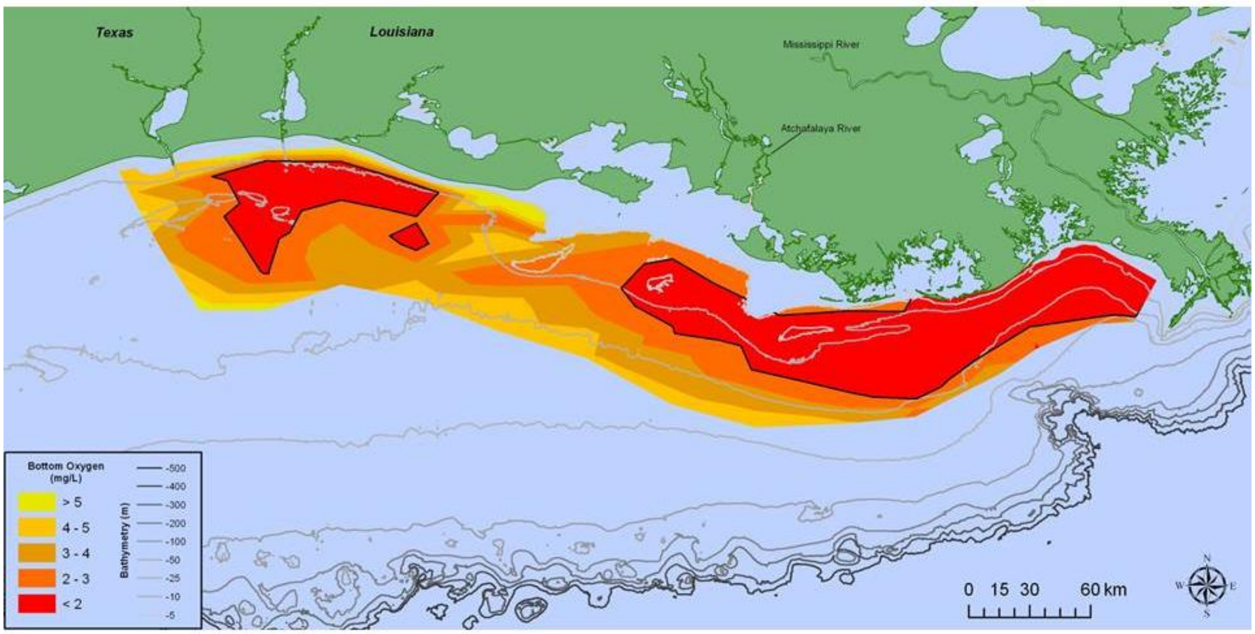
PRESS RELEASE

LOUISIANA UNIVERSITIES MARINE CONSORTIUM
August 4, 2014

The 2014 area of low oxygen, commonly known as the ‘Dead Zone,’ measured 13,080 square kilometers (= 5,052 square miles) as of Aug 1, 2014 at the end of the **30th** such cruise. Based on the May nitrogen load from the Mississippi River, the area was predicted by Gene Turner, Louisiana State University, to be 14,785 square kilometers (5,708 square miles). The size is proportional to the loading of nitrogen in the Mississippi River (in May), and the 2014 size fits well into the model prediction range.

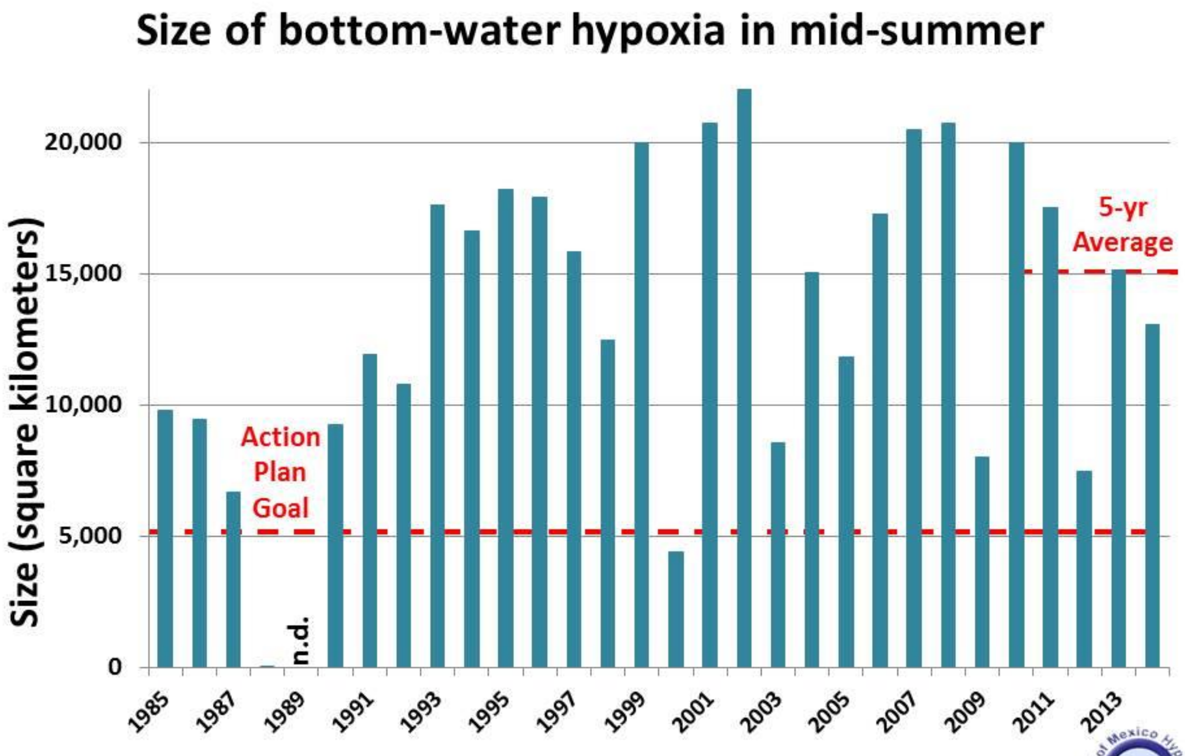
Bottom-water Dissolved Oxygen – 2014



Distribution of bottom-water dissolved oxygen July 27-August 1 (west of the Mississippi River delta), 2014. Black line indicates dissolved oxygen level of 2 mg/L.

Data source: Nancy N. Rabalais, LUMCON, and R. Eugene Turner, LSU
Funding sources: NOAA Center for Sponsored Coastal Ocean Research and U.S. EPA Gulf of Mexico Program

The July distribution of hypoxic waters is most often a single continuous zone along the Louisiana and adjacent Texas shelf, but this year was located in two separate areas. The largest area was off central to southeastern Louisiana between the deltas of the Mississippi and Atchafalaya rivers, and the smaller was off southwestern Louisiana.



Data source: Nancy N. Rabalais, LUMCON, and R. Eugene Turner, LSU
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The average size for the last five years is 14,352 square kilometers (= 5,543 square miles) and is three times larger than the environmental target (5,000 square kilometers; 1,991 square miles) approved by a federal/state task force in 2001 and maintained by the same task force in 2008.

These 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 550. 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.

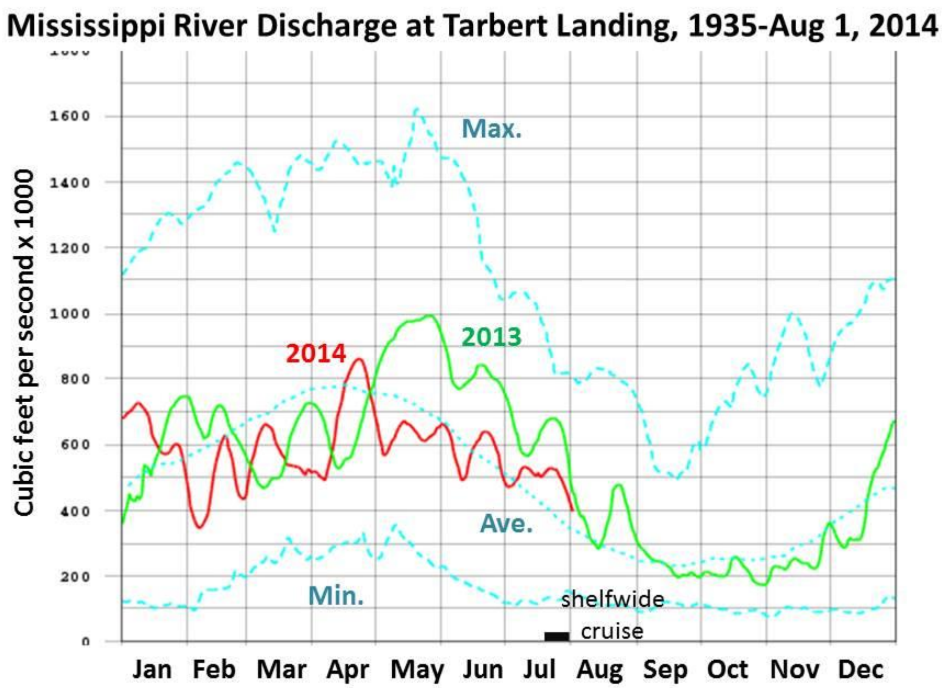
There is a series of coupled cause-and-effect relationships linking the amount of water emptying into the Gulf of Mexico and water quality in the Mississippi River to hypoxia. The fresher, warmer water in the upper layer is separated from the saltier, colder water in the lower layer, resulting in a barrier 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 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, but is still increasing. 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. Pilot projects and recent development have demonstrated that this can be done for crops with benefits for farm communities, soil health, erosion reduction, and without compromising yields or profit.

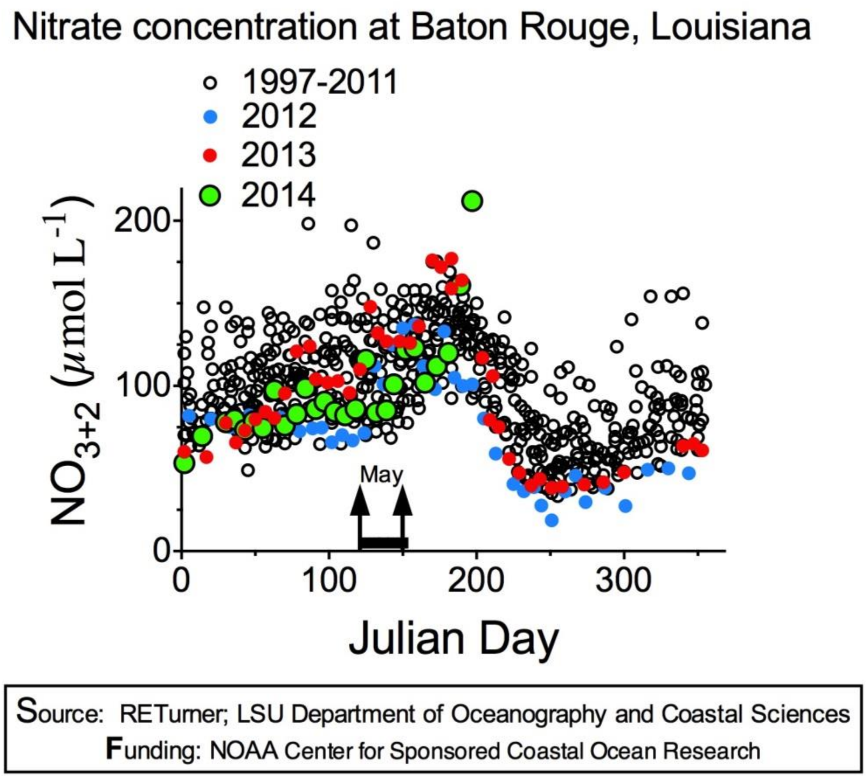
The long-term pattern in the hypoxic zone size shows that there is a greater sensitivity to nutrient loading that is carried over from one year to the next. These ‘legacy’ effects can be explained as the result of incremental changes in organic matter accumulated in the sediments one year, and metabolized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

2014 Conditions

The Mississippi River discharge was near the long-term average since 1935 along with a slightly lower nitrate concentration in the river at Baton Rouge, Louisiana. Immediately preceding the survey cruise, he river discharge was slightly above average, and the nitrate concentration increased well above average and reached a near-record high

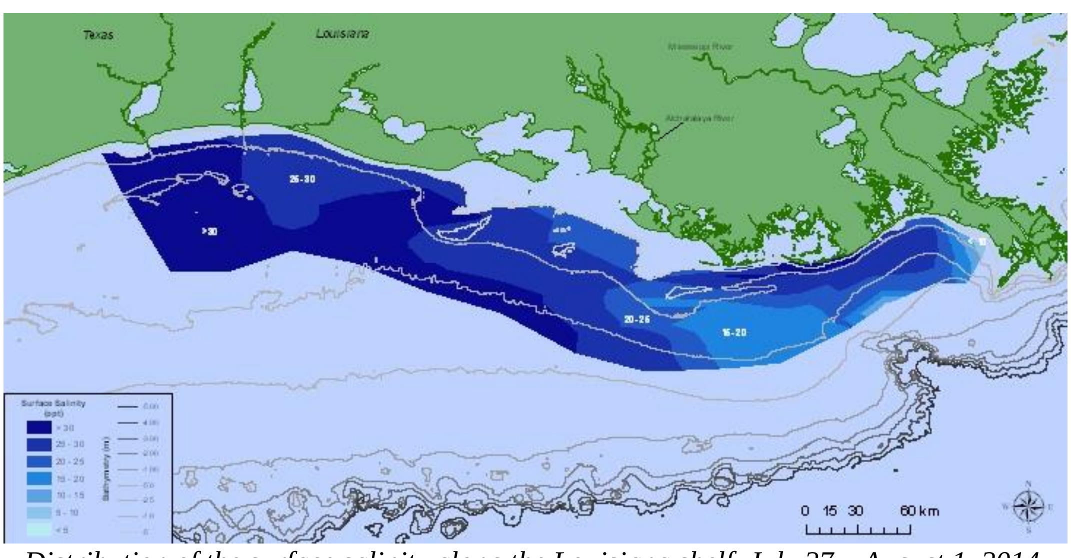


Flow of the Mississippi River at Tarbert Landing since 1935 with discharge for 2014 in red, compared to long-term conditions (http://www2.mvn.usace.army.mil/eng/edhd/tar.gif). The horizontal black bar indicates the timing of the survey cruise.

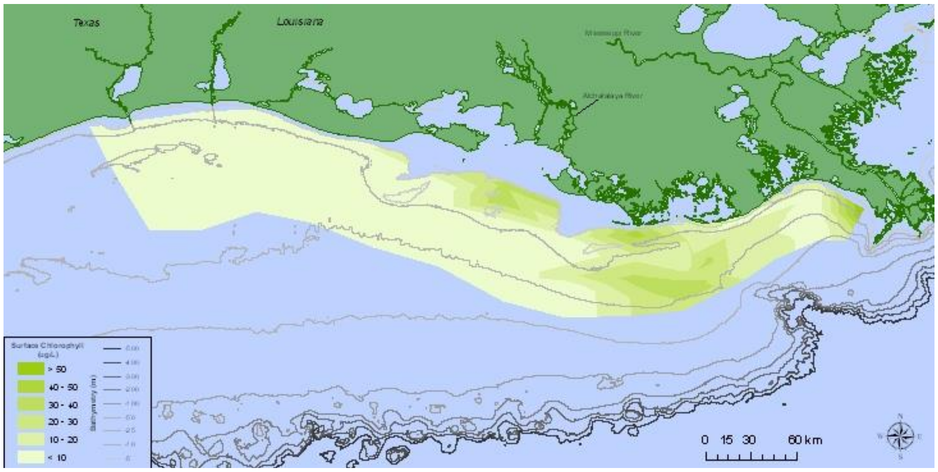


The concentration of nitrite+nitrate (NO_{2+3}) at Baton Rouge, Louisiana, from 1997 through mid-July. 2014. The data for 2012, 2013and 2014 are shown separately.

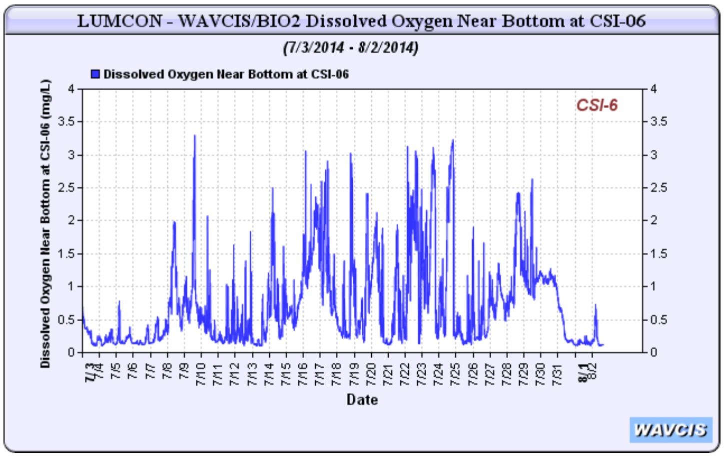
The late burst of nutrient loading and freshwater discharge generated lush conditions for phytoplankton growth off the Mississippi and Atchafalaya Rivers. The winds and currents were pushing the Atchafalaya River to the east of its delta, so that much of the biological productivity was located between the two river deltas. The area to the west of the Atchafalaya delta was probably residual from earlier in the month, and larger in size than mapping done by the National Marine Fisheries Service as part of their SEAMAP cruises on the *Oregon II*, and a cruise undertaken by Texas A&M University, both in June and early July. The lowered salinity and high chlorophyll biomass are obvious in the distribution maps below. These areas were also supersaturated with dissolved oxygen with saturations well above 100% and one reading at 245% dissolved oxygen saturation.



Distribution of the surface salinity along the Louisiana shelf, July 27 – August 1, 2014.

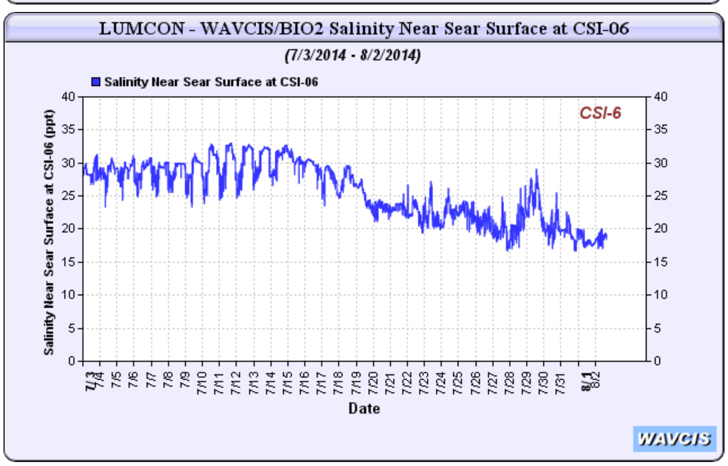


Distribution of the surface water chlorophyll a biomass along the Louisiana shelf, July 27 – August 1, 2014

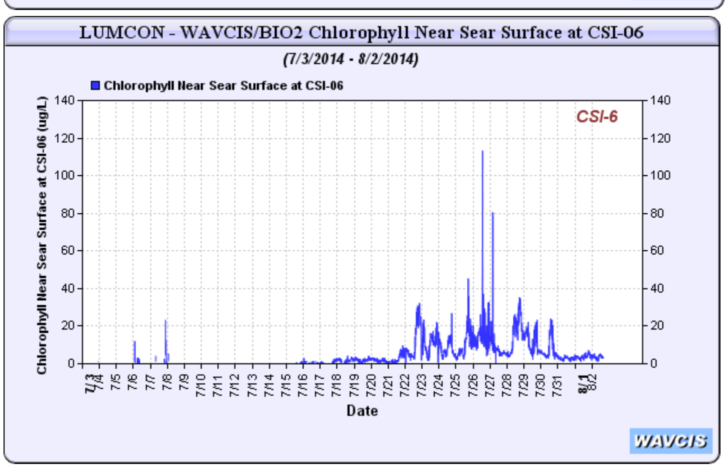


The physical and biological conditions for the three weeks before the survey cruise are depicted in these time series from station C6C in 20-m water depth offshore of Terrebonne Bay.

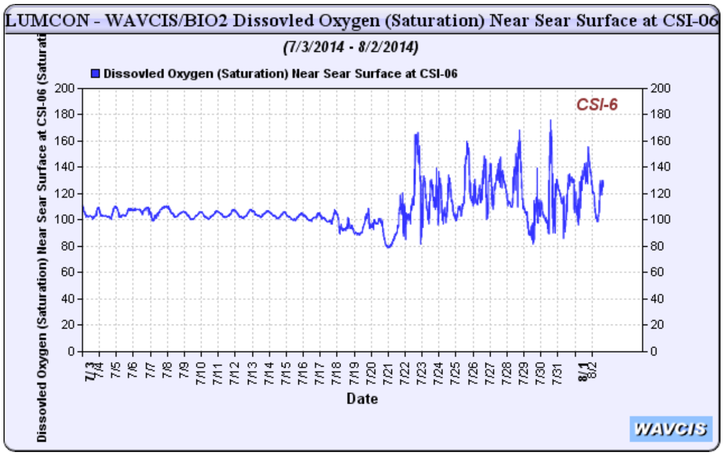
The bottom water oxygen at C6C was mostly below 2 mg/L but there was much mixing with the water column above rather than a constant value close to 0 mg/L as in most years.



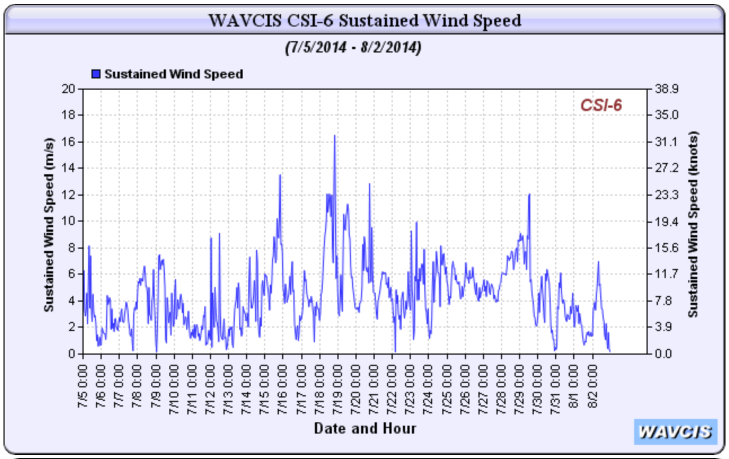
The signature of higher than average river discharge beginning in mid-July is seen in a decline of salinity in surface waters.



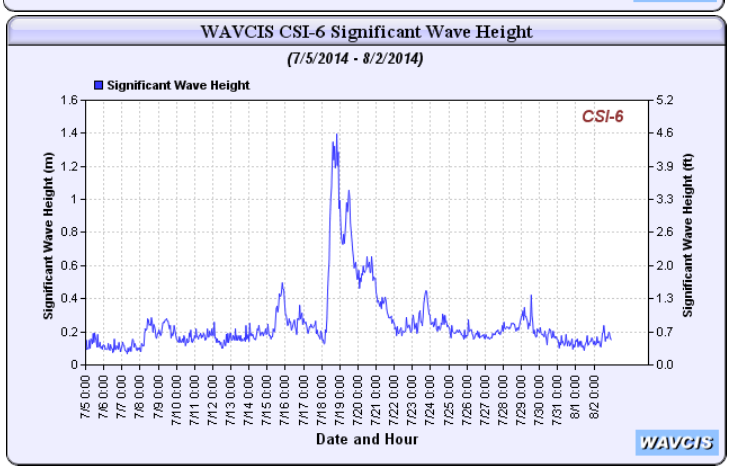
Along with the lower salinity, the nitrate load of the Mississippi River was also higher during that period, which led to increases in chlorophyll in the surface waters. Surface water production lags after the delivery of river water to the Gulf.



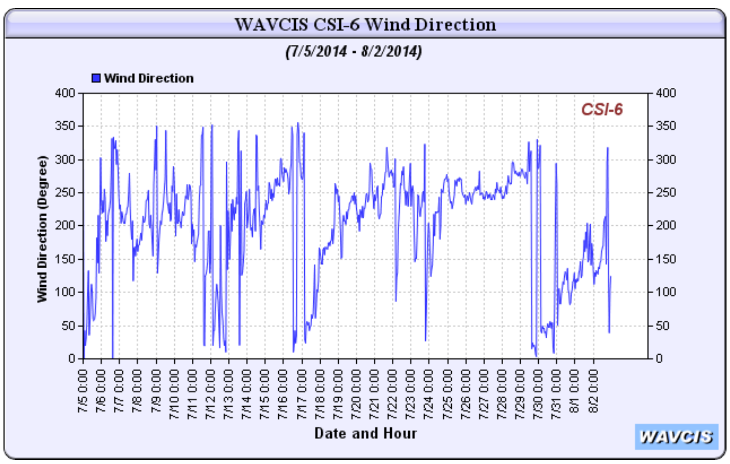
The high chlorophyll biomass generated high amounts of dissolved oxygen in the process of photosynthesis, and oxygen-supersaturated waters were prevalent in the high chlorophyll areas (see shelfwide map of chlorophyll).



Wind conditions will mix the water column and force the currents. The mid-part of July was quite windy with speeds of 10 to 20 knots. These values are relevant to the increases in bottom-water oxygen above 2 mg/L at station C6C.



The higher wave height in mid-July may have also been responsible for some mixing. This also helps explain the well-mixed upper water column to the west of the Atchafalaya River.



The direction from which the wind blows also determines the ‘foot print’ of the bottom-water hypoxic water mass. The winds were sustained from the west for much of mid-July and part of survey cruise time. This helps explain the movement of the water masses to the east.

Data source: N. Rabalais, LUMCON, LSU WAVCIS, http://wavcis.csi.lsu.edu/

The multiple inputs of data available to explain the distribution and nature of the hypoxic water mass are compelling. Hypoxia is a recurring environmental problem in Louisiana (and sometimes 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.

30th Anniversary Cruise

This year's shelfwide hypoxia cruise is the 30th since 1985. Such an enduring effort and wealth of data are a priceless rarity in ecosystem research and education. The efforts of many collaborators over the years have resulted in outstanding improvements in our knowledge that have been communicated through a relentless effort in books, journal articles, data archives, teaching, educational outreach, public talks, as well as congressional briefings and legislation. But much remains to be learned as management and policy changes occur, climate fluctuates, global warming increases and the unknowns are revealed.

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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, highlights of the 30th anniversary, and previous cruises.

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