Training Course on Climate & Water Affairs in Southeastern Europe

20–24 April 2009

Sts. Cyril and Methodius University
Skopje, Republic of Macedonia

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Note: This report was prepared by Dr. Michael Glantz of CCB and does not necessarily reflect the views of the other organizers. The report was reviewed by the participants and changes were made accordingly.

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Introduction

The World Meteorological Organization (WMO) Hydrology and Water Resources, the UN Water Decade Programme on Capacity Development (UNW-DPC), and the Consortium for Capacity Building (CCB) at the University of Colorado in Boulder, USA, convened the Training Course on Climate and Water Affairs in Southeastern Europe in Skopje, Republic of Macedonia, on 20-24 April 2009. The workshop was hosted by the Faculty of Civil Engineering at Sts. Cyril and Methodius University.

The Dean of the Faculty of Civil Engineering, Dr. Peter Cvetanovski, officially opened the workshop and was followed by the welcoming comments of Dr. Pece Nedanovski, Vice Rector of Sts. Cyril and Methodius University. The local workshop organizer, Dr. Cvetanka Popovska, Faculty of Civil Engineering at Sts. Cyril and Methodius University, made a PowerPoint presentation on the history of the university and also provided background information about the Republic of Macedonia. Dr. Reza Ardakanian, Director of the UNW-DPC, welcomed the participants on behalf of the organizers of the course and presented perspectives on the objectives for involvement of this course. He also provided information about the creation of the UNW-DPC. Dr. Matthew Hare presented an overview of what UNW-DPC expected to be accomplished during the 5-day training course.

The meeting gathered together 19 participants from Albania, Bosnia-Herzegovina, Macedonia, Romania, Central Asia (Tajikistan and Kyrgyzstan), Iran, Libya, and one observer-participant from Austria.

Educators and university administrators from around the region came to the meeting to discuss the multidisciplinary concept and aspects of Water and Climate Affairs and how it might be sustainably developed at their universities or training centers. Discussions centered on the urgent need for developing a focus on climate and water issues and on the issue of what would be needed in order to introduce courses or programs (curricula) focused on using the “Water and Climate Affairs” template as a guide to course development on campuses in the various countries.

A few years ago Dr. Michael Glantz (CCB) developed the concept of Climate Affairs in order to assist in educating educators and training trainers on the importance of research and training about the impacts on societies --- and on the ecosystems on which societies depend --- of climate variability, climate change, and extreme events. The “affairs template” encompasses science, impacts, policy & law, politics, economics,

technology and ethics & equity issues related to the multifaceted interplay among climate, water, weather and society.

At the workshop Hare (UNW-DPC) led an open discussion about curriculum development. Mr. Claudio Caponi (WMO) presented information about the educational concerns and the role of the WMO's Hydrology and Water Resources Programme.

Glantz, who conceived the idea of the "Affairs" template, began the training course by introducing the participants to the multidisciplinary, multifaceted concept of Climate and Water Affairs. He noted that this was the second such workshop on Climate and Water Affairs: the first was convened in December 2006 at the Water Resources University in Hanoi, Vietnam <http://ccb.colorado.edu/waf>. In both workshops, participants were given a "Viewbook" prepared by CCB. It illustrated many of the ideas and issues that are encompassed by the notion of "educating educators and training trainers" about the interactions of climate, water, weather, and society.

Because of the multidisciplinary nature of Climate and Water Affairs, discussions were allowed to follow paths of interest of the participants as they arose throughout the meeting. As a result, the initial program shifted in opportunistic ways throughout the week. Nevertheless, most of the ideas in the Viewbook were discussed but not necessarily in ways originally intended.

Climate and Water Affairs: What Is It? Why Now?

Glantz discussed the workshop in terms of what he called "the three O's": outreach, outputs and outcomes. ***Outreach*** involves education and training activities that focus on the sharing of information for purposes of education. It involves, for example, generating awareness of climate and water issues among the participants.

Output refers to the various reports, articles and websites that were prepared for the workshop and provides insight into the issues and deliberations that took place at the workshop, as well as this summary. This report and the Viewbook are prime examples of output, in that they are tangible products of the workshop.

Outcomes are the knowledge and interests that have been left behind among the participants and their institutions, once the workshop has ended and the conveners returned home. Outcomes are much more difficult to quantify for a variety of reasons, not the least of which is that time is needed to try to implement findings and recommendations produced by workshop participants and organizers. The overarching goal and its measure of real success would be to generate sustainable outcomes.

The activities of the Climate and Water Affairs approach span the "three 0's." It is designed to develop awareness and to enhance the understanding of Climate and Water Affairs among educators and trainers in a wide range of disciplines, that climate and water directly and indirectly affects just about all aspects of human activities in

developed and developing countries alike. No place on Earth is immune from the influences of atmospheric processes. It is based on the view that decision makers worldwide can improve the way that socio-economic sectors of society might better cope with changes in climate, water or weather processes, especially their anomalies. Thus, the purpose of Climate and Water Affairs is to foster the development of programs at colleges, universities, and other educational and training institutes around the world.

All societies are now adversely affected at one time or another by climate anomalies and by record-setting extremes. It is already clear that the global climate regime has been visibly changing, and it is incumbent on decision makers to protect society from the impact of foreseeable changes in climate, global to local. Climate and Water Affairs programs can enable students, trainers, and educators alike to concentrate part of their educational activities in an area of research, impacts, application, and policy centering on the climate system and on climate- and water-related issues.

Climate and Water Affairs can help to strengthen the capacity of individuals as well as institutions of the urgent need to understand more clearly the influences of climate and water variability and change on human activities and on ecosystems worldwide. This knowledge can then be used to help societies cope more effectively with direct and indirect influences of climate on societies and, at the same time, better address the adverse ways that societies can influence climate on a range of time and space scales. It also serves to spark interest in climate and water knowledge and to enhance climate and climate-related literacy among those whose careers are not necessarily in scientific fields. Generating awareness about the importance of climate, weather, and water-related knowledge will produce a citizenry that can support governmental representatives who have to make climate-sensitive decisions on behalf of society. This brings to mind the following guiding principle: ***"Knowledge is Power. Sharing Knowledge is Empowering."***

Climate and Water Affairs provides an alternative path to generating and enhancing science literacy and education at the university level. It introduces science to people in a way that "backs them (and, therefore, the general public) into an appreciation of science at a sufficient level of understanding." By focusing at first on anomalies or extremes that attract the attention of the public, one can then weave into discussions/discourse the science behind the reasons for the anomalies or extremes. Most often those anomalies with which societies, industrialized and developing, must cope are related to climate, water, and weather. No single discipline and no single socio-economic sector can act alone either to fully understand climate-society-environment interactions or to effectively address problems or prospects raised by those interactions.

Dr. Rita Colwell, former Director of the US National Science Foundation, has commented, *"In the 21st Century we have to develop an integrated approach across the disciplines to understand the complexity of water issues worldwide."* The organizers of this workshop fully agree with this sentiment.

It is often useful to remind policy makers that, as climate systems do not respect political borders, it is most likely that the responses required to address their impacts will cut across bureaucratic jurisdictions, underscoring the need for multidisciplinary decision making.

By focusing primarily, but not exclusively, on educating educators of undergraduates and trainers of people already in the work force, they become knowledgeable about climate change, one of the most important issues of our time, and therefore become potential consultants, if not advisors, to decision makers on climate- and water-related issues from their own disciplinary perspectives. In turn, these educators are then in a position to educate and train undergraduates, graduates, and people in the work force. Within a few years, their students are most likely to have taken an increasingly influential role in the policy and other decision-making processes in government agencies, educational institutions, and corporate structures. This represents a win-win-win-win situation: for government, educators, students and the general public. It is very important to keep in mind that multidisciplinary research and application efforts should not be viewed as weakening the focus on the disciplines but in fact strengthens them.

The three areas of climate, water and weather are so intertwined that each by itself is difficult to fully understand or discuss without bringing into the discussion the other two areas. For example, one cannot talk about water issues effectively without taking into account where the water comes from and where it goes, as well as its uses and properties. Likewise, it is not possible to talk about climate (precipitation, temperature, vapor, clouds, evaporation, oceans, etc.) without taking weather or water into account. Weather too is obviously an integral aspect of climate and water issues.

If one had to succinctly summarize the operational goals of a Climate and Water Affairs activity or program, it would include the following:

- Foster a multidisciplinary focus
- Embed hydrological and climate sciences in social issues
- Educate educators and train trainers on climate, water and weather issues
- Build human and institutional capacity
- Encourage development of university curricula
- Catalyze interactions

Concerns of the Participants about Climate and Water

Several figures in the Viewbook served to underscore the scarcity of freshwater on our planet. One graphic noted that only 2.5% of the earth's water are freshwater resources and of that only 0.3% is accessible to humanity, with the remaining freshwater locked up in glaciers, snow cover and groundwater.

Glantz noted that in every country there are quotes about the importance of water to

meet societal and individual needs. “Water is Life” is an adage that exists in many cultures and is right to the point. Another by Leonardo da Vinci is “Water is the driver of Nature.” Yet another popular belief in the United States is that “Water flows uphill to money.”

Glantz commented on the phrase, “We all live downstream,” noting that although it is a nice sounding phrase, its meaning might not be so clear to many. It refers to the fact that those upstream have advantages over those downstream because the upstream people can take control over the timing, quantity and quality of water in the stream. However, he also drew attention to the fact that those upstream are also functionally, if not geographically, downstream of others, either politically or financially. Therefore, they must act with restraint on actions that could adversely affect those who are downstream in a watershed (or downwind in an airshed). A country downstream might grow food for export from the water in the lower reaches of a river, while those upstream may have the water but not the ability to grow food in the amounts needed for its citizens. Compromise is required. This is a real case and it is hoped that the policy makers involved are aware that they too are downstream of others.

Participants were then asked to provide round-the-table introductions to themselves and their universities. Each was then asked by country or region to address the following questions:

- Identify the ecosystems of concern in your country or region.
- Identify the pressures (natural and social) on maintaining them.
- Identify the level of interest in the environment of students in country.

[NB: The following brief statements were presented informally for the purpose of illustrating a few of a country’s environmental concerns. Again, these comments are meant to be illustrative, not exhaustive, and are clearly not official statements.]

. ***Bosnia-Herzogovina:*** The UNDP (UN Development Programme) indicates that 40% of the Bosnian population is below the country’s poverty line. The Tara River emerges from the confluence of the Opasnica and Verusa Rivers in the Dinaric Alps of Montenegro, flows 144 km northward and converges with the Piva River near the Bosnian border to form the Drina River. The Tara River is the largest European supply of drinking water. In April 2005, the governments of Bosnia and Montenegro abandoned a plan to construct a hydroelectric dam along the Drina River. However, in September 2006 a protocol was signed between the two countries, and a result the building of an electric power plant is planned, despite all efforts to protect the river and watershed. Hutovo Blato is a nature reserve in Herzogovina with an abundance of fish and birds. However, Croatia and Serbia would like to build a dam inside the reserve. The Bosnian participants highlighted these regional transboundary political and environmental problems. The level of interest in the environment by students in Bosnia is very high, depending on the faculty. It is important to supply information to the faculty in order to energize the

students.

. ***Romania:*** In Romania, every type of ecosystem is important, and most of the country is protected: attempts to protect the ecosystems have been made by the local authorities and by non-governmental organizations. Perhaps the most important ecosystem is the Danube reserve, which borders on the Black Sea. Almost the entire Danube delta is located within Romania, although the country shares a border with Hungary and Serbia to the west, the Ukraine and the Republic of Moldova to the northeast, and Bulgaria to the south. There has been pressure from the Romanian side regarding whether Ukraine needs to build channels, which would affect the water levels in the Danube. An environmental assessment by several authors brings up many contradictions. For the present, it is stable. Other ecosystems are the plains, mountains, and coastal areas. Sandy areas benefit from special protections. The level of interest in environmental issues by students in Romania is very high, and the level of interest depends greatly on the faculty, especially in the environmental sciences.

. ***Albania:*** The country is between two seas, the Adriatic and the Ionian. It is a small country of fewer than 28,000 kilometers, with a population not more than 3 million. More than 75% of the country is mountainous, and there are many sources of clear drinking water. There are many lakes, bringing a high diversity of ecosystem habitats. From the point of view of the social and political situation, Albania is going through a change from being a closed political situation to becoming more open. Before this change, climate problems were related to industries, but at the present all economic activity is suppressed and pollution problems have diminished. In Albania, the level of interest by students in environmental studies is quite high, and students are very interested in engineering and construction issues.

. ***Macedonia:*** The shared lake between Macedonia and Greece, Dojran Lake, has reached the level of an environmental catastrophe. Due to drought in the late 1980s and overexploitation of water for irrigation, the water level in the lake has dropped drastically, causing a serious shock to the lake's ecosystems. Some fish species have disappeared entirely, and tourism has dried up as well, since the coastline has turned into mud. Macedonian ecologists have initiated a number of international actions for its protection. Lake Dojran is the smallest of three tectonic lakes, with Lake Prespa the next in size, and Lake Ohrid the largest. Prespa shares a border with Macedonia, Albania, and Greece. Lake Ohrid is shared with Albania. The water level in Ohrid has remained stable, but Prespa has lost water volume. Natural processes seem to be the reason for this, but the rapid decrease in precipitation remains a mystery. Some scientists believe it is part of a natural cycle, others believe it is due to climate change. The Vardar River is the longest and most significant river in the country and has lost water quality related to human activities. The level of interest in environmental issues by students in Macedonia is very low. In a joint study with the Italian government, only a few students have recently chosen environmental engineering. The

interest is lower because it is not seen as being profitable.

. ***Central Asia:*** (Kyrgyzstan) Due to a variety of landscapes and microclimates, there is a wide range of types of ecosystems. More than 68% of the territory is desert. The most variable ecosystems lie in the middle mountainous zone where 14 of 22 classes of ecosystems occur. At present there is no single natural ecosystem on the territory of the country, which does not suffer from human influence. Due to the utilization of the water for irrigation, many rivers have disappeared. Strong pasture destruction occurs along the arid and semiarid foothills of the plains, intermountain valleys, riverbanks, and desert steppes.

. ***Central Asia:*** (Tajikistan) In the major part of the mountainous territory, avalanches are common, particularly in February-March. In 1978, the largest number of days with avalanche formation occurred, with all travel stopped, and communication and electricity disrupted. From 1961 to 1990, there has been an increase in the numbers of days with avalanches. Mudflows are often observed in the foothills and the mountainous regions of Tajikistan, with negative consequences for settlements and the national economy. Drought occurred in 2000 and 2001, when agricultural crop production dropped by 30% or more. In 2002, hail and rainstorms caused significant damage to the agricultural sector. In Central Asia, more students are becoming interested in economics, and the level of interest in environmental issues is mixed.

Iran: Iran borders the Gulf of Oman, the Persian Gulf and the Caspian Sea and is sandwiched between Iraq and Afghanistan. Iran has a variable climate. There are no major river systems in the country, and mountains impede access to the Persian Gulf and the Caspian Sea from many parts of the country. Iran shares borders with Armenia, Azerbaijan, Pakistan, and Turkmenistan, including nearly 650 km of water along the southern shore of the Caspian Sea. Iran generally has an arid climate, with most precipitation received between October and April. In most of the country, annual precipitation averages 25 cm or less, except for the higher mountain valleys which average at least 50 cm annually. There is intense pressure on the Iranian ecosystems as a result of mountainous terrain, high snowfall, and a population migration occurring from rural areas to cities, as well as deforestation. Changes in land use continue at a very high in Iran today. Desertification is also an ongoing problem. The level of interest in environmental issues by students in Iran is increasing: since unemployment is high, students are moving toward an interest in the environment.

Libya: Libya is located in northern Africa. Close to 95% of the total area of the country is mostly desert. and it suffers greatly from ongoing drought and desertification. The country is rich in oil reserves, and the government invested the oil income to establish a great man-made river to solve the problem of water scarcity. The Libyan National Meteorological Center (LNMC) provides meteorological services to the country. The LNMC also coordinates with other national sectors, including the faculties of science, agriculture, and other university centers and provides

> them with useful documents, including educational materials for children, secondary and university schools. The level of interest in the environment by students in Libya is high, since the country suffers so greatly a shortage of water, and students are concerned to find a solution to this problem.

Problem Climates or Problem Societies?

Glantz raised the issue of blame for the increasing severity of climate, water and weather-related impacts on societies and on ecosystems. How do we apportion “blame” for severity of impacts between natural factors, such as climate gone awry and society’s maladaptive practices? In other words, it is a question of “Problem Climates or Problem Societies,” or both. This question is about an important but relatively neglected objective: how to determine which adverse impacts on societies and on ecosystems can be attributed to the natural climate system (its variability, change, extremes) and which can be blamed on human activities (e.g., land use planning).

Almost 50 years ago, U.S. Geographer Glenn Trewartha published a book entitled *The Earth's Problem Climates* (1961, University of Wisconsin Press). He noted that his selection of case studies was based on what he considered at that time to be the earth's "problem climates" using information that was available up to 1960. That was a period when climate was accepted as being either a resource, a hazard, or as a constraint (meaning obstacle) to economic development prospects. He described a problem climate as one that does not really conform to what might be expected for given latitude. He then focused on what he called "regional climatic aberrations." Trewartha explicitly noted that he was writing for physical scientists, and not for the general public. He wrote that,

> *It is designed to meet the needs of those interested in the professional aspects of climate rather than laymen. A methodical description of all the earth's climates is not attempted, for many areas are climatically so normal or usual that they require little comment in a book that professes to emphasize the exceptional.*

Given the creeping, now accelerating, interest in the global climate system and about climate change and its impacts on societies and ecosystems over the past several decades since 1960 (the year Trewartha’s book was published), coupled with the step-like change in public concern following the unexpected recognition of the global warming threat to humanity by the Nobel Peace Prize Committee in 2007, one cannot help but ask: is such a statement still valid?

Are there really areas on the globe that could be described as "climatically so normal or usual that they require little comment"? Are there really today only a few exceptional "problem climates"? Glantz noted that all parts of the globe have been, are, or are expected to experience abnormal climate conditions as the atmosphere continues to heat up. In other words, all climate regimes have become problem climates in the 21st Century. Given what we know today about human influences on the atmosphere at

local, regional and global scales, we should also be asking questions about societies' roles in both the creation or continued persistence of problem climates.

There are at least two ways to look at the term “problem climates”: from a physical (natural science) perspective or from an anthropocentric (social science and humanities) perspective. Climate processes are natural processes that center on the physical characteristics and behavior of the atmosphere. The second perspective is anthropocentric, because human activities interact with climate processes and with the resources on which those activities depend.

Problem climates, then, are created or fostered not only by variations as well as profound changes in rainfall, temperature, pressure, or wind, but also by changes in human activities, such as deforestation, urbanization, desertification, and fossil fuel burning. For their part, societies can no longer be portrayed as victims of the climate system (its means, modes, extremes and changes) but are involved in the various ways that the climate system and its impacts might be changing. ***Societies must now be viewed as a key component of the climate system, along with forests, land cover, sea ice, clouds, and so forth.***

The phrase "problem societies" refers to societal influences on climate and climate-related characteristics that in turn affect the ability of society to interact effectively with the climate system. Accepting the fact that there are many things about the behavior of the atmosphere that we still do not know or understand, it is also important to note that there is a considerable amount of usable information we do know about the interactions between human activities and the climate system. Nevertheless, societies knowingly still engage in activities that not only increase their vulnerability but also can reduce their resilience in the face of a varying and changing climate system.

While every regional or local climate can be viewed to varying degrees as a problem climate in the natural science sense, the word "problematic" better captures the contemporary realization of what constitutes a problem climate. It suggests the reality of a need for an holistic view of the climate system in which human activities have become another factor that forces changes in climate.

Revisiting the “Four Laws of Ecology”

In the early 1970s, American Ecologist Barry Commoner identified what he referred to as the “Four Laws of Ecology.” These laws seem to be as pervasive, almost immutable, as are many of the laws of physics and mathematics. His laws were based on his observations at the time about human interactions with nature. It could be effectively argued that they are generally as valid today as they were then, at the beginning of the contemporary environmental movement. The laws can be applied not only to ecosystems but also to the atmosphere as well (and more specifically to the global climate system). Yet, to new researchers concerned with or involved in undertaking research for climate and water impact studies, these laws are likely unknown.

Commoner's Four Laws were presented to the participants in an attempt to generate a renewed awareness and interest in them of the current generation of students and educators. The laws are as follows:

1. Everything is connected to everything else.
2. Everything must go somewhere.
3. Nature knows best.
4. There is no such thing as a free lunch.

An example of the four laws is that of the tall smokestack. Tall stacks were originally designed to take local pollutants that resulted from manufacturing processes and put them just high enough into the atmosphere that they would be dispersed to … well, frankly, anywhere else but locally. The phrase used at the time to describe this process was "The solution to pollution is dilution." Over time, however, people in downwind locations complained that they were the victims of pollutants from elsewhere and they reacted politically to have the process stopped. Hence, there was a call for the enforcement of a "polluter pays" principle: those causing the harm from pollution to others must pay for the cleanup and removal of the pollutants and the repair of their adverse impacts on the built as well as natural environment. The slogan that could have then been written was: "The solution to dilution is pollution." If pollution could be contained at the local level, then local authorities would have to take responsibility for clean-up as well as prevention. The example of the tall smokestack provides a glimpse of each one of the Four Laws of Ecology noted above.

Virtual Water

The notion of virtual water was introduced. Virtual water refers to the water used in the production of a goods or services primarily in the context of international trade. The concern about this aspect of water use centers on the concern that the scarce water resources of some countries are used to produce products for export as opposed to use for domestic food production or other water-sensitive activities. As reported in Wikipedia,

> *Professor John Allan was the creator of the virtual water concept, which measures how water is embedded in the production and trade of food and consumer products. For his contributions he was awarded the 2008 Stockholm Water Prize. In awarding this prize, the Stockholm International Water Institute (SIWI) stated that "Virtual water has major impacts on global trade policy and research, especially in water-scarce regions, and has redefined discourse in water policy and management. By explaining how and why nations such as the US, Argentina and Brazil 'export' billions of litres of water each year, while others like Japan, Egypt and Italy 'import' billions, the virtual water concept has opened the door to more productive water use." As Allan stated: "The water is said to be virtual because once the wheat is grown, the real water used to grow it is no*

longer actually contained in the wheat. The concept of virtual water helps us realize how much water is needed to produce different goods and services. In semi-arid and arid areas, knowing the virtual water value of a good or service can be useful towards determining how best to use the scarce water available."

One recent example (of many) is the flower-growing industry in Kenya (East Africa). This industry was designed to export fresh flowers daily to the United Kingdom and perhaps other countries in Europe. Kenyan growers engaged in this relatively new export business made a good living by this practice. Water to grow flowers, however, was not used to, say, grow food for domestic consumption but instead was used to grow flowers for European markets, thereby exporting Kenya's virtual water in the form of flowers. Recently, there have been protests in the UK for the UK to stop the import of those flowers for a variety of reasons, including virtual water and the carbon footprint left in order to fly the flowers to distant markets.

The Value of Water and Climate Information

Caponi presented information to the participants about the World Climate Conference 3 (WCC3) to be held in late August to early September 2009 in Geneva, Switzerland. The information that follows is taken from the WCC3 conference website http://www.wmo.int/wcc3/page_en.php.

Conference theme

The overarching theme of the Conference is "Climate prediction and information for decision-making: focusing on scientific advances in seasonal to inter-annual time-scales, taking into account multi-decadal prediction". It includes the application of climate prediction and information to societal problems enabling adaptation to climate variability and change in various sectors such as agriculture and food security, forestry, energy, water, health, urban and rural settlements, infrastructure, tourism, wildlife, trade and transport that contribute to sustainable socio-economic development.

Better climate information for a better future

There will be four sub-themes in parallel sessions on:

Advancing climate prediction and information science
Climate risk management strategies and information needs
Climate impacts and adaptive strategies
Mainstreaming climate predictions and information services.

As the focus of the conference is on the integration of climate prediction and information in decision-making in relation to user needs, there will be parallel sessions for sectors that contribute to sustainable socio-economic development

such as agriculture and food security, energy, water, health, tourism, disaster management and transport.

Not just another climate conference

WCC-3 will establish an international framework to guide the development of climate services which will link science-based climate predictions and information with climate-risk management and adaptation to climate variability and change throughout the world.

Over the decades, WMO has enhanced capacities in meteorology, hydrology and related geosciences to provide services that enable humankind to cope with climate conditions. The enormous amount of data gathered and archived by WMO, together with its global data-processing and telecommunication systems, is a resource that can help significantly to develop climate services and products. These include accurate climate predictions and maps of, and return periods for, potential risks and opportunities concerning renewable energy sources, urban management and disease outbreaks.

Global, regional and national climate prediction centres have the skills to produce useful climate predictions and information. These skills, however, vary from region to region and country to country. The capacities of developing countries and Least Developed Countries need to be strengthened to enable them to produce accurate and useful products and services.

Climate provides societies with opportunities, as well as risks. The needs of different societies have to be well understood and integrated in the generation of products and services. Climate monitoring and prediction must be improved and appropriate policies developed. These requirements cannot be achieved by individual countries alone. The world is served by one climate system that redistributes heat, energy and other atmospheric and oceanic constituents; worldwide cooperation is therefore indispensable.

Adequate monitoring of the climate system enables timely detection of transboundary hazardous climate systems. The world must come together to improve climate prediction and information services that will significantly contribute to the United Nations Millennium Development Goals, the United Nations Framework Convention on Climate Change Bali Action Plan and the Hyogo Framework Action on disaster risk reduction.

WCC-3 will build on our resulting improved understanding of the climate system and advances in the science of climate prediction and information that can contribute to enhancing the well-being of society. It will focus on establishing services that enable decision-makers to better manage the climate opportunities and risks associated with extreme climate conditions and allow communities to improve their ability to adapt to long-term climate change.

WCC-3 will establish an international framework to develop climate services

which will bridge the gap between the assessment reports of the Intergovernmental Panel on Climate Change and the services required to adapt to climate variability and change at regional and sectoral levels.

WCC-3 is also expected to provide direction to address climate-related risks, such as droughts, floods, extreme cold, heat waves, famine and outbreaks of certain diseases, which, as well as threatening lives and livelihoods, affect health and the availability of essential needs such as food, water and energy.

Expected outcomes

The major expected outcome of the Conference is an international framework facilitating efforts to reduce the risks and realize the benefits associated with current and future climate conditions by incorporating climate prediction and information services into decision-making.

Other expected outcomes include:

Improved data-gathering networks and information management systems for both climate and climate-sensitive sectors; Improved integration of regional and national infrastructure for the effective delivery of climate information and predictions to national governments, agencies and the private sector; Strengthened scientific and technical capabilities to provide more credible and user-oriented climate information and predictions by reinforcing international, national and regional scientific mechanisms; Enhanced ability of governments, societies and institutions to access and use climate prediction and information. The outcomes of the Conference will complement work underway under the United Nations Framework Convention on Climate Change Bali Action Plan and the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters.

Caponi then presented some highlights of the *Expert Meeting on Water Manager Needs for Climate Information in Water Resources Planning* that was held 18-20 December 2006. Discussion followed about the need to improve monitoring and forecasting of meteorological and hydrological conditions. He noted that there is a difference between the data needs that a climatologist or hydrologist might need and what a water resource manager might need. For example, the need for more refined information about flooding in Mozambique was needed.

Cognitive Mapping Exercise

In this session, Hare introduced participants to the concept of “cognitive mapping.” This mapping exercise would help to identify what would be needed in the process to develop an interdisciplinary curriculum at a university. He posed the following questions for universities to consider:

- Why teach about climate and water affairs?
- What would be the teaching goals for this new course?
- Does it need to differ from traditional teaching methods?
- Who is(are) the target group(s)?
- What kinds of materials and support are needed?
- Are there professors to work with?
- What time period would be needed for a Climate Affairs course or program?
- How might multidisciplinary students be evaluated?
- What is the benefit to the university of this course?
- What formal actions are needed for its establishment?
- Whose permissions are required?

Following Hare's presentation, participants discussed the benefits, problems and prospects that might be associated with the development of such a program for students. Some participants expressed interest in climate and water affairs activities focused at the undergraduate level, while others favored the graduate school level. It was in part a question of when to educate students (and, therefore, their faculty) about climate and water issues: some educators felt that it would be important to establish the program earlier, while others indicated that entry into a climate and water affairs activity would require a basic level of knowledge prior to offering focused climate and water curricula. The participants then formed small groups to engage in more focused discussions on the above questions.

The cognitive mapping exercise resulted in the development of a group model based on the inputs suggested in the brief exercise by the participants from the universities of the Southeastern European region and other countries at the workshop. The model demonstrated to the participants a process that could be followed to demonstrate to university administrators how his/her university might approach developing a multidisciplinary Climate and Water Affairs activity, an activity could take the form of a course, a certificate program, a summer training session, a minor area of concentrated study or a degree program.

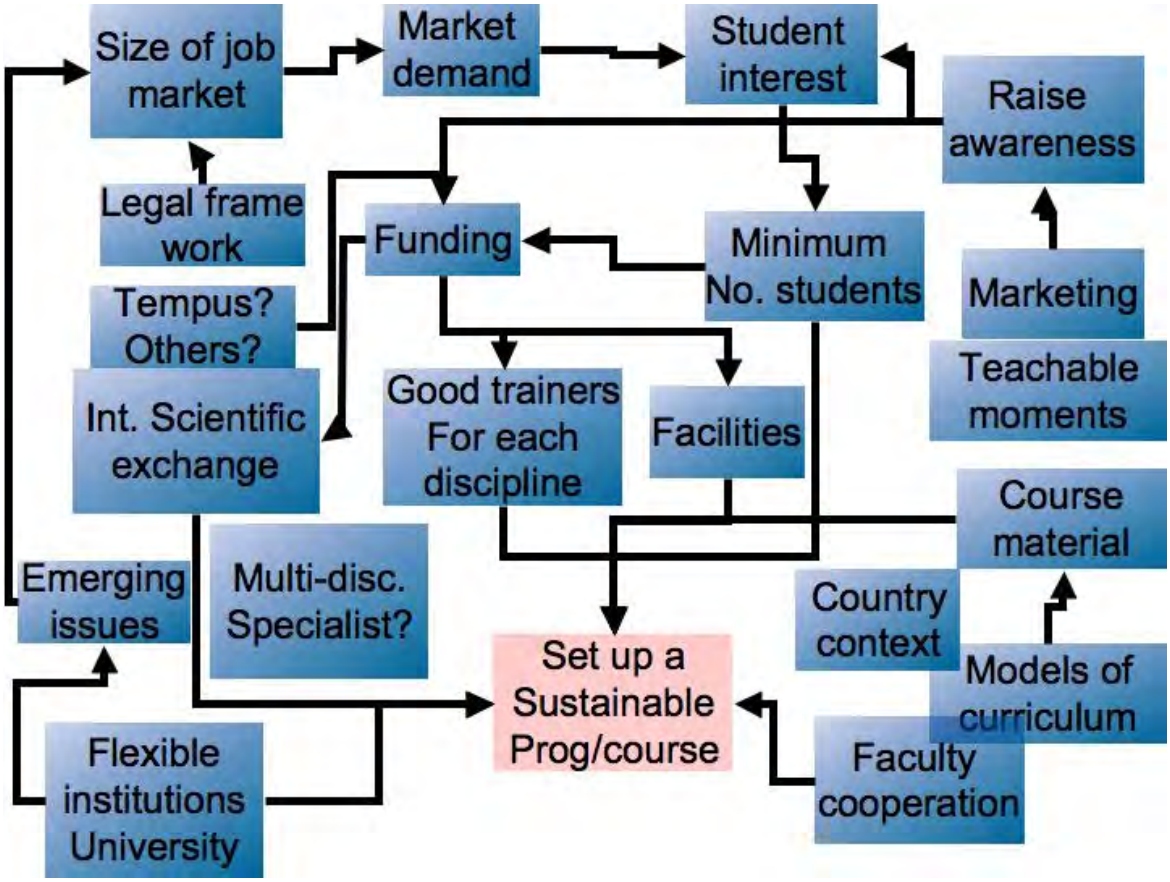


Chart compiled by Matt Hare based on participant input

Climate Change and Extremes

In this session, Glantz gave a presentation about climate change and its impacts on extreme events. Researchers in general, backed by the Intergovernmental Panel on Climate Change, Fourth Assessment Report (IPCC AR4) findings, believe that the frequency as well as the intensity and magnitude of climate, water and weather-related anomalies will increase as a result of the increased warming of the earth's atmosphere. Others suggest that we are to expect such extreme episodes every so often even under normal climate conditions. Climate varies from seasons to years and decades and centuries and so on.

Scientific uncertainties notwithstanding, scientific evidence suggests mounts supporting the view that stronger extremes are linked to a warmer atmosphere. However, whether these deadly extremes --- like Hurricane Katrina, Supercyclone Orissa, Supertyphoon Maeme, Cyclone Nargis --- are the result of natural variability or human-induced changes to the atmosphere's chemistry provides little comfort to the victims. In any case the "Precautionary Principle," as well as the historical hurricane record, needs to be taken into account. The Precautionary Principle, as noted by the World Lake Vision Committee is as follows:

> *Governments should not use the lack of full scientific information as a reason to postpone action to prevent serious irreversible environmental damage.*

It seems that, as each decade has progressed since the 1970s, we have witnessed some of the signs that scientists had been warning about that are related to the gradual warming of the Earth's atmosphere. For example, sea level continues to rise; 96 percent of the world's glaciers are receding; warm climate ecosystems are moving upslope to higher altitudes into previously cooler climates and latitudes; exotic species and disease vectors are appearing in new locations poleward, adjusting to warmer winters and hotter summers. Droughts seem to be recurring with greater frequency and intensity in some drought-prone locations, and floods seem to be doing the same in flood-prone locations. Even more alarming is the fact that Arctic sea ice has been disappearing at an increased rate and is now at its smallest surface area in a century. The disappearance is highly visible from satellites and suggests that the impacts of climate change on ecosystems may also be accelerating and that the computer-generated scenarios for 2050 could appear in reality as early as 2020. In other words, 2020 may be the new 2050 as far as the realization of climate change scenarios go, and 2050 may prove to be the new 2100.

Many environmental changes are taking place earlier than expected, at rates faster than expected, and in places where they were often unexpected. We are starting to see stronger storms, some of which are called "superstorms." In fact we are even witnessing the possible development of "seasons of superstorms." A most recent geophysical event (not weather-related) was the 26 December 2004 killer tsunami in the Indian Ocean when hundreds of thousands perished. Another was Hurricane Mitch in late 1998 (over 17,000 dead). Yet another was the 1999 Supercyclone in Orissa, India

(20,000 dead). Supertyphoon Maemi hit South Korea in 2003. There seems to be an increase in the number of blockbuster, record-setting, killer natural disasters since the late 1980s: tropical storms, winter storms, wildfires, and the biggest most damaging El Niño events of the century in 1982-83 and in 1997-98, and so on.

While a lot of the computer model-based climate change scenarios yield foreseeable consequences of global warming out to the year 2050, 2070, or even 2100, we are already witnessing some of what scientists expect to take place in the distant future taking place now in different parts of the globe. Coral reefs are dying worldwide. Permafrost is melting. Each year seems to be ranked in the hottest ten on record. Tropical storms in the Atlantic and Pacific are increasing in frequency and intensity, and so forth. These are changes that have already been suggested verbally as well as in print for a couple of decades. They are no longer speculative changes. They are real.

Compounding physical and biological changes that are accompanying global warming (all observers admit that the climate has warmed in the 1900s by about 0.7 deg C) are demographic changes, such as in population growth and migration, land transformation and other land use patterns, heightened exploitation of a wide range of natural resources, and increases in water and food shortages in many parts of the globe. In addition, there is a movement of populations worldwide toward coastal areas, areas that are increasingly going to be at risk to tropical storms, storm surges and sea level rise.

Large computer models have produced several climate change scenarios for the year 2050. They are suggestive and illustrative, but not definitive. Researchers on social issues are then expected to determine how best society might prepare for and react to such an eventuality. In this regard, improvements in the way we deal with contemporary hazards and disasters can help to prepare future generations. One way to assess society's ability to cope with extreme anomalies in the future is to assess how they have been coping with contemporary anomalies. The truth is that most anomalies of climate, water and weather can serve as teachable moments to decision makers at all levels of society, both within and outside of government.

Hurricane Katrina as a Teachable Moment

Hurricane Katrina in late August 2005 slammed into the Gulf of Mexico's coasts of Louisiana, Mississippi and Alabama and exposed just how vulnerable all societies are, regardless of level of technological development. No society has as yet managed to climate-proof its territory from the vagaries of climate, water and weather events … and not just extremes.

All of America (and the world in fact) watched helplessly as victims in the disaster zone, especially those highlighted in the city of New Orleans, were pleading for help from anyone --- and for several days. government help did not arrive in a timely way and was blamed for unnecessary death, destruction and misery. Hurricane victims were trapped on rooftops, inside hospitals, inside convention centers and football fields. They begged

for bottled water, food, baby formula, diapers, toilets as well as for a helicopter to come and rescue them, and so on. The damage from this hurricane, estimated at upwards of $250 billion US, is now considered the costliest “so-called” natural disaster in at least 100 years; some have said in the history of the United States.

This anomaly, like others, identified several lessons that governments as well as organizations and individuals could implement to lessen the adverse impacts of future hurricanes. For example, (1) Katrina showed that even with a perfect forecast, as was the one for Katrina [60 hours in advance of landfall], there could be widespread destruction and deadly impacts. (2) Early warning systems must include more than just a warning but also a viable response mechanism. Students who are attracted to stories about the social and economic impacts of a hurricane can then be taught how hurricanes form, pick up speed and intensity and can shift directions. These are just some aspects of Hurricane Katrina serving as a teachable moment.

Participants were asked to identify the extreme events of concern that occur in their country (or region). They were then asked to consider how a 2 deg C warming might affect the timing intensity, magnitude and even location of those events.

Presentation on Existing Curricula

Hare provided resource information about existing curricula available on the Internet. He referred to a model, involving 32 different universities across Europe, Africa, and Central Asia, that had been developed for course curricula.

> *Adaptive water management (AWM) is a structured process for improving systemic management policies and practices by learning from the outcomes of implemented management strategies and by taking into account changes in external factors. By doing so, it explicitly recognizes uncertainty.*[*]

Hare explained that AWM refers to how one might act, while facing major uncertainties. He also explained the following sites:

- the NeWater curriculum <http://www.newatereducation.nl>
- the WISE-rtd curriculum <http://www.wise-rtd.info>

[*] Source: Pahl-Wostl, C., P. Kabat, and J. Moltgen (eds.), *Adaptive and Integrated Water Management: Coping with Complexity and Uncertainty*, Springer-Verlag, 75-96, and Pahl-Wostl, C., forthcoming: *Adaptive Management in the Context of Integrated Water Management*. NeWater curriculum, Ver. 2.0, NeWater online curriculum on Adaptive River Basin Management. http://watereducation.gwsp.org/ NeWater Project Contract No. 511179 GOCE.

- the UN-Water curriculum <http://ocw.unu.edu>

The NeWater Curriculum allows anyone to change his/her system from Water Management to Adaptive Water Management (AWM), and AWM can be altered, adapted and used. In the event of its use it must be cited and acknowledged.

Hare noted that universities have a responsibility to assure that students not only think sustainably, but act sustainably as well. Information that can help students and faculty alike to change attitudes and, therefore, to change behavior is essential in order to get information to stakeholders.

Discussion followed about the fact that the information should not be used blindly and without consideration of the quality of the materials. One needs to be prudent to check the validity of information with other colleagues before incorporating it into a curriculum. It is important to keep in mind that the Internet is a proverbial “gold mine”, when properly used. However, it can also be a minefield to those unfamiliar with how to determine the quality of information downloaded from the Internet.

Problems associated with language and translations were discussed. Those for whom English is a first language may not fully understand the problems associated with translation. Once text has been translated from English into another language, it often does not convey the thoughts that were intended. This is a valid concern with regard to translation from one language into another, including simultaneous and universal translation. So, it is very important to assure that what is taught to students and faculty in their native language (especially new concepts) has been correctly interpreted from another language.

Terminology: Adaptation, Mitigation, Prevention

Discussion then shifted to some key terms used in the scientific impacts literature that relate to coping with global warming. The two dominant strategies are as follows:

- *Adaptation* [proactive and reactive responses to the societal and ecological impacts of climate change].
- *Mitigation* [attempts to reduce greenhouse gas emissions]

The UN Framework Convention for Climate Change (UNFCCC) defines adaptation as impacts clearly related to global warming and not to either climate variability or climate and weather extremes. For its work, however, the IPCC (Intergovernmental Panel on Climate Change) defines adaptation broadly to include impacts of climate, whether natural or human-induced.

Adaptation can also be used to represent a pro-active (as opposed to reactive) response to a stimulus. It means that actions can be taken by society to avoid a worst-case outcome, once an impact of global warming has been deemed foreseeable.

Foreseeability is a notion that in essence is a qualitative expression of probability. While meteorological or hydrological hazards cannot be avoided, the severity of their impacts might be softened, if not avoided altogether, with proper planning.

The Netherlands provides an example of actions that have been taken based on foreseeability. Political leaders have provided considerable funds to develop plans to live with the water. For centuries they have relied on dikes and dams to reclaim land from the sea as a significant portion of the country is near, at or below sea level. Planners are designing a settlement --- "hydropole" --- that can live on the water. They are also planning to give land back to the river and to the sea by moving out of floodplains. With significant sea level rise expected in this century, they are seeking to remove people from global-warming-related harm's way.

Because various academic, research and policy communities use the terms "adaptation" and "mitigation" in ways that conveys different, sometimes conflicting, ideas, it is necessary that their intended meanings be made explicit for the sake of clarity.

Glantz also suggested that "prevention," once seen as an important strategic response to climate change causes, should again be considered in its own right as a prominent response to global warming and not buried within the term "adaptation" because any actions that might be taken than can reduce greenhouse gas emission should be viewed as preventive of additional harm to the atmosphere.

Resilient Adaptation

Glantz introduced the notion of "resilient adaptation." He began by noting that all societies are vulnerable to climate, water and weather perturbations, and many are vulnerable to relatively low level perturbations not just the most extreme events. The ability for a society to withstand or at least reduce the impacts of such perturbations depends on their socioeconomic, political and cultural conditions at the point of time of the climate- or water-related shock. In addition, not all societies are in a socio-economic or political condition that allows them to rebound quickly from the impacts of a climate, water or weather extreme.

The notion of "resilient adaptation" is borrowed from the field of psychotherapy. In psychotherapy, it is designed to assist individuals during their formative years to engage in social activities that foster ability to better cope with personal as well as social change. In the context of environmental change in general, and climate and water change in particular, it can be used to improve societal responses to climate change. For example, when applied to the climate change issue, resilient adaptation draws on the strengths of each of the concepts – resilience and adaptation. The former is focused on the more distant future, while the latter is focused on the near term.

Resilient adaptation can help societies as well as individuals (perhaps even civilizations) to face more effectively an uncertain climate future. Such climate change will also be accompanied by changes in variability from season-to-season, year-to-year and decade-to-decade, as well as by changes in the intensity, duration and location of climate-related extremes. As adaptation strategies and tactics are increasingly proposed to cope with a warming atmosphere, it is not only necessary but it is imperative that those measures be evaluated not only for their near-term benefits, but for their longer-term implications as well.

Resilient adaptation complements the concept of the Precautionary Principle (mentioned earlier) that, if followed, serves as an early warning about how to proceed in the face of potential unknown environmental changes and impacts that might take place as a result of human activities. It is yet another way to remind planners about the Pecautionary Principle. Planners need to consider the downstream ramifications of the impacts of their plans to cope with a changing climate. The most widely used description of the Precautionary Principle is found in Article 15 of the Rio declaration of 1992:

> *In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*

Geo-Engineering and the Climate System

Glantz identified a number of geo-engineering schemes that have either been proposed or have actually been undertaken in order to overcome the limitations imposed either by the climate system or by other aspects of the natural environment. Climate has been changed by human activities at the local level (e.g., the urban heat island effect) and at the regional level (as a result of tropical deforestation or desertification). Today, humans are influencing climate at the global level.

Some types of climate modification have been inadvertent; that is, they have resulted in unintended consequences of actions unrelated to deliberate attempts to influence or change atmospheric processes. Other modification schemes are advertent, meaning that they are planned in order to achieve a specific goal, such as cloud seeding or snow pack augmentation in mountainous regions or, with regard to climate change, the widespread planting of trees to take carbon out of the atmosphere.

Throughout history and up to the present, one can identify three general views about societal interactions with nature: (1) society in harmony with nature; (2) society subordinate to nature; and (3) society dominating nature. The latter perspective --- dominating nature --- is ever-present, as can be seen from the growing list of suggestions to alter climate, water and weather processes that can affect human

activities positively or negatively. Examples of attempts to dominate nature include the following: diverting the flow of northward-flowing Siberian rivers toward the deserts in Central Asia, eliminating Arctic sea ice, damming semi-enclosed seas (Bering Sea, the Gulf of Mexico, the Mediterranean Sea at Gibraltar), attempts to modify hurricane intensity or to steer hurricanes away from continental coastlines ("Project Stormfury"), "blacktopping arid coastlines" (using asphalt strips along coastal deserts), towing icebergs from the Antarctic to coastal arid areas, and so forth. These schemes have been proposed since the late 1800s and they likely work in theory. A few have been put into practice. Today, scientists are proposing geo-engineering schemes that they themselves had previously ridiculed or dismissed as folly. But, concern about a greenhouse effect that is out of control is a dread factor that scientists wish to avoid.

After Kellogg, W.W. and S.H. Schneider, 1974: Climate stabilization: For better or worse? *Science*, **186**(4170), 1163-1172.

Another example of a potential geo-engineering attempt at adaptation to climate change at the global level is the call by high-ranking scientists, including a Nobel Laureate, to inject into the stratosphere, high above the earth's surface, sulphur dioxide in an attempt to mimic the impacts on the stratosphere of an volcanic eruption in order to cool down the Earth's atmosphere for several years. The purpose of injecting sulphur dioxide is to reflect the sun's rays back into space. This process would have to be repeated. However, recent studies have suggested that such an attempt to geo-engineer the global climate system could result in an unintended consequence : the continued thinning of the so-called Antarctic ozone layer.

With specific regard to climate change, many technological fixes are offered to correct human-induced environmental insults to the atmosphere, e.g., to climate, water and weather systems. However, the only way to truly "fix" the human contribution to the global warming problem is to address the central cause(s), and that requires reducing sharply, and soon, GHG (greenhouse gas) emissions. All other proposals to arrest global warming are uncertain in their outcomes, and most likely would be extremely costly. In addition, several of the proposed technological fixes provide temporary solutions only to a much more profound and longer-lasting environmental change.

SWOC Exercise (for developing a university Climate and Water Affairs activity)

As noted in an FAO training paper,
(http://www.foodsec.org/DL/course/shortcourseF2/en/pdf/trainerresources/annex0206_01.pdf)

> *One useful tool for synthesizing the evidence gathered and drawing out recommendations is to conduct a SWOC analysis. The purpose of a SWOC analysis is to identify the main **S**trengths, **W**eaknesses, **O**pportunities and **C**onstraints that characterize a particular situation or entity. SWOC analysis is often used as a management tool…. This will enable you to organize, summarize and even prioritize the wealth of information you have gathered through answering the questions in the assessment process. The SWOC approach essentially looks at internal and external processes to detect the positive and negative factors that impact on the total outcome.*

In order to introduce participants to a SWOC assessment (Strengths, Weaknesses, Opportunities, and Constraints), and apply it to Climate and Water Affairs participants were clustered into groups to identify the different aspects of a SWOC in a preliminary exercise, as they applied to the possibility of undertaking Climate and Water Affairs-like programs from the perspective of their specific university or training program.

This was also done for a previous workshop. The results of the following small group discussions are for illustrative purposes only. They can be compared to the SWOC assessment done for similar purposes at the previous climate-related workshop held in Bangkok. (http://ccb.colorado.edu/apn/report/swoc.php)

Strengths

Improved sector expertise, cooperation & lifestyle
Inter-disciplinary approach supported
Good capacities in present institutions
Good awareness of environment in country
Develop awareness of extremes
Internationalisation / international interest
Make use of experiences/material of established courses
Improving well-being of future generations

Now is a good teachable moment
Having human resources/staff
Existing lecturers
Legal framework existing
Existing departments on environments
Possibility to move on to PhD studies
Existing infrastructure
Possibility to initiate new public policy
Cooperation between universities & faculties (all levels)
Identifying a balance between theoretical and practical
High interest in environment
Good job opportunities for this interdiscipline
Existing International university partnerships supporting curriculum
Strong levels in natural science – already 1 curricula MSc

Weaknesses

Lack of experience in interdisciplinarity
Lack of labs, data and equipment
Sustainability of courses? Lack of identifiable long-term support
Lack of student motivation
Lack of market demand
Financial situation of university
Too broad a subject?
Approval limited by not being a recognised specialised job
Low implementation of env. Action plans in country
Low level of communication between institutions
Lack of literature on new methods (in all languages)
Lack of experienced profs & international exchange
Lack of online support
Not good relations with government

Opportunities

To raise awareness generally
Knowledge dissemination
Model (first) approach to be used by others
Participation in international projects
Possibility of graduates to work in international organizations
Cooperation between universities & faculties (all levels)
Teachable moment is now!
International GO support
Increasing interest of media
Lisbon treaty on climate change
Raise international funds due to need of subject
To increase level of research capacity in fields
Mainstreaming global env issues in other disciplines

Internationalisation of students and teachers
Student mobility
Strengthen sharing across disciplines
Knowledge coming from this course

Constraints

Finances for:
- Lecturers
- Students
- Library, data (old libraries, labs)
- HR development
- Institutional development

Lack of incentivising regulation
Bureaucracy (university & government)
Interest of decision makers (or lack thereof)
Market demand
Mentality – values of society (fear of no jobs available)
Competition with other courses in university
Low awareness of necessity of prog (university level)
Low level of cooperation within university & others
Ministries are difficult to communicate with
Low capacity at systemic level -- bureaucratic inertia
Reaching a critical mass of people trained in a Uni/country
Sensitivity of public awareness

The results of the SWOC analysis, together with knowledge about Climate and Water Affairs course content, the group model, and discussions throughout the week, enabled the participants to then sketch out and discuss the type of course that they could conceive of developing in their universities. The majority of the latter focused on postgraduate programs. Hare concluded by highlighting some of the major capacity development needs associated with interdisciplinary curriculum development in the higher education sector, as referred to by the participants:

- Workshops for decision makers, in order to raise awareness about climate and water affairs so that there are policies created that increase the size of the job market requiring interdisciplinary applicants;
- An exchange pool of lecturers as a temporary measure to make sure that universities have access to lecturers who can teach particular disciplines adequately to students of other disciplines;
- Training of trainers courses, a long-term measure to develop the skills base of lecturers within the universities in interdisciplinary teaching;
- Development of knowledge bases on teaching materials, including models of successful interdisciplinary courses; and
- Institutional and financial support for the sharing of courses between universities.

WMO Climate and Water Department and Water Resources

Caponi reminded the participants that although the WMO in engaged in international exchanges among countries, it only provides advice to countries when advice is requested.

In general terms, according to the WMO, a “Hydrological Service” is defined as an institution whose business is information about the water cycle (the hydrological cycle) and which may provide services relating to such information. The business may or may not be a profit-making business, but it implies that managers of Hydrological Services should (1) recognize that their primary reason for existence is to serve their many clients; (2) adopt or develop administrative, management and leadership practices to produce the best possible results in terms of efficiency, effectiveness and responsiveness; and (3) ensure that the assets of the Hydrological Service are not depreciating and that its prospects for future business are expanding rather than contracting.

Caponi also referred to the objectives of the WMO's Hydrology and Water Resources Program, 2000–2009:

(1) To apply hydrology to meet the needs for sustainable development and use of water and related resources;

(2) To mitigate water-related disasters; and

(3) To ensure effective environmental management at national and international levels.

The program is implemented through five mutually supporting components:

- Basic Systems in Hydrology
- Forecasting and Applications in Hydrology
- Sustainable Development of Water Resources
- Capacity Building in Hydrology and Water Resources
- Water Related Issues

In this context, the Climate & Water Affairs workshop is designed to assist educators to become better managers and to be successful at demonstrating to high-level managers that their activities continue to be of major importance to societal well being.

Caponi then discussed the socioeconomic benefits as a result of these activities of national hydrological services. Hydrological products have no intrinsic value in an economic sense, but acquire value by influencing behavior of users whose activities are influenced by water quantity, quality, timing and access. The societal and individual benefits of increased hydrological information are the increases in the economic efficiency of the decisions taken with that information (as opposed to the ones taken

without it). One problem is that the benefits aspect is often more difficult to evaluate than the costs aspect.

Value of data can be defined as the difference of benefits from a project resulting from decisions made and actions taken with and without the data. This concept is generally applicable but difficult to apply. A prescriptive approach assumes that users behave in a manner consistent with prescribed principles, and generally involves the use of formal models for decision-making. Descriptive approach attempts to describe the actual behavior of users, and may or may not involve the use of formal models. Forecast decision systems can be classified according to deterministic vs. probabilistic forecast, single objective vs. multi-objective decisions, monetary vs. non-monetary objectives, static decision vs. dynamic decision problems, and optimal vs. non-optimal decision procedures.

Caponi also informed participants that the WMO had convened several conferences to address specifically the use and value of meteorological and hydrological information for governments, societies, corporations, groups and individuals. For example, in September 2005 the WMO organized in Geneva an Experts Meeting on “The Economic Value of the Hydrologic Information and Services provided by NHSs”. In addition, the preparation of a set of Guidelines on the Economic Valuation of Hydrological Services is under preparation.

Another Experts Meeting on “The Needs of Water Managers for Climate Information in Water Resources Planning” was held in December 2006 in Geneva. The results of these expert meetings could serve to form the basis for the integration of climate information into water resources planning and management.

Caponi also informed participants about the WMO's International Conference on “Secure and Sustainable Living: Social and Economic Benefits of Weather, Climate and Water Services” that was held in Madrid, Spain, 19–23 March 2007. The Conference provided an important occasion for representatives of various sectors of society to describe how the environment impacts them; how weather, climate and water information helps them make decisions and reduce risks; and to outline what changes are needed to improve decision-making.

Summary

Several concepts were presented toward the end of the workshop. They are noted as follows:

Social inventions: These are concepts or images that tend to energize the public and or policy makers to change their behavior and way of thinking about how people and societies on the planet chose to exploit or conserve their finite resources. Global change, for example, is a social invention. It has led to the reorganization of university curricula on various campuses. The thinning of the ozone layer over Antarctica was

labeled as the ozone hole, another social invention. The point is that new technologies are not the only things that can change human behavior: techniques or the way people do things can also change human behavior.

Ordinary knowledge: Charles Lindblom (author of the concept “muddling through”) believed that most decision makers based their decisions on what he termed “ordinary knowledge” and not necessarily on the knowledge they happened to acquired in the classroom.

Improvization is the engine of resilience: In the face of uncertainties decision makers are often forced to choices in a crisis mode. Some authors argue that “improvisation” Is the result of interpretation of a situation and the need to take action. Aspects of improvisation include a sense of awareness and considerable flexibility.

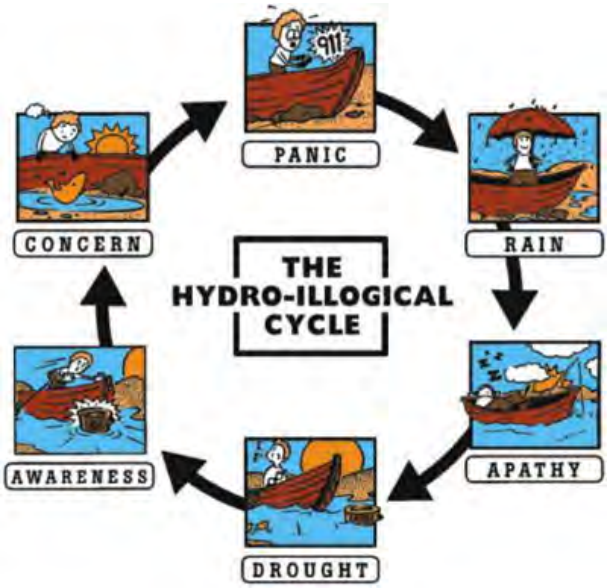
Changing climate: Today, global warming is usually referred to as climate change. This is a polarizing concept that prompts some of the doubters about global warming to oppose any actions that might seek to mitigate the impacts of a warmer Earth. It also suggests that climate change is an event. Another way to phrase this is to refer to a changing climate. No one denies that the climate is constantly changing. A changing climate is less polarizing and suggests that a changing climate is a process.

Climate-proofing: This concept is increasingly being used in attempts to protect societies from the adverse impacts of climate extremes and now climate change. It is a controversial concept in that, while it is highly unlikely that any society will be able to protect itself from the vagaries of climate, it is also misleading to the public, which is led to believe they can be protected from climate variations, extremes and change.

Creeping environmental changes: Most of the environmental changes in which humans are involved are of the slow onset, incremental and cumulative kind. Today’s soil erosion (or air pollution, or CO2 emissions, or tropical deforestation or changes in water quality) is not much different than yesterday’s and tomorrow’s not much worse than today’s. They are not of interest to policy makers until they have reached a crisis or crossed a threshold of change. However, once those incremental changes have turned into a crisis that policymakers are forced to pay attention.

The language factor: The words that are used to describe new concepts or processes do not often translate well or directly from English into other languages. For example, the word “adaptation” may translate differently into other languages because even in the English language and moreso even within the same academic field adaptation applied to climate change is not a precise term. To the UNFCCC (UN Framework Convention on Climate Change) adaptation refers to responses impacts in environment that can be directly attributed to or associated with global warming. To the IPCC, however, adaptation refers to responses to impacts regardless of cause. Thus, there is a hidden problem that few people think about, especially at international meetings (though it is also a problem at national ones as well). Much more attention needs to be paid to the cross-culture sharing of concepts to assure that their true meaning is well understood.

Hydro-illogical cycle: This concept is best explained with the following graph of this cycle.



Credit: National Drought Mitigation Center

"War on Climate": Societies, since the beginning of their existence, have been in a conflict situation with a variable and changing local to global climate regimes. Over time societies have adjusted their activities to cope with climate conditions, averages and extremes of temperature and precipitation. However, the climate is always changing and is not stationary. That means that societies constantly have to stay vigilant (hence the need for early warning systems) in order to anticipate and to cope with foreseeable as well as surprising changes that might occur. A profound global warming and its impacts on societies and on ecosystems on which they depend present a formidable "opponent" to policy makers as they seek to protect their citizenry from climate, water and weather related harm of a truly surprising nature.

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AGENDA

Monday, 20 April

9:00 - 9:45 am:	Opening ceremony
9:45 - 10:30:	Introduction to the Prototype Training Course on Climate and Water Affairs
10:30 - 11:00:	BREAK
11:00 - 11:30:	Roundtable introduction of participants
11:30 - 12:15 pm:	Why Climate and Water Affairs? Why Now?
12:15 - 2:15:	LUNCH
2:15 - 3:15:	Climate and Water Science
3:15 - 3:45:	BREAK
3:45 - 4:45:	Climate and Water Impacts on Ecosystems: Millennium Ecosystem Assessment (Ecosystems goods and services for human well-being)
4:45 - 5:45:	Climate and Water Impacts on Society
5:45 - 6:00:	Outline of participant activities throughout the workshop

Tuesday, 21 April

9:00 - 10:00 am:	Problem Climates and Problem Societies: Commoner's "4 Laws of Ecology"
10:00 - 11:00:	Climate and Water Politics, Policy and Law, National and International
11:00 - 11:30:	BREAK
11:30 - 12:30 pm:	Climate and Water Economics
12:30 - 1:45:	LUNCH
1:45 - 2:45	Climate and Water : Ethics and Equity
2:45 - 3:30:	The Role that Climate and Water Affairs Might Have on Curricula Development
3:30 - 4:00:	BREAK
4:00 - 5:00	The Role that Climate and Water Affairs (cont.)

Open discussion

Wednesday, 22 April

*Session: Variability and Extremes Case Studies (9:00 - 11:00 am)

9:00 - 10:00:	Impacts I: Too Much Water - Floods
10:00 - 11:00:	Impacts II: Too Little Water - Low Rainfall Areas; Droughts and Dry Spells
11:00 - 11:30:	BREAK

*Session: Climate Change (11:30 am - 5:15 pm)

11:30 - 12:15 pm:	Water and Climate Change: Extreme Events, Changes in Rainfall,

	Rates of Glacier Melt, Changes in Seasonality
12:15 - 2:15:	LUNCH
2:15 - 4:00: `	UNW-DPC: Adaptation to Climate Change in the Water Sector and Adaptive Management for Long-term Risk Management
4:00 - 4:30:	BREAK
4:30 - 5:15:	Geo-engineering for Climate and Water Resources

Thursday, 23 April

9:00 - 9:45 am:	Resilient Adaptation
9:45 - 10:30:	Climate and Water Resources and Sustainable Use and Development of those Resources
10:30 - 11:00:	The WMO & UN Water Activities in Climate and Water
11:00 - 11:30:	BREAK
11:30 - 12:15 pm:	Socioeconomic Benefits of Climate and Water Services: In Theory and in Practice
12:15 - 2:15:	LUNCH
2:15 - 5:15:	Approaches to Curricula Development for Climate and Water Affairs: A SWOC Review. (Coffee break at will)

Friday, 24 April

9:00 - 11:00 am:	Review of the Climate and Water Affairs Approach to Training
11:15 - 12:15 pm:	NEXT STEPS
12:15pm – 2:00:	LUNCH

Adjourn