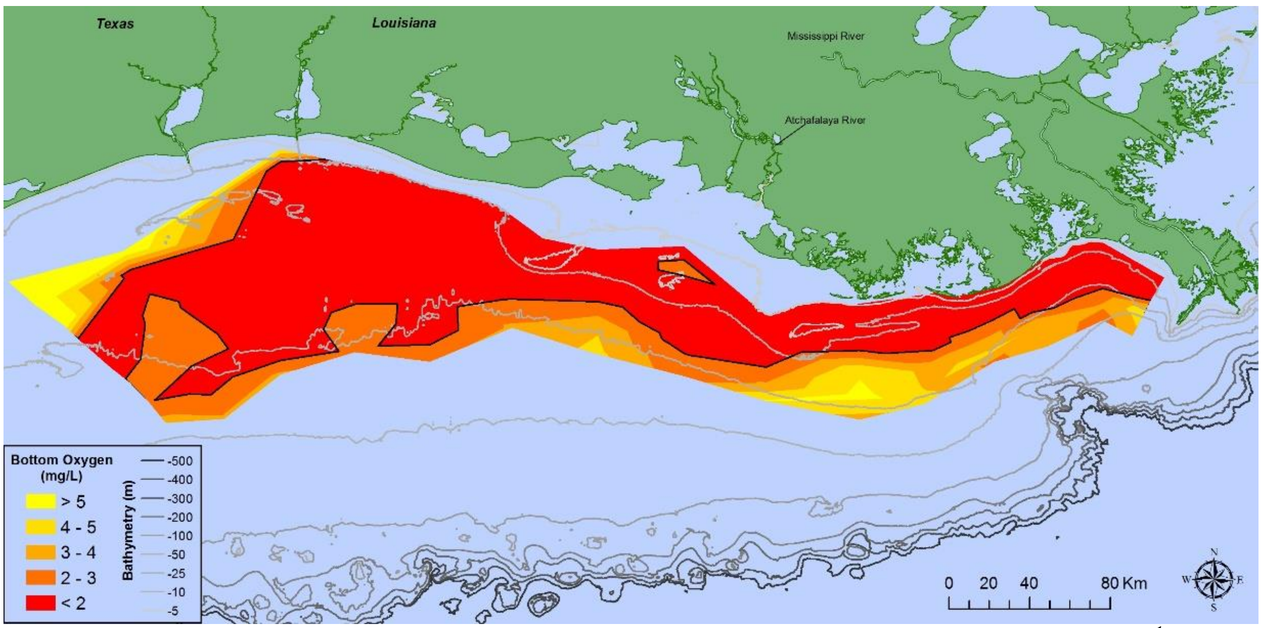
PRESS RELEASE

LOUISIANA UNIVERSITIES MARINE CONSORTIUM
August 2, 2017

SUMMARY

The 2017 area of low oxygen, commonly known as the 'Dead Zone,' measured 22,720 square kilometers (= 8,776 square miles) is the largest size measured to date since the standardized mapping cruises began in July 1985. July 24 – July 30, 2017, the dates of this year's cruise, mark the **31st** cruise measuring the area of hypoxia (low oxygen) in the northern Gulf of Mexico. Based on the May nitrogen load from the Mississippi River, the area was predicted by LSU/LUMCON to be 26,131 km^2 (10,089 mi^2) of the bottom of the continental shelf off Louisiana and Texas. The size is the largest yet and is 4.5 times the Mississippi River Nutrient/Hypoxia Task Force environmental goal of 5,000 square kilometers (1,900 square miles). Mississippi River discharge, well above average in May with high nitrate concentrations, provided a high nitrate load, the best predictor of the summer size of bottom-water hypoxia.

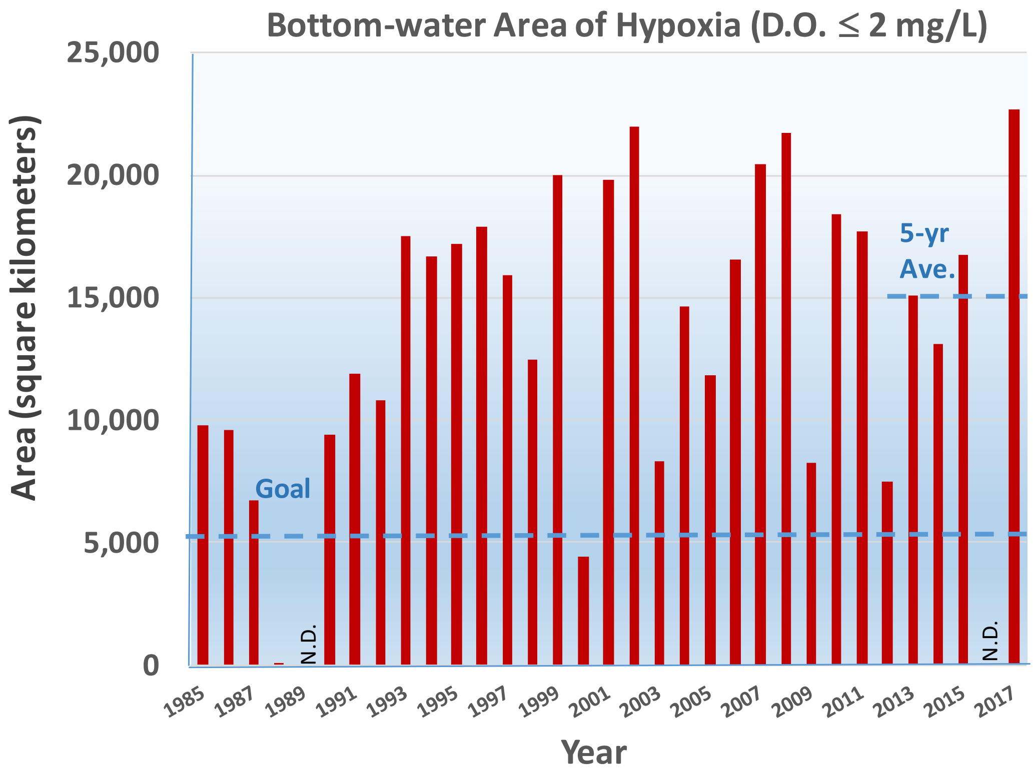


Distribution of bottom-water dissolved oxygen, July 24 – July 30, 2017. Black line denotes 2 mg l^{-1}. Data source: N. N. Rabalais, Louisiana State University & Louisiana Universities Marine Consortium; R. E. Turner, Louisiana State University. Funding: National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science.

Please note that the entire area was not mapped because of insufficient days on the ship, and that Quality Control/Quality Assurance standards for processing the data may change the overall estimate and other environmental parameters.

The average size for the last five years, including this year, is 15,032 square kilometers (= 5,806 square miles). The 31-year average (less 1989 and 2016) is 14,042 square kilometers (5,424 square miles). This year's 'Dead Zone' is the size of New Jersey.

MORE DETAILS



Historic size of hypoxia from 1985 to 2017. There are no data (n.d.) for 1989 and 2016. The value for 1988 is 42 square kilometers and barely visible on the scale.

A notable feature of this year's distribution of low oxygen is the mostly continuous band of extremely low oxygen concentrations alongshore at the nearshore edge of the zone. Values there were very often less than 0.5 milligrams per liter and close to 0 milligrams per liter (anoxia). The definition of hypoxia is 2 milligrams per liter. The low oxygen waters also reached well up into the water column, at least on the eastern area of the map.

Low oxygen areas are sometimes called 'Dead Zones' because of the absence of commercial quantities of shrimp and fish in the bottom layer. The number of Dead Zones throughout the world has been increasing in the last several decades and currently totals over 500. The Dead Zone off the Louisiana coast is the second largest human-caused coastal hypoxic area in the global ocean and stretches from the mouth of the Mississippi River into Texas waters and less often, but increasingly more frequent, east of the Mississippi River.

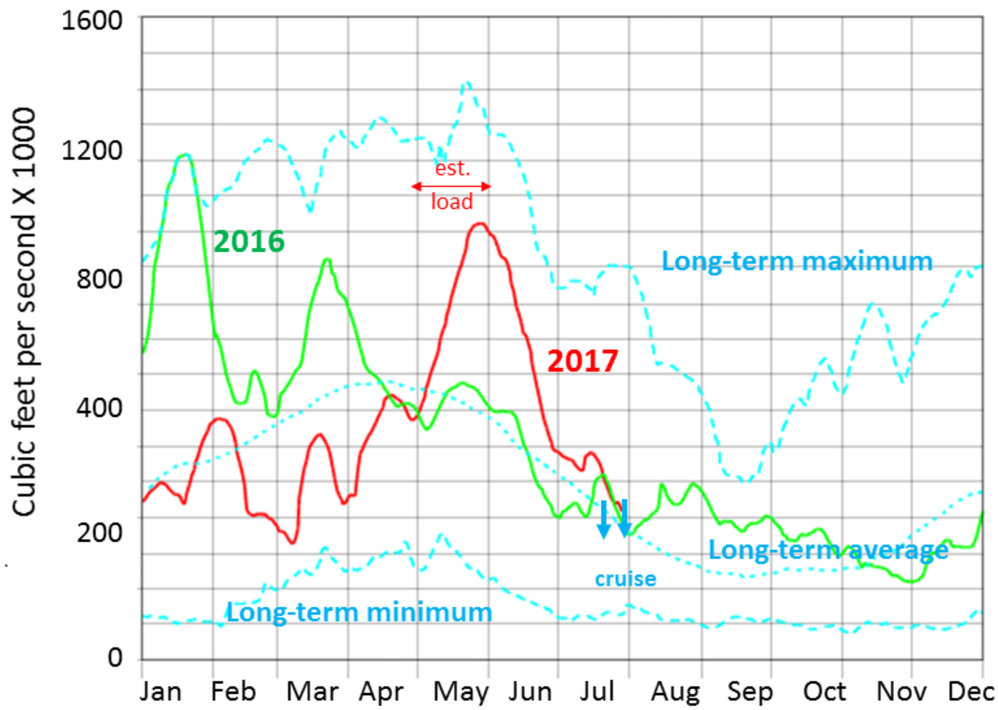
There is a series of coupled cause-and-effect relationships linking the amount of water emptying into the Gulf of Mexico and water quality in the Mississippi River to hypoxia. The fresher, warmer water in the upper layer is separated from the saltier, colder water in the lower layer, resulting in a barrier to the normal diffusion of oxygen from the surface to the bottom. The excess nutrients delivered by the river stimulate high phytoplankton biomass offshore, which fuels the coastal food web but also contributes to high carbon loading to the bottom layer. The decomposition of this carbon by bacteria in the bottom layer leads to the low oxygen that is not resupplied from the surface waters.

The amount of nutrient loading from the river increased considerably in the 1960s as a result of more intense agricultural activity in the watershed. The primary driver of the increased nutrient loading is agricultural land use, which is strongly influenced by farm policy. The nitrogen load has stabilized somewhat in the last two decades. Additionally, the nitrate portion of the total nitrogen load is increasing. This is important, because the nitrate-N concentration and load is proportional to the phytoplankton produced and the subsequent bottom-water hypoxia. Reducing the size of the hypoxic area requires, therefore, changes in land use practices. Pilot projects and recent developments demonstrate that this can be done for crops with benefits for fregional and local water quality, farm communities, soil health and erosion reduction, and without compromising yields or profit.

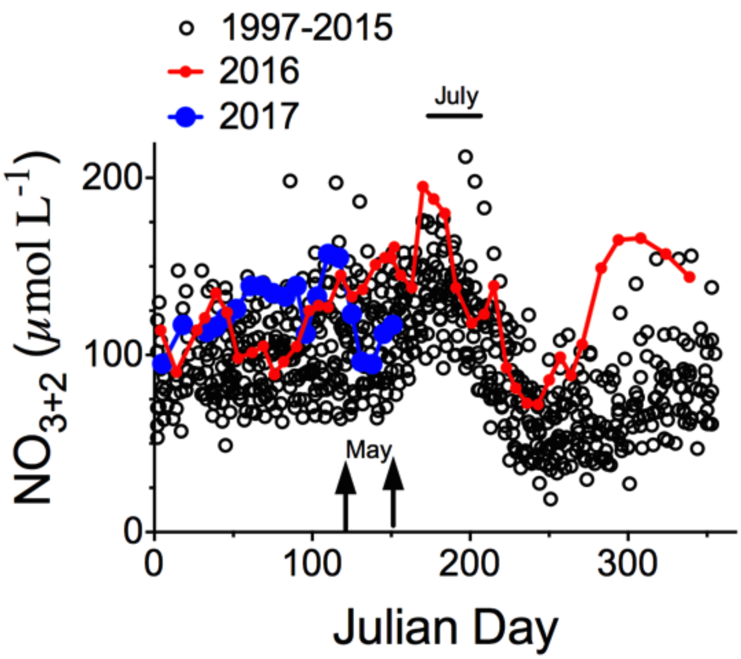
The long-term pattern in the hypoxic zone size shows that there is a greater sensitivity to nutrient loading that is carried over from one year to the next. These 'legacy' effects can be explained as the result of incremental changes in organic matter accumulated in the sediments one year, and metabolized in later years, by changes in the nitrogen form, or long-term climate change.

2017 Conditions

The Mississippi River discharge and its associated nutrient load is the single factor that explains most of the variability in the summer size of low oxygen. The May river discharge was well above average compared to the long-term average since 1935. The May river discharge was well above average for the month, nitrate concentrations were average, although near the long-term maxima for January through April. The figure below illustrates with the pointer on the left, the timing of the nitrate load when the prediction was made for the mid-summer cruise (double blue arrows).

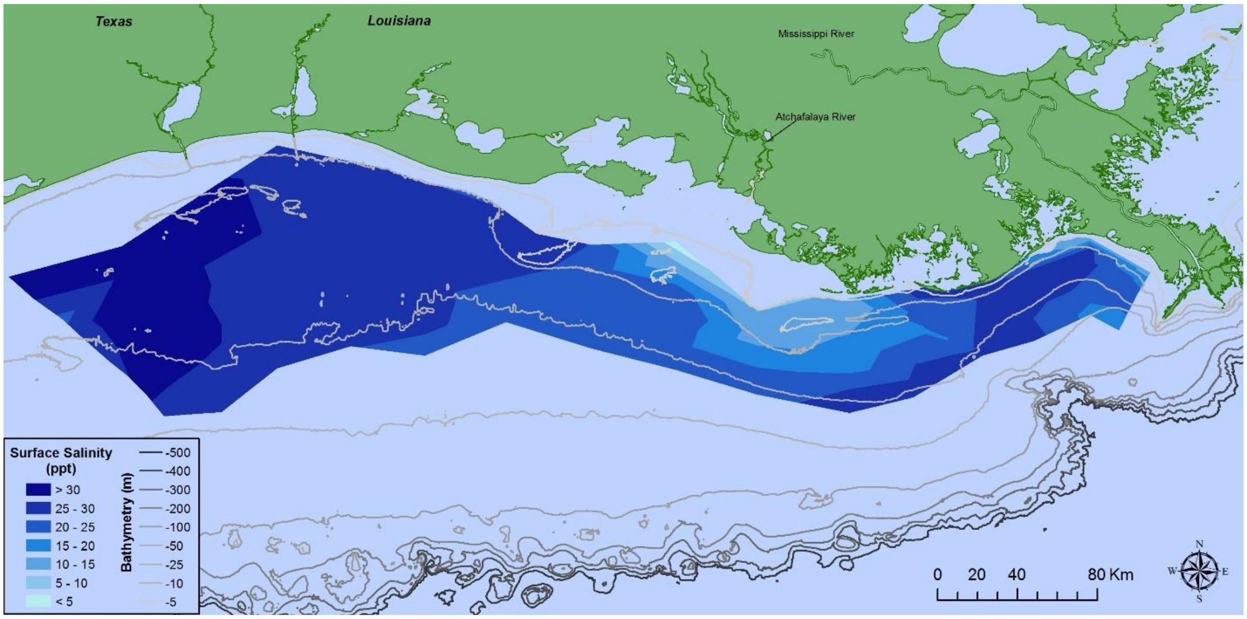


Flow of the Mississippi River at Tarbert Landing LA since 1935 with discharge for 2017 in red, compared to long-term conditions (http://www2.mvn.usace.army.mil/eng/edhd/tar.gif).



The concentration of nitrite+nitrate (NO_{2+3}) at Baton Rouge, Louisiana, from 1997 through May 30, 2017. The data for2016 and 2017 are shown separately. Source: R. Eugene Turner, LSU Department of Oceanography and Coastal Sciences. Funding: NOAA National Centers for Coastal Ocean Science.

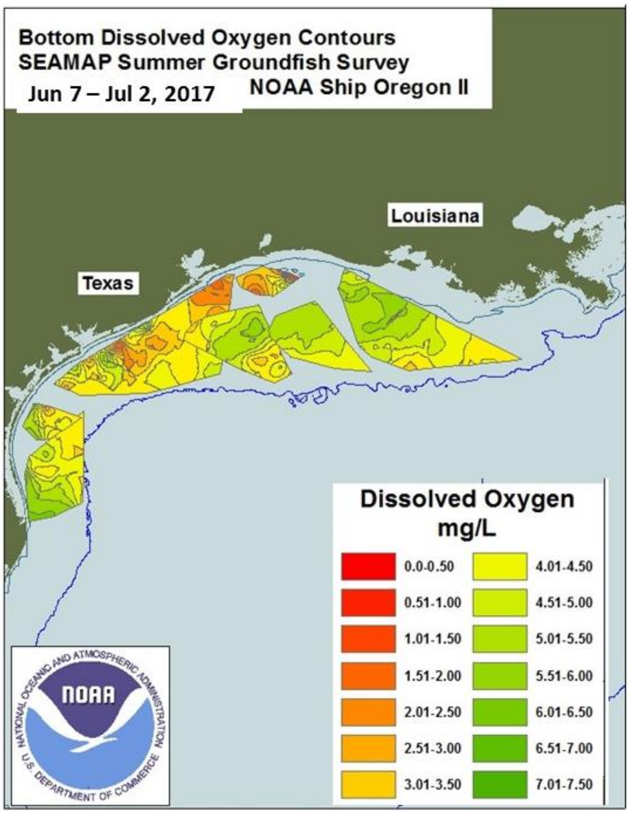
Conditions favorable for the formation and maintenance of hypoxia, water column stratification and nutrient-enhanced algal growth, continued well up to the time of the cruise and are still present over much of the study area. The high river flow in May and June was retained on the shelf, at least through the mapping of hypoxia. Salinities > 30 were rare. The amount of Mississippi and Atchafalaya fresh water can be seen in the figure below.



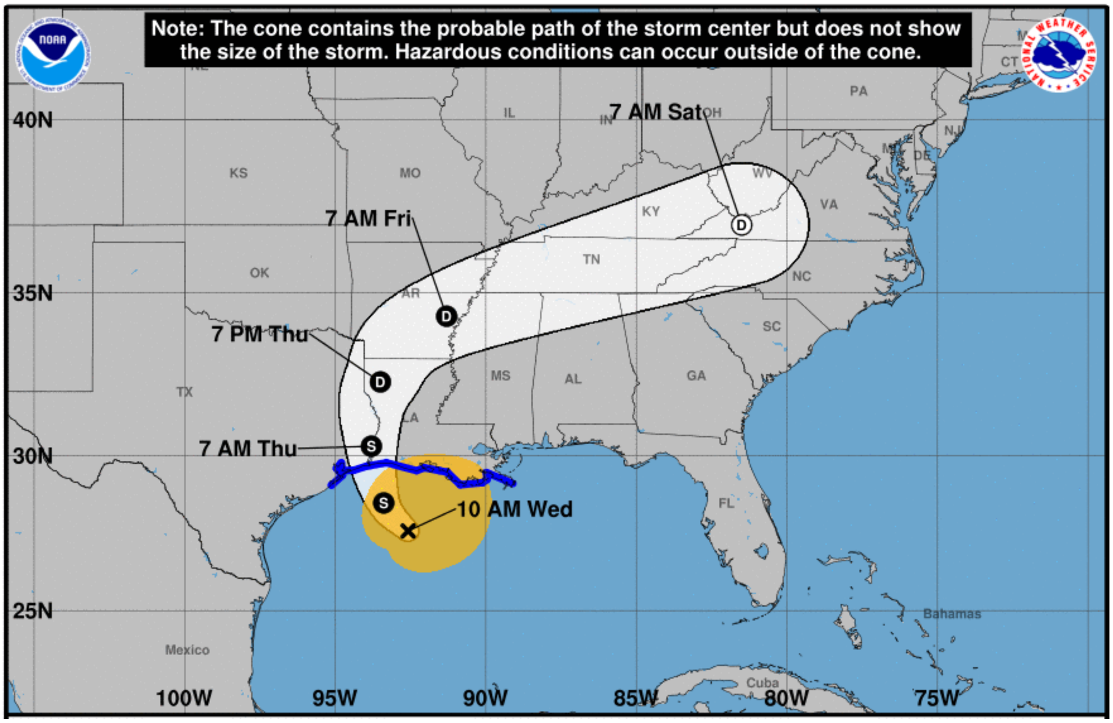
Distribution of the surface salinity along the Louisiana shelf, July 24 – July 29, 2017.

Progression of 2017 Hypoxia

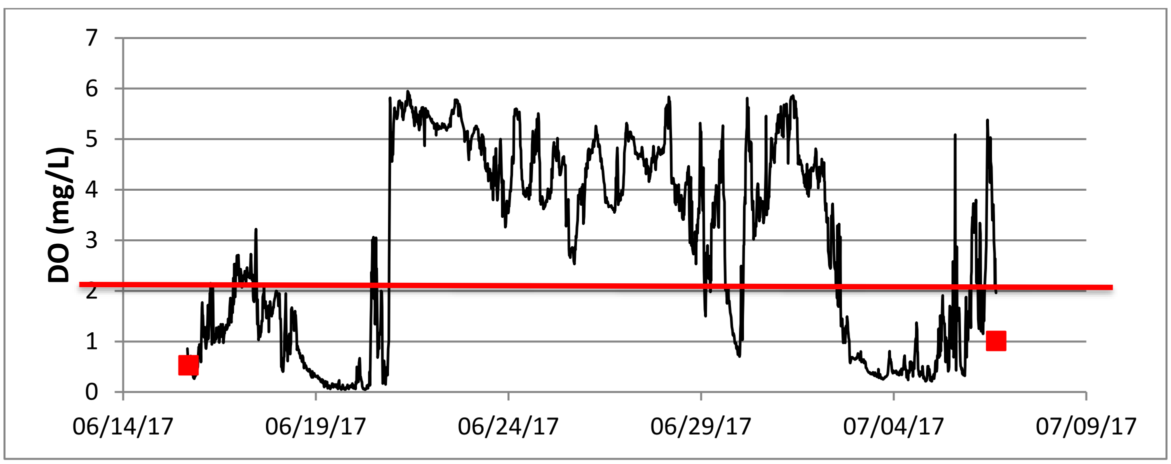
The National Marine Fisheries Service groundfish surveys on the NOAA vessel Oregon II (SEAMAP cruises) was the first systematic mapping of the summer. The areas off Texas and Louisiana were occupied from June 7 – July 2, 2017. Low oxygen occurred off Galveston Bay and Lake Sabine (the Texas-Louisiana border) before Tropical Storm Cindy crossed the coastline at that location on June 22. Waters that were stratified and supported low oxygen conditions below the surface layer were most likely disrupted, and the water column was not restratified by the time the remainder of the survey was conducted off Louisiana. The disruption of hypoxic bottom-waters was recorded off Terrebonne Bay, 200 km west of the Mississippi River delta, following the passage of the storm center. The low oxygen on the bottom there was well below 2 milligrams per liter for a month and a half before the passage of the storm.



Bottom-water oxygen concentrations from SEAMAP groundfish surveys (map modified to show Texas and Louisiana). Source: https://service.ncddc.noaa.gov/rdn/www/media/hypoxia/maps/2017-hypoxia-contours.jpg



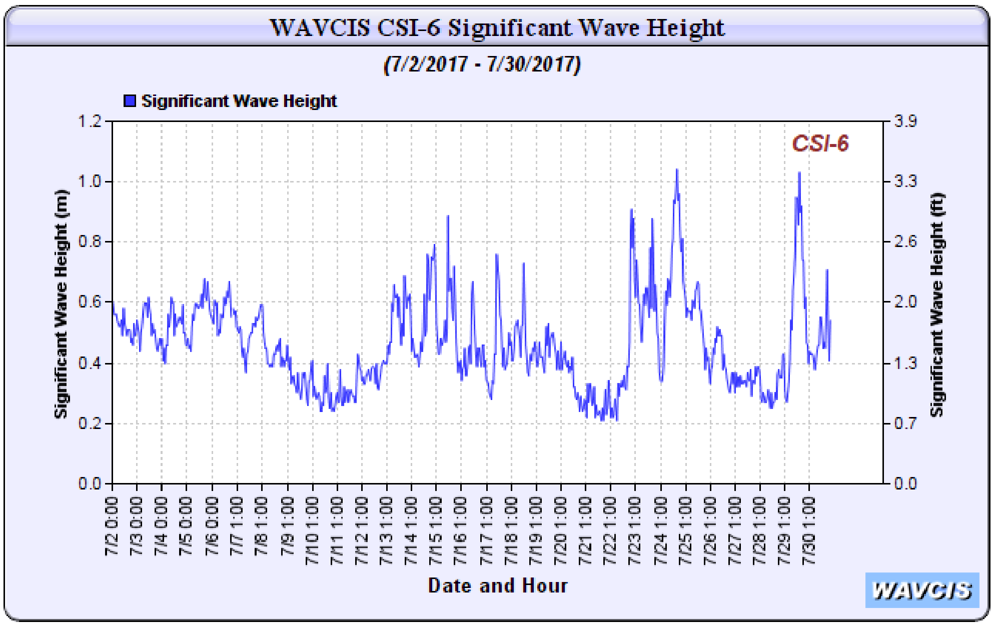
Tropical Storm Cindy likely path of storm center on June 21, 2017.



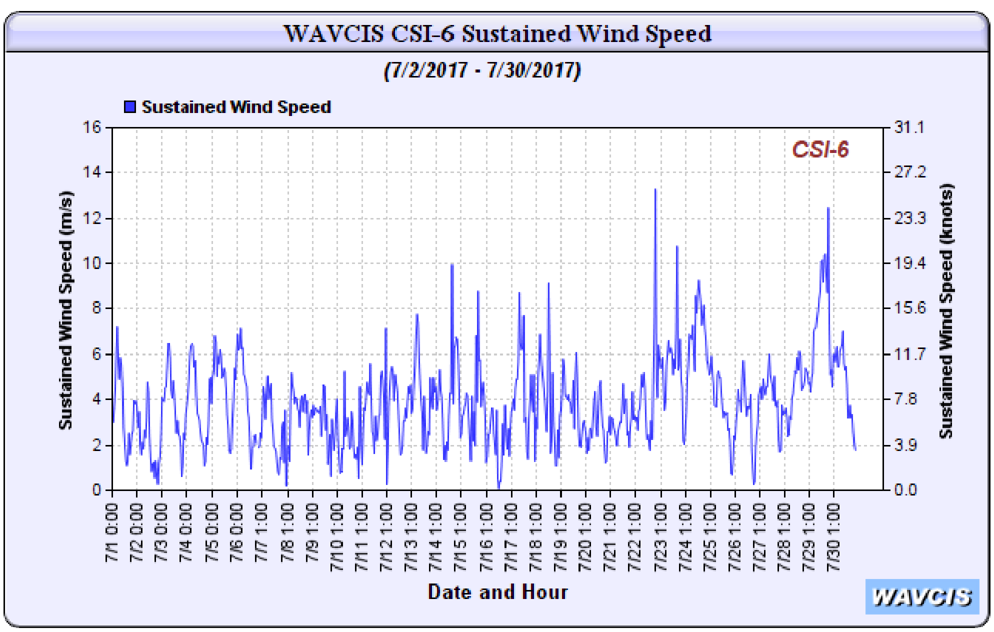
Bottom-water dissolved oxygen in 20-m depth off Terrebonne Bay before and after Tropical Storm Cindy (unpublished data of Nancy Rabalais, LSU/LUMCON).

The area of hypoxia on the Louisiana shelf adjacent to the Mississippi River is the focus of an NSF collaborative Ocean Acidification project, pH Dynamics and Interactive Effects of Multiple Processes in a River-Dominated Eutrophic Coastal Ocean, is led by Wei-Jun Cai (University of Delaware) and Nancy Rabalais as co-PIs. Cai was mapping oxygen and CO_2 conditions the week and a before the LSU/LUMCON cruise. The low oxygen on their cruise from July 7-21 showed a discontinuous distribution of hypoxia on the southeastern Louisiana shelf and a larger low oxygen area west of the Atchafalaya River. They did not occupy all the same stations as the Rabalais et al. cruise did, and others that Rabalais did not occupy. Cai et al. did not go farther west than Lake Calcasieu, transect K of Rabalais et al., nor did they go as far east as the Rabalais et al. cruise (i.e., transect A′). The Cai et al. cruise did not send a second, smaller CTD unit to within 0.5 m of the seabed to capture readings from near-bottom waters. The estimated area of bottom-water oxygen concentrations less than or equal to 2 milligrams per liter for the area mapped by Cai et al. was 13,600 km^2. The large and rapid seasonal decrease in pH of nGOM bottom waters and its link to eutrophication, respiration and hypoxia under the Mississippi River plume provides an ideal natural laboratory to study the interactions between OA and biogeochemical processes.

For much of the two weeks prior to the shelfwide mapping, the winds were predominantly from the west and southwest, and pushed the water from the Atchafalaya River to the east of its delta. These conditions would also help push less saline waters This also provided for a more stratified (layered) water column in the center of the study area and supported more low oxygen. Winds were mostly calm for that period as well, and allowed for the strengthening of the stratification and support of low oxygen conditions across the broader area.



Data from http://www.wavcis.lsu.edu station CSI-6, where oxygen meters are deployed (Rabalais et al. station C6C).



Data from http://www.wavcis.lsu.edu station CSI-6, where oxygen meters are deployed (Rabalais et al. station C6C).

The multiple inputs of data available to explain the changing distribution and size of the hypoxic water mass are compelling. Hypoxia is a recurring environmental problem in Louisiana (and becoming more so in Texas and Mississippi) offshore waters. Long-term research and observations are the best ways to test and calibrate ecosystem models, to recognize the dynamic nature of our changing environment(s), and to improve the basis for sound management decisions.

The annual measurement of the hypoxic area also provides a critical scientific record of the trend of hypoxia in the Gulf to determine whether efforts to reduce nutrient loading upstream in the Mississippi River Basin are yielding results. Maintaining such a valuable ecological dataset can be difficult. However, without these continued observations and related research and modeling, the ability to predict changes in the ecosystem resulting from nutrient mitigation efforts in the Mississippi River watershed will be stymied.

For further information, contact:
Dr. Nancy N. Rabalais, nrabalais@lumcon.edu, 985-851-2801 wk, 985-870-4203 c, or
Dr. R. Eugene Turner, euturne@lsu.edu, 225-578-6454 wk

Graphics by Leslie Smith, Nancy Rabalais, R. Eugene Turner, Claire Windecker, and LSU's WAVCIS.

Visit the Gulf Hypoxia web site at http://www.gulfhypoxia.net for maps, figures, additional graphics and more information concerning this summer's research cruise and previous cruises.

Funding source for this year's cruise:
National Oceanic and Atmospheric Administration, Center for Sponsored Coastal Ocean Research