ECOFOR – Lake Erie Update – 5/18/07

WATERSHED: A large proportion of our early efforts has been spent collecting and synthesizing the necessary data for the DLBRM and SWAT models as well as for nutrient budgets and river export load estimation. These efforts are ongoing, but substantial progress has been made. All of the point source phosphorus data for the six jurisdictions around Lake Erie (Indiana, Michigan, New York, Ohio, Ontario, and Pennsylvania) has been collected and is currently undergoing quality assurance checks. Estimates for 2003 are completed, 2004 estimates have been completed except for Ohio and Ontario, and 2005 data are still being checked. U.S. and Canadian climate data from weather stations located around Lake Erie has been collected for the period of record through 2005.

All of the atmospheric loading data has been received from Environment Canada and load estimates have been made. All of the tributary data from Heidelberg College has been aggregated. Tributary data has also been collected from Ontario and Michigan. Data has not yet been acquired for some minor tributaries in Ohio and New York.

Spatial data (mostly GIS data layers) for use in DLBRM and SWAT is currently being collected. We have received assurance of several GIS data layers from the Institute for Fisheries Research at the University of Michigan. They have compiled a large database of GIS data for watersheds surrounding Lake Erie as part of their Lake Erie GIS (LEGIS) project. LEGIS will provide land use maps, digital elevation maps, and stream channel maps for watershed modeling. Soil type GIS layers are also needed for both SWAT and DLBRM, but this data has only been located for the U.S. watersheds around Lake Erie.

Because input data is still being collected, little progress has been made in modeling. However, some important preparations are underway. Nathan Bosch went to College Station, Texas to attend the SWAT Advanced Workshop from October 16-20. Here he learned new sensitivity analysis and calibration techniques useful to the SWAT modeling in the ECOFOR project. These new techniques have already been tested and determined useful on two of the Lake Erie watersheds. Incorporation of the newest SWAT version (ArcSWAT 2005) has begun as well. The new software has been obtained along with supporting materials. Preliminary DLBRM model runs have been calibrated and verified for selected Lake Erie watersheds on the U.S. side.

Planning and thinking has begun on model simulations designed to test future climate change scenarios and agricultural best management practice implementation. Previous work using SWAT in climate change study has been referenced, and a new EPA climate change module (Climate Assessment Tool in BASINS interface) is being explored. A list of potential best management practices that can be simulated with SWAT has been created.

HYPOXIA: The activity of the hypoxia modeling team has been focused on acquiring data and developing and applying level 1 hypoxia models. We have acquired or made a request for all historical Lake Erie data relevant to the assessment and model development of dissolved oxygen in the lake. These data include all available historical data collected by EPA, Environment Canada, States adjacent to Lake Erie, Ontario, NOAA, and specific programs such as the Lake Erie Trophic Study, and IFYLE. Types of data being collected include: lake geometry and bathymetry data, hydrometeorological data, and physical, chemical, and lower food web biological data relevant to hypoxia model development, evaluation and application.

The level 1 models planned in this project are all 1D (vertical) models aimed at identifying the relative importance of the establishment of temperature profile and associated hypolimnion volume due to hydrometeorological factors (i.e., wind, solar radiation) on the timing, duration, and magnitude of hypoxia in the central basin. We have developed a 1D thermal profile model that will be initially calibrated and evaluated against the 2005 IFYLE data. We will develop a

simple 1D dissolved oxygen model that will link to the thermal profile model. The DO model will operate at the same time and space scale as the thermal profile model and will compute the dissolved oxygen profile (with 1D assumptions) as a function of the temperature profile, upper and lower boundary conditions, and various formulations for the rate of water column deoxygenation and sediment oxygen demand. The linked model will initially be applied to the years 1994, 2004, and 2005 because those years have the most developed data sets for driving and evaluating the model. Eventually, we will apply the model to years from 1983 – 2005 (except 1985, 1989, 1995) for which we have complete data sets of required hydrometeorological and dissolved oxygen data in the system. Also, we will apply the model to 1979 (and perhaps some other years in the 1970s if data can be obtained) because it provides a condition with considerably higher phosphorus loading, with which we will evaluate the relative contribution of weather and phosphorus loading on the oxygen profiles.

We have also been reviewing the literature on estimation of modeling uncertainty in an effort to develop a methodology for quantifying model uncertainty for use in this project.

ECOLOGICAL EFFECTS: We are developing a suite of models to explore how hypolimnetic hypoxia impacts ecological interactions and fisheries production in the central basin of Lake Erie. Our ultimate goal is to apply these models to forecast how fish production in Lake Erie would be affected by potential, future nutrient loading scenarios and hypoxia dynamics.

In applying our models, we will build directly on the efforts of other project components (i.e., we will use the output from Watershed and Hypoxia forecasting models as input for our models). Thus, the thrust of our model application efforts will occur towards the end of the project (i.e., after other project components have generated watershed and hypoxia forecasts).

During the current initial phase of the project, we are primarily working to develop and parameterize ecological models. To accomplish this goal we are relying on a variety of existing data: physical measures (temperature, water clarity, oxygen concentration), fisheries harvest data, annual fisheries-independent stock assessments, hydro-acoustic estimates of fish biomass, benthic macroinvertebrate surveys, zooplankton surveys (from optical plankton counter, net collections and pump samples), and fish samples (midwater and bottom trawl caught fish allowing for quantification species-specific vertical distributions and diet contents). Most of these data were collected through the IFYLE (International Field Years on Lake Erie) program and state/provincial agency-based monitoring efforts.

Most of the data which we will use for model development and parameterization have been previously collected and analyzed (primarily through IFYLE-related efforts). However, some previously collected data now require compilation, processing and analyses before they can be used for model development and parameterization. To this end, over the past six months we have analyzed biological data (zooplankton, benthic macro-invertebrate, and fish) and compiled historical fisheries and fisheries-independent data (including manual data entry from paper copies). To assist with these efforts we have hired temporary hourly technicians and a graduate student research assistant.

As we move forward with this project, we will hire multiple post-doctoral scientists who will work on model development and application. We are currently advertising for a postdoc to develop and apply bioenergetic growth rate potential models for Lake Erie fishes.

PRESENTATIONS:

Croley, T.E. Great Lakes Climate Change Thermodynamic Impacts Assessment. Oral presentation at the International Association for Great Lakes Research 50th Annual Conference on Great Lakes Research, University Park, PA. June 1, 2007.

Dolan, D.M., Richards, R.P., Piette, C.M. Improved Spatial and Temporal Total Phosphorus Loads for Lake Erie Ecosystem Models, 2003-2005. Oral presentation at the International Association for Great Lakes Research 50th Annual Conference on Great Lakes Research, University Park, PA. June 1, 2007.

Dolan, D.M., Richards, R.P., Piette, C.M. Regression Analysis of Phosphorous Loading Data for the Maumee River, Water Years 2003-2005. Oral presentation at the International Association for Great Lakes Research 50th Annual Conference on Great Lakes Research, University Park, PA. June 1, 2007.

Ludsin, S.A., Vanderploeg, H.A., Pothoven, S.A., Mason, D.M., Hook, T.O. and Ruberg, S.A. Hypoxia Effects on Habitat and Prey Availability for Rainbow Smelt in Central Lake Erie. Oral presentation at the International Association for Great Lakes Research 50th Annual Conference on Great Lakes Research, University Park, PA. June 1, 2007.

Roberts, J.J., Höök, T.O., :Ludsin, S.A., Pothoven, S.A., Vanderploeg, H.A. and Nalepa, T. The ecological response of yellow perch to hypoxia in Lake Erie's central basin. Oral presentation at the International Association for Great Lakes Research 50th Annual Conference on Great Lakes Research, University Park, PA. June 1, 2007.

Rucinski, D.K., D. Beletsky, J.V. DePinto, D. Scavia, D. Schwab. Model analysis of climate effects on dissolved oxygen in the central basin of Lake Erie. Oral presentation at the International Association for Great Lakes Research 50th Annual Conference on Great Lakes Research, University Park, PA. June 1, 2007.