General Circulation of the Gulf of Mexico and Satellite Oceanography

Frank Muller-Karger
University of South Florida
College of Marine Science

Biographical Information
Frank Muller-Karger

Education:

1979 BS Biological Oceanography. Florida Institute of Technology. Melbourne, FL.
1984 MS Oceanography. Institute of Marine Science. University of Alaska.
1988 PhD in Marine and Estuarine Sciences. University of Maryland.
2001 Master of Science in Management. University of South Florida.

Employment:

1989-present	Professor, University of South Florida, College of Marine Science
2007/09	Dean, School for Marine Sci. and Technology, U Mass Dartmouth
2001/04	Commissioner, U.S. Commission on Ocean Policy / JOCI

Professional Interests and Expertise:

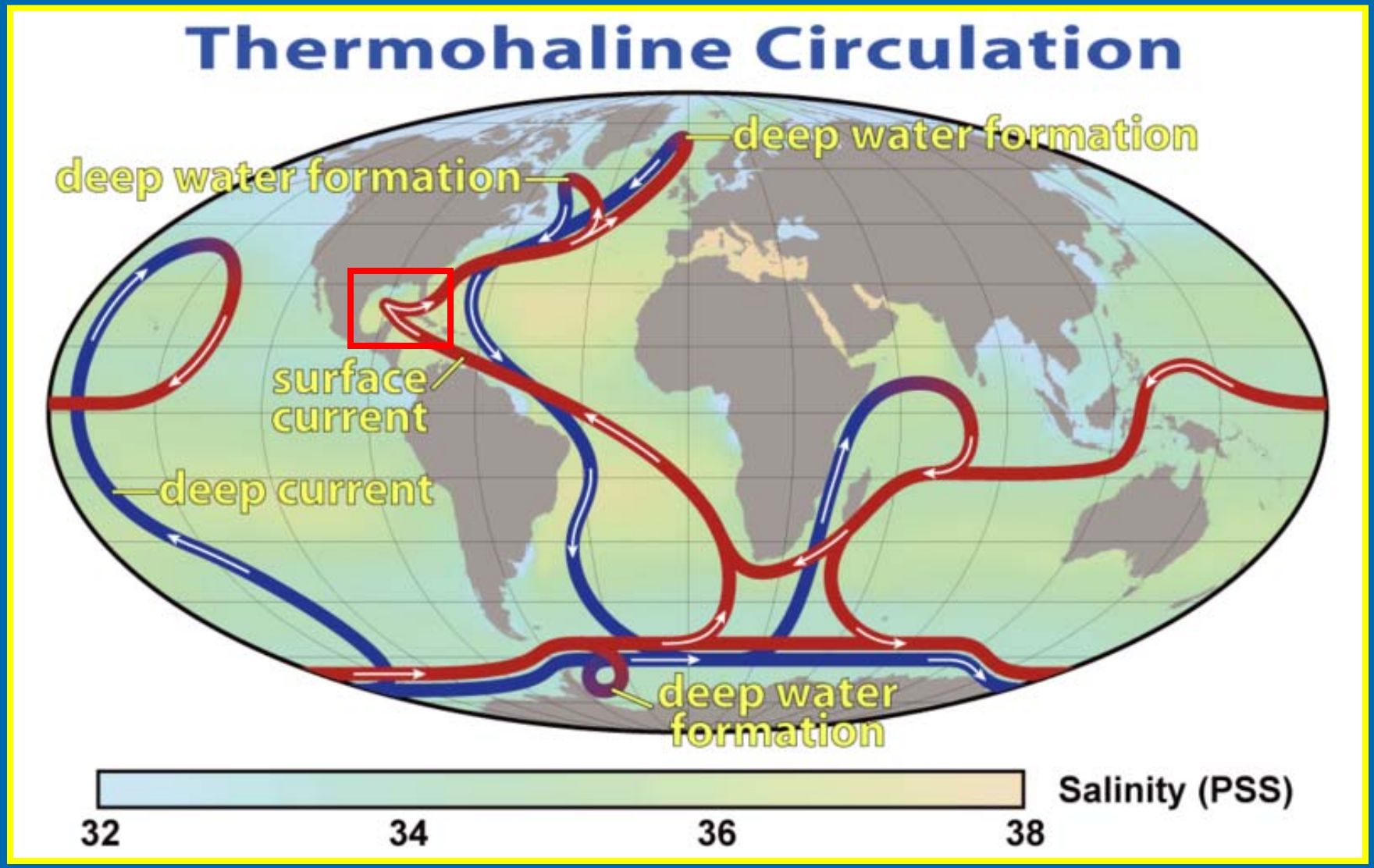
Interdisciplinary Earth science and Earth observation
Oceanography, coastal and estuarine science
Satellite oceanography
Science education
Ocean Policy

Acknowledgement

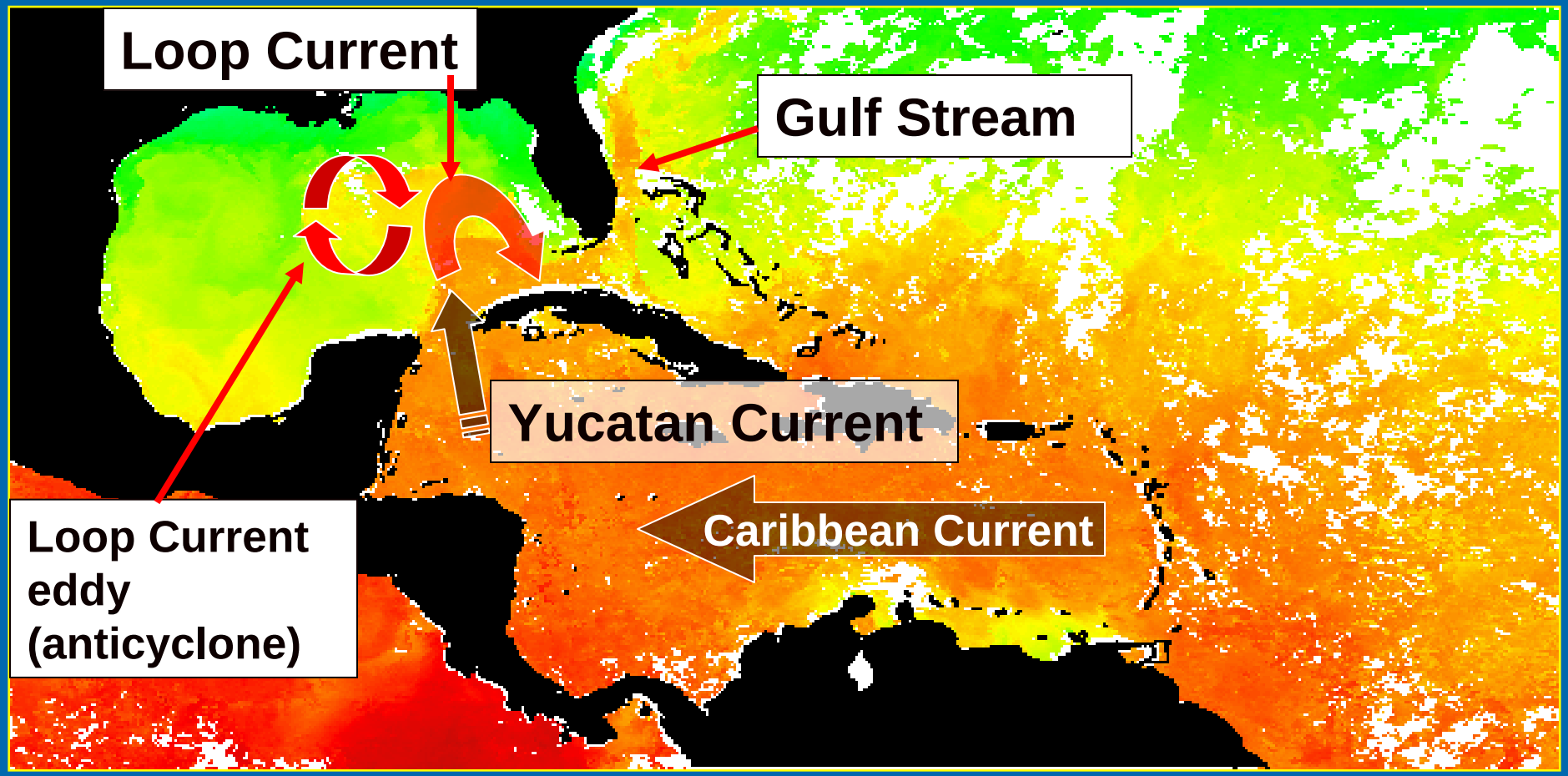
Material used obtained from:

NASA, NOAA, Navy/NRL
State of Florida
ROFFS, Inc.
University of South Florida

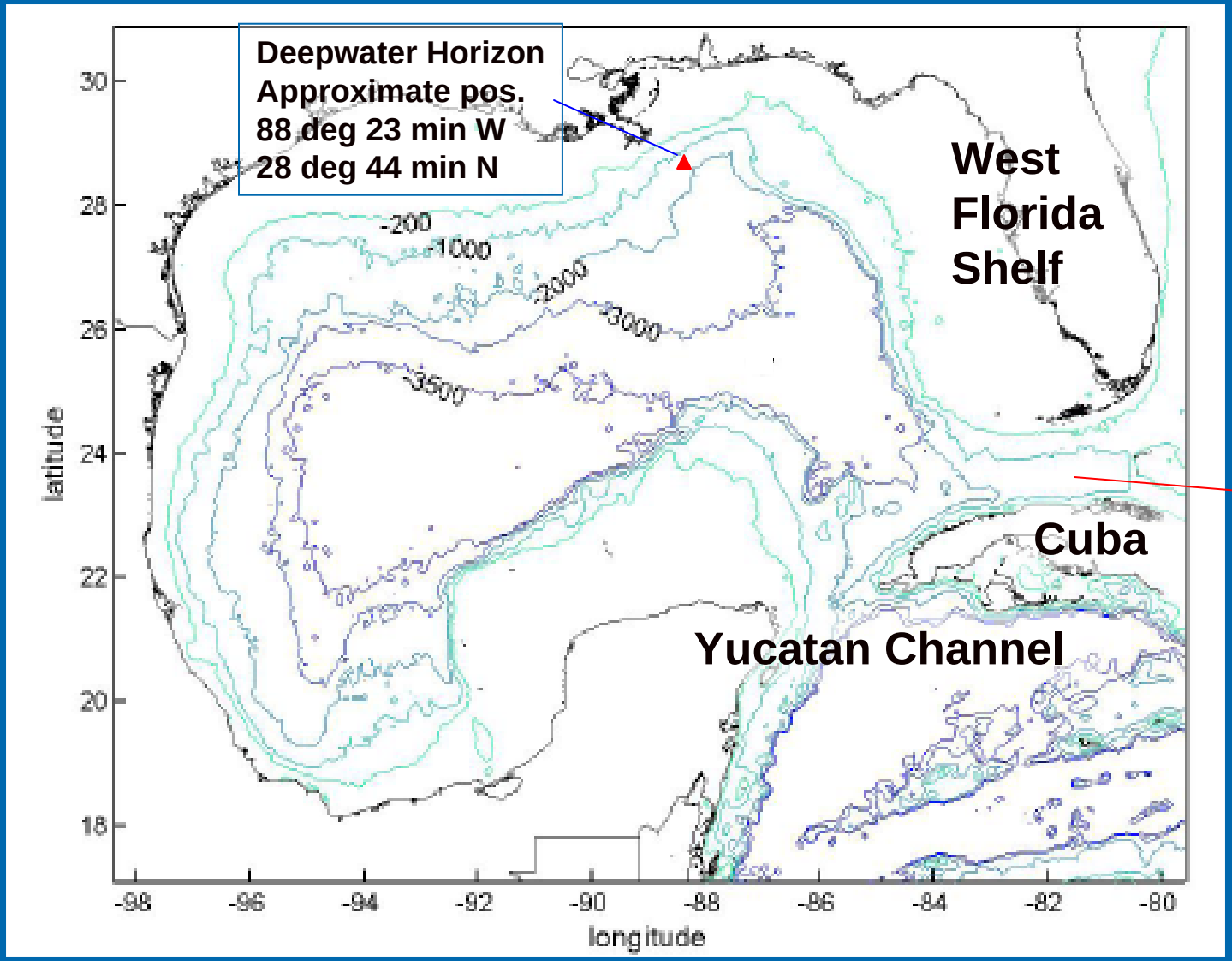
Simplified circulation of the ocean and location of the Gulf of Mexico



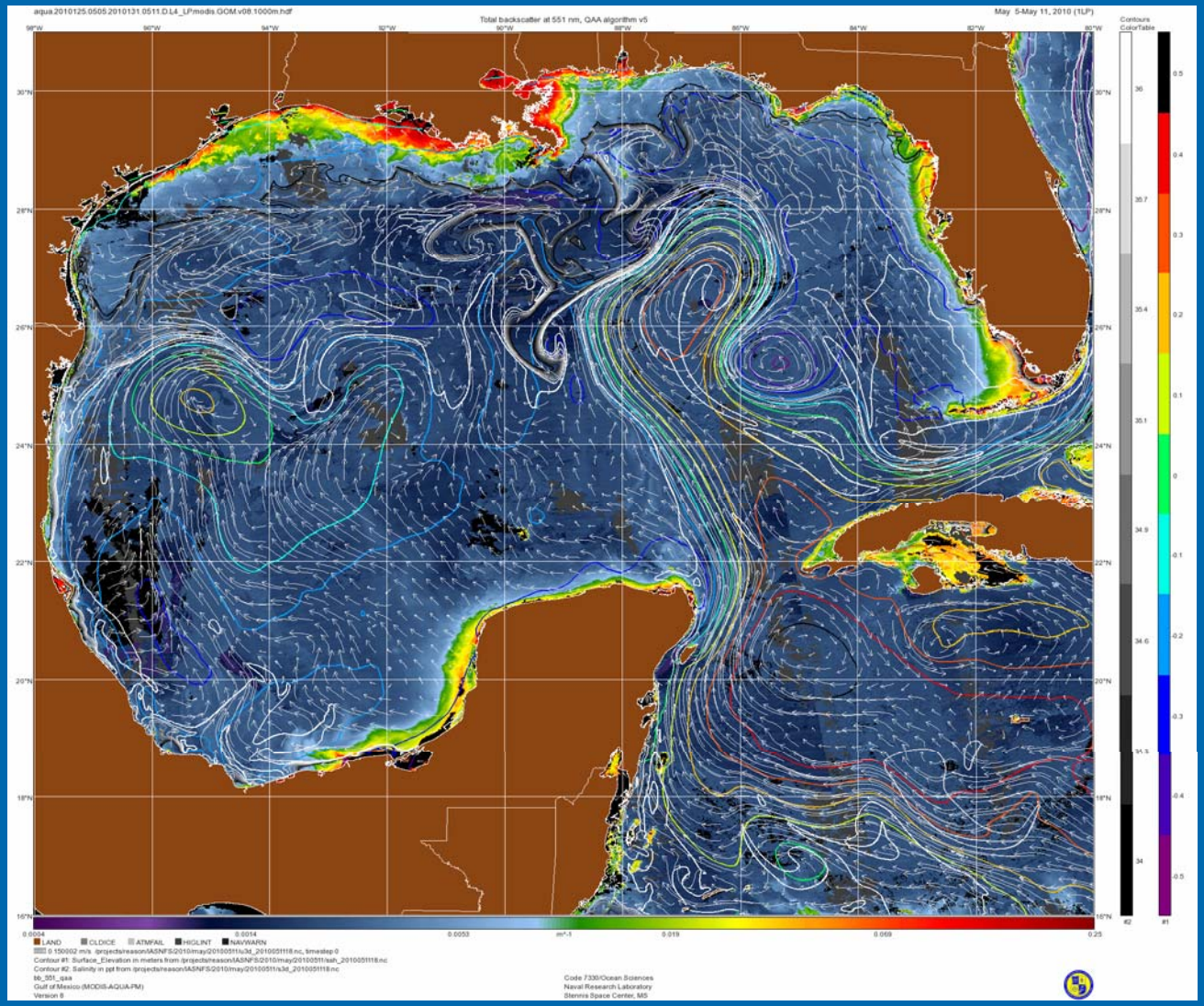
Intra-Americas Sea (Sea Surface Temperature Satellite Image)



The Gulf of Mexico Bathymetry



The Loop Current



Characteristics:

Large “loop”

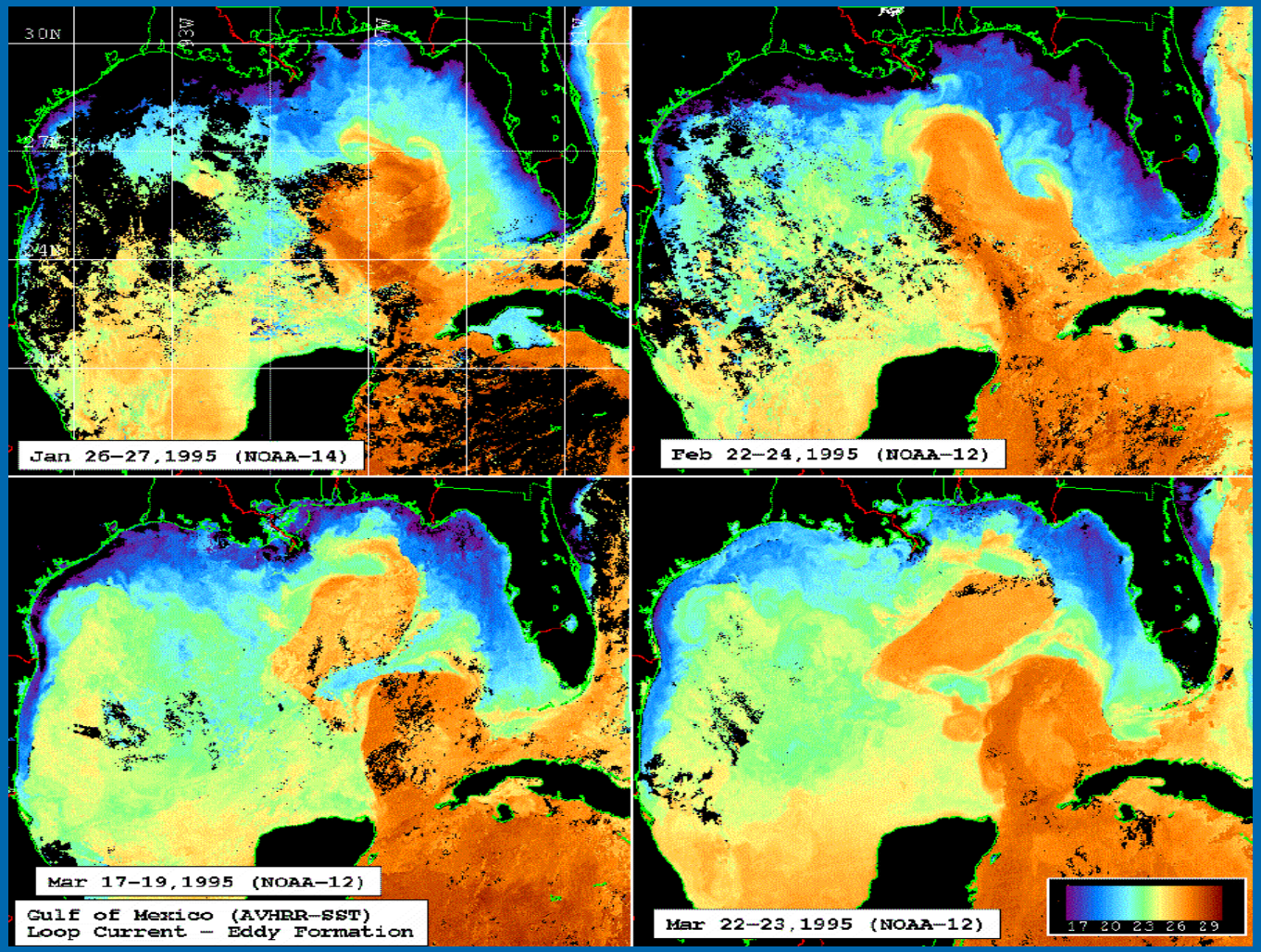
~27 million cubic meters per second

~1 to 3 knots

May 5-17 2010

Simulation Image: Naval Research Lab (NRL)

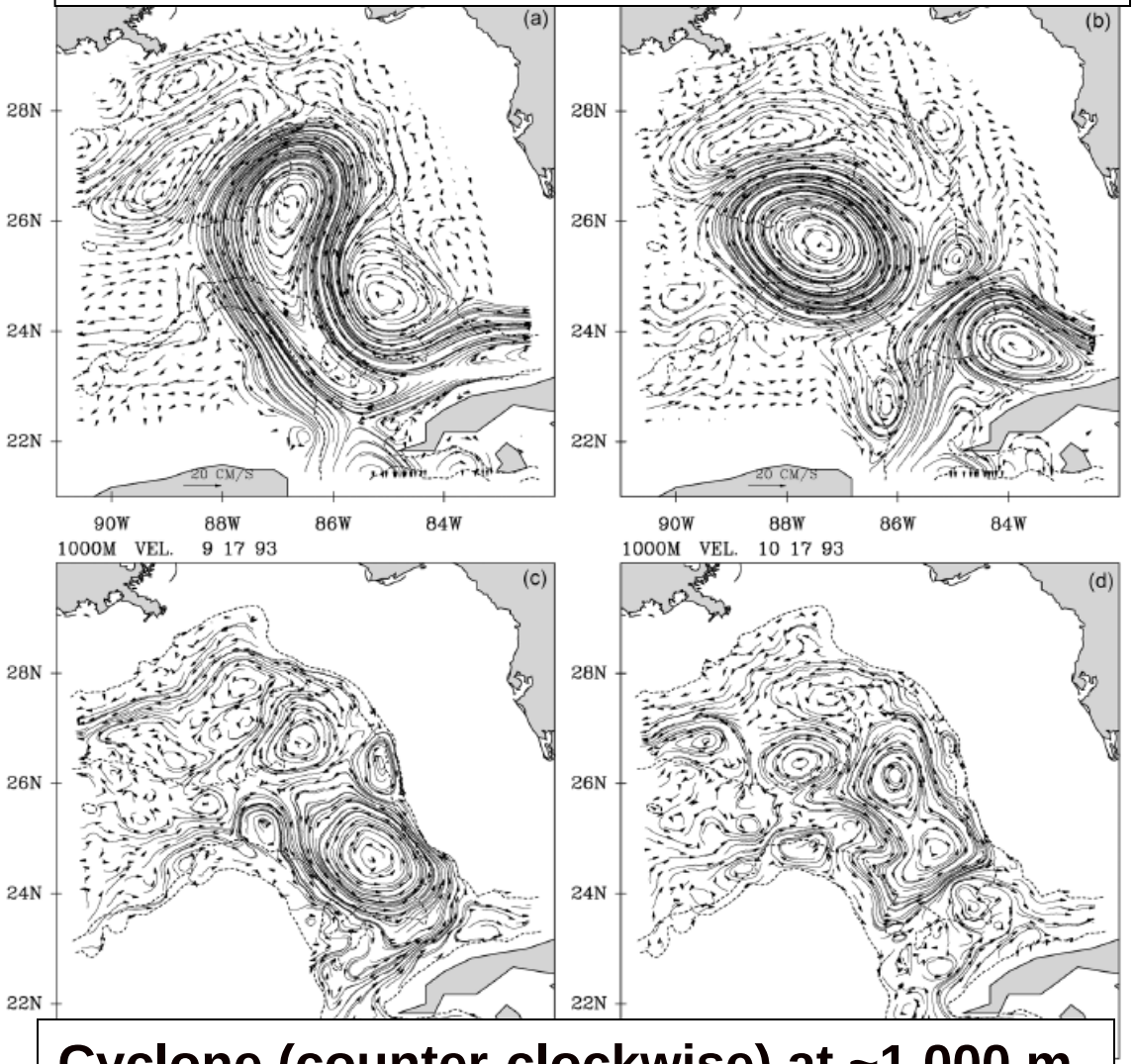
Typical eddy-shedding cycle of the Loop Current: 9-14 months



Loop Current, fully extended

Loop Current eddy: anticyclone (clockwise) motion, Westward drift

Anticyclone (clockwise) at surface



Cyclone (counter-clockwise) at ~1,000 m

Figure 3. Simulated circulation from a doubled-resolution POM experiment (Oey and Lee, 2002) showing an example when east Campeche Bank and Tortugas cyclones *appear* to cleave the Loop Current, leading to separation; please see text for more details. The top panels (a and b) are for currents at $z = -50$ *m* and the lower panels (c and d) for $z = -1000$ *m*. Left panels precede right panels by *30 days*. The picture is from the *12th year* of a *17-year* run. Contours show the *1000 m* and *3000 m* isobaths.

Simulated Circulation

Near-surface and 1,000 m depth

From:
Oey, L.-Y., T. Ezer, and H.-C. Lee Loop Current, Rings and Related Circulation in the Gulf of Mexico: A Review of Numerical Models and Future Challenges. Geophysical Monograph Series. AGU. 2005

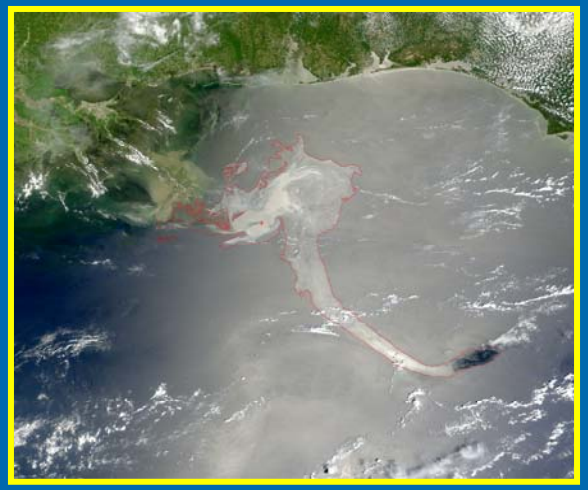
Note: we have NO observing system in place to observe below the surface

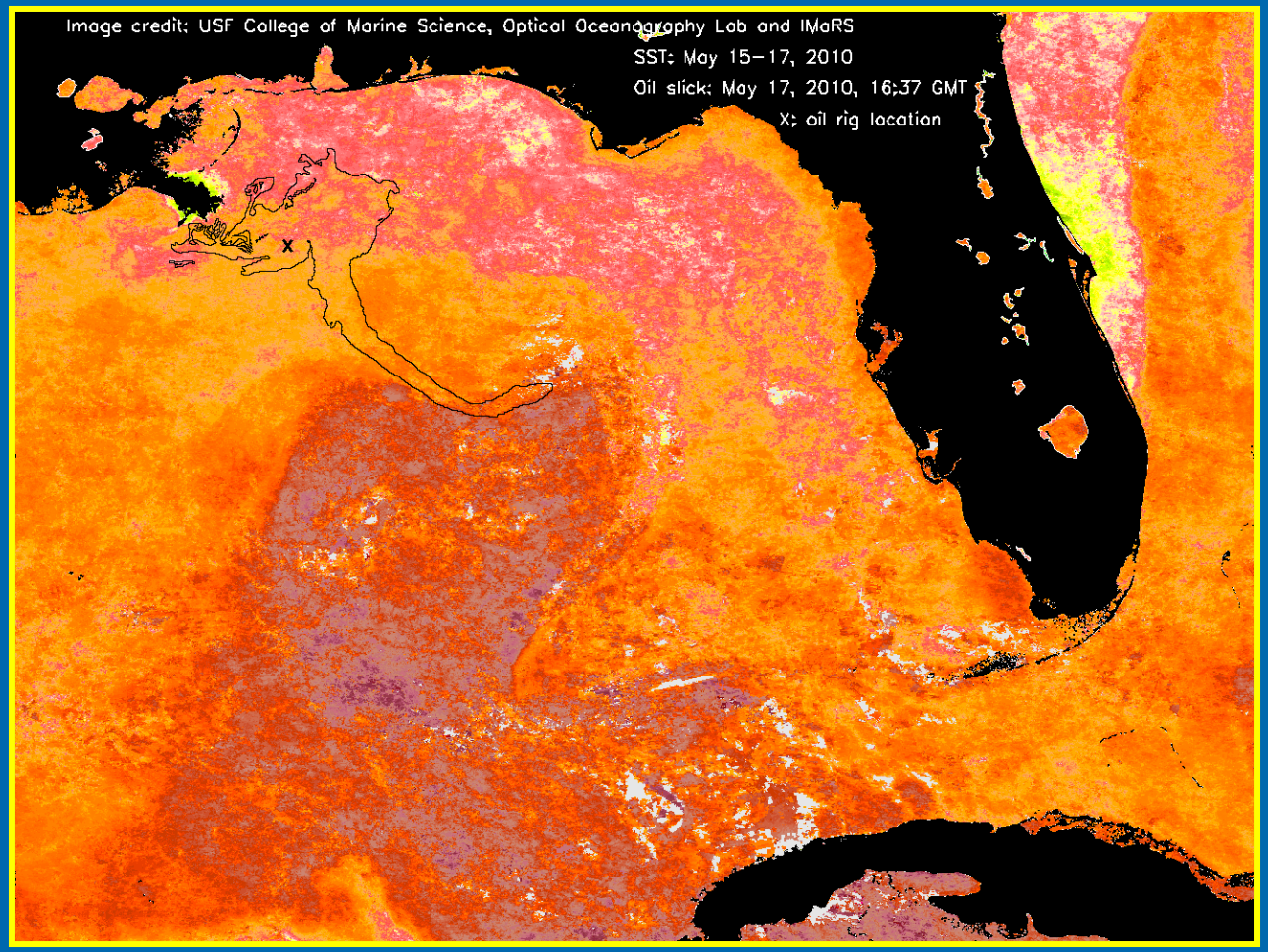
Observing the surface ocean with satellites

NASA, NOAA, European satellites

- NOAA AVHRR (15, 16, ,17, 18, 19)
  - (IR - 1.1km)
- Metop_A (1.1km)
- TERRA & AQUA MODIS
  - IR and Ocean Color 1.1km
  - RGB 250m and 1.1km
- ENVISAT MERIS
  - Ocean Color 300m and 1.1km

NASA and NOAA Satellite Imagery

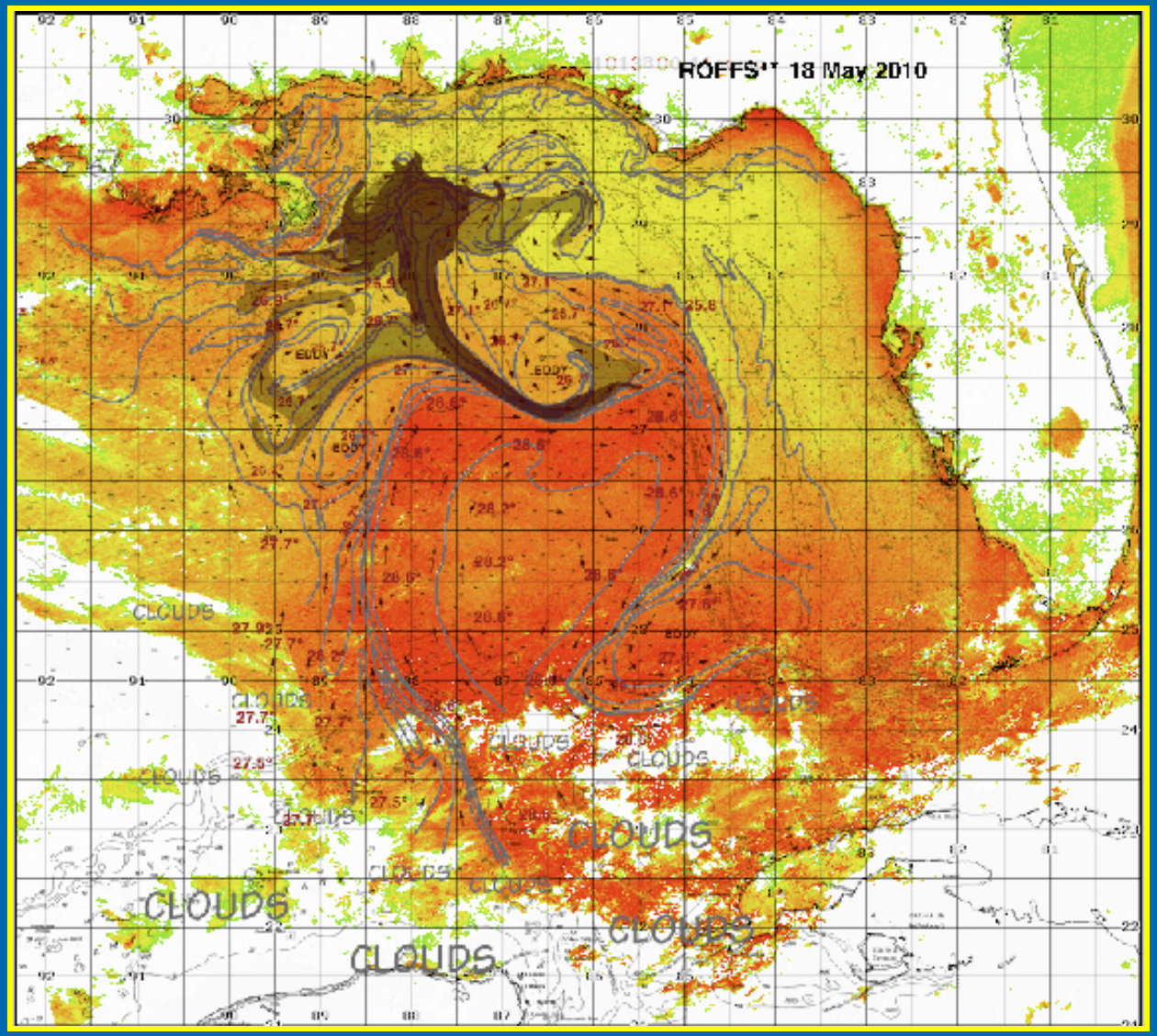




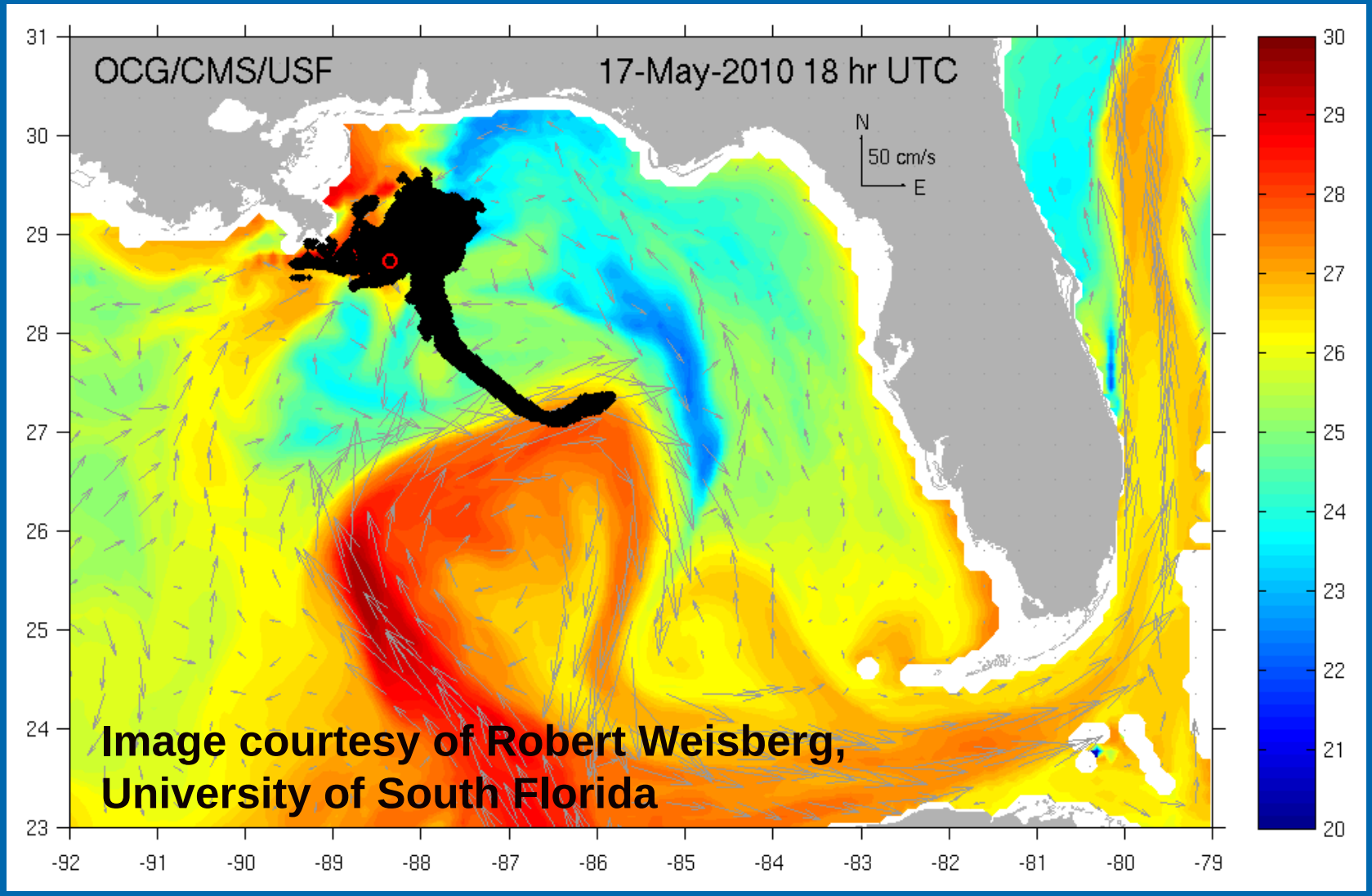
17 May 2010

Images analyzed by Dr. C. Hu, University of South Florida

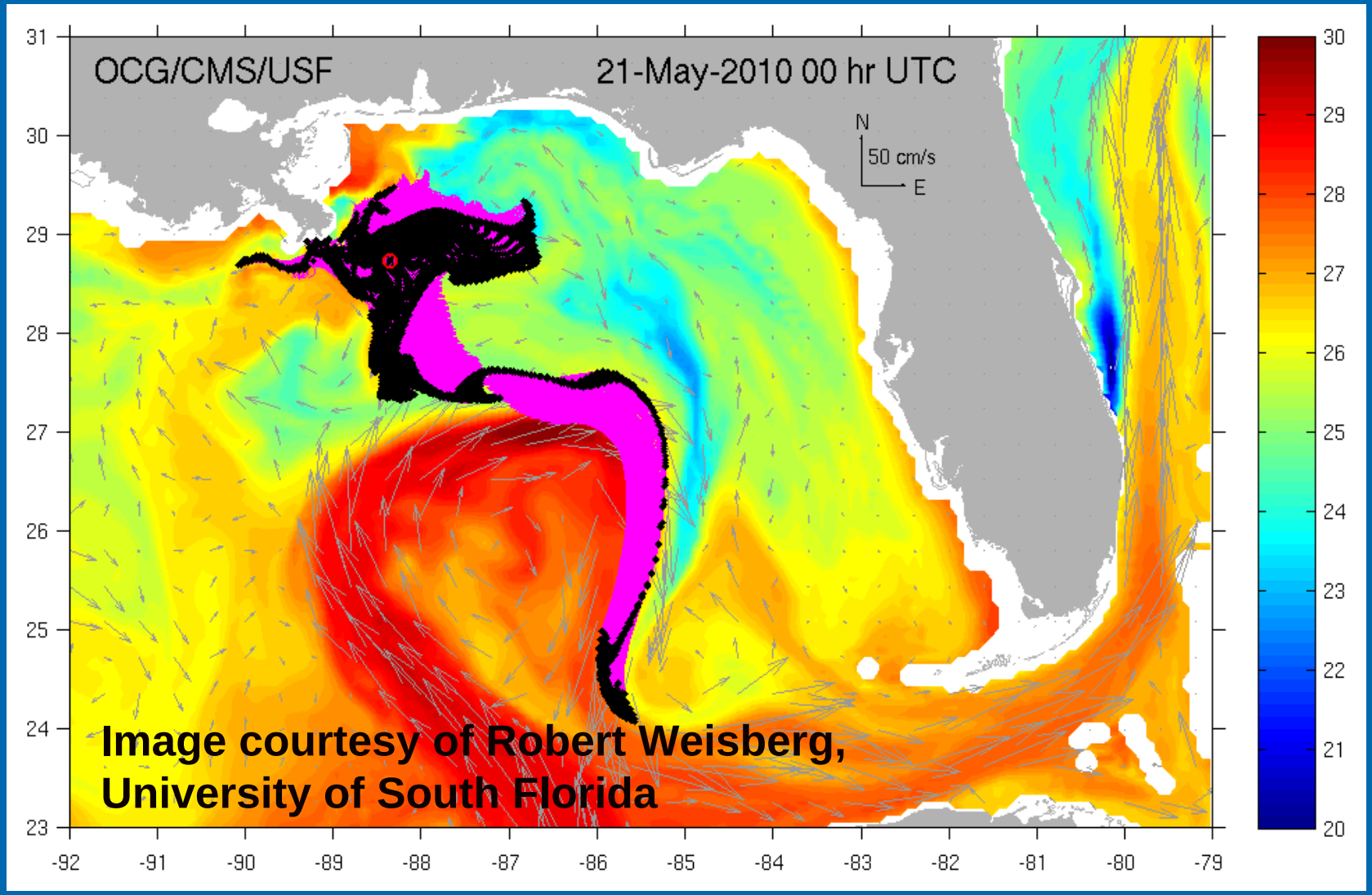
ROFFS, Inc. Analysis 18 May 2010
NOAA AVHRR temperature, Aqua and Terra MODIS
Analysis of oil location



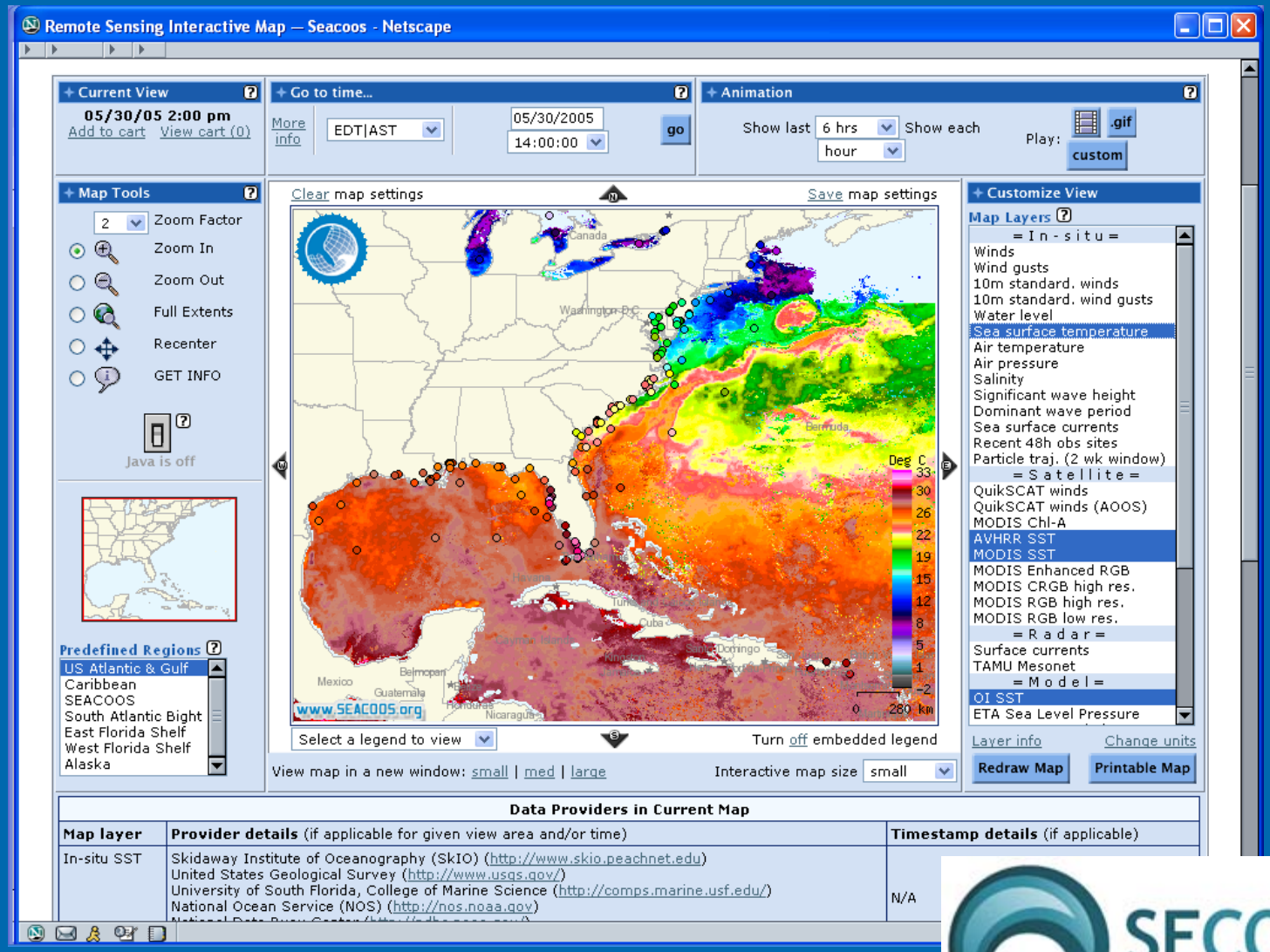
Simulations of oil trajectory at the surface (17 May 2010)



Simulations of oil trajectory at the surface (21 May 2010)



Coastal Ocean Observing Systems: http://secoora.org; http://gcoos.org



SECOORA
Southeast Coastal Ocean Observing Regional Association

RECOMMENDATIONS: Short-term, oil-spill related

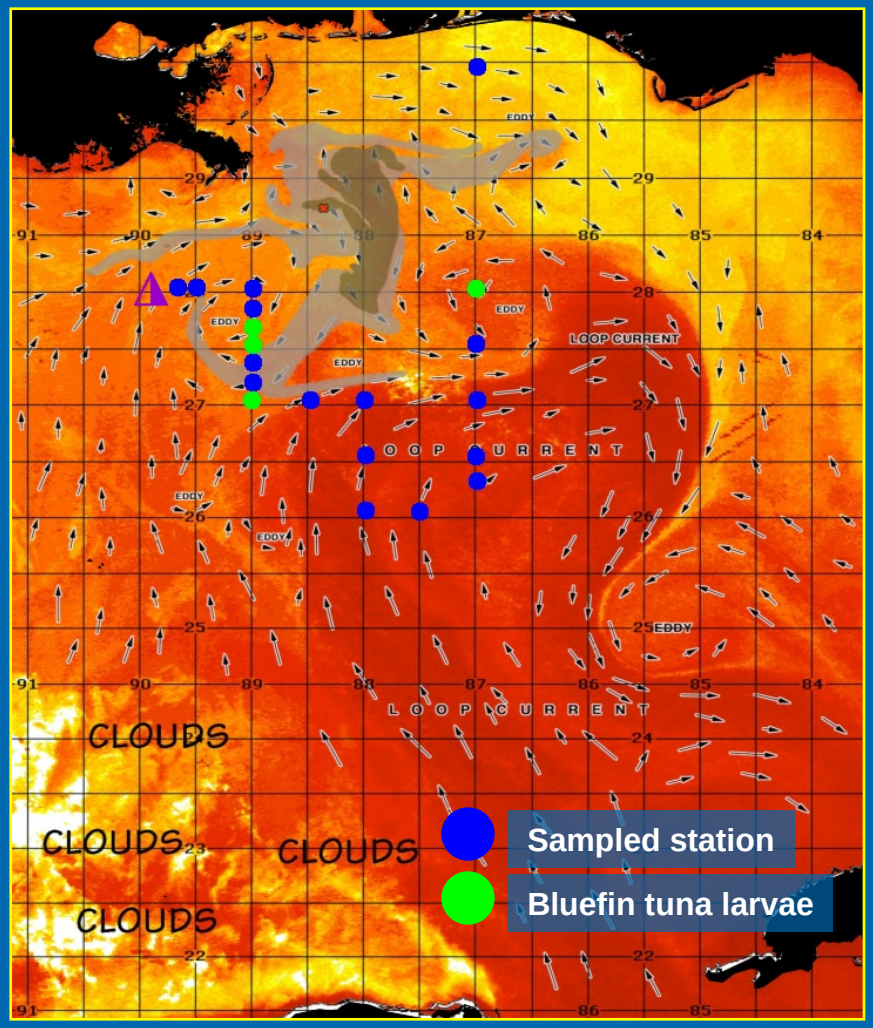
- US Government coordinate and fund broad coalition of academic, industry, government researchers to energize Coastal Ocean Observing Systems (COOS/IOOS):
  - Use regional experts, with most comprehensive knowledge and infrastructure dedicated to Gulf of Mexico research
  - Establish time series of sampling and monitoring in a grid covering the Gulf of Mexico and US East Coast
    - Integrate biological, chemical, physical and geological oceanography, focusing on ecological studies (fish, fish larvae, corals, other benthic and pelagic organisms)
    - Estimate volume, concentration, motion of dispersing material and impacts
  - Use satellites, ships, autonomous vehicles, moorings, numerical simulations

RECOMMENDATIONS: Short and mid-term

- NASA, NOAA, USGS coordinate and fund a capable and robust national (U.S.) constellation of Earth-observing satellite missions, to enable serious ecosystem and climate science and management programs
- This needs to be FULLY planned and integrated with in-situ observing systems
- Engage in international collaboration in the region to conduct joint research and assess impacts

2010 NOAA Atlantic Bluefin Tuna cruise and oil spill

- **The oil slick is impinging on spawning habitat for bluefin tuna and other organisms**
- **We are using daily satellite imagery to track the spill**
- **Sampling before oil reaches the spawning habitat may allow some quantification of the impacts on spawning habitat**



Analysis from ROFFS, Inc.