The Lake Michigan Mass Balance Program (LMMB) - Fluxes of Carbon and Nutrients

Primary Investigator: Brian Eadie - NOAA GLERL (Emeritus)

Overview

This project provides specific data related to the needs of the EPA-sponsored Lake Michigan Mass Balance Study (LMMB), which seeks to determine a mass balance of inputs and outputs of select contaminants for Lake Michigan. The LMMB Study is designed to answer questions posed in the amended Clean Air Act, and to assist environmental managers in developing and implementing the Lake Michigan Lakewide Management Plan.

The overall objective is to quantify the absolute flows of target contaminants (PCB, trans nonachlor, Atrazine, and mercury) through the Lake Michigan Ecosystem and to test the applicability of mass balance models to simulate those flows.

GLERL’s specific objectives for this project are:

- Quantify the seasonal fluxes of mass, organic carbon, nitrogen (and provide sub-samples for associated contaminant analysis) from the surface waters to near the sediment-water interface from our sediment traps
- Coordinate analysis of carbon, stable isotopes, nutrients and organic contaminants from the surface 0-1cm intervals of 131 sediment samples.
- Coordinate analysis of sediment profiles of PCB congeners at 3 sites where geochronology implies sedimentation has been well-behaved. These data will be used to deconvolve source functions for the northern, central, and southern basins of the lake for the PCB models.
- The overall strategy of this field study is to carefully characterize the settling flux of organic matter and chemical contaminants to surface sediments during an approximately 14 month field collection (1994-95)
Scientific Rationale

During the past two decades, inventories of persistent, bioaccumulative organic contaminants have decreased dramatically in the Great Lakes ecosystem, clearly demonstrating the effectiveness of regulatory decisions about the production and use of certain classes of industrial and agri-chemicals. Unfortunately, the rate of decline in PCB levels in the Great Lakes ecosystem has apparently slowed during the second half of the 1980’s and the most recent data shows little or no change in PCB levels in the Great Lakes fishery. This apparent stabilization of PCB levels near the FDA advisory level (2 mg/g-wet tissue) is problematic for Great Lakes water quality managers. On one hand, the persistence of PCBs in Great Lakes fish has led to the call for additional regulations, as embodied in the Great Lakes Water Quality Guidance (Federal Register, 1993). Others have argued that the decrease in the rate of recovery of PCBs in the Great Lakes is a natural consequence of internal recycling and continental-scale atmospheric exchange, and that further regulations are neither cost-effective or warranted. EPA has selected a mass balance modeling structure as a framework for regulatory decision and is using this program to carefully test this approach.

Accomplishments

- Completed analysis of thousands of sediment samples establishing the best-characterized lake sediment-particle information base for any large lake.
- Submitted sediment trap, surface sediment carbon, grain size analysis, mass fluxes, PCB and trans nonaChlor data; these data have been formally accepted by the EPA.
• Submitted report to the EPA for a chapter in their LMMB PCB final report. This completes all products required by EPA for the LMMB program.
• Hosted two day sediment model development workshop for LMMB in April 2001. Established final criteria for the scope of the sediment transport modeling component of the overall mass balance model.
• Completed PCB and PAH data analysis for surface sediments; calculated estimates of sampling and analytical precision
• Completed analysis of composite approximately 50 cores and measured the PCB inventory within the lakes’ depositional regions - for transport model calibrations.

Plans

Use PCB and PAH data in overall estimates of surface concentrations, accumulation rates, and inventories for the lake

Incorporate PCB, PAH, and trap flux measurements into manuscripts

Report distribution and accumulation of organic carbon and nutrients throughout the lake and an attempt to mass balance those constituents.

Report distribution and accumulation PCB congeners and PAH compounds, among others and an attempt to “fingerprint” various sources for these constituents.

Products

Publications


