society. Here, the focus is on extreme meteorological events (climate, weather) and their impacts on human activities around the globe (e.g., related to food, energy, water, health, public safety). Also in these first few units students will begin to identify case studies that might interest them. These case studies, while focusing on climate aspects, will also put climate in the context of many other physical, biological, social and political factors (such as population increases and shifts).

Unit 5: (climate affairs and law)

In this unit students address the policy and legal aspects of climate and climate-related issues. Here, we discuss an overview of the legal aspects of air pollution, acid rain, ozone depletion, and global warming. For example, Anita Halvorsen has written a law thesis on how international legal instruments have enhanced the inequality between rich and poor countries [REF].

Unit 6: (Bettsell)
This unit focuses on the ethical aspects of climate. This relates to the ethical aspects of the impacts of climate variability and extreme events on society (e.g., why is it the poor that always live in harm’s way?); North-South issues; rich-poor issues; the role of humanitarian assistance and responsibilities not only of rich countries to poor ones but of rich elites within a country to the poor within the country. In this regard ‘climate rights’ and ‘climate responsibilities’ will be discussed.

Unit 12:

The role of the media in discussing, describing, explaining climate and climate-related issues, including forecasts, to the public will be the focus of this unit.

Unit 13:

In this unit, we return to global warming. Some of the proposed scenarios highlighting the potential impacts of climate change are discussed (changes in precipitation, temperature, seasonality, sea level rise and demographic changes).

Unit 14:

The methods of analysis with respect to climate impacts on society are discussed. These include both qualitative as well as quantitative methods of assessment. Included here would be an approach known as "forecasting by analogy". Difficulties encountered in attempts to attribute effects to causes, as well as costs and benefits of climate impacts on societies and ecosystems will be discussed.

Unit 15: (Mickey Glantz)
### Course-Related Aspects of Climate Affairs

In the following section, two ideas are proposed: (1) the notion of a "climate cell" and (2) a generic outline for a one semester introductory course on climate affairs. Both of these ideas are appropriate for the classroom and for web-based distance learning.

#### The Notion of Climate Cells

We have developed the notion of "cells" in order to help students identify potential courses that they could take at Columbia. They can also be modified for use by faculty to organize a region-specific climate-related course. The cells have the appearance of a 4 by 4 Rubik's cube. Along one dimension are geographic regions (for example, Latin America, Asia, Africa, Europe). Along another axis are the four aspects of climate (variability, fluctuations, change and extreme events). On the third axis are placed the sectors of society affected by climate (food, water, energy, human health).

The categories identified as the components of a climate affairs program — variability, fluctuations, change and extremes — are to serve as guidelines for countries, sectors and issues on which educators and students can focus. So, for any given issue, say drought, one can find an article, chapter, book or news report that will discuss it in the context of a geographic region and its multi-sectoral, first- and second-order impacts on society and the natural and built environments. This strongly suggests the value of using a matrix, when identifying educational and research material to address climate issues in an academic setting.

The matrix will help to assure those who prepare climate affairs courses or programs that their materials have encompassed all the relevant and key aspects of the issues they wish to share with their students. Once the geographic region has been selected (from local to global). The matrix would include the sectors of concern, the impacts of concern, the political aspects of concern to the educator (or to the student).

As an example, use a fictitious article on the Internet on drought in Northeast Brazil in order to identify the various aspects that the topic raises. Drought impacts food
production in a region where poverty is widespread, where water is in short supply, where many farmers are subsistence farmers, where people migrate from the region to urban slum areas and into the Amazon rainforest. The drought affects the federal government's development prospects, as development funds and loans become diverted to cope with drought-related problems.

Thus, the article addresses climate science (drought), first and second order impacts or water resources and on society, sustainable development, poverty and development, climate extremes and development prospects, "downstream" impacts in the rainforest and in urban centers, among other issues.

Objective of Climate Cells

By using climate cells taken from a 4X4X4 cube using climate aspect, geographic region, and societal sector, one can identify appropriate materials to tailor a climate affairs course to the expertise of the educator and the needs and interests of the students

Cell Dimensions (4X4X4)

- Climate aspects: Climate variability, Climate fluctuations, Climate change, Extreme events
- Geographic regions: Latin America, Africa, South and Southeast Asia, Central Asia [NB: These could be further subdivided into supra-national regions, countries, sub-national regions or eco-regions].

Latin American Cell Prototype (climate, region, sector)

Climate Affairs can be easily applied to Latin America for the following reasons, among others. (This prototype is in the process of being "fleshed out.")

- Growing concern about climate change (rainfall, ENSO, sea level rise)
- Fear that climate-related hazards are becoming more frequent, more deadly and more costly throughout the region
- Environmental justice issues are increasingly being raised, following droughts, mudslides, flooding
- Sustainable development and climate variability and change concerns
- Public health and climate concerns
- Improvement in the science and monitoring of the global climate system
- Growing awareness of the need to consider climate information in risk-related decision making
- The realization that costly climate related impacts on a national economy can in many instances be mitigated by human activities

Climate science

- Regional climates
- Problem climates
- Tropical storms
- ENSO cycle
- Extreme events
- Climate-environment-society interactions
- Forecasting
  - Variability
  - Change
  - Extremes

Climate impacts (on ecosystems)

- Rainforests
- Arid areas
- Slopes
• Coastal ocean
• Jungles
• Wetlands
• Frost, fire, drought, flood
• Streamflow

*Climate impacts (on societies)*

• drought & flood
• food security
• water resources (national, transboundary)
• energy production and consumption
• health
• public safety
• infrastructure
• politics & economy

*Climate ethics*

• Who is affected?
• Whom to protect?
• regional response
• development aid
• disaster relief
• core vs. periphery
  • domestic
  • international

*Climate politics*

• International

• shared resources
• national vs. regional politics

*Domestic*

• rich vs. poor
• up- vs. downstream
• urban vs. rural

*Climate economics*

• Climate & development
• pay now or pay later
• discount rates
• trade-offs
• risk analyses (risk takers, avoiders, makers)
• who benefits from climate variability, extremes, forecasts? Who loses?
• GHG reduction

*Climate policy & law*

• Domestic
  • GHG emissions
  • deforestation
  • fisheries
  • air pollution

• International
  • regional cooperation
  • debt for nature swaps
  • IPCC + COPs negotiations
Climate impact methods

- Qualitative
  - historical
  - analogies
  - case studies
- Quantitative
  - modeling
  - statistical
  - risk assessment
  - surveys
  - GIS

CELL 2: Possible research topics for sub-Saharan climate and climate-related research

- History of interest in climate in the region
- specific country focus
- forecast value
- comparative value to countries or sectors in sub-Saharan Africa of climate and climate-related forecasts
- eco-justice issues
- natural disasters
- The role of climate factors in other environmental problems in sub-Saharan

Sub-Saharan African Cell Prototype (climate, region, sector)

Climate Affairs can be easily applied to Africa for the following reasons, among others.

- Growing interest in various climate issues throughout Africa and in other countries and donor, development and humanitarian organizations
- Growing concern about climate change (rainfall shifts, ENSO, sea level rise)
- Fear that climate-related hazards are becoming more frequent, more deadly and more costly throughout the region (droughts, floods, diseases)
- Environmental justice issues are increasingly being raised, following extreme events, and with regard to the dissemination of forecasts
- Sustainable development and climate variability and change concerns
- Public health and climate concerns
- Improvement in the science and monitoring of the global climate system
- Growing awareness of the need to consider climate information in risk-related decision making
- The realization that costly climate-related impacts on a national economy can in many instances be mitigated by human activities

Climate science

- Regional climates
- Problem climates
- Tropical storms
- ENSO cycle
- Extreme events
- Climate-environment-society interactions

Forecasting
  - Variability
  - Change
  - Extremes

Climate impacts (on ecosystems)
• Rainforests
• Arid areas
• Slopes
• Coastal ocean
• Jungles
• Wetlands
• Frost, fire, drought, flood
• Rivers
• Inland seas

**Climate impacts (on societies)**

• drought & flood
• food security
• water resources (national, transboundary)
• energy production and consumption
• health
• public safety
• infrastructure
• politics & economy

**Climate ethics**

• Who is affected?
• Whom to protect?
• regional responses
• development aid
• disaster relief
• core vs. periphery
  o domestic

• international

**Climate politics**

• International
  o shared resources
  o national vs. regional politics

• Domestic
  o rich vs. poor
  o upstream vs. downstream
  o urban vs. rural

**Climate economics**

• Climate & development
• pay now or pay later
• discount rates
• trade-offs
• risk analyses (risk takers, avoiders, makers)
• who benefits from climate variability, extremes, forecasts? Who loses?
• GHG reduction

**Climate policy & law**

• Domestic
  o GHG emissions
  o deforestation
  o fisheries (inland and coastal)
  o air pollution
• International
  o regional cooperation
  o foreign debt
  o IPCC + COPs negotiations

*Climate impact methods*

• Qualitative
  o historical
  o analogies
  o case studies

• Quantitative
  o modeling
  o statistical
  o risk assessment
  o surveys
  o GIS

Possible research topics for sub-Saharan Africa climate and climate-related research

• History of interest in climate in the region
• specific country or region focus
• forecast value
• comparative value to countries or sectors in Africa of climate and climate-related forecasts
• eco-justice issues
• natural disasters
• The role of climate factors in other environmental problems in Africa

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