Loop Current Eddies (LCEs) interactions using HYCOM

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OUTLINE

- LCEs in the GOM and Research Questions
- Model Configuration & Isolated LCE initialization
- Results (model & satellite altimetry)
- Conclusions
- Acknowledgements
- Future plans

“LCEs are important in mass, heat, salt flux and regional currents in the GOM”

- Shedding from the Loop Current at ~10 months period
- Long standing warm-core eddy : ~ 2 years

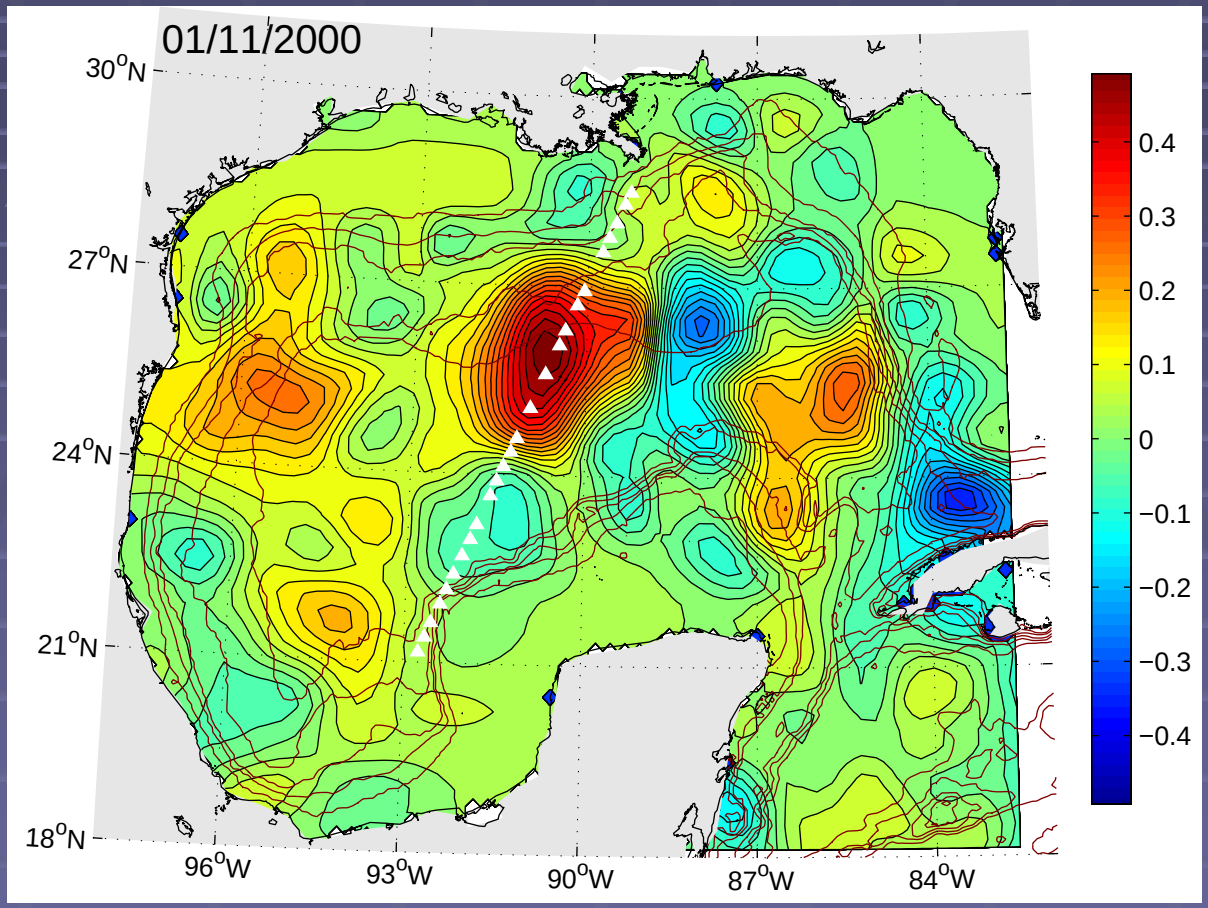
  - Horizontal scale : ~300 km - Vertical depth: ~1000 m
- Bimodal path : southwestward, westward at 2-5 km/day

Research Questions

- How the LCEs interact with anticyclonic, cyclonic eddies and both?
- What is the subsequent evolution?

LCEs from satellite altimetry

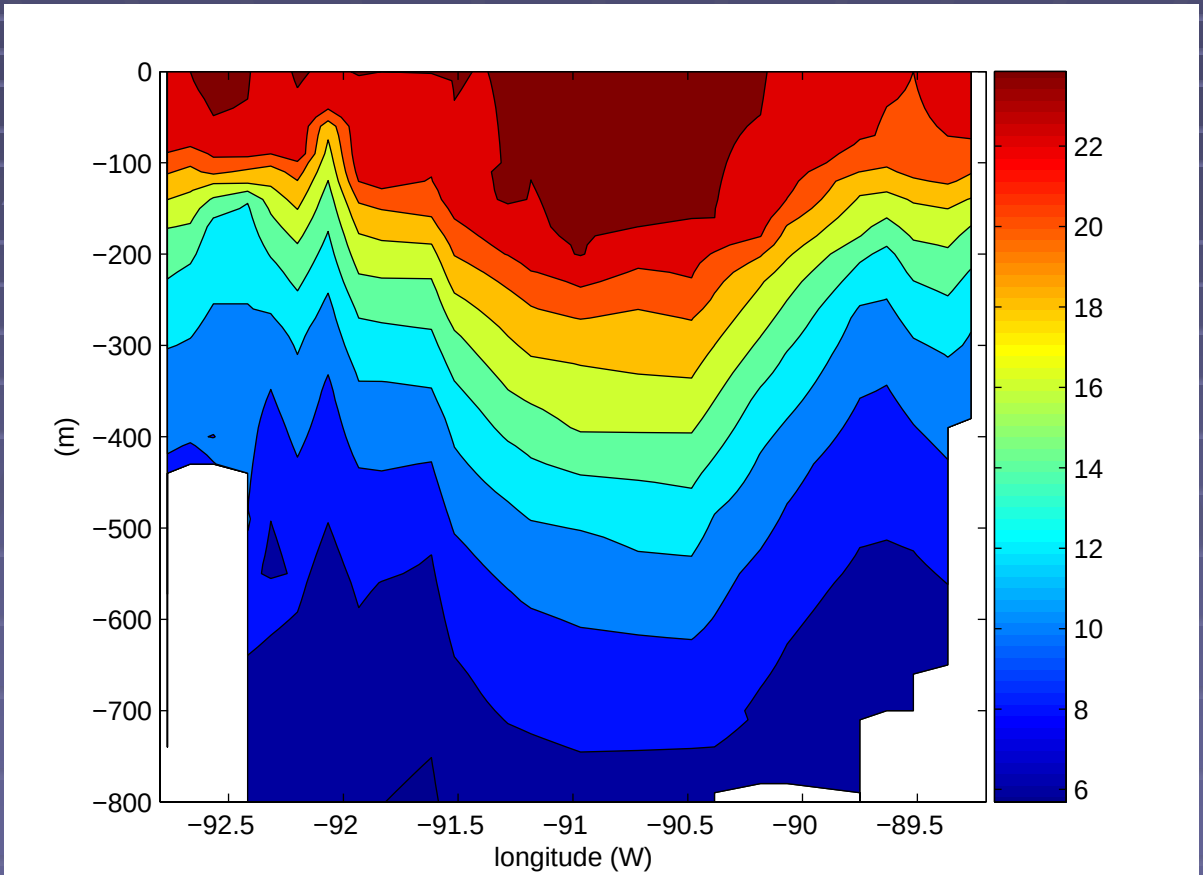
SSH anomaly in 11 January 2000 from MODAS



- Horizontal scale: ~ 350 km
- Height difference between the center and the rim: ~50 cm

LCE Vertical Structure

Temperature in January 2000 from NODC GTSPP

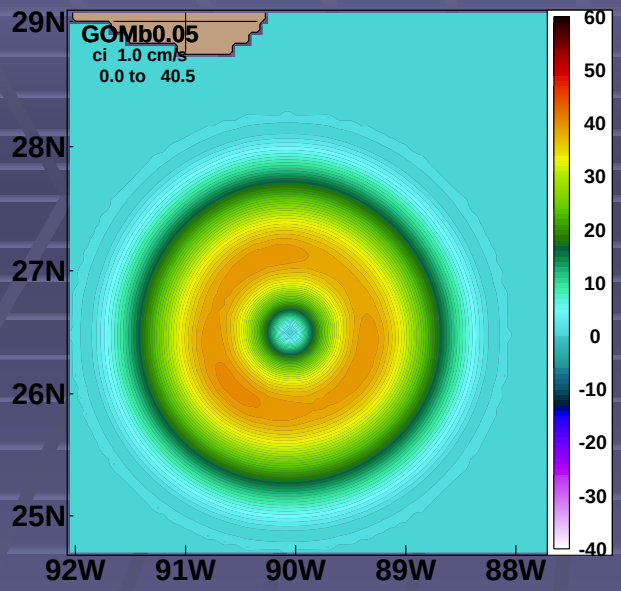


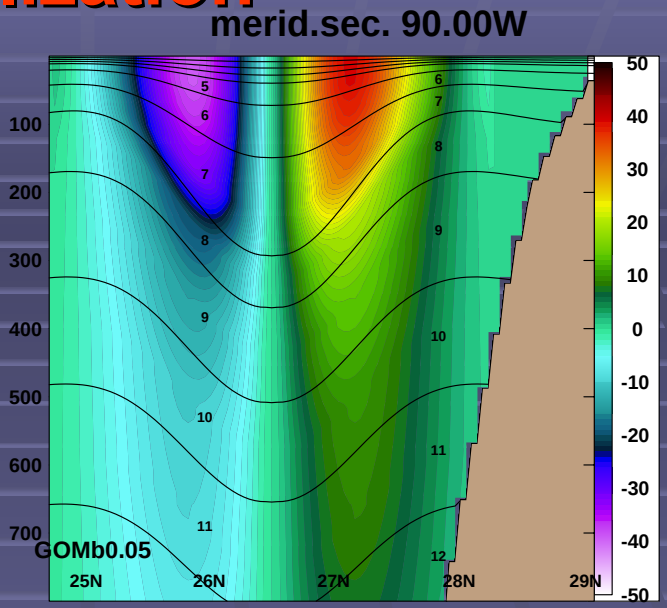
- Vertical scale: ~1000 m
- Interface depth difference: 200-300 m
- Temperature difference : 5°C at 200m

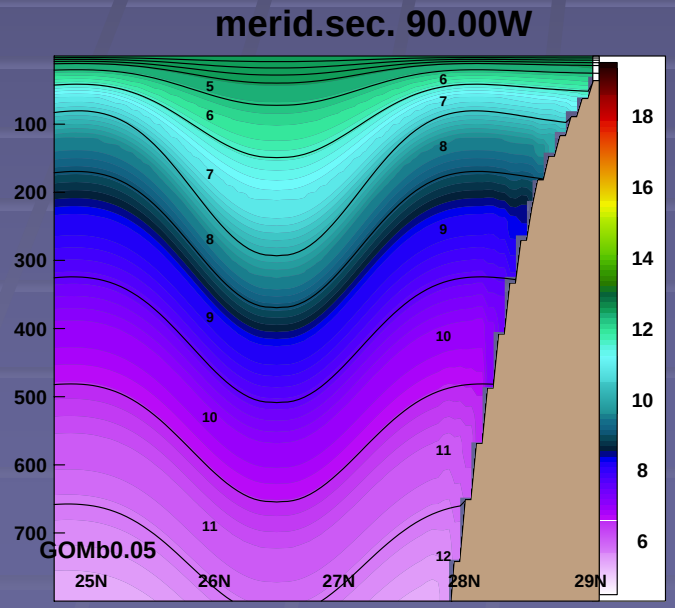
Model configuration

- HYCOM Model (http://hycom.rsmas.miami.edu)
  - 3-d primitive equation model
  - sigma-z-rho Hybrid coordinate model (Bleck&Boudra 1981)
  - designed for accurate transition from deep to shallow water
  - developed by NOPP and HYCOM consortium
- Model Domain
  - GOM bathymetry from ETOPO5
  - 1/20^{o} grid resolution (5 km)
- Stratification
  - 14 vertical layers from GDEM climatology (Teague et al. 1990)
  - horizontally uniform density distribution
- No wind/surface forcing
- No Lateral Boundary forcing
- Satellite altimetry by MODAS
- Eddy Tracking based on max/min SSH for a given eddy

Isolated LCE Initialization

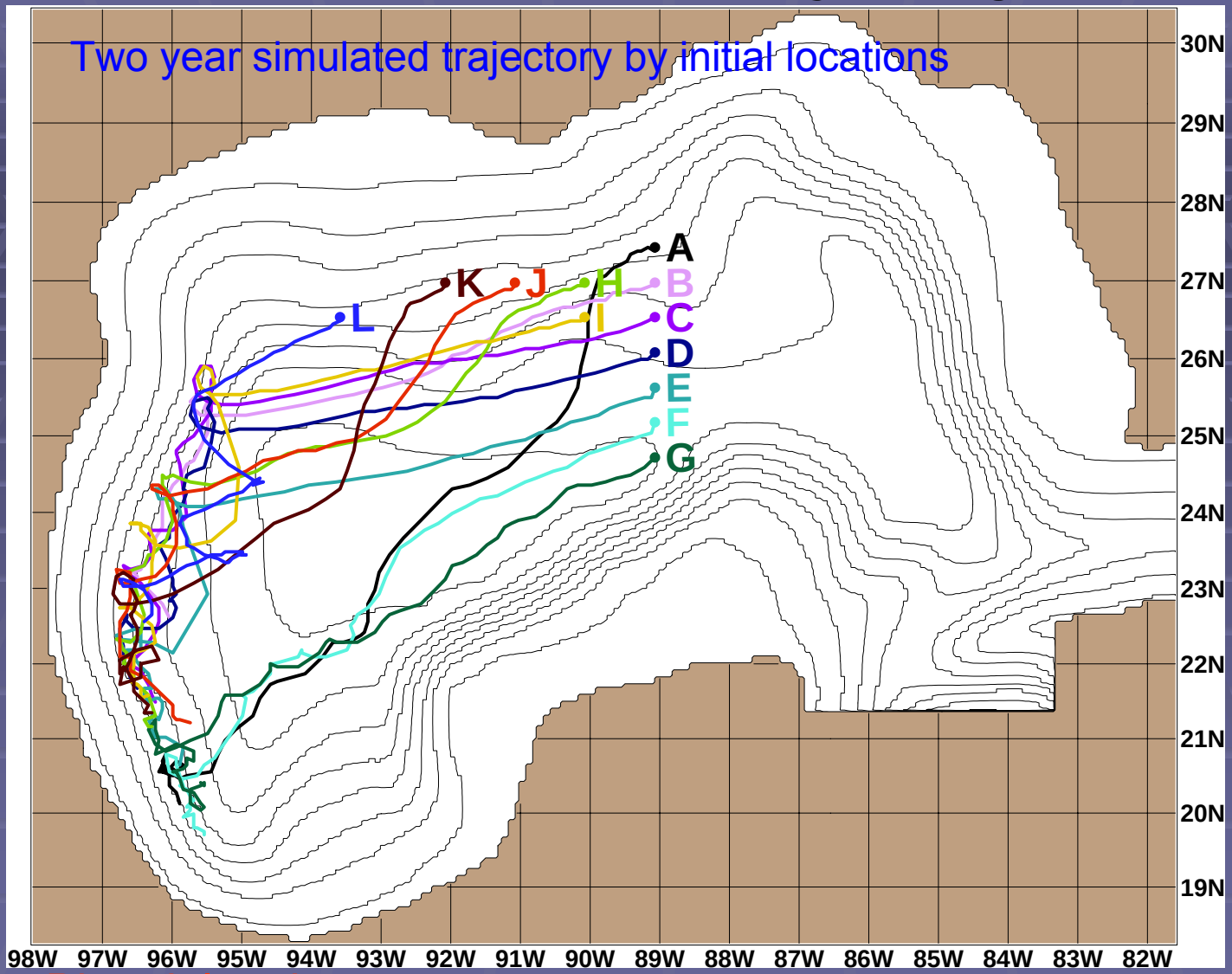






- Herbette et al. (2003, JPO)
- geostrophic current & layer thickness calculated
- Initial diameter = 320 km
- Max swirl speed=40 cm/s
- Interface depth deference between the center and the rim=~200m

Isolated LCE trajectory



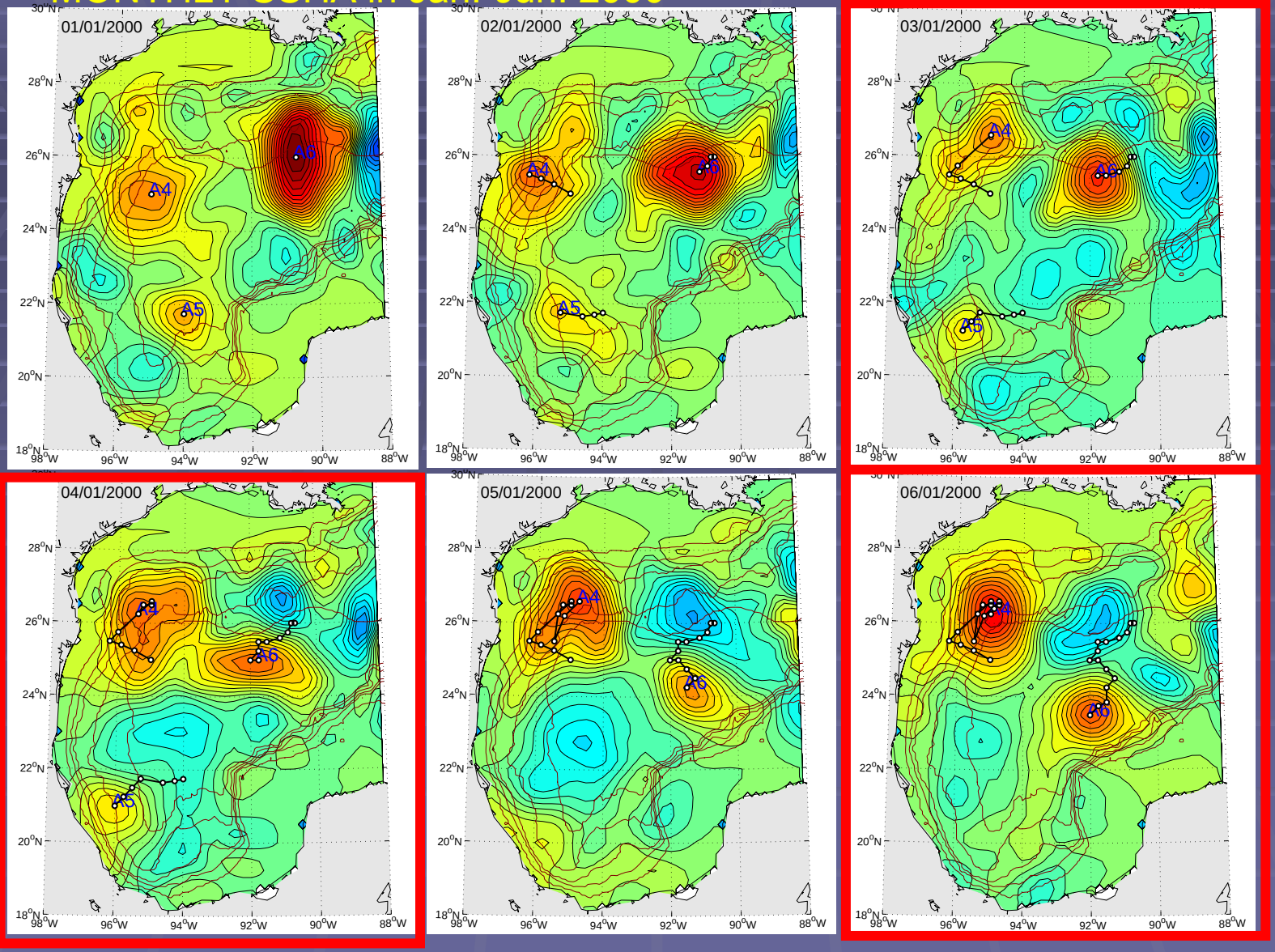
- Bimodal path

  - southwestward: interaction with topography and the trailing cyclone

  - westward: cross the central portion without interaction

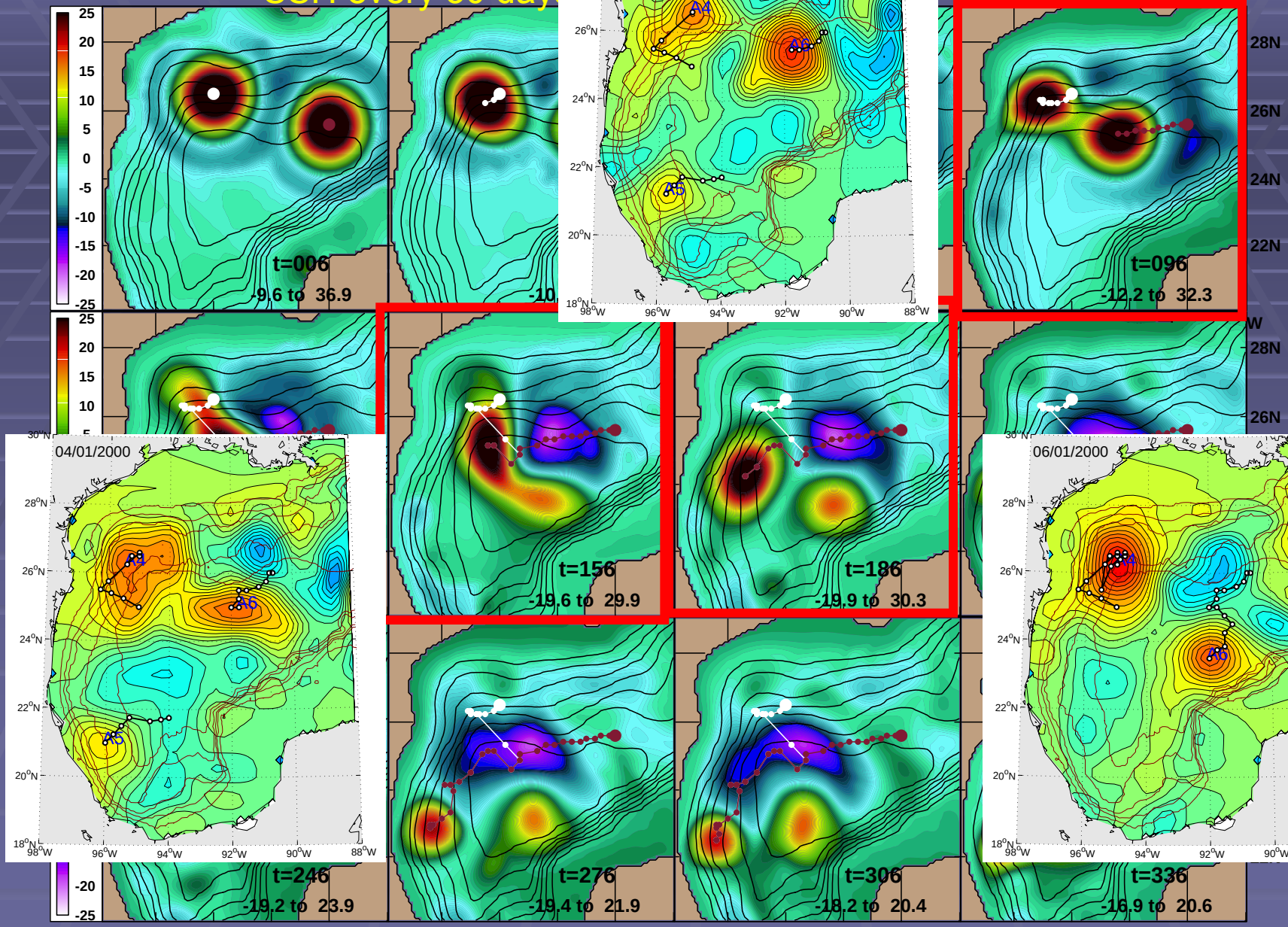
LCE-LCE interaction

MONTHLY SSHA in Jan.-Jun. 2000



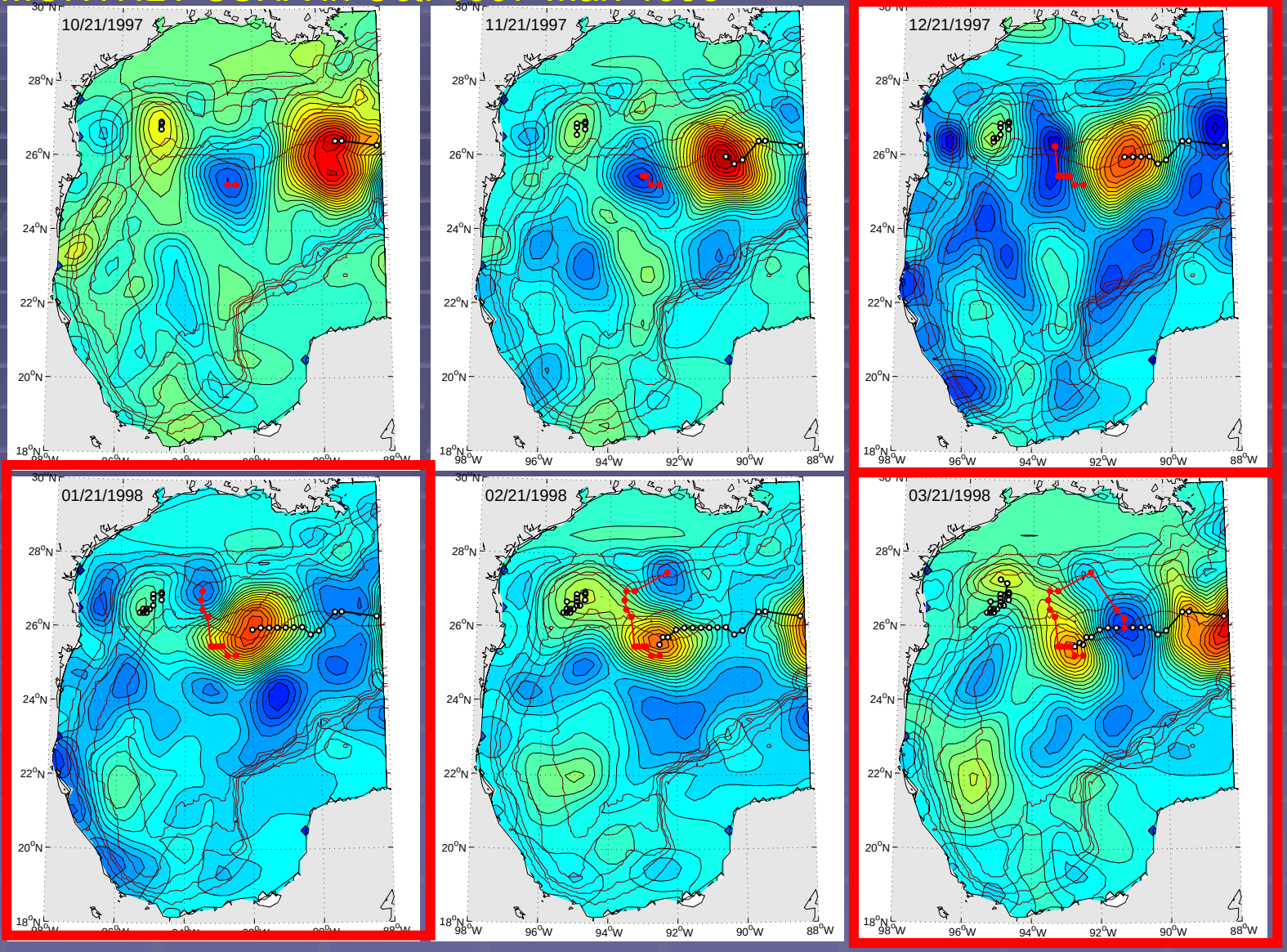
A

SSH every 30 days

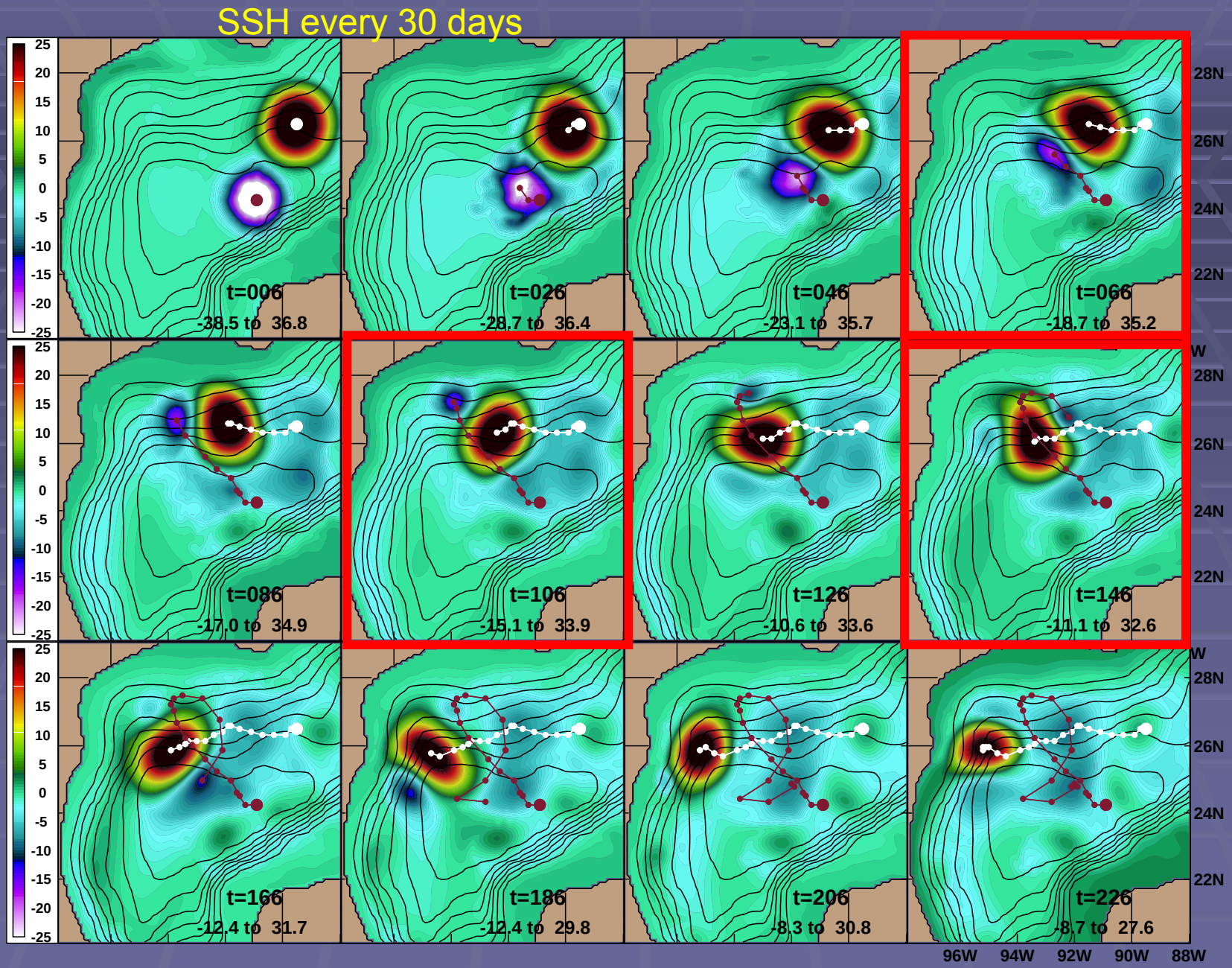


Cyclone-LCE interaction

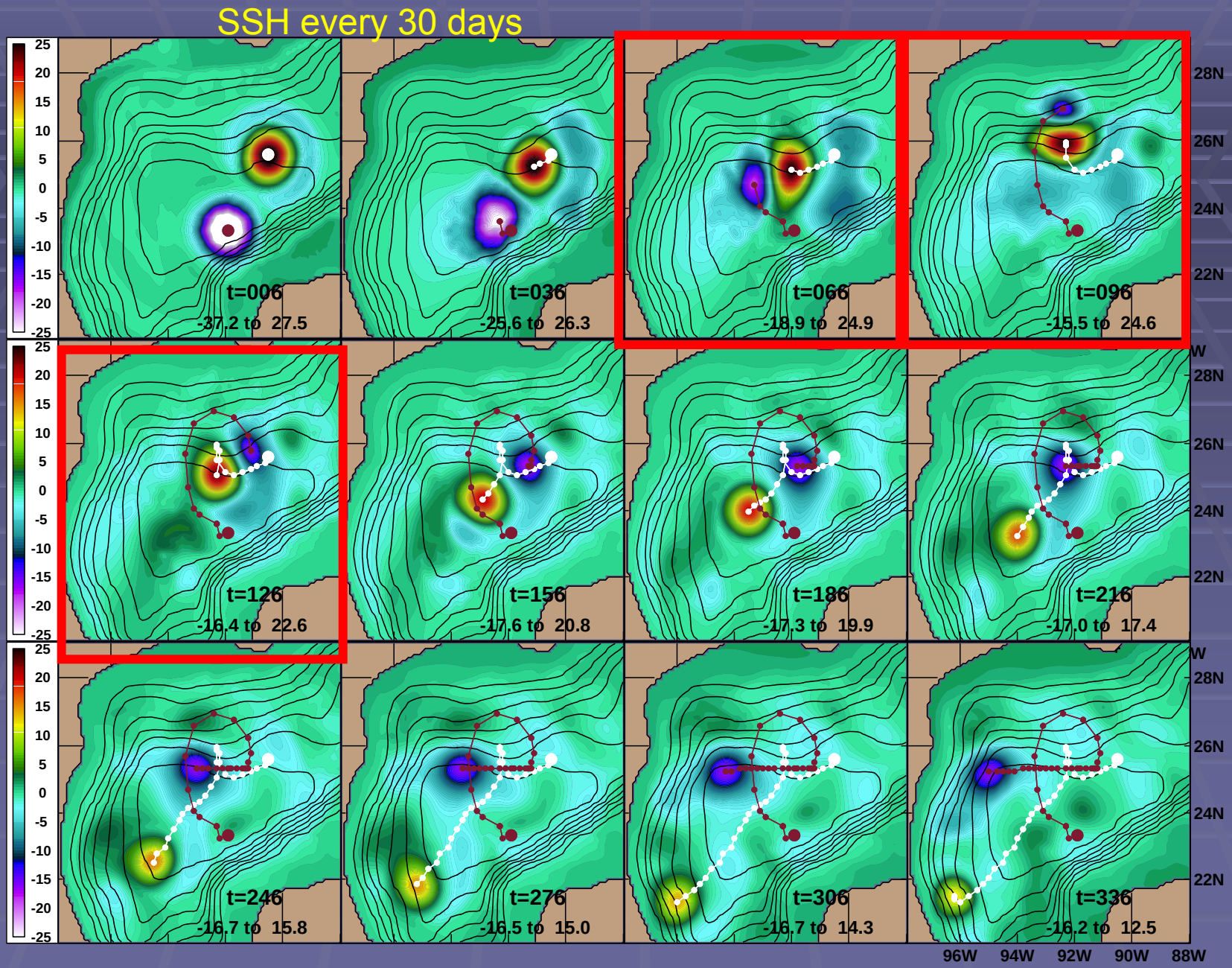
MONTHLY SSHA in Oct. 1997-Mar. 1998



CA interaction

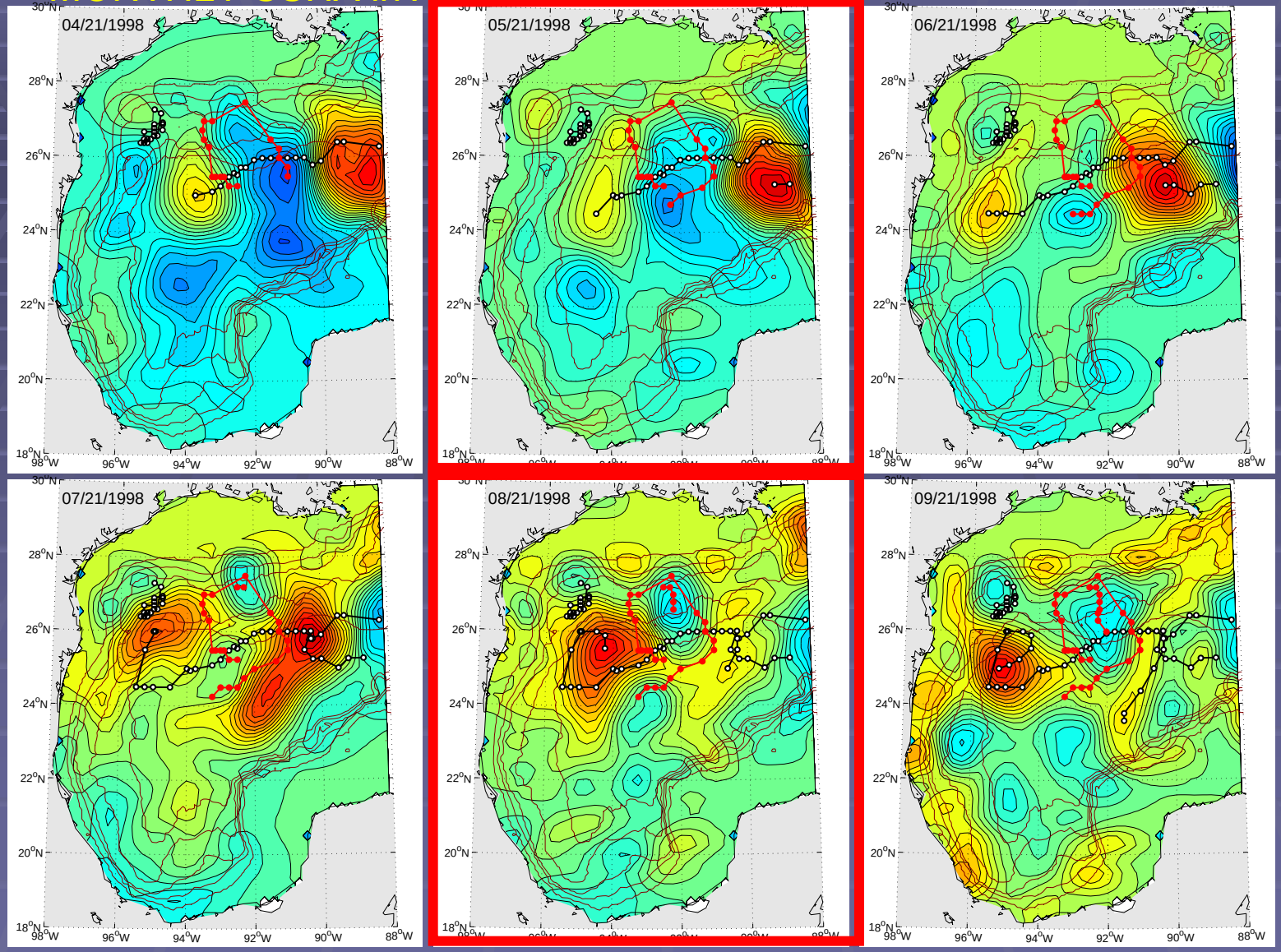


CA interaction

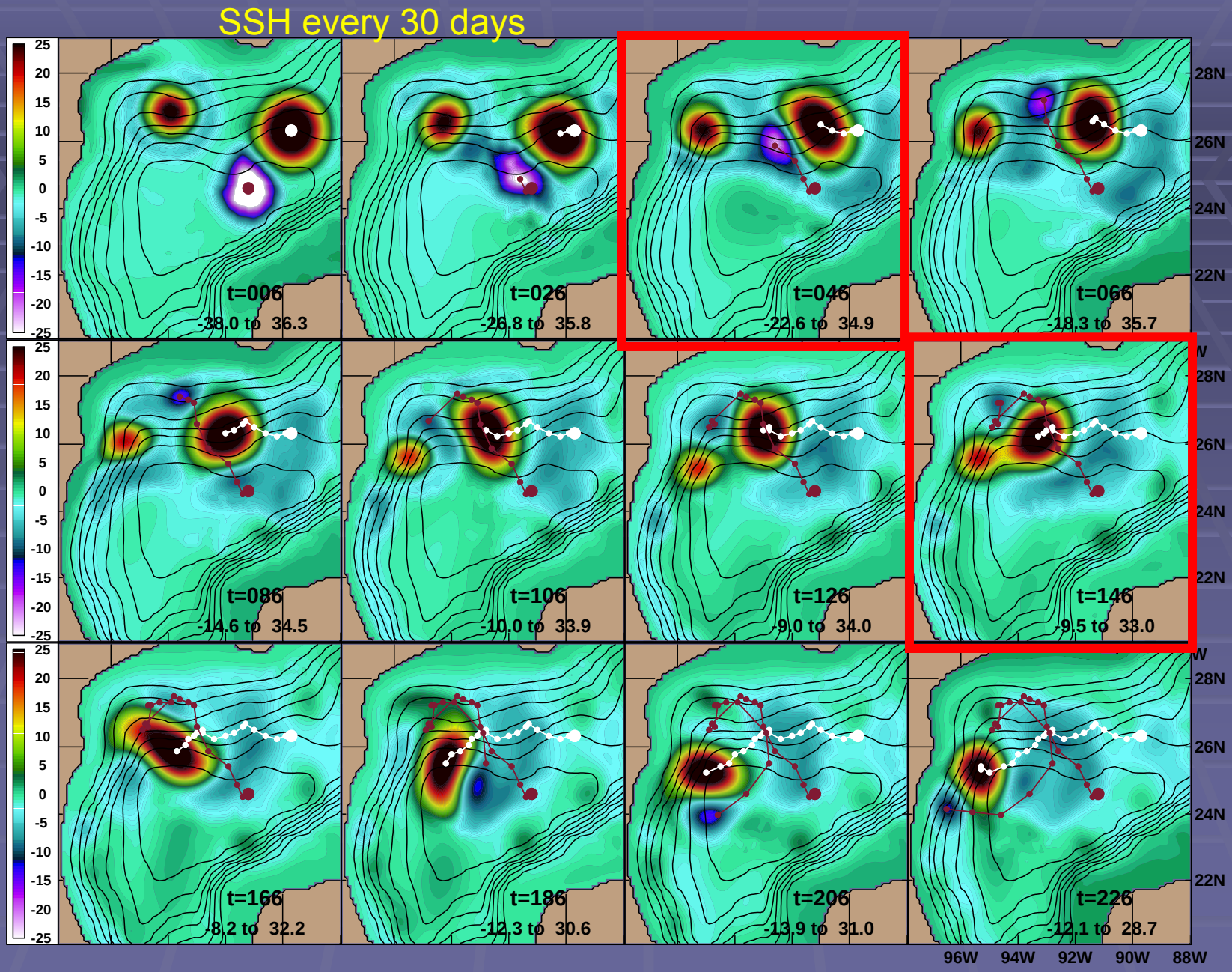


LCE-cyclone-LCE interaction

MONTHLY SSHA in Apr -Sep, 1998



ACA interaction



Conclusions

- Bimodal paths of isolated LCEs
  - southwestward by interaction with topography & trailing cyclone
  - westward path without interactions
- AA interaction
  - merging by LCE stalling at the northwest corner
  - splitting by cyclone to the north which induces eastward translation
- CA interaction
  - northward translation by the cyclone to the west
  - cyclone circles around the LCE
- ACA interaction
  - merging, splitting, cyclone circling occur simultaneously

Acknowledgements

- HYCOM Developing Group
- Dr. Wallcraft (NRL) for HYCOM setup and plotting package
- Dr. Herbette (UMR, France) for vortex initialization code
- Dr. Barron (NRL) for MODAS data
- Support by SEED and other projects

Future plans

- Combined Effect of topography, forcing, stratification, current
- Comparison with other models (ROMS)
- GOM circulation comparison between ROMS and HYCOM