2007 Forecast of the Hypoxic Zone Size, Northern Gulf of Mexico

Abstract

The prediction of the size of the hypoxic zone for July, 2007, is that it will cover 22,127 km^2 (8543 mi^2) of the continental shelf off Louisiana and stretch into Texas. If the area of hypoxia becomes this large, then it will be the largest measured since mapping began in 1985. This forecast is based on the United States Geological Survey (USGS) estimate of nitrogen load from the Mississippi River watershed to the Gulf of Mexico. This predictions discounts the effect of large storm events, which will temporarily disrupt the physical and biological system attributes promoting the formation of the low oxygen zone in bottom waters.

1. Hypoxic water mass The hypoxic zone in July from 1985 to 2006 has varied from 40 to 22,000 km^2 (15 to 8,494 mi^2). Hypoxia as a large-scale phenomena was unlikely to have occurred before the 1970s. Hypoxic water masses form from spring to fall on this coast because the consumption of oxygen in bottom water layers exceeds the re-supply of oxygen from the atmosphere. The re-aeration rate is negatively influenced by stratification of the water column which is primarily dependent on the river's freshwater discharge. The oxygen consumption rate in the bottom water is dependent on the formation of organic matter in the surface layer, its sinking to the bottom layer, and its decomposition rate. The organic matter production rate is directly related to the nitrogen supply rate. The transport to the bottom layer is the result of sinking of individual cells (considered a minor contribution), as the excretory products of the grazing predators (zooplankton) which 'package' them as fecal pellets, or as aggregates of cells, detritus and mucus. Microbial decomposition in the bottom layer degrades the organic matter and consumes oxygen in the process. The production rate is a nutrient-limited rate, and nitrogen supply (and perhaps phosphorus) is the key limiting nutrient.

2. Model parameters A simple statistical model describes the variation in the size of the hypoxic zone in July (Turner, R.E., N.N. Rabalais, and D. Justic 2006. Predicting summer hypoxia in the northern Gulf of Mexico: Riverine N, P, and Si loading. Marine Pollution Bulletin 52:139-148). The nitrate+nitrite load delivered to the Gulf of Mexico by the Mississippi in May is used for predictive purposes. The residence time of the surface waters along this coast is about 2 to 3 months in the summer, hence the 2-3 month lag between the loading rate and the size of the hypoxic zone. The loading of nitrogen is the product of nitrogen concentration X discharge. For this estimate, the 2007 May load is based on the river discharge for the main channel of the river flowing past New Orleans and the water flowing into the Atchafalaya Basin. The measured May, 2007, nitrate+nitrite concentration at Baton Rouge are above average (1997-2007; Fig. 1) and the total discharge remains below the long-term average. The USGS web site (http://toxics.usgs.gov/pubs/of-2007-1080/discussion_net_improve.html) has more information on the calculation.

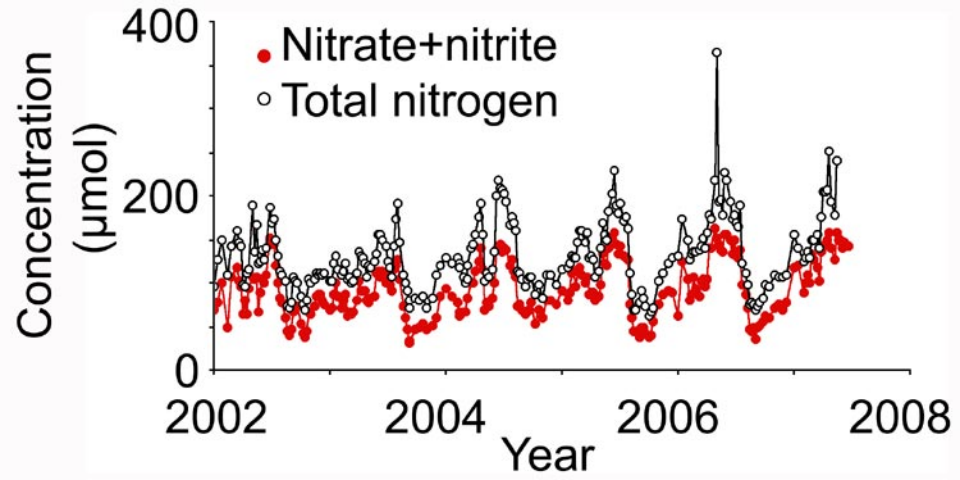

Figure 1. The concentration of nitrate+nitrite and total nitrogen at Baton Rouge from 2002 to May 2007. Data collected and analyzed by the NOAA-funded research group at LUMCON and LSU.

3. Model prediction The model describes the previous size of the hypoxic zone quite well (Fig. 2). The size of the zone for 1998, 2003 and 2005 was not modeled because of strong storms that occurred just before or during the survey. These storms move water masses around and disrupt the stratification of the water column. The prediction last year was 99% of the measured size. The estimate this year is that the size of the zone in July will be about 22,127 km^2 (8543 mi^2). A post-cruise assessment will be made at the end of the summer.

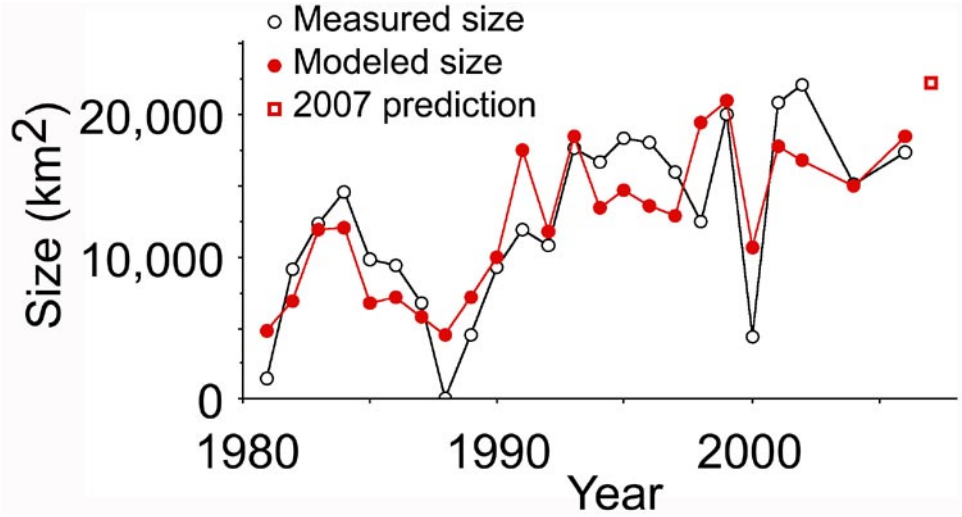

Figure 2. The model predictions and the preliminary estimate of the size of the hypoxic zone for 2007. 10,000 km^2 = 3,861 mi^2.

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