Using the Chesapeake Bay Program Interpolator to analyze Chesapeake Bay monitoring program data

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DO Assessment in the Chesapeake Bay Seminar – May 7, 2013

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Bay monitoring

- Maryland Department of Natural Resources and Old Dominion University conduct monitoring cruises on the main stem and tidal tributaries of the Chesapeake Bay
- Cruises are conducted monthly except during June, July, and August which have two cruises per month
- These data are used in the Chesapeake Bay and tidal tributary interpolator to assess summer anoxic and hypoxic conditions

The interpolator

- The interpolator was developed by Lowell Bahner of the NOAA Chesapeake Bay Office
- The current version (V4.6) has been used since August 2006
- It computes water quality concentrations in either 2- or 3-dimensions of the Bay and tidal tributaries depending on user input

Interpolator description

- The interpolator is cell-based
- Cell size for the Bay is 1 km east-west, by 1 km north-south, by 1 m vertical from surface to bottom
- There are 238,669 cells by depth for all 77 segments of the Bay and tributaries
- The mid-point of each cell is typically computed from the four nearest neighboring water quality values
- Due to stratification, water quality in the Bay varies more vertically than horizontally, so the interpolator will widen the vertical search window for water quality data to find the four nearest neighbors

Three dissolved oxygen case studies

- Summer dissolved oxygen conditions following a spring “freshet”
- Hurricane Irene – a wind-driven mixing event
- Effects of a dry spring and summer on the hypoxic volume of the Bay

A spring “freshet”

- MODIS image of the Bay following a storm on 10 March 2011 with 2.61 inches of precipitation recorded at BWI Airport
- Precipitation delivers sediment and nutrients
- Layer of fresh water contributes to stratification
- Algae blooms deplete oxygen, which is not replenished below the pycnocline

Processes that contribute to low DO in Chesapeake Bay

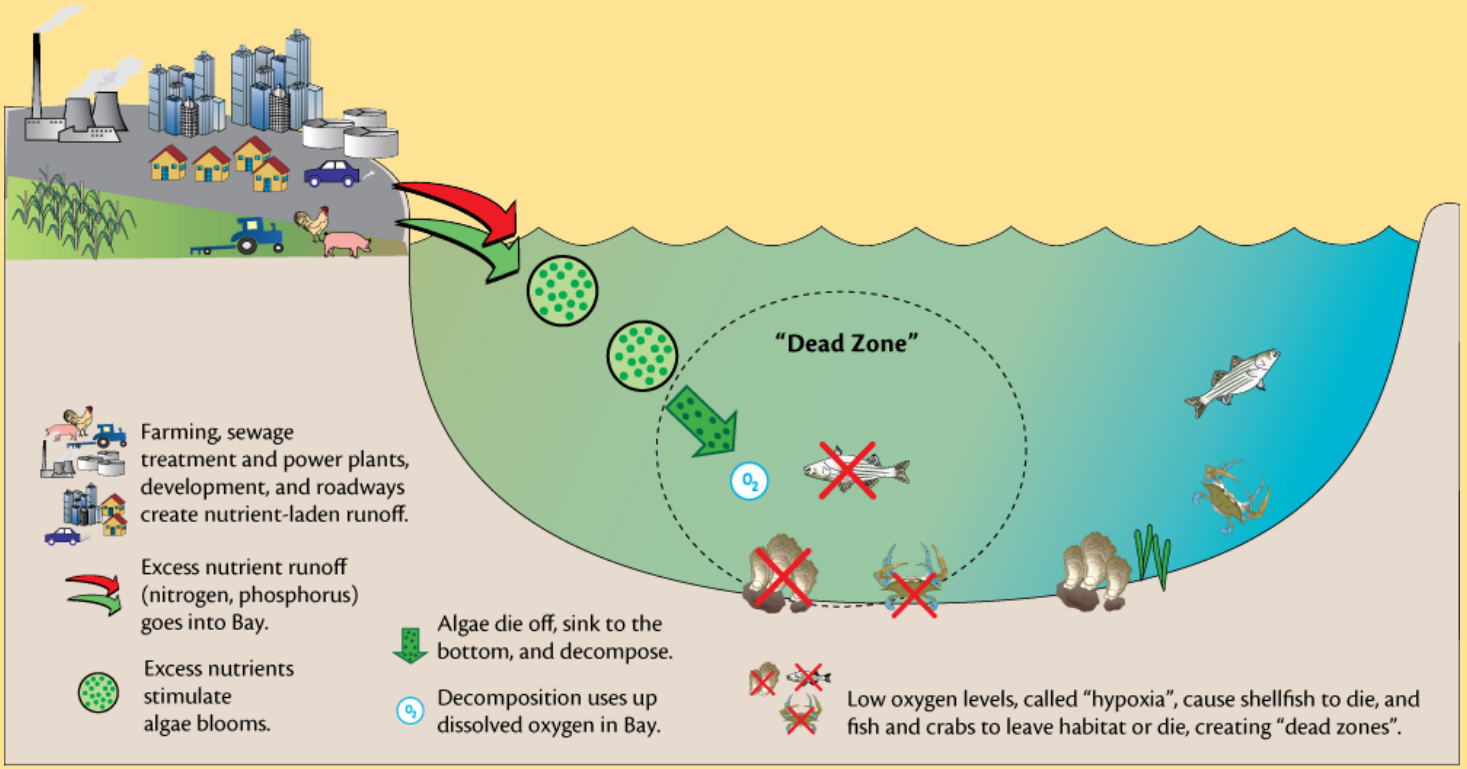
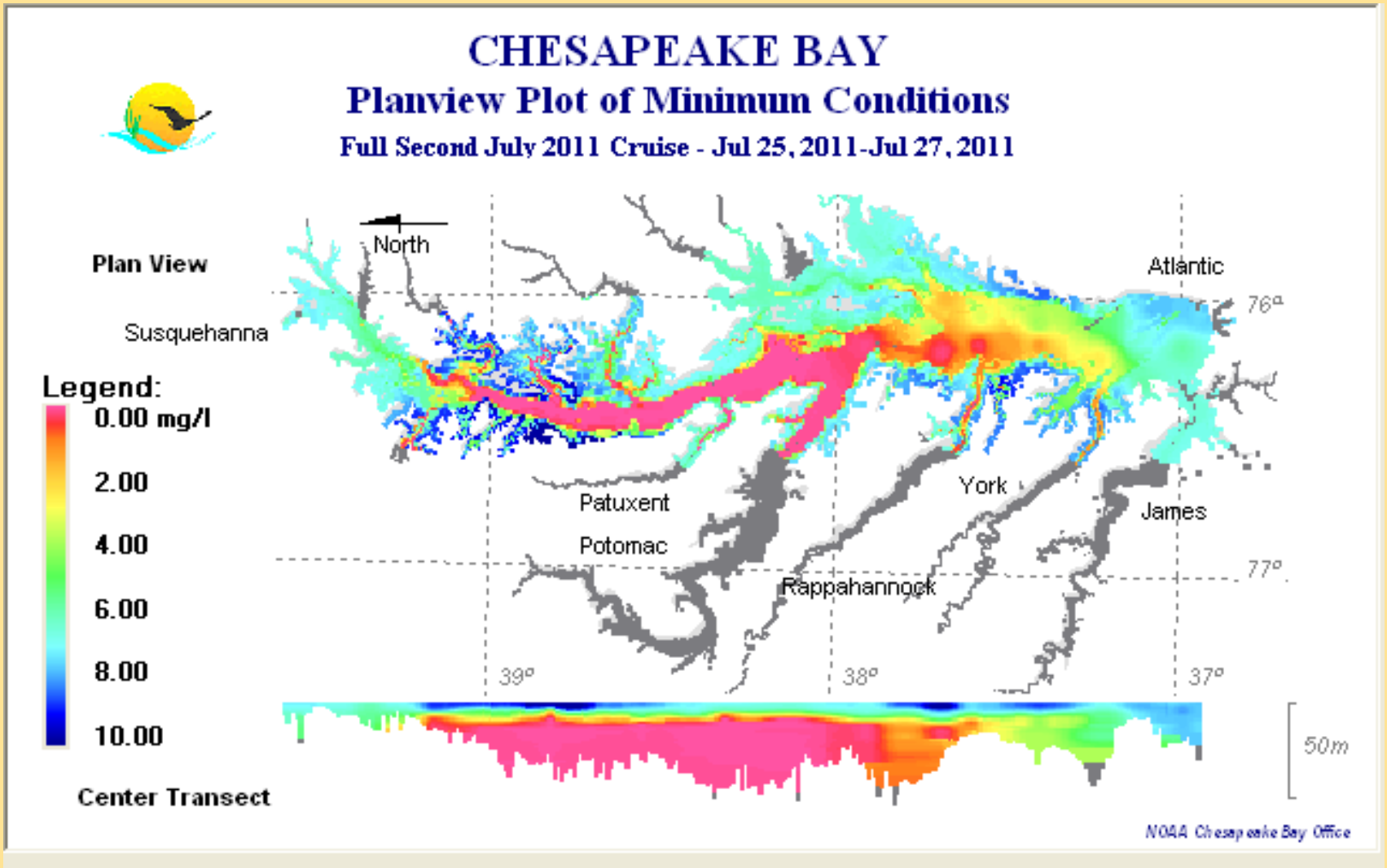
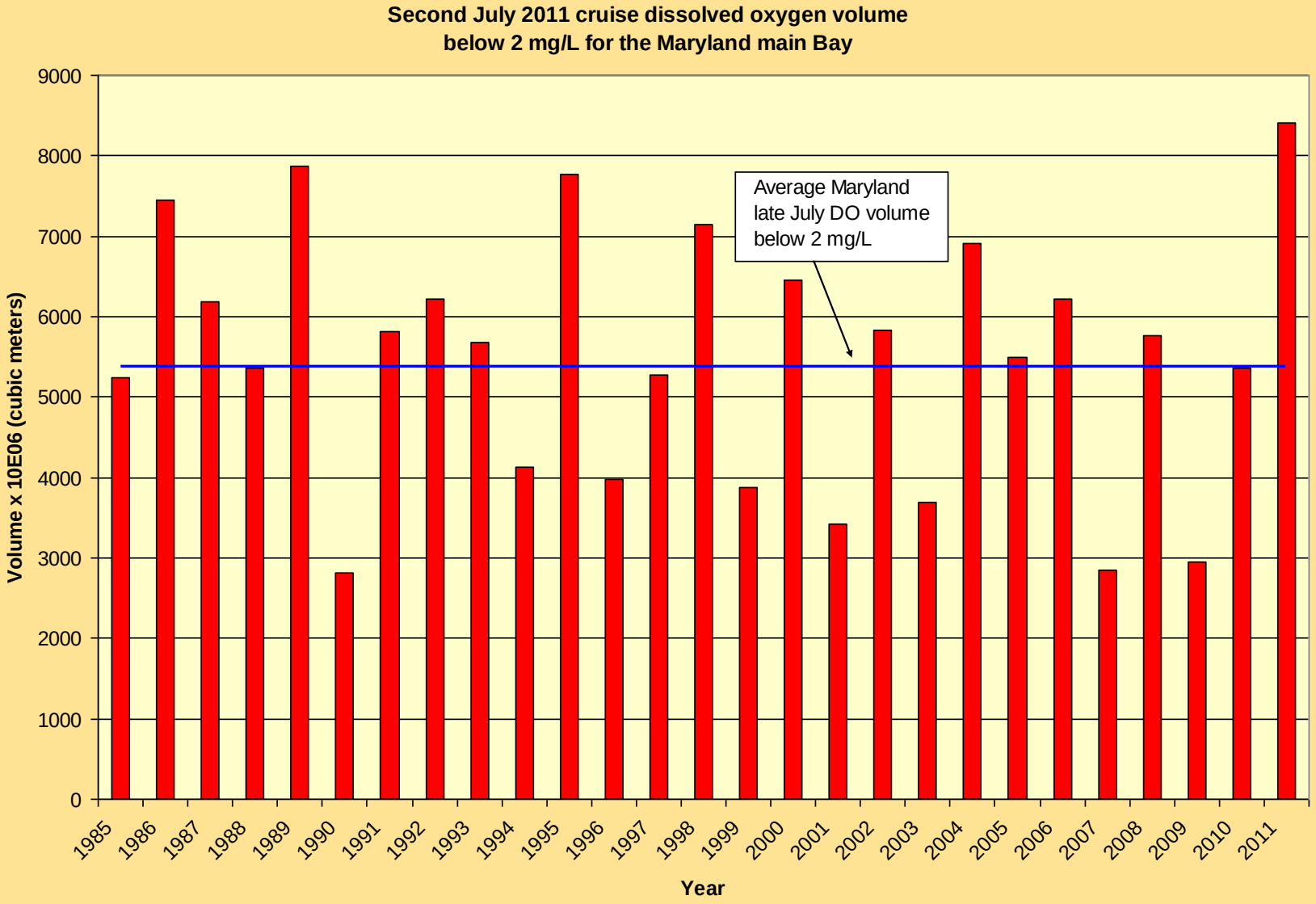


Diagram courtesy of Integration and Application Network (ian.umces.edu)

Interpolator plot for second July 2011 cruise

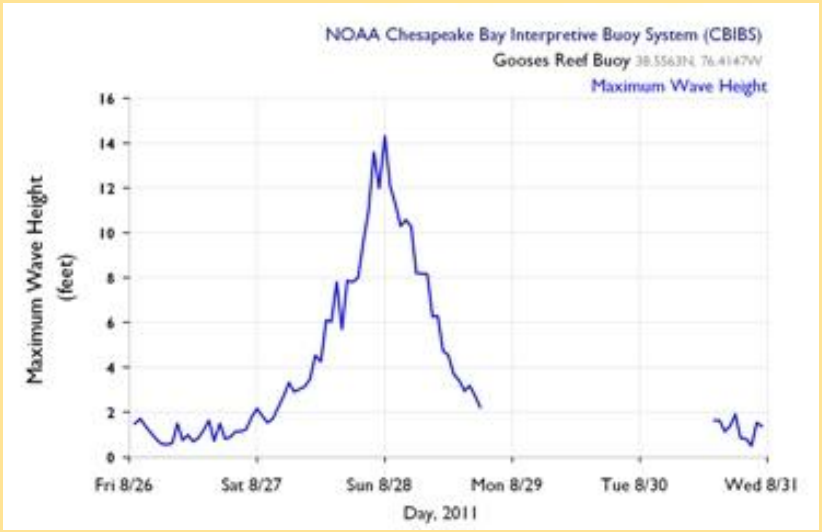


Volume of water below 2 mg/L calculated with the interpolator for second July 2011 cruise



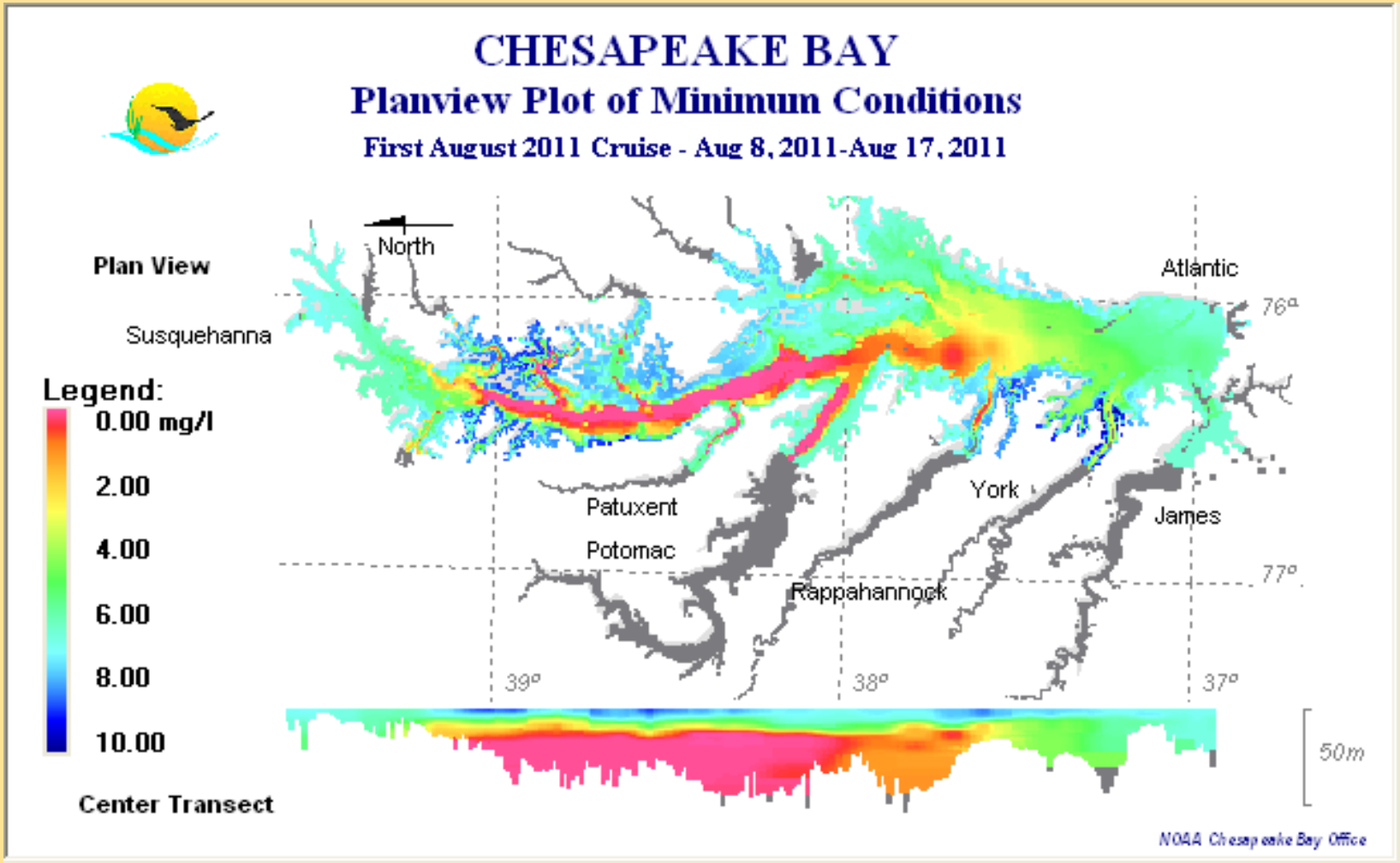
Dissolved oxygen in the Bay is also influenced by mixing events

- Strong wind is capable of mixing Bay waters and breaking up the pycnocline that separates upper oxygenated water from bottom low DO water
- Hurricane Irene hit the Bay region in late August 2011
- Sustained wind speed of close to 40 knots and gusts over 50 knots on the Bay

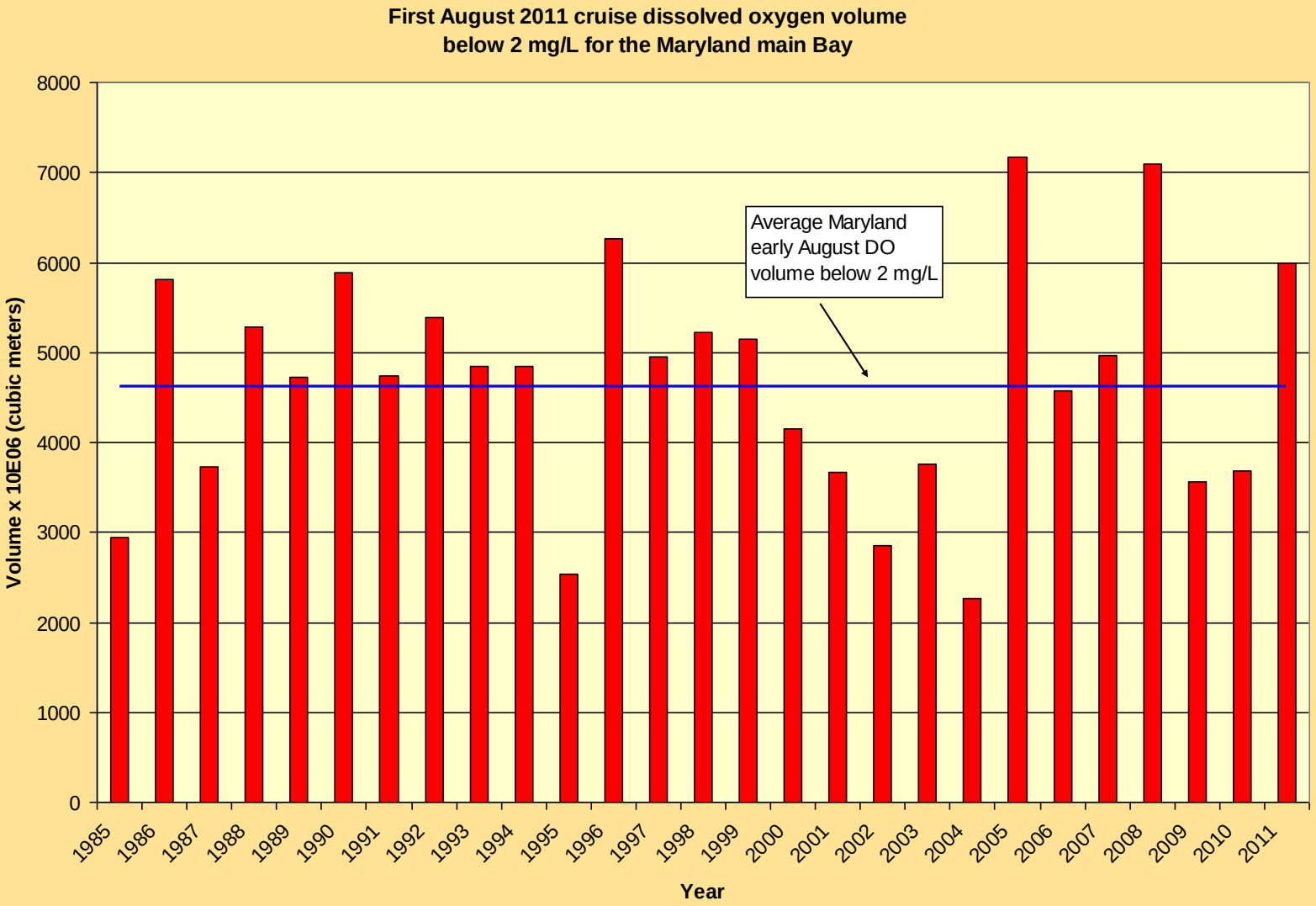


NOAA – Chesapeake Bay Office / MD DNR GOOSES Buoy

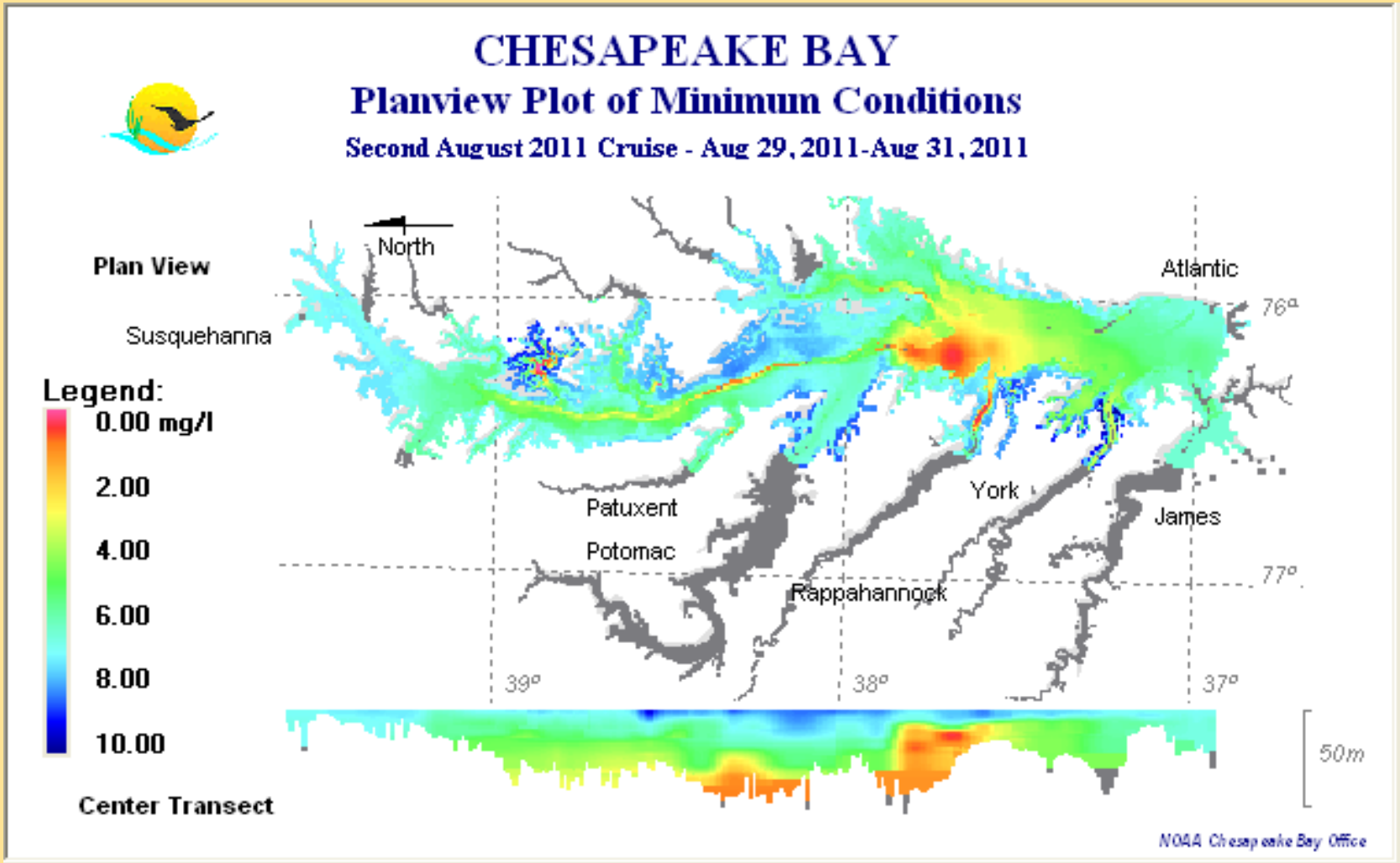
Interpolated DO data before Hurricane Irene



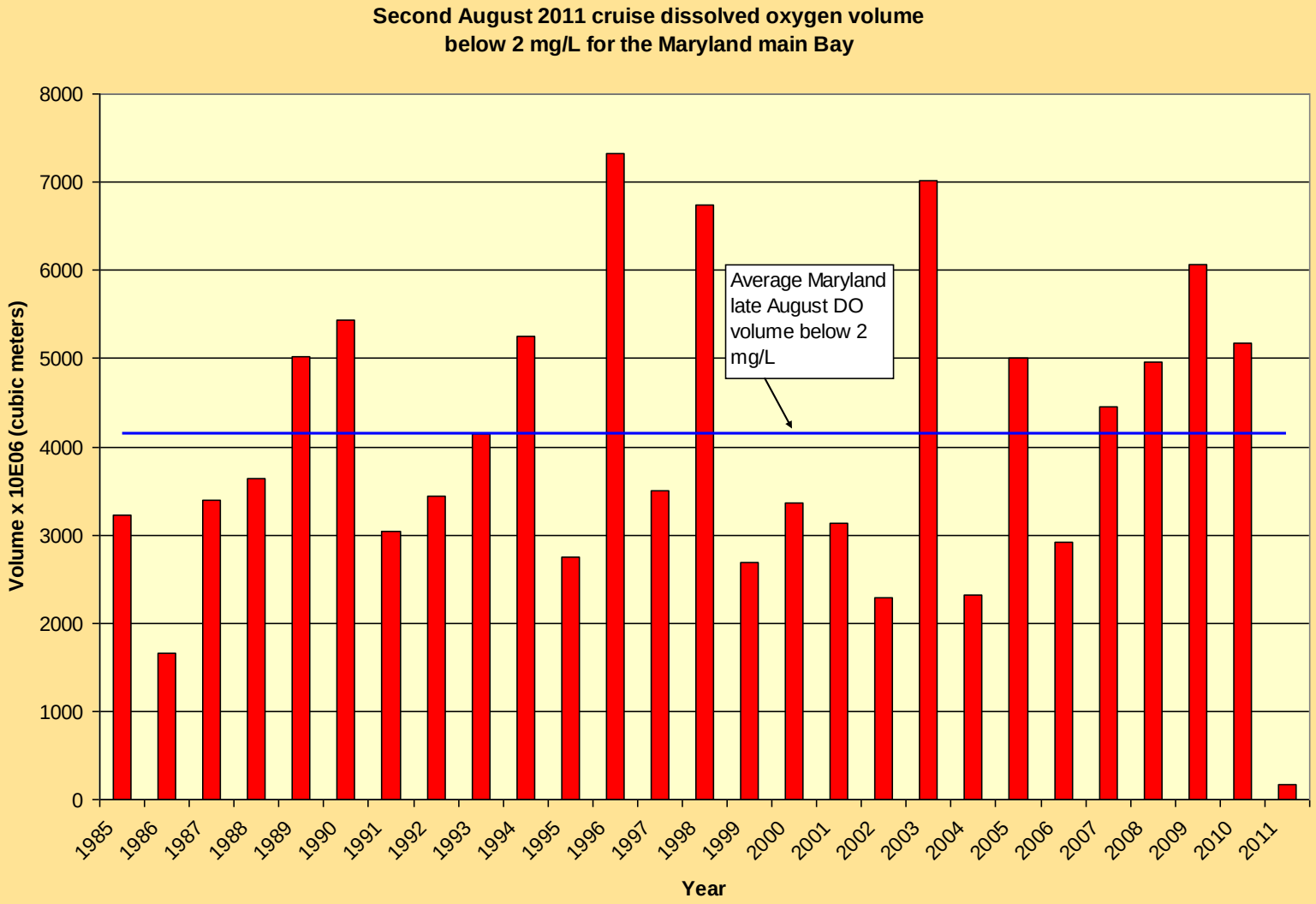
DO volume below 2 mg/L well above average before Hurricane Irene



Interpolated DO data after Hurricane Irene

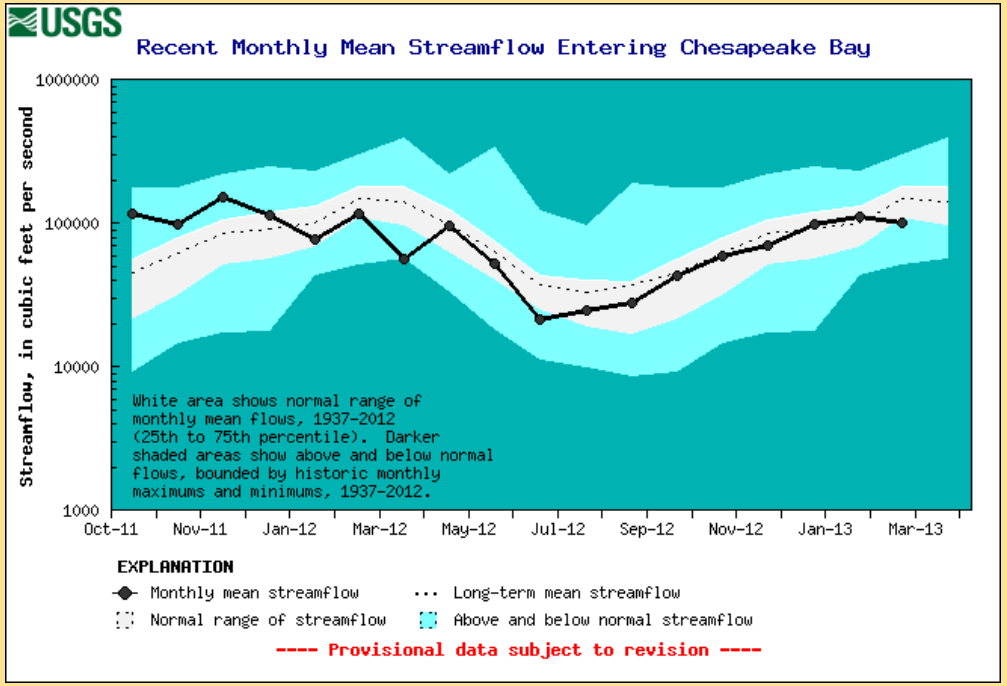


DO volume below 2 mg/L all but disappeared after Hurricane Irene



Dissolved oxygen is also influenced by low flow to the Bay

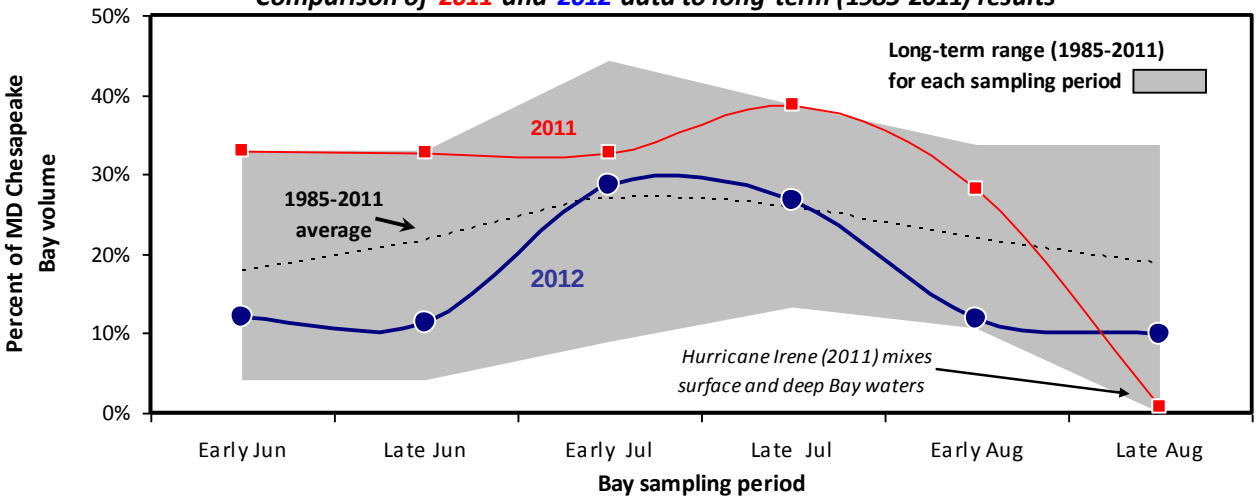
- Stream flow entering Chesapeake Bay was near the historic minimum in March 2012
- Flow returned to the normal range in April and May, but dropped to below normal in June
- Flow was in the normal range for the rest of the summer, but low



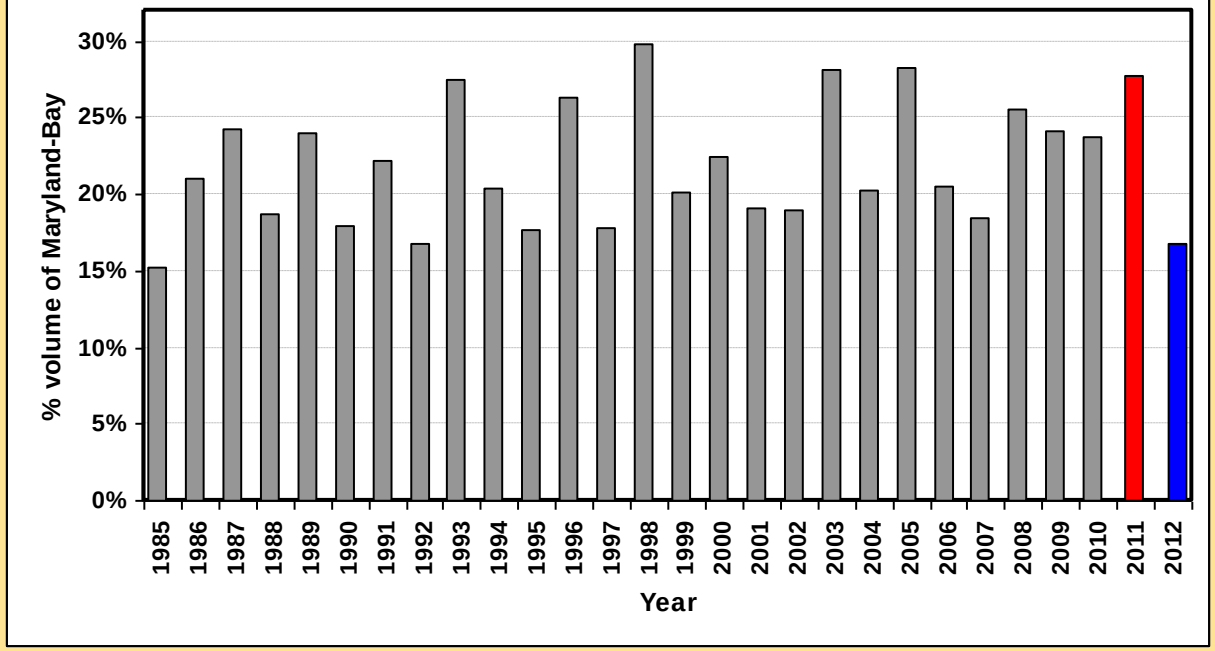
http://md.water.usgs.gov/waterdata/chesinflow/recent/

Seasonal volume of low dissolved oxygen waters (< 2 mg/L) in Maryland portion of mainstem Chesapeake Bay.

Comparison of 2011 and 2012 data to long-term (1985-2011) results



Average summer volume of "Dead Zone " in Chesapeake Bay (Maryland) (June-August, 1985-2012)



Comments and questions

http://www.mdkidspage.org/BayBridge.htm