"Focus on Sea Level Rise and Coastal Erosion as a Natural Hazard: Education Challenges"

DHS Summit Conference

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Significance of Long-Term Sea Level Rise and Coastal Erosion

1. Migration of Population to Coastal Areas

2. Infrastructure Investment in Coastal Areas

3. Pervasiveness of Sea Level Rise and Coastal Erosion

Outline

- Quantify Sea Level Rise (SLR)
- Causes of Sea Level Rise
- Relationship of Coastal Erosion to SLR
- Human Responses to Sea Level Rise and Coastal Erosion
- Educational Challenges

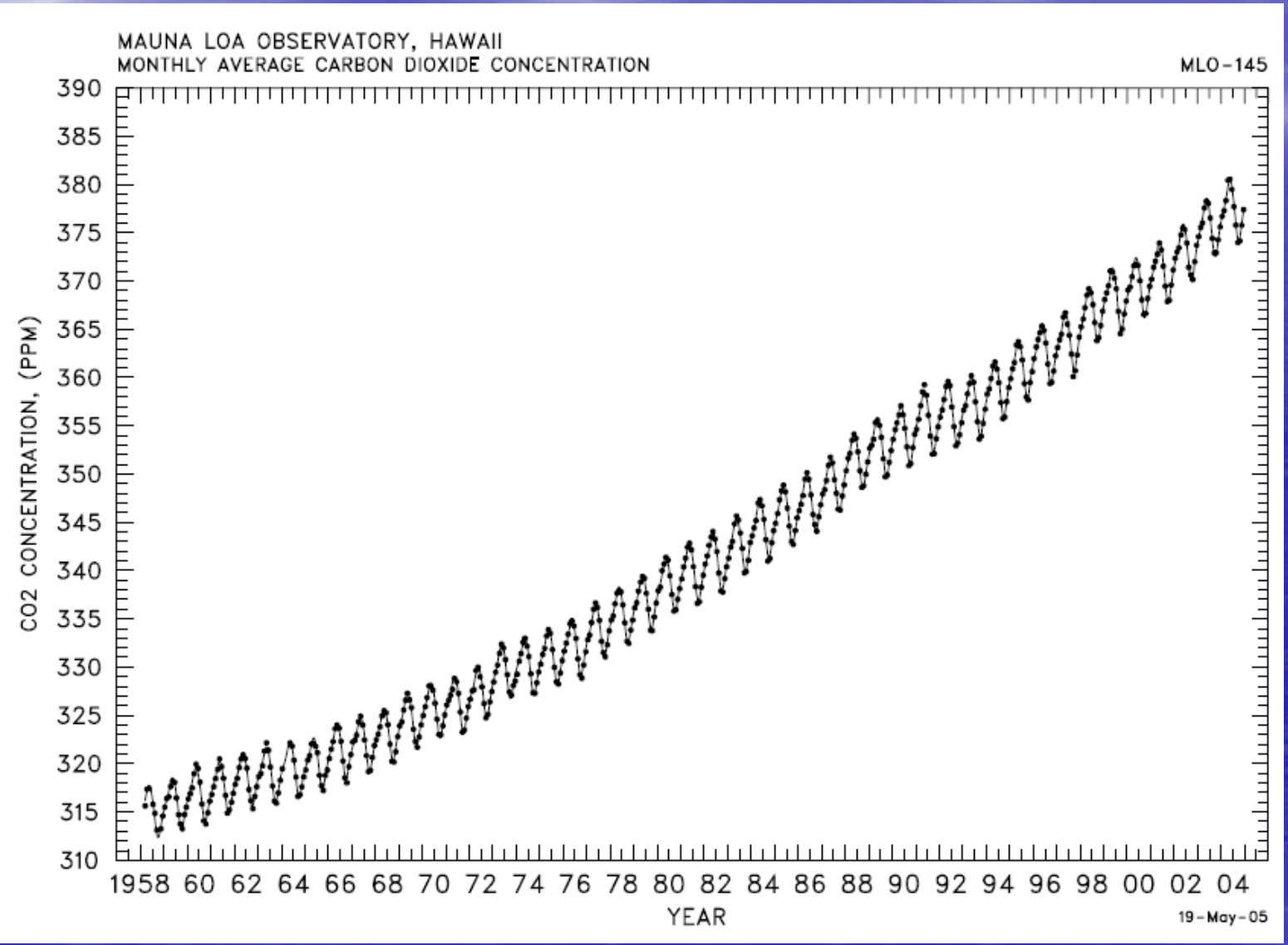
Sea Level Rise (SLR) and Coastal Erosion: The Issues

- Associated With Global Climate Change
- Evident That Humans Have Affected CO_2 in the Atmosphere
- Eustatic Sea Rise is Approximately 2 mm/year (0.66 feet per Century)
- However, it is Not so Clear That, to Date, SLR is Being Affected by Humans.
- Sea Level Rise Places Erosional Pressure on Shorelines
- The Bruun Rule Predicts 50 to 100 Units of Shoreline Retreat for Each Unit of SLR

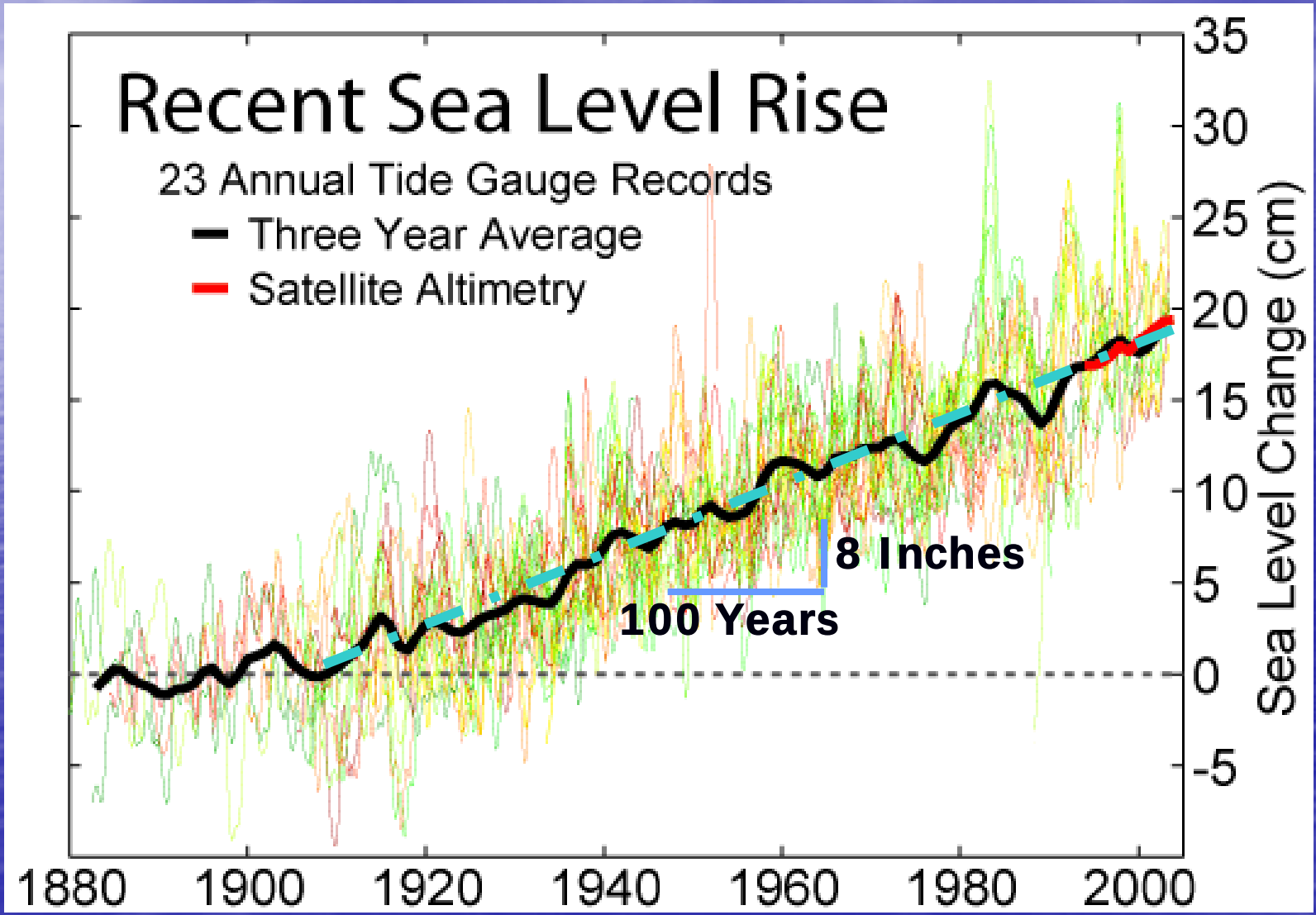
Three Methods For Coping With Beach Erosion

1. Retreat
2. Beach Nourishment
3. Armoring (Seawalls, Groins, etc.)

CO_2 Concentrations, Mauna Loa, HI



Average Sea Level Rise Over the Last 120 Years

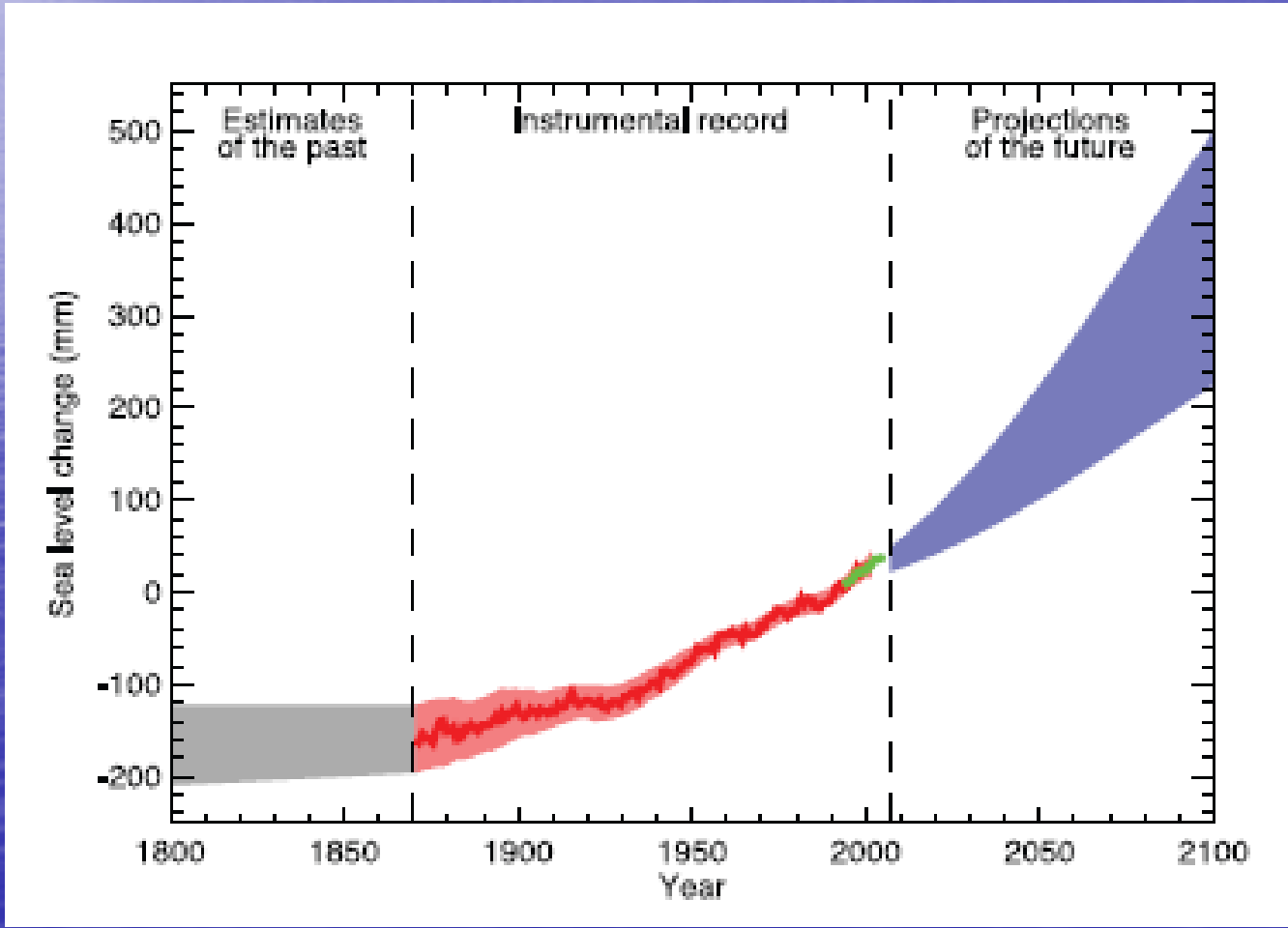


From Douglass

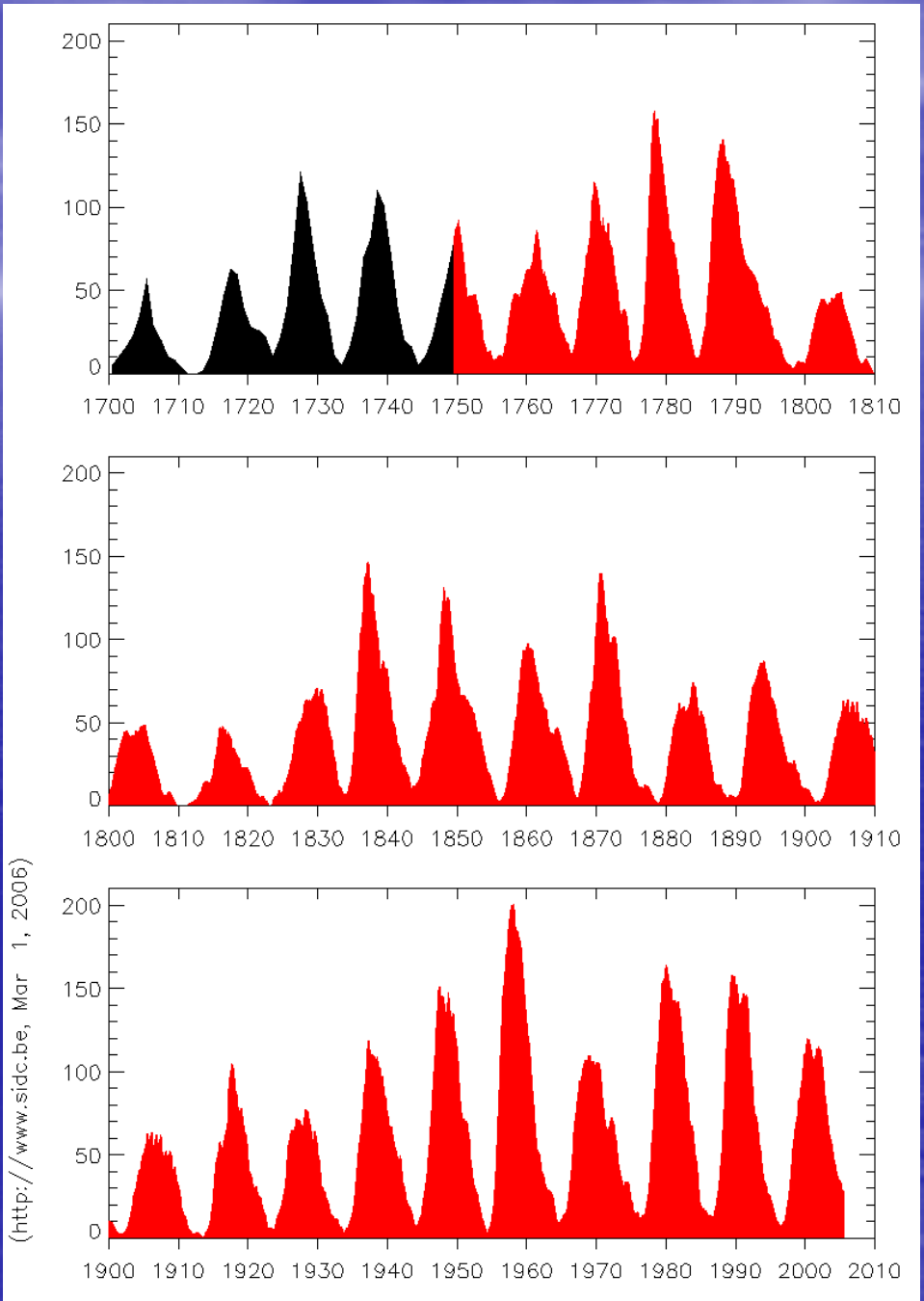
IPCC Projections of Future Sea Level Rise

Date of IPCC Prediction	Time Period (Years)	IPCC Sea Level Rise Ranges	IPCC Mid Range Estimate
1995	1990 to 2100	15 cm to 95 cm	50 cm
2001	1990 to 2100	8 cm to 88 cm	49 cm
2007	1990 to 2090	22 cm to 44 cm	33 cm

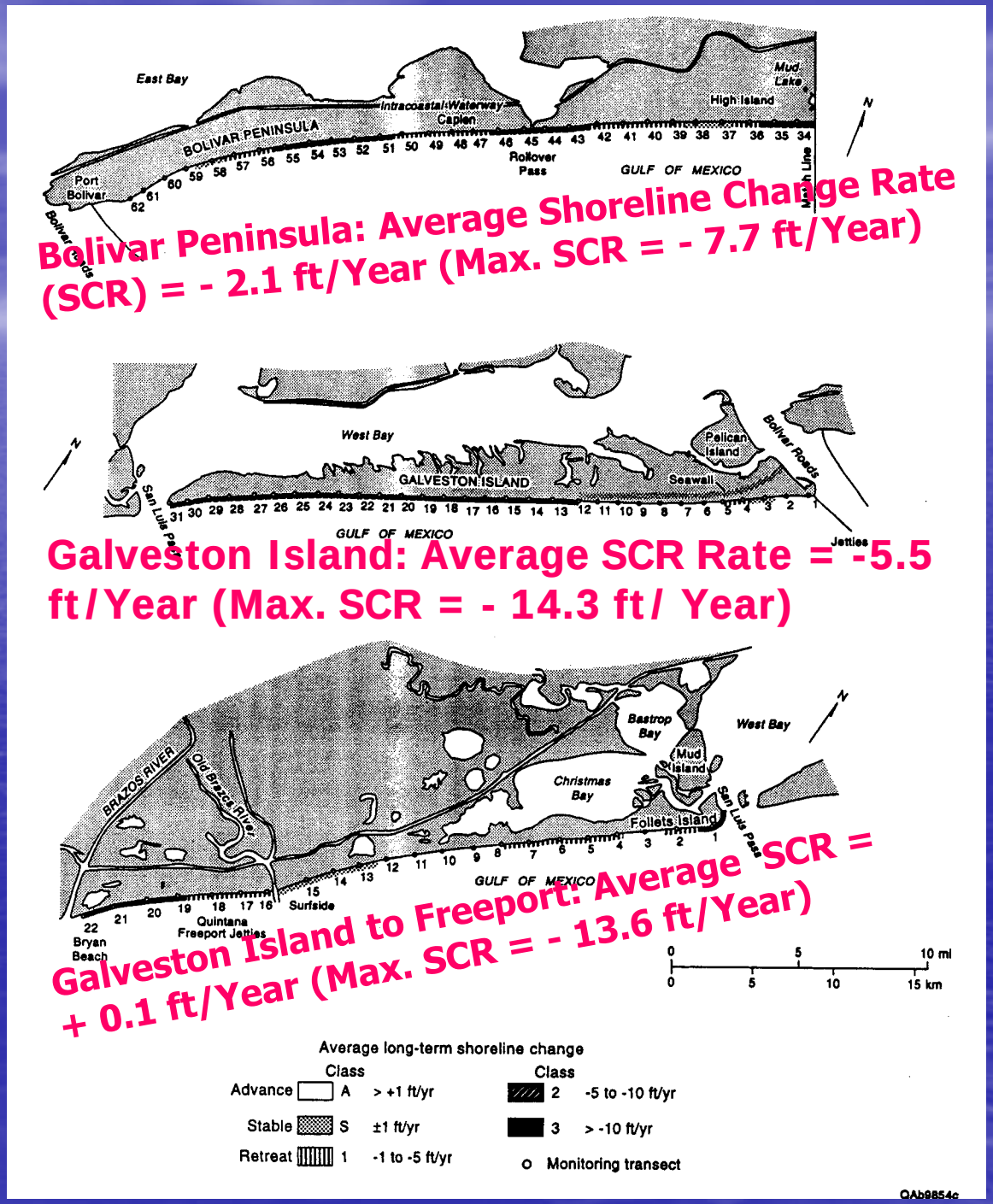
IPCC Sea Level: Past and Future



300 Years of Sun Spot Activity at Edinburgh, England



Erosion Rates Along the Texas Coast: 1974 to 1996. (Morton and McKenna, 1999)



Before Ike Photograph on Bolivar Peninsula (USGS)

After Photograph on Bolivar Peninsula (USGS)

Local and “Dish Pan” Scour Around Pile-Supported Structure, Bolivar Peninsula

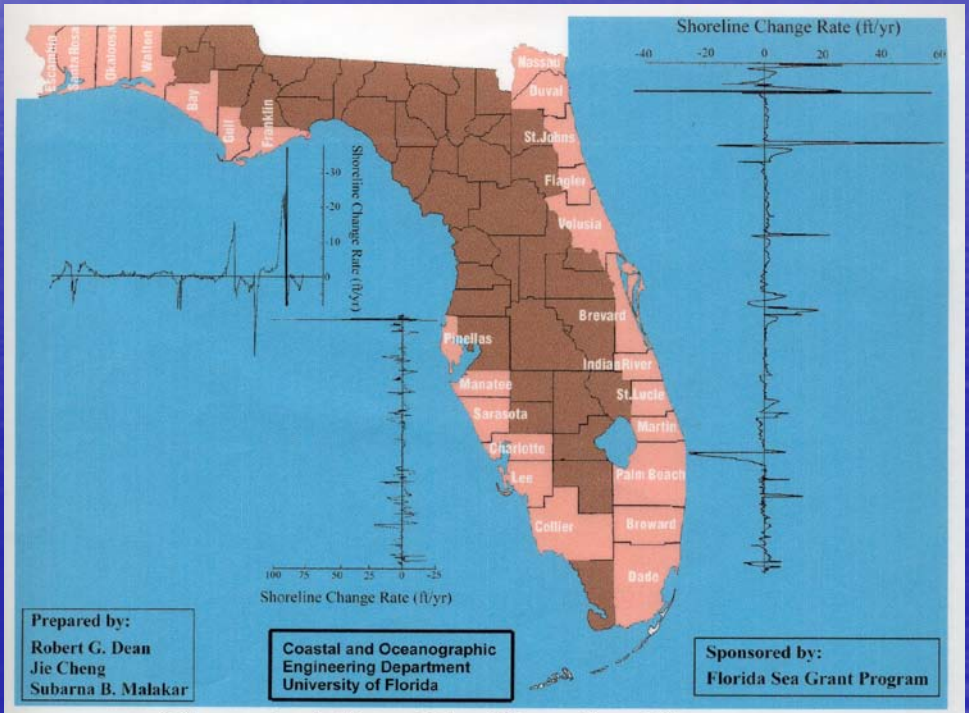
One of Seven “Hardened” Structures, Eastern Bolivar Peninsula (Hurricane Ike)

Plan for Major Hurricane Effects

Mississippi Coast: After Hurricane Katrina (1,000 Year Storm Surge?)

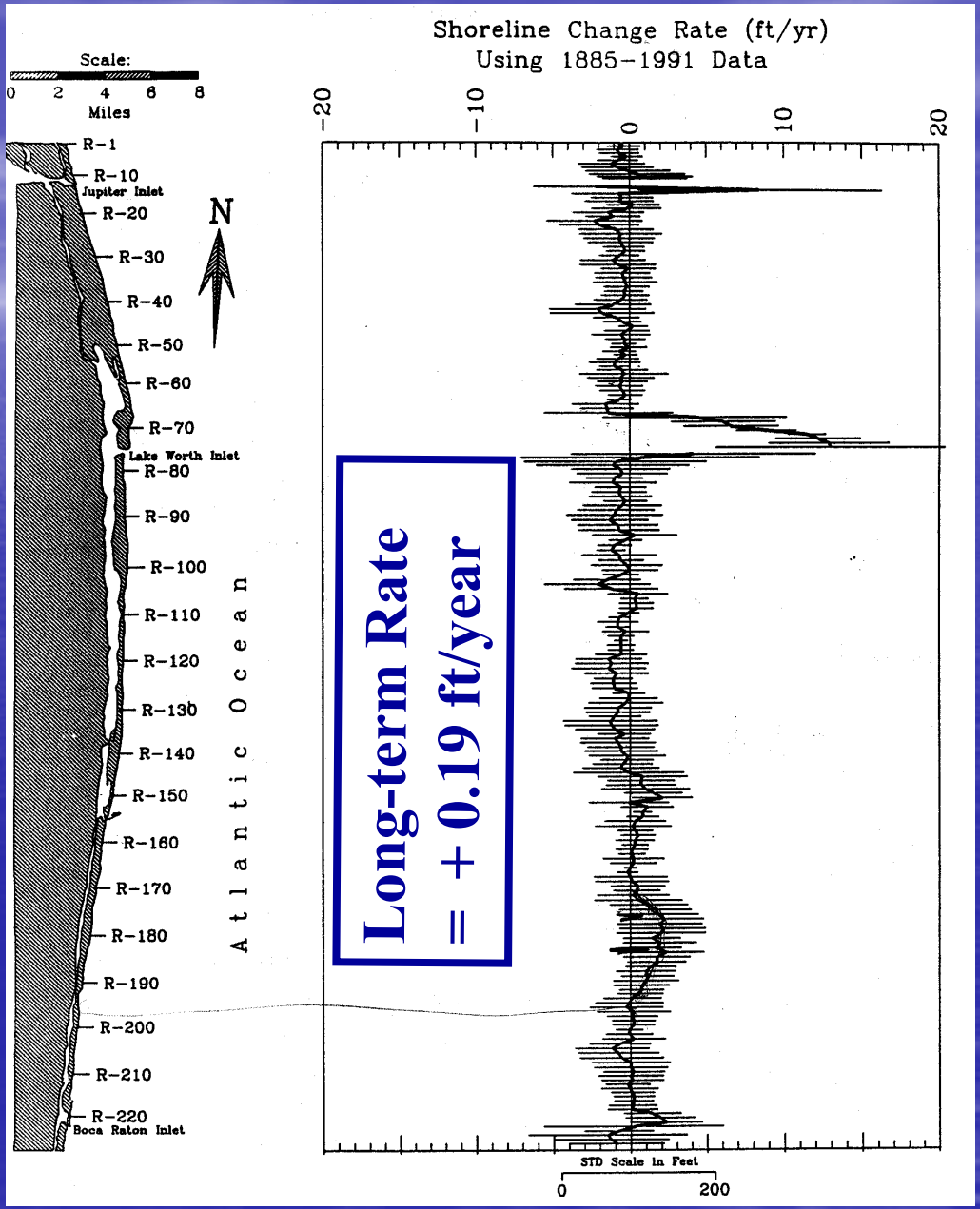
Program Assessment: Shoreline Change Rates

- Basis for Assessment:
- Atlas of Shoreline Change Rates (Funded by Sea Grant)



Characteristics of the Shoreline Change Along the Sandy Beaches of the State of Florida: An Atlas

Palm Beach County Long-Term: 1883 to 1991



Educational Need:
Improved Capabilities to Quantify the Causes of Shoreline Change

Shoreline Change Rates in Florida (All Sandy Beach Counties)

Shoreline Considered (Length in Parentheses)	Shoreline Change Rates (ft/year)		Difference (ft/year)
	Before Program	After Program	
East Coast (365 Miles)	-0.08	4.24	4.32
West Coast (269 Miles)	-0.11	1.21	1.32
Total (634 Miles)	-0.093	2.95	3.04

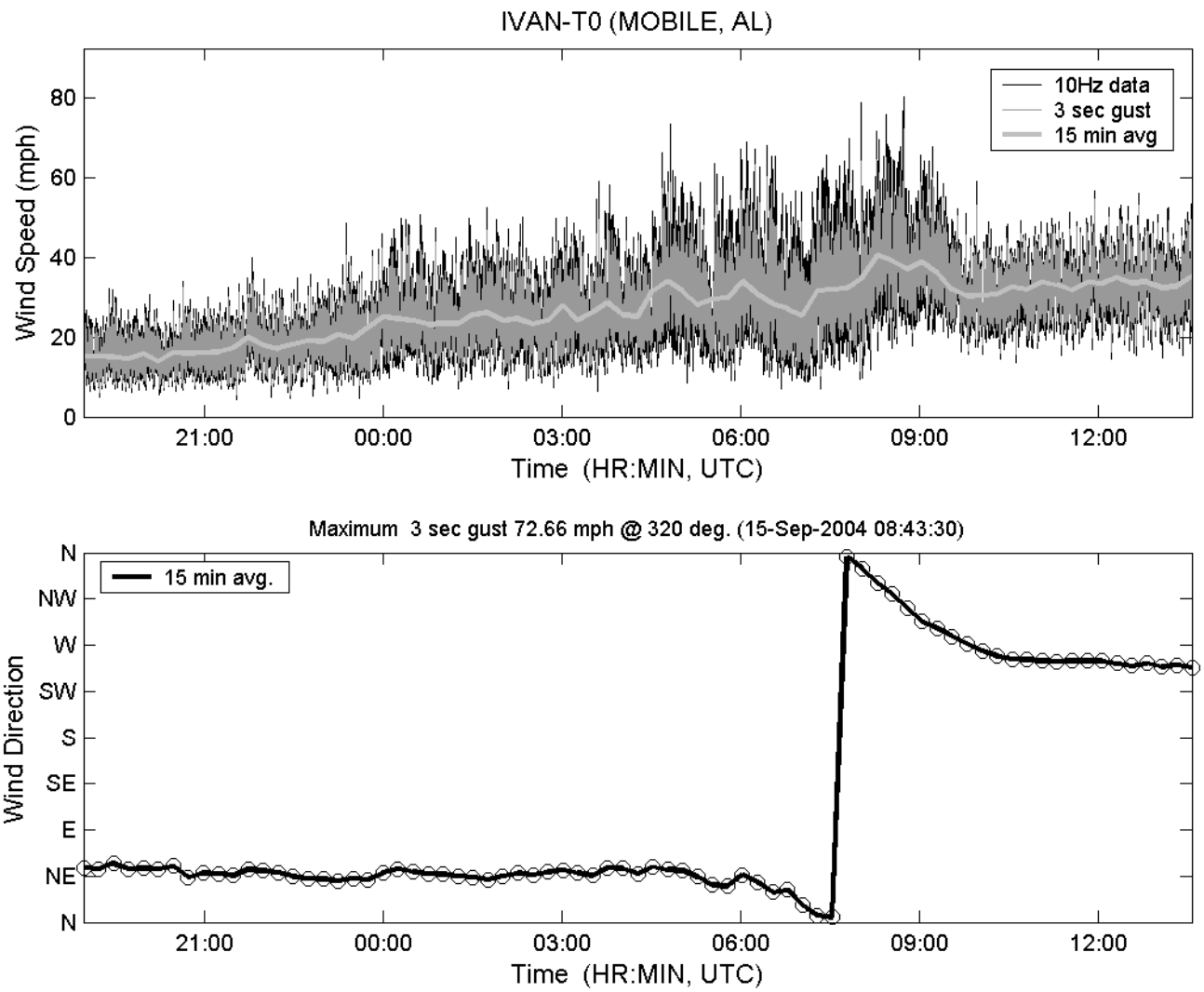
Quantification of Hurricane Effects

- Wind Towers
- Portable Tide Gages
- Deployed Wave and Tide Gages
- Constructed Wind Fields
- Numerical Modeling

One of Six Wind Towers Deployed in Hurricane IKE

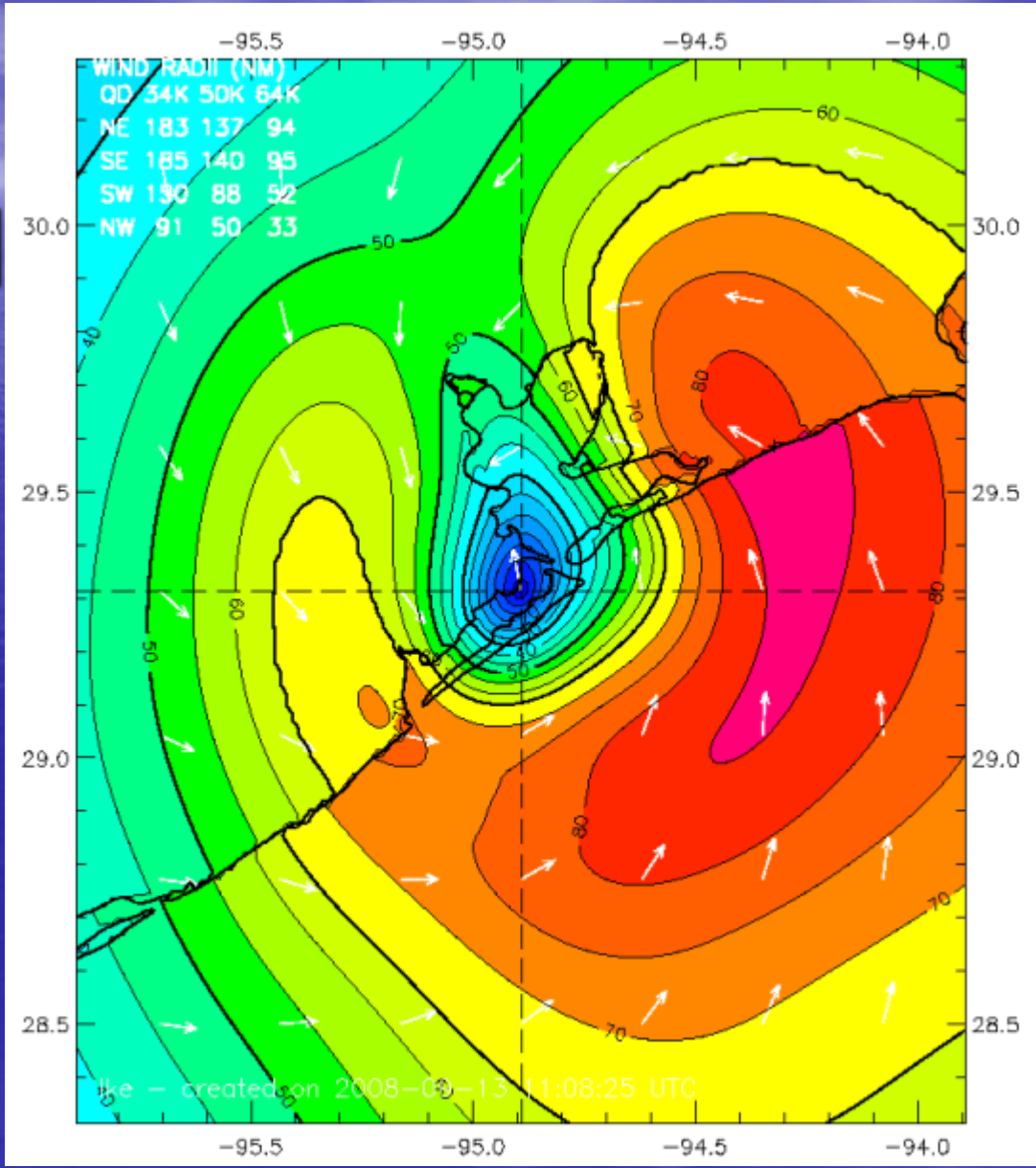
Florida Coastal Monitoring Program

Wind Record From Florida Coastal Monitoring Program



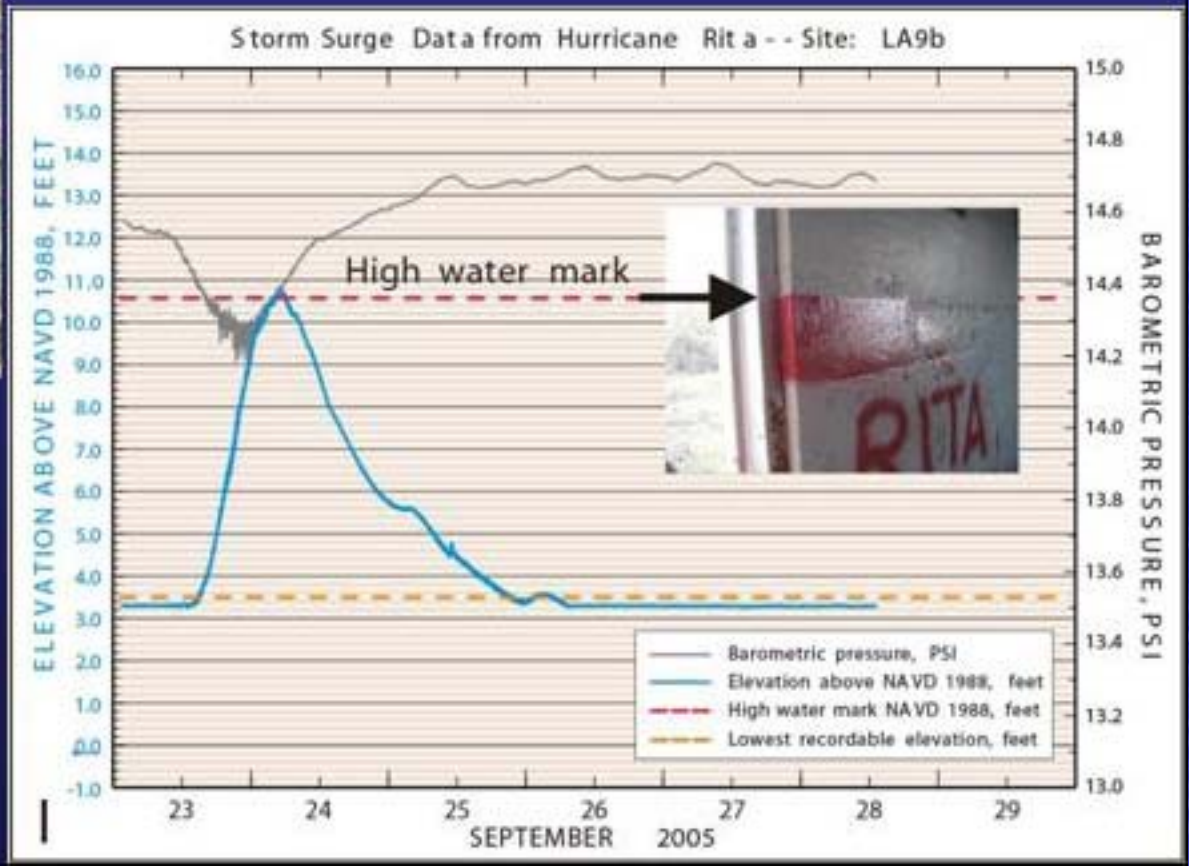
Reconstructed Wind Field Near Landfall

(Hurricane Research Division of NOAA)



USGS
STORM SURGE GAGES

Hurricane Rita, 2005



Wave and Tide Gage Deployment

- 5-10 bases at a time, depending on helicopter
- 10-20 deployments in a day, depending on conditions
- Requires good prior connections with helicopter companies

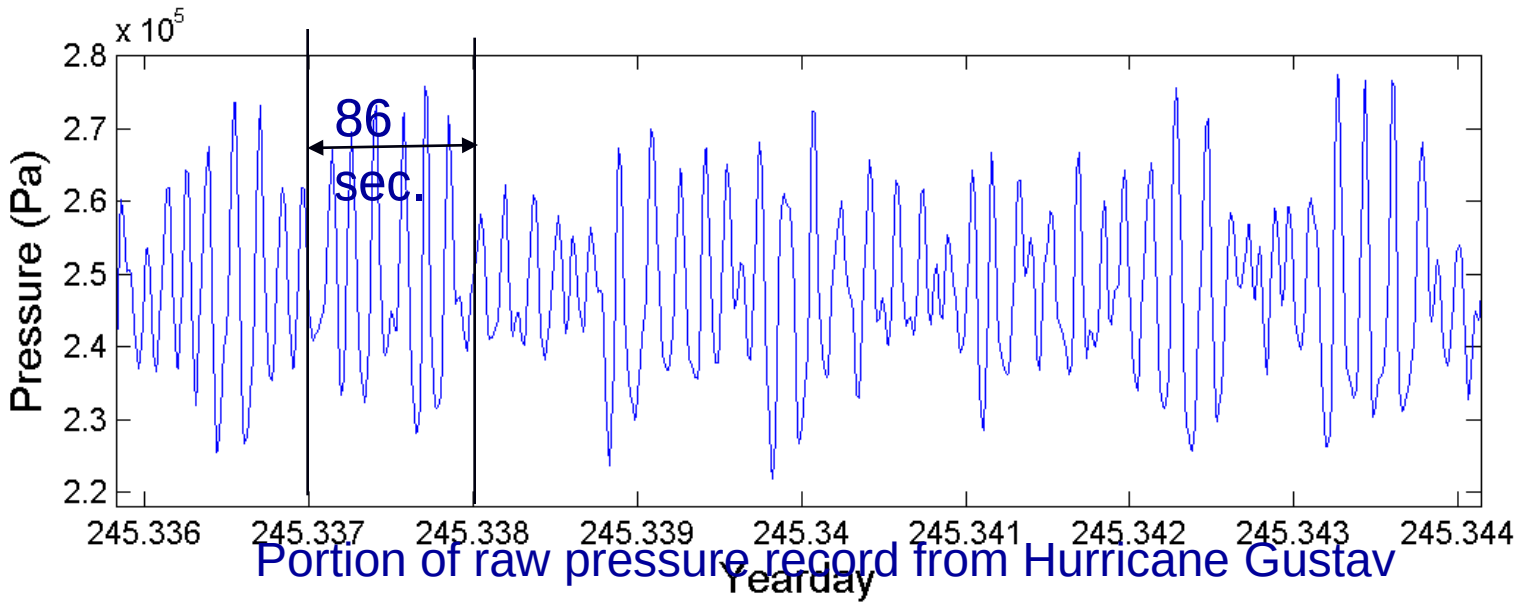
Andrew Kennedy Program

Helicopter training for deployment

Bases packed for deployment

Data Analysis (Hurricane Ike)

- Waves and Surge computed from the same pressure data time series
  - Low frequency data gives surge
  - Processed high frequency gives wave information



Portion of raw pressure record from Hurricane Gustav

Educational Challenges

- Improved Analysis Methods for Interpreting the Causes of Sea Level Rise and Whether or Not, Acceleration of SLR is Occurring
- Investigation of Causes of Changes in Sea Level Rise Rates (Sun Spots?)
- Develop Better Understanding of the Differences Between Tide Gage Data and Satellite Altimetry
- Frequent (Annually) Data Collection of the Rate of Change of the Nation's Shorelines (LIDAR)
- New Methodologies for Putting Into Perspective a Recent Event (What Was Return Period?)

Educational Challenges (Continued)

- Develop More Storm Worthy Designs for Coastal Construction
- Develop Methods for Planning in Advance Orderly Retreat Where and When Appropriate (Was the Recent Major Storm a 30 Year or a 1,000 Year Event?)
- Identify New Sources of Beach Nourishment Material
- Improve Methods of Sediment Delivery Over Long Distances (10s of Miles)
- Establish Methods to Identify The Best Approach to Cope With Sea Level Rise and Coastal Erosion

Educational Challenges (Continued)

- Establish Appropriate Planning Horizons
- Documentation of Hurricane Effects
- Prediction of Foundation Scour During Extreme Events
- Develop Improved Methodology to Interpret and Predict Shoreline Response

I Look Forward to Your Questions!