Opening Ceremony

Climate Variability and Change and their Health Effects in the Caribbean: Information for Adaptation Planning in the Health Sector

MASTER OF CEREMONY

Ms. Clare Forrester

Media/Communications Advisor, Office of Caribbean Program Coordination (CPC), Pan American Health Organization (PAHO) / World Health Organization (WHO)

HEAD TABLE

The Hon. Elizabeth Thompson

Minister of Physical Development and Environment, Barbados

Senator the Hon. Jerome Walcott

Minister of Health, Barbados

Mrs. Veta Brown

Caribbean Program Coordinator, PAHO/WHO

Dr. Carlos Corvalán

Department of Protection of the Human Environment, WHO, presenting on behalf of WHO and the Interagency Network on Climate and Human Health

Mr. Vincent Sweeney

Executive Director, Caribbean Environmental Health Institute (CEHI)

Opening Ceremony Addresses

MRS. VETA BROWN

Mrs. Brown welcomed participants on behalf of PAHO with special mention of appreciation from the Director of PAHO/WHO, Dr. George Alleyne. Mrs. Brown stressed the importance of the conference in providing a forum for the sharing of information on adaptation to global climate change. Mrs. Brown emphasized the concern of Dr. Alleyne regarding the state of preparedness systems in the region for dealing with the impacts of climate change. She said that this was especially paramount noting the disparity in the well-being of peoples in poor and rich nations. She expressed particular concern for the territories of Latin America and the Caribbean. Mrs. Brown noted that, in these regions, health care systems are already stressed with the incidence of hypertension, diabetes, cancer, and Human Immunodeficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS). It was stated that a hint of the impact that climate change may have on health system capacity is evident in the increased occurrence of vector-borne diseases, such as dengue fever.

Other signs of the impact of climate change, Mrs. Brown noted, include the fish kills experienced throughout the Caribbean region, which have been linked to increased microbial activity resulting from increased sea surface temperatures. In addition, Mrs. Brown noted, the region is vulnerable to

- flooding;
- fresh water contamination;
- contamination of aquifers by influx of sea water due to increase in sea levels; and
- impact on sustainable development and social development infrastructure.

She opined that non-action would have disastrous effects and further stated that it is imperative that all regional stakeholders, including PAHO, regional governments, and non-governmental organizations (NGOs), be involved in strategic planning and implementation of preparedness programs for adaptation to climate change.

SENATOR THE HON. JEROME WALCOTT

Minister Walcott extended a welcome to all participants and congratulated PAHO on its initiative in the organization of the conference. He felt that the importance of the conference to the region was indicated by the overwhelming response by governments and NGOs. He expected health and environmental planners to gain from the exchange of information as outlined by the objectives of the conference. Minister Walcott stressed that the concerns of Small Island Developing States (SIDS) regarding climate change and the impact on health include

- impact on children, elderly and the poor;
- rise in sea level;
- depletion of fish stocks;
- impact on agriculture;
- floods and drought;
- population displacement; and
- an increase in the incidence of vector-borne diseases.

Recognition was given to the contribution of greenhouse gases to climate change. Also of concern, as expressed by Minister Walcott, was the increased exposure to ultraviolet radiation (UV) resulting from the depletion of the ozone layer by chlorofluorocarbons. Minister Walcott commended regional organizations such as CEHI for their role in educating the region and initiating preparedness programs for climate change. The need for cooperation between the private and public sectors in related initiatives was also emphasized.

DR. CARLOS CORVALÁN

Dr. Corvalán acknowledged the partnership of WHO, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in the collaborative work on the impact of climate change on human health. He began by addressing why and how much the current knowledge on climate change should be of concern to the health sector. He stated that predicted trends in climate change could lead to a suppression of the well-being of regional populations. Known facts are signals to be concerned about: 1998 was the warmest year ever recorded and the 1990's the warmest decade on record. In addition, patterns suggested that El Niño occurrences have been more frequent and persistent than in the previous 100 years. Dr. Corvalán added that this trend is expected to impact on the severity of weather systems and ultimately could lead to human health impacts resulting from flooding, damage to sewerage systems, contamination of ground water, impact on food production, and the alteration in the distribution of some disease vectors.

He then described the role of the Interagency Network on Climate and Human Health, which is a formal recognition of the partnership between WHO, UNEP and WMO in addressing climate change and health issues in the past decade. The work of the Network focuses on three areas: information exchange, capacity building, and research promotion. In this context, the Network works towards the achievement of local, national, and global preparedness for climate change. Dr. Corvalán informed participants of the publication of the text on Climate Change and Human Health: Risks and Responses that will be available in 2003. He then thanked the co-organizers of the conference.

THE HON. ELIZABETH THOMPSON

Minister Thompson gave the feature address in which she acknowledged the nexus of health, environment, and development. She stressed the need for focus to be given to response systems and services, and added that programs must be effective in promoting behavioral change. She noted that some of the expected impacts, as informed by the Caribbean Planning for Adaptation to Global Climate Change (CPACC) project, include

- 8-15 % loss of coastal land;
- denuding of coastal marine habitats, including sea grasses and coral reefs and the loss of associated marine species;
- an increase in the salinity of water used for irrigation and impact on agriculture; and
- an increase in events of algal blooms.

Minister Thompson stated that research continues to unearth health risk factors. An example was offered in which links between the increase in the incidence of asthma and a number of factors were indicated in the results of a research project supervised by research scientists and health professionals in Barbados. The supervisors of the project were Professor L. Moseley of the University of the West Indies (UWI), Cave Hill Campus; Dr. R. Naidu of the Queen Elizabeth Hospital; and Mr. C. Depradine of the Barbados Meteorological Office. The factors identified included variations in wind speed, atmospheric Saharan dust concentration, and variation in temperature.

Minister Thompson expressed increasing concern about sea level rise and population displacement giving rise to a generation of environmental refugees. Increasing exposure to UV due to damage to the ozone layer was

also raised as an issue of concern with particular impact in the Southern Hemisphere. She highlighted the situations in Argentina and Australia where real effects were being experienced in the increase in occurrence of eye disease in animals and skin cancer in humans, respectively.

Minister Thompson stressed that it is important for SIDS to assess the socio-economic implications of climate change for human health and well-being. This, she stated, requires inter-sectoral collaboration in the common goal of sustaining national development. Ultimately, protection of social capital was said to be paramount. Minister Thompson informed participants that the Barbados Government was committed to this effort and is prepared to inject in excess of 100 million dollars (U.S.) in various sectors.

MR. VINCENT SWEENEY

Mr. Sweeney of CEHI gave the closing remarks. Mr. Sweeney thanked the Minister of Health, Senator the Hon. Jerome Walcott, and the Minister of Physical Development and Environment, the Hon. Elizabeth Thompson, and the Government of Barbados for the support given to the organizers of the conference. He also extended appreciation to the organizers PAHO, WHO, WMO and UNEP for the timeliness of the initiative. The assistance offered by the Caribbean Epidemiology Centre (CAREC), the Caribbean Conservation Association (CCA), UWI and CEHI in the planning stages was also acknowledged. The students of St. Martins Mangrove Primary School were also commended for their cultural presentation and warm welcome to the participants. Finally, appreciation was extended to participants for their involvement, which he assured would prove to be invaluable to the outcome of the conference.

Conference Proceedings

Climate Variability and Change and their Health Effects in the Caribbean: Information for Adaptation Planning in the Health Sector

Keynote Speakers

CONFERENCE CHAIR AND MODERATOR
Dr. Ulric O'D. Trotz
CPACC/Adapting to Climate Change in the Caribbean (ACCC), UWI Centre for Environment and Development (UWICED), Cave Hill Campus, Barbados

ULRIC O'D. TROTZ

Dr. Trotz welcomed the two keynote speakers:

- His Excellency Tuiloma Neroni Slade, Ambassador of Samoa to the United Nations, Chairman of the Alliance of Small Island States (AOSIS), and
- Professor Tony McMichael, Director of the National Centre for Epidemiology and Population Health, Australian National University.

Dr. Trotz recognized the involvement of the Government of Barbados in facilitating the conference. He expressed great appreciation for the support extended, at the highest political level, for the mandate of CPACC.

Dr. Trotz stressed that the need for inter-sectoral collaboration would be a focus of the conference. He also anticipated that the keynote speakers would provide a springboard for the proceedings in their addresses.

HIS EXCELLENCY TUILOMA NERONI SLADE
Climate Change and Health, and the Sustainable Development of Small Island Developing States -- the Perspective of the Alliance of Small Island States

Ambassador Slade commended PAHO and WHO on the propitious organization of the conference as it relates to the upcoming summit in South Africa during which the agenda of the United Nations Conference on Environment and Development will be subjected to a ten-year review. He anticipated that the outcome of the conference would offer challenging points for discussion as it feeds into the 2002 Earth Summit. His Excellency acknowledged that the Programme of Action signed in Bridgetown, Barbados at the (1994) Conference on SIDS was catalytic in spurring global action. He praised the Barbados Programme of Action (BPOA) for highlighting the special concerns of SIDS, including vulnerability to climate change, issues of health and education with special focus on disadvantaged groups, such as women and the poor, and pressures of increasing populations, urbanization and disease.

Ambassador Slade acknowledged that SIDS were especially challenged in dealing with factors impacting on national development due to deficiencies in resources, capacity, health care systems, and response mechanisms. He highlighted the vulnerability of SIDS to natural disasters, including volcanic activity, cyclones, hurricanes and tsunamis. He further stated that the implementation of coping mechanisms, including plans of action, adaptability strengthening, and community-based systems, was essential to minimize impact. In addition, His Excellency expressed a strong feeling that estimation of future impacts should include economic forecasting as

it relates to impacts from epidemics on health care systems and income generating activity, such as tourism and foreign reserves.

Sea level rise was targeted as of special concern to SIDS as an impact of climate change and expected outcomes were outlined as

- displacement of coastal communities,
- disturbance of agricultural activity,
- coastal erosion, beach loss and related decline in tourism, and
- intrusion of sea water in freshwater aquifers.

Reemergence of vector-borne diseases was also deemed an issue of paramount concern. Ambassador Slade projected that the spread of dengue and malaria would continue to exact a toll on the elderly and children under the age of five. Practical options to head off such impact were suggested to be enhancement of public awareness regarding conditions promoting viability of the vectors and improved sewerage and drainage systems.

His Excellency was emphatic in stating that a collaborative effort was needed in the development of island capacity. To this end, he added, AOSIS has been involved in inter-regional exchanges via meetings and workshops. He recognized the need for the results of scientific research to inform policy development and envisioned that academic institutions will assist in this area by cross-linking and sharing the outcome of research initiatives.

In conclusion, he hoped that information sharing, an expected outcome of the conference, would lead to real and practical solutions to the peculiar problems faced by SIDS and the fostering of a spirit of partnership and cooperation.

PROFESSOR TONY McMICHAEL
Global Climate Change: Where and When Might We Detect Health Impacts?

Professor McMichael's address focused on the detection of health impacts from climate change. He opened by stating that uppermost in consideration should be obtaining the answers to the questions of where and when climate change might be detected.

He elaborated that the rise in Earth's surface temperature was now estimated to be above the band of historical climatic variability. The efforts at reducing greenhouse gas emissions to acceptable levels will not alter the current effects of warming, including oceanic expansion, he stressed. Professor McMichael emphasized that the task of current research initiatives is to learn from past experiences, improve methods of detection, and incorporate all data into formulation of predictive models. He recognized the challenges involved in relation to the degree of uncertainty associated with forecasting.

Professor McMichael outlined evidence of challenges ahead to health care systems and sustainable development in general as:

- doubling of the frequency of extreme weather events has occurred in the last decade;
- the impact of the El Niño - Southern Oscillation (ENSO) on populations has increased in the last 20 years;
- in the South Pacific, an increase in dengue epidemics has been linked to La Niña years;

- in Ethiopia, initial investigations suggest a close relationship between an increase in malaria and rising temperatures;
- in Lima, Peru, a close link between higher temperatures and the incidence of diarrhea has been established; and
- in New Zealand, a study spanning the period 1965-2000 indicated some impact of temperature on the occurrence of salmonella disease.

Furthermore, the Professor assessed other detection signs of the impact of climate change to be enteric infections, tick-borne encephalitis and decline in cereal grain production. He reported that predictive models for the Caribbean suggest impacts to include

- a 2-4 °C temperature rise by the year 2050,
- a reduction in annual rainfall,
- a decline in crop yields, and
- a rise in the transmission of malaria.

Professor McMichael concluded by stressing that it was essential that Health Ministries play a central role in planning for adaptation to climate change by development and implementation of inter-sectoral policy, thus enabling the convergence of all stakeholders.

Technical Presentations and Panel Discussions

Session #1 - Climate Change and Climate Variability

MODERATOR

Roger S. Pulwarty
U.S. National Oceanic and Atmospheric Administration (NOAA) and University of Colorado at Boulder, U.S.A.

LIST OF PRESENTERS

Tamara Creech
U.S. National Climatic Data Center (NCDC), North Carolina, U.S.A.
Chris Sear
Natural Resources Institute, University of Greenwich, Kent, U.K.
Michael Taylor
Department of Physics, UWI, Mona Campus, Jamaica
Jorge E. Gonzalez
Mechanical Engineering Department, University of Puerto Rico at Mayaguez

TAMARA CREECH

Climate Change and Climate Variability - The Fundamental Climate Issues

Ms. Creech presented findings of the WMO/UNEP Intergovernmental Panel on Climate Change (IPCC). She outlined the following fundamental issues.

- A definite increase in carbon dioxide levels has been detected over the last two hundred years.
- The IPCC Third Assessment Report confirmed a temperature increase of 0.6 °C over the last century.
- High temperature records were established for 1998.
- Minimum temperature has been increasing at a faster rate than maximum temperature, suggesting a general warming.

- Precipitation levels have registered increases in the range 0.5 to 1.0 % per decade in the Northern Hemisphere and an average of 2.4 % per decade in the Tropics.
- Sea levels have shown an increase of 10 to 25 cm over the past 100 years on record. There is a projected rise of sea level over the next 100 years due to thermal expansion and melting of glaciers.

CHRIS SEAR
Climate Change Impacts on Small Island States – Caribbean Concerns and Recommendations for Action

Dr. Sear emphasized the need for the views of all stakeholders to be included in the policies of mitigation. Sustainable development was seen as key to building capacity for adaptation to climate change. Countries were advised to aim for quantitative risk assessment of impacts to inform decision makers and formulate plans of action.

A likely scenario was presented involving impacts from greenhouse gas emissions. The scheme for decision making followed:

Greenhouse gas emissions

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Determination of climate scenarios and predictions from modelling

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Identification of biophysical and socio-economic impacts

↓

Identification of livelihood impacts

↓

Plan of action for mitigation

This approach was taken in a number of U.K. dependencies where modelling for the impact of increased temperatures was carried out. The application of models led to a prediction of variability in precipitation. Recommendations for the development of forecasting systems included

- the determination of climate factors likely to have an impact,
- the sensitization regarding local comprehension of climate change,
- the estimation of the magnitude of impacts on key sectors, such as health, tourism and agriculture, and
- collaboration with stakeholders.

MICHAEL TAYLOR
Caribbean Climate Variability – Evidence of El Niño and Longer Time-scale Climate Change

Dr. Taylor presented data that reflected marked interannual variability in precipitation in the Caribbean. Evidence suggested that the Caribbean rainfall season was bimodal with an early season during the months of May to July and a late season during the months of August to November. Analysis of the data led to the conclusion that interannual variability during the early season was driven by changes in the sea surface temperature (SST) in the Tropical North Atlantic, while the late season was influenced by (among other things) Equatorial Pacific SST anomalies. Consequently, whereas the El Niño phenomenon directly altered Caribbean rainfall variability during the late season, its effect on the early season was by proxy. Dr. Taylor recommended that the differing forcing mechanisms for each portion of the Caribbean rainfall season should be considered in the design of forecasting systems for the region. He suggested that separate predictive models for the early versus late rainfall season may be of greater use to the Caribbean region.

Evidence for global warming in the Caribbean region was also gleaned from the results of a study of trends in temperature and precipitation indices derived from station data for 30 Caribbean nations. Trends observed included

- an increase in the number of days with higher minimum and maximum temperatures,
- a decrease in the number of days with lower daytime and nighttime temperatures, and
- an increase in the number of consecutive dry days.

Although the data suggested the occurrence of climate change, additional research was deemed necessary to minimize the degree of uncertainty.

JORGE E. GONZALEZ
Urban Heat Island Studies for San Juan, Puerto Rico

Dr. Gonzalez presented data that indicated the appearance of a hot spot in the metropolitan area of San Juan, Puerto Rico. Satellite imaging of the area revealed higher than normal temperature readings over areas void of natural vegetation and supplanted by concrete buildings. This Urban Heat Island Effect (UHI) was studied and conditions that promote its development were identified as

- moisture,
- vehicular and industrial emissions, and
- the presence of concrete buildings and the reduction of circulation.

It was concluded that future occurrences of hot spots will be linked to the expansion of urbanization. This effect is of significance to the Caribbean region and Dr. Gonzalez recommended that urban development policies be implemented to mitigate the occurrence of UHI.

Panel Discussion – Session #1

Joe Prospero of the University of Miami suggested that climate change models consider Saharan dust as a parameter. He stated that data suggest that Africa is experiencing an intensive phase of drought and the concentration of dust reaching the Caribbean region is estimated to be 3 to 4 times higher than that experienced in the 1960s.

Dale Rankine, a representative of the Jamaican Meteorological Service, stated that, while models of climate change have produced meaningful results, there are two areas of concern giving reason for exercising caution when using model outputs. These are as follows:

1. the predictive models in current use have resolutions that are much larger than that of Caribbean islands and even the region when taken as a whole;

2. the unavailability of verified and accurate data places a constraint on the use of currently available models.

Chris Sear of the Natural Resources Institute, University of Greenwich, responded by advising that strengthening of environmental services would equip communities with the ability to respond to early climate changes while improvements in accuracy of forecasting are sought. He emphasized that plans should be implemented to deal with current situations instead of waiting on research findings.

Concern was raised regarding the difficulty of securing data on the real impact of natural disasters. Chris Sear was asked about his strategy for such data acquisition. He indicated that he collects information directly from those who are immediately impacted. He felt that it was important for decision makers to interact directly with impacted communities to gather useful information.

Jonathan Patz of the Johns Hopkins Bloomberg School of Public Health queried whether the UHI in San Juan was also influenced by chemical air pollution. Jorge Gonzalez explained that indicators suggest that high ozone concentrations may be a contributing factor in the occurrence of UHI. He further informed the participants that atmospheric chemical reactions were not included in the model used.

Tony McMichael, Director of the National Centre of Epidemiology and Population Health in Australia, suggested to Jorge Gonzalez that his study be expanded to an international scale involving a wider network of urban areas. He also asked whether Jorge Gonzalez had any insight into the reasons for observed variation in response to temperature variability by urban populations.

Jorge Gonzalez affirmed that collaborative efforts are in progress regarding the expansion of the research into UHI. He also welcomed input from Professor McMichael.

He said he could speak to the situation in San Juan regarding response to temperature variability and suggested that access to appliances that could relieve the effects of temperature extremes was a factor.

Jorge Gonzalez also felt strongly that the results of the UHI study reflected the need for laws to mitigate the effects of climate change. He stressed the importance of exposing the policymakers to information generated by research.

Session #2 - Health Status in the Caribbean Region and Frameworks for Assessment

MODERATOR

Samuel C. Rawlins
CAREC, Port of Spain, Trinidad and Tobago

LIST OF PRESENTERS

C. James Hospedales
Director, CAREC, Port of Spain, Trinidad and Tobago
Vincent Sweeney
Executive Director, CEHI, Castries, Saint Lucia
[Speaking for Herold Gopaul of CEHI, Castries, Saint Lucia]
Veta Brown
Caribbean Program Coordinator, PAHO/WHO, Barbados
Emilio Sempris
Coordinator of the National Climate Change Program of Panama, National Authority for the Environment, Panama, Republic of Panama *[Speaking for Ligia Castro de Doens, Water Center for the Humid Tropics of Latin America and the Caribbean, Panama, Republic of Panama]*
Roger S. Pulwarty
NOAA and University of Colorado at Boulder, U.S.A.

C. JAMES HOSPEDALES

Caribbean Health Situation: Summary for Climate Change and Human Health

Dr. Hospedales gave an analysis of the Caribbean situation. He emphasized that sustainable development in the region is dependent on the implementation of policies that

recognize the interrelationship of economic activity, environmental conservation, and health and education. He noted that the Caribbean has experienced increased life expectancy due to improvements in housing, food, water and sanitation, and the availability of vaccines and antibiotics, but new challenges to health care systems are appearing, such as AIDS, violence and injuries, and other lifestyle diseases, as well as new agents such as the West Nile virus. Dr. Hospedales said that there is evidence suggesting that there is a marked increase in the region in the last 10 years in the incidence of dengue and hemorrhagic dengue, malaria (Guyana) and food-borne diseases.

Acknowledgment was given to the fact that the Caribbean economy is driven by tourism. He predicted that climate change would impact on the growth of tourism, taking into consideration the interplay of threats to health. Response mechanisms implemented to deal with these challenges should include integrated surveillance systems. Dr. Hospedales was emphatic in his assessment that health and economic productivity were linked and that safeguards must be taken to avoid reversal in gains due to environmental threats.

VINCENT SWEENEY [for HEROLD GOPAUL]
Climate Variability and Change and their Potential Health Impacts for Caribbean States - An Environmental Health Perspective

Mr. Sweeney outlined the mandate of CEHI as the development of program initiatives aimed at building capacity in environmental health in the Caribbean Community (CARICOM) member states. He also commented on the collaborative efforts of CEHI with the CPACC project in preparing the region to cope with the impact of climate change.

Mr. Sweeney explained that the vulnerability of SIDS to climate change and climate variability was linked to their geographical location, dependence on biodiversity, and the fragility of ecosystems and their interrelationships. Health parameters of concern were stated to include

- air pollution,
- water- and food-borne diseases,
- vector- and rodent-borne diseases, and
- sea level rise.

Mr. Sweeney assessed that the response to these challenges to environmental health required strengthening of public health infrastructure. He recommended strengthening of surveillance systems via a multi-sectoral approach with the inclusion of all stakeholders.

The promotion of research in the region by institutions such as CAREC and UWI was seen as a necessary component in the strengthening of the public health sector. Mr. Sweeney made reference to the ACCC project, which specifies the impacts of climate change on the health sector as

- an increase in the incidence of dengue, asthma and malaria,
- an increase in the incidence of skin cancer due to increased exposure to UV, and
- an increase in nutritional deficiencies due to decreased food production.

Response mechanisms by the health sector as recommended by the ACCC project include

- improved data collection,
- public education and awareness,
- improved health service planning and delivery – early warning systems, and
- improved disaster management.

Mr. Sweeney concluded that promotion of awareness and education among the political directorate, decision makers, professionals and the general public is required for the adoption and implementation of strategies for adaptation to climate change.

VETA BROWN
Challenges of the Health Systems in relation to Climate Change

Mrs. Brown addressed the challenges that face Caribbean health systems in relation to climate change. She identified one such challenge as the development of response capability. This, she outlined, requires knowledge of parameters, establishment of systems, and access to resources.

Challenges to the development of intervention strategies include improvements in monitoring analysis, public health surveillance, social participation in health planning and management, regulatory frameworks, improvement in the quality of services, and the promotion of research. Possible areas for research focus in the Caribbean were listed as the economics of health care, factors impacting on mortality rates, and the quantification of climate change impact. Generally Mrs. Brown stressed the need for strengthening of the national health authority.

EMILIO SEMPRIS AND
LIGIA CASTRO DE DOENS
Conceptual and Methodological Framework for the Assessment of Vulnerability and Adaptation to Climate Change in the Health System

Mr. Sempris outlined the shortcomings in the first generation of Vulnerability and Adaptation (V&A) Assessments in the context of the Initial National Communications to the United Nations Framework Convention on Climate Change (UNFCCC). He indicated that the findings of the Central American regional assessments suggested the institutionalization of vulnerability assessment in the form of the Promote Adaptation Policy Framework, a tool for the Second Generation of V&A Assessments. The aims are strengthening of national meteorological services, statistical offices and health surveillance systems, as well as improvement in access to health services.

Mr. Sempris further expressed concern about the difficulty in quantifying the extent of vulnerability and the need for sustained political will to address adaptation to climate change. His recommendations for the development of a Systemic Adaptation Framework to reduce vulnerability to climate change as well as to short-term extreme weather events included standardization of the scientific and political approach, improvement in the collection and management of climate change data, enhancement of public awareness, implementation of preventive instead of reactive strategies, stakeholder participation at all stages, integrated assessment through synergies amongst social, natural and technological sciences, and costing of impacts and adaptation options. The aim is to implement policies determined to have priority.

ROGER S. PULWARTY
Designing Effective Assessments and Responses to Climate-related Health Risks: What Do We Know and What Do We Need to Know?

Dr. Pulwarty began his presentation by defining a route to the design of response systems. He emphasized that such a route should involve:

Integrated Assessment → Forecast Projections → Dissemination of Information → Utilization of Information

He continued that examination of the disaster preparedness strategy was essential to determine the interrelationships of research, policy, and operating mechanisms. He stressed that early warning systems must be clear, relevant, timely and affordable and that, to be effective, any efforts at developing early warning systems must be embedded within longer-term vulnerability reduction strategies and in integrated environment-health and decision making frameworks. It was deemed essential that response mechanisms be linked to household strategies for coping and risk behavior.

Dr. Pulwarty strongly supported the view that partnerships should be established including the stakeholders,

health professionals and policymakers. He spoke of the need for research and applications to support adaptive management of climate-related health risks. He concluded that there must be synergy between the researchers and the population being impacted to improve the efficacy of designed systems.

Panel Discussion – Session #2

Initial discussion centered around the limitations inherent in regional research due to lack of available resources and deficiencies in mechanisms currently in place. Sam Rawlins of CAREC and Michele Monteil of UWI, St. Augustine Campus expressed concern about the level and quality of research being done in the region. Acknowledgment was made of the constraints, but the panel was asked if there were any recommendations for the building of research capacity.

Veta Brown advised of efforts which were being made to promote health policy research, and highlighted roles for the Caribbean Health Research Council and UWI (Sir Arthur Lewis Institute of Social & Economic Studies at UWI) to promote research, inform decision makers, and hence impact on policy as it relates to adaptive health management strategies. James Hospedales of CAREC stated that CAREC regularly holds meetings with collaborators to determine their needs. He further anticipated that the conference would highlight health parameters of concern and build partnerships and links that could lead to the generation of research initiatives. Vincent Sweeney expressed a concern regarding the translation of information garnered from research done by scientists and environmentalists into language that facilitates action by policymakers. He felt that this barrier must be overcome so that decisions would be fueled by rigorous data.

Tony McMichael, of the National Centre for Epidemiology and Public Health in Australia, commented on the need for the building of local capacity for data collection. He suggested that multicentered research was imperative and that it had the added benefit of information exchange. Roger Pulwarty queried whether a regional information system could be developed after careful consideration of the components and partnerships required.

Jorge Gonzalez stressed the need for climate change to be part of the national agenda. He envisioned that a collaborative effort among governments and other institutional agencies could lead to the generation of a regional agenda.

Session #3 – Linkages Between Climate and Human Health
(PART I)

MODERATOR
Patricia Aquing
CEHI, Castries, Saint Lucia

LIST OF PRESENTERS
Samuel C. Rawlins
CAREC, Port of Spain, Trinidad and Tobago
Guillermo L. Rua
Program for the Study and Control of Tropical Diseases, University of Antioquia, Medellin, Colombia
Nancy D. Lewis
Director of Studies, East-West Center, University of Hawaii, Honolulu, Hawaii, U.S.A.
Michael P. Hamnett
Director, Social Science Research Institute, University of Hawaii, Honolulu, Hawaii, U.S.A.
Brian Challenger
Consultant, Ministry of Public Utilities, Antigua and Barbuda
Dana Focks
Infectious Disease Analysis, Gainesville, Florida, U.S.A.

SAMUEL C. RAWLINS
How Climate Impacts on the Occurrence of Dengue Fever: A Fifteen Year Retrospective Study of Correlation of Dengue Fever and Rainfall in Trinidad and Tobago

Dr. Rawlins stated that the objective of the research project was to determine if a link existed between rainfall, temperature and the incidence of dengue. Data collected for El Niño years and the years immediately following an El Niño (El Niño + 1) for the period 1986-2000 revealed a link between rainfall and an upsurge in dengue fever. The strongest effect was observed for 1998, an El Niño + 1 year. It was suggested that improper water storage during El Niño years promotes breeding of the vector. High rainfall periods subsequent to an El Niño occurrence naturally provide conditions for larval development of the mosquito vector. Temperature was also seen as a factor because of the influence on the breeding cycle of the mosquito vector.

Dr. Rawlins explained that the collection and analysis of such data allowed for the prediction of impacting periods and the implementation of preparedness plans. Future work via the Assessments of Impacts and Adaptations to Climate Change (AIACC) project will investigate seasonal dynamics and the effects of ENSO and non-ENSO cycles.

GUILLERMO L. RUA
El Niño Southern Oscillation (ENSO) Related to Malaria Transmission, Density and Parity of Anopheles albimanus (Diptera: Culicidae) in Colombia

Dr. Rua reported that research was carried out to determine if climatic conditions of temperature, humidity and precipitation affected malaria transmission and the population dynamics of the malaria vector. Data were collected from two sample areas in Colombia with the assistance of local meteorological stations.

A significant correlation was found between environmental temperature and the number of malaria cases. No link was established between the incidence of malaria and precipitation or humidity. In addition, no association was found between the density or parity rate of *Anopheles albimanus* and malaria transmission. The density and the parity rate of *An. albimanus* were not associated with temperature or humidity in either locality. An increase in the density of the *Anopheles* mosquito population was linked to increased precipitation. It was concluded that an expansion of the study was necessary to clearly establish the climatic variables impacting on malaria transmission.

NANCY D. LEWIS AND MICHAEL P. HAMNETT

Climate Variability and Human Health in the Pacific Islands

Dr. Lewis and Dr. Hamnett discussed the Pacific Islands Regional Assessment of the Consequences of Climate Variability and Change, the Pacific ENSO Applications Center (PEAC) and a series of research efforts on the impact of climate variability on health in the Pacific Islands. The Regional Assessment was based very heavily on input from community stakeholders. The development of PEAC's forecasts and climate information products involved on-going interaction with climate information users. During the 1997-1998 El Niño, climate forecasts were used by public health officials to warn people in the U.S. Freely Associated States about the increased risk of water-borne and water-related diseases due to severe droughts.

Their current climate and health study is a joint venture with health ministries and meteorological services in Cook Islands and Fiji as well as the Fiji School of Medicine. It is aimed at developing a better understanding of the relationship between changes in rainfall and temperature and diseases in the Pacific Islands to facilitate better use of climate forecasts in public health applications. Preliminary discussions have begun on comparing their work in Cook Islands and Fiji with similar projects that are starting in Barbados and Saint Lucia.

BRIAN CHALLENGER

Health Sector Climate Change Impacts and Adaptations: Initial Assessment Results from Saint Lucia

Mr. Challenger presented preliminary findings on the impact of climate conditions on the health sector in Saint Lucia. An effort was made to identify the elements of the health sector that were more susceptible to climate change. Methodology from the UNEP 1998 handbook was applied in the investigation of vector - borne diseases likely to be impacted by climate variability. An attempt was made to identify high-risk groups in Saint Lucia that were vulnerable to drought, floods, hurricanes and heat stress. In addition, efforts to link specific health impacts to each environmental extreme were made. Mr. Challenger indicated that particularly vulnerable and high-risk groups were likely to include

- persons with existing health conditions (e.g., heart disease and asthma),
- poor communities with inadequate infrastructure, and
- communities at higher elevations.

He recommended that adaptation options should be designed to minimize impacts by educating the public and integrating with existing health sector planning.

DANA FOCKS

Impact of Anticipated Climate Change on Dengue in the Caribbean Based on the New Ocean/Atmosphere-Coupled Hadley Climate Model version 3 (HadCM3) and Report on Statistical and Neural Net Early Warning Systems for Dengue on the Island of Java

Dr. Focks revealed the results of the application of the Hadley climate model version 3. He predicted an impact of climate change on the transmission of dengue. The model projects a modest temperature rise in the eastern Caribbean and a reduction in rainfall. This rainfall deficit is anticipated to impact on conditions required for larval breeding of the mosquito vector *Aedes aegypti*.

Dr. Focks further outlined the methodology applied in the development of an early warning system used at a study site in Indonesia. The steps involved

- historical research to determine the epidemic years,
- identification of predictor variables (e.g., SST), and
- prediction of high-risk periods.

This approach was assessed by Dr. Focks to be successful in providing time to implement response mechanisms. He, however, advised that effective mitigation was essential to the process.

Panel Discussion – Session #3

The tone of the discussion in this session reflected the participants' lack of confidence in the current knowledge of the parameters for dengue and malaria. Concern was raised by Michele Monteil, UWI about the outbreaks of dengue outside of El Niño periods and she questioned whether there was any investigation of a link to ethnicity. In response, Sam Rawlins of CAREC stated that ethnicity is present every year and that additional research will be forthcoming to establish impacts of climate variability during non-El Niño periods.

He confirmed the need for more rigorous clinical collection of data and sampling. Dana Focks suggested a strengthening of laboratory surveillance techniques to identify the type of virus circulating.

Dana Focks recommended that forecasting systems include an examination of the factors that drive ENSO and not simply the occurrence of ENSO. There was general agreement that there is a dire need for early warning systems to motivate communities into action to minimize the impact of climate on health as it relates to vector-borne diseases.

Session #4 – Linkages Between Climate and Human Health
(PART II)

MODERATOR

Leslie Walling
CPACC/ACCC, UWICED, Cave Hill Campus, Barbados

LIST OF PRESENTERS

Avril M. Siung-Chang
PAHO, Port of Spain, Trinidad and Tobago
Christina Kellogg
Center for Coastal Studies, U.S. Geological Survey, St. Petersburg, Florida, U.S.A.
Edmund Blades
Department of Biological and Chemical Sciences, UWI, Cave Hill Campus, Barbados
Nancy Maynard
Associate Director, Environment and Health, Goddard Space Flight Center, U.S. National Aeronautics and Space Administration (NASA), Greenbelt, Maryland, U.S.A.

AVRIL M. SIUNG-CHANG

Unusual Climatic Conditions Associated with Mass Fish Mortalities in the Southeast Caribbean from Trinidad and Tobago to Barbados, During the Period July to October, 1999

Dr. Siung-Chang presented evidence for the possible cause of the mass fish mortalities in the Southeast Caribbean during the period July to October 1999. She demonstrated a link to the reef fish kills with a number of observations made during that period, including

- high rainfall during 1999 in northern South America,
- an increase in SST,
- a decrease in surface water salinity,
- unusual reverse currents, and
- discoloration of sea surface water.

The heavy rains in 1999 followed a prolonged El Niño period that lasted from 1997 to 1998. Satellite imagery supported the observations, showing large quantities of fresh water from the Amazon and Orinoco river basins being swept into the Southeast Caribbean in the form of retroflection eddies, thus causing low salinities, higher temperatures and reverse currents. Low salinities and the presence of the mainly freshwater bacterium *Streptococcus iniae*, isolated from dead and dying fish collected in Barbados, provided evidence of the link between the unusual rainfall and the fish kills.

Dr. Siung-Chang recommended that a network of marine scientists and institutions be established to share information and expertise to improve response times and mechanisms for extreme marine events.

CHRISTINA KELLOGG

Characterization of Microbial Communities Associated with African Desert Dust and their Implications for Global Human and Ecosystem Health

Dr. Kellogg outlined the results of an ongoing study in which stations in Bamako (Mali, West Africa) and the Virgin Islands in the Caribbean monitored African dust for the presence of microorganisms. Results showed some commonality between the two stations in the types of bacterial and fungal species cultured from dust samples collected. Dust from both locations was found to contain pathogens capable of infecting plants, animals and immunocompromised humans.

The transcontinental movement of microbes in African dust was seen to have implications for ecosystems, agriculture and livestock, and human health. Retrospective analyses have linked the occurrence of events of coral bleaching and disease outbreaks in reef species with peaks in African dust. In addition, a marked increase in the populations of microbes in the air was noted during peak dust periods at the station in the Virgin Islands.

Dr. Kellogg informed participants that future research will involve monitoring for chemical contaminants, including polyaromatic hydrocarbons and pesticides.

EDMUND BLADES

The Transport of Soil Dust and Microbes from Africa and their Relationship to Asthma in Barbados

Mr. Blades presented the findings of a study in which the main objectives were the identification of viable microorganisms in the trade winds on Barbados and the possible correlation with asthma. Daily aerosol samples were collected from 1996 to 1997 at the University of Miami Tower at Ragged Point, the easternmost point in Barbados. Viable fungi and bacteria were only observed in the presence of African dust, none in air from Europe or North America. Satellite imagery demonstrated that the African dust is transported across the entire Caribbean from the Southern to Northern islands. Peak periods were observed during April and summer from July to October.

A variety of microbes and spores were identified in the dust on analysis. An increase in *Bacillus* species was detected during the peak periods of 1997 relative to 1996. In a graphical analysis of data, there was no readily apparent correlation between the presence of fungi and bacteria in the dust at peak periods and asthma cases recorded at Barbados's Queen Elizabeth Hospital. However, a close correlation between the presence of spores from local sources and asthma cases was noted. Some correlation between asthma and rainfall was suggested by the data.

Mr. Blades projected that future research will lead to a local warning system for asthma based on routine measurements of spore and pollen.

NANCY MAYNARD
Satellites as Shared Resources for Caribbean Climate and Health Studies

Dr. Maynard presented an overview of the use of remote sensing for studies of climate, environment and health in the Caribbean and provided a series of examples of the uses of satellites for these studies, including

- algal blooms,
- sediment runoff and transport,
- pollutant transport,
- coral reef monitoring,
- vector-borne disease studies,
- African dust in the islands, and
- severe storms / hurricanes.

In addition, she presented a number of examples of user-friendly satellite data - useful for environment and health studies - that are available "now" in real time to all users via the Internet. This served as an introduction to a NASA/Goddard Space Flight Center demonstration of the use of these data (and demo compact disc (CD)) in the workshop that would follow the conference. Data included wind speed, wind direction, ocean true color, chlorophyll concentration, rainfall estimation, sea surface height, near real-time land products, aerosol conditions, ozone, vegetation index and water vapor.

Panel Discussion – Session #4

Joe Prospero of the University of Miami commented that the aerobiological studies by Christina Kellogg and her colleagues in West Africa were unique and interesting. However he voiced strong doubts about the validity of the data obtained on St. John, Virgin Islands, where sampling was carried out on the extreme western end so that trade winds passing over the island undoubtedly picked up large amounts of local microorganisms. This would explain why Kellogg *et al.* obtained concentrations over 100 times greater than those reported by Blades *et al.* who used similar techniques but carried out their sampling on the easternmost coast of Barbados, free from local impacts. The large discrepancy in the species observed by the two groups is also consistent with contamination from local sources on St. John. Christina Kellogg admitted that some local contamination could have taken place but insisted that the increase in the density of species during peak dust periods was significant. Joe Prospero replied that Christina Kellogg and her colleagues never actually measured dust; they inferred its presence. Christina Kellogg also described some of the differences in sampling methodology between her work and that of Joe Prospero's group, which could account for the differences in results seen.

Jonathan Patz of Johns Hopkins University queried whether there was any correlation between occurrence of meningitis and dust periods. Christina Kellogg replied that to date evidence was lacking. Edmund Blades added that the concentration of dust was not at the critical mass to impact on the transmission of meningitis, the spread of which is facilitated primarily by close contact and droplet infection (an infection transmitted by droplets of saliva expelled from the upper respiratory tract while coughing or sneezing). Michele Monteil of UWI, St. Augustine suggested that consideration be given to the probability of a lag time between exposure to bacillus species identified in Sahara dust and the onset of acute asthma, rather than to coincidence of exposure and occurrence of asthma. She felt that the information would be more useful and

greater correlation may be seen. Since it was suggested that Sahara dust clouds contain potentially infectious organisms and allergenic plant material, it was important to consider the onset of asthma exacerbation following dust exposure in relation to the perceived pathophysiology, be this allergic or infectious. Dana Focks suggested some specific parameters for consideration, such as exercise and arthropod droppings.

Finally Joe Prospero informed the participants that the project presented by Edmund Blades was in its early stages and that they were seeking support from various agencies to expand the work. They also offered to cooperate with other regional groups who might be interested in participating in this study or in initiating similar ones dealing with aerosols and health.

Session #5 – Public Health Policies and Strategies for Adaptation to Climate Variability and Change

MODERATOR

Roger S. Pulwarty
NOAA and University of Colorado at Boulder, U.S.A. *[for Ulric Trotz, CPACC/ACCC, UWICED, Cave Hill Campus, Barbados]*

LIST OF PRESENTERS

A. Anthony Chen
Department of Physics, UWI, Mona Campus, Jamaica
Ana Rosa Moreno
United States-Mexico Foundation for Science, Mexico City, Mexico
Paulo L. Ortiz Bulto
Climate Center, Meteorological Institute, Havana, Cuba
Sari Kovats
London School of Hygiene and Tropical Medicine, London, U.K.
Leslie Walling
CPACC/ACCC, UWICED, Cave Hill Campus, Barbados

A. ANTHONY CHEN

Is the Climate Right for Predicting and Mitigating an Outbreak of Dengue Fever?

Dr. Chen reported on the AIACC project. He stated that one of the objectives of the project was to devise an early warning system with mechanisms for the prediction of outbreaks of dengue fever. He acknowledged that any model cannot account for all factors and degree of impact and hence probability statements are given due to the degree of uncertainty. Predictions from the Caribbean Institute of Meteorology and Hydrology (CIMH), Climate Studies Group Mona (CSGM) and researchers in Cuba were considered vital to such a study. Knowledge of the entomology of the vector was also deemed essential in the estimation of the impact of variables, such as temperature. It was also said to be imperative to include socio-economic factors. Dr. Chen listed a number of advancements that should be attained before forecasting for the Caribbean region was attempted. These included

- a comprehensive understanding of the systems impacting on regional weather (e.g., El Niño),
- links with international predicting centers, and
- expansion of regional research by practitioners (e.g., CIMH, CSGM and researchers in Cuba).

His answer as to whether the region had attained the capacity to issue alerts was no. He strongly felt that more retrospective studies were needed. In addition, he envisioned that future research initiatives and sharing of information would build regional capacity and confidence in the science of forecasting health impacts of climate change. He supported the view that the development of a mitigation network required collaboration between scientists and health boards. Dr. Chen warned that the process of formulating a response system could be impacted if the flow of information was impeded.

ANA ROSA MORENO
Climate Change and Human Health: Risk Communication and Information

Ms. Moreno expressed the view that risk communication and risk information must be accessible, accurate, timely and useful to exact efficacy. She stressed the need for education programs to be tailored to specific geographical areas and demographic populations. It was also recommended that the dissemination of information be broadened and that capacity building for the management of information be provided. An information strategy involving the use of varied media and modern technology was considered vital.

A central clearinghouse with country-specific data and information on diseases influenced by climatic variations should be established. This was considered essential for quality control and ready access by researchers. Ms. Moreno concluded that inter-sectoral communication and convergence was necessary in the development of adaptation strategies.

PAULO L. ORTIZ BULTO
Impacts of Climate Change and Variability on Some Diseases in the Tropical Region: An Example of the Strategies for Adaptation to Climate Variability and Change

Dr. Ortiz opened his presentation by outlining the areas related to health that can be impacted by climate change and variability. He stated that the use of predictive modelling for health impacts of climate change has been limited. Predictive models of physical systems and physiologic systems are well established. However, many aspects of human systems are not readily amenable to modelling.

Another problem in these studies is reduction to an analysis of precipitation and temperature. However, rainfall effects on diarrhea, for example, are nonlinear and cannot be easily extrapolated to other regions. Yet the approach of linear association between two variables continues.

Dr. Ortiz and his colleagues have developed a new approach, which considers complex indices to simulate and to explain the combined actions of various processes and climate. These include

- changes in biological transmission,
- ecological change,
- epidemiological change, and
- socio-economic change.

This index approach describes climate anomalies in different scales, such as Interannual, Seasonal and Interseasonal variability. The increment of the climate variations can also generate ecological and socio-economic changes, and it can increase or decrease the incubation period and transmission of pathogenic organisms, which are extremely sensitive to climatic fluctuations. Therefore the proposed indices should describe the climatic anomalies. For example, one effect of interannual climate variability is a prolonged drought that affects ecosystem dynamics. In the case of vector-borne disease, as an example, the influence of climate on health is given by three components: the distribution and quality of surface water; the life cycle of the disease vector and host-vector relationships; and ecosystem dynamics of predator-prey relationships.

Using this methodological approach in dynamic models, he elaborated that these areas can therefore be targeted for research into the development of early warning mechanisms. He listed a number of diseases that were found sensitive to climate variability in Cuba. These included acute diarrheal disease (ADD), viral hepatitis, acute respiratory infections and malaria. Application of this Bioclimatological Monitoring System was found to be successful. Case studies in Cuba revealed that ADD peaked in the winter season, and this allowed for implementation of control programs. Changes in variability associated with climate change may be more important than changes in mean climate for some diseases. Generally, Dr. Ortiz felt that overall

monitoring analysis, including assessment of related costs to the health sector, will enhance the level of preparedness for periods of stress and improve the standard of human health in the region.

Dr. Ortiz concluded by saying that these new developments in climate forecasting can provide the basis for a proactive approach to the spread of human diseases. They can mitigate or prevent outbreaks before they occur, saving lives and scarce resources of the public health system. Integrating health surveillance with climate monitoring, Early Warning Systems can help decision makers to adopt the correct strategy to face outbreaks.

SARI KOVATS

Guidelines to Assess the Potential Health Impacts of Climate Variability and Change

Ms. Kovats described the Guidelines for National Assessments of the Health Impacts of Climate Change. This project is supported by Health Canada and WHO (Geneva and Rome). National Assessments, also called "Vulnerability and Adaptation Assessments", are formal assessments that address a country's response to climate change, sometimes within the legal framework of the UNFCCC. A few developed countries have undertaken extensive reviews of the potential impacts of climate change on human health (U.S.A., Canada and the U.K.).

A brief description of the Guidelines was outlined. New methods and tools are needed to produce health impact assessments of climate change at the national level. The generic tools and guidelines available for climate impact assessment are based on top-down methods of scenario-based modelling - reflecting the focus on the biophysical impacts (hydrology, agriculture) for which large-scale models are available. This approach is often not useful for health impact assessments in developing countries, which should focus on describing vulnerability. Activities during and after the assessment should involve

- capacity building,
- interdisciplinary convergence, particularly between the public health sector and climatologists/meteorologists,
- development of a research agenda,
- continued assessments, and
- policy recommendations that reduce vulnerability to potential health impacts (adaptation).

Ms. Kovats stressed the need for a review of previous assessments in order to identify the lessons learned. She anticipated that the guidelines would be available in 2003.

LESLIE WALLING

Adapting to Climate Change in the Caribbean

Mr. Walling reported on the achievements of CPACC and the projections for the future. He outlined the objectives of the Phase I CPACC project over the period 1997-2001 as assisting CARICOM States to address the adverse effects of global climate change, and particularly sea level rise, through

- vulnerability assessment,
- adaptation planning, and
- capacity building linked to adaptation planning.

He explained that the project adopted a collaborative approach to implementation with the 12 participating Caribbean States, the Organization of American States (OAS) and UWICED. The CPACC project components were listed as

- the design and establishment of a sea level/climate monitoring network,
- the establishment of databases and information systems,
- an inventory of coastal resources and use,
- the formulation of a policy framework for integrated adaptation planning and management,
- coral reef monitoring for climate change,

- an economic valuation of coastal and marine resources,
- the formulation of economic / regulatory proposals, and
- a greenhouse gas inventory.

Mr. Walling considered the main achievement of the project as the development of national adaptation to climate change policies and implementation strategies in each of the CARICOM member states. Individual achievements were seen as the establishment of a regional network of sea level/hydrometeorology monitoring systems, the establishment of a sub-regional coral reef monitoring network, the delivery of national geographic information system (GIS)-based coastal resource information systems, and an increased appreciation of climate change issues at the policymaking level.

He reported that, in February 2002, CARICOM Heads of Government had endorsed the establishment of a Regional Climate Change Centre to continue the work of CPACC in aiding Caribbean countries to prepare for the adverse effects of global climate change. The Caribbean Community Climate Change Centre (CCCCC) is mandated to coordinate, support and facilitate climate change adaptation initiatives in CARICOM member states and eventually the Wider Caribbean. Initially this will involve, but not be limited to, the execution of two regional climate change adaptation projects: Mainstreaming Adaptation to Climate Change (MACC) and ACCC.

Mr. Walling stressed that a regional approach was essential to meet the obligations of multi-governmental agreements. He recognized the need to engage regional expertise and asserted that a multi-sectoral and multi-stakeholder approach would be taken in the development of management systems.

Panel Discussion – Session #5

The presentations stimulated the participants to express their fears that environmental justice may not be served and that the efforts at establishing preparedness systems in the region would be foiled by the lack of support by international policy. A query was raised regarding whether there is any cross-linking of regional activities on adaptation to climate change with those in the developed nations that carry the brunt of responsibility for global warming due to their level of greenhouse gas emissions. There was concern raised about the nature of the policies regarding environmental issues in the developed nations and the disjointedness between dissemination of information and behavioral action. Leslie Walling of CPACC /ACCC pointed out that the concerns of SIDS and low lying coastal developing states (LLCDS) were different from those of the developed nations. In addition, he affirmed that global economic interests, not scientific fact, determined the nature and quality of the international global climate change mitigation and adaptation interventions, to the disadvantage of SIDS and LLCDS.

Interesting suggestions were proposed by the participants in relation to proactive steps that could lead to increased responsiveness to the discourse on climate variability and change:

- approaching the commercial sector for funding of research initiatives as sectors, such as the agriculture industry and economies that are not diversified, could be severely impacted by the effects of climate change;
- the inclusion of a climate change tax by tourism-dependent territories for development of national adaptation to climate change strategies;
- linking environmental impacts to tourism and finance to convince the political directorate;
- lobbying of international insurance companies to include greening clauses in their insurance policies and link premiums to reduction of greenhouse gas emissions; and
- presenting regional insurance companies with an estimation of the future cost of extreme weather events to the insurance industry in the event of climate change to influence policymakers.

Support for the idea of focusing on the impact of change on socio-economic activity came from Tony McMichael. He stressed that sustainable development discourse is essential and that the extent of emerging risk to populations must influence policy discussion.

The topic of risk communication was also addressed. Roger Pulwarty wondered whether the risk communication being developed was indeed transferring useful information to the public. Ana Rosa Moreno reiterated the need to focus on target audiences and to disseminate information tailor-made to impact on behavioral change. She further stated that the language of communication and the selection of media and the descriptive methodology (e.g., puppetry) were essential considerations in the development of information tools. Ms. Moreno also recommended that healthy relationships be established with media houses.

Conference Closing Ceremony

Climate Variability and Change and their Health Effects in the Caribbean: Information for Adaptation Planning in the Health Sector

HEAD TABLE

Dr. Joan L. Aron
Technical Coordinator and Consultant, PAHO/WHO, Washington, D.C., U.S.A.

Dr. Joel D. Scheraga
Director of the Global Change Research Program, U.S. Environmental Protection Agency (EPA), Washington, D.C., U.S.A.

Mrs. Veta Brown
Caribbean Program Coordinator, PAHO/WHO, Barbados

DR. JOAN L. ARON

Dr. Aron thanked all participants for their attendance and active participation in making the conference a success. She expressed gratitude to Mr. Harry Philippeaux for his invaluable assistance and to Mrs. Veta Brown for her sterling leadership in bringing the conference to fruition.

DR. JOEL D. SCHERAGA

Dr. Scheraga spoke on behalf of the conference sponsors. He acknowledged the assistance of Dr. Carlos Corvalán (WHO) in the conceptualization and design of the conference, and thanked all of the organizations that co-sponsored the conference along with EPA. He stated that the conference had exceeded the sponsors' expectations. He commended presenters for the outstanding quality of their research and expressed appreciation for the quality of dialogue and the spirit of collaboration that took place.

Dr. Scheraga noted the importance of bringing a regional perspective to the issue of adaptation to climate change to protect public health. He highlighted the importance of continued funding for regional research and data acquisition in order to improve the resilience of communities to climate variability and change and to protect public health. He also encouraged the continued involvement of stakeholders from the public health and affected communities in the assessment of the potential health impacts of climate change and the development of adaptation options.

He suggested that the conference was an initial stepping stone along the road of preparing the region for climate change through adaptation. Dr. Scheraga expressed optimism for the future. He noted that developing and developed nations were linked by common earth systems and therefore share common concerns in the protection of public health, the earth environment, and society. He also noted the ongoing commitment of EPA, in collaboration with NOAA, NASA, the U.S. National Science Foundation and the private sector in the U.S.A., to promote

research, training, capacity building and sharing of information with policymakers, resource managers, public health officials and other decision makers throughout the world. He hoped that additional similar partnerships would be established in the future.

MRS. VETA BROWN

Mrs. Brown expressed pleasure at the level of interest demonstrated by the participants and emphasized the need for follow-up activities to sustain the spirit of collaboration. She stated that the conference offered opportunities for networking of professionals from varied communities and the formation of links via which useful information can be shared.

Mrs. Brown thanked participants for their contribution in making the exciting and demanding program of the conference a success. She hoped that equitable partnerships would be built in the ongoing process and supported by the new bonds formed during the conference. She expressed appreciation for the commitment to the process and respect for professionalism displayed.

In conclusion, Mrs. Brown, on behalf of WHO and PAHO, thanked Joan Aron, Harry Philippeaux, the co-organizers and the technical staff for their role in the successful staging of the conference.