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Mechanisms Controlling Hypoxia: Update and Plans for 2013

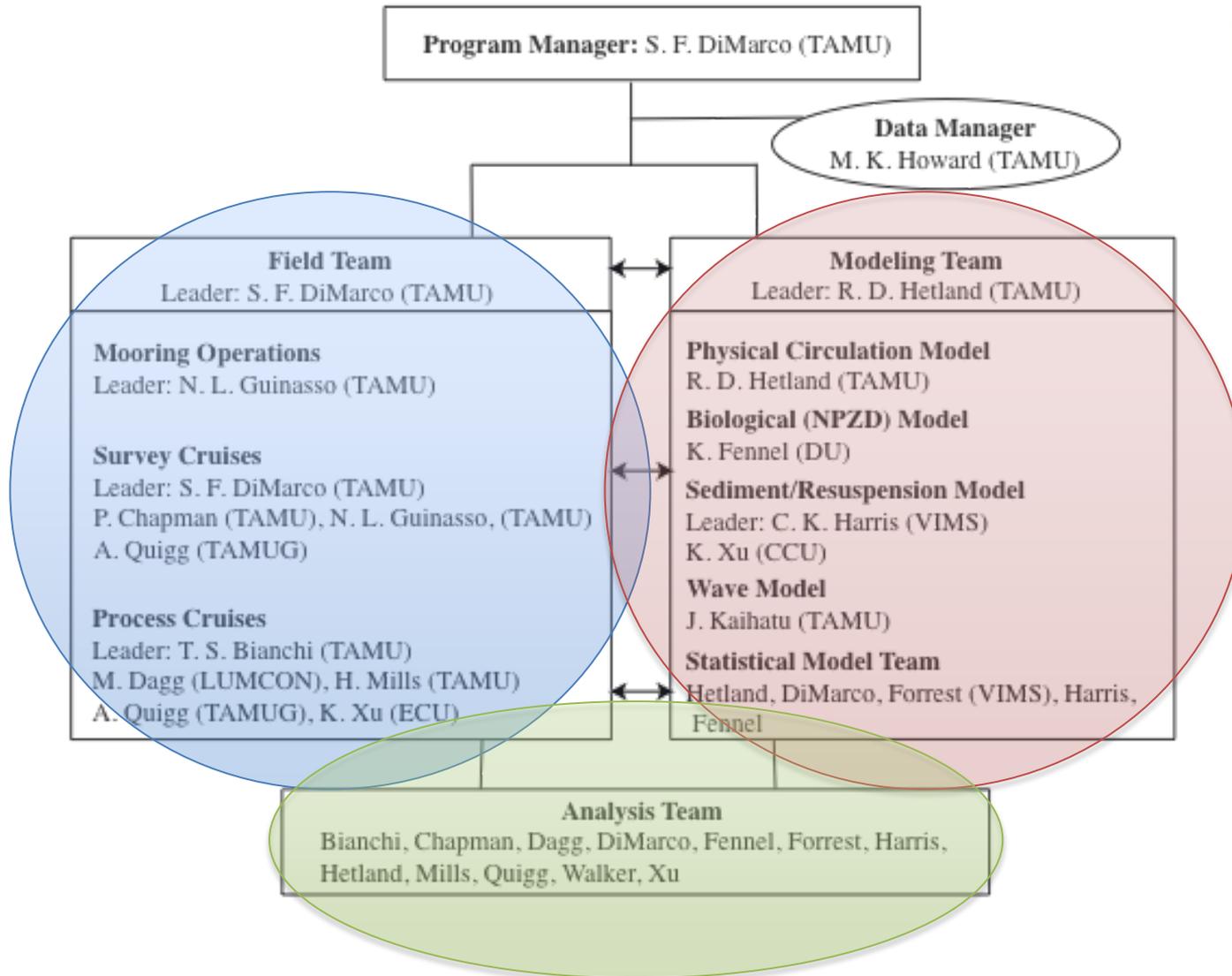
Steven F DiMarco

Department of Oceanography
Texas A&M University

Forum for Gulf of Mexico Hypoxia Research
Coordination and Advancement

Stennis Space Center
17-19 April 2013

Project Management



MCH Objectives



The scientific objectives are to investigate:

- (i) how wind, river discharge, and currents affect stratification over the Texas-Louisiana Shelf;
- (ii) how water column processes, organic and nutrient inputs, and benthic oxygen demand vary along the shelf from the Mississippi River Delta to coastal Texas; and
- (iii) to enhance a realistic coupled physical-biological-geochemical numerical model of the northeastern Gulf of Mexico with integrated and coupled surface gravity waves, and a diagenetic model of the upper seabed.

MCH Outcomes Summary



- NOAA Center for Sponsored Coastal Research
 - 2003-2007: NA03N0S4780039 (5 PIs)
 - 2006-2010: NA06N0S4780198 (7 PIs)
 - 2009-2014: NA09N0S4780208 (14 PIs)
- 21 Process Cruises: 2003-2012
- Six Survey Cruises: 2010-2012
- Annual Mooring Deployments
 - Two locations: South Marsh, LA, and Galveston TX
- Website
 - hypoxia.tamu.edu

Accomplishments 2012

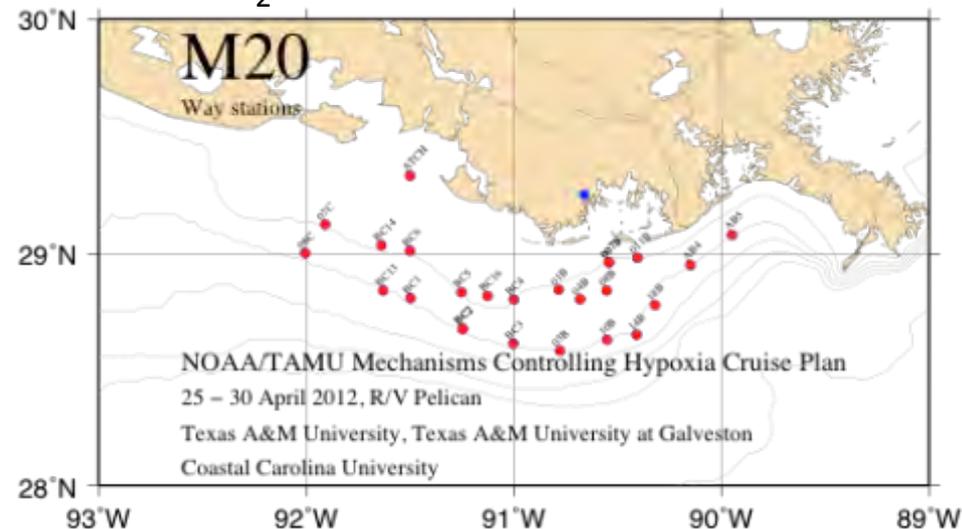


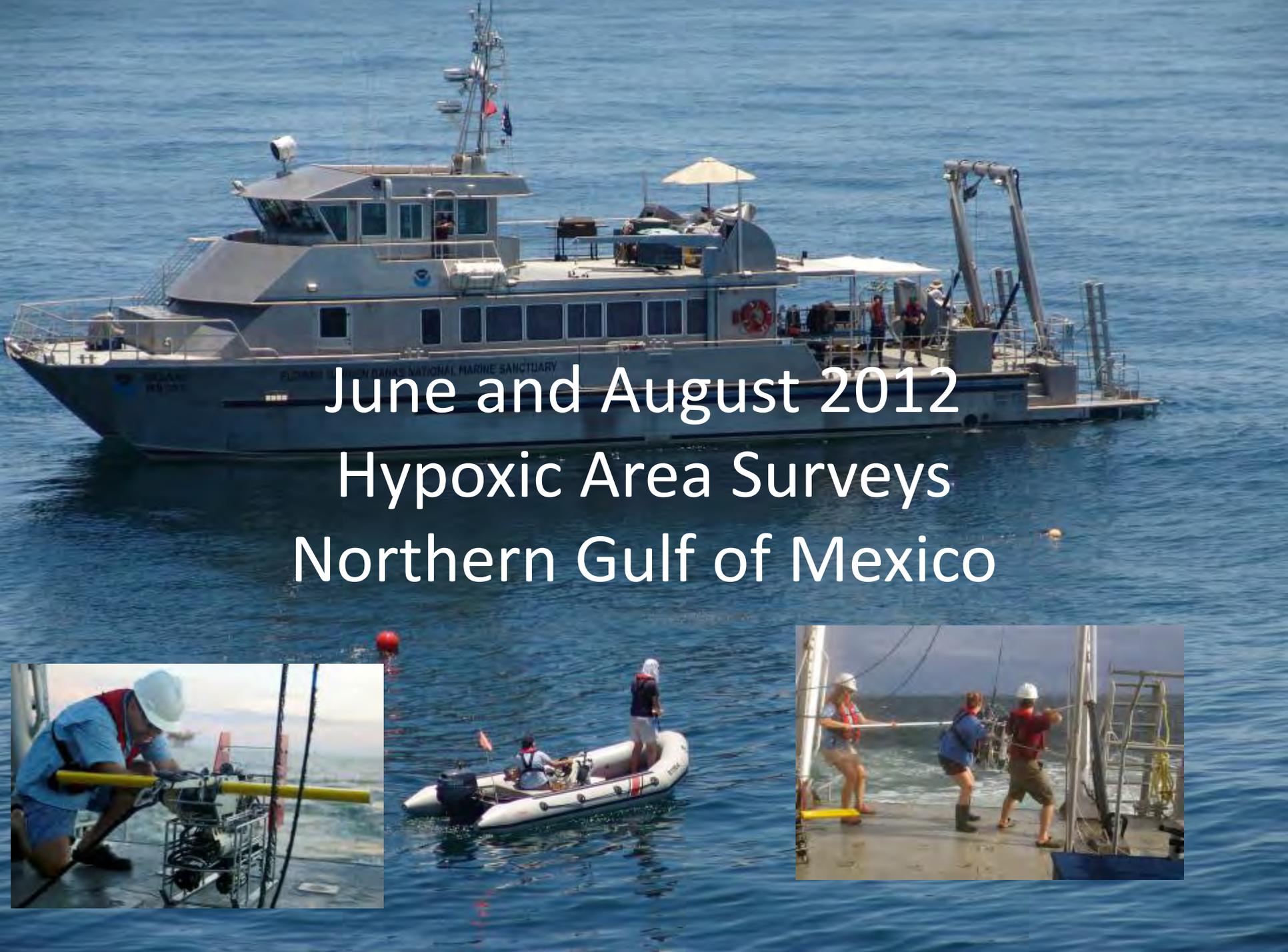
- Process Cruises 2012
 - April (M20)
 - R/V Pelican, Chief Scientist: A Quigg (TAMU-G)
 - August (M21)
 - R/V Pelican, Chief Scientist: A. Quigg (TAMU-G)
- Survey Cruises 2012
 - June (MS05)
 - R/V Manta, Chief Scientist: S. DiMarco (TAMU)
 - August (MS06)
 - R/V Manta, Chief Scientist: S. DiMarco (TAMU)
- Analysis and Publications

Survey Cruises



- Cruise plan April (M20) and August (M21)
- Objectives
 - to conduct 24-hour microbial, zooplankton, phytoplankton, DOC/POC, sediment, and biomarker process measurements at 4 stations;
 - to obtain a series of box-cores for GUST sediment erodibility measurements;
 - to obtain zooplankton and phytoplankton flux measurements;
 - to obtain microzooplankton DNA data
 - to obtain alkalinity and DIC data to estimate CO₂ fluxes
 - to collect hydrography data

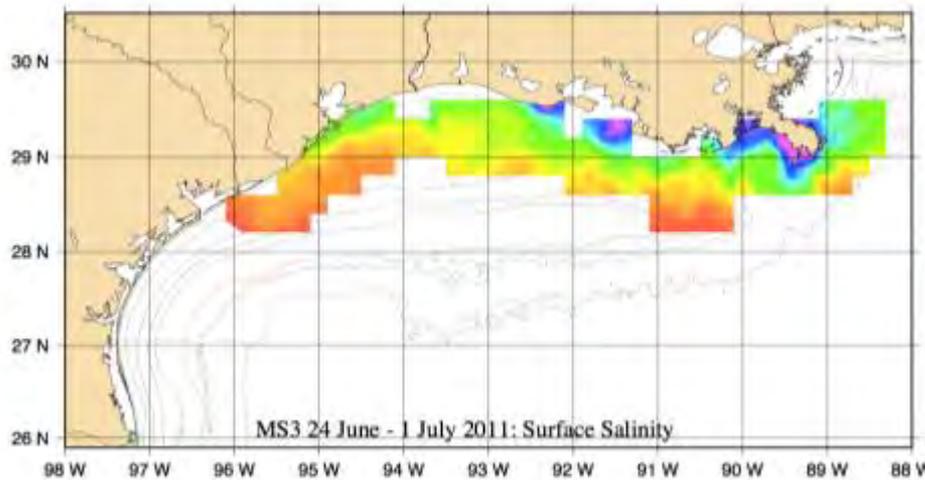




June and August 2012 Hypoxic Area Surveys Northern Gulf of Mexico

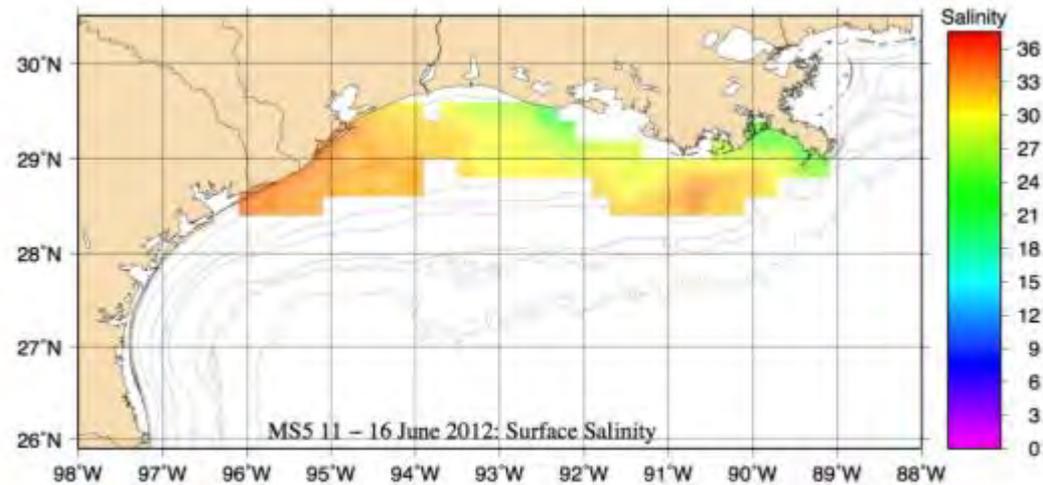


Surface Salinity 2011 versus 2012

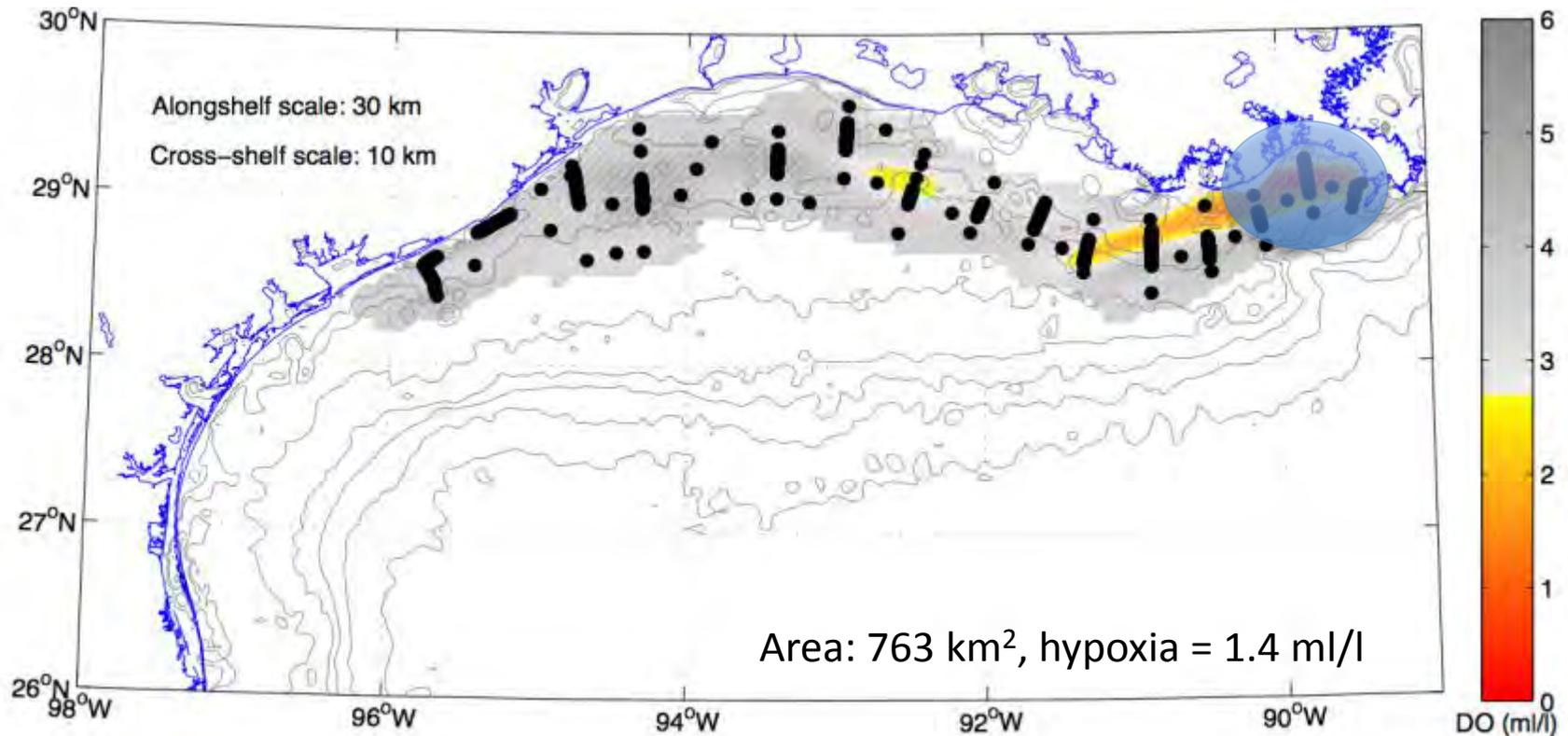


June 2011: Mississippi River Flood

June 2012: Drought



11-16 June 2012



SeaSciences Acrobat towed vehicle



- Sea Sciences Acrobat. Undulating towed body. Sensors: Seabird CTD, SBE43 Oxygen sensor, Wetlabs FLNTB fluorometer and turbidity sensor.
- A RINKO fast-response oxygen sensor (on loan from Rockland Oceanographic Services) will be integrated into the CTD system.
- Winch system, Computer logging system. Tracking pinger, depth finder (optional).
- Flow-through system: thermosalinograph, Chelsea fluorometer. Debubbler, associated hoses, clamps, logging computer.



Acrobat Recovery

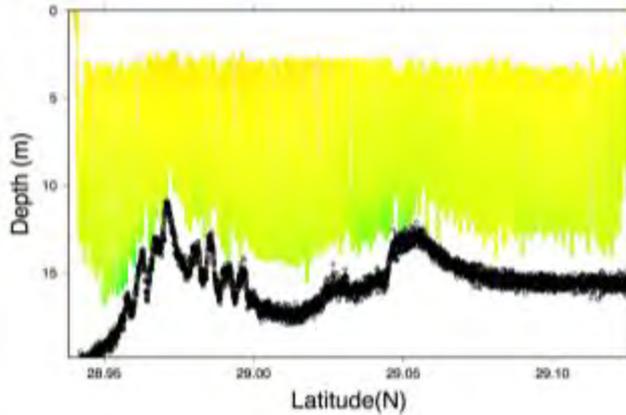


Acrobat Deployment

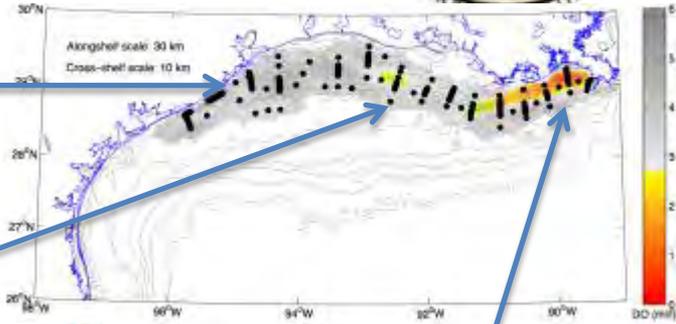




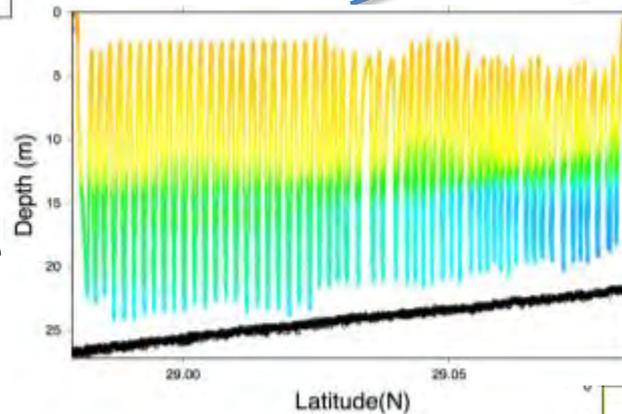
Oxygen Transects June 2012



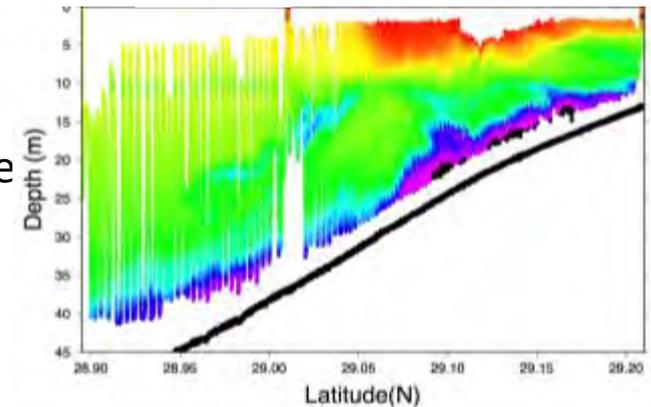
Galveston: no halocline,
Well-mixed water column



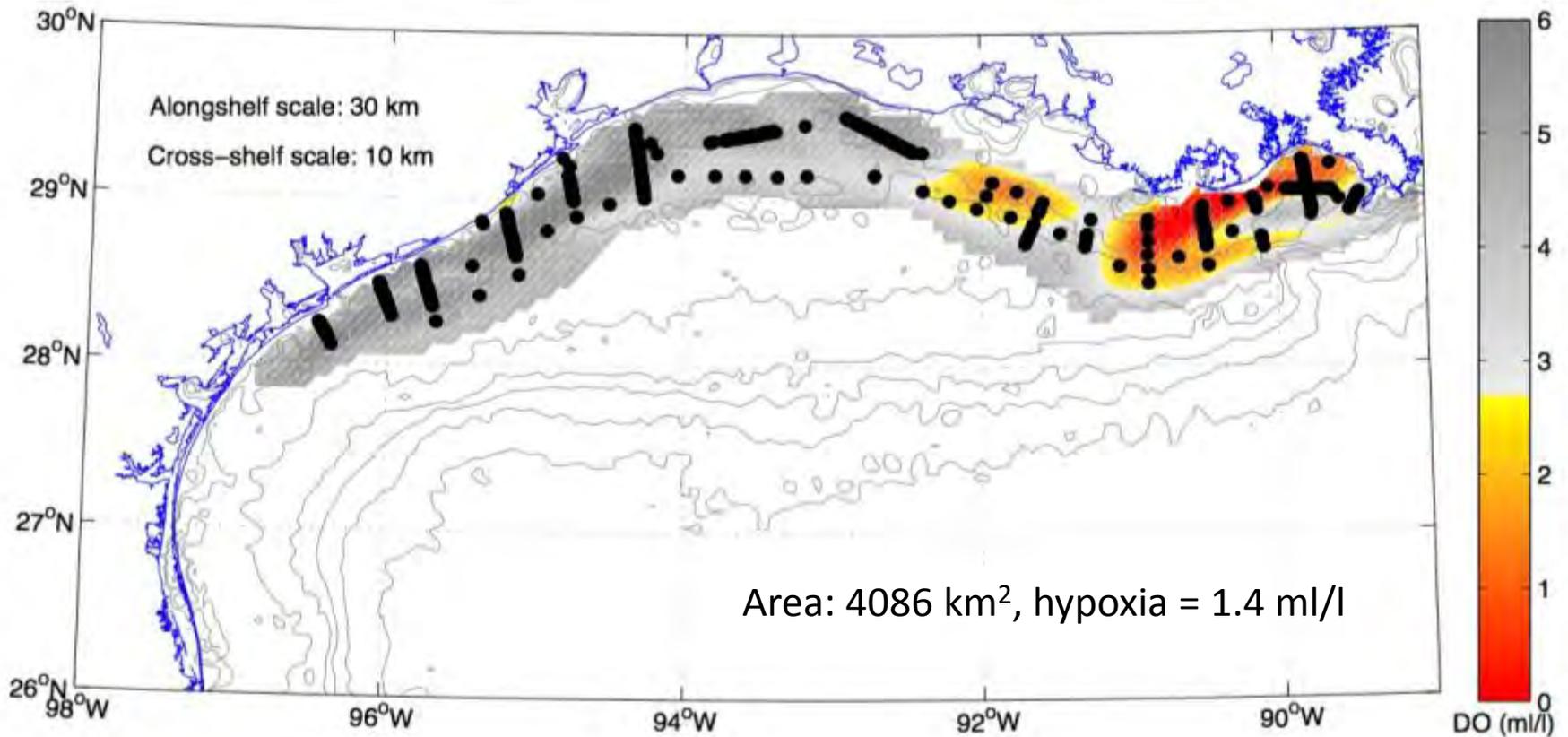
Atchafalaya: weak halocline,
slightly depleted subpycnocline
oxygen



Louisiana Bight: strong halocline
hypoxic bottom waters

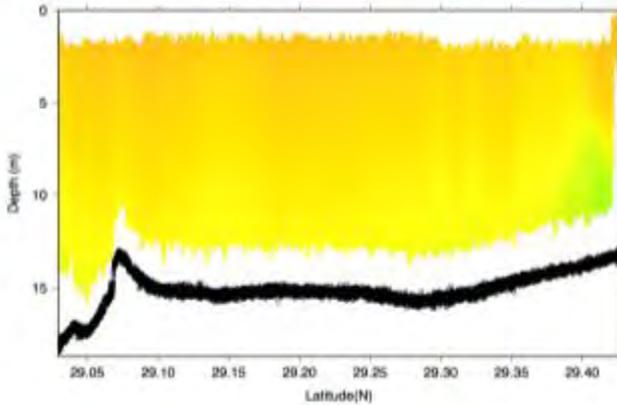


16-21 August 2012

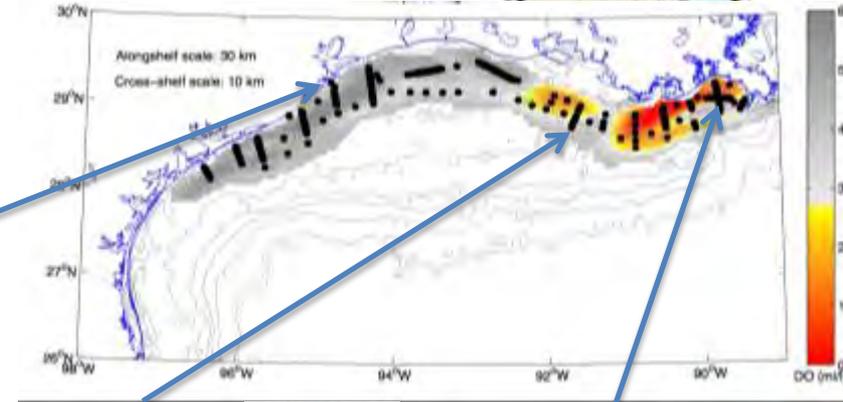




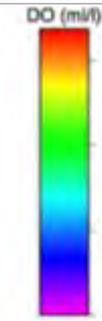
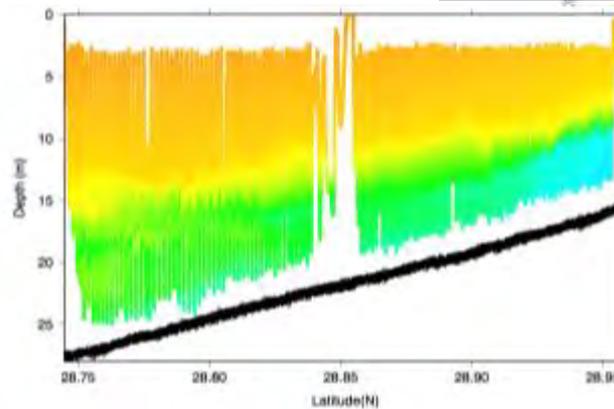
Oxygen Transects August 2012



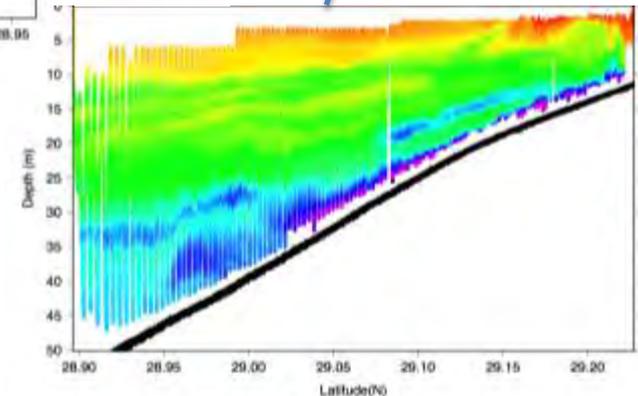
Galveston: no halocline, Weak thermocline, Slightly depleted subthermocline oxygen



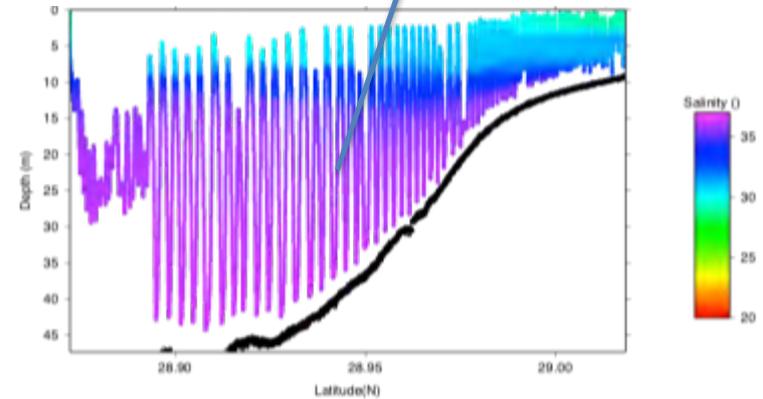
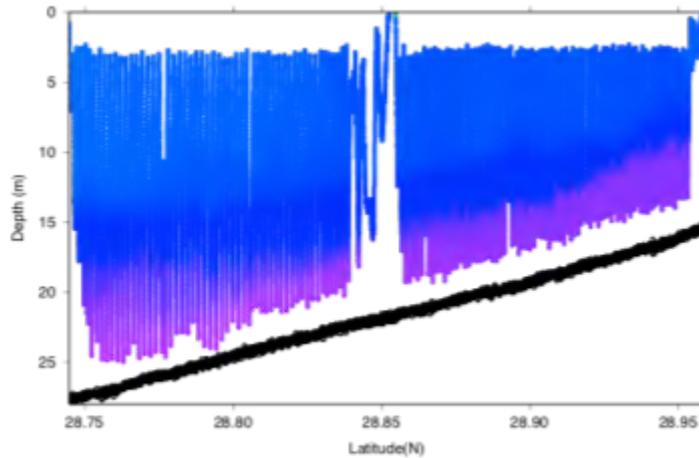
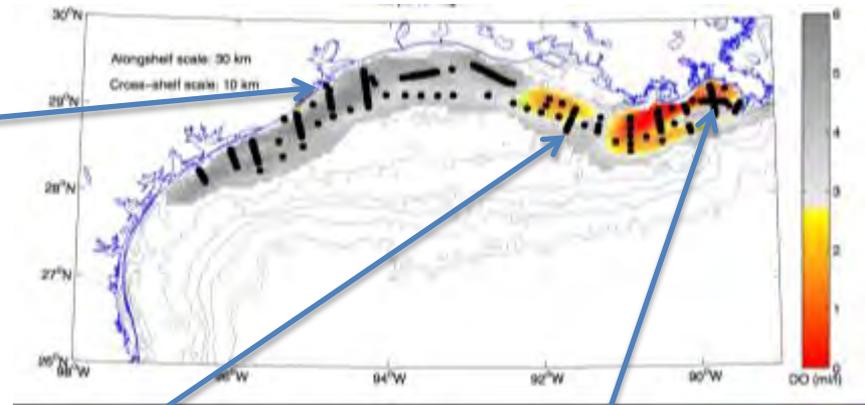
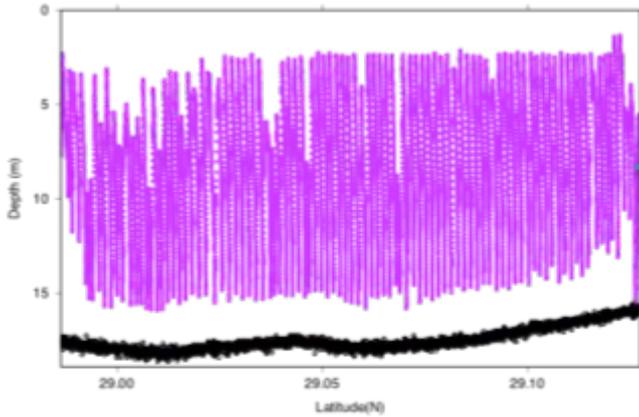
Atchafalaya: moderate halocline, Moderate depletion of subpycnocline oxygen



Louisiana Bight: strong halocline, hypoxic bottom waters

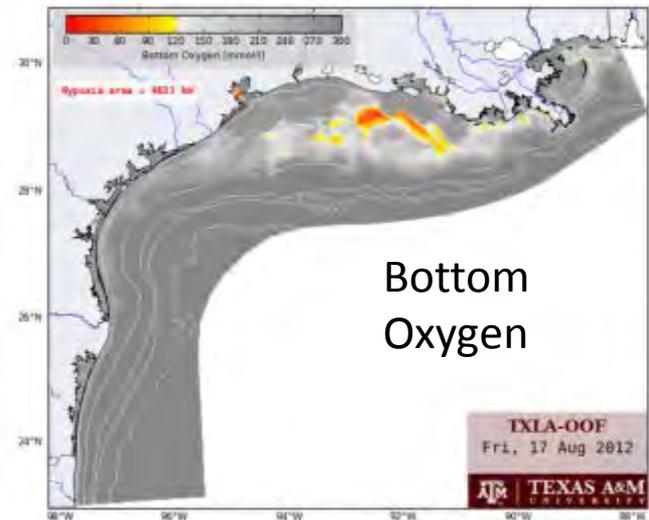
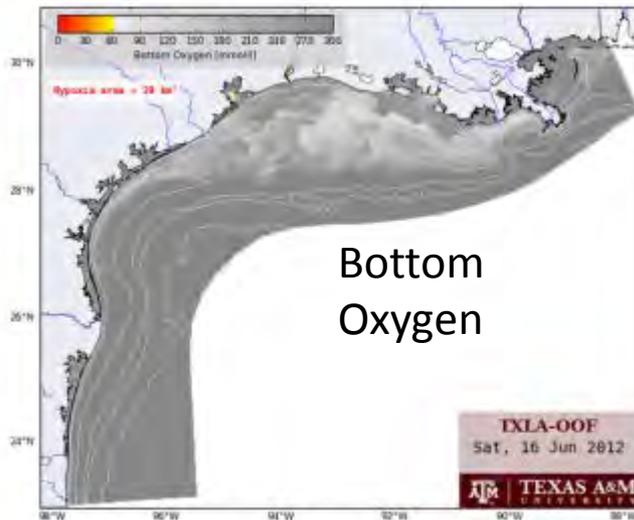
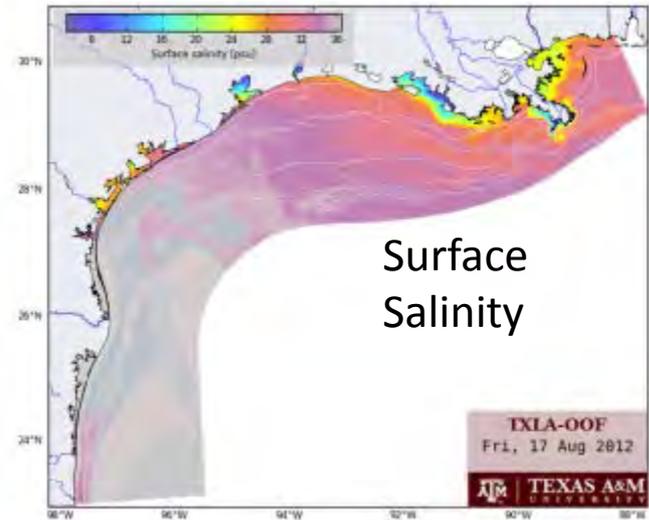
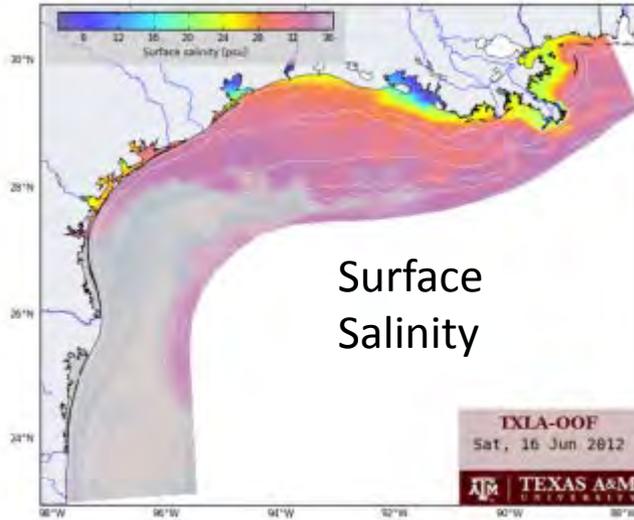


Salinity Sections: August 2012



Operational Circulation Model

<http://pong.tamu.edu/~mma/oof/main/forecast.php>



Field Plans for 2013



- Survey Cruises
 - M07: 14-21 June, R/V Manta
 - Coordinate with SEAMAP Summer cruise (NOAA-NMFS)
 - M08: 4-10 August, R/V Manta (if funds exist)
- Numerical Model Forecast
- No shelf process cruises
- No shelf mooring deployments

MCH Publications: 2013

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1. Marta-Almeida, Martinho, Hetland, Robert D., Zhang, Xiaoqian, 2013. Evaluation of model nesting performance on the Texas-Louisiana continental shelf, *Journal of Geophysical Research*, (in press)
2. TS Bianchi, F Garcia-Tigreros, SA Yvon-Lewis, M Shields, H J Mills, D Butman, C Osburn, P Raymond, G C Shank, S F DiMarco, N Walker, B Kiel Reese, R Mullins-Perry, AS Quigg, GR Aiken, E L Grossman, 2013. Enhanced transfer of terrestrially derived carbon to the atmosphere in a flooding event. *Geophysical Research Letters* 40 (1), 116-122.
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4. †J. Strauss, E. Grossman, S. F. DiMarco. Stable isotopes in mollusk shells as indicators of benthic respiration and freshwater penetration on the Texas-Louisiana Shelf. *Bulletin of Marine Science*. Doi:10.5343/bms.2011.1047. 88(4), 817-842 (26).
5. †J Strauss, Ethan L Grossman, S. F. DiMarco, 2012. Stable isotope characterization of hypoxia-susceptible waters on the Louisiana shelf: Tracing freshwater discharge and benthic respiration, *Continental Shelf Research* 47, 15 September 2012, 7-15.
6. †Feng, Y., S. F. DiMarco, and G. A. Jackson, The relative role of upwelling favorable wind and Mississippi River forcing of the northern Gulf of Mexico hypoxia, *Geophys. Res. Lett.* doi:10.1029/2012GL051192, 39, L09601.
7. Hetland, R.D., Fennel, K., Harris, C.K., Kaihatu, J., Xu, K. and DiMarco, S.F. (2012) Integrated bio-physical modeling of the Louisiana-Texas (LATEX) Shelf, U. S. Department of the Interior. Bureau of Ocean Energy Management Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2012-108, 128pp.
8. †Laurent, A., Fennel, K., Hu, J., and Hetland, R., 2012, Simulating the effects of phosphorus limitation in the Mississippi and Atchafalaya River plumes, *Biogeosciences* , 9, 4707-4723, doi:10.5194/bgd-9-5625-2012
9. †Reese, B. K., H. J. Mills, S. E. Dowd and J. W. Morse. 2012. Linking molecular microbial ecology to geochemistry in a coastal hypoxic zone. *Geomicrobiology Journal*. In press. doi 10.1080/01490451.2012.659331
10. †Smith, Richard W., TS. Bianchi, and Xinxin Li, 2012. A re-evaluation of the use of branched GDGTs as terrestrial biomarkers: Implication for the BIT Index. *Geochimica et Cosmochimica Acta*, pp 14-29. doi:10.1016/j.gca.2011.11.025
11. Zhang, X., RD Hetland, M Marta-Almeida and SF DiMarco, 2012. A numerical investigation of the Mississippi and Atchafalaya freshwater transport, filing and flushing times on the Texas-Louisiana Shelf, *Journal of Geophysical Research*, vol. 117, C11009, doi:10.1029/2012JC008108
12. Zhang, X., Marta-Almeida, Martinho, Hetland, Robert D., 2012. A high-resolution pre-operational forecast model of circulation on the Texas-Louisiana continental shelf and slope, *Journal of Operational Oceanography*, vol. 5, no. 1

A photograph of a sunset over the ocean, taken from the deck of a ship. The sun is a bright red orb on the horizon, casting a shimmering path of light across the water. The sky is filled with soft, orange and yellow clouds. In the foreground, the dark silhouette of the ship's deck and railings is visible, with some equipment and cables. The overall mood is serene and contemplative.

Questions

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TAMU Glider Plans: 2013



- New TAMU Glider Facility
 - Ballasting tank: summer 2012
 - Maintenance and Teaching Lab
- Two Teledyne-Webb coastal Slocum gliders
 - CTD, chlorophyll fluorescence, dissolved oxygen
- Deployments (planned):
 - MS07 June 2013: Galveston to Flower Gardens
 - GISR G04 July 2013: Shelf-slope Macondo spill site