

# Climate Change

## Charlotte Harbor National Estuary Program

Lisa Beever

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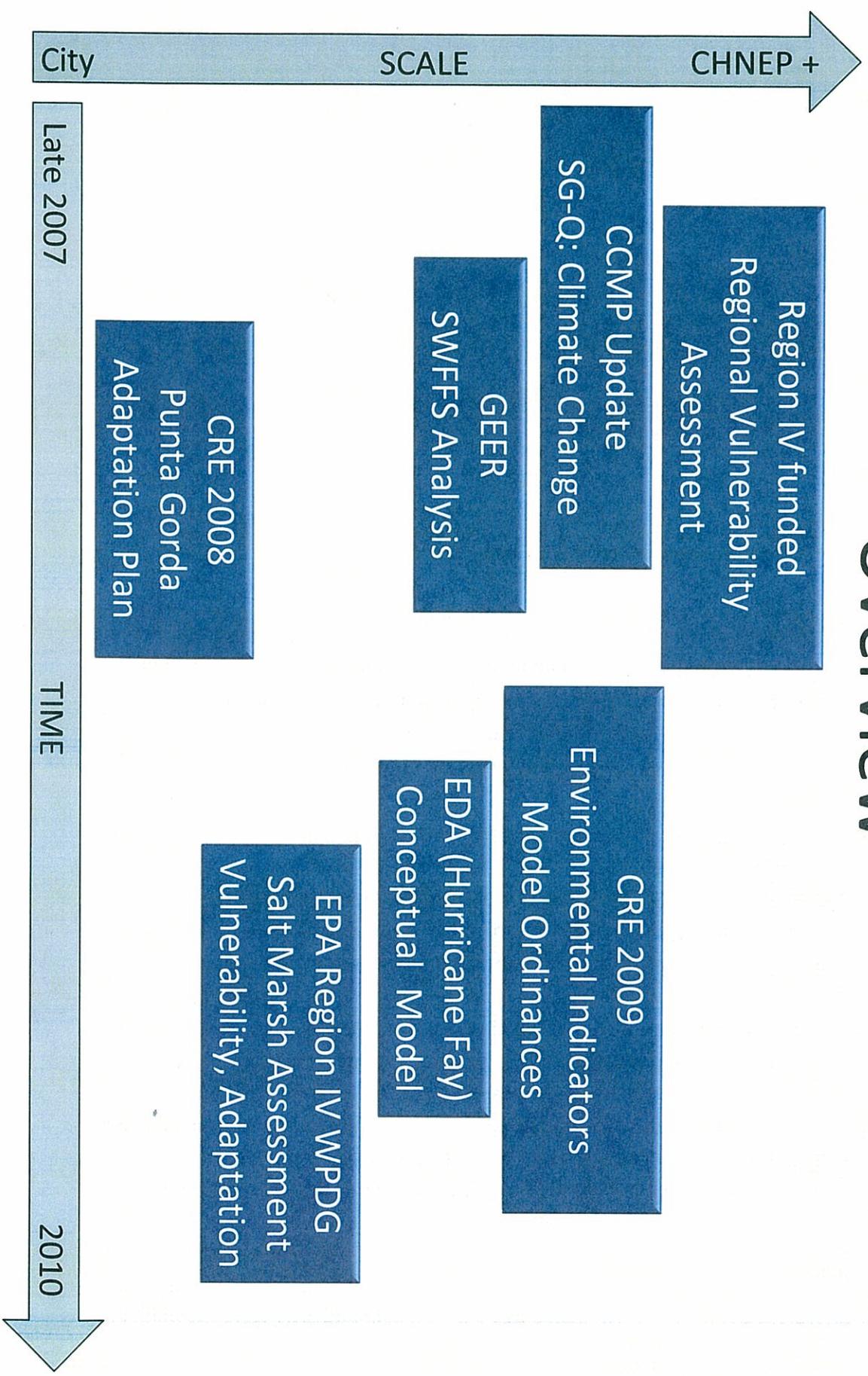
The Charlotte Harbor National Estuary Program (CHNEP) was named as one of 6 Climate Ready Estuary (CRE) pilot programs by the Environmental Protection Agency in 2008. This designation came as a result of incorporating climate change issues in the CHNEP Comprehensive Conservation and Management Plan amendment, a plan required by the Clean Water Act. CHNEP and the Southwest Florida Regional Planning Council (SWFRPC) are implementing 3 distinct but interrelated projects which address climate change issues. These projects include:

- A Vulnerability Assessment for the shared areas of the CHNEP and SWFRPC;
- An Adaptation Plan for a small coastal city (City of Punta Gorda); and
- Assessment of the Southwest Florida Feasibility Study (SWFFS). The presentation may be found at: <http://conference.ifas.ufl.edu/GEER2008/videos/geer.html>

Additional projects related to climate change that CHNEP and SWFWMD are developing include:

- Environmental Indicators for Climate Change
- Model Local Government Ordinances for Climate Change Resiliency
- Conceptual Model and Decision Support System for Climate Change Resiliency
- Climate Change Vulnerability Assessment and Adaptation Opportunities for Salt Marsh Types in Southwest Florida.

# CHNEP / SWFERPC Climate Projects Overview



**Everglades National Park***Climate Change Coordination*

**POC: David Hallac, Biological Resources Branch Chief**  
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Everglades National Park is working with the USGS and the SFWMD to integrate monitoring, research, and modeling to evaluate the environmental response from climate change and sea level rise (SLR). **Hydrologic monitoring and modeling** in cooperation with USGS, SFWMD, and universities provides primary data for developing alternative scenarios for Everglades wetlands and Florida Bay communities. **Coastal vegetation monitoring** documents the distribution and abundance of rare plants that may be affected by SLR, to assist in modeling of SLR impacts and the adaptability of coastal communities. Carbon dioxide flux monitoring in mangrove communities describes the resilience to hurricane disturbance and their capacity for carbon assimilation. **Habitat models** will demonstrate SLR impacts to Spotted Seatrout, blue crab, Florida Bay seagrasses, and anuran (frog and toad) communities. **Landscape vegetation succession model** will provide projections of spatial changes in vegetation and provide input to wildlife habitat models. **Communications and data sharing** are critical to improved response to climate change and we participate in local, regional and federal workshops, providing presentations, fact sheets, and technical reports on potential ecological consequences of climate change in south Florida and the Everglades.

**Environmental Protection Agency****Summary of Environmental Protection Agency (EPA) Climate Change Activities  
Potentially Relevant to CERP Restoration**

1. National Activities
  - a. Proposed Clean Air Act Endangerment finding (mobile and stationary source)
  - b. Proposed Mandatory Greenhouse Gas Reporting rule
  - c. Support to Congress for greenhouse gas legislation (Waxman Markey)
2. National Water Program Strategy: Response to Climate Change (Sept. 2008)
  - a. Addresses climate change impacts to water resources: climate change science, air and water temperature, rainfall/snowfall levels and distribution, storm intensity, sea level rise, coastal/ocean characteristics
  - b. Identifies climate change goals and response actions for: greenhouse gas mitigation, adapting water programs, climate change research, education, program management
  - c. Actions include: carbon sequestration, research on ecosystem services and ecosystem restoration, using the watershed approach, and recommendations on certain types of restoration projects
  - d. Link: <http://www.epa.gov/water/climatechange/strategy.html>.
3. EPA Region 4 is focusing on energy efficiency, biofuels and adaptation through: a Regional workgroup, Draft Regional strategy and specific initiatives and projects
4. EPA Region 4's focus on adaptation includes: an Assessment of Adaptation Challenges and Options for the Southeast US (2010) in partnership with EPA Office of Water and Office of Air and Radiation, a Climate Change Vulnerability Assessment for the Charlotte Harbor NEP area (soon), a Climate Change Adaptation Plan for Punta Gorda, FL (soon) through the EPA Climate Ready Estuaries program

## POCs

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## Florida Atlantic University

## Point of Contact:

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South Florida is on the front lines of risks associated with climate change impacts. In response, Florida Atlantic University (FAU) has formed a coalition of research institutes and assembled interdisciplinary teams to assist in developing adaptation and mitigation strategies to prepare for and lessen climate change effects. This is a collaborative effort with stakeholders at national, state, and local levels. The South Florida Climate Change and Energy Initiative's (CCEI) goal is to provide accurate and current local climate change science information, and to develop strategies and programs to minimize the inevitable climate change impacts on South Florida. Florida Atlantic University recognizes our critical role in the adaptation and mitigation of climate change impacts on the region. CCEI is a cross-university program creating relevant linkages across disciplines. With FAU as the lead institution and University of Miami as the co-lead, CCEI includes more than 80 faculty members in a multitude of climate change-related disciplines. Collectively, we have strong collaborative linkages with local, state and federal governmental and non-governmental organizations, the business community, and public. Other potential University collaborators include: University of South Florida, Florida Gulf Coast University, and Columbia University.

**Climate Change and Energy Initiative (CCEI)  
For  
South Florida  
Summary**

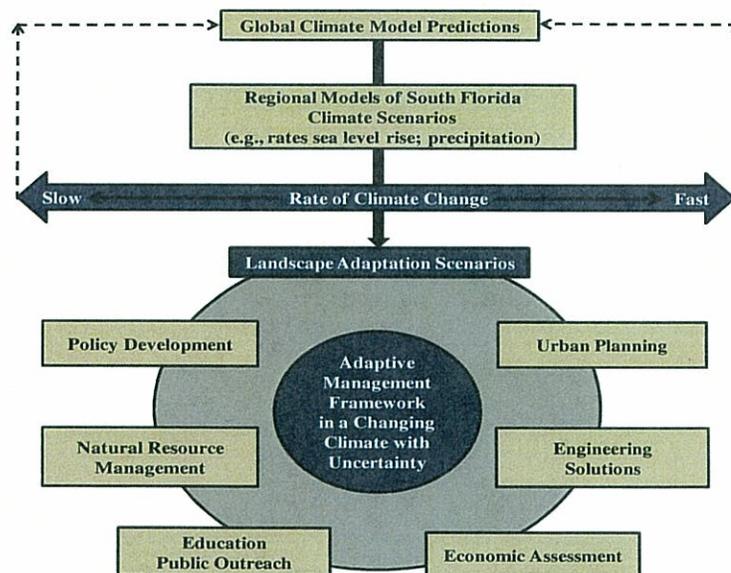
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Based on current climate change data and projections, the South Florida Peninsula is globally, one of the most vulnerable developed regions, with significant risks involving, major human populations, vast economic assets, and natural resources of national significance, including the Everglades. The low-lying topography of South Florida makes the area particularly vulnerable to rising sea levels as the oceans expand and glacial ice melts. Sea level rise and the increase of land and water temperatures at the rates projected by the Intergovernmental Panel on Climate Change (IPCC) 4<sup>th</sup> Assessment report will have an effect on every aspect of life in South Florida. Among the impacts, some already apparent, are periods of drought alternating with heavy precipitation, saltwater intrusion into important aquifers, increases in heat-related and insect-borne diseases, changes in the range of exotic species, ocean acidification and the impact of sea-level rise on manmade coastal systems. Careful planning can anticipate and manage many of these impacts.

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One of the most urgent issues in climate change adaptation and mitigation is the need for education and outreach on all levels. The linking of sound science with local

knowledge and community decision-making provides the academic flexibility and the expertise necessary for the successful coordination and dissemination of information that can address this critical area. While there are a number of discipline specific studies and programs occurring, CCEI will specialize in the linking of these efforts, focusing attention on the complex interactions between marine systems, local economy, mandated policies and regulations, and the community issues of our region. CCEI will create an information base that will allow for adaptive management of impacts of climate change as they occur. CCEI will develop strong inter-disciplinary teams to facilitate the transfer of technical climate information to regional policy-makers, planners, engineers and the public in an adaptive management framework. Global climate model predictions will be scaled to regional models to develop climate scenarios for South Florida. Output from these local models will be used to develop "Landscape Adaptation Scenarios" by a team of urban planners, engineers, economists, educators, political scientists, and natural resource managers. Because of the current uncertainty in the rates of change and their intensity, an integrative process will be established whereby as additional scientific data are available, the landscape adaptation scenarios will be updated and modified accordingly. A forum for discussion and the development of multi-media, multi-route methods of information dissemination will be established to keep all partners and the public aware of the current findings and publications from CCEI. We know that the interdisciplinary approach, with strong central coordination, is the most promising strategy to achieve the goals of climate change adaptation and mitigation through an emphasis on stakeholder education and outreach.



**FWC Climate Change Efforts**

FWC Agency Point-of-Contact: Chuck Collins, Regional Director, South Region  
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The FWC hosted a Climate Change Summit in October, 2008 to solicit information which could be integrated into the FWC's agency strategic planning and existing structure. To ensure an effective coordinated process Executive Director Ken Haddad established a Climate Change Oversight Team. Climate change for the Florida Fish and Wildlife Conservation Commission involves two tracks. One track relates to Governor Crist's executive orders issued in 2007 and our efforts to become a greener agency through the reduction of our Green House Gas emissions. The second track relates to our mission to "manage fish and wildlife for their long term well being and the benefit of people". We have established a number of teams within the agency to address several goals along these two tracks:

Goal 1: Comprehensive integration of climate change thinking, planning, and actions agency-wide.

Goal 2: To provide communications support, guidance and direction for climate change policies and activities of the FWC.

Goal 3: Develop capacity of FWC to avoid, reduce, and manage the impacts of climate change on Florida's fish and wildlife.

**FWC Exotic Species Management**

FWC Point –of-Contact: Scott Hardin, Section Leader, Exotic Species Coordination  
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Over the last three years FWC has coordinated with the Dept of the Interior to eradicate the Gambian pouch rat and has a separate management action ongoing to address the purple swamp hen. In 2007, the FWC began holding Pet Amnesty events throughout the state to provide the opportunity for people to surrender their nonnative pets free of charge with no penalties. Nonnative reptiles, amphibians, birds, fish, mammals and invertebrates are accepted at Amnesty Day events. Domestic pets, such as dogs, cats or ferrets, are not accepted.

Another goal of the program is to foster responsible pet ownership. Current exotic pet owners and anyone interested in acquiring a nonnative pet can come and talk to experts to learn more about that animal's needs. Amnesty day events are free and open to the public. Low cost microchipping is offered at many Amnesty Day events.

## **Climate Change: U.S. Fish and Wildlife Service Actions**

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Climate change is arguably the most significant and challenging issue to rise to prominence since the original formulation of the Comprehensive Everglades Restoration Plan (CERP) in 2000. It is significant because scientific consensus estimates suggest that climate change is likely to have important impacts on south Florida. It is a challenge because climate change is an issue that will likely affect a wide variety of human and natural systems, and must be addressed within a context of considerable uncertainty in policy, human adaptive responses, and indirect effects. The challenge of climate change also arguably makes the need for Everglades restoration even more clear. Restoration promises to build resilience within species populations and habitats throughout the greater Everglades ecosystem. In addition, hydrologic restoration could help partially stave off other impacts such as salt water intrusion within Florida's essential groundwater system, which supplies drinking water to millions of people.

In order to help plan and manage effectively in the face of such uncertainties, the U.S. Fish and Wildlife Service (FWS), U.S. Geological Survey (USGS), and Massachusetts Institute of Technology (MIT) are assembling the best available information on climate change and how it will affect Department of the Interior (DOI) "trust resources" such as National Wildlife Refuges and threatened and endangered species in the greater Everglades ecosystem, which is defined as the 19 county area within the geographic region overseen by the FWS South Florida Ecological Services Office. This effort has two key objectives. The first is to collect and organize the best information now available related to climate change and determine potential impacts on trust resources in the greater Everglades ecosystem. A great deal of effort is now underway to understand how climate change could affect south Florida, and a key first step will be amassing this information and presenting it in a user friendly way with a specific focus on trust resources. A second key step will be developing a set of regional-scale "alternative futures" that spatially simulate likely climatic, hydrologic, and land use conditions in the future (e.g., based on IPCC scenarios). In essence, MIT will work with FWS and USGS and outline several scenarios that characterize possible future conditions for trust resources by incorporating changes expected from the Everglades restoration effort; potential land use changes based on development trends and other information; and forecasted impacts based on the best available science for climate change.



## ENERGY CONSERVATION STRATEGY SUMMARY

The information below is gleaned from the Federal ENERGY INDEPENDENCE AND SECURITY ACT OF 2007; Florida's 2008 Energy and Climate legislation which did not get needed authorization in 2009, and assorted other sources.

- The first section is the “bullet points” contained in the federal legislation, section 544.
- The second section constitutes bullet points from other sources.
- The third section is largely a bookmark regarding important—and controversial—Federal legislation on Cap and Trade that will readdress some of the climate and energy efforts made recently.
- The last section is a bullet point summation of 7 trends we are facing

### **I. Energy Efficiency Conservation Strategy (Energy Independence Act) Employed these terms in this framework, *italics* are my additions:**

#### Goals

Strategies to achieve goals

Efficiency

Reduce consumption

Change behavior

Methods to measure progress

Reporting

Progressive Timelines For Objectives (*such as by 2010, cut use by 10%, by 2012 convert 10% of use from fossil fuels to renewable*)

#### Conducting Residential and Commercial Building Audits

*(All buildings, starting with Government)*

#### Financial Incentives Programs

Grants for Non-profits/Governmental agencies for retrofits

#### Energy Efficiency and Conservation Programs;

For Buildings and Facilities

New Construction

Retrofits

Design and Operation of the Programs

Maximum Participation and Efficiency Rates

Public Education—Particularly at the home level, for gardening, use of hand tools, “how to”

literature.

Measurement and Verification Protocols

Identification of Energy efficiency Technologies

Programs to Conserve Energy Used in Transportation

Flextime

Satellite Work Centers

Zoning (etc) Guidelines

Non-motor vehicle infrastructure (Bike/Pedestrian)

Synchronize Traffic Lights

Transit

(Other)

Develop and Implement Building Codes and Inspection Services

Energy Distribution Technologies That Increase Energy Efficiency

Distributed Resources

District Heating and Cooling Systems  
 Participation and Efficiency rates for Material Conservation Programs Including  
 Source Reductions, Recycling, and Recycled content procurement programs.  
 Capture Landfill Emissions  
 Replacement of Traffic Signals/Street lighting  
 Light emitting diodes  
 Improved Technologies  
 On building or site energy production  
 Solar  
 Wind  
 Fuel cells  
 Biomass

## **II. Other Applicable Activities, gleaned from other laws or models**

Local Food, fiber, fuel production  
 Fish harvesting  
 Farmland protection and expansion  
 Fertilizer and pesticide/herbicide containment  
 Soil conservation  
 Forestry maintenance and expansion  
 Land Use Code Review on Restrictions and prohibitions on energy saving  
 measures, including Deed restrictions  
 Local fuels or energy production (blending fuels, if appropriate)  
 Energy use conversions from high forms (oil) to low forms (wind)  
 Thermostat settings relating to clothing/appearance codes  
 Carpool contact or Coordination Centers  
 Transit/parking coordination  
 Housing/Apartment minimum sizes  
 Parking Lot Sharing Systems  
 Telecommuting  
 Renting, Leasing, Conferences, Green Guidelines  
 Purchasing Green Guidelines  
 Fleet Management—Greening the Fleet  
 Fuel Allocation/Emergency Allocation Plans  
 Water, Wastewater, Stormwater performance savings

## **III. Cap and Trade---- Opportunities**

New legislation is being worked through Congress which will provide more direction, particularly on capturing emissions. Much of what the County has undertaken through its resource management efforts provides opportunities for at least managing and balancing the necessary greenhouse gases through expanded capture efforts on County properties. It is too early (July 1, 2009) to draw fixed conclusions on the Legislation.

## **IV. Worrisome Trends:**

1. Declining Revenues due to declining property values and family incomes
2. Increased relative costs for gas, diesel, heating oil
3. Inflation in relative cost of equipment, etc (for example, costs of purchasing dropping by 5% in a budget with 10% less revenues is an inflation of relative cost.)
4. Increased percentages of population unemployed and homelessness
5. Increase in crime rates and general scofflaw attitude in responsibilities
6. Resource depletion in regions serving urban areas
7. Shrinking capacity of local governments in response to the above six criteria.

ARM Loxahatchee National Wildlife Refuge

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**Climate Change Coordination: provide a broad picture of the climate change research and actions that are being planned or conducted by the various agencies relevant to the restoration of the South Florida Ecosystem.**

- Lox has notable interest in climate change issues, esp. as it relates to future changes in land use in adjacent areas.
- Lox is participating in USGS/MIT MUSIC project to look at alternative futures related to climate change as part of FWS' EcoTeam

## Climate Change Coordination Miami-Dade County

### Climate Change Advisory Task Force

In July 2006, The Miami-Dade County Board of County Commissioners (BCC) passed an ordinance that established the Miami-Dade Climate Change Advisory Task Force (CCATF), a diverse, multidisciplinary group of 25 representatives of various sectors of the community. The CCATF serves as an advisory board to provide climate change-related technical assistance to the BCC. The Task Force is charged with identifying potential future climate change impacts to Miami-Dade County and providing ongoing recommendations regarding mitigation and adaptation measures to respond to climate change. Six Task Force committees have been established to focus on specific areas of climate change mitigation and adaptation: 1) Science; 2) Greenhouse Gas Reduction; 3) Built Environment Adaptation; 4) Natural Systems Adaptation; 5) Economic, Social, and Health Adaptation; and 6) Intergovernmental Affairs. Additional County staff and representatives from numerous universities, local businesses, and environmental and regional organizations that participate in the associated committee meetings. In April 2008, the BCC accepted the "Second Report and Initial Recommendations" from the committees, as presented by the Task Force. An annual update is expected in fall of 2009. The 2008 report is posted at the following web site: [http://www.miamidade.gov/derm/library/08-10-04\\_CCATF\\_BCC\\_Package.pdf](http://www.miamidade.gov/derm/library/08-10-04_CCATF_BCC_Package.pdf)

The County is almost finished with establishing both the regional and county operations greenhouse gas emissions baseline for 2005. It should be completed in August '09. The County will begin to develop a new Climate Action Plan and Climate Change Adaptation Plan as part of the development of a formal Sustainability Plan. The development of all three plans is expected to take ~ 1 year or more.

The Science Committee focused on sea level rise, and recommended that a specific effort be undertaken to develop detailed maps, based on LIDAR or other similar topographic surveys, to illustrate a series of sea-level-rise scenarios. The Department of Environmental Resources Management (DERM) has completed the first stage of a Terrain Mapping Project. Four draft landscape maps (one current condition and three future scenarios) have been created to show the potential impact of sea level rise in Miami-Dade. These maps are **not** a finished product; therefore, they should **not** be used for any planning decisions or projects. The model and maps will be updated as new data, input, and analysis become available. Efforts to incorporate additional topographic data and surveys from Everglades National Park are contemplated. The draft maps and related information are at the following web site: [http://www.miamidade.gov/derm/climate\\_change\\_impact\\_on\\_florida.asp](http://www.miamidade.gov/derm/climate_change_impact_on_florida.asp)

The Natural Systems Adaptation Committee has provided several recommendations, including coordination of a regional "Vital Signs Monitoring" program, directed at providing critical information on important indicators of climate change, such as sea level, weather-related parameters (temperature, rainfall, etc.), coral cover and sea temperature, landscape level vegetative patterns, salt intrusion, and invasive species patterns. A workshop to identify opportunities for collaboration and partnership is proposed for the near future.

### Contact Information:

Miami-Dade Department of Environmental Resources Management (provides logistical staff support to the CCATF and Committees)  
Lisbeth Britt, Environmental Resources Project Supervisor  
305 372-6903  
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South Florida Water Management District  
Point of Contact: Tom Teets/Joni Warner  
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**Climate Change Coordination: provide a broad picture of the climate change research and actions that are being planned or conducted by the various agencies relevant to the restoration of the South Florida Ecosystem.**

Project Paragraph: The South Florida Water Management District is involved in both intergovernmental coordination efforts and scientific and technical aspects of climate change. Staff is communicating with local governments on their climate change initiatives and participating on some of the local climate change task forces. The SFWMD has been gathering information associated with governmental and non-governmental organization climate change initiatives.

For more than two decades, scientists and engineers at the South Florida Water Management District have conducted extensive research on the natural variability of climate to understand the teleconnections linking such phenomena as El Nino, La Nina and Atlantic Multidecadal Oscillation to south Florida's rainfall and flow patterns. More recently, the SFWMD established an interdepartmental team to coordinate the internal and external efforts on climate change and its impact on SFWMD's mission. The team is in the process of developing a white paper on the subject.

Current progress of the technical work includes an analysis of historical trends in both temperature and precipitation, evaluation of the 20<sup>th</sup> century projections of General Circulation Models, and analysis of sea level rise data around the state of Florida. In addition, the group at SFWMD has reviewed an extensive collection of literature to understand the uncertainties in projections of climatic parameters such as precipitation, temperature and evapotranspiration as well as sea level rise. The focus of FY10 would be to continue the data analysis and understand the uncertainties of climate projections with a view to develop information that would be useful for planning level analysis.

It is clear that a concerted effort is required to coordinate local, state, federal and academic activities regarding climate change research with a view to have a common set of assumptions and projections to benefit water resources management in all agencies. In addition, there are many research topics for which the SFWMD would need federal assistance, as they are beyond its capabilities to conduct such research.

**U.S. Army Corps of Engineers (USACE)**

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Existing USACE national planning guidance on Sea Level Rise (SLR) is currently being updated and is expected to be issued in July/August 2009 as a new Engineering Circular (EC). It will continue to follow National Research Council (NRC) recommendations to consider a range of SLR scenarios (low, medium and high) as a method to help address uncertain future conditions and identify alternative projects that will be resilient and adaptable. The USACE supports use of Risk-Informed Decision-Making processes which use a range of future scenarios to help planners identify and address the potential risks and consequences of various design options particularly for low probability events that could have major consequences.

The April 1999 CERP Report (the Yellow Book) considered the CERP's ability to mitigate 0.5 ft of SLR, and determined that it could be handled with operational changes, but these would result in more frequent water supply restrictions and other constraints. CERP Guidance Memorandum #16, dated May 27, 2004, directed the RECOVER team to evaluate CERP performance at the most probable scenarios including 0.8 ft of SLR. The September 2008 report by the NRC's Committee for Independent Scientific Review of Everglades Restoration Progress (CISRERP) criticized CERP implementing agencies for not completing this effort, and recommended expanded studies for a range of SLR scenarios to 3 ft or higher, based on more recent climate change information.

Jacksonville District RECOVER staff held a coordination meeting in Jan 2009 with CERP partner agencies to identify climate change related ongoing and planned activities and to initiate a CERP Technical Report that will identify the sensitivity of the CERP to potential climate change impacts for a range of scenarios with 1-5 ft of SLR. This initial CERP Technical Report will have a level of detail similar to a traditional USACE Reconnaissance report. It will also include a work plan for a second CERP Technical Report for more detailed studies in 2010 – 2011 which are expected to address sea level rise, plus other climate change impacts such as potential precipitation and evaporation changes. The initial draft report and work plan are tentatively scheduled to be done in Fall 2009 and may be submitted to the new CISRERP panel for their review and comment.

USDA-NRCS

Bill Reck

Climate Change Coordination

In terms of Climate Change, everything is relevant to the South Florida Ecosystem.

NRCS provides technical assistance to land-users, communities, units of state and local government, and other Federal agencies in planning and implementing conservation systems. NRCS provides financial assistance to encourage the adoption of land treatment practices that have been proven to provide significant benefits to the public. Financial assistance is awarded to participants who voluntarily enter into contracts, easements, and agreements to conserve natural resources. Agriculture makes a positive contribution to local air quality and the Nation's efforts to sequester carbon as well as reduce fossil fuel energy use. NRCS currently incorporates air quality and carbon sequestration considerations into conservation planning with producers. Additionally NRCS is expanding plant materials research to develop plant varieties that maximize carbon sequestration.

Ongoing: Ed Wright, Environmental Liaison, NRCS, (386) 329-4116, [Edward.Wright@fl.usda.gov](mailto:Edward.Wright@fl.usda.gov)

## USGS work with Climate Change in the Everglades

USGS / FISC 2008-2009 Research Overview

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USGS Florida Integrated Science Center (FISC) investigations of climate change in the Everglades focus on the potential impacts of sea level rise on built and natural hydrologic interfaces, coastal processes, karst aquifer dynamics, and biological resources/wildlife management. **Built/natural water systems:** USGS-FISC evaluates data from wells in Miami-Dade County sea-water encroachment monitoring network to determine the landward extent of seawater in the Biscayne aquifer, improve the accuracy of the monitoring network, and created an integrated management system for water managers. In Pompano beach, FISC is developing a tool for future well field water management by simulating historic patterns of saltwater intrusion in northern Broward county and quantifying the effects of natural and anthropogenic stressors. **Coastal processes:** USGS-FISC coastal investigations have lead to improved models of storm surge, which is critical to managing coastal habitats. FISC is conducting research on the potential responses of Florida shelf ecosystems to changing levels of atmospheric CO<sub>2</sub>. **Karst aquifers:** USGS research investigates the hydrogeologic framework of karst aquifers, which is critical to understanding how sea level rise will affect Everglades Restoration. Research on conduit flow process is being used to better simulate horizontal flow conditions and plans are underway to transfer the modeling technology. Investigations of the Biscayne aquifer's porosity are leading to better procedures for simulating ground-water flow within the aquifer, and the methods for applying this to adaptive management are being developed. **Biological resources/wildlife management:** FISC's integrated Manatee-TIME model, used to investigate effects of specific water management scenarios on manatee populations in the Ten Thousand Islands area, is being updated to test for the effects of sea level rise (for more, see the new science section). FISC also conducts research on the population ecology, monitoring, and simulation modeling of crocodiles, amphibians, pythons, and small mammals that will be valuable to test for changing in distribution due to changing environmental factors. Finally, FISC is looking at the impacts of changing ocean pH, temperature, sea level, and other factors to coral reefs (see the new science section).

## **New USGS Scientific Investigations in the Everglades**

USGS Florida Integrated Science Center (FISC) research includes improved water depth estimation capabilities, research on emerging water quality issues, groundwater-surface water modeling, integrated hydrology-manatee modeling, and coral reef ecology. **Water depth estimation capabilities:** The Everglades Depth Estimation Network (EDEN) is a primary product of the RECOVER monitoring and assessment plan, offering continuous water level data for the Everglades that is critical for large-scale field operations, research, and assessments in the Everglades. **Emerging water quality issues:** New research investigates occurrence of organic wastewater compounds (antibiotics, hormones, and pharmaceuticals) in water treatment facility effluent. Research on the microbial ecology of the upper Floridan aquifer looks at geochemical parameters of public health interest in native versus blended waters. Work on land-based pollution from coastal submarine groundwater discharge sites looks at the suspected link between macro algae and the Broward county shelf and the relationship between algal blooms and native benthic ecology. **Coupled surface water-groundwater models:** FISC is current in discussions with the Army Corps of Engineers in Jacksonville, the FWS in Vero Beach over tentative plans to build a web interface to access and display Everglades coupled ground water and surface water models that could be used to assess the impact of sea level rise and salt water intrusion on water management, habitat stability, and vulnerability to coastal storms. **Hydrology-manatee modeling:** FISC is expanding on its integrated TIME-Manatee model by further integrating it with the Cape Sable offshore tidal boundary, incorporating vegetative data, and improving hindcasting. The expanded model will be used to test for the effects of multiple sea level rise and CERP restoration scenarios on vegetation change, including mangrove-marsh ecotones, mapping hotspots of ecotone change, and determine spatially-explicit habitat suitability for species of interest. **Coral reef ecology:** New research on coral reef ecosystems is looking at the impacts of changing climate conditions, ocean pH, and sea level coral disease, benthic habitats, and coral calcification (growth) rates.

Organization: NOAA/AOML

Point of contact: Chris Kelble, NOAA/AOML Ocean Chemistry Division

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NOAA is taking the lead in climate change research by developing the National Climate Service (NCS), designed to be the nation's identified, accessible, official source of authoritative, regular, and timely climate information. NOAA's vision for the NCS is a Service that leads to *"an informed society anticipating and responding to climate and its impacts"*. NOAA's mission for the NCS is *"to develop and deliver research, information and services to enhance society's ability to understand, anticipate, mitigate, and adapt to climate variability and change"*.

Specific activities envisioned by NOAA for the NCS include collection and analysis of historical and real-time data, establishment of monitoring and assessment programs, scientific research and modeling, predictions and projections, provision of decision support tools and early warning systems, and the development and delivery of valued climate services.

Locally, for south Florida the most pressing issues related to climate change are sea level rise and ocean acidification. Sea level rise will be one of the emphases of the NCS. In addition, NOAA is currently developing an ocean acidification research plan for the Southeast U. S. and the Gulf of Mexico that is south Florida intensive and is specifically focused on the effects of ocean acidification on subtropical ecosystems. NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) has recently hired several ocean acidification experts and will aim to take a leading role in this research area.

## USGS Climate Change Research

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- **Past and Future Impacts of Climate Change on Coastal Habitats and Species in the Everglades — An Integrated Modeling Approach**

KB Langtimm, Eric Swain, Tom Smith, Don DeAngelis, Dennis Krohn and Brad Stith

- Enhance existing hydrology model to hindcast SLR and historic vegetation change
- Add a land elevation change component
- Add mechanistic models of vegetation change
- Add hurricane disturbance
- Use new model to assess habitat suitability for focal species
- Develop predictive capability for SLR under restoration and management scenarios

- **Modeling Hydrologic Flow and Vegetation Response across the Tamiami Trail and Coastal Watershed of Ten Thousand Islands NWR**

Thomas W. Doyle and Ken W. Krauss

- Monitoring study providing baseline data for developing a coastal hydrodynamic model that will be valuable for documenting observed changes over time from changes in freshwater delivery and increasing sea level and hurricane storm surge events

- **A Coupled Surface Water and Ground-Water Model to Simulate Past, Present, and Future Hydrologic Conditions in DOI Managed Lands**

Melinda Lohmann, Eric Swain, Chris Langevin, John Wang

- Model (BISECT- Biscayne and Southern Everglades Coastal Transport Model) uses the FTLOADDS coupled code to simulate CERP scenarios in ENP and BNP
- Model Simulations will look at water budgets, freshwater flows to coast, salinity transport, and GW movements focusing on changes to GW flow in the L-31 canal area under different restoration scenarios
- BISECT can run scenarios with sea level rise estimates and other climatic changes

- **Development and Stability of Everglades Tree Islands, Ridge and Slough, and Marl Prairies**

Debra Willard and Christopher Bernhardt

- Research on the timing of marl prairie development documents the combined impacts of climate variability and water-management practices on formation of this critical habitat
- Future land-cover changes resulting from restoration of “natural” flow patterns are likely to trigger further changes in temperature and precipitation, which will ultimately affect discharge to the estuaries and salinity

- **Alligator and American Crocodile nesting habitat**

Ken Rice and Kristen Hart

- Both alligators and crocodiles require sandy upland areas adjacent to estuarine habitat for nesting
- Such low-lying coastal areas may be affected by sea level rise scenarios associated with climate change, and may very well disappear if sea level rises by several meters

- **Habitat use and movements of threatened and endangered sea turtles, Dry Tortugas National Park**

Kristen Hart

Each of three species of sea turtles use different benthic resources for food:

Green turtles (*Cheonia mydas*) eat seagrass

Hawksbills (*Eretmochelys imbricata*) eat sponges

Loggerheads (*Caretta caretta*) consume lobsters, crabs and fish discards

Methods currently used:

- Satellite and acoustic telemetry to determine habitat utilization patterns (n=16 turtles of 3 species) and use of available nesting beaches
- Genetic analysis to determine location of origin, stock structure
- Stable isotopes and oral lavage (regurgitated stomach/gut content analysis) to determine preferred diet items

**NOAA Fisheries Southeast Fisheries Science Center, Miami****Summary of New Science and Climate Change****Development of Biological and Physical Indices for Stock Evaluation in the Dry Tortugas Pink Shrimp Fishery. 2008 FATE Project.**

Joan Browder, NOAA NMFS Southeast Fisheries Science Center, Miami  
Maria Criales, Claire Paris, and Laurent Cherubin, CIMAS-RSMAS, University of Miami  
Yan Jiao, Virginia Polytechnic Institute

The goal of the NOAA National Marine Fisheries Service FATE (Fisheries and the Environment) program is to provide information necessary to effectively adapt fishery management to take into account and mitigate the ecological, social, and economic impacts of major shifts in fisheries productivity. A FATE project was initiated in summer of 2008 at the Southeast Fisheries Science Center, in collaboration with the Cooperative Institute for Marine and Atmospheric Science at the University of Miami, Rosenstiel School of Marine and Atmospheric Science. The project's purpose is to analyze the response of pink shrimp to environmental variation and incorporate ecosystem indicators into stock assessments and ecosystem assessments in order to better inform both fishery managers and water managers about stock status and factors causing variation. A biophysical Lagrangian model of larval behavior is being coupled to a coastal hydrodynamic model to simulate the migration of pink shrimp larvae from the Tortugas spawning grounds to nursery habitat in Florida Bay and the return trip of young adults to the spawning grounds. The model is designed to simulate the use of selective tidal transport (STT), a vertical migratory behavior in which larval shrimp ascend into the water column during the flood tide and descend to the bottom during ebb tide in order to migrate shoreward and young adult shrimp do the opposite to migrate toward the spawning grounds. The project will examine the interconnections between shrimp behavior and local, mesoscale, and regional-scale processes in migrations of larvae to the nursery grounds and young adults back to the spawning grounds. Basic questions to be addressed will help refine stock assessments by improving predictions of recruitment to the fishery. The project will also help to better define the interrelationships of fishery spawning and recruitment with postlarval concentrations at the entrance to the nursery grounds and the density of juvenile pink shrimp on the nursery grounds. This will enable researchers to better connect water-management-influenced environmental conditions in Florida Bay to the productivity of the fishery.

This project started in the summer 2008 and employs one postdoctoral fellow and a PhD student at CIMAS, as well as the principals.