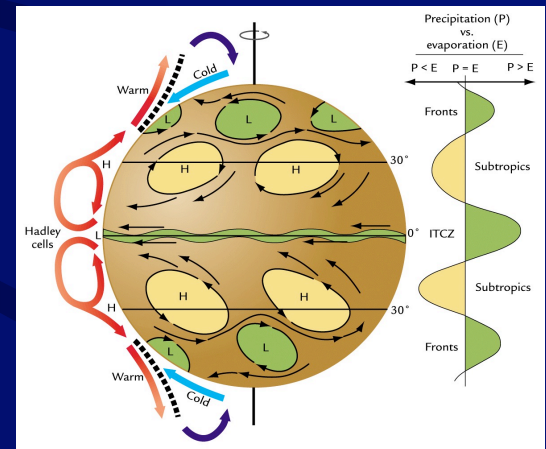
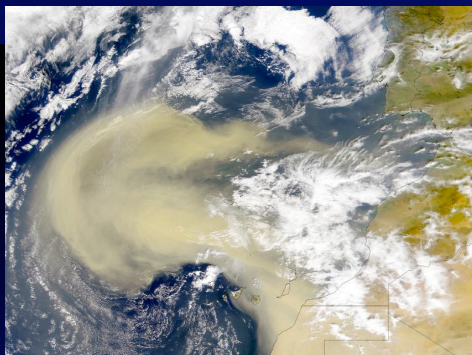
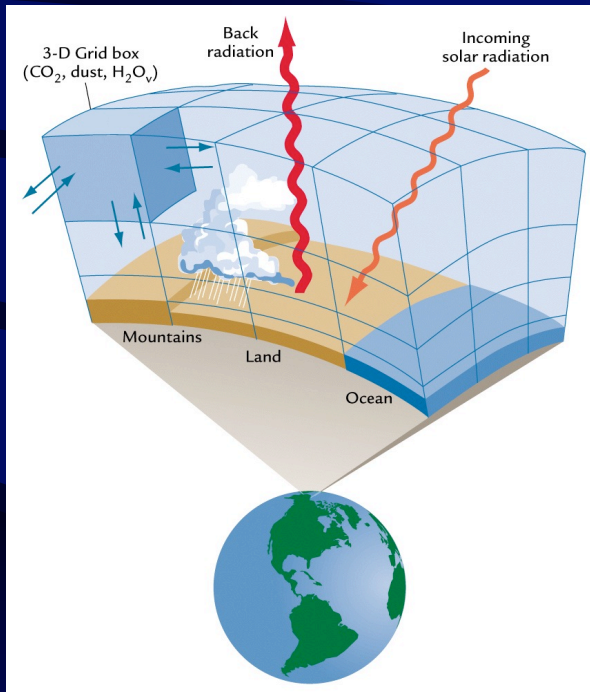
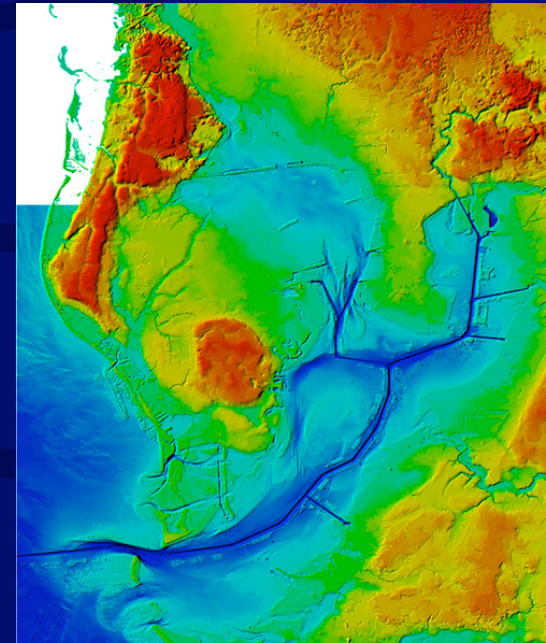
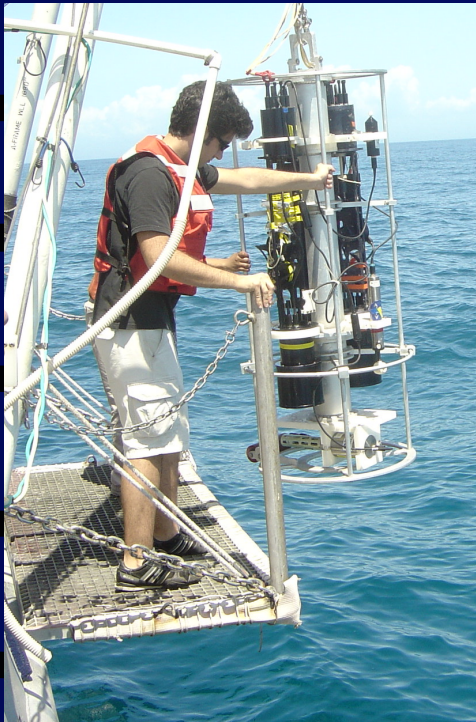


# Global Change: Past and Future



Benjamin Flower, Pamela Hallock Muller, Al Hine,  
David Hollander, and David Naar

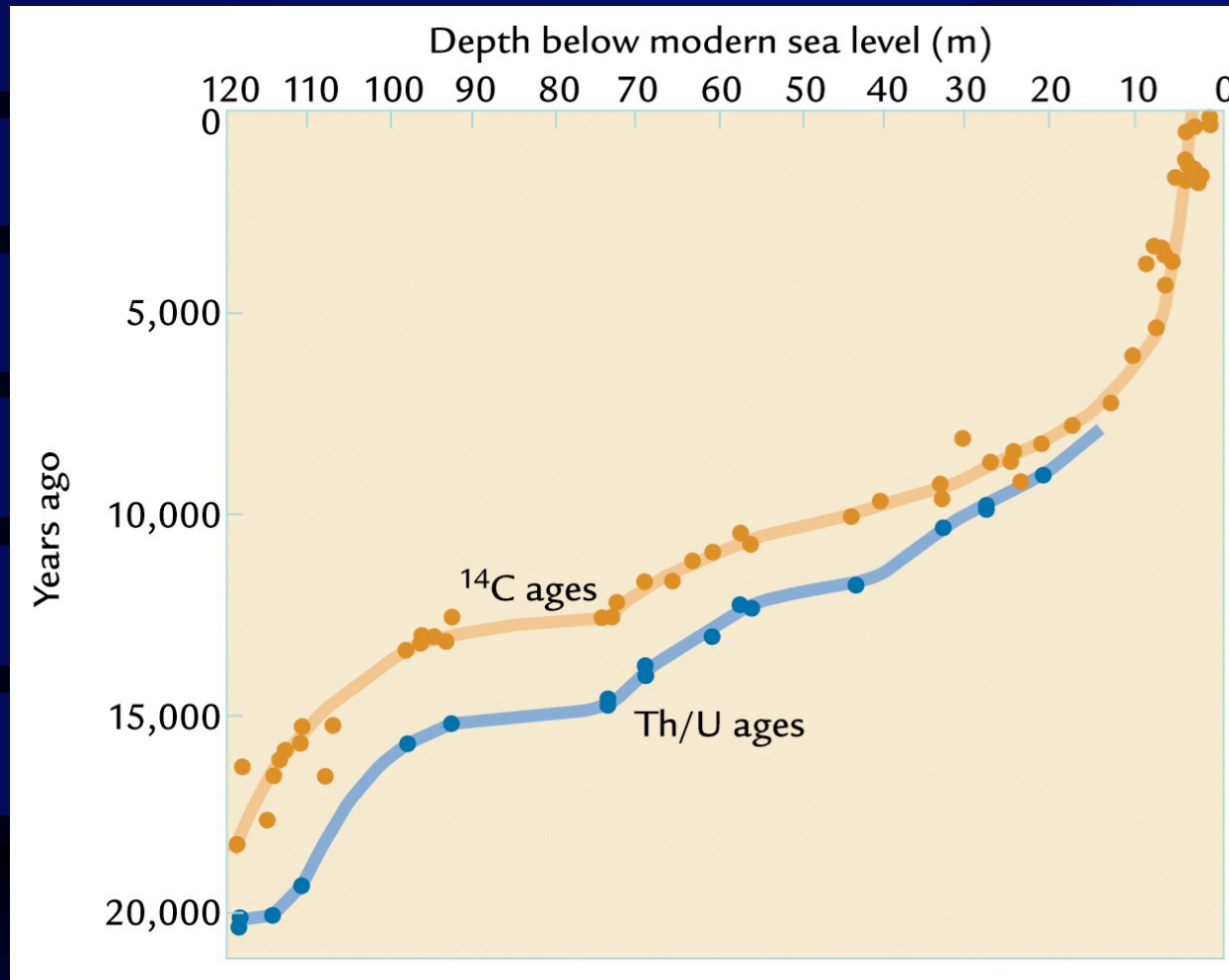
# Goals of this presentation

- 1) Geological Oceanography component of the CMS Strategic Plan
- 2) Major questions of societal relevance
- 3) Opportunities for collaboration

# **Geological Oceanography component of the CMS Strategic Plan**

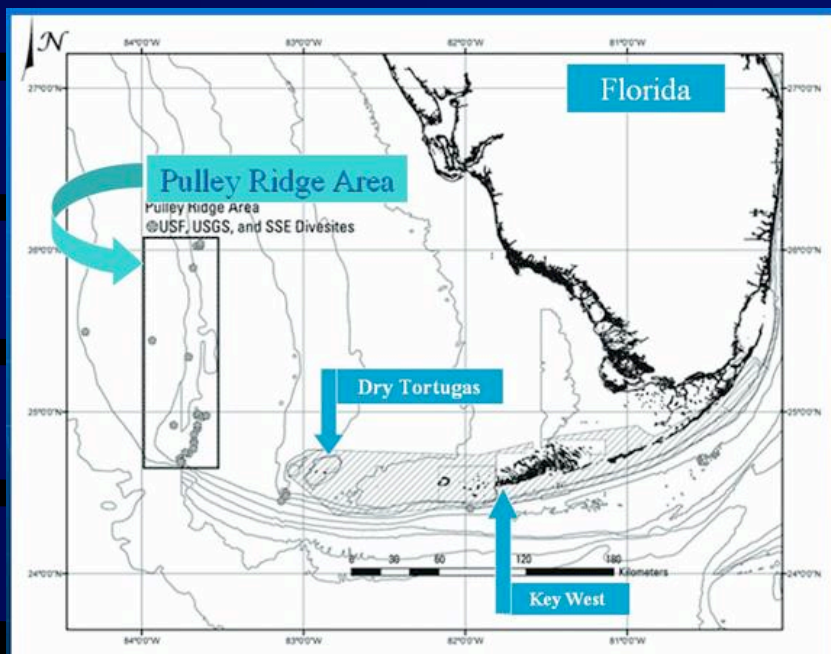
- **Biogeochemistry and Geobiology**
- **Continent – ocean interactions**
- **Abrupt natural and anthropogenic climate change**
- **Modern and ancient hydrologic dynamics**

# 1) Is recent sea level rise unprecedented?



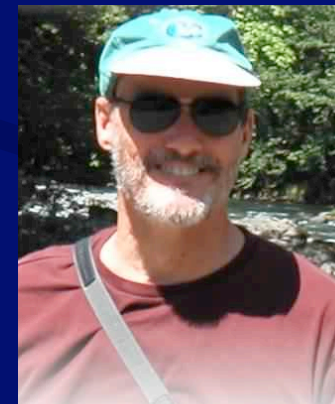
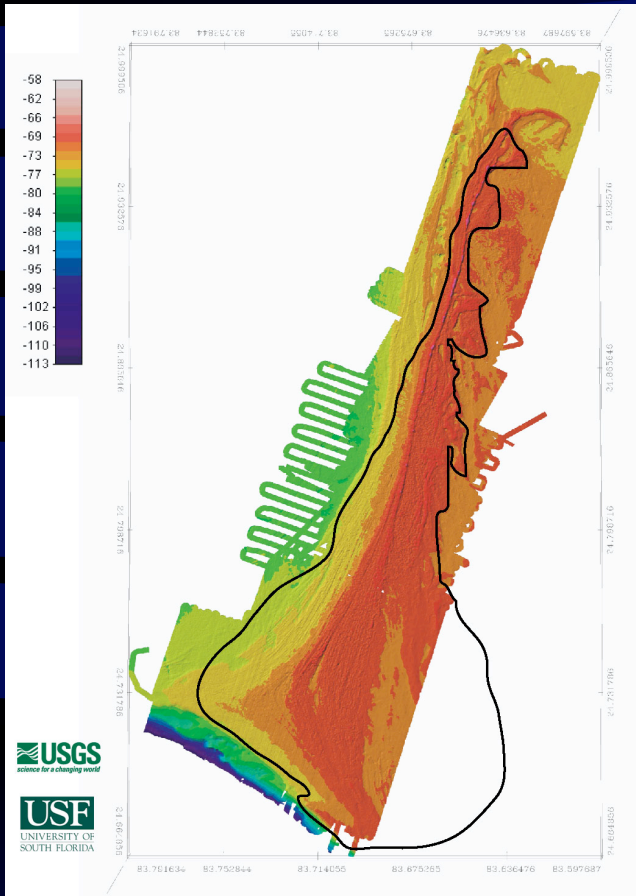
- No, sea-level rose  $\sim 24$  m in  $< 500$  years ca. 15 ka ( $\sim 5$  cm/y)
- What is the influence of sea-level change on continental margin systems (including reefs) past and future?

# Pulley Ridge Project



- US Geological Survey, Florida Institute of Oceanography, NOAA, Florida Department of Environmental Protection, National Geographic Society, and the CMS (Dr. Hine and Dr. Locker)

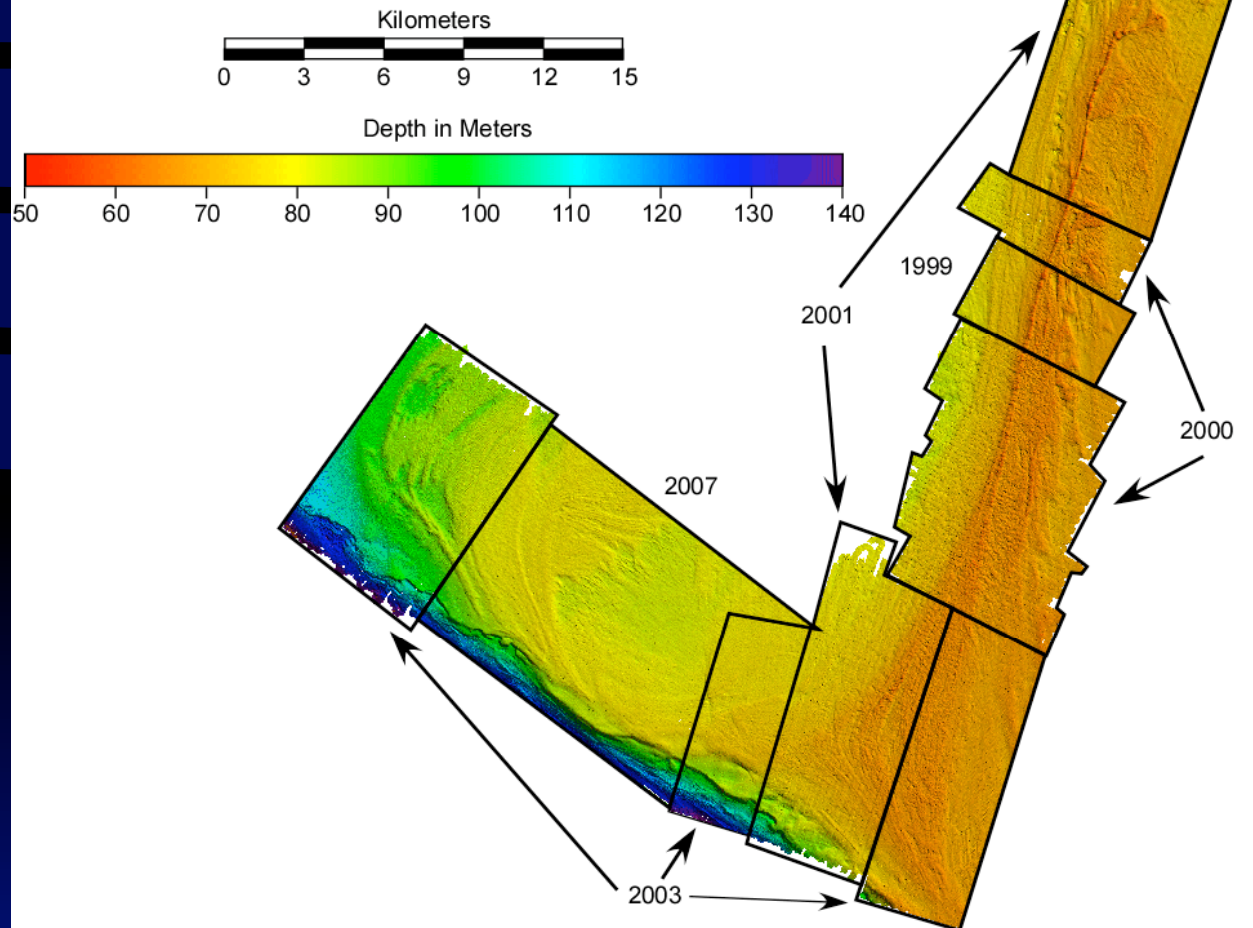
# Pulley Ridge: The deepest active reef



- Deepest light-dependent reef (60-70 m) off continental U.S.
- Considered for designation as a Marine Protected Area

# New bathymetry data from Pulley Ridge

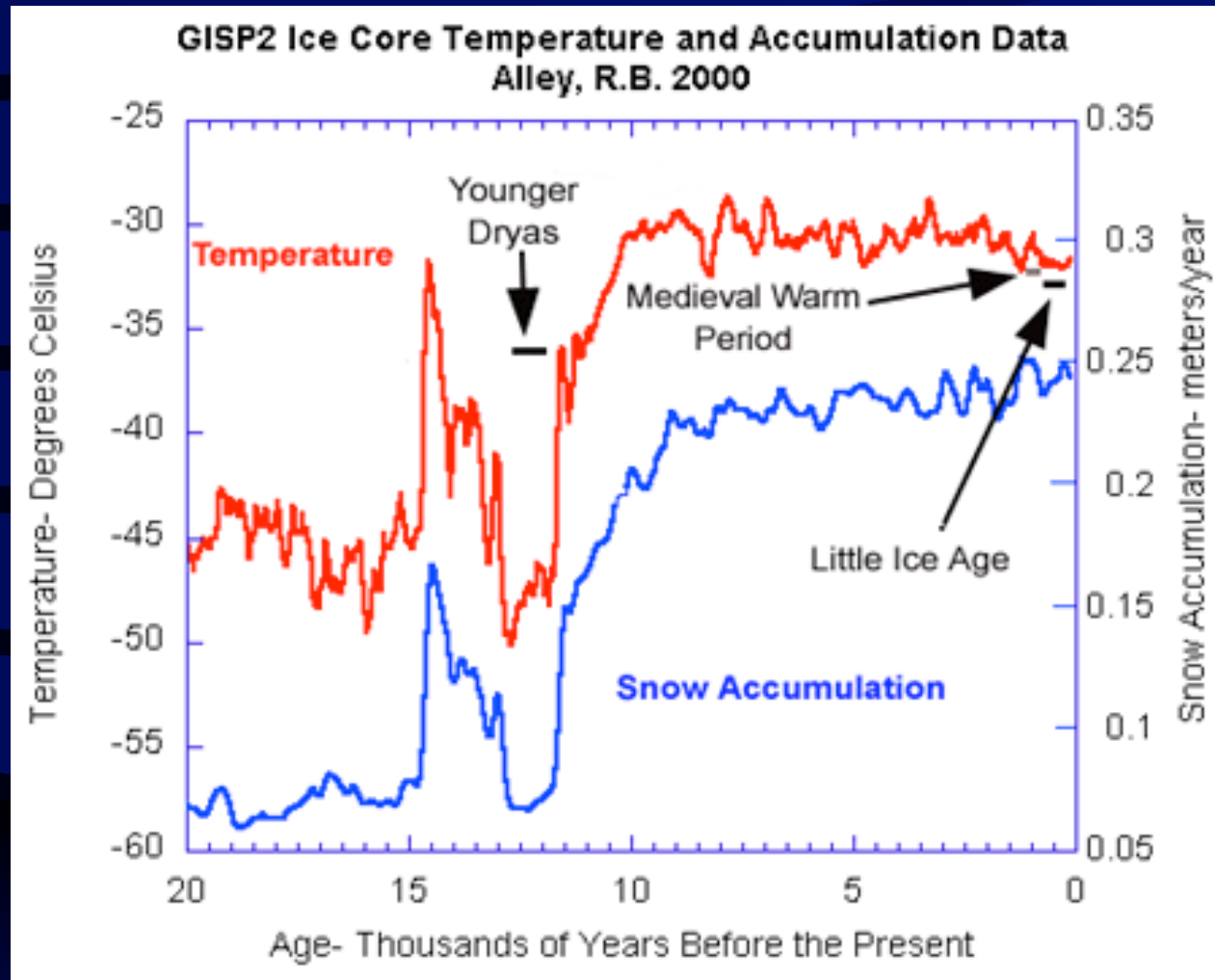
Pulley Ridge Multibeam Data collected by Naar and Donahue with assistance and funding from SUS, FIO, USF, USGS and NOAA



- 2007 cruise discovered living coral at 81 m



## 2) Is recent climate change unprecedented?



- No, past abrupt climate change was common ( $>10^{\circ}\text{C}$  in 100y)
- What caused the Younger Dryas and the Little Ice Age?

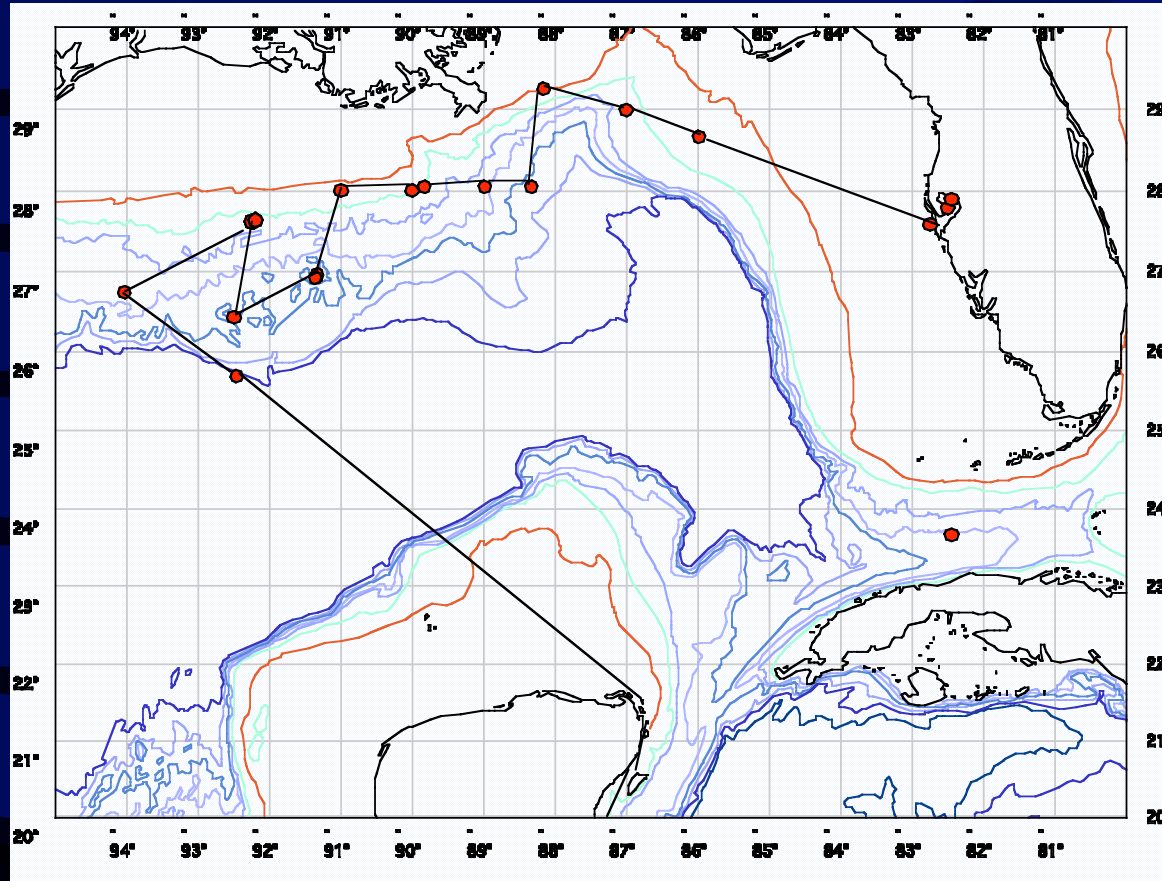


# Gulf of Mexico sediment coring



- Past cruises on the R/V *Marion Dufresne* and R/V *Longhorn*
- Planned Integrated Ocean Drilling Program (IODP) cruise

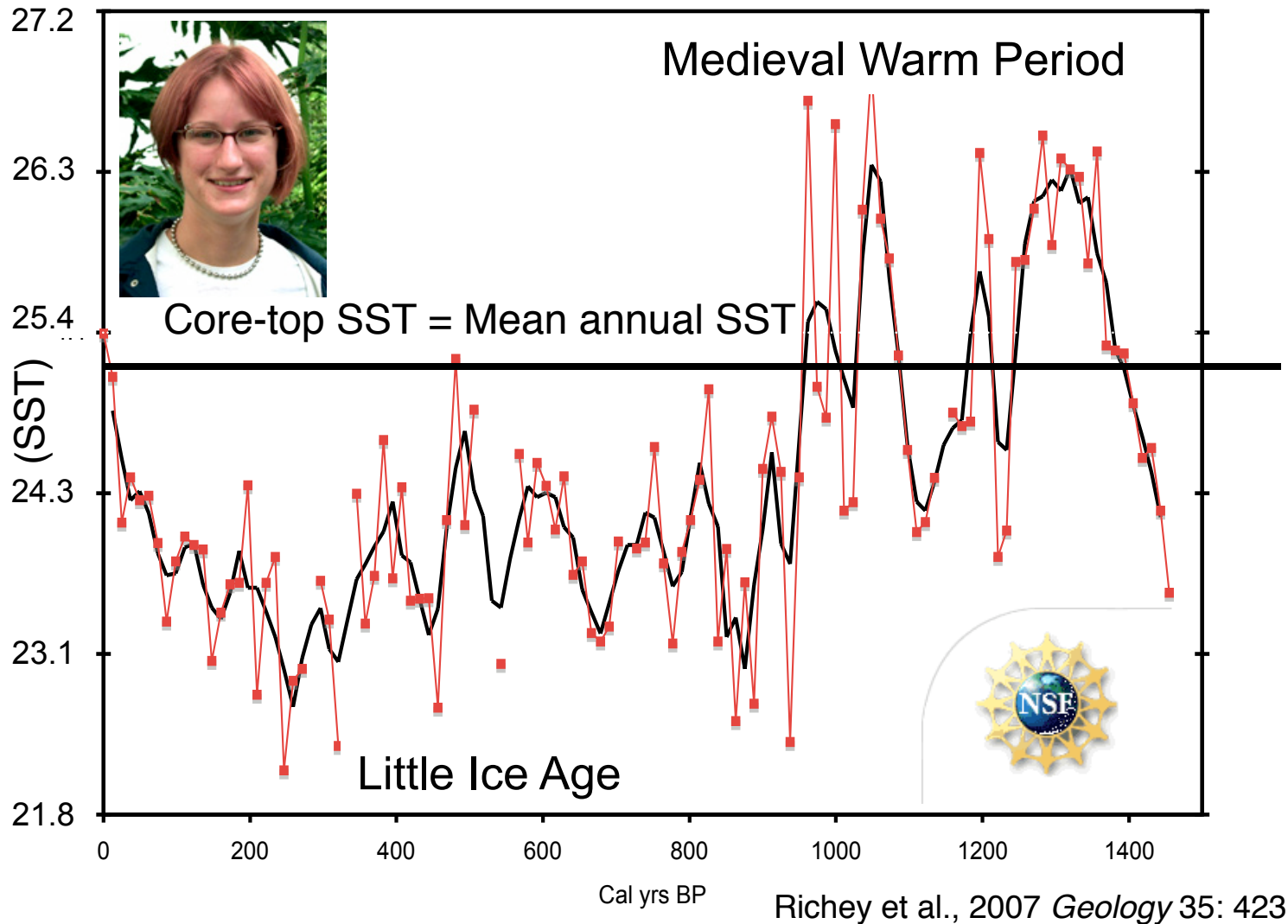
# IMAGES cruise in 2002



- Collaborations with US Geological Survey, Eckerd College, Florida Institute of Oceanography, and nine other institutions
- Provided material for Gulf of Mexico paleoclimatology and Tampa Bay prehistory projects

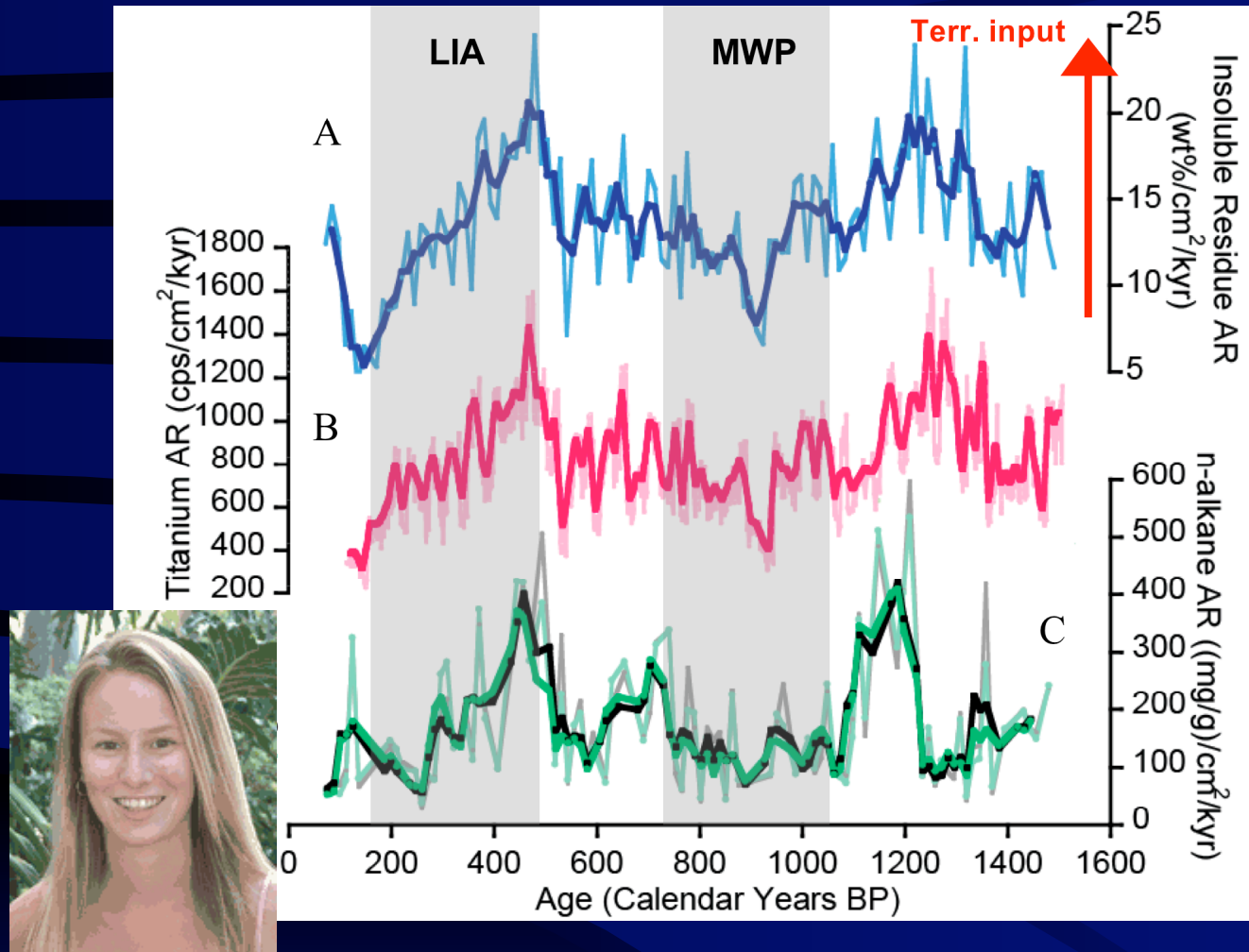
# Gulf of Mexico SST

Sea-surface temperature



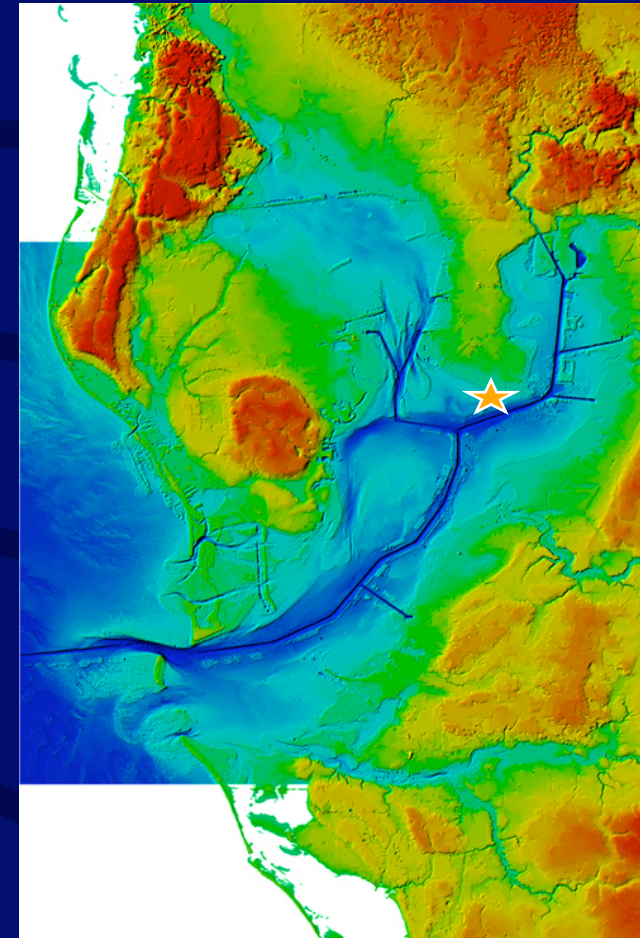
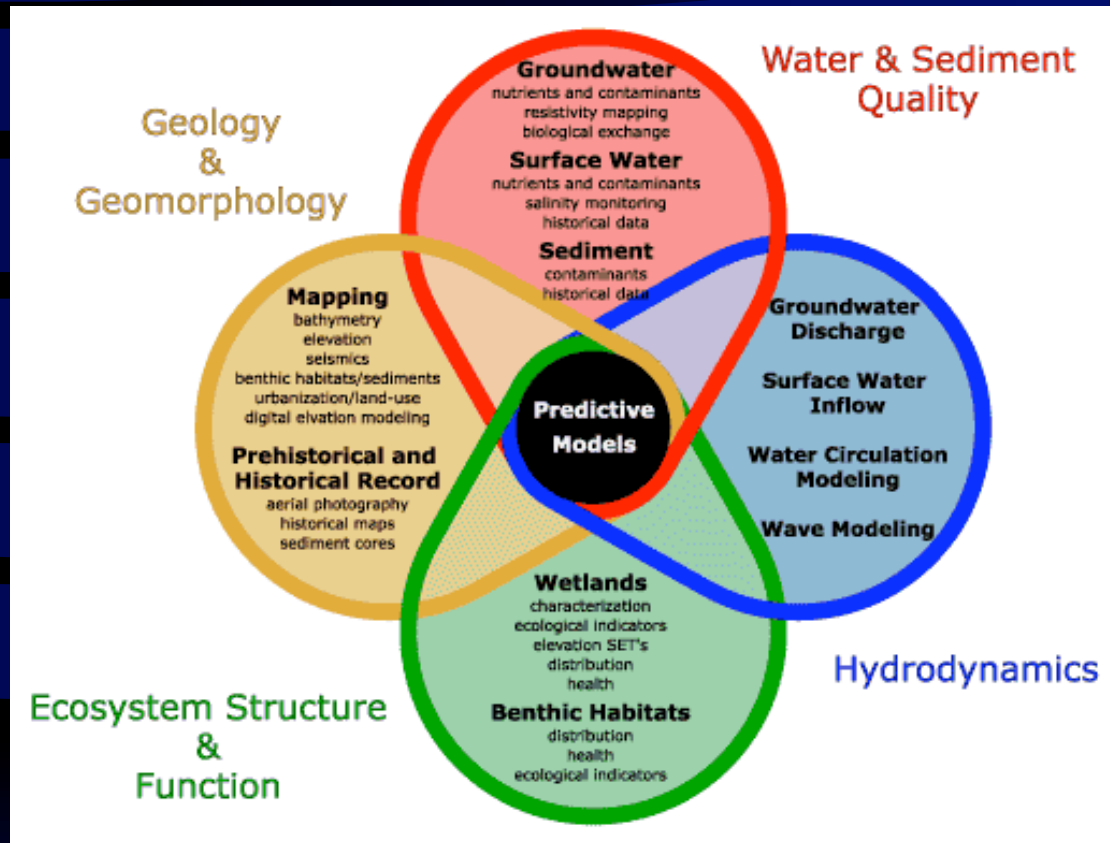
- Large cooling (3°C) from MWP to LIA
- Modern temperatures are not unprecedented

# N. America – Gulf of Mexico interactions



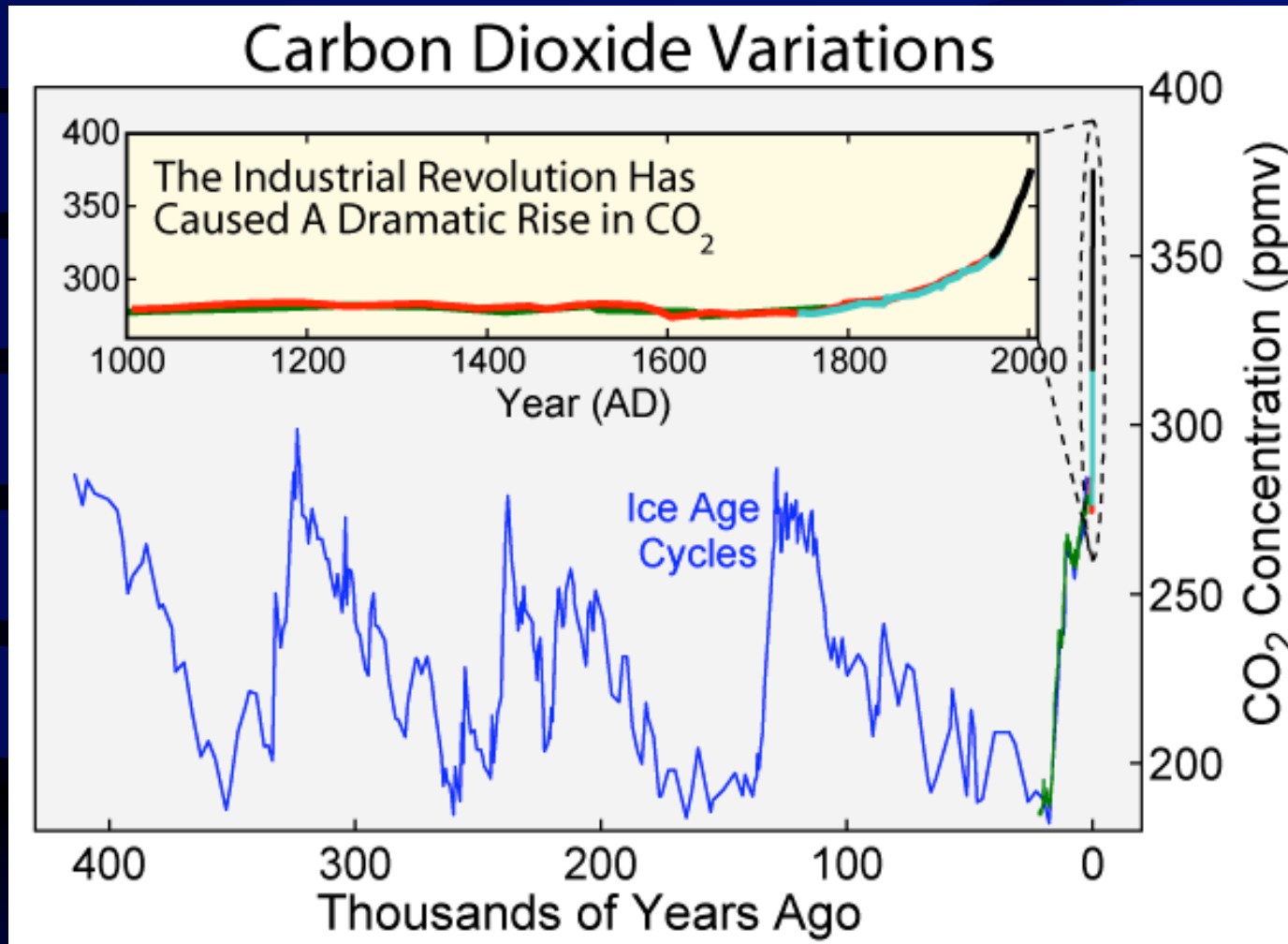
- Coherent accumulation rate changes in three independent proxies for terrigenous input from North American continent
- Mississippi River discharge during cold *and* warm phases

# USGS Tampa Bay Project: Prehistory



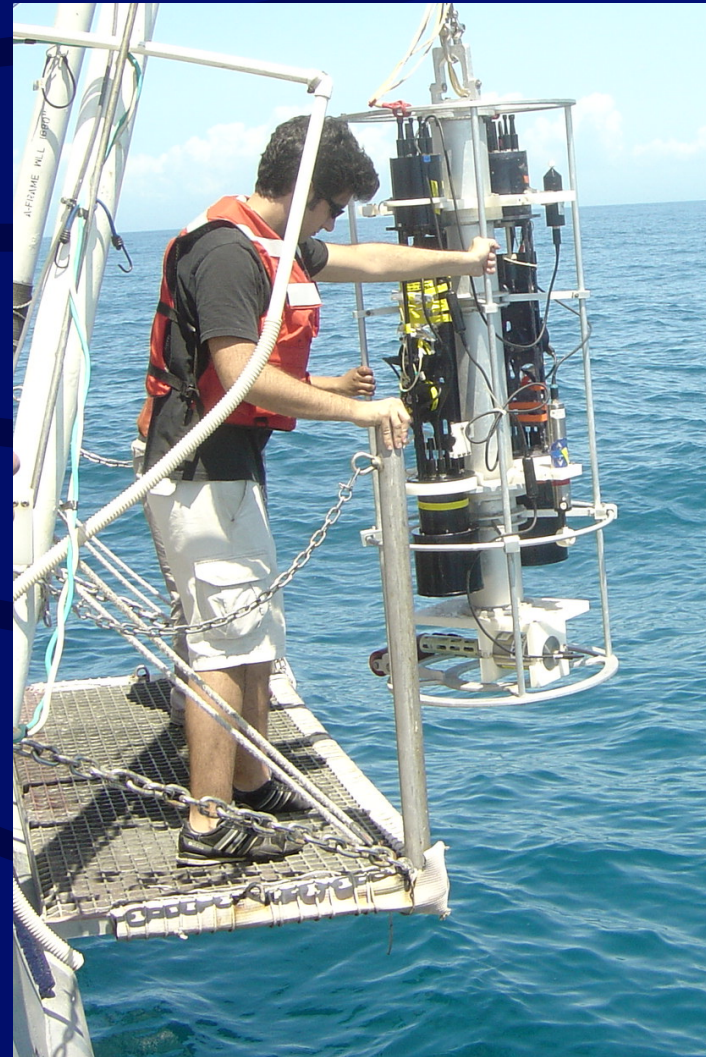
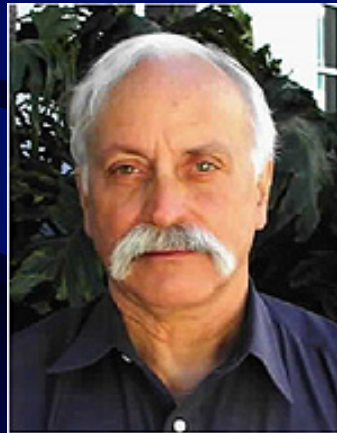
- Tampa Bay was a freshwater lake 21,000 to 12,000 years ago
- Linkage to a multi-disciplinary, multi-institution project

### 3) Is recent CO<sub>2</sub> rise unprecedented?



- Yes, CO<sub>2</sub> levels and rates of change are unprecedented in the past 800,000 years
- CO<sub>2</sub> change since the Industrial Revolution (>100 ppmv) is greater than the glacial-interglacial range (~90 ppmv)

# The other CO<sub>2</sub> problem: Ocean Acidification



- Dr. Hallock Muller, Dr. Byrne, USGS researchers, and collaborators are measuring pH changes and quantifying effects on carbonate organisms



# Opportunities for collaboration



## Analytical capabilities

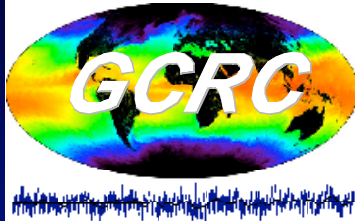
- Stable isotopes and elemental ratios in carbonates and other minerals, water, organic material, and individual molecules
- Seawater carbon and nutrient geochemistry
- Sea-floor and sub-surface mapping

Strategic hires in global and meso-scale ocean/atmosphere modeling and high-resolution paleoclimatology (planned)

## Collaborative proposals targeting external funding

- NSF Geosciences and Atmospheric Sciences
- NSF Coral Reefs Initiative
- NSF Geobiology
- Integrated Ocean Drilling Program

Global Climate Research Center  
University of South Florida





# Global Change: Past and Future

