

CLIMATE ALERT

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Island States Fear Rising Seas Will Drown Their Beaches and Storm Surges Wash Away Their Homes Unless World Finds Way to Address Climate Change

(Editor's note: The small island states of the Caribbean, Pacific, Indian Ocean, Africa, Mediterranean and South China Sea have united in an organization called the Alliance of Small Island States. AOSIS has a membership of 42 countries and observers; 36 belong to the UN, making up about 20 percent of its membership. The study reported on below covers the effects of climate change on three geographic regions of these island countries.)

Changing climate, overdevelopment and expanding population are storm clouds gathering over the small island nations. "The threat to small island states is a harbinger of the broader challenge to the whole world from global climate change," says John Topping, president of the Climate Institute.

A series of articles in a special issue of the *Journal of Coastal Research*, edited by Dr. Stephen Leatherman, describes the predicament of these nations in three areas, the Caribbean and the Pacific and Indian Oceans. The authors are

members of the US Country Studies team, supplemented by other island researchers. Dr. Leatherman is director of the Laboratory for Coastal Research and the International Hurricane Center of the Florida International University in Miami. He is co-

island countries have good reason to feel overwhelmed. Their problems can only worsen as beaches erode, water tables rise and supplies of fresh water for humans and agriculture shrink. Storm surges from hurricanes, the most devastating aspect of tropical storms, can exceed six meters, destroying coastal structures and reconfiguring coastlines.

A typical island nation has a half a million residents occupying less than 10,000 square kilometers (4,000 square miles). Living at or near existing sea level, the residents need to see alternatives to abandoning their homes, moving they don't know where, and perhaps losing their cultural heritage. Despite the islands' diverse outlooks, their need to work together is

evident as they plan for the rising waters which are the most dramatic consequences of climate change.

"There is still a window of opportunity and time to allow for planning and adaptation," says Heidi Primo, climate change

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S. Leatherman Photo

Exposed coconut tree roots indicate beach erosion, but a new tourist hotel has been built close to this retreating shoreline, Kosrae Island, Micronesia

chairman of the Board of Directors of the Climate Institute.

Most vulnerable of all coastal areas to accelerating sea-level rise, and with limited resources to handle existing environmental problems — such as explosive growth and pollution — these

GUEST COLUMN

AOSIS Chairman Slade Details Vulnerabilities of Small Island States

By Tuiloma Neroni Slade, Permanent Representative of Samoa to the United Nations and Chairman of the Alliance of Small Island States

Climate change threatens the very life force of small island developing states. They will be the first to face the full impact of global warming.



Tuiloma Neroni Slade

They are they most vulnerable to climate change, and its consequences would be particularly disastrous for them, though they emit little of the greenhouse gases themselves.

The impacts of sea-level rise pose the greatest threat. In some island groups, like Kiribati, Seychelles and Maldives, large areas of land are less than a meter above present sea level. Such low-lying islands are particularly vulnerable, but high islands will also be badly affected by the likely impacts on their people, economic activity and infrastructural development as a whole.

Climate's Major Role

The ocean exerts a strong influence on small islands, moderating and influencing the weather. In most cases over half of the population resides within two kilometers of the coast, increasing vulnerability to sea-level rise. Economic activities are frequently dominated by specialist agriculture — such as sugar cultivation — and by tourism, both of which are strongly influenced by climatic factors.

Small island developing states already suffer disproportionately from extreme occurrences,

as has been shown by the loss of life, agricultural losses and damage to property, infrastructure and utilities associated with recent hurricanes in the Caribbean, and similar events in the Pacific. They are likely to experience considerable economic, social and cultural dislocation should the frequency and/or intensity of these events increase.

Islands Could Be Uninhabitable

Even a sea-level rise of 20 centimeters or less can have devastating impacts on many small islands. The natural underground reservoirs of fresh water in several island states (Maldives, Tuvalu, Kiribati, Marshall Islands) is already seriously contaminated by salt-water intrusion. A rise of 50 centimeters or more would have even more disastrous implications. Low-lying atolls like Tokelau, Marshall Islands, Tuvalu, Maldives and Kiribati would be rendered uninhabitable. Major population displacements would be experienced in Micronesia, Palau, Nauru, French Polynesia, Cook Islands and Tonga, among others. Small islands with extensive coastal plains and little highland, such as Barbados, Antigua and Barbuda and the Bahamas, would also be highly vulnerable.

Exorbitant Protection Costs

A case study of the likely impacts of an accelerated one-meter rise in sea level by 2100 on the Marshall Islands has shown that between 10 and 30 percent of the shoreline would be eroded or forced back and 60 percent of the arable land would be lost. There would be a significant increase in the frequency of severe floods and a reduction in the underground fresh water on which the Islands depend. The cost of protecting the coast is estimated to be four

to six times the country's gross domestic product and well beyond its means

Kyoto Targets Too Low

Given these alarming circumstances, the Alliance of Small Island States (AOSIS), in the ongoing international climate change negotiations, continues to stress the urgency of the situation and to call for far greater effort by the industrialized countries to reduce their greenhouse gas emissions. While welcoming the setting of specific legally binding targets in Kyoto last year, AOSIS considers the target percentages far too low and inadequate, measured against the scientific evidence produced by the Intergovernmental Panel on Climate Change.



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Island States

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coordinator for the Federated States of Micronesia, "but the seriousness of potential impacts cannot be ignored by policymakers if valid solutions and adaptation strategies are going to be embraced."

The states have many constraints to achieving the ideal of sustainable development: their small size, limited range of natural resources, susceptibility to hurricanes and tsunamis, restricted biological diversity, great distance from markets, lack of educated specialists. In fact, says Leatherman at the conclusion of his overview of the volume, it is likely that sea-level rise and its impacts will "place the goal of sustainable development well beyond the reach of small island states."

Various Predicaments

Some of the dilemmas the countries face are physical, some cultural. The coral reef islands of the Maldives, Marshalls, Tuvalu, Kiribati and Tokelau have no higher land where the people can move and pursue their livelihoods.

Higher ground on the volcanic islands of Montserrat and the Seychelles is mostly rugged, forcing the residents to pursue their agricultural activities on the coastal fringes. In addition, "the rate of population growth exceeds economic growth, and this fact increases the pressure on the small island states to provide basic services," Dr. Orman Granger of the University of California, Berkeley, points out. Also the rate of emigration of skilled residents is high.

The two million people living in the small states of the eastern Caribbean are already seeing higher seas and a rise in recent years of the number and intensity of hurricanes.

The high, lush and forested island of Kosrae in the Federated States of Micronesia (FSM) has large amounts of unsettled land in the interior and plenty of surface water run-off. But the land tenure practices of the island illustrate how culture and tradition can

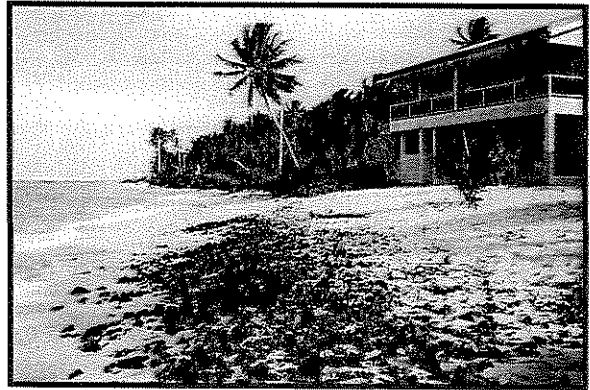
place obstacles in the path of adapting to climate change. Kosrae families owned parcels of upland forest till WWI when the Japanese colonial government declared these areas public Japanese land. After WWII and following independence from the US the state took over the land, and ownership is now being tested in the

courts. The majority of families own one parcel on the coastal fringe and one inland where they practice mixed traditional agroforestry. Most say they would be willing to move inland if roads and electricity (which do not now exist) moved with them. But they are also attached to their coastal homes, and to their ancestors' grave sites which lie on the coastal margins.

Pros and Cons of Tourists

Tourism, which is such an important factor in the economies of many of these countries, provides financial benefits but imposes environmental costs. The tourist industry is responsible for more than 15 percent of the GNP in the Caribbean and the Maldives (Indian Ocean). It competes for scarce resources, increases water pollution and upsets ecosystems. And an increase in beach erosion from high seas leads to a reduction in the number of tourists arriving.

On Takunsak beach, Kosrae, FSM, volcanic rock used by the highway department to shore up a road eroded so readily that it was carried away by littoral currents to blight a nearby tourist beach. [See photo] The newly constructed circle island highway on Kosrae, just landward of the beach, is already experiencing erosion and failure. Schools have been built



Waves turned volcanic boulders used for highway building into rubble, scattering it along beach of tourist hotel

at the water's edge and are in a very vulnerable position.

Rate of Erosion

The beaches on Kosrae are eroding at one foot a year, and many houses, built right beside the vertical coral rubble seawalls are periodically flooded, destroyed and rebuilt. Flooding and storm surges will be even more frequent as the seas rise.

In some small islands, the fresh-water lens — the layer of water lighter than the underlying salt water and floating on top of it — is a critical resource for drinking and for crops. Rising sea level will greatly reduce the lens which in some small atolls is now only a few centimeters deep. The Marshall Islands are already experiencing difficulties as mounting seas push salt water into ground water supplies, rendering them useless for agriculture and threatening the islands' potable supplies. Some small islands of the Maldives have already been abandoned.

Environmental Refugees

Many small countries will lose significant amounts of land area if sea levels rise. Environmental refugees may be forced to flee and resettle in neighboring mainland countries at great economic and social costs. In the Maldives, which consists of 1190 small islands with an average elevation of 1 to 1.5 meters, submergence and erosion will convert many smaller islands to sandbars and significantly reduce

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Island States

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usable dry land on larger, more populated islands.

The Global Environment Facility initiated in 1997 the Caribbean Planning for Adaptation to Global Climate Change Project for small island states. Adaptation planning will consist of regional data collection, impact and vulnerability studies, and assessment of policy options.

Data Aids to Planning

A crucial planning factor for all the countries is knowledge of how much and how fast the seas are rising. Scientists are certain of the direction if not the exact degree of climate change. But measuring the increase in sea level on many islands is severely hampered by lack of facts, topographic maps, tidal and wave data, records of historical storm surges. Even for rudimentary estimates on which to base forecasts, 20 years of data are needed. A Global Sea-level Observing system — a worldwide network of more than 300 tide gauges begun in 1985 — will collect long-term information on sea level and climate changes which can be used for predictions after the turn of the century.

Trend analysis provides one method of predicting the future erosion rate of sandy beaches. Map and aerial photographic data, going back a century, show historical changes in the shoreline. The Global Information System (GIS) of metric mapping, a computer-based program, reveals very detailed and accurate information on past shoreline behavior.

Another commonly used method, the Bruun Rule, a geometric balancing of sand in an on/offshore direction, would need much more basic research to be useful. In this case, the Rule relies on good wave data which are not generally available for small island states, and since it is based totally on sandy beaches it cannot be

applied to coral reef nations.

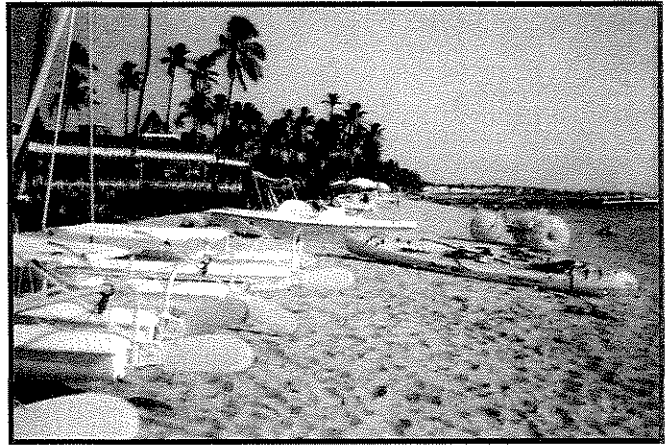
The simplest approach to studying the permanent submergence of low-lying lands — inundation analysis — is done by field profiles extending across the beach and island to determine how far inland a 1 to 1.5 meter sea rise would reach beyond the present shoreline. From this, the appropriate amount of land loss would be calculated; comparing the inundated area with the total island area would yield the percentage of land lost.

Aerial photographs showing vegetable zones (which are closely related to elevation) could help in drawing contour (elevation) maps. Global Positioning System (GPS) technology is now becoming affordable, making precise surveying possible on a worldwide basis.

Protecting the Shoreline

Response to the impact of the rising seas entails either stabilizing the shoreline or retreating inland. Holding back the sea as water levels rise is "technically feasible but not environmentally or economically sound," says Leatherman. The Intergovernmental Panel on Climate Change has calculated that the cost for new construction to protect the Caribbean shoreline including low coasts, cities, harbors, island elevation, and beach nourishment, and excluding unprotected dry lands, lost ecosystems, salt intrusion and increased storm frequency, would amount to \$11 billion — far beyond the means of the governments concerned.

Coastal protection is not assured in the face of accelerating sea-level rise and exacerbated coastal erosion. Protection systems such as



Pinneys Beach, Nevis, before Hurricane Luis, August 1995

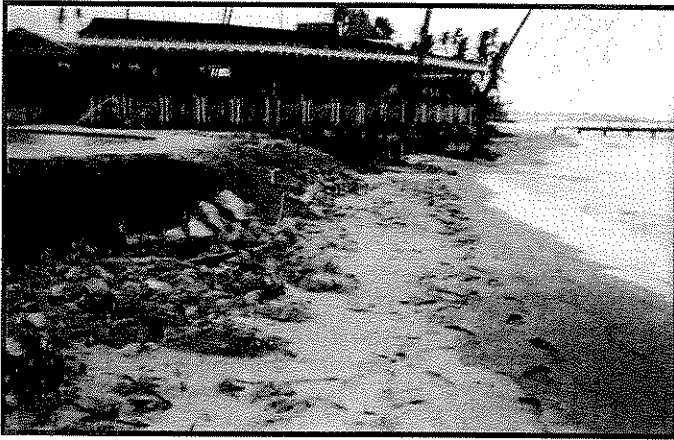
sea walls often "have been ill-conceived, causing as much or more damage than good." They encourage unwise building of hotels and roads too close to the eroding shore. The consequences in Sri Lanka, for instance, are all too clear, "beautiful white sandy beaches squeezed out of existence."

Beach nourishment, a preferred alternative in the US, is not an economic option in the island states. No river systems deposit sand, and there is no clearing of major navigation channels to produce dredgings.

Often sand mined from beaches as a source of construction and reclamation material and a base for concrete block houses, is actually a cause of beach erosion. In Grenada, sand mining is a major source of beach degradation. In Anguilla it is estimated onshore sand reserves will be depleted within the next two years.

Managing Retreat

The "retreat" option could result from "catastrophic abandonment" after a hurricane or tsunami. A more "orderly retreat" will require a lead time of several decades, as a gradual process. The best approach would be to anticipate the rate of beach loss and prohibit construction too close to the water's edge. Building setbacks could protect beaches as erosion accelerates in coming decades. However, tourist



Pinneys Beach, Nevis, after Hurricane Luis, October 1995.

beaches can be ultimately lost on some atolls which are so narrow there is no room to move back. Promoting the health of offshore coral reefs and existing mangroves could provide natural defenses against an increase in eroding and flooding.

The Pacific Way

Chalapan Kaluwin and Andrew Smith of the South Pacific Regional Environmental Programme of Western Samoa point out that there are benefits as well as constraints in the unique mind-set — the “Pacific Way” — of small island states. These benefits include a high level of community involvement in coastal resource use and management, intimate involvement with the resource, strong customary land and marine tenure systems, strong indigenous cultures. They embody mechanisms for managing natural resources, cultures and kinship groups closely attuned to the family and community. They recognize the need for sharing resources, consensus decision-making, resource management practices of an integrated rather than sectoral nature.

Conclusions

“Activities must begin in anticipation of the impact of sea-level rise and climate change,” says Leatherman. He lists the following coastal adaptation measures which small island states should adopt in response to today’s problems and

Plan for buffering capacity
Plan for sewage and pollution treatment.

(However, while “coastal zones” are distinct areas in large island states, the concept is irrelevant in the majority of Pacific islands where “coastal zone management” is essentially whole island management, Katuwin and Smith note. Transfer of this “classical” management from the developed continental situation to the Pacific islands has failed they say. Zoning, based on artificial boundaries, is usually culturally inappropriate and administratively almost impossible to enforce, as customary ownership of land and marine areas takes precedence over eminent domain and common property ownership. Most countries in the region lack the data for establishment of complex planning and management strategies and the human and financial resources to implement and enforce them.)

Nevertheless, Gillian Cambers of Puerto Rico’s Sea Grant College Program supports the need to develop ICZM programs to deal with beach erosion, loss of wetlands and pollution, but she notes that, “ICZM programs are not developed quickly. They take years and sometimes decades as people are trained, plans developed and legislation drafted.” Shoreline armoring needs to be understood. Setback guidelines need to be

global warming:

1) Implement integrated coastal zone management

Plan for erosion protection and flooding during storm surges

Protect scarce natural land

revised and implemented. The public and special interest groups (real estate developers, tourism officials, hotel associations, etc.) need to understand concepts such as coastal planning and climate change.

2) Maintain natural protective ecosystems

Keep hotels and tourist development from edge of shoreline

Protect wetlands

Reduce, discourage, try to find alternatives to sand mining for road construction and building material, especially coral reef blasting

3) Discourage shoreline stabilization

Shore-hardening structures, especially seawalls and revetments, should not be used in lightly developed areas or along prime tourist beaches

Allow beaches to gradually retreat in response to sea-level rise, preserving tourist beaches in more landward positions

Seawalls and other hard stabilization measures are recommended for highly urbanized areas that cannot reasonably be moved

4) Use setbacks for coastal development

Establish buffer areas

5) Improve data bases for monitoring coastal processes

Tide gauge records

Wave and beach monitoring programs to delineate beach erosion trends

6) Enforce hurricane and earthquake resistant building codes

Protect from storm surge, wave uprush and scour

7) Educate island citizens

In schools, place more emphasis on climate change, coastal hazards and resource management

For adults, establish neighborhood and state programs

(To order this publication : *Journal of Coastal Research*, Special Issue #24, Fall 1997, “Island States at Risk,” P.O.Box 1897, Lawrence, KS, 66044. Ph. 785/843-1221)

Climate Institute News

The Climate Institute has a large advisory board of distinguished experts from around the world who can be called on for help on Institute projects, with over 40 members from nearly 20 countries. Advisory Board members have assisted on briefing projects and helped with conferences.

Recently the Institute added the seven new members listed below:

Dr. Hans Bjerregard

A long-time expert in renewable energy, Dr. Bjerregard established his own consulting firm on the subject in 1982 and has been chairman of the Danish Organization for Renewable Energy since 1986. He was chairman of the Forum for Energy and Development, an umbrella organization of 13 Danish development and energy NGO's, in 1996 and has served on various official committees on renewable energy of the Danish government including the Advisory Board of Renewable Energy.

Dr. Rene Karottki

Mr. Karottki's experience covers a broad range of energy and environmental programs both in his own country, Denmark, and in Africa, Latin



Rene Karottki

America and Asia. He designed an NGO-collaborative program on sustainable energy between South Africa and Denmark. He developed a photovoltaic water program for Zimbabwe and led a team on a crop waste briquetting pilot project there. He was a team leader for a program on regional cooperation with Small Island States in the South Pacific, and convenor of an NGO-Island forum in Barbados. He conducted a feasibility study on wind energy in the Gobi

Desert, Mongolia. He was responsible for a wind turbine design program for the PRC, and a training program on renewable energy and energy efficiency planning for India. He conducted a feasibility study on solar water heaters in Kenya and worked on a transfer of wind pump technology to Mauritania. He led an appraisal mission on windpumps and greenhouse farming in Bolivia and directed preparation for installation of a 75kW wind turbine in Brazil.

His publications include a 1997 educational book on energy and development, "Solar Energy — the Future of the Earth," and has directed video/slides/ film programs for development organizations and TV stations.

Besides serving as a lead official in many energy organizations in Denmark and internationally, he has been a representative at various international conferences such as COP3, INC-9, and PrepCom 4.

Dr. A. Barrie Pittock

Head of the Climate Group of the Australian CSIRO Division of Atmospheric Research, Dr. A. Barrie Pittock has worked for more than

30 years in a variety of fields for CSIRO. The Climate Group has collaborated on more than 50 impacts projects with a particular focus on stratospheric ozone, solar-weather relationships, surface climate change, the climatic effects of nuclear war, and the greenhouse effect. At present the Group is developing a risk assessment framework for climate impacts and adaptation.



A. Barrie Pittock

Syeb Ayub Qutub



Syeb Ayub Qutub

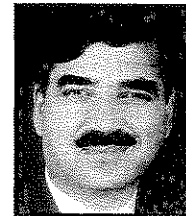
Mr. Qutub is founder-member and currently president of PIEDAR, a not-for-profit institution conducting environmental action research on grass roots organizations in 32 villages and 8 low-income urban communities in Punjab, North-West Frontier Province, and Baluchistan in Pakistan. He was coordinator and principal writer of Pakistan's National Conservation Strategy and has served as consultant for two Mid-East countries and undertaken assignments for the Asian Development Bank, CIDA, The Netherlands, UNCHS, UNEP, and the World Bank.

Mohammad Rafiq

Mr. Rafiq, a forestry expert, is head of IUCN (The World Conservation Union) program in Pakistan. In much of his career he has concentrated on rural and community development, especially in two large social forestry programs in the North-West Frontier Province:

The aim of the Kalam Integrated Development Project is to raise the living standards of the Kalam tribes in the mountain forests of NWFP, improving forest management, agricultural productivity, social and physical infrastructure, working toward sustainable management.

The Social Forestry Project Malakand is a community initiative striving to restore the denuded landscape of the Malakand Agency. The community is working together to regenerate and maintain the productivity of the hillsides and community wastelands.



Mohammad Rafiq

Dr. Cynthia Rosenzweig

The focus of Dr. Rosenzweig's work is on the impacts of environmental change, including global warming and El Niño events. She is a research scientist at the National Aeronautics and Space Administration and an adjunct research scientist at Columbia University's Earth Institute. Currently she is leading a NASA Earth Observing System interdisciplinary science team and recently directed a study for the USEPA on Climate Change and Food Security with participating scientists in 25 countries. Her latest book, *Climate Change and the Global Harvest*, co-authored with Daniel Hillel, was published this year by Oxford University Press.



Cynthia Rosenzweig

Colorful Book by Leatherman Tells You Everything You Need to Know For Your Next Trip to the Beach

Dr. Stephen P. Leatherman, co-chairman of the Climate Institute, has published an elegant book on the beaches of the United States. Some of the brilliant photos were taken by the author and others by professional photographers. They show a double rainbow over Kakalau Beach in Hawaii, another beach whose sand is turned to orange by the setting sun, and the Coast Guard Beach on Cape Cod before the 1978 blizzard.



Stephen Leatherman

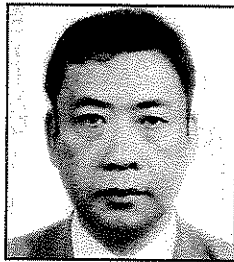
America's Best Beaches was written as a sideline to Dr. Leatherman's scientific work on coastal storm impacts, beach erosion and the effects of sea-level rise.

Besides ranking the nation's beaches — the Top 10 and the best for : swimming, surfing, sports, wilderness, walking, city, and novelty — in just over 100 pages, the book contains information on beach combing and sand-collecting. It includes factual information: in general gently sloping beaches as in Panama City Beach, FL, produce fine sand; clams weighing up to 20 pounds can be found on some beaches in Washington state; and the sand on Sand Beach, Acadia National Park in Maine is composed of crushed spines of sea urchins (ground fine by the waves) and other shell debris.

To make it affordable, Dr. Leatherman published the book himself. It costs \$19.95 including shipping and handling, and can be ordered toll free by credit card at 1-888-top beaches.

Dr. Katsuo Seiki

It is with great regret that the Climate Institute reports that Dr. Seiki, who was recently appointed to the



Katsuo Seiki

Board of Advisors, died very suddenly.

Dr. Seiki had been executive director of Global Industrial and Social Progress Research Institute (GISPRI) in Tokyo since 1992. He accepted that position after retiring from many years with the Ministry of International Trade and Industry where he held a variety of positions

in international trade policy, international energy policy, and global environmental affairs. Dr. Seiki was also a vice chairman of the Intergovernmental Panel on Climate Change.



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Miami Conference Seeks Common Intra-American Climate Strategy

About 200 public officials, scientists, environmentalists and corporate planners are expected for the December 2 - 4, 1998 Conference on **Climate Change and the Intra-Americas: Vulnerability, Adaptation and Mitigation**. Slated for Florida International University in Miami, this conference is convened by the Climate Institute, the Organization of American States (OAS), the International Hurricane Center, the US Environmental Protection Agency and the National Oceanic and Atmospheric Administration.

Drawing participants from Mexico, Central America, small island nations in the Caribbean, and in the US, South Atlantic and Gulf Coast states, the conclave seeks to develop a common regional strategy to address climate change. Hurricanes, sea-level rise, coral and wetlands loss, and ENSO disruption, including forest fires, are

threats faced alike by wealthy US Gulf states and much poorer nations to the South.

Preliminary results of a six-million-dollar study of climate change vulnerability adaptation in the Caribbean islands will be unveiled. Funded by the Global Environment Facility, this study has been administered by the OAS and has melded together scientists and planners.

The International Hurricane Center, now headed by Dr. Stephen Leatherman, one of the world's leading experts on sea-level rise, and Co-Chairman of the Climate Institute, is seeking to build a common Caribbean-wide approach to severe storms and related climatic challenges. Set up by Florida following the ravages of Hurricane Andrew, the Center seeks to ensure that the region is better prepared for future storms.

Its focus is on construction techniques, building codes, improved storm warning systems and other means of reducing storm havoc.

The Miami conference will highlight creative regional responses — Barbados' efforts to promote renewable power, Mexico City's initiative to green its urban bus fleet, and environmental initiatives underway in US cities from Chattanooga to Miami. Harvey Ruvin, Clerk of Courts and the County Commissioner of Dade, is chairing the planning committee. Ruvin, long active in the National Association of Counties and the International Council for Local Environmental Initiatives, has been an outspoken advocate of aggressive municipal action to address climate change.

Conference agenda and other details are available on the Climate Institute web site (www.climate.org). For further information please contact Michele Pena (202-547-0104, x. 13) or mpena@climate.org.

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