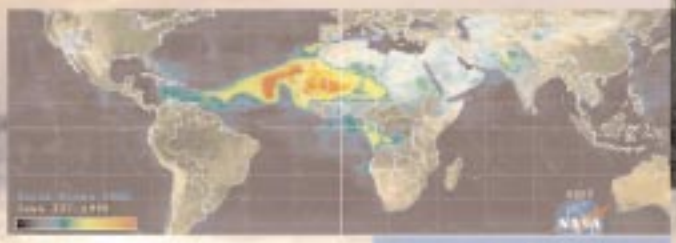
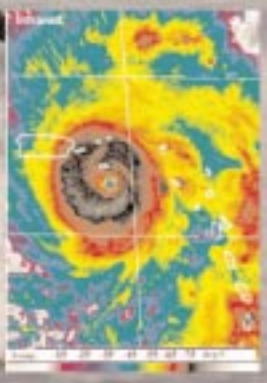
# Climate Variability and Change and their Health Effects in the Caribbean:

## Information for Adaptation Planning in the Health Sector

Conference May 21-22, 2002
Workshop May 23-25, 2002
St. Philip, Barbados, West Indies





HEALTH CANADA
SANTÉ CANADA

ENVIRONMENT CANADA
ENVIRONNEMENT CANADA

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

## Conference May 21-22, 2002
## Workshop May 23-25, 2002
## St. Philip, Barbados, West Indies

*Edited by*

**JOAN L. ARON**
Consultant, Division of Health and Environment
Pan American Health Organization
Washington, D.C.

**CARLOS F. CORVALÁN**
Department of Protection of the Human Environment
World Health Organization
Geneva

**HARRY PHILIPPEAUX**
Office of Caribbean Program Coordination
Pan American Health Organization
Bridgetown, Barbados, West Indies

WHO Library Cataloguing-in-Publication Data

Climate variability and change and their health effects in the Caribbean : information for adaptation planning in the health sector, conference May 21-22, 2002, workshop May 23-25, 2002, St. Philip, Barbados, West Indies / edited by Joan L. Aron, Carlos F. Corvalán, Harry Philippeaux = Variabilidad y cambio climático y sus efectos sobre la salud en el Caribe : información para planificar la adaptación en el sector salud, conferencia 21-22 de mayo de 2002, taller 23-25 de mayo de 2002, St. Philip, Barbados, West Indies / editado por Joan L. Aron, Carlos F. Corvalán, Harry Philippeaux

1.Climate 2.Environmental health 3.Health policy 4.Health status 5.Forecasting 6.Ecosystem 7.Caribbean region I.Aron, Joan L. II.Corvalán, Carlos F. III.Philippeaux, Harry.

ISBN 92 4 159071 8 (English) (NLM classification: WA 30)
ISBN 92 4 359071 5 (Spanish)



ISBN 92 4 159071 8

Printed in the United States of America

**Cover design:**
Mark Nardini

**Cover photographs and images:**

*Background:*
Parent and child enjoying a beach in Barbados at sunset. Source: World Health Organization. WHO-PAHO Digital Photo Library. Image No.WHO-385084.

*Inset, starting in upper right corner and proceeding clockwise:*
Hurricane Lenny causing coastal flooding in Dominica, 1999. Source: Pan American Health Organization. Disasters and Humanitarian Assistance, Images from Hurricane Lenny, November, 1999.
http://www.paho.org/English/PED/pedlenny.htm
See photograph in upper left corner of webpage.

Hurricane Lenny over the Eastern Caribbean in the visible and infrared spectrum from Geostationary Operational Environmental Satellite (GOES)-8, 1999. Source: U.S. National Oceanic and Atmospheric Administration. National Environmental Satellite, Data, and Information Service.
http://orbit-net.nesdis.noaa.gov/arad/fpdt/pix/Lenny.jpg

*Aedes aegypti*, the mosquito that transmits dengue virus, engorged with human blood. Source: U.S. Centers for Disease Control and Prevention. Dengue Branch, San Juan, Puerto Rico.

Earth Probe TOMS Aerosol Index for June 23, 1998, showing African dust being transported westward over the Atlantic Ocean, extending as far west as the Caribbean Islands and even into Florida. Source: Dave Larko, Ozone Processing Team, U.S. National Aeronautics and Space Administration, Goddard Space Flight Center.

# Contents

**Central America and the Caribbean**


Courtesy of the General Libraries of the University of Texas

# Foreword

This conference and workshop has provided a timely forum for sharing information on adaptation to global climate change. This is of paramount importance considering the disparity in the well-being of peoples in poor and rich nations. The Director of the Pan American Health Organization, Dr. George Alleyne, has expressed his particular concern for the territories of Latin America and the Caribbean and the state of preparedness of systems in the Region for dealing with the impacts of climate change. The vulnerability of the Region to various natural disasters, challenges to meet the demands of pressing health issues which affect the productivity of the communities, and the changing socio-economic climate all have an impact on the sustainable development of the Region.

Expanding the sensitivity to the possible impacts of climate change and resources to effect strategic planning and the implementation of preparedness programs require the active partnership of all the regional stakeholders. These should include international agencies, regional governments, and non-governmental organizations and our communities. The conference and workshop resulted in the establishment of networks which will facilitate the sharing of both technical and other resources to promote action rather than non-action in our quest to limit the impact of climate change.

Mrs. Veta Brown
Caribbean Program Coordinator
Pan American Health Organization
Bridgetown, Barbados, West Indies

# Acknowledgments

Many thanks are due to the work of the International Steering Committee and the Local Organizing Committee.

The International Steering Committee consisted of the following members:

| | |
|---|---|
| **Joan L. Aron** (*) | Science Communication Studies, Columbia, Maryland, U.S.A. |
| **Carlos Corvalán** | World Health Organization, Geneva, Switzerland |
| **Kristie Ebi** | World Health Organization, European Centre for Environment and Health, Rome, Italy, and Electric Power Research Institute, Palo Alto, California, U.S.A. |
| **Luiz A. Galvão** | Pan American Health Organization, Washington, D.C., U.S.A. |
| **Janet Gamble** | U.S. Environmental Protection Agency, Washington, D.C., U.S.A. |
| **Hiremagalur Gopalan** | United Nations Environment Programme, Nairobi, Kenya |
| **Paul Llansó** | World Meteorological Organization, Geneva, Switzerland |
| **Nancy Maynard** | U.S. National Aeronautics and Space Administration, Greenbelt, Maryland, U.S.A. |
| **Kakuko Nagatani-Yoshida** | United Nations Environment Programme, Regional Office for Latin America and the Caribbean, Mexico City, Mexico |
| **Jonathan Patz** | Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland, U.S.A. |
| **Harry Philippeaux** | Pan American Health Organization, Office of Caribbean Program Coordination, Bridgetown, Barbados |
| **Espen Ronneberg** | United Nations, New York City, U.S.A. |
| **Joel Scheraga** | U.S. Environmental Protection Agency, Washington, D.C., U.S.A. |
| **Juli Trtanj** | U.S. National Oceanic and Atmospheric Administration, Silver Spring, Maryland, U.S.A. |

(*) Technical Coordinator

The Local Organizing Committee consisted of the following members:

| | |
|---|---|
| **Patricia Aquing** | Caribbean Environmental Health Institute, Castries, Saint Lucia |
| **Clare Forrester** | Pan American Health Organization, Office of Caribbean Program Coordination, Bridgetown, Barbados |
| **Vicky Greenidge** | Pan American Health Organization, Office of Caribbean Program Coordination, Bridgetown, Barbados |
| **Manasseh King** | Ministry of Health, St. Michael, Barbados |
| **Ronald Knight** | Ministry of Health, St. Michael, Barbados |
| **Brenda Lashley** | Pan American Health Organization, Office of Caribbean Program Coordination, Bridgetown, Barbados |
| **Chester Layne** | Barbados Meteorological Office, Christ Church, Barbados |
| **Mark Lee** | Caribbean Conservation Association, St. Michael, Barbados |
| **Tony Nicholls** | Ministry of Physical Development and Environment, St. Michael, Barbados |
| **Maria Pena** | University of the West Indies, Cave Hill Campus, St. Michael, Barbados |
| **Margaret Pestaina-Jeffers** | Caribbean Institute of Meteorology and Hydrology, St. James, Barbados |
| **Harry Philippeaux** (**) | Pan American Health Organization, Office of Caribbean Program Coordination, Bridgetown, Barbados |
| **Sam Rawlins** | Caribbean Epidemiology Centre, Port of Spain, Trinidad and Tobago |
| **Ulric Trotz** | Caribbean Planning for Adaptation to Global Climate Change, Lazaretto Complex, Black Rock, St. Michael, Barbados |
| **Faye Wharton-Parris** | Premier Event Services, St. Michael, Barbados |

(**) Local Coordinator

Thanks also go to Sonia Peter from Barbados Community College, who served as Rapporteur for this conference and workshop; Laura Arelle, a consultant in Mexico City, who translated the document from English to Spanish; and Ana Rosa Moreno, Environmental Health Program Coordinator at the United States-Mexico Foundation for Science, who graciously offered to review the Spanish translation.

The entire Office of Caribbean Program Coordination of the Pan American Health Organization deserves a special note of appreciation for their efforts in setting up and running this conference and workshop.

The Pan American Health Organization/World Health Organization organized this conference and workshop under the auspices of the Government of Barbados and the Interagency Network on Climate and Human Health formed by the World Health Organization, the World Meteorological Organization and the United Nations Environment Programme. The supporting agencies were the U.S. Environmental Protection Agency (Global Change Research Program in the Office of Research and Development), the U.S. National Oceanic and Atmospheric Administration (Office of Global Programs), the U.S. National Aeronautics and Space Administration (Earth Science and Public Health Program), Health Canada (Climate Change and Health Office) and Environment Canada (International Relations Directorate). Participating Caribbean institutions and organizations were the project on Caribbean Planning for Adaptation to Global Climate Change, the Caribbean Environmental Health Institute, the Caribbean Epidemiology Centre and the Caribbean Institute of Meteorology and Hydrology.

### *Electronic Sources of Information*

Presentations, photographs, videos, newspaper articles and other background information on this conference and workshop are on the compact disc that accompanies this report.

For online information about this conference and workshop, visit:

- WHO Department of Protection of the Human Environment's Climate and Health Program.

  http://www.who.int/peh/climate/climate_and_health.htm

- NOAA Research In the Spotlight Archive of Spotlight Feature Articles.

  http://www.oar.noaa.gov/spotlite/archive/spot_archive.shtml

# List of Acronyms and Abbreviations

| | |
|---|---|
| **ACCC** | Adapting to Climate Change in the Caribbean |
| **ADD** | Acute Diarrheal Disease |
| **AIACC** | Assessments of Impacts and Adaptations to Climate Change |
| **AIDS** | Acquired Immune Deficiency Syndrome |
| **AOSIS** | Alliance of Small Island States |
| **BPOA** | Barbados Programme of Action |
| **CAREC** | Caribbean Epidemiology Centre |
| **CARICOM** | Caribbean Community |
| **CCA** | Caribbean Conservation Association |
| **CCCCC** | Caribbean Community Climate Change Centre |
| **CD** | Compact Disc |
| **CEHI** | Caribbean Environmental Health Institute |
| **CIMH** | Caribbean Institute of Meteorology and Hydrology |
| **CPACC** | Caribbean Planning for Adaptation to Global Climate Change |
| **CPC** | Office of Caribbean Program Coordination |
| **CSGM** | Climate Studies Group Mona |
| **D.C.** | District of Columbia (Washington, D.C., U.S.A.) |
| **ENSO** | El Niño - Southern Oscillation |
| **EPA** | U.S. Environmental Protection Agency |
| **GIS** | Geographic Information System |
| **HIV** | Human Immunodeficiency Virus |
| **Hon.** | Honorable |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **LLCDS** | Low Lying Coastal Developing States |
| **MACC** | Mainstreaming Adaptation to Climate Change |
| **NASA** | U.S. National Aeronautics and Space Administration |
| **NCDC** | U.S. National Climatic Data Center |

| | |
|---|---|
| **NGO** | Non-governmental Organization |
| **NOAA** | U.S. National Oceanic and Atmospheric Administration |
| **OAS** | Organization of American States |
| **PAHO** | Pan American Health Organization |
| **PEAC** | Pacific ENSO Applications Center |
| **SIDS** | Small Island Developing States |
| **SST** | Sea Surface Temperature |
| **St**. | Saint |
| **UHI** | Urban Heat Island Effect |
| **U.K**. | United Kingdom of Great Britain and Northern Ireland |
| **UNEP** | United Nations Environment Programme |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **U.S**. | United States of America |
| **U.S.A**. | United States of America |
| **UV** | Ultraviolet Radiation |
| **UWI** | University of the West Indies |
| **UWICED** | UWI Centre for Environment and Development |
| **V&A** | Vulnerability and Adaptation |
| **WHO** | World Health Organization |
| **WMO** | World Meteorological Organization |

# Executive Summary

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

*"I hope also that your work will result in greater understanding, perhaps renewed and greater commitment from our international partners to assist small island States in confronting climate change and its effects. Perhaps when the human health costs of climate change are appreciated and added to the material costs and environmental damages faced by small island States a new spirit of partnership and cooperation will emerge."*

*His Excellency Tuiloma Neroni Slade, Keynote Speech*
*Barbados, May 21, 2002*

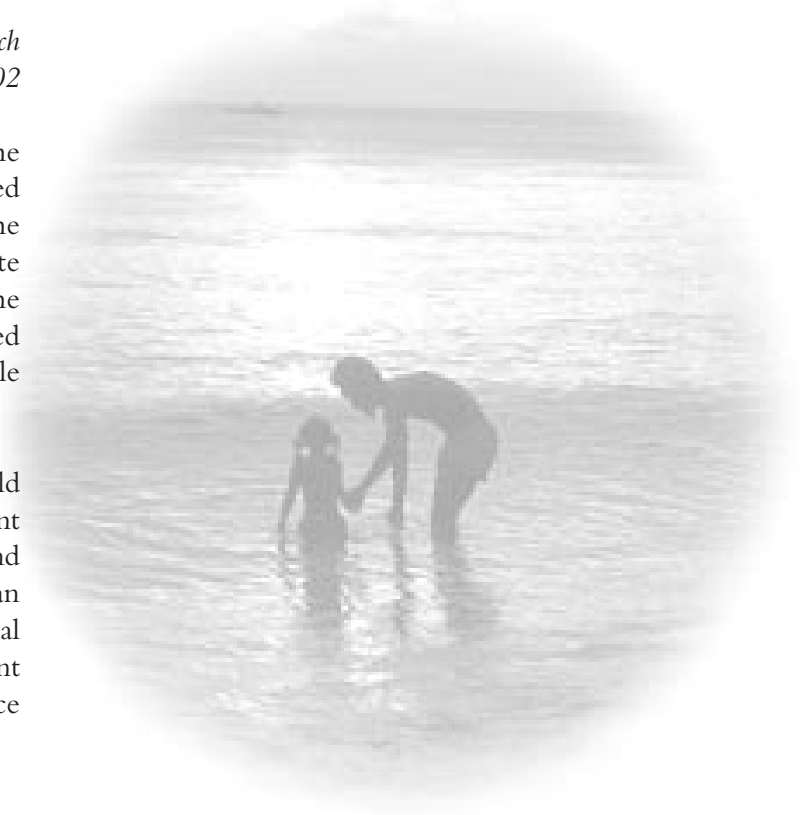
*"Ministries of Health should play a central role in this response -- but should also remember that finding enduring solutions will depend on inter-sectoral communication and convergence."*

*Professor Tony McMichael, Keynote Speech*
*Barbados, May 21, 2002*

Small island states are particularly vulnerable to the effects of climate variability and change. As exemplified in the quotations above from keynote speeches, the Barbados Conference and Workshop on Climate Variability and Change and their Health Effects in the Caribbean addressed the seriousness of health-related consequences and the inter-sectoral nature of possible responses.

The Pan American Health Organization (PAHO)/World Health Organization (WHO) organized this event under the auspices of the Government of Barbados and the Interagency Network on Climate and Human Health formed by WHO, the World Meteorological Organization and the United Nations Environment Programme. The overall objectives of the conference and workshop were to:

1. inform health scientists, practitioners, and officials of the impacts of climate variability and long-term climate change in the Caribbean region;
2. integrate health-relevant sectors (e.g., water resources, agriculture and fisheries);
3. introduce strategies in coastal zone management as they relate to sewage disposal and other health issues;
4. foster joint interdisciplinary research projects among local participants, as well as developed/developing nation scientist partnerships; and
5. promote the incorporation of global, regional and national climate information into planning for public health services at the national level.



The conference was open to the public with approximately 145 participants. The geographic focus of the conference portion was broader than island countries and included mainland countries in the Caribbean basin as well. Most participants came from the Caribbean region. The countries and territories represented were Anguilla, Antigua and Barbuda, Australia, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Canada, Colombia, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Kenya, Mexico, Netherlands Antilles, New Zealand, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Suriname, Trinidad and Tobago, United Kingdom of Great Britain and Northern Ireland, and United States of America.

The presentations for the conference began with an opening ceremony that included two directors of Caribbean regional health offices, two Barbados ministers, and the Secretariat of the Interagency Network on Climate and Human Health. The first keynote address highlighted the vulnerability of Small Island Developing States to climate change, with particular concerns for sea level rise and the reemergence of vector-borne diseases. The second keynote address focused on the detection of health impacts from climate change, stressing the need to introduce adaptive intersectoral policies despite uncertainties about forecasts of climate change and associated impacts.

There were 23 technical presentations, five panel discussions and a poster session. They collectively

1. provided an overview of the basic concepts of climate variability and change;
2. reviewed health status in the Caribbean region with particular reference to climate variability and change;
3. presented frameworks for evaluating the vulnerability of the health system to climate variability and change;
4. presented frameworks for assessing and responding to climate-related health risks;
5. examined linkages between climate and human health; and
6. examined public health policies and strategies for adaptation to climate variability and change.

Major health issues highlighted were vector-borne diseases (dengue, malaria), waterborne diseases, heat stress, asthma, disaster response to climate and weather phenomena, and toxins in fish. The emphasis was on work conducted in or relevant to the Caribbean basin. Some presentations discussed ecological effects that are unique to the Caribbean, focusing on an episode of massive contamination of the sea linked to river outflows from South America as well as the annual atmospheric transport of African dust across the Atlantic to the Caribbean. The policies and strategies for adaptation to climate variability and change covered a broad range of topics, from the control of specific diseases to general communication strategies for climate and health.

The workshop was organized into five workgroups with 39 participants from the region, including the public health, climate/weather and environment sectors. The workshop focused on Caribbean islands and the Caribbean Community countries. The countries and territories represented were Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, British Virgin Islands, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Netherlands Antilles, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago. The

specific objectives of the workshop were designed to provide more detail within the overall objectives of the conference and workshop stated above. The specific objectives of the workshop were to:

1. generate awareness of the impact of climate variability and change on health in the Caribbean region (including other regions with closely-related issues, such as the Pacific Islands);
2. understand how climate data are and could/should be used in health planning;
3. identify the elements of a framework for proactive health/climate actions to assess vulnerabilities and implement mitigation and adaptation strategies in relation to adverse health impacts of climate variability and change;
4. discuss and define the roles of health and climate professionals in the implementation of the framework for proactive health/climate actions;
5. identify key partners and assess institutional/organizational arrangements that must be strengthened and what new entities must be put in place at the national and regional levels to assess vulnerabilities and implement mitigation and adaptation strategies in relation to adverse health impacts of climate variability and change; and
6. identify follow-on capacity-building activities to address climate variability and change and health nationally and regionally.

The workgroups along with facilitators and resource people discussed issues of awareness, use of data, roles of health and climate professionals, and institutional linkages needed. They reached consensus on 22 recommendations for future work on climate and health in the region. The consensus recommendations generally fall into the categories of enhancing awareness, using data and strengthening institutions.

## Recommendations by Workshop Consensus

### *Awareness of Impact*

1. Build awareness throughout the region.
2. Expand the knowledge base of relationships between climate variability and change and health, through nationally- and regionally-based research and engagement of existing interpretive expertise.
3. Identify entry points to build this awareness and develop adaptation and prevention strategies.
4. Promote cross-sectoral communication and consultation in developing these strategies (entry points can be both event- and stakeholder-based).
5. Establish early warning systems that incorporate monitoring of seasonal, interannual and long-term climate events.

### *Public Health Programs and Planning: Using Data*

6. Conduct inventories of existing data, identify current data gaps, and develop strategies to fill these gaps.
7. Establish better data management systems, programs and practices, including the establishment of data quality standards and the distribution of examples of best practices regionally.
8. Identify, engage and enhance appropriate national and regional institutions for data handling, analysis, and tertiary, multi-sectoral product development; and facilitate and enable networking.
9. Encourage fuller use of available data through regional and national capacity building (human resources, information technology, etc.).
10. Develop and maintain firmer inter-sectoral linkages.

### *Public Health Programs and Planning: Using Data Special Situations: El Niño - Southern Oscillation (ENSO); Sea Level Rise*

11. Establish verifiable links between ENSO, extreme weather events, and climate variability and health consequences in the Caribbean.
12. Identify and map locations, hazards and communities especially at risk and vulnerable to sea level rise and associated health risks, taking a holistic, cross-sectoral view.
13. Develop long-term adaptive strategies for sea level rise, based on an understanding of current coping strategies and of national development priorities.

### *Institutional and Organizational Arrangements*

14. Evaluate current indicators and generate regional standards.
15. Work effectively with policymakers to enhance awareness of climate variability and change, and to catalyze discussion at national and regional levels.
16. Develop institutional arrangements for data integration and dissemination.
17. Improve exchange of knowledge by developing effective mechanisms for information sharing.
18. Improve national and regional facilities and funding for interdisciplinary research.
19. Improve education and training through further workshops, follow-on networking (beginning with the participants of this workshop), and structured training at local, national and regional levels.
20. Find and use entry points for climate/health issues.
21. Engage existing regional and national institutional mechanisms and processes for climate change adaptation, including national climate committees and the Caribbean Community Climate Change Centre.
22. Obtain institutional support from international organizations (especially PAHO) in activities related to capacity building, research and regional/national assessments.

## Acknowledgments

The supporting agencies were the U.S. Environmental Protection Agency, the U.S. National Oceanic and Atmospheric Administration, the U.S. National Aeronautics and Space Administration, Health Canada and Environment Canada. Participating Caribbean institutions and organizations were the project on Caribbean Planning for Adaptation to Global Climate Change, the Caribbean Environmental Health Institute, the Caribbean Epidemiology Centre and the Caribbean Institute of Meteorology and Hydrology.

# 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

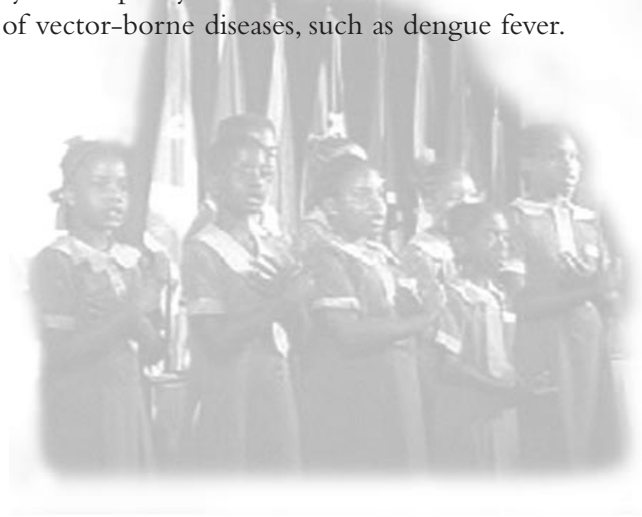
**Mr. Vincent Sweeney**

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

↓

Determination of climate scenarios and predictions from modelling

↓

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.

# Opening of the Workshop

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

### OPENING

Dr. Joan L. Aron, PAHO consultant and technical coordinator of the conference and workshop, welcomed the participants to the workshop and invited Dr. Carlos Corvalán of WHO to give the opening address.

### DR. CARLOS CORVALÁN

Dr. Corvalán thanked the participants for their keen interest. He alerted the gathering that the Workshop on Climate Variability and Change and their Health Effects is an initiative that will hopefully build on the objectives of a previous workshop held in the Pacific (Samoa) in 2000. He emphasized the importance of sensitizing the public to the possibility of escalation of current problems by the impact of climate change. He expressed concern about the impression, held by many, that such environmental health problems are only the responsibility of the environment sector or of the health sector. Dr. Corvalán anticipated that the recognition of the need for inter-sectoral collaboration will be a major outcome of the workshop. He suggested that some of the key points for discussion should include

- required actions in the health sector for adaptation to climate change,
- key partnerships required,
- assessing capacity-building needs, and
- addressing future steps, including recommendations for action.

He urged workshop participants to engage in open dialogue with the objective of outlining the goals, achievements and leadership expected from the partnership with PAHO/WHO. He emphasized that the conclusions of the workshop will be used by PAHO/WHO in developing future regional initiatives on climate change.

### DR. JOAN L. ARON

Dr. Aron provided the orientation for the workshop. She offered direction by informing the group that work sessions will follow an integrated approach with information from facilitators serving to fuel discussions. The broad objectives of the workshop were then listed.

The workshop was expected to:

- generate awareness of the impact of climate change/variability on health in the Caribbean region with consideration given to regions with similar issues (e.g., the Pacific Islands);
- enhance the understanding of how climate data are and could/should be used in health planning;
- identify the elements of a framework for proactive health/climate actions to assess vulnerabilities and implement mitigation and adaptation strategies in relation to adverse health impacts of climate change/variability;
- discuss and define the roles of health and climate professionals in the implementation of the framework for proactive health/climate actions;
- identify key partners and assess institutional/organizational arrangements that must be strengthened and determine what new entities must be put in place at the national and regional levels to assess vulnerabilities and implement mitigation and adaptation strategies in relation to adverse health impacts of climate change/variability; and
- identify follow-on capacity-building activities to address climate change/variability and health nationally and regionally.

### *Expectations of Workshop Participants*

Following is a sample of the expectations as expressed by the workshop participants.

- To be exposed to risk communication methods proven to be successful in enhancing public awareness (Antigua and Barbuda, Jamaica).
- To be sensitized to the issues of climate variability/change and the relationship to health by professionals.
- To gather information and share with relevant sectors on returning home (Belize).
- To obtain strategies for the integration of climate change and health in environmental policy.
- To learn about the Caribbean situation and offer assistance.
- To share satellite services and form partnerships in planning for adaptation to climate change (NASA).
- To share methods of data collection and archiving (NCDC).
- To gain a sense of regional needs and strategies for implementation and to establish a Caribbean-Pacific linkage for sharing of information (CEHI).
- To become aware of available resources and accessibility.
- To gain a comprehensive understanding of health factors relating to climate variability/change and strategies for coping.
- To gain knowledge of the impact of climate variability/change on dengue and possible interventions.
- To establish regional partnerships with climate change planners, such as CPACC, and to gain an assessment of regional vulnerability and available services in relation to the development of early warning systems.
- To become involved in technical cooperation programs with member countries and engage in discussions on mitigation as it relates to disaster preparedness (PAHO/Trinidad and Tobago).
- To enhance awareness of the use of remote sensing in data acquisition for analysis of climate change patterns and to determine the needs of researchers in the region so that products can be tailor-made for relevance to the region (NASA).
- To learn more about climate change, coastal zone management and health factors, as well as to form linkages (Suriname).
- To form regional links for public health surveillance and to determine how scientific results can be used to predict impacts and advise policymakers regarding environmental health (Cuba).
- To form linkages for sharing of information that can be used in the establishment of a National Environmental Health Unit (Haiti).
- To gain exposure to the key issues on climate change and environment to assist in the formulation of teaching objectives for a module on vector control (Barbados Community College's Division of Health Sciences).
- To discuss ways of coordinating research activity in the region (Antigua and Barbuda).
- To forge awareness of the role of meteorological offices in strategic planning and development of early warning systems.
- To discuss strategies for strengthening inter-sectoral collaboration and the establishment of regional and national surveillance systems in the context of a regional framework for action (Barbados).
- To forge regional linkages (Saint Vincent and the Grenadines).
- To harness the skill of meteorological services in the generation and dissemination of relevant and useful information linking the impact of weather on public health and to collaborate in the use of climate forecasting for the minimization of the impact of weather on public health (WMO).
- To use information gained as an integral part of planning in the environmental health sector (Ministry of Physical Development and Environment/Barbados).

- To gain knowledge of the best practices applied intra- and inter-regionally in quantitative research, risk management and public awareness.
- To strengthen the linkage among the ministries (e.g., Environment/Public Health).
- To be empowered to sensitize people at home and raise awareness.
- To receive sufficient data and information to make appropriate decisions regarding climate change- and health-related national activities.
- To urge the players in the country to participate more actively in climate change through health activities.
- How choice of research questions can be informed by public health needs.
- Increasing awareness of climate and health on all time scales.
- To construct the overall framework within which climate / health studies can be placed.
- To improve national and regional collaboration.
- Use of data / development of indicators within the context of sustainability.
- How to ensure coordination among countries after meeting.
- How do we make sure that others are not left out / back?
- To see the possibility of Pacific - Caribbean collaboration.
- Risk management and communication research.
- "Best practices" for climate/health studies.
- Identification of priorities.

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

### *Workshop Activity*

The participants were divided into five workgroups. A primary consideration was to group people together who would work together in the future. Therefore people from different sectors in the same country were usually grouped together. However, every group had multiple countries represented. Each workgroup selected a chairperson, a rapporteur and a delegate. The groups were assigned the task of discussing selected issues according to guidelines suggested in the workshop program and with the aid of background information provided by facilitators. The delegates were given the responsibility of reporting, in plenary, the conclusions and recommendations of their individual workgroups in the final session of the workshop.

### *Regional Issues and Topic Facilitators*

**Awareness of the Impact of Climate and Health in the Caribbean Region**
**Jonathan Patz**
Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, U.S.A.

**Public Health Programs and Planning: Using Health, Climate and Environment Data**
**Sari Kovats**
London School of Hygiene and Tropical Medicine, London, U.K.

*Short presentations added to the schedule to address particular needs*

***Integrated System for Health and Environmental Applications***
**Gilberto Vicente**
George Mason University and NASA, U.S.A.
***El Niño Southern Oscillation (ENSO) and its Impacts***
**Roger Pulwarty**
NOAA and University of Colorado at Boulder, U.S.A.

**Framework for Actions and the Roles of Health and Climate Professionals**
**Alistair Woodward**
Wellington School of Medicine, Wellington, New Zealand

**National /Regional Institutional Arrangements and Follow-on Capacity-Building Activities**
**Ulric O'D. Trotz**
CPACC/ACCC, UWICED,
Cave Hill Campus, Barbados

### *Issue # 1*
### AWARENESS OF THE IMPACT OF CLIMATE AND HEALTH IN THE CARIBBEAN REGION

**FACILITATOR**
**Jonathan Patz**

**PRESENTATION**

Dr. Patz instructed the members of each workgroup to examine the health situation in their individual countries. He further sensitized the groups to points for consideration as issues of relevance to local communities. These were listed as:

- vectors and related factors, such as the effect of temperature on larval development;
- UHI;
- fish kills;
- availability of tools for data acquisition (e.g., remote sensing);
- transatlantic dust;
- precipitation levels;

- temperature change – IPCC predicts 1.4 to 5.8°C rise by 2100; and
- sea level rise – IPCC predicts 9 to 88 cm rise by 2100.

The groups were advised to link specific climate change impacts to related health issues. He also suggested that discussions should identify stakeholders, decision makers, the current state of systems, and channels available for dissemination of information.

### *Issue #2*
### PUBLIC HEALTH PROGRAMS AND PLANNING: USING HEALTH, CLIMATE AND ENVIRONMENT DATA

**FACILITATOR**
**Sari Kovats**

**PRESENTATION**

Ms. Kovats gave an overview of data that could be used in public health planning for climate-related impacts on health. These data can be used for:

- development of a model on which to base an early warning system;
- validation/testing of a model;
- evaluation of interventions/responses;
- risk mapping -- in time and space;
- targeting resources (demographic/household surveys, census); and
- health surveys -- cross-sectional studies to detect risk factors.

These methods were illustrated with the example of data used as part of an early warning system for a climate-sensitive disease such as malaria:

- climate forecasts (rainfall and temperature anomalies 3 - 6 months ahead);
- satellite data -- proxies for weather or vegetation indices (e.g., Normalized Difference Vegetation Index);
- socio-economic data (e.g., census information on populations);
- weather data [climate stations]; and
- health surveillance (case detection to confirm the start of an epidemic).

The groups were then instructed to focus their discussions on restraints in data acquisition.

## *Added to Schedule*

### *Issue*
### INTEGRATED SYSTEM FOR HEALTH AND ENVIRONMENTAL APPLICATIONS

**FACILITATOR**
**Gilberto Vicente**

**PRESENTATION**

Dr. Vicente demonstrated the use of an interactive CD showing NASA's Integrated System for Health and Environmental Applications currently in development as part of NASA's Earth Science and Public Health Program. The purpose of this system is to provide guidance for quick access to user-friendly satellite data and products for health and environmental applications. The system aims to satisfy an increasing demand by the health community for data and information on many different environmental factors pertinent to the links between disease occurrence and transmission and the environment.

These data and information are important for monitoring, risk mapping and surveillance of epidemiological parameters on a large number of different spatial, temporal or spectral resolutions. Dr. Vicente stressed that, in order to improve the manipulation and integration of both health and remotely-sensed environmental data for addressing these issues, we need to develop systems

that allow the use of remote-sensing data beyond the research community into operational disease surveillance and control.

The current system under development at NASA's Earth Science and Public Health Program and presented during the workshop is designed to provide quick and easy data access to people unfamiliar with remote-sensing technology, but responsible for making decisions about the control of outbreaks of environment-related infectious diseases. The focus of the project is to create personalized tools to serve the needs of users with very little knowledge in the field of remotely sensed data acquisition and manipulation, but have an important role in the decision making processes at the local, state and federal levels. This is a NASA attempt to decrease the gap between the remote-sensing science/research community data producers/users and the operational/application users in the medical and epidemiological fields.

A demonstration CD was distributed during the workshop. Additional information is available by contacting Dr. Vicente at NASA: gvicente@pop900.gsfc.nasa.gov (see also the entries for Dr. Maynard and Dr. Vicente on the registration list).

### *Added to Schedule*

***ISSUE***
**EL NIÑO SOUTHERN OSCILLATION (ENSO) AND ITS IMPACTS**

**FACILITATOR**
**Roger Pulwarty**

**PRESENTATION**

Dr. Pulwarty provided background information on ENSO and its impacts. The ENSO cycle includes El Niño and La Niña events. He informed the groups that El Niño and La Niña occurrences have been estimated to have 30-40 % impact on climate change, and a knowledge of the frequency of occurrence can help in preparedness planning for agricultural activity. He established the effects of the systems indicating that El Niño leads to warmer SSTs in the central and eastern equatorial Pacific Ocean during the months of May to July, while La Niña has the opposite effect.

He added that researchers have linked decreased precipitation and tropical storm activity in the Caribbean with an El Niño year and the reverse effect for a La Niña year. Some of the other effects of an El Niño year included decrease in river levels, sea water intrusion in aquifers and hence increased salinity of ground water. The impact of these conditions should therefore be considered in preparedness planning and mitigation of effects.

The groups were advised that factors other than the state of tropical Pacific Ocean SSTs may influence regional climate variability. Some of these factors include local atmospheric dynamics, SST in other ocean basins and land surface conditions. In linking ENSO to health, Dr. Pulwarty suggested that the impact of climate in triggering or exacerbating health-related occurrences should be the focal point. He concluded by admitting that the dynamics of ENSO are not fully understood and hence a degree of uncertainty is associated with the use of prediction models. He noted, however, that some success has been achieved

from modelling using local and regional data, and examples were drawn from applications in the agriculture sector in Trinidad, specifically the sugar cane industry. The current forecast for 2002 (at the time of the workshop) predicted a weak warm phase of ENSO and an average hurricane season.

### *Issue #3*
### FRAMEWORK FOR ACTIONS AND THE ROLES OF HEALTH AND CLIMATE PROFESSIONALS

**FACILITATOR**
**Alistair Woodward**

**PRESENTATION**

Dr. Woodward presented questions for consideration during the discussion of the topic:

- How should assessment of climate change impacts on health be approached?
- What steps should be taken to improve adaptive capacity and to mitigate climate change?
- What part should climate and health professionals play in making these changes?

He advised that discussions should focus on how territories can strengthen adaptive capacity. He also suggested that current problems associated with climate variability should be connected to future impacts of climate change. Consideration should also be given to the difficulty of influencing public response to impacts that may occur in 50 to 100 years. Woodward then offered a framework for action that included:

- use of local knowledge;
- empowerment of agencies and institutions;
- examination of policy and institutional changes that would impact both the short and long term; and
- enhancement of public awareness of the need to plan for long-term effects.

### *Issue #4*
### NATIONAL/REGIONAL INSTITUTIONAL ARRANGEMENTS AND FOLLOW-ON CAPACITY-BUILDING ACTIVITIES

**FACILITATOR**
**Ulric O'D. Trotz**

**PRESENTATION**

Dr. Trotz gave a comprehensive overview of the developments leading to the institutionalization of climate change activity in the Caribbean. He indicated that the BPOA, conceptualized at the SIDS conference in 1994, laid down the framework for the implementation of sustainable development strategies that included preparedness for climate change. The CPACC project was initiated with assistance from the OAS and the World Bank with funding through the Global Environment Facility. The Regional Project Implementation Unit, staffed with regional professionals, was responsible for the management of the regional project in twelve CARICOM countries.

Four years of sustained effort led to the establishment of National Climate Committees in each territory with responsibility for the implementation of activities. These committees were established through the efforts of National Focal Points appointed by Governments to coordinate national activities under the project, and they consisted of representatives from different governmental sectors, non-governmental organizations and the private sector. Through this process, linkages were

developed with the political directorate. At the regional level, such linkages are made through the mechanism of reporting on Climate Change activities to the CARICOM Council of Ministers responsible for Trade and Economic Development under the agenda item dealing with sustainable development.

The success of CPACC led to the endorsement by CARICOM ministers of a permanent regional institutional mechanism to address climate change issues. The CCCCC has been proposed and subsequently approved of as the appropriate institutional mechanism to continue the work completed by CPACC in December 2001. The CCCCC became a legal entity in February 2002, when it was finally approved at the Inter-sessional meeting of CARICOM Heads of Government held in Belize. A decision regarding the host territory will be made in July 2002. CCCCC is mandated to act as

- an executing agency for regional climate change programs and projects,
- an advisory mechanism on climate change policy to the CARICOM Secretariat and its member countries, and
- a source of scientific and technical information on climate change and its potential impacts in the region.

The CCCCC will be the focal point of all climate change activities in the region and will work toward the establishment of an effective regional network geared to addressing climate change issues in the region.

Dr. Trotz expressed anticipation that the conference activities would lead to enhancement of regional networking and welcomed the initiative in linking climate change to public health. He commended organizers for the inter-sectoral blend of the participants invited to the conference. He cautioned that it was essential for requirements from varying sectors to be clearly defined so that meaningful outputs result from collaborative and cross-linking activities. He added that careful analysis of the current status in terms of data, records and available tools must be made to provide a platform for future capacity building. He felt strongly that priority must be given to building national capacity and developing modalities to address concerns at a national level.

Generally, he envisioned building of regional capacity such that this capacity could be made available to enable individual countries to address national issues of import. In conclusion, he intimated that he expected the pooling of regional expertise to provide the capacity to form international partnerships in making contributions in other environmental areas of concern, including biodiversity, desertification and regulations on ozone-depleting chemicals.

*The schedule was modified to combine the discussion of Topics 3 and 4 in plenary, leaving more time on the final day to develop a group consensus on recommendations.*

### *Plenary Session on Institutional and Organizational Arrangements*

Participants met in plenary to discuss institutional frameworks. Shown below are the categories addressed and the responses captured.

#### NEW STRATEGIES FOR INSTITUTIONAL AND ORGANIZATIONAL ARRANGEMENTS

- Strengthening of surveillance systems and data collection as well as further use of CAREC.
- Support of AIACC research into links between climate change and diseases (e.g., dengue).
- National Forum for discussion of mediating factors and the generation of data.
- Periodic review of indicators in planning.

- PAHO / WHO and the Caribbean Disaster Emergency Response Agency should give a presentation at the next Health Ministers conference to inform policymakers.
- Survey to gauge state of preparedness, data acquisition, methodologies and surveillance systems.
- Cross-linking with international agencies for data acquisition.
- Development of a regional Environmental Statistics Unit.
- Increase in accessibility of regional data and use of modern information systems.
- Regional meeting on climate, environment and health for information exchange and climate forecasting.

**CAPACITY-BUILDING ACTIVITIES NEEDED TO ASSESS VULNERABILITY AND IMPLEMENT MITIGATION AND ADAPTATION STRATEGIES**

- Integration of the knowledge base regarding climate and health as well as targeting of youth via educational programs.
- Strengthening of laboratory infrastructure for analysis.
- Strengthening of information technology infrastructure.

- National cross-sectoral database.
- Improvement in communication systems.
- Introduction of climate change modelling into curriculum at the undergraduate level.
- Collaboration with community groups in planning and management for mitigation/adaptation.
- Development of reliable models to inform mitigation efforts.

**NEED TO MAXIMIZE INTERSECTORAL LINKS**

- Regional newsletter.
- Individual efforts at maintaining links established at conference.
- Ongoing development of regional plans of action, sharing and updating.

### *Final Conclusions and Recommendations*

Delegates from the five workgroups met with Jonathan Patz and Chris Sear as facilitators. They drafted a document of conclusions and recommendations from the workshop. The summary of discussion and conclusions appears in this section of the report. These represent various individual opinions, but they do not necessarily represent the consensus opinion.

In contrast, the recommendations were refined in plenary session and do reflect the consensus made by the workshop. They appear in the section entitled Recommendations by Workshop Consensus, which immediately follows the delegates' report.

### *Delegates' Report*

'Public Health Community' is here defined as all persons who share a common responsibility for health and welfare of community and nation, including government institutions, and public and private practitioners.

## *Discussion Topics*

### I. AWARENESS OF IMPACT

***Q. A. Does the public health community in your country believe the climate issue is important? If yes, why? If no, why not?***

All agreed that there was some awareness of climate issues in their countries. In some cases though, recognition of the issues' importance is restricted to policy-makers and public health officials. Often the public at large is not aware that climate variability and change are already adversely impacting on their lives. Indeed, lack of public awareness is a real barrier to effective political action in many communities. However, in Cuba, all communities are well informed through the media and educational programs.

The evidence for this answer includes the fact that all represented countries signed the UNFCCC. In some territories, climate change committees already exist. Also, health communities are already informed through their recognition of relevant links and their need to deal with non-communicable diseases, such as heart disease, hypertension and others that are aggravated by heat stress; as well as to address the issue of communicable diseases influenced by current climate, including dengue, gastro-enteritis, etc. (These diseases are possible entry points for the recommended future activities on climate and health in the region.)

A current requirement is to provide timely early warning capabilities for hurricane preparedness and other severe weather events. (Early warning is a possible entry point for capacity building and other recommended future activities on climate and health in the region.)

Three reasons are identified to explain why understanding in the health community is sometimes limited:

- lack of access to information about climate and health relationships and a lack of interpretive expertise;
- no common terminology used by health and climate professionals; and
- lack of understanding concerning the difference between climate variability and climate change.

In some countries, the public has limited awareness because of the 'newness' of the issue and its 'remoteness' from their daily lives. But there were presented several specific examples (cases) which demonstrate some localized awareness because of recent events. These include, for example, fish kills, floods, drought, dengue outbreaks and heat-stressed chickens (adversely affecting their owners' livelihoods).

***Q. B. How would you use presentations from the conference on climate and health in the Caribbean to enhance awareness of the impact of climate change/variability on health?***

Participants and other health community actors should take and explain the workshop findings to policy and decision makers and other stakeholders, at local to national levels (including politicians, insurers, health agencies, etc.); and using information and contacts, they should establish and inform public awareness programs. Proposed activities include:

- hosting of inter- and cross-sectoral workshops, panel discussions and other events for all stakeholder groups;
- lobbying strongly for the inclusion of climate change issues in school and college curricula… "Save (our home) for future generations";
- involving the media and government information services, both as partners and as promoters;
- introducing the concept of risk assessment into the public consciousness;
- using already established regional and international institutions and agencies: ACCC-MACC, UWI, AIACC, PAHO/CPC, CEHI, CAREC, CIMH, CCA, PAHO/WHO, WMO, UNEP;
- generating promotional materials and dissemination strategies, including using music disc jockeys and similar entertainers to promote the message, providing bumper stickers and memorabilia and the like; and

- partnering community leaders and institutions (for example, community centers and local NGOs).

***Q. C. Are your responses to A and B different for seasonal to interannual climate variability such as El Niño, as compared with long-term global climate change? If so, why?***

The answer is sometimes no. One reason is that the public health community simply has not grasped the significance of the difference between climate change and variability. There was a strong feeling that issues of short-term variability (which have immediacy) are available as entry points with which to introduce longer-term issues to identify and inform stakeholders at all levels. It should be possible to generate win-win now strategies (immediacy and relating to 'today's concerns') which will spin off longer-term benefit. It is recognized, however, that there is a possible downside of 'sidelining' climate change (as opposed to climate variability). The logic goes: "if we are going to do this anyway, why do we need to care about the longer-term future impact of (uncertain) climate changes?"

In order to address some of these issues, the following actions were recommended:

- establish early warning systems for seasonal, interannual and long-term effects;
- develop and implement legislation and regulations to reduce vulnerability to seasonal and interannual climate variability: building codes, coastal zone management, etc.; and
- make use of panels of global, regional, intraregional and especially national experts to speak to issues 'endemic' to islands and countries.

It is necessary to carefully define mitigation, since it has different meanings in different professional communities.

***Refer to Recommendations by Workshop Consensus 1 - 5 under Awareness of Impact.***

## II. PUBLIC HEALTH PROGRAMS AND PLANNING: USING DATA

***Q. A. What kinds of data are used in public health programs and planning?***

The workshop participants generally agreed that most surveillance and monitoring aspects of most public health programs use the following data:

- weather/climate data, such as temperature and especially rainfall;
- derived information (i.e., not strictly raw or primary data), such as forecasts (hurricane, severe weather events, etc.);
- indices, such as the Global Solar UV Index and Mosquito Breteau Index;
- rates, such as mortality and morbidity, and disease-specific incidence and prevalence data;
- economic data, such as the gross domestic product, budget, etc.;
- demographic and other social data; and
- other: water availability and quality, waste water system data, etc.

There are large variations between islands, however, in the amount, the temporal and spatial specificity and the quality of the data used in health community planning.

***Q. B. What data could/should be used in public health programs and planning?***

The workshop participants prepared the following list of data:

- climatic indices or variables, including drought indices and hydrological variables;
- environmental data, including such as earth observation (remotely sensed) imagery and data, mapping, coastal zone profiling, water quality, hydrological data, air quality and UV data, etc.;

- expanded health data, including, for example, pupae per person (pupa is a stage of mosquito develop ment); and
- data integrated, stored and analyzed using GIS technologies, such as delineated zones of health hazard, flood risk, routings for disaster response, control planning and evaluation.

***Q. C. What are existing or foreseen constraints regarding application of climate and environment data to health issues? and What are the strengths and weaknesses of health, climate and environment data? Include other sources of data as appropriate.***

**Strengths**

- tradition of data collection in all represented countries;
- legislation for collection and reporting;
- accessibility to data on the internet (could be a weakness unless confident of weeding out poor data/information);
- some history of regional collaboration.

**Constraints / Weaknesses**

- limited sharing of data amongst agencies and lack of feedback to data providers;
- inappropriateness of data and limited systematization;
- limited data quality and availability, inadequate storage;
- lack of financial and human and other resources to analyze data rigorously;
- infrastructural and information technology weaknesses;
- lack of regional co-ordination and data exchange;
- weak reporting mechanisms;
- lack of cross-sectoral dialogue (especially with respect to water supply and waste management, tourism, agriculture and fisheries);
- some data networks are inadequate to represent spatial variability (e.g., rainfall gauge networks);
- s• lack of an 'information culture' on some islands;
- information that is not user-friendly;
- political insensitivity to scientific data and their limitations.

***Refer to Recommendations by Workshop Consensus 6 – 10 under Public Health Programs and Planning: Using Data.***

**El Niño Southern Oscillation (ENSO)**

***Q. A. What is the current forecast for El Niño? What are the possible implications for the Caribbean region? What are the major health concerns? What are the possible responses?***

At the time of the workshop, the current forecast was for a weak warm phase of ENSO later in the year 2002, but that this could strengthen the following year 2003. At the time of the workshop, an above-average hurricane season had been forecast for 2002.

***Response:*** *maintain guard*

It is important to note that the Caribbean Region is exposed most years to flooding due to storms and hurricanes and drought, irrespective of El Niño and La Niña. Therefore, preparedness should not focus just on the El Niño and La Niña forecast.

**Sea Level Rise**

***Q. B. How are coastal zones vulnerable to sea level rise? What are the possible implications for the Caribbean region? What are the major health concerns? What are the possible responses?***

- Caribbean coasts are vulnerable to sea level rise.
- Many coasts are vulnerable to erosion.
- Many coasts are vulnerable to salt water intrusion.
- There is a risk of increasing the number of habitats for some mosquito vectors.

- There is a significant risk of increased coastal flooding and loss of natural resources (reefs, mangroves, sea grasses, beaches and other coastal habitat, with indirect but important impacts on fisheries, algae and biodiversity); and adverse impacts on tourism, coastal structures, roads, water supply systems and other built infrastructure.
- There would be an increased gastroenteritis risk from water contamination.
- There may be a risk of population displacement.
- Human interventions (such as dredging) may ameliorate or worsen impacts.
- There are other economic implications and possible mental and physical stress on local populations.

Responses and solutions include long-term adaptation strategies, evacuation plans and building sea defenses. Water supply policies need refinement to account for likely sea level rise. Zonal planning (Integrated Coastal Zone Management) will be required. The development of sea level rise response policies will have to combine elements of

- Protection,
- Adaptation, and
- Retreat,

depending on local situations, resources and policy. Other responses will include improving

- emergency preparedness programs,
- health education, and
- early warning systems.

***Refer to Recommendations by Workshop Consensus 11 - 13 under Public Health Programs and Planning: Using Data/ Special Situations: El Niño-Southern Oscillation (ENSO); Sea Level Rise.***

## III. INSTITUTIONAL AND ORGANIZATIONAL ARRANGEMENTS

This section contains lists of recommendations from the plenary, with no prioritization or workshop consensus.

***Q. A. What institutional and organizational arrangements must be strengthened and what new entities must be put in place at the national and regional levels?***

**National:**

- Strengthen health surveillance and monitoring systems, with assistance from CAREC.
- Build national forums.
- Undertake a survey and inventory of current data and surveillance systems.
- For effective outcomes, link and work at departmental level – forming personal networks and links at this level of government.
- Establish national environmental information units to 'handle' environmental data relevant to health and other sectors (i.e., to bring together, integrate, analyze, generate products and distribute data and information).

**Regional:**

- Evaluate currently commonly used indicators and generate regional standards if appropriate.
- Charge one agency to lead on climate change - health issues and give it a responsibility for delivery.
- Establish protocols for disease data (examples already exist).

**National and Regional:**

- Integrate across sectors.
- Fund demonstration projects of climate-health relationships, both nationally and regionally.
- Use appropriate data resolutions to represent geographic diversity.

- Develop institutional arrangements for data integration and dissemination.
- Generate political will by placing climate variability and change and health linkage issues on the agenda of the regional health ministers' conference.
- Convene regular meetings of climate, health and environment professionals, nationally and regioally, to exchange information and ideas.

***Q. B. What capacity-building activities will you develop in your country to assess vulnerabilities and implement mitigation and adaptation strategies in relation to adverse health impacts of climate change / variability?***

**National:**

- Develop laboratory infrastructure and information technology systems.
- Make centralized national databases accessible for all sectors and cross-sectorally.
- Develop education and public awareness campaigns.

**Regional:**

- Build on the current and planned initiatives.

**National and Regional:**

- Develop human capacity training (especially of young scientists) in assessing vulnerability.
- Develop skills transfer, long-term training programs, and short-term training (individual consultations).
- Evaluate current surveillance methods and archives.

In order to make these efforts sustainable, the groups affected must develop ownership of the issue.

***Q. C. How can you maximize the activities and linkages in the health, climate and environment sectors to exploit information from existing and new entities?***

**National**:

- Develop community-based interventions and collaboration.
- Develop knowledge of the science and the social and political process of mitigation.

**Regional:**

- Make best use of CPACC outputs (and follow-on projects ACCC and MACC).
- Maximize use of existing links.

**National and Regional:**

- Establish credible communications strategies.
- Develop predictive models through research in order to guide mitigation at multiple levels.
- Use workshops to incorporate new information over time.
- Use regional (and national, where possible) newsletters (including existing ones) and the internet to disseminate widely information on activities and climate–health links.

Three key entry points were confirmed to be these stakeholder groups:

- water resource managers;
- disaster managers; and
- vector control officers.

Other stakeholder groups need to be found (e.g., tourism officials).

Finally, it was noted that a gradual and staged approach would be beneficial, as would an interdisciplinary collaboration using further, focused regional workshops.

***Refer to Recommendations by Workshop Consensus 14 – 22 under Institutional and Organizational Arrangements.***

# Recommendations by Workshop Consensus

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

### *Awareness of Impact*

1. Build awareness throughout the region.
2. Expand the knowledge base of relationships between climate variability and change and health, through nationally- and regionally-based research and engagement of existing interpretive expertise.
3. Identify entry points to build this awareness and develop adaptation and prevention strategies.
4. Promote cross-sectoral communication and consultation in developing these strategies (entry points can be both event- and stakeholder-based).
5. Establish early warning systems that incorporate monitoring of seasonal, interannual and long-term climate events.

### *Public Health Programs and Planning: Using Data*

6. Conduct inventories of existing data, identify current data gaps, and develop strategies to fill these gaps.
7. Establish better data management systems, programs and practices, including the establishment of data quality standards and the distribution of examples of best practices regionally.
8. Identify, engage and enhance appropriate national and regional institutions for data handling, analysis, and tertiary, multi-sectoral product development; and facilitate and enable networking.
9. Encourage fuller use of available data through regional and national capacity building (human resources, information technology, etc.)
10. Develop and maintain firmer inter-sectoral linkages.

### *Public Health Programs and Planning: Using Data Special Situations: El Niño - Southern Oscillation (ENSO); Sea Level Rise*

11. Establish verifiable links between ENSO, extreme weather events, and climate variability and health consequences in the Caribbean.
12. Identify and map locations, hazards and communities especially at risk and vulnerable to sea level rise and associated health risks, taking a holistic, cross-sectoral view.
13. Develop long-term adaptive strategies for sea level rise, based on an understanding of current coping strategies and of national development priorities.

### *Institutional and Organizational Arrangements*

14. Evaluate current indicators and generate regional standards.
15. Work effectively with policymakers to enhance awareness of climate variability and change, and to catalyze discussion at national and regional levels.
16. Develop institutional arrangements for data integration and dissemination.
17. Improve exchange of knowledge by developing effective mechanisms for information sharing.
18. Improve national and regional facilities and funding for interdisciplinary research.
19. Improve education and training through further workshops, follow-on networking (beginning with the participants of this workshop), and structured training at local, national and regional levels.
20. Find and use entry points for climate/health issues.
21. Engage existing regional and national institutional mechanisms and processes for climate change adaptation, including national climate committees and the CCCCC.
22. Obtain institutional support from international organizations (especially PAHO) in activities related to capacity building, research and regional/national assessments.

# Closing of the Workshop

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

Participants were asked to offer suggestions that could lead to improvement of the outcomes in future workshops on the same theme. Several individuals responded with an assortment of ideas.

- Inclusion of national climate change coordinators.
- Inclusion of case studies, technical reports.
- Simpler framing of workshop questions.
- Inclusion of personnel in disaster preparedness and water resource management.
- Inclusion of environmental NGOs.
- Provision of more perspectives on climate change.
- Earlier distribution of invitations.
- Invitation of media personnel.
- Extension of workshop period.

### WORKSHOP CLOSING CEREMONY

Dr. Joan L. Aron expressed thanks to all those contributing to the success of the workshop. Special mention was made of Premier Event Services, Merville Lynch Services, Technician Ricardo King, Rapporteur Sonia Peter and Vicky Greenidge of the conference secretariat. Ms. Greenidge was presented with a token of appreciation on behalf of all participants.

Dr. Luiz A. Galvão, Coordinator of the Environmental Quality Program in the Division of Health and Environment for PAHO/WHO, and Mr. Harry Philippeaux, Environmental Health Advisor for the Caribbean for PAHO/WHO, were then invited to address the gathering.

### DR. LUIZ A. GALVÃO

Dr. Galvão thanked all of the co-organizers: UNEP, WMO, EPA, NOAA, NASA, Health Canada, Environment Canada, CPACC, CEHI, UWI, CAREC, CIMH, CCA and especially the Government of Barbados.

Dr. Galvão expressed regret at not being in attendance from the inception of the workshop, but welcomed sharing the accomplishments with the co-organizers UNEP and WMO. He thanked Joan Aron for catalyzi ng the participants and Harry Philippeaux for his expertise as technical advisor. He reaffirmed the commitment of PAHO/WHO in supporting regional capacity building for adaptation to climate change. Dr. Galvão reassured the gathering that PAHO will continue its role as coordinator for the sharing of information and networking of regional organizations.

### MR. HARRY PHILIPPEAUX

Mr. Philippeaux expressed delight over the development of the general proceedings which, in his estimation, exceeded all expectations. He lauded the workgroups for persisting during the technical difficulties and thereby contributing to the success of the conference and workshop. Participants were commended for exemplary performance throughout the proceedings and especially for the enthusiasm displayed in the discourse on climate variability and change.

Mr. Philippeaux extended gratitude to the Barbados Government, especially the Ministries of Physical Development and Environment and Health, for their investment that made the conference not only possible, but a success. He also acknowledged the expertise of Joan Aron, whom he considered to be the pulse of the activity. Recognition was also given to the facilitators for their presentations, which sustained the interest in the activities, and special mention was given to Dana Focks for the impromptu training session he provided for the Barbados professionals. Appreciation was extended to Clare Forrester, PAHO communications advisor,

for her sterling job working with the press and in informing the press; Brenda Lashley, PAHO System Administrator, for her assistance with the information technology needs; and Sonia Peter as Rapporteur of the conference and workshop. Mrs. Brown, Caribbean Program Coordinator of PAHO, was singled out for her leadership role in cooperating with international, regional and local interests in the development of a product relevant to all stakeholders.

Mr. Philippeaux expressed gratitude to all co-organizers for the collaborative effort, including UNEP, WMO, EPA, NOAA, NASA, Health Canada, Environment Canada, CPACC, CEHI, UWI, CAREC, CIMH and CCA. He considered the major achievements of the conference and workshop to be the map of the mandate for the CCCCC, the sensitization of inter-sectoral groups regarding climate change, and the linkage of the health, environment and meteorological services units. He recommended that each participant be an ambassador and seek to integrate activities in planning and development in their countries. In addition, he suggested that each participating country replicate the activities of the conference and workshop to secure a national consensus and pledged support from PAHO.

The workshop was then declared closed.