NOAA Center of Excellence for Great Lakes and Human Health

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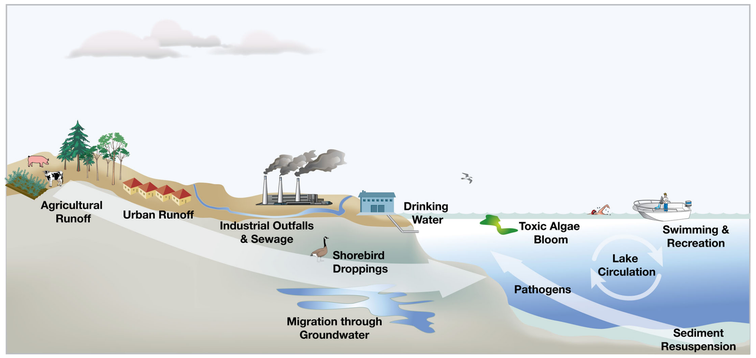
Goal

The NOAA Center of Excellence for Great Lakes and Human Health works to **understand** and **forecast** the inter-relationships between the Great Lakes ecosystem, water quality, and human health with **the goal of predicting and reducing human health threats** in the Great Lakes.

The overall purpose of the Center of Excellence for Great Lakes and Human Health is to use a multi-disciplinary approach to make forecasts that reduce the risk to human health in the Great Lakes in three main areas:

Beach Closures **Harmful Algal Blooms** **Drinking Water Quality**



The ecosystem processes affecting water quality, beach closings, and harmful algal blooms are all similar. Land-use and meteorological processes and events in the watershed determine the fate and probability of transport of bacteria or pathogens to beaches, drinking water intakes, and regions of harmful algal bloom generation. Defining and forecasting these relationships is the research focus of the Center.

Science Behind Forecasts

Ecosystem forecasting predicts the effects of biological, chemical, physical, and human-induced changes on ecosystems and their components.

Beach Quality Forecasting

The Center has been developing models to simulate and predict the river plume characteristics of major tributaries of the Great Lakes based on real-time measurements and predictions of winds, waves, and currents. These models will eventually be linked with existing data on beach bacteria to create models that predict bacteria concentrations at beaches.

Comparison of model simulation to aerial photography of Grand River flow into Lake Michigan on June 6, 2007.

From satellite and coastal modeling to prediction.

Harmful Algal Blooms Forecasting

Research on harmful algal blooms focuses on understanding which factors, such as sunlight, nutrients, and water temperature, influence algal growth and toxin production as well as detecting toxic strains of algae within blooms. Using a combination of satellite imagery, hydrodynamic predictive modeling, and extensive field sampling, we have developed forecasts of *Microcystis* blooms for western Lakes Erie.

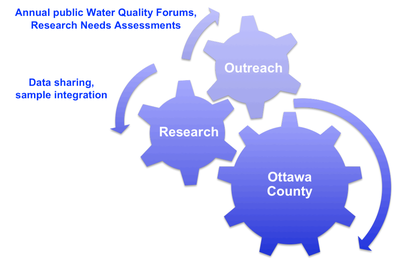
Users

Outreach

CEGLHH's Outreach Program serves two goals. First, to build cross-disciplinary working relationships and information-sharing partnerships **with natural resource/ environmental, public health, and drinking water decision-makers and stakeholders** to disseminate scientific research in a user-friendly format to aid local officials in decision-making.

Grand Haven Beach Forecast Development Partnership

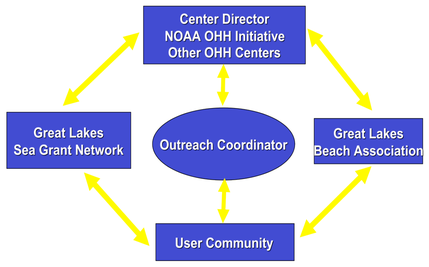
CEGLHH ⟷ **Ottawa County Health Department (coastal western Michigan)**



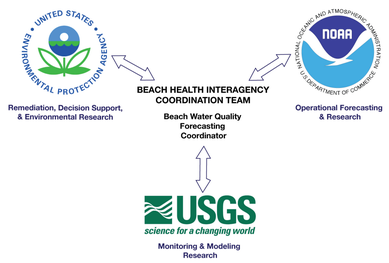
Algae Identification discussion during HAB Training workshop in Minnesota. Co-hosted with Minnesota Pollution Control Agency and Minnesota Sea Grant (above). Credit: B. Liukkonen

Breakout group during HAB needs assessment in Wisconsin. CEGLHH co-hosted with Wisconsin Sea Grant. (below). Credit: K. McKinney.

Second, to work with multiple stakeholder groups to assess user needs and guide CEGLHH research to focus on specific areas that may be of importance and value to beach managers and drinking water quality operators. An example of this is our partnership with Ottawa County, in western Michigan. The extensive field research conducted in Ottawa County for beach water quality forecasting has led to a mutually beneficial partnership of data, research, education, and outreach over the last five years.



Federal Collaboration on Beach Health in the Great Lakes



Collaborative Partnerships

Strong, active partnerships, particularly with the Great Lakes Beach Association (comprised of beach managers, public health officials, and beach researchers) and the Great Lakes Sea Grant Network, provide access to diverse user groups with interests in Great Lakes and Human Health and reinforce information-sharing partnerships. CEGLHH's research embodies multi-institutional collaborations to build on expertise from differing scientific agencies and disciplines. We created and chair the Federal Beach Health Interagency Collaboration Team that brings NOAA, USEPA, and USGS together monthly to align beach forecasting research in the Great Lakes.

Michigan State University · Sea Grant Michigan Sea Grant College Program · NOAA NOS · University of Michigan · USGS science for a changing world

Status

Beach Water Quality Forecasting

Current daily beach monitoring, which uses the 'persistence model' of using yesterday's *E. coli* measurements to determine today's beach bather water quality is not effective in predicting swimming conditions today. This model has been shown to be relatively ineffective and inaccurate, with error rates of up to 50%. Nowcast models using statistical regression methods improve correct prediction of swimming conditions by 20 to 30% or more over the current technology. This swimming information is provided by the afternoon of the same day.

In collaboration with University of Wisconsin- Milwaukee, Michigan State University, and USGS, we are developing high resolution hydrological models to predict runoff and spatially explicit hydrodynamic models that are used to predict currents near beaches. Coupled with the forecasting system, the models will provide real-time nowcasts and forecasts of bacterial transport from point sources. In the past four years, we have developed operational nearshore beach forecasts to predict
The fate of water from tributaries and potential impacts on swimming beaches in 4 locations for 18 beaches. These coastal forecasts are updated six times daily and provide forecasts up to five days in advance.

CEGLHH Operational Nearshore Beach Forecasts

Harmful Algal Blooms

Expansive blooms of *Microcystis* have caused considerable concern to the Great Lakes region due to the use of these waters for drinking water and recreational activities. Microcystin, the toxin, has been observed in both regions above the recommended limit of µg/L and poses a threat to human health. Therefore, the ability to detect the onset and exter of these blooms and forecast their transport and distribution in the water is crucial to help decision-makers reduce human health risks from contaminated drinking or swimming/ recreational water.

Passive remote sensing (from either satellite and fixed-wing platforms) offers the potential for geographically comprehensive assessments of *Microcystis* distribution in near real time Such an approach currently is utilized for the Great Lakes-Lake Erie Harmful Algal Bloom (GL HAB) Bulletin, whereby *Microcystis* blooms are depicted based upon spectral signatur as detected by the medium resolution imaging spectrometer (MERIS; Wynne et al. 2008). The GL HAB Bulletin then relies upon multi-day projections of select physical parameters (e.g. wind velocity/direction, water movement, etc.) to forecast passive bloom transport. Notably, interactive environmental predictors and/or quantifiers for *Microcystis* abundance are not incorporated into Bulletin simulations and as a consequence, actual prediction for, and validation of, *Microcystis* abundance is lacking.

Lake Erie drifter study tracks- August 25, 2010. Harmful algal blooms foul beaches and impact drinking water intakes. Identifying and predicting bloom movement will aid drinking water intakes in making sound decisions to protect human health.