



Working Together to Address the Effects of Climate Change on Water Resources

Webcast sponsored by EPA's Watershed Academy

Tuesday, October 27 2009, 1- 3pm Eastern

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The Watershed Academy



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Topics for Today's Webcast

- How is climate changing, what are the impacts on water, and what does this mean to U.S. water program managers?
- What is the EPA National Water Program doing about climate change and its effect on water resources and programs?
- Case Study: Charlotte Harbor Climate Ready National Estuary project



How is climate changing, what are the impacts on water, and what does this mean to U.S. water program managers?

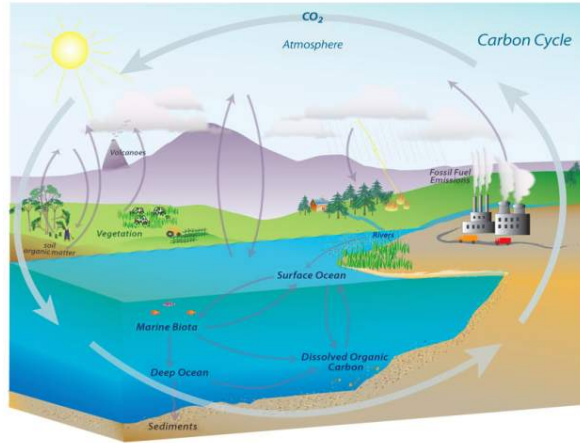
Karen Metchis
Climate Advisor
U.S. EPA Office of Water



Climate: Weather, such as temperature, precipitation and wind, averaged over an extended period of time



What is the Cause of Climate Change? The Global Carbon Cycle

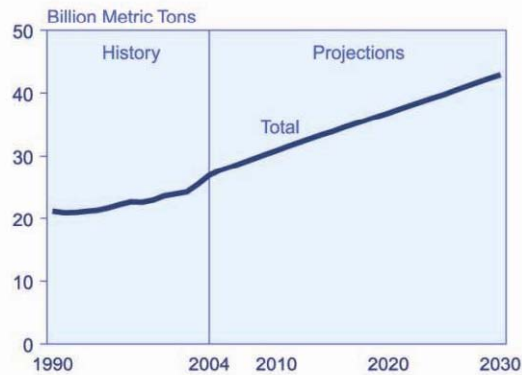


Source: NOAA , www.esrl.noaa.gov

What is the Cause of Climate Change? Carbon Dioxide & Other Heat Trapping Gases

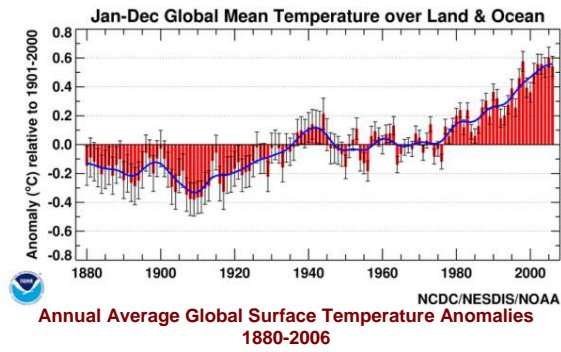


World Energy-Related Carbon Dioxide Emissions



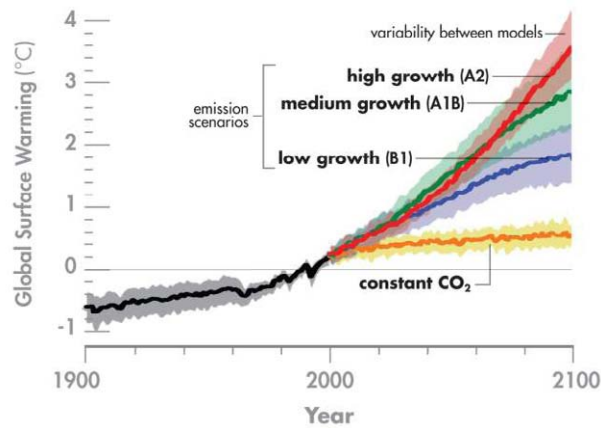
Source: EIA, *International Energy Outlook 2007*

How Is the Climate Changing? Observed Temperature Changes



The 10 warmest years on record globally have all occurred since 1995, and seven of those have occurred since 2001.

How Is the Climate Changing? Projected Temperature Change

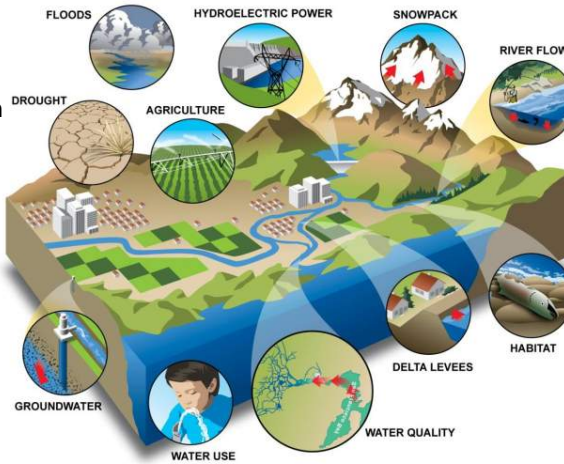


Source: NASA Earth Observatory,
based on IPCC Fourth Assessment Report (2007)

Why Does Climate Change Matter to Water Program Managers?

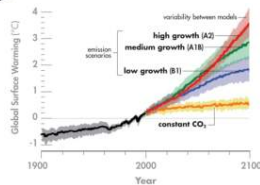


- Temperature change drives other changes in natural environmental processes that in turn affect the quality and quantity of our water resources.
- Steps taken to reduce the release of greenhouse gases may have consequences for water resources and programs.



Source: California – Department of Water Resources. Climate Change in California Fact Sheet.

What Are the Water-Related Effects of Climate Change in the U.S.?



Source: NASA Earth Observatory, based on IPCC Fourth Assessment Report (2007)

Warmer water



Precipitation changes



Source: NOAA, www.katrina.noaa.gov

Increases in tropical storm intensity



Source: USEPA, www.epa.gov/cre

Ocean and coastal changes



Source: Maps of Lands Vulnerable to Sea Level Rise as found in EPA 2008u
Sea level rise

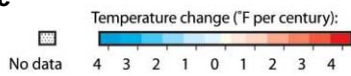
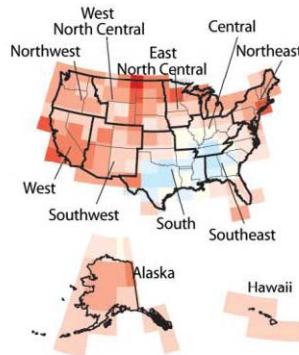
The Effect on Water Resources Air & Water Temperature Increases



“All of North America is very likely to warm during this century, and the annual mean warming is likely to exceed the global mean warming in most areas...warming in the USA is expected to exceed 3.6 ° F by nearly all models.”

—IPCC, 2007c

Annual Mean Temperature Anomalies
1901-2005



Source: NOAA/NESDIS/NCDC, as found in EPA 2008v

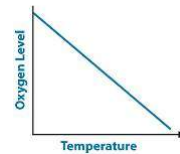
The Effect on Water Resources Water Temperature Increases



Changes in the distribution and survival of aquatic species



Algal blooms



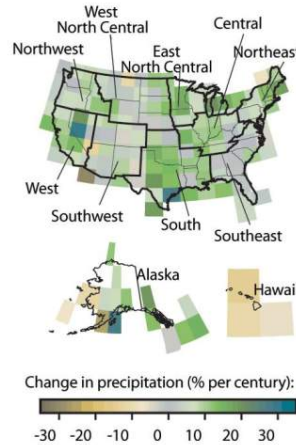
Lower dissolved oxygen levels



The Effect on Water Resources Precipitation Changes

- Annual average precipitation is expected to increase in the northeast and decrease in the **southeast**
- Greater variation in precipitation, including more intense drought and extreme rainfall events
- More precipitation falling as rain instead of snow, resulting in changes in the amount of snow cover
- Changes in size and location of waterbodies and wetlands

Annual Precipitation Trends 1901-2005



Source: NOAA/NESDIS/NCDC, as found in EPA 2008t



The Effect on Water Resources Precipitation Changes

Water quantity

- Reduced ground water and surface water supply in some areas
- Reduced reliability of snow pack as a water 'reservoir'
- Increased water demand due to higher temperatures



Water quality

- Increased runoff resulting in erosion and sedimentation
- Overwhelmed water infrastructure due to flooding

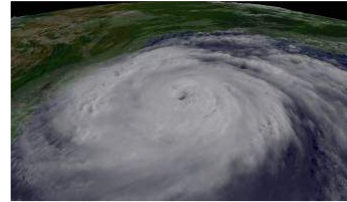




The Effect on Water Resources Increases in Storm Intensity

Warming air and sea surface temperatures are expected to result in greater intensity of tropical storms, accompanied by:

- Stronger peak winds
- Increased rainfall
- Larger storm surges



Intensified hurricanes and tropical storms



The Effect on Water Resources Increases in Storm Intensity



Contaminated waters



Damaged wetlands



Source: Louisiana DEQ
**Flooded Wastewater
Treatment Plant**



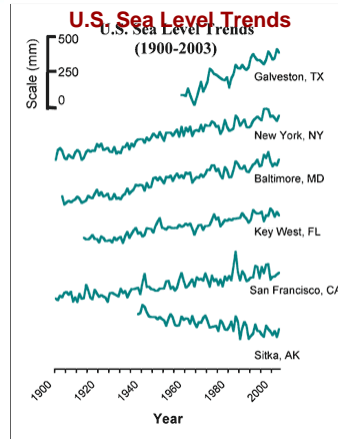
High wind damage



The Effect on Water Resources Sea Level Rise

“Sea levels are rising
worldwide and along
much of the U.S. coast.”

– IPCC, 2007c



Source: Monthly and Annual Mean Sea Level Station Files from the Permanent Service for Mean Sea Level (PSMSL) at the Proudman Oceanographic Laboratory



The Effect on Water Resources Sea Level Rise

- Displacement of coastal wetlands and habitat
- Increased coastal erosion
- Salt water intrusion in drinking water supplies
- Inundation of wastewater treatment infrastructure





The Effect on Water Resources Ocean and Costal Changes

Biological habitat changes are expected in the oceans as the air temperatures increase:

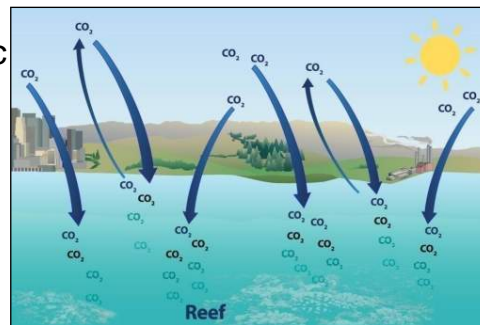
- Estuarine waters become more saline as sea levels rise
- Ocean temperatures increase
- Ocean acidification



The Effect on Water Resources Ocean and Costal Changes

What is Ocean Acidification?

- Increased atmospheric carbon dioxide levels result in increased ocean absorption of carbon dioxide
- Causes a deficit of the carbonate ions that coral and other marine organisms need to build their skeletons





What Is the Relationship Between Energy, Water Resources and Climate Change?

- Reduced water flows could limit hydropower and power plant cooling
- Geological sequestration of CO₂ from coal-fired power plants could pose a risk to underground sources of drinking water
- Demand for biofuels could lead to increased agricultural nutrient runoff
- Water collection, treatment and distribution accounts for 4% of energy use in the U.S.



Coal-fired electric power plant



What Are Other Effects of Climate Change?



Agriculture



Forestry



Recreational Opportunities



Health



Summary: Implications of Climate Change for the EPA National Water Program

- Climate change will affect every aspect of our national water program
- We need to prepare to adapt to these impacts while also building our understanding of the changes
- This will require a flexible and iterative approach that does not assume the hydrologic cycles of the future will be like the past



Questions?





What is the EPA National Water Program doing about climate change and its effect on water resources and programs?

Michael Shapiro,
Deputy Assistant Administrator,
U.S. EPA's Office of Water



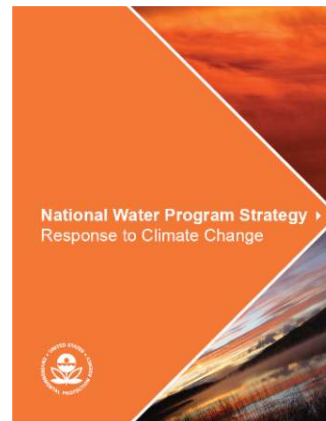
A changing climate in the years ahead will raise new challenges for improving the quality of the Nation's waters.



What Is EPA's National Water Program Doing to Address the Effects of Climate Change on Water Resources?

*National Water Program Strategy:
Response to Climate Change*

- Goal 1:** Water Program Mitigation of Greenhouse Gases
- Goal 2:** Water Program Adaptation to Climate Change
- Goal 3:** Climate Change Research Related to Water
- Goal 4:** Water Program Education on Climate Change
- Goal 5:** Water Program Management of Climate Change





Goal 1: Greenhouse Gas Mitigation Strategies for Water Programs

- Energy conservation & energy generation at water facilities
- Water conservation and water reuse
- Green infrastructure and low impact development
- Carbon sequestration



Energy Efficiency & Energy Generation

Ensuring a Sustainable Future:
An Energy Management Guidebook
for Wastewater and Water Utilities



JANUARY 2008

- Energy Efficiency
 - *Sustainable Future: Energy Management Guidebook for Wastewater & Water Utilities*
 - Workshops, Assistance
 - *Effective Energy Conservation - Guide for POTWs* (2010)
 - Small Utility Energy Audit Protocol (beta 2009)
- Energy Generation
 - Combined Heat & Power Guide (2010)
- Stimulus 'Green Project Reserve' \$1.4B
 - energy efficiency, water conservation, reuse



Water Conservation & Reuse

WaterSense

- A voluntary partnership program to promote the value of water and support smart decisions about water use and water-using products
- EPA develops specifications; labeled products are certified by independent 3rd parties
 - Final WaterSense Label specifications: toilets, faucets, faucet accessories and flushing urinals
 - Draft specifications: new homes, showerheads
- *In 2008, WaterSense labeled products saved 9.3 billion gallons of water and more than 1 billion kWh*



Water Conservation & Reuse

- **Water Conveyance Leak Detection and Remediation**
 - Guidance & Training: Control & Mitigation of Drinking Water Losses in Distribution Systems (pending release)
- **Water Availability, Variability and Sustainability (WAVS) for Drinking Water Systems**
 - Supporting States' exploration of water conservation and resource management



Water Conservation & Reuse

- NAS Study: “Assessment of Water Reuse as an Approach for Meeting Future Water Supply Needs” (expected late 2010)
- Results will be used to:
 - Update and revise “2004 Guidelines for Water Reuse”
 - Develop case studies of reclaimed municipal effluent as an alternative water supply by various industries.
 - Compare performance, costs, energy requirements and GHGs to different levels & types of wastewater treatment
 - Compare costs, energy requirements and GHGs for water reclamation/reuse vs. other water sources



Green Buildings & Green Infrastructure

- **Tools and Technical Assistance**
 - Green Calculator – estimates runoff volume reductions
 - WERF Cost Tool – estimates & compares costs
 - EIA Section 438 - guide to federal agencies
 - *GI and green buildings have been targeted by States for disbursing Stimulus ‘Green Project Reserve’ dollars*



- **GI in Regulatory Programs**
 - Guidebook & Technical Support: Incorporating GI into permits, enforcement orders, TMDLs & water quality standards
 - ‘Green’ long-term control plans



Carbon Sequestration

- Geologic Sequestration Regulation
 - Underground Injection Control Program to protect underground sources of drinking water
 - Proposed Rule July 2008
 - Notice of Data Availability August 2009
 - Anticipate Final Rule in early 2011



Additional EPA Programs for Greenhouse Gas Mitigation



Office of Air and Radiation

EPA Office of Air and Radiation

www.epa.gov/climatechange

- Domestic and International Climate Change Policy
- Clean Air Act and Greenhouse Gases
- National Greenhouse Gas Inventory and Mandatory Reporting Rule
- Voluntary Programs





Goal 2: Adaptation Strategies for Water Programs

EPA is working to adapt its base programs and provide information, tools and assistance to States, Tribes and local governments.

- Water Quality & Watersheds
- Wetlands, Estuaries and Ocean Environments
- Water Infrastructure



Water Quality

- Evaluating Health & Environmental Risks
 - Epi study of difference in health risks of recreating in tropical waters vs. other waters
 - Quantitative microbial risk assessment on relationship of pathogens & changing environmental parameters and health effects
 - Ocean Acidification NODA
- Methods and Tools
 - Stony coral biocriteria methods manual
 - BASINS Climate Assessment Tool
 - For environmental impact forecasting



Water Quality

- **Assessing Emerging Industries**
 - 2010 304(m) planning - review of new industrial sectors and emerging industries
 - "Applicability of ELGs & and Categorical Pretreatment Standards to Biodiesel Mfg" (August 11, 2008)
 - Biodiesel and Ethanol Technical Guidances



Water Quality

- **Addressing Wet Weather and Other Impacts**
 - Incorporating Green Infrastructure principles into wet weather permitting.
 - Evaluating implications of climate on NPDES program
 - Evaluating policy and technical implications of velocity or flow standards



Wetlands, Estuaries and Ocean Environment

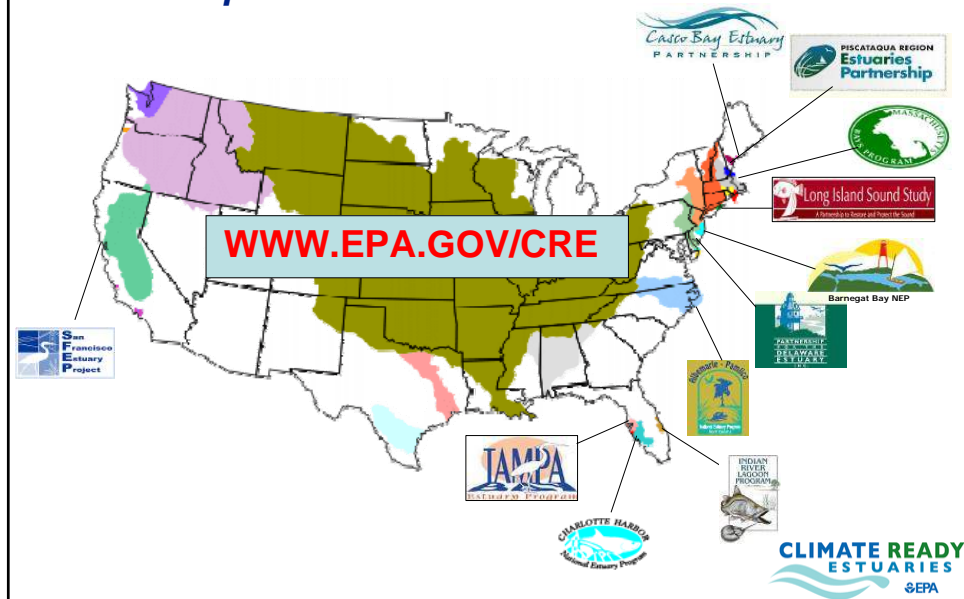
- Building Resilience in Wetlands
 - National Wetland Hydrology Mapping standard
 - Finalized July 7, 2009
 - Next: Implementation Strategy
 - National Wetland Survey includes parameters relevant to study of climate change impacts
 - Wetlands Mitigation Rule (Final March 2008)



Wetlands, Estuaries and Ocean Environment

- Place-based Strategies
 - Chesapeake Bay Initiative – EO 13508, Section 202(d) Climate Change
 - Gulf of Mexico
 - Coral Reef Task Force – Climate Change Working Group
 - Climate Ready Estuaries...

Climate Ready Estuaries – Partnership with 11 NEPs and EPA



CRE- Building Capacity for Coastal Climate Change Adaptation

- Technical assistance, tools, outreach
 - Web (www.epa.gov/cre)
 - Publications
 - *Synthesis of Adaptation Options*
 - *Guidance for Coastal Climate Adaptation Planning*
 - Direct Technical Assistance
 - Vulnerability Assessments
 - Climate Change Indicators and Monitoring
 - Estimating Ecosystem Services Loss
 - Outreach and Education
 - Wetlands Adaptation
 - Model Ordinances





Water Infrastructure

- Building Readiness with “Climate-Ready Water Utilities”
 - FACA working group to advise EPA on development of a new program and tools for addressing climate change
- Vulnerability Assessment & Preparedness Tools
 - CC Risk Assessment and Awareness Tool – software to assess vulnerability of assets to climate change
 - supports adaptation decisions & planning; builds awareness (beta early 2010)
 - Climate Change Vulnerability Decision Framework and Best Practices (available early 2010)
 - Emergency Response Table Top Planning Tool – being expanded to include climate change threat scenarios



Water Infrastructure

- Drinking Water and Clean Water State Revolving Funds (SRFs)
 - Available for Climate Adaptation and Mitigation Projects
 - Stimulus ‘Green Project Reserve’ \$1.4B allocated for energy efficiency, water conservation, water reuse



Goal 3: Research Strategies for Water Programs

- CCSP Synthesis & Assessment Products
- USGCRP Synthesis Report
- ORD & OST Research
- Collaborative Workshops & Tool Development
- National Water Program Research Forum



Additional EPA Climate Change Programs



**EPA Office of Research and Development
Global Change Research Program**

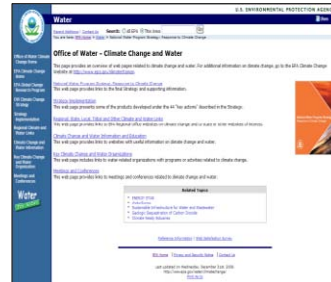
www.epa.gov/ord

Mission: Assess the impacts of global change—particularly climate variability and change—on air and water quality, ecosystems, human health, and socioeconomic systems in the United States, and provide timely and useful information and decision-support tools to policy makers and resource managers to help them adapt to a changing climate.



Goal 4: Education Strategies for Water Programs

- Water program climate Web page
- E-Newsletter
- Webcasts
- Regional forums and stakeholder conferences



www.epa.gov/water/climatechange



Goal 5: Management Strategies for Water Programs

- Incorporate climate change into daily operations
- Support EPA Regional planning and implementation of climate change actions
- Collaborate with other EPA Program Offices
- Increase federal interagency coordination on water and climate, e.g.
 - WestFAST
 - HUD-DOT-EPA Sustainability Partnership
 - CEQ Task Force



US Army Corps of Engineers®



For More Information

EPA Office of Water

www.epa.gov/ow/climatechange



Questions?



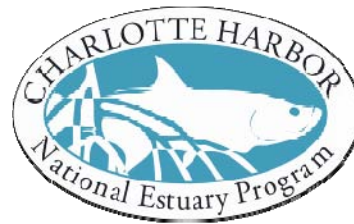


Climate Ready Estuaries

Lisa Beever, Director,
Charlotte Harbor National
Estuary Program, Florida
lbeever@swfrpc.org



**National Estuary
Programs:** Created
under Section 320 of
the Clean Water Act,
under auspices of
EPA. 28 in nation.



Climate Ready Estuaries Website

Visit the Climate Ready Estuaries Website to find information on climate change impacts and adaptation, including:

Basic Information

What are the projected climate change impacts to coastal systems? What can be done to address these impacts?

Where You Live

Where are the National Estuaries and what climate change impacts assessment and adaptation efforts are underway in your region?

Explore Climate Ready Estuaries

Learn how the program is working with coastal managers to advance coastal adaptation to climate change.

Coastal Toolkit

What tools and information will help you get started assessing climate change vulnerabilities, finding data, and developing adaptation plans?

www.epa.gov/cre



PROGRAM CONTACTS

If you are a coastal manager with specific questions on the program, please contact:

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EPA Office of Air and Radiation
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John Wilson
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Oceans and Coastal Protection Division
EPA Office of Water
(202) 566-1158

For media or press inquiries, please visit
www.epa.gov/newsroom/contact-us.htm.

**CLIMATE READY
ESTUARIES**
EPA

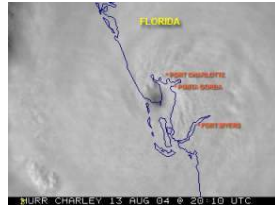
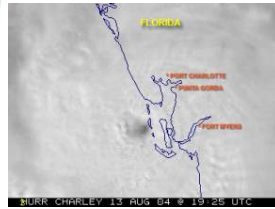


Office of Air and Radiation
Office of Water
EPA 430-F-08-027a
February 2009

Recycled/Recyclable
Printed on paper that contains at least 50% post consumer fiber.



Why Charlotte Harbor NEP?



- Host agency's 2 decades of storm surge modeling & hurricane planning.
- 2001 500-yr & 2008 100-yr droughts.
- 2004 Category 4 land-falling storm; Hurricane Charley.
- Climate-aware population.

Committing to Our Future

A Comprehensive Conservation and Management Plan
for the Greater Charlotte Harbor Watershed
from Venice to Bonita Springs to Winter Haven



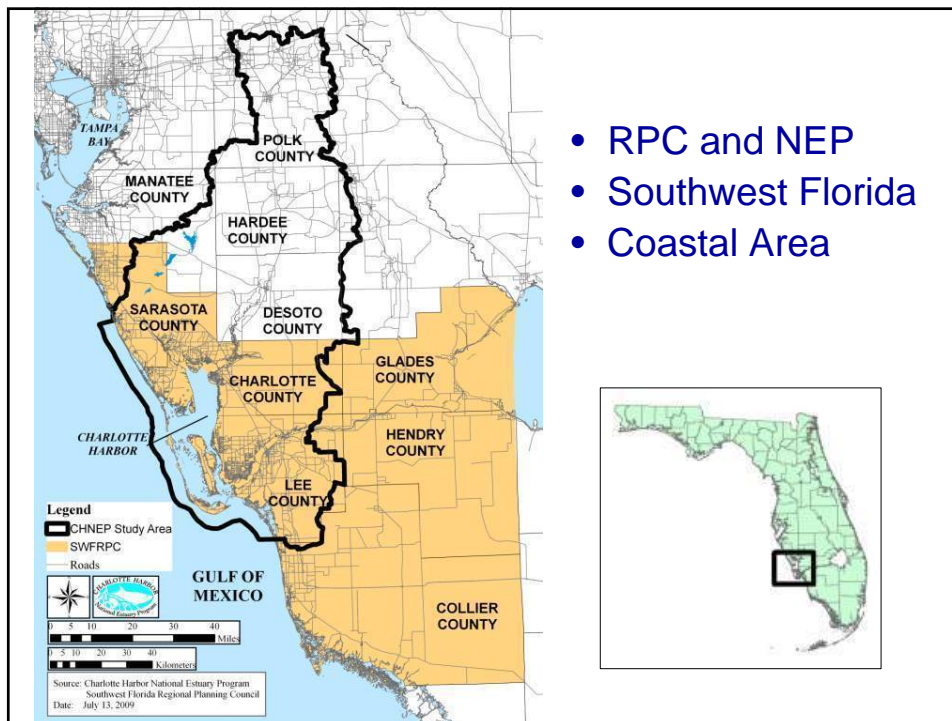
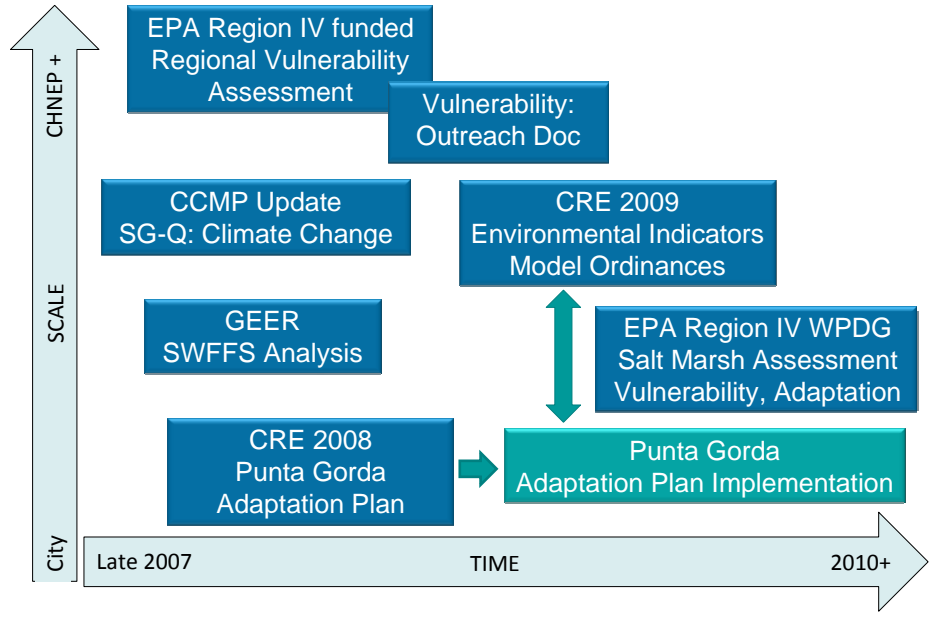
Update 2008

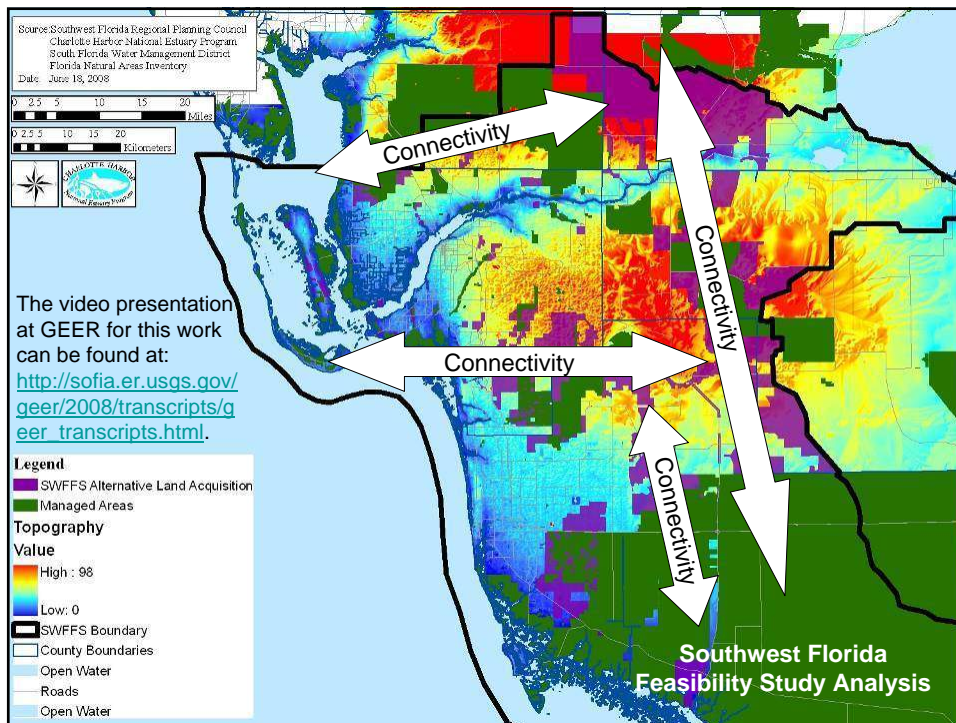
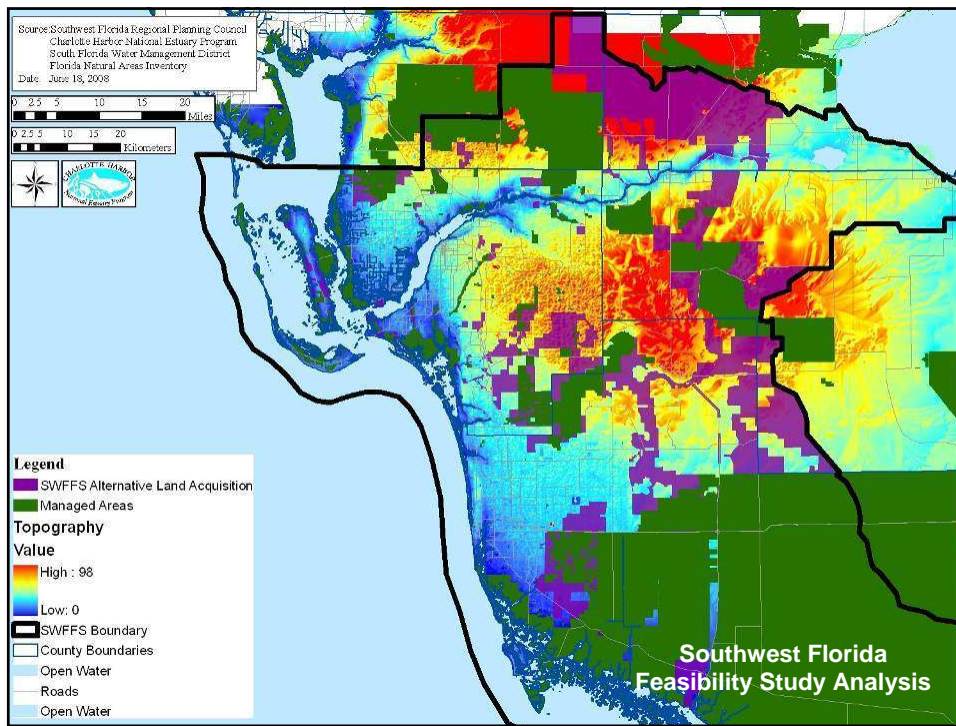


Comprehensive Conservation and Management Plan

SG-Q: Build capacity for communities and their local leadership to mitigate and adapt to the effects of climate change through joint efforts.

CHNEP Climate Projects Overview

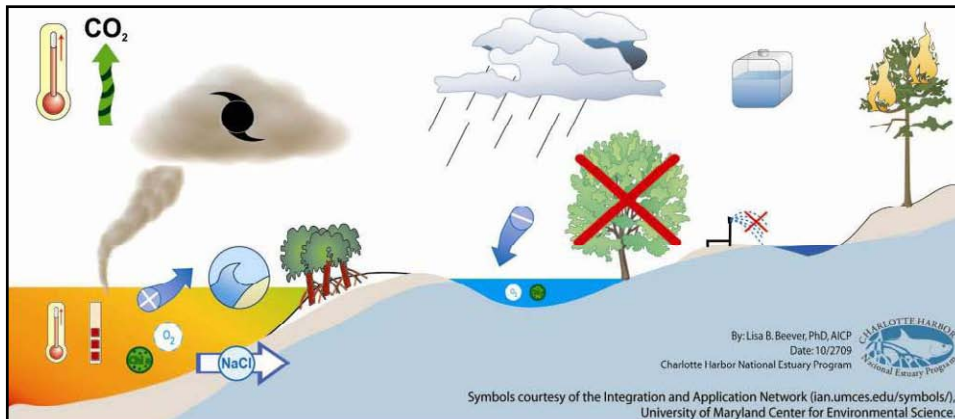






Southwest Florida Vulnerability Assessment

- Review and catalog of Climate Change literature, 65+ articles and reports
- Database of 84 Potential Hydrologic, Habitat, Water Quality Effects
- Grouped Vulnerabilities (Drivers, Stressors, and Impacts)



Climate Change Drivers and Stressors

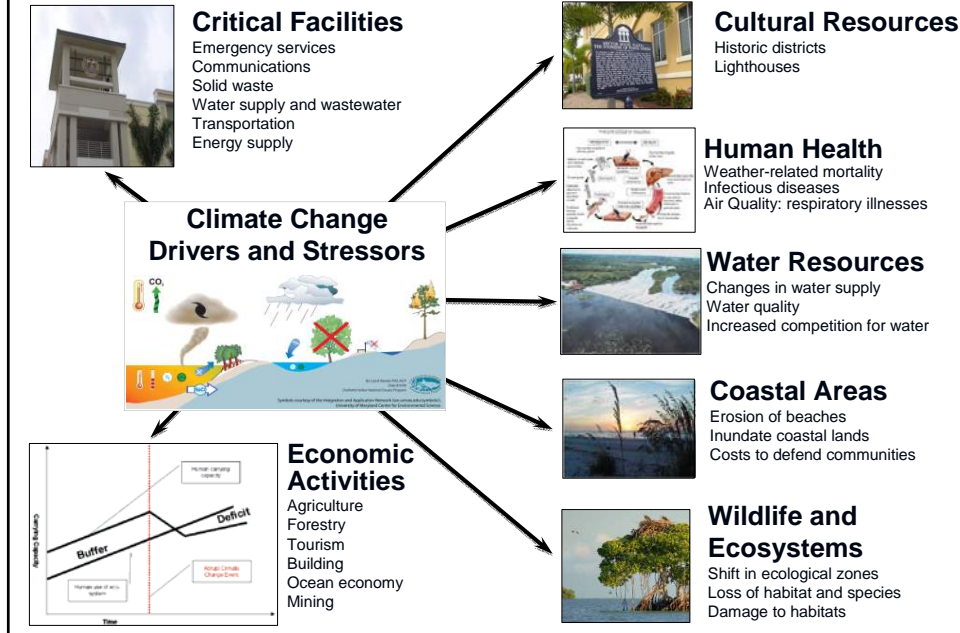
Charlotte Harbor Region

Drivers- Drivers include air temperature, air chemistry, water temperature and water chemistry. Air temperature increases as CO₂ and other greenhouse gases are emitted, fuel is burned , deforestation occurs , along with global and regional cyclical variations.

As air temperature increases, so does water temperature . As atmospheric CO₂ levels increase, ocean acidity also increases. Reduced dissolved oxygen and increased chlorophyll a in freshwater lakes and streams, estuaries, and seas is also possible.

Stressors- With the above drivers, stressors on natural and human systems occurs. The climate becomes unstable with resulting changes in precipitation , humidity , and storm and wind intensity. Changes in rainfall patterns, results in altered hydrology (changes in stream flow), drought and increase chances of salt water intrusion . Water temperature and other changes increase sea level and storm surge . Landform changes are the result of new coastal energy gradients and biological processes .

Potential Impacts of Climate Change



CRE 2008- Adaptation Plan



- Punta Gorda adopted Comp Plan language related to SLR in 2007
- Council voted unanimously to partner with CHNEP/SWFRPC to develop plan
- 3 workshops w/ 4 public participation games to derive vulnerabilities, adaptation options, and priorities.
- Plan undergoing public, City staff, and council member review.
- Due for adoption 11/18/09.

- Card Game (brainstorm & prioritize vulnerabilities)
- Envelopes Game (brainstorm adaptation options)
- Thumbs up/down (Consensus on vulnerabilities)
- Board Game (Locate, prioritize, discard adaptations)

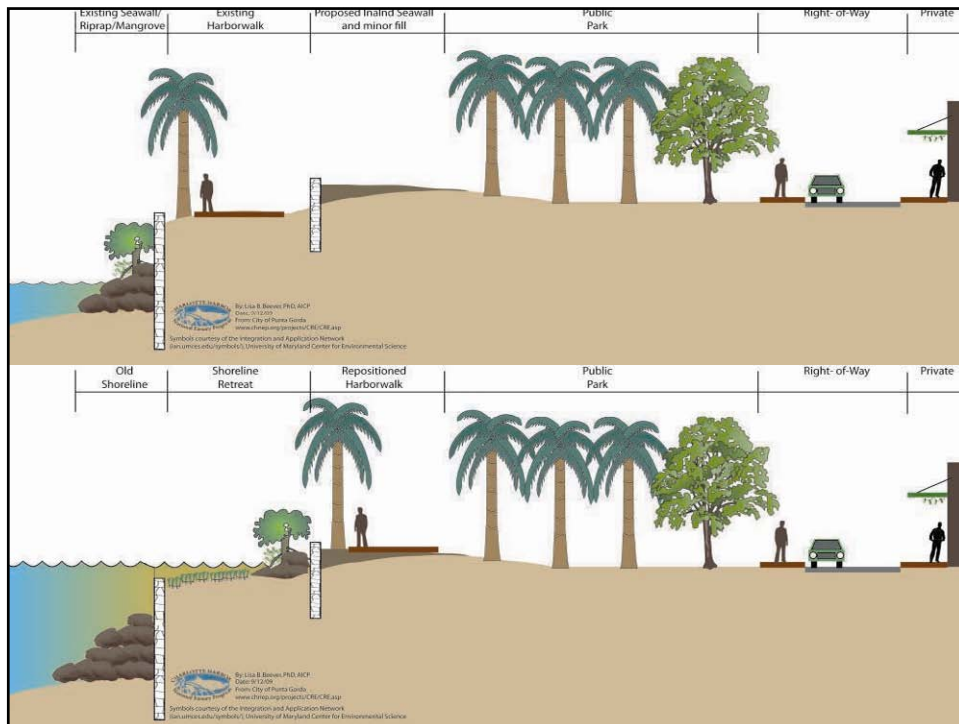


April 9, 2009
Public Workshop




City of Punta Gorda Adaptation Priorities

- Seagrass protection and restoration.
- Xeriscaping/native plant landscaping.
- Comprehensive plan to show which areas will retain natural shorelines.
- Constrain locations for certain high risk infrastructure.
- Restrict fertilizer use.
- Promote green building alternatives through education, taxing incentives, green lending.
- Drought preparedness planning.



CRE 2009- Model Ordinances



- CHNEP Attorney organizing local land use planners and elected officials and EPA staff to outline comprehensive plan and ordinance language to improve community resiliency.
- Punta Gorda partnering with University of Florida Law School to develop comprehensive plan and ordinance language to implement Adaptation Plan



CRE 2009- Environmental Indicators

- ICF hired to develop a set of 3-5 key climate change indicators and a climate change monitoring plan.
- Utilize vulnerability assessments and local secondary data as beginning.
- Committee of creative scientists to assist via conference calls over 8 month period.

HA-a: Amount of time that freshwater flows remain within the natural seasonal variation for the Caloosahatchee River.

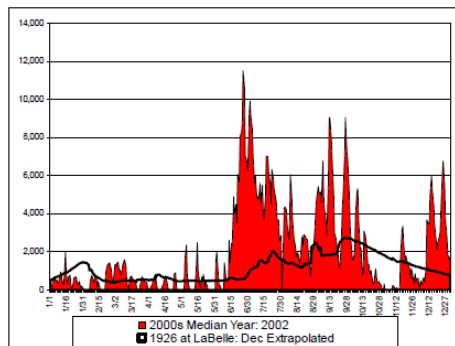
Summary: The SFWMD database DBHYDRO contains historic and current flow data for the Caloosahatchee River collected by US ACOE at S-79. Program staff has used these data to graphically look at trends in flow over the period of record. In addition, George B. Hills Co. collected daily flows near LaBelle during most of 1926.

Available Products:

- Daily flows at S-79, beginning 5/1/66.
- Daily flows at S-77, beginning 10/1/38.
- Daily flows at LaBelle, 1/1/26-11/28/26.

Gaps:

- 1) Determine the natural variation of flow in the Caloosahatchee and analyze the amount of time the flows are outside the range.

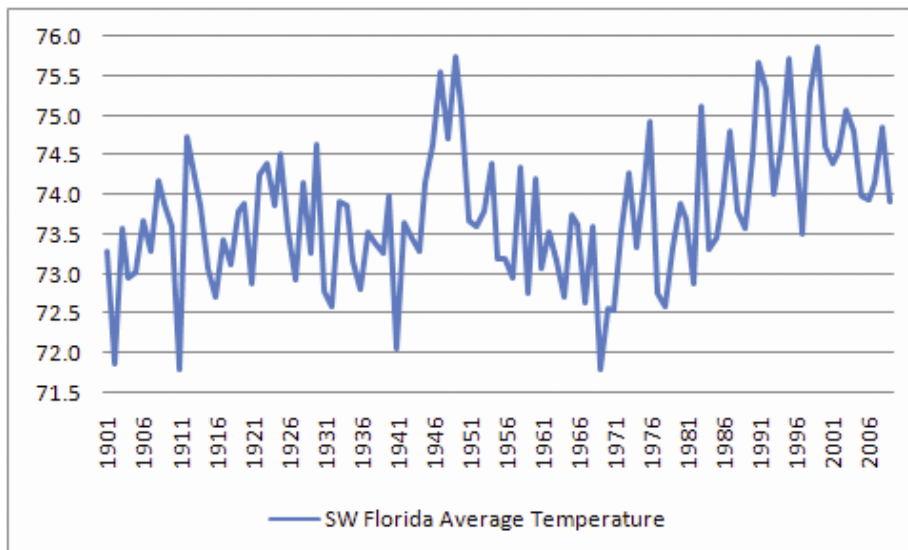


Target:

- Mean monthly minimum flow of 500 cfs and maximum flow of 2,800 cfs at S-79.

	1900	2008	Scenario	2100	Citation
Average Air Temperature (F)	73.1	74.4	Lower	76.6	Stanton and Ackerman 2007
			Moderate	78.5	Analysis of local data since 1968
			Upper	85.6	USGCRP 2009
Days per year over 90°	75.5 ¹	96.5	Lower	122	Rate applied from 1901-1919
			Moderate	150	Rate applied from 1931-1949
			Upper	180	USGCRP 2009
Water Temperature ² (F)	80.6 ³	81.7	Lower	82.8	IPCC 2007b
			Moderate	82.9	FOCC 2009
			Upper	85.3	IPCC 2007b
Air CO ₂ Levels (ppm)	298.0	387.0	Lower	450.0	USGCRP 2009
			Moderate	680.0	USGCRP 2009
			Upper	950.0	USGCRP 2009
Water pH	8.2	8.1	Lower	8.0	Royal Society 2005
			Moderate	7.8	Royal Society 2005
			Upper	7.7	Royal Society 2005
Rainfall (inches)	50 ⁴	50 ⁴	Lower	50	Stanton and Ackerman 2007
			Moderate	48	Average
			Upper	45	Stanton and Ackerman 2007
Rainfall Delivered in Heavy Downpours (% increase)	x	20%	Lower	44%	USGCRP 2009
			Moderate	54%	Average
			Upper	64%	USGCRP 2009
Sea Level Rise (inches)	0.0	8.0	Lower	7.1 + 8	Stanton and Ackerman 2007
			Moderate	19.8 + 8	EPA 1995
			Upper	45.3 + 8	Stanton and Ackerman 2007

Patterns of Average Temperature





Vulnerability & Adaptation for 5 SWF Salt Marsh Types

- Inventory and map the physical extent of 5 marsh types: salt marsh-mangrove transition, high marsh, oligohaline marsh, salt pan, and salt marsh algae.
- Identify significant potential effects on these salt marsh ecosystems from anticipated climate change.
- Identify opportunities for avoidance, minimization, mitigation & adaptation.
- Interactive maps on www.CHNEP.org.



2007



Acknowledgements

- Bob Howard, EPA
- John Wilson, EPA
- Jeremy Martinich, EPA
- Tim Liebermann, SFWMD
- Jim Beever, Southwest Florida RPC
- Whitney Gray, Southwest Florida RPC
- Joan LeBeau, City of Punta Gorda
- Mitchell Austin, City of Punta Gorda
- Cathy Olson, Lee County



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Next Watershed Academy Webcast

**An Urgent Call to Action:
Nutrient Innovations Task Group Report**

Tuesday, December 1, 2009



The Watershed Academy



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