Remote Sensing of Loop Current Frontal Eddy Cyclones

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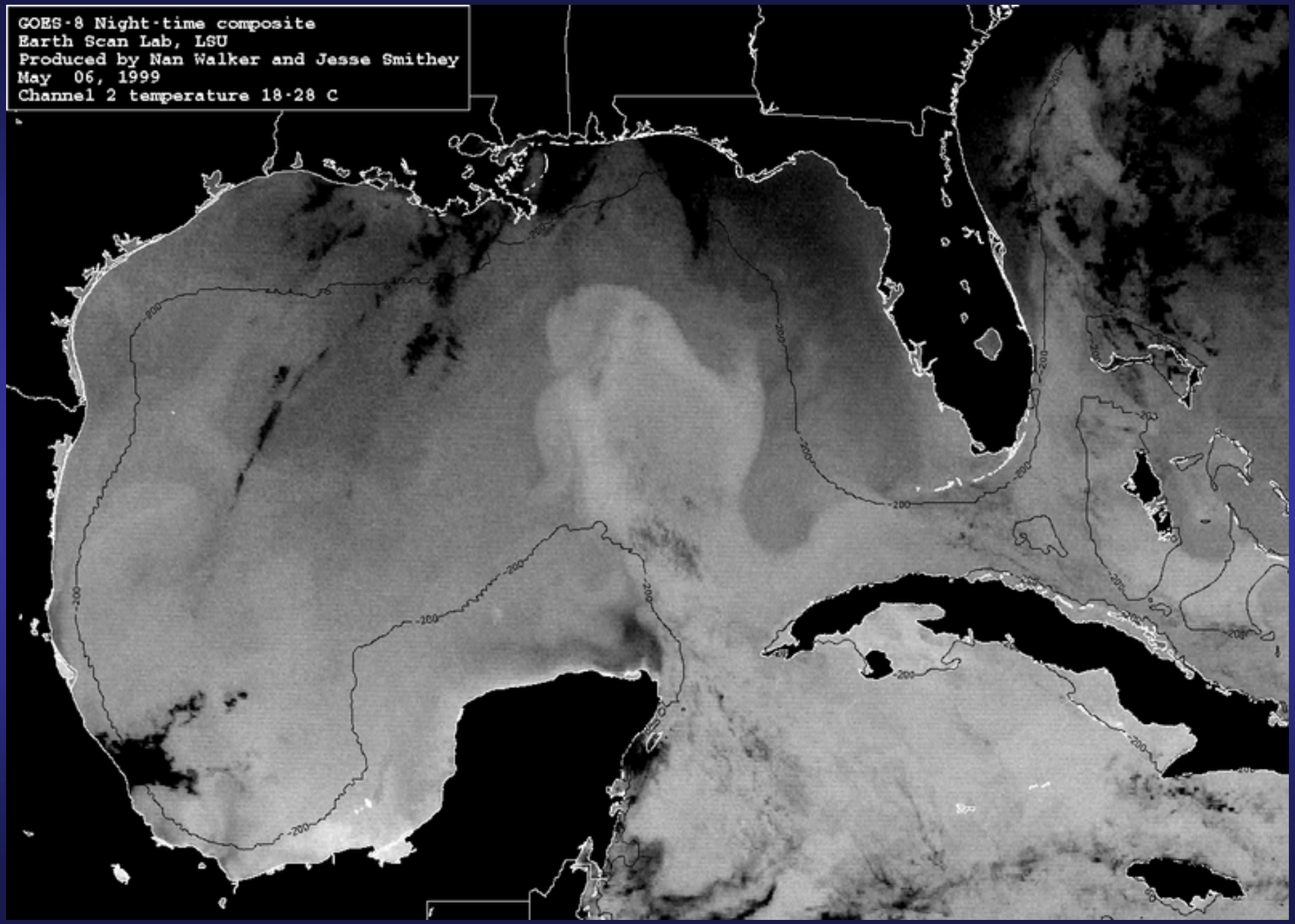

GOES-8 Night-time composite
Earth Scan Lab, LSU
Produced by Nan Walker and Jesse Smithey
May 06, 1999
Channel 2 temperature 18-28 C

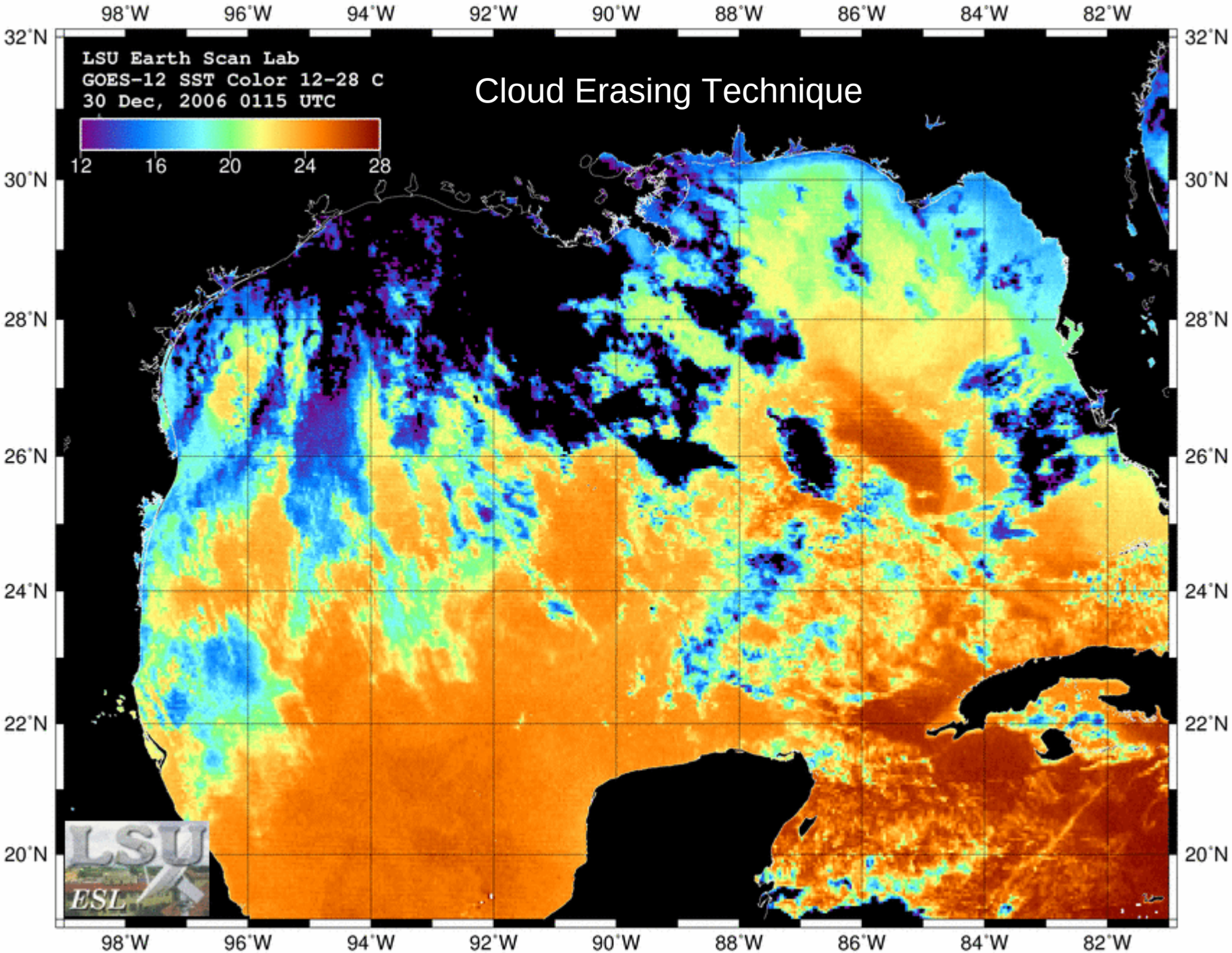
Main Objectives

- To develop, apply, and assess new remote sensing tools for detecting LCFEs and predicting regions of strong currents.

- To characterize the basic circulation characteristics of LCFEs and space/time variations in dimensions, propagation speed, frequency, intensity and vertical structure (i.e., an advanced LCFE climatology).

Data

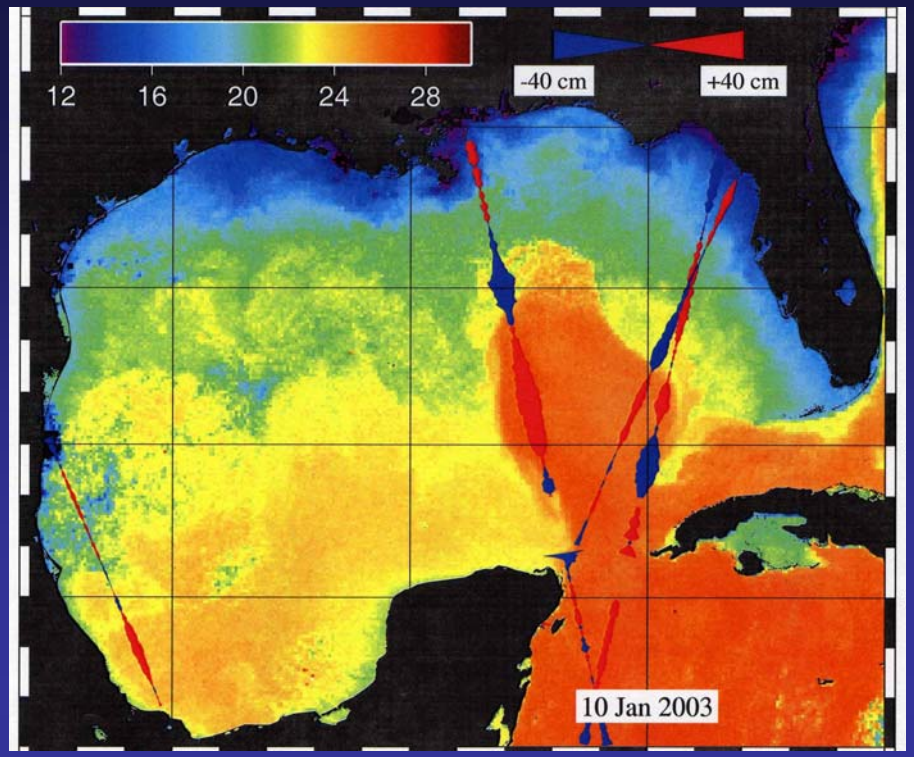
- **LSU GOES mid-infrared night-time de-clouded composites (daily updates)**
- **CCAR sea surface height measurements (interpolated and gridded daily update; along-track data)**
- **Horizon Marine satellite-tracked Argos drifter data (drogued to 50m)**
- ***Integration of products and daily updates on Earth Scan Laboratory web site: http://www.esl.lsu.edu/research/CMI-GOES***

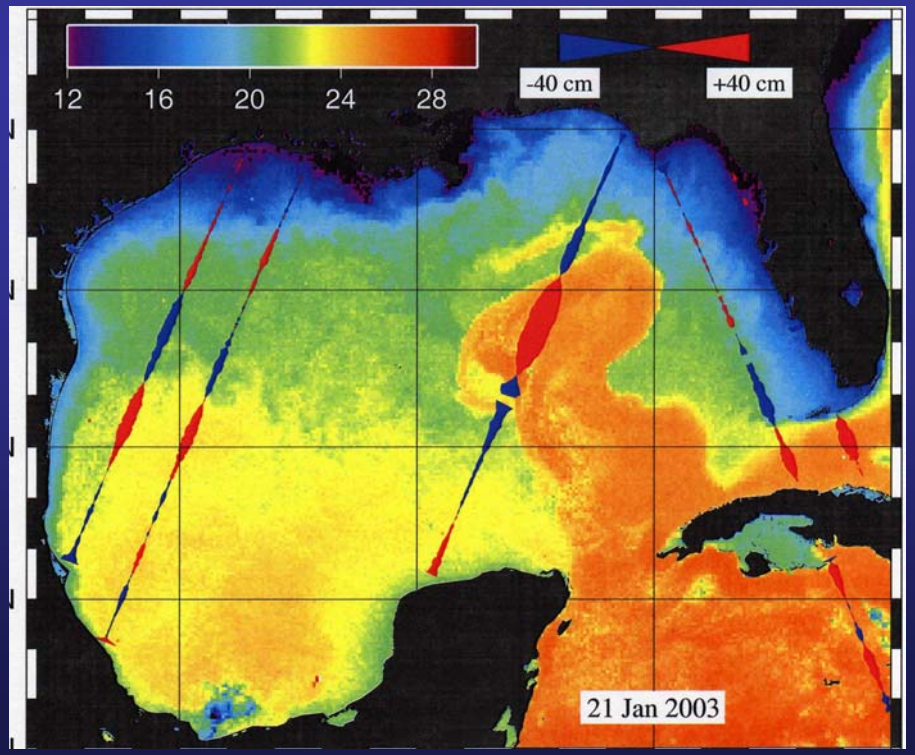


Cloud Erasing Technique

Why do we need SST data?

Integration of GOES SST and SSH Along-Track Data

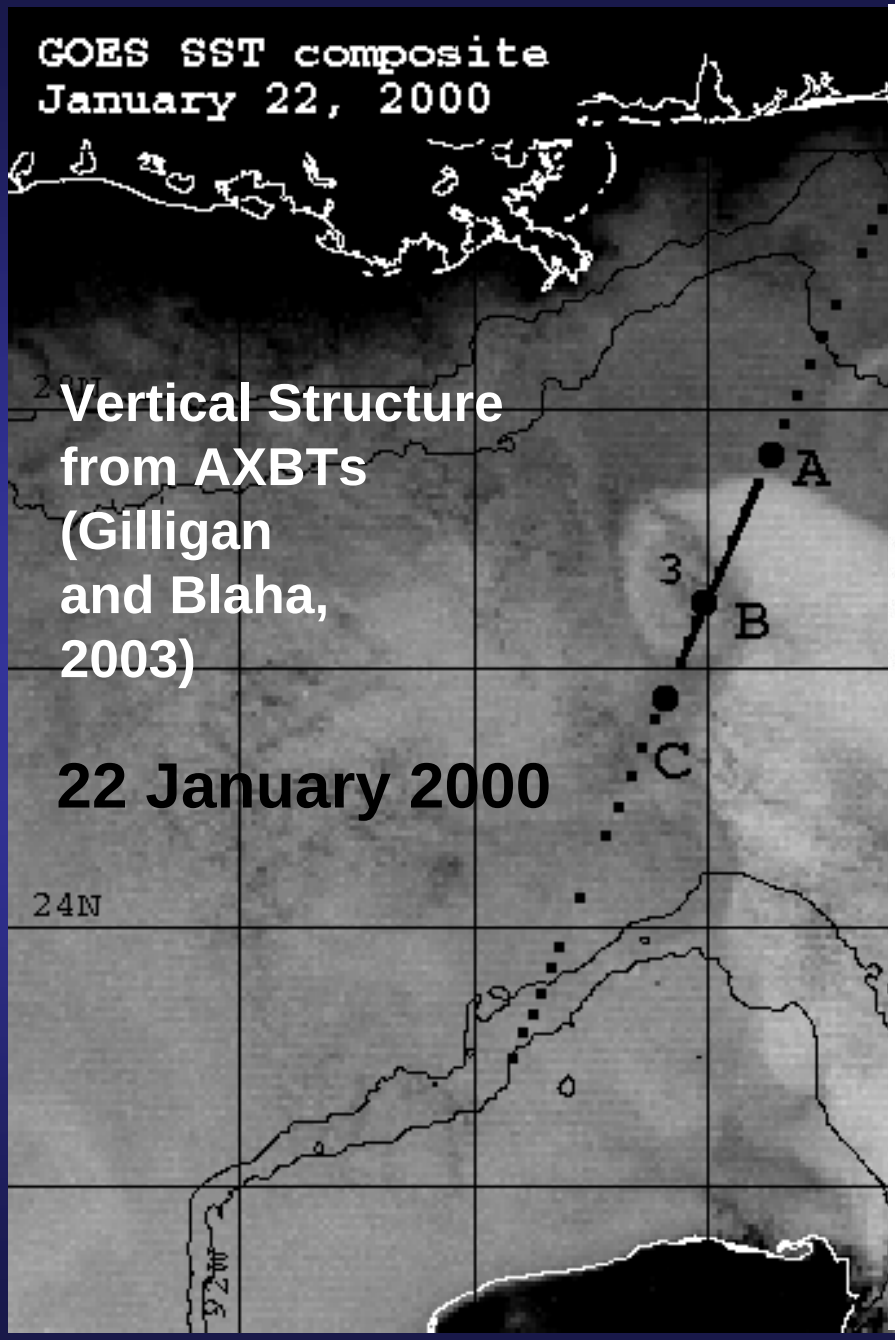




Long periods between re-sampling, even with several altimeters

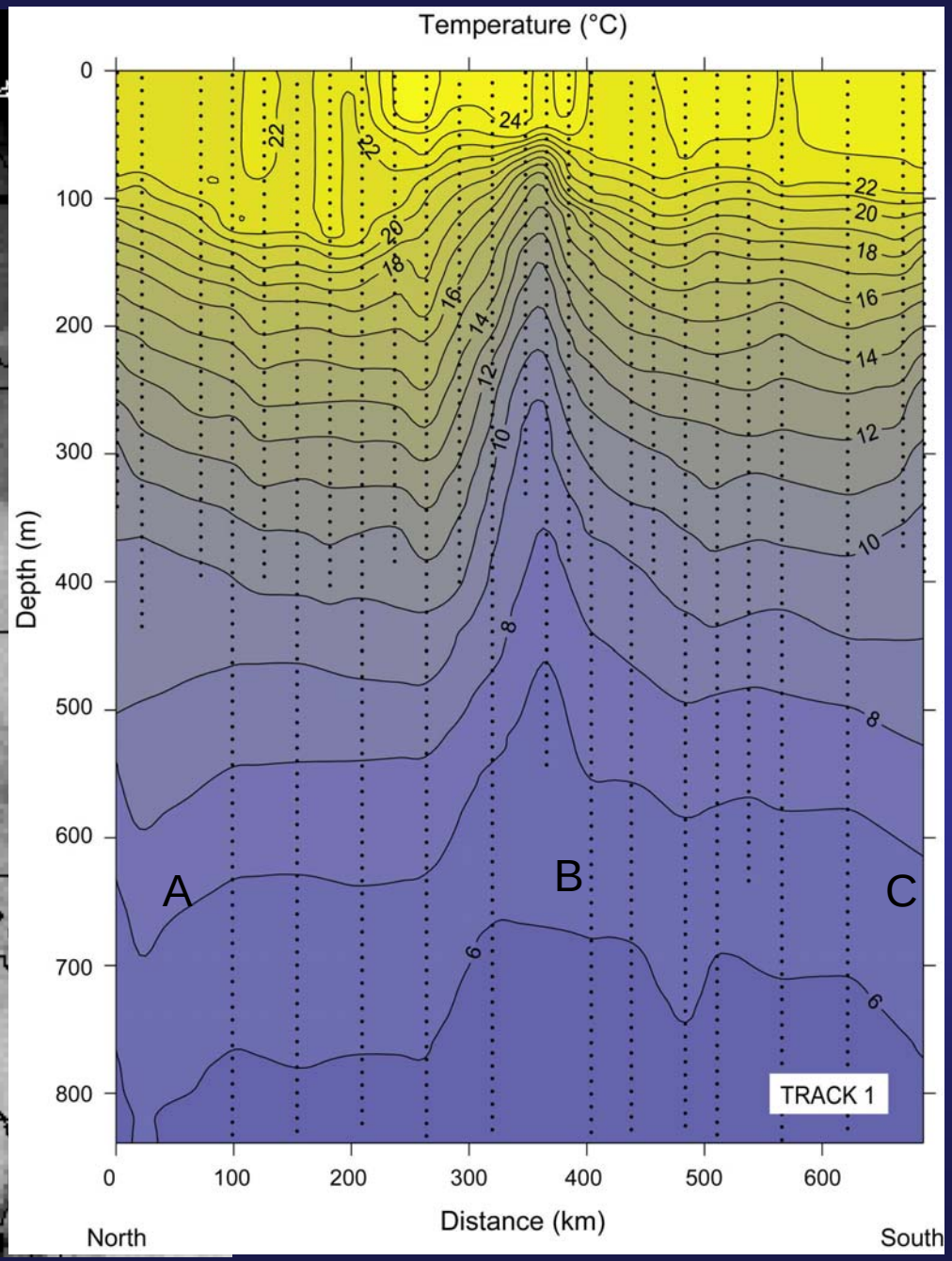
Circulation Case Studies

- January 2000
- February 2001
- February and March 2002

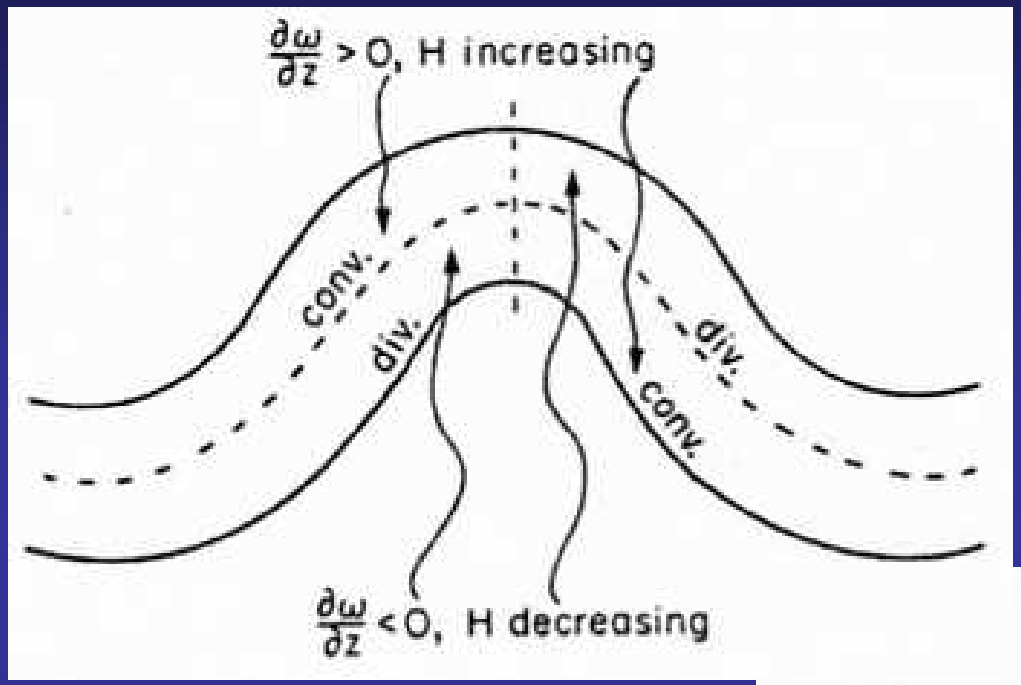


Vertical Structure from AXBTs (Gilligan and Blaha, 2003)

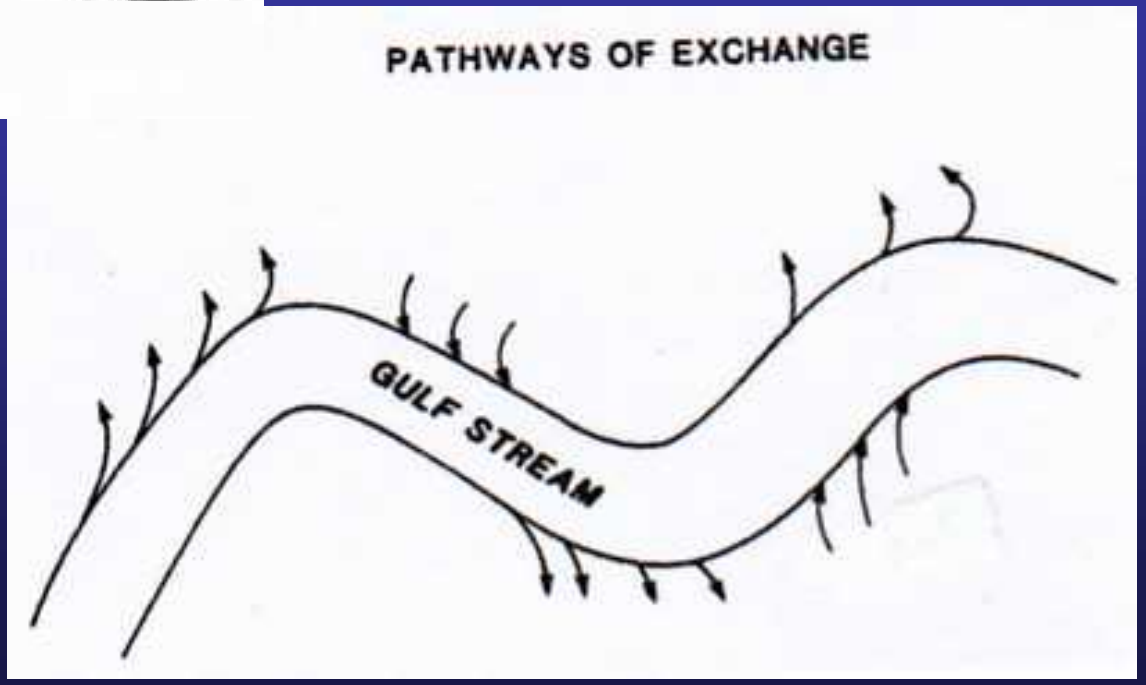
22 January 2000



Bower and Rossby (1989) and Bower (1989) described upwelling/downwelling, divergence/convergence and cross-frontal motion associated G.S. meanders.



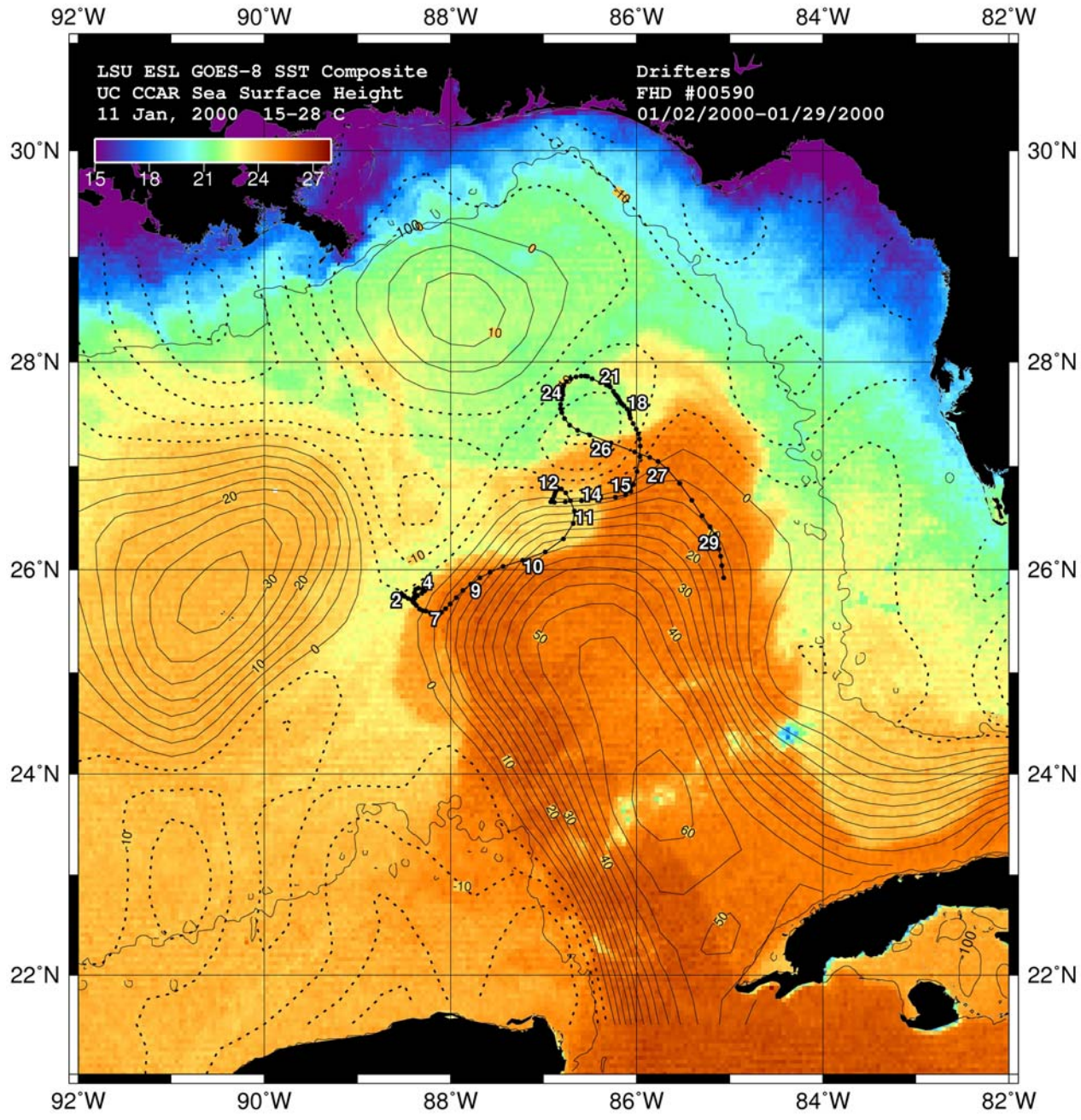
Vertical RAFOS float motion of 400m!



11 January 2000

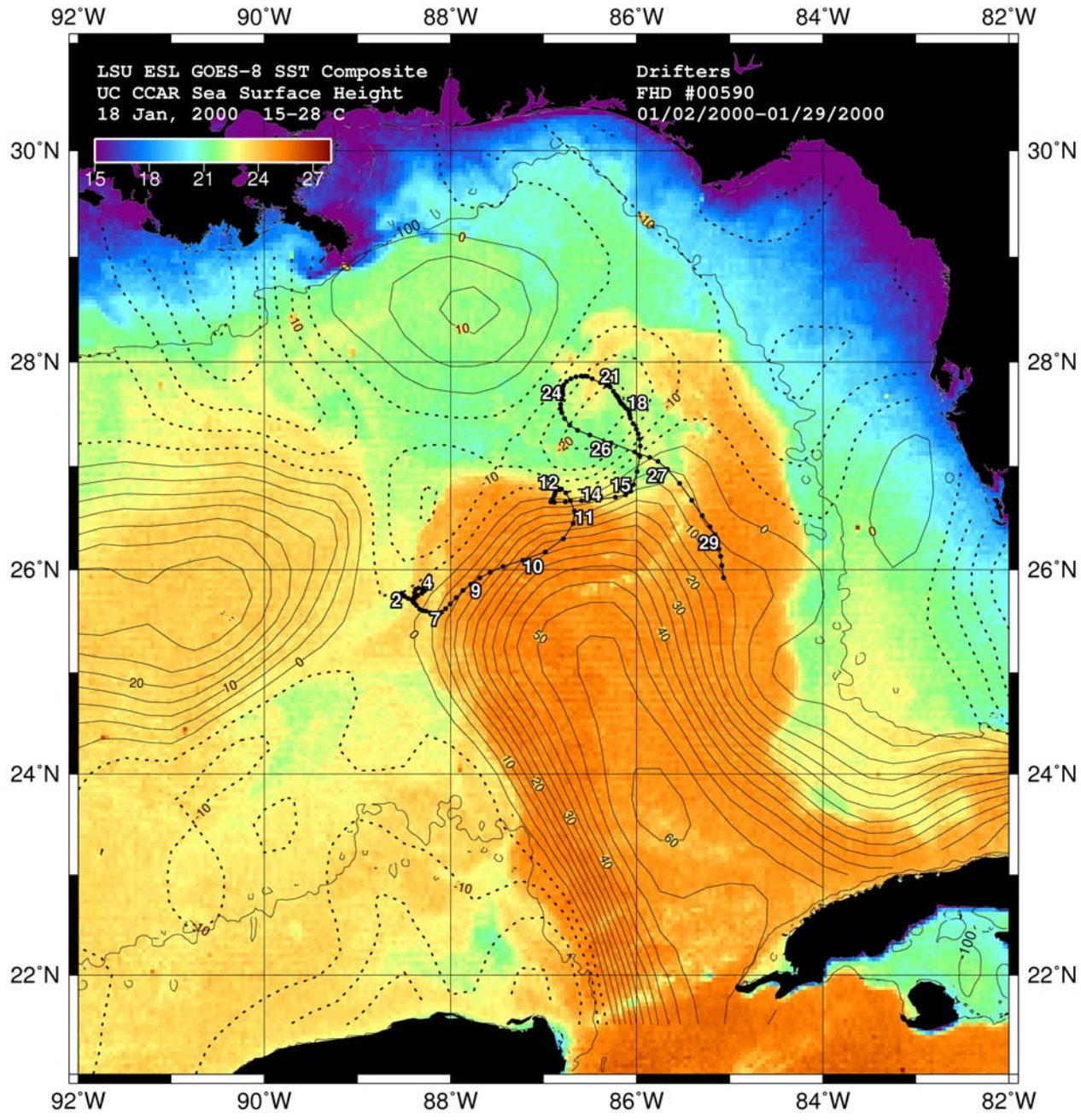
Drifters show cross-frontal exchange of water.

LCFEs intensify upon moving into region of pre-existing cyclonic Circulation.

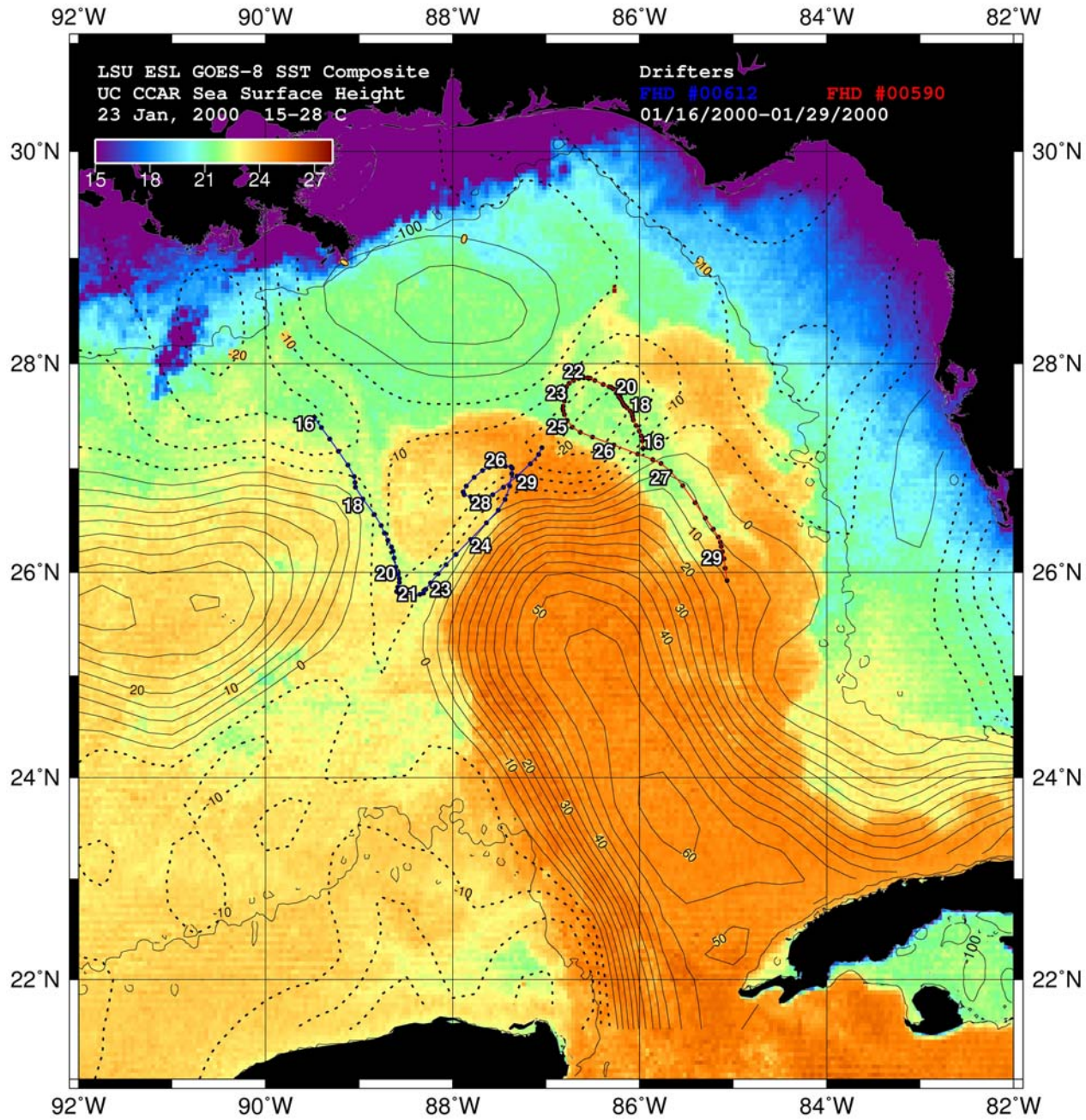


18 January 2000

Intensification of 2 LCFEs



23 January 2000

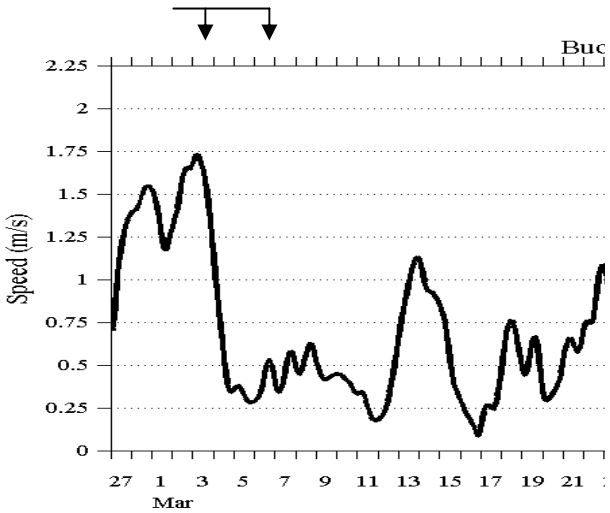


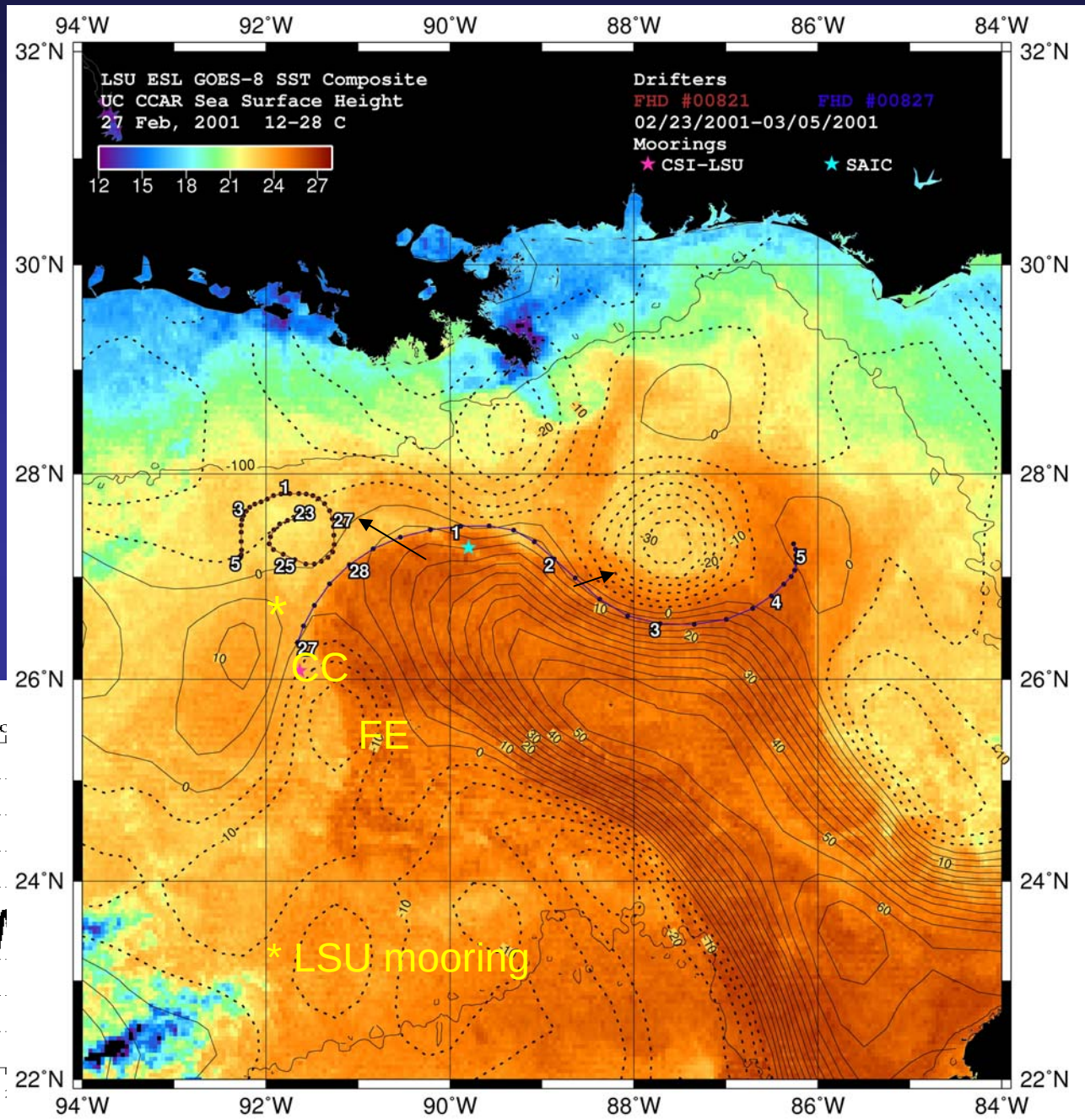
Propagation speed 12 km/day

27 February 2001

Accelerations in Loop Current near surface …

and strongest bottom currents of 10-month record at 2250m!

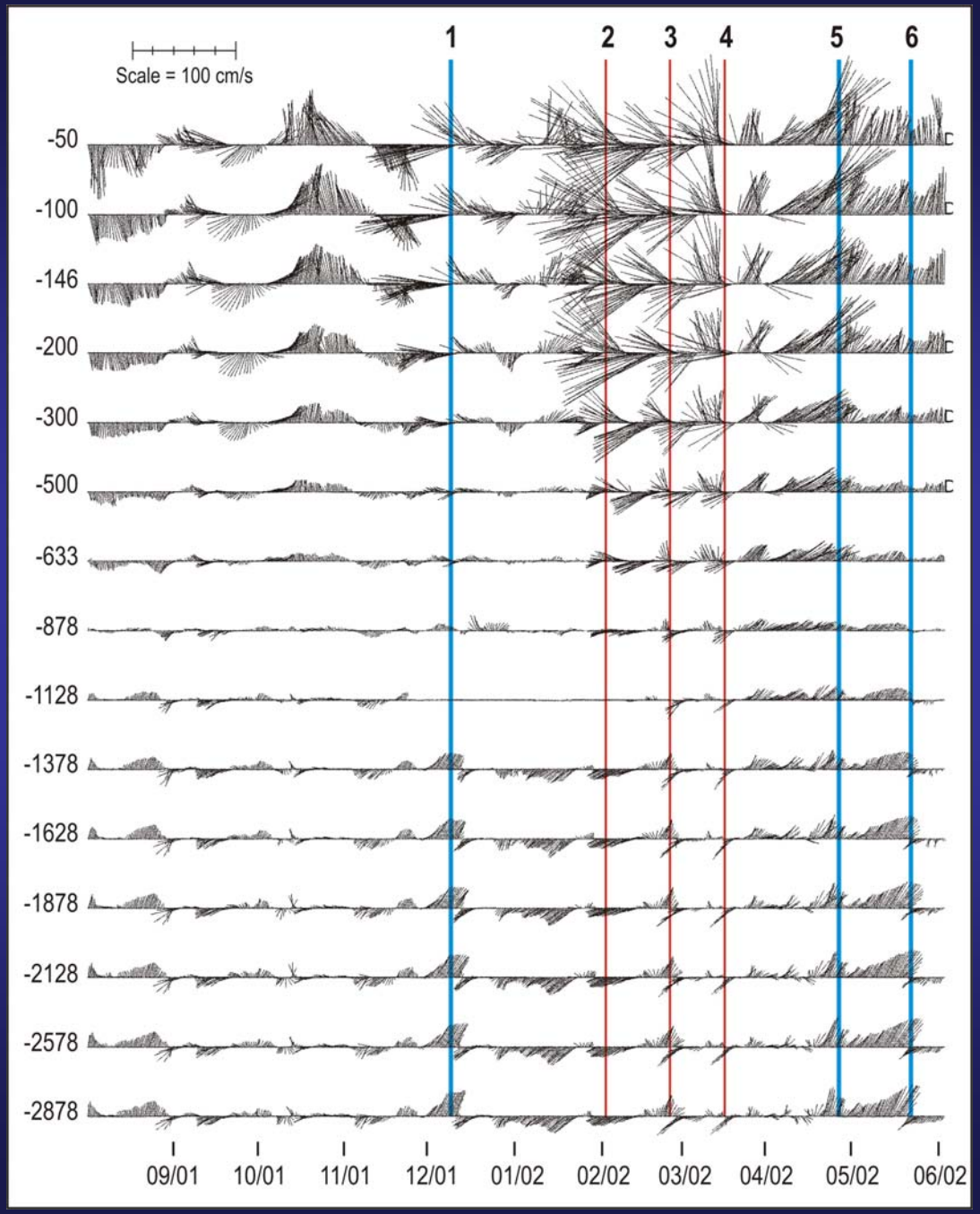


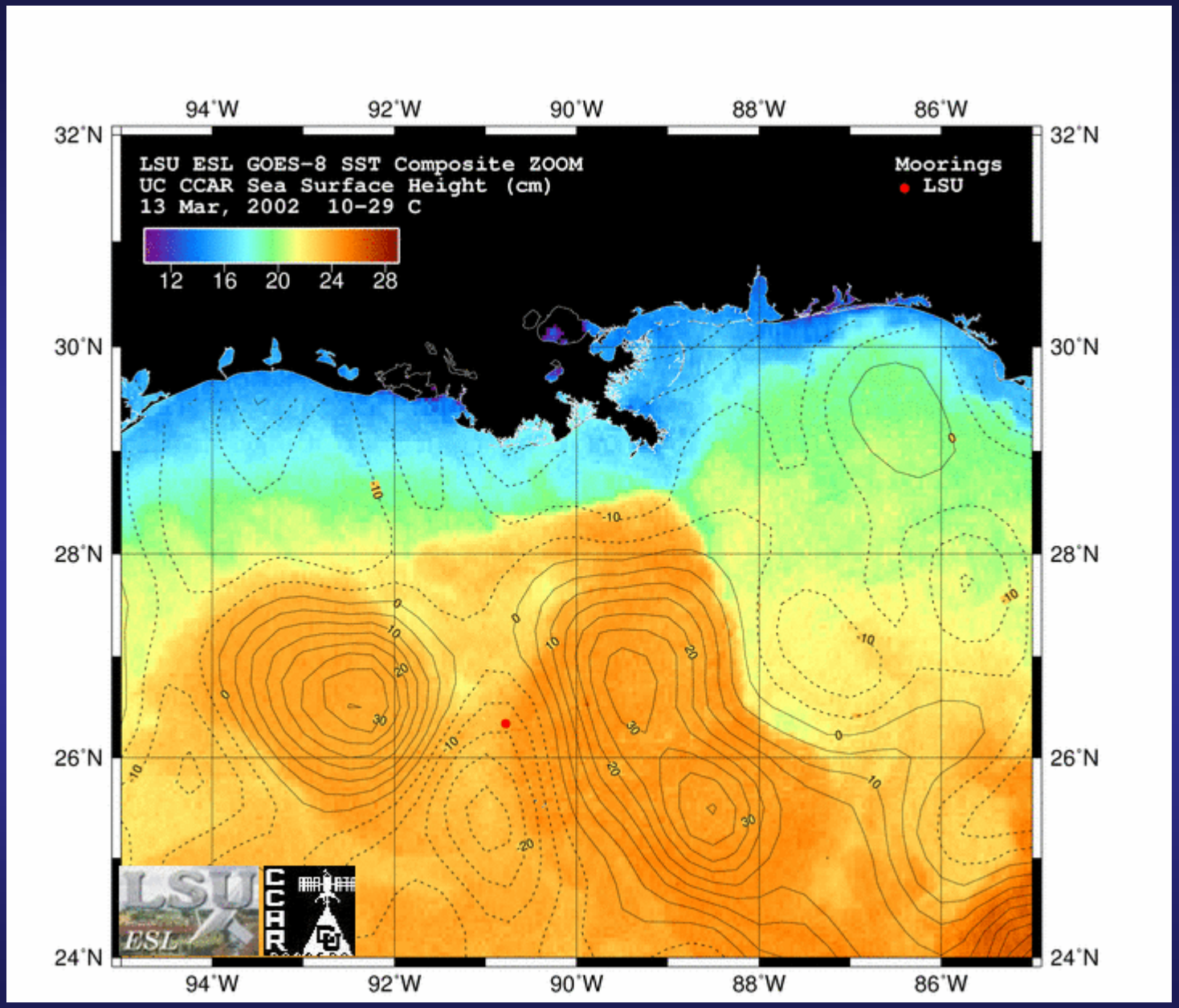


February and March 2002

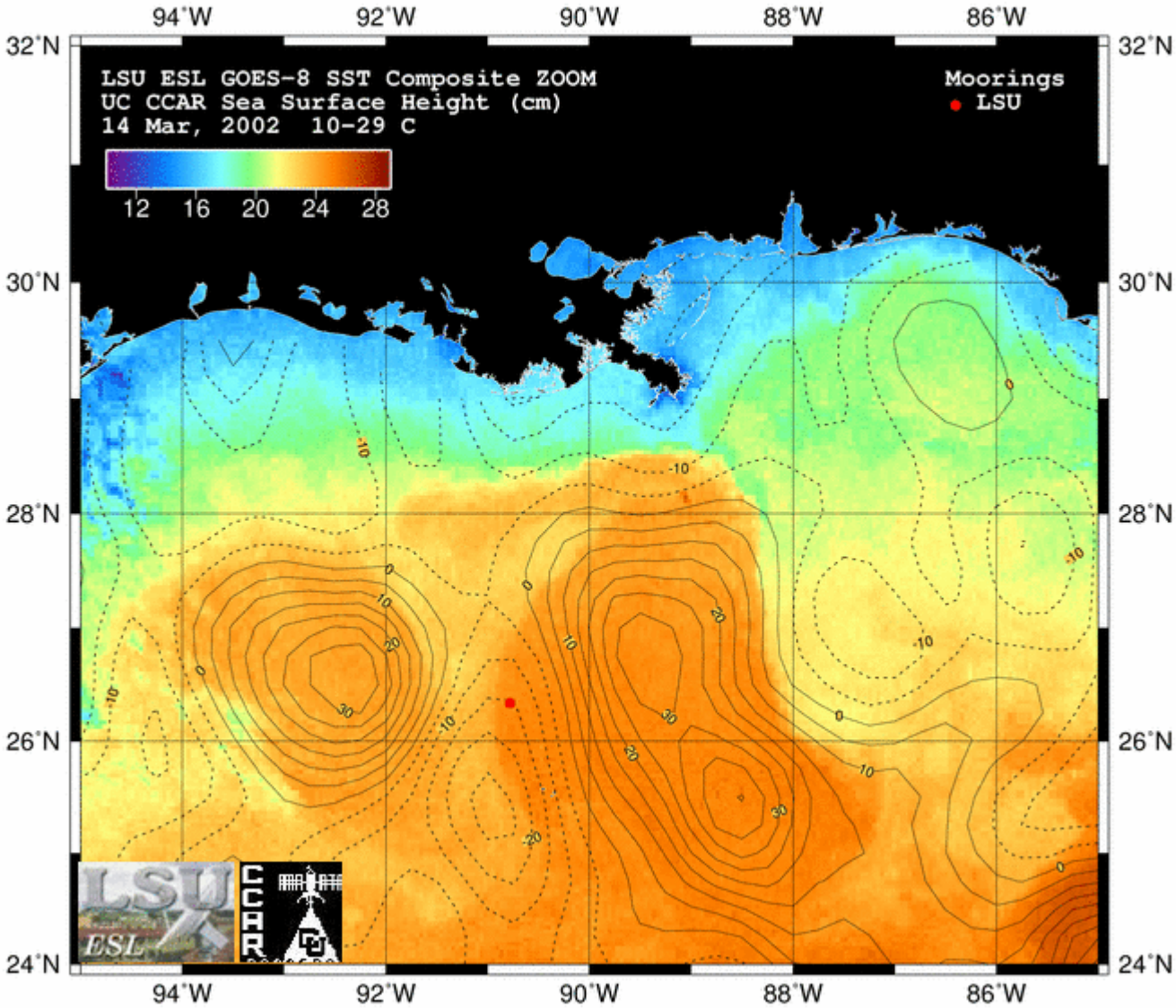
Three short-lived pulsed events

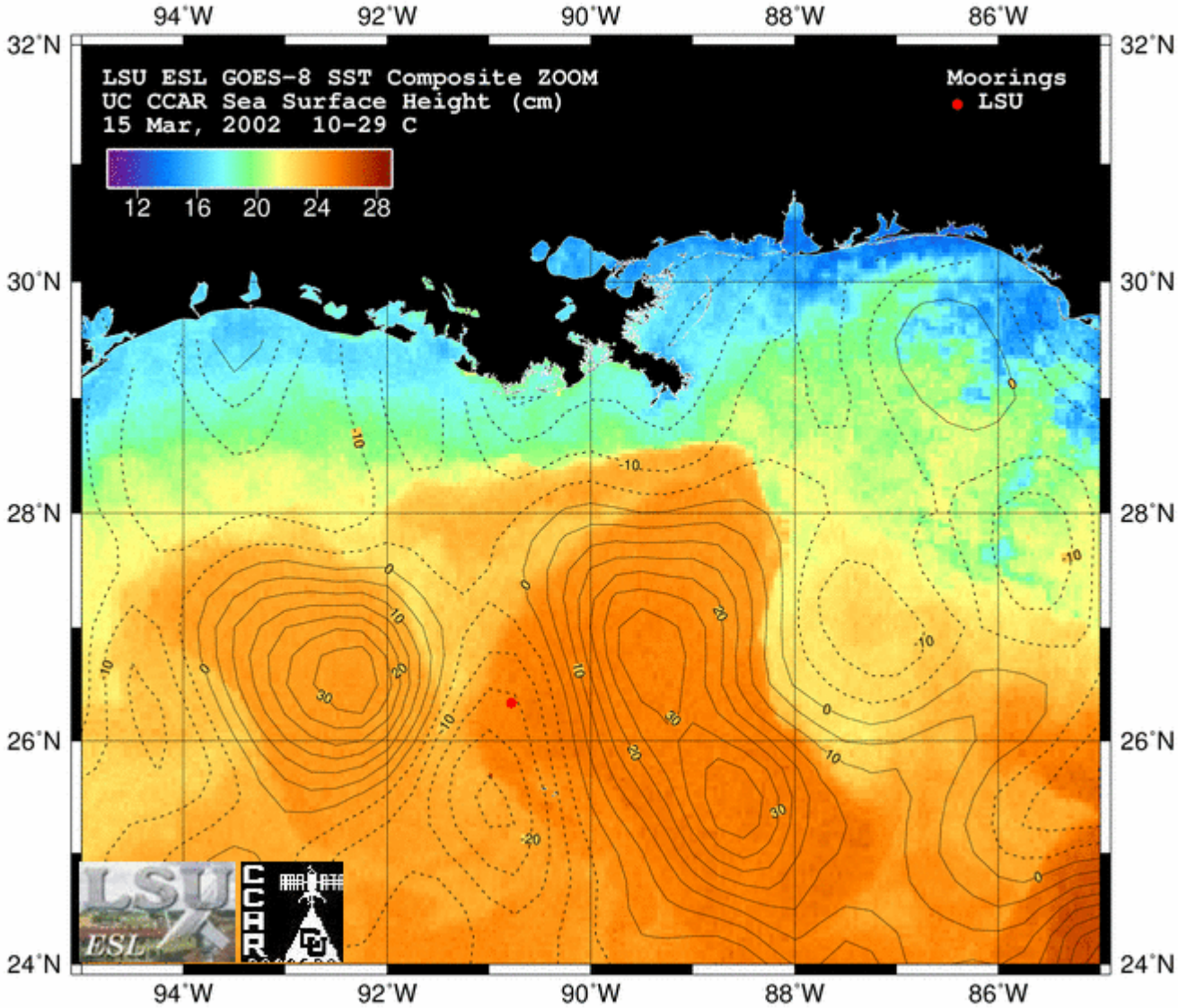
LCFE and WCRFE intrusion/intensification over mooring

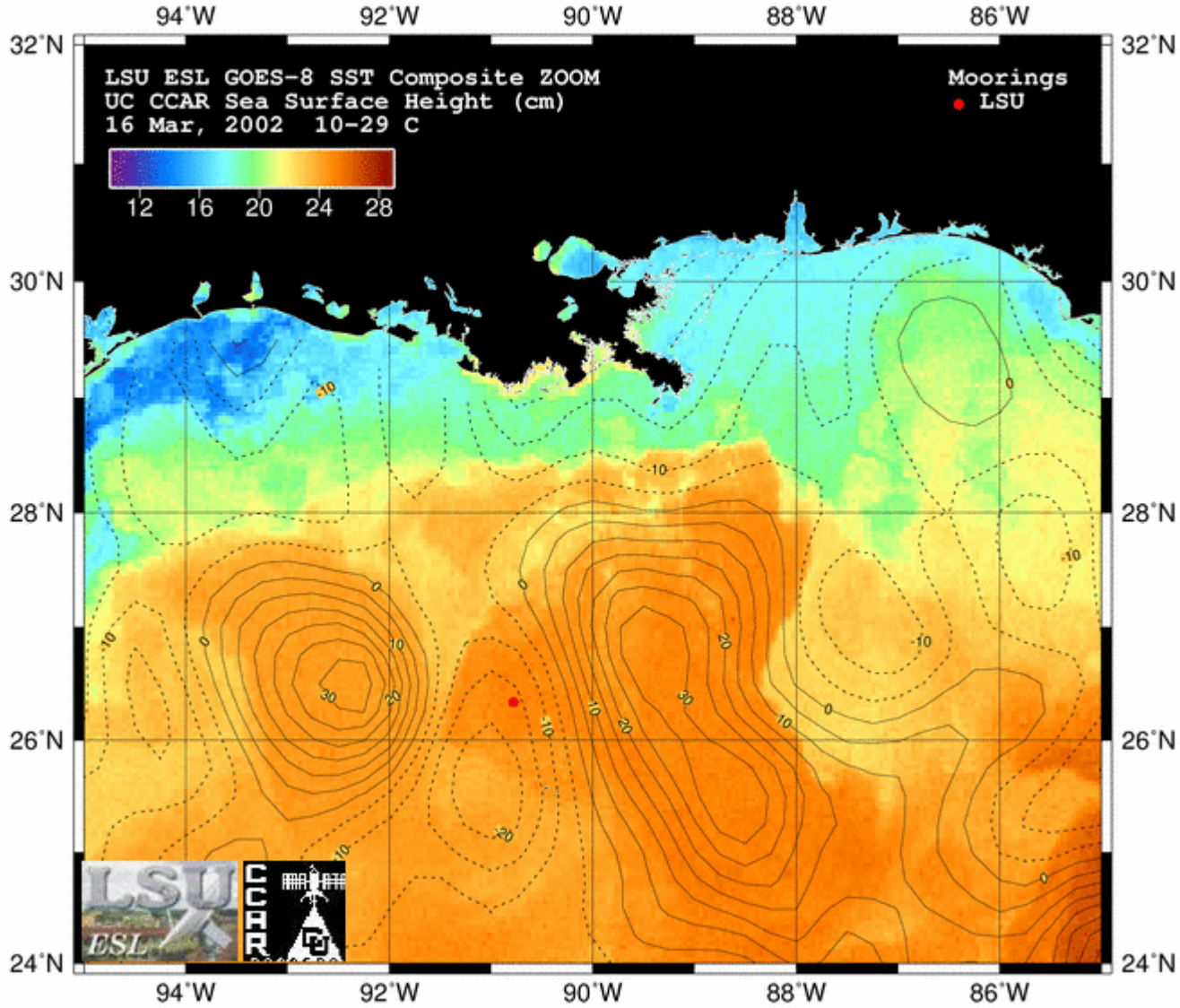


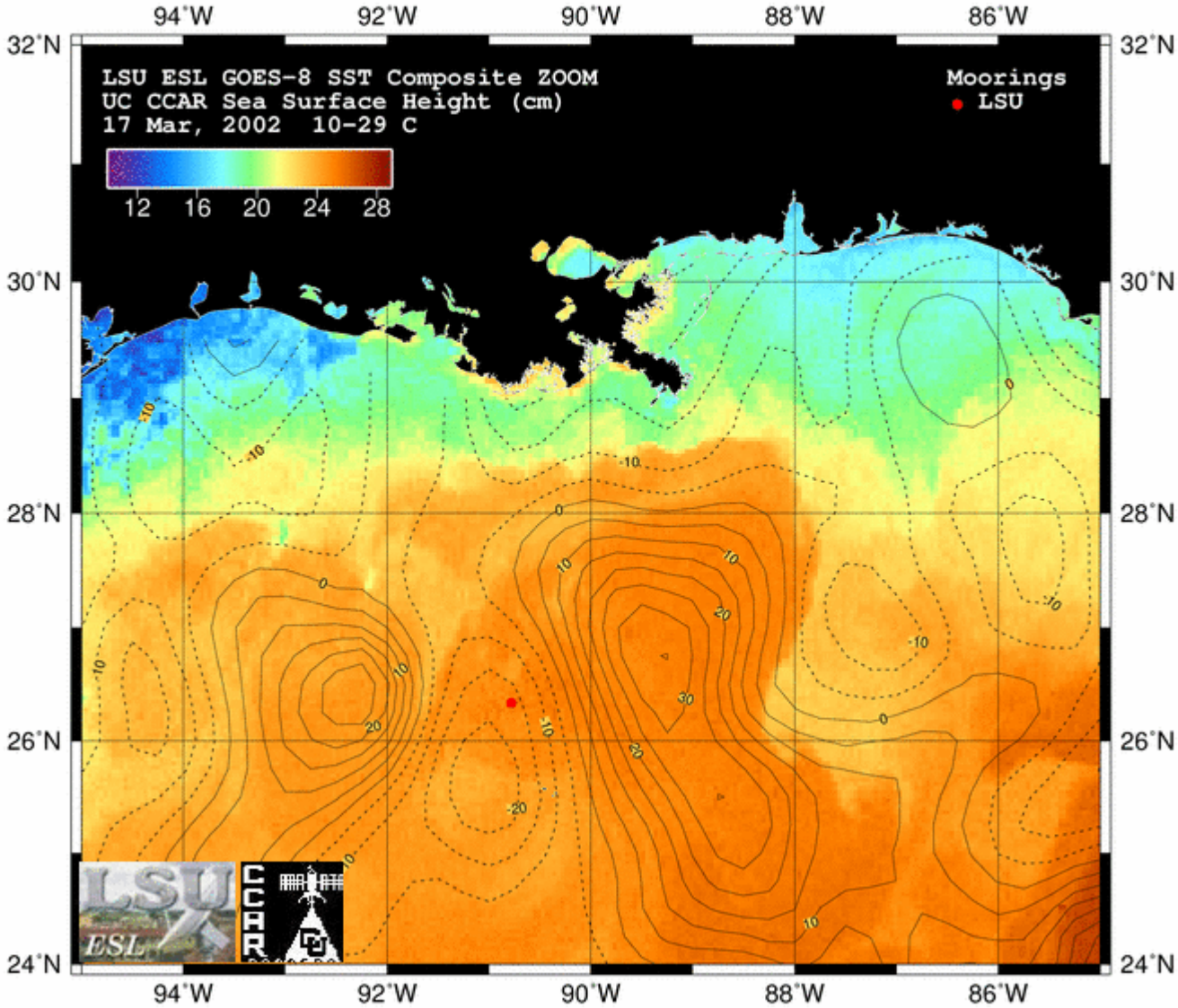


Intensification of a WCRFE over LSU mooring


LSU ESL GOES-8 SST Composite ZOOM
UC CCAR Sea Surface Height (cm)
14 Mar, 2002 10-29 C
12 16 20 24 28
Moorings
LSU
94°W 92°W 90°W 88°W 86°W
32°N 30°N 28°N 26°N 24°N
LSU ESL
CCAR


LSU ESL GOES-8 SST Composite ZOOM
UC CCAR Sea Surface Height (cm)
15 Mar, 2002 10-29 C
12 16 20 24 28
Moorings
LSU
94°W 92°W 90°W 88°W 86°W
32°N 30°N 28°N 26°N 24°N
LSU ESL
CCAR


LSU ESL GOES-8 SST Composite ZOOM
UC CCAR Sea Surface Height (cm)
16 Mar, 2002 10-29 C
12 16 20 24 28
Moorings
LSU
94°W 92°W 90°W 88°W 86°W
32°N 30°N 28°N 26°N 24°N
LSU ESL
CCAR

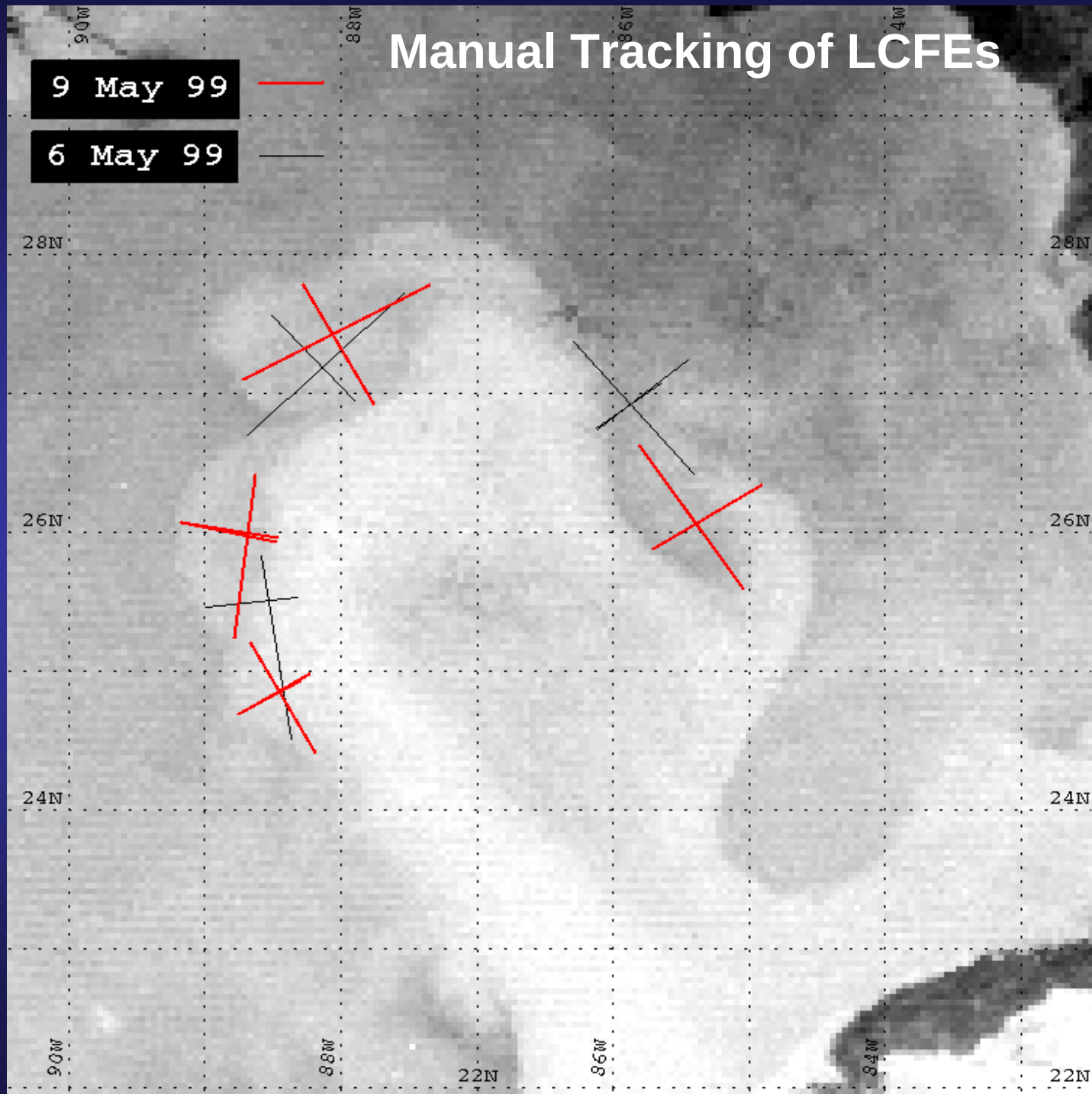

LSU ESL GOES-8 SST Composite ZOOM
UC CCAR Sea Surface Height (cm)
17 Mar, 2002 10-29 C
12 16 20 24 28
Moorings
LSU
94°W 92°W 90°W 88°W 86°W
32°N 30°N 28°N 26°N 24°N
LSU ESL
CCAR

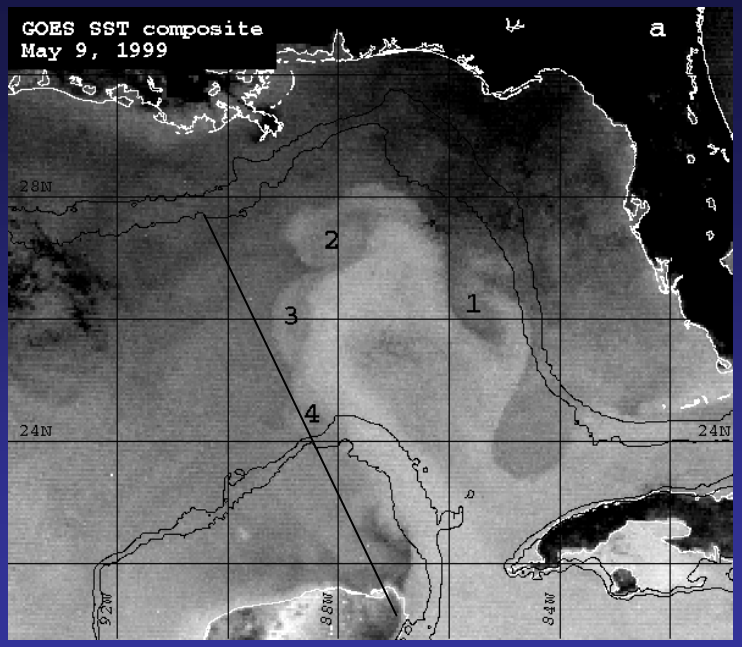
May 1999

Propagation Speeds:
*5–36 km/day

Dimensions:
*60–225 km

Typical Configuration:
*2 to 4

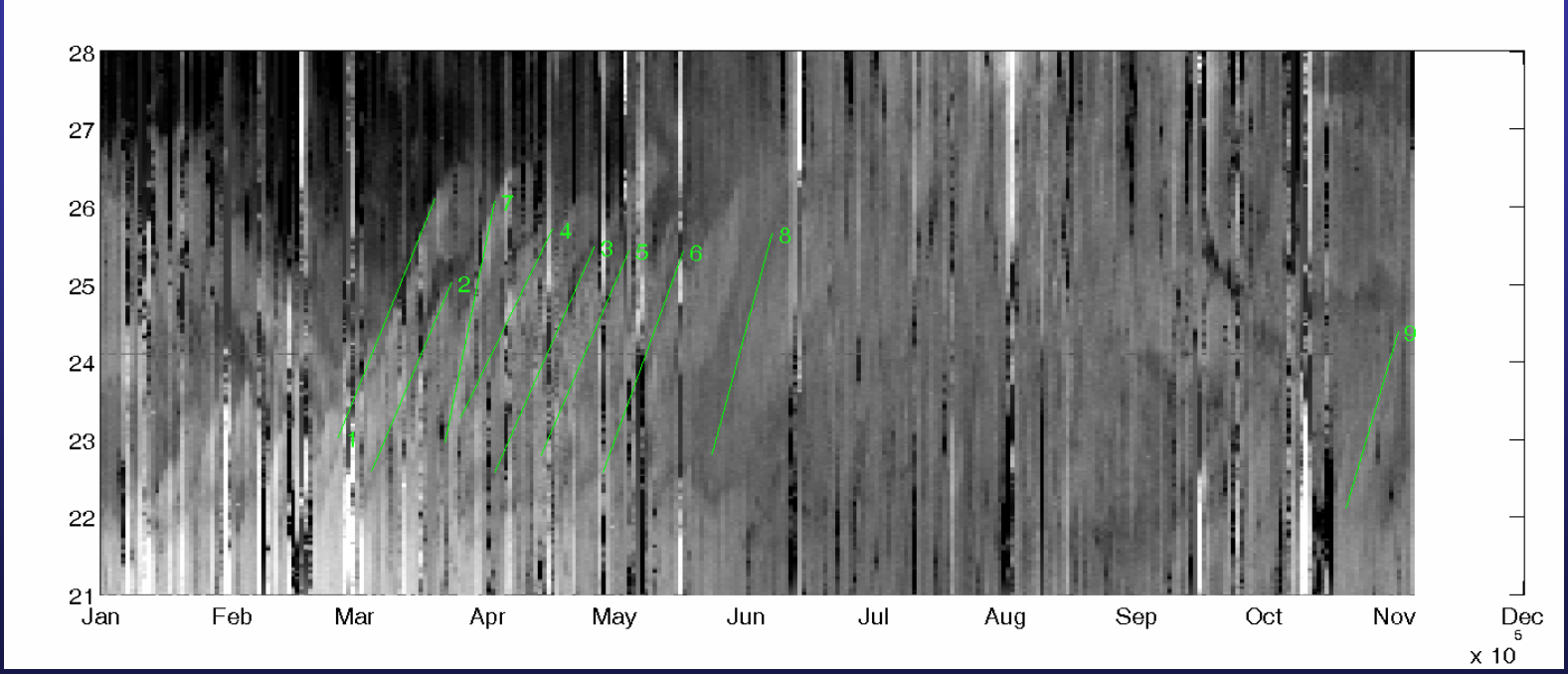




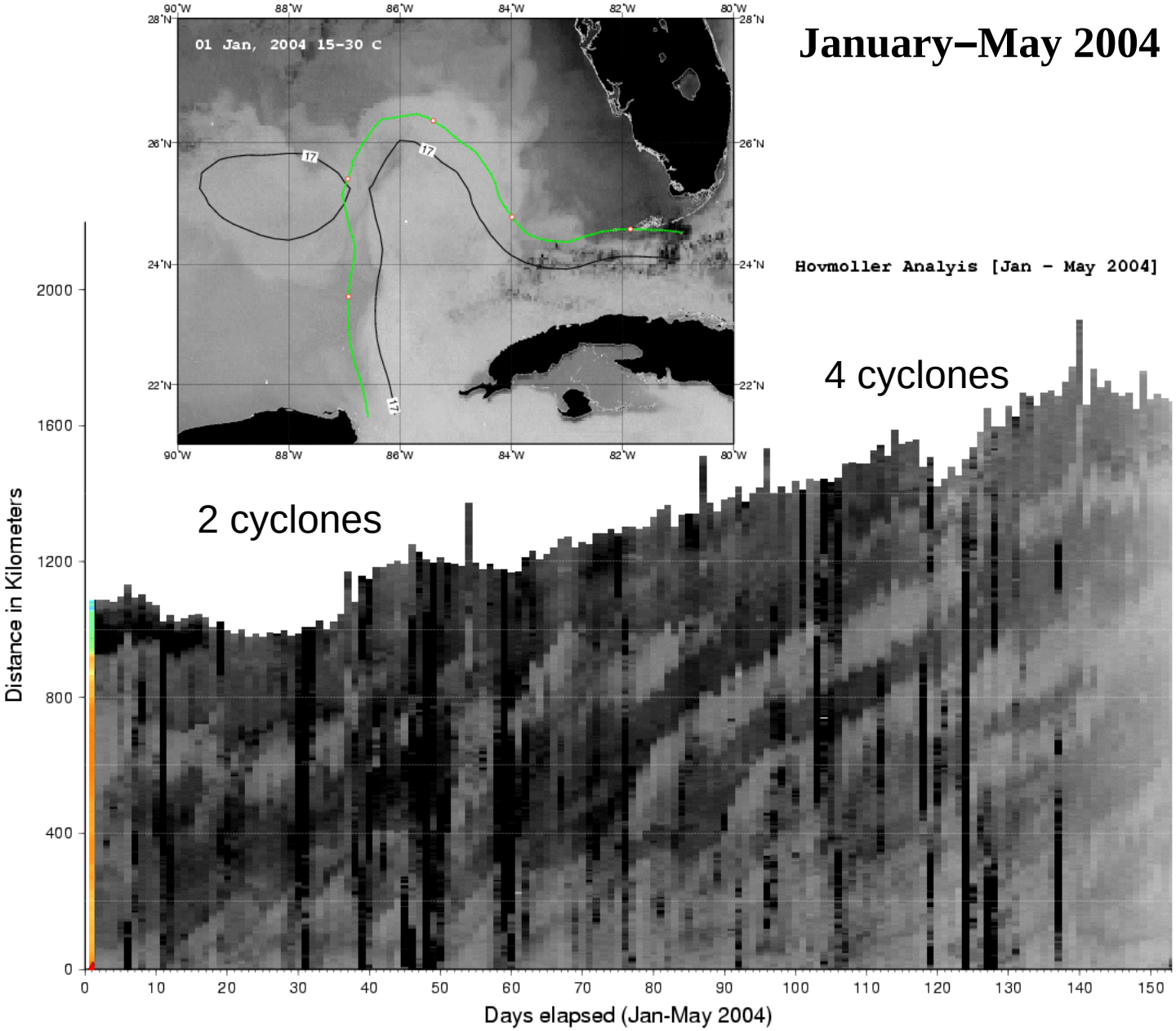
7–9 day Frequency

#1	16.836
#2	16.088
#3	15.441
#4	13.966
#5	15.861
#6	18.869
#7	33.458
#8	25.035
#9	23.179
Mean	20 km/day

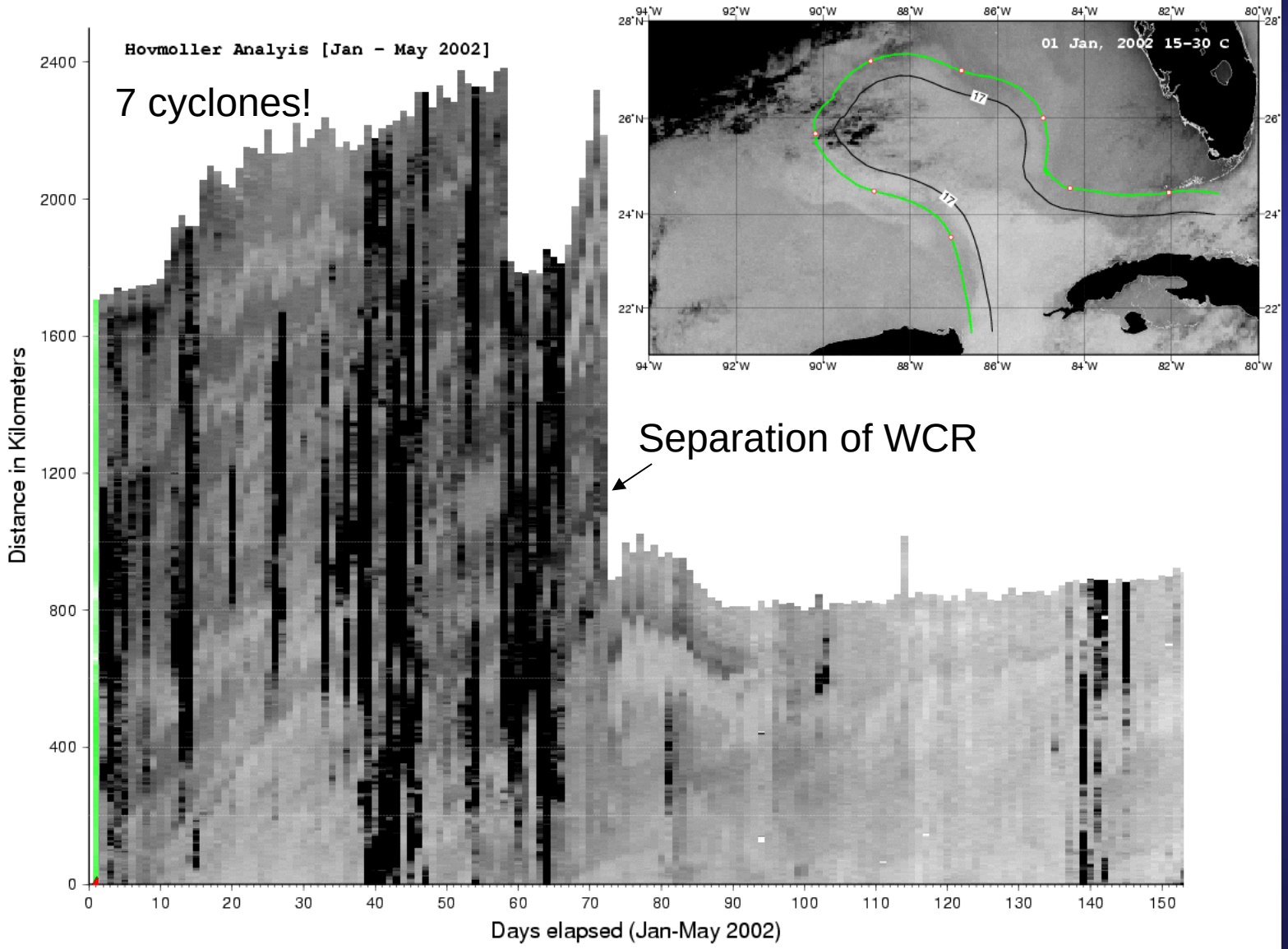
Hovmoller Diagram: Time/latitude plot of SST January–November 2004



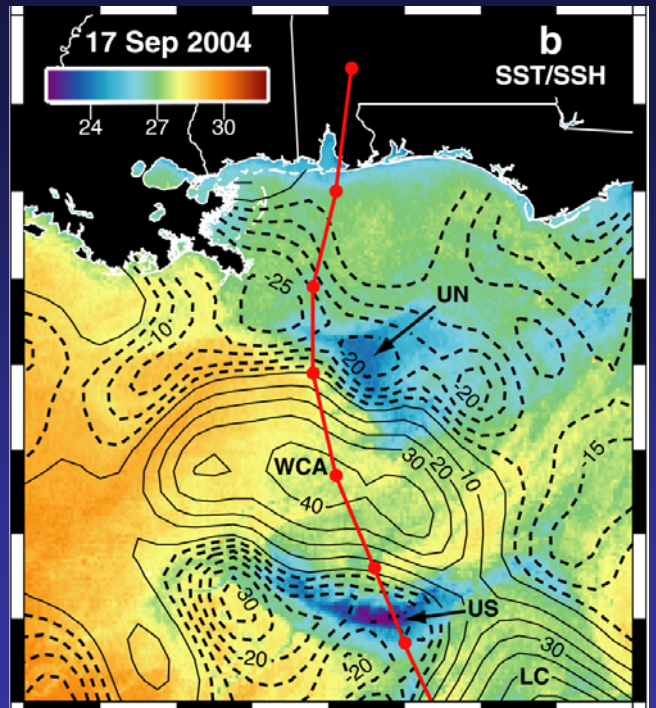
January–May 2004

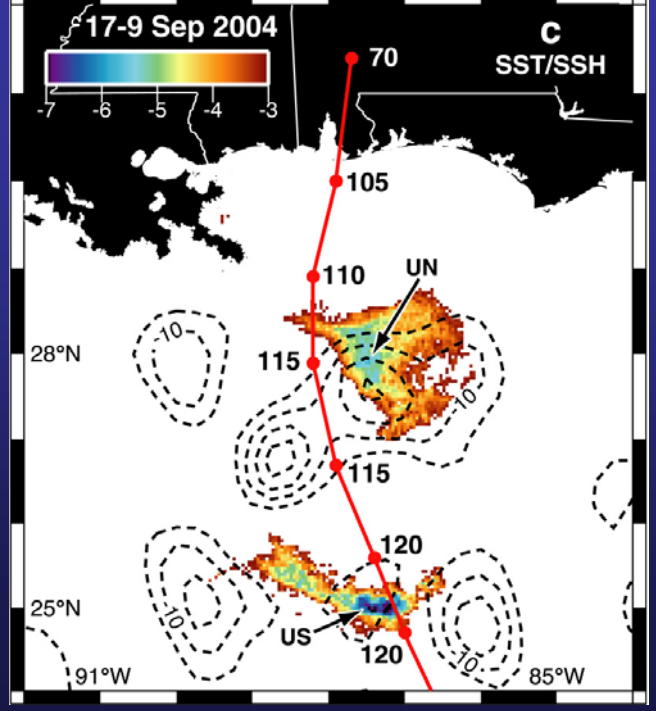


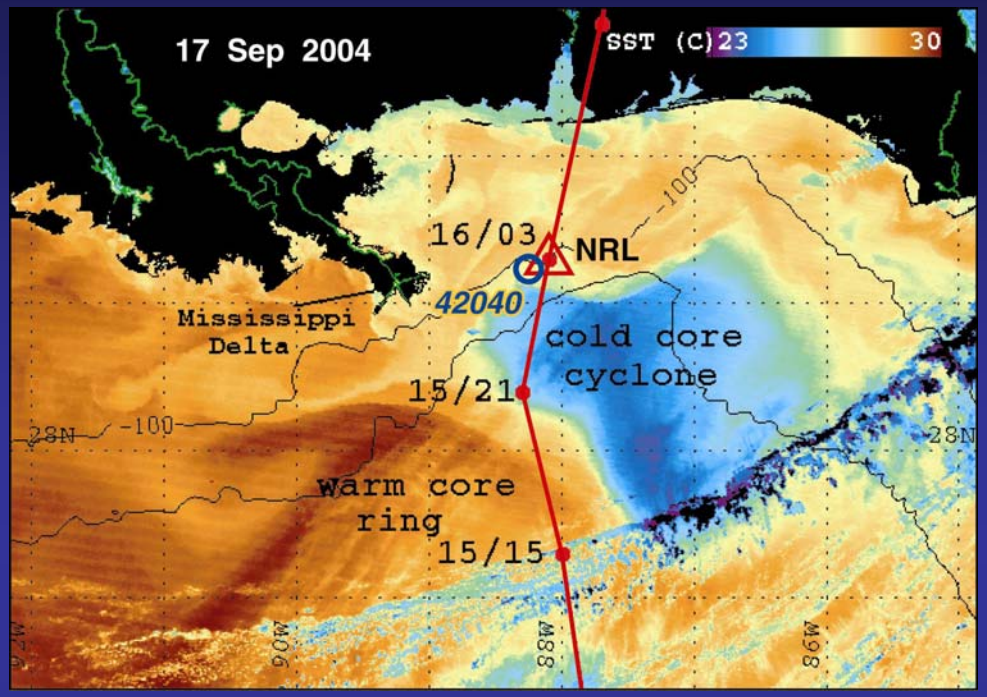
January–May 2002 Abnormal NW Intrusion of LC



Cyclones: important role in air-sea interactions during hurricane transits of Gulf of Mexico!







Observations and Preliminary Conclusions

- LCFEs and WCRFEs increase near surface velocities (100–175 cm/s).
- LCFEs/LC meanders can energize entire water column through divergence/convergence and upwelling/downwelling mechanisms.
- LCFEs develop rapidly to maximum dimensions north of the LC where stream path curvature induces relatively large vertical and lateral motion.
- LCFEs and WCRFEs play an important role in hurricane intensity changes!
- Automatic tracking procedures provide a useful technique for quantifying:
  - phase/ translation/propagation speed
  - frequency
  - dimensions
- Along-track SSH data in tandem with drifters and SST will enable quantifying intensity changes along the LC margin for selected time periods.

Acknowledgments

- MMS and LSU for funding
- Alaric Haag for GOES data capture
- LSU Earth Scan Laboratory student staff for GOES image processing
- CCAR staff for altimetry data processing

References

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Gilligan, M.J. and J. Blaha. 2003. Gulf of Mexico airborne survey, January 2000: Dynamic height determination using airborne expendable bathythermographs, Tech Note TN 01-03. Naval Oceanographic Office, Stennis Space Center, MS.