Mixing processes and oxygen depletion in the central basin of Lake Erie: current status of lake recovery

William J. Edwards, David A. Culver, Chris R. Rehmann, David Rockwell, and Sandra Hellman

Abstract: Phosphorus inputs into Lake Erie steadily decreased from 1975 to 1982, when point source target loading goals were met, but the lake has been slow to recover. Nutrient regeneration from anoxic sediments contributes to the problem. Oxygen depletion in the central basin of Lake Erie has been a topic of intensive study by the USEPA since the 1970s, including annual late-summer monitoring of oxygen concentrations at 10 offshore stations. Anoxia in the central basin has continued to occur, and recent USEPA data show that phosphorus concentrations in the basin have increased over the last few years. Variation in the thickness of the hypolimnion and recent declines in water level suggest that the physical processes of mixing need to be incorporated into models of oxygen consumption in the central basin.

Staff of USEPA’s RV Lake Guardian visited 10 central basin stations on 21-22 July 1999 as part of their long-term oxygen depletion study. Using a Seabird CTD they sampled dissolved oxygen, fluorescence, temperature, and photosynthetically active radiation (PAR) with depth. We also sampled the above parameters using a temperature gradient microprofiler (TGMP). Total phosphorus, soluble reactive phosphorus, nitrate, ammonia, and chlorophyll a were sampled using Niskin Bottles at six depths at each site. In addition, one site was sampled over a 24 h period to evaluate diel changes in mixing, including penetrative convection and shear, which may impact the development of anoxic
sites. We are evaluating eddy diffusion coefficients to determine the fluxes of oxygen into and out of the hypolimnion and sediments using temperature gradient microstructure from the TGMP. At the same time, we are comparing the oxygen profiles with those from the CTD to enable a comparison of previous years’ data.