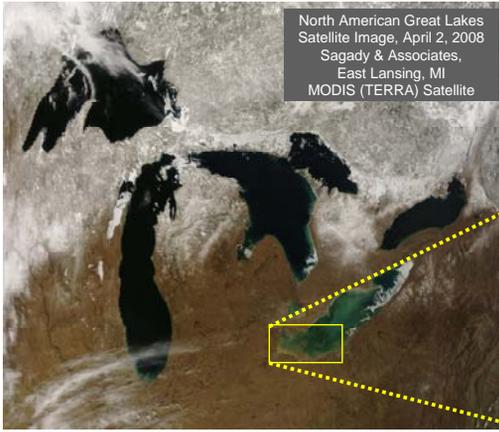


Coastal Eutrophication and Hypoxia: Expressions of a Global Problem in the Western Basin of Lake Erie

North American Great Lakes Satellite Image, April 2, 2008
Sagady & Associates,
East Lansing, MI
MODIS (TERRA) Satellite

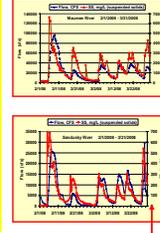


Runoff of nutrients from agricultural lands and from inadequately treated sewage represents a major pollution problem in many coastal areas of the globe. These nutrients, especially phosphorus and nitrogen, result in eutrophication. Eutrophication is characterized by excessive growth of harmful algae and by hypoxia – the development of zones of low dissolved oxygen concentrations. Both of these conditions degrade coastal ecosystems and adversely affect human populations. The Gulf of Mexico, Chesapeake Bay and Lake Erie are three coastal areas in the United States that illustrate coastal eutrophication.

Within the Great Lakes, the western and central basins of Lake Erie are most heavily impacted by nutrient and sediment runoff. These basins are very shallow, and, as the southernmost of the Great Lakes, contain the warmest water. Land use within the watersheds draining into the western basin is dominated by intensive row crop agriculture. The nutrient losses per acre of cropland from these watersheds are among the highest in the United States.



Western and Central Basins Lake Erie Satellite Image, April 2, 2008
Sagady & Associates, East Lansing, MI.



Orientation to Western Lake Erie

LANDSAT 7 Image, January 2, 2007

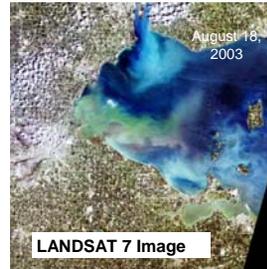
These satellite images and aerial photographs illustrate sediment pollution and algal growth in the coastal zones of western and central Lake Erie.



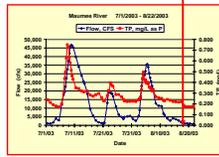
The National Center for Water Quality Research (NCWQR) at Heidelberg College has been measuring the transport of nutrients and sediments at selected river stations since 1974. The locations of our current sampling stations are shown in the adjacent map. The stations are located at U.S. Geological Survey stream gages where continuous stream flow data are available. The NCWQR uses automatic sampling equipment at each station to collect samples every eight hours, year round. The samples are returned to the NCWQR laboratories at weekly intervals for chemical analyses. The resulting data sets are used to calculate the tons of nutrients, sediments, and pesticides exported from the watersheds upstream from the sampling stations.

One use of the NCWQR data sets is to develop linkages between storm event loading of nutrients and sediments into Lake Erie with the resulting patterns of sediment dispersion and algal growth in the Lake. Suspended sediments carry attached nutrients and serve as a marker for dissolved nutrients that accompany eroded sediments from cropland.

The graphs below each satellite image or photo show the storm runoff events that occurred in the days preceding the satellite image. Each graph shows the stream flow in cubic feet per second and the concentration of suspended sediments or total phosphorus at the monitoring stations. The rainfall on the watershed that generated the runoff event generally preceded the peak flow at the monitoring station by two to four days.

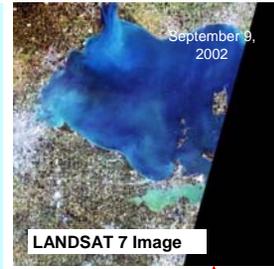


LANDSAT 7 Image

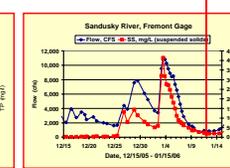
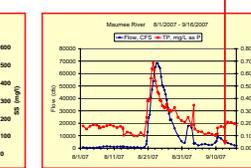
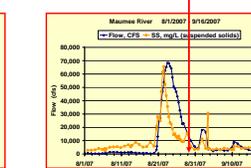
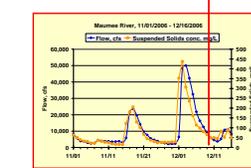
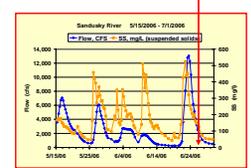
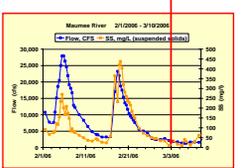
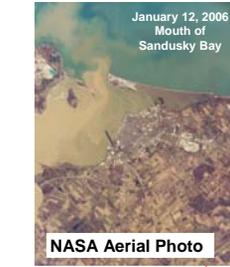
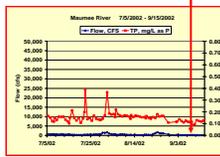


In July and August 2003, three major runoff events occurred in the Maumee River (left). That summer had the most severe blue-green algal blooms that have been observed in recent years.

In 2002, there were no significant runoff events in the Maumee River (right). That summer had the smallest algal growths observed in recent years. Sandusky Bay contained dense algal blooms in both years.



LANDSAT 7 Image



If upward trends of dissolved phosphorus runoff from cropland continue, conditions in western basin of Lake Erie may deteriorate even more.

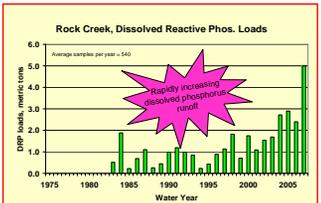
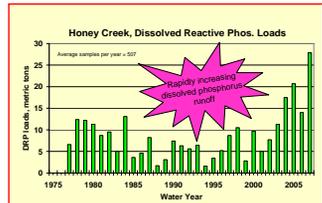
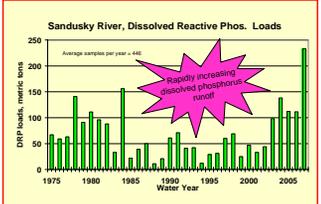
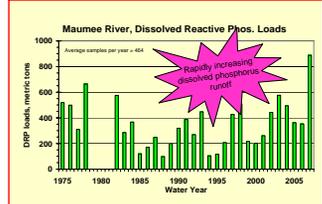
Agricultural pollution abatement programs in northwestern Ohio have focused on reducing sediment and particulate phosphorus runoff to the lake, using a combination of reduced till and no-till cropping systems, along with buffer strips. NCWQR river monitoring programs have documented the success of these efforts.

Unfortunately, the crop production methods that have accompanied these conservation tillage programs have resulted in major increases in dissolved phosphorus runoff. Since dissolved phosphorus is particularly effective in stimulating excessive algal growth, the increases in dissolved phosphorus are suspected of being a significant contributor to the worsening eutrophication problems in Lake Erie.

Current farming methods that contribute to excessive dissolved phosphorus runoff include:

1. Phosphorus accumulation in the surface layers of soil, in the absence of tillage that inverts the soil.
2. Fall and winter surface applications of fertilizer and manure without incorporation.
3. Maintenance rather than draw-down applications of phosphorus fertilizers, where justified by soil tests.

The NCWQR has recently received two major grants to work with the agricultural community to address the problems of increasing dissolved phosphorus runoff.



Annual dissolved phosphorus export (tons) from northwestern Ohio watersheds, as measured by the NCWQR at Heidelberg College.

Web sites for more information

1. <http://wqi-data.heidelberg.edu> for NCWQR tributary loading data.
2. <http://landsat.ohiolink.edu> for LANDSAT 7 images of Ohio.
3. <http://heidelberg.edu/wqi/> for general information about the National Center for Water Quality Research at Heidelberg College.
4. <http://www.heidelberg.edu/academiclife/academicinformation/departments/waterresources> for information about Heidelberg's Water Resources Major.
5. <http://www.epa.state.oh.us/dsw/cafo/PTaskForce/PTaskForceWorkgroup.html> for information about Ohio's Lake Erie Phosphorus Task Force.

For questions about this poster and its contents, please contact Dr. David Baker, National Center for Water Quality Research, Heidelberg College. (dbaker@heidelberg.edu). This poster was produced under Project # 833 from the Great Lakes Protection Fund. Students interested in looking into possible independent study projects relating to the linkage of satellite images with the NCWQR's tributary loading data should contact Dr. Baker.

