| criteria | criteria | criteria | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primary author | Chapra and Dolan | DePinto | Leon et al. | Zhang | Obenour | Stumpf | Yerubandi et al. | Rucinski | Auer & Tomlinson | Higgins |
| model name | TP mass balance | WLEEM | ELCOM-CAEDYM | EcoLE | Bayesian CYN | Bloom severity | Lam 9-box | Central basin hyoxia | Great Lakes Cladophora | Cladophora growth |
| short description | Great Lakes total phosphorus mass balance | 2-D coupled EFDC hydrodynamics, SWAN wave model, SEDZLJ sediment transport, A2EM water quality (based on HydroQual RCA model) | 3-D coupled ELCOM–CAEDYM | 2-D CE-QUAL-W2 model | Probabilistic, empirical cyanobacteria forecasting model | Cyanobacterial Index (CI) - phosphorus loading empirical model | NWRI 9-box model of circulation, eutrophication and hypoxia in Lake Erie | 1-D thermal-DO model coupled with POM | Mechanistic Cladophora growth model | Mechanistic Cladophora growth model |
| Spatial configuration | 3 basins in Lake Erie | Western Lake Erie; curvalinear orthogonal grid (~1 km) | 2 km grid with 40 vertical layers | 65 vertical layers (1 m intervals) and 222 longitudinal segments from west to east. | Western Lake Erie | Western Lake Erie | 3 basins x 3 verical water column layers in Lake Erie | 48 vertical layers in central basin | Process (biomass density) model applied in Lakes Huron and Michigan | Process model applied at 5 sites in eastern Lake Erie |
| Nearshore resolution? | No | Yes | Yes | No | No | No | No | No | Applicable to nearshore. | Applicable to nearshore. |
| Responds to meterorologic forcing? | No | Yes | Yes | Yes | No | No | Yes (vertical mixing is calibrated using 1-D thermal model) | Yes | Yes (light) | Yes (light, wind or waves) |
| Temporal domain | Annual resolution; Calibration (1968-2008) | Daily resolution; Initial calibration (2005); refined calibration (2006-09); application and confirmation (2009-2013). | Hourly averages for 190 days in 2002 (mid-April to mid-October) | Daily resolution (May–September); Calibration (1997); Verification (1998 and 1999) | CYN bloom size (dry weight in MT) forecast from "Effective" spring phosphorus load; calibration to 2002-2013 | Summed areal CI (estimate of surface Microcystic concentration) regression against total spring discharge or P loading; Calibration (2002–2011). | Daily resolution; Calibration (1978); Confirmation pre- (1967-1982) and post-Dressenids (years unknown). | Daily resolution; Calibration (1987–2005) | Daily resolution; Lake Huron (May-August 1979); Lake Michigan (July-September 2006) | Daily resolution; May-October 2002 |
| Model outputs/state variables: | | | | | | | | | | |
| Nutrients | Total phosphorus | Reactive and labile DRP; SRP; particulate inorganic and organic phosphorus; algal P and sediment P. Calibrated to total and dissolved P. | Dissolved inorganic nutrients (PO4, NO3, NH4, DIC, and RSi), dissolved organic (DOC, DON, and DOP) and particulate detrital organic matter groups (POC, PON, and POP) | Nitrate, ammonium, phosphate, carbon dioxide, soluble reactive silica, labile dissolved organic matter, labile particulate organic matter, and particulate silica. | Spring (January-June) weighted TP loading from Maumee River | Spring discharge (March-May) and TP loading (March-June) from Maumee River | Total P, SRP | Available (DRP) and unavailable (organic) phosporus | Dissolved reactive phosporus is input from observation data or boundary condition from high-resolution model (ELCOM-CAEDYM) | Soluble reactive phosporus is input from observation data or boundary condition from high-resolution model (ELCOM-CAEDYM) |
| SRP? | No | Yes | | Yes | | | Yes. | Yes | Yes | Yes. |
| T, DO, TSS | No | Simulations compared to continuous monitoring of turbidity, conductivity, and temperature. | Temperature, dissolved oxygen and inorganic suspended solids size classes | Temperature and dissolved oxygen | | | Temperature and dissolved oxygen | Temperature and dissolved oxygen | | Daily turbidity or TSS used to estimate PAR extinction coefficient. |
| Phytoplankton | Trophic condition | Functional groups: green algae, diatoms, blue-green (cyanobacteria). Calibrated to chlorophyll a. | Biomass of five phytoplankton functional groups (early diatoms, late diatoms, cyanophytes, flagellates, "other") modelled, intracellular N and P storage | Non-diatom edible algae, non-diatom inedible algae (dominated by Microysytis), and diatoms. Monod kinetics w/ constant cell stoichiometry. | | | No. | Chlorophyll a (1 functional group) | | |
| Cyanobacteria | No | Yes | Yes. | Yes. | CYN bloom size deived from remote sensing and Bridgeman (plankton tow) data | Cyanobacterial Index (CI) measurments deived from remote sensing and Bridgeman (plankton tow) data | No. | No | | |
| Zooplankton | No | Yes | No. | Cladocerans and life-staged copepods (eggs, nauplii, copepodites, adults). | | | No. | 1 functional group | | |

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| model name | TP mass balance | WLEEM | ELCOM-CAEDYM | EcoLE | Bayesian CYN | Bloom severity | Lam 9-box | Central basin hyoxia | Great Lakes Cladophora | Cladophora growth |
| Dreissenid mussels | Included by increasing TP settling velocity following infestation (~1990) | Yes | No. | Included as external forcing (grazing and nutrient excretion) | | | Included by increasing TP settling velocity following infestation. | No | | |
| Benthic algae? | No | Yes | No. | No | | | No | No | Cladophora biomass density, internal P content and biomass sloughing rate. | Cladophora biomass density, internal P content and standing stock, biomass sloughing rate. |
| SOD | No | | Yes; function of temperature and DO | No. | | | SOD modeled as a function of TP loading. | SOD modeled as a function of TP loading. | | |
| Sediment P release | | Diffusion and resuspension, supported by process (flux and sediment trap) data | ? | | | | Phosphorus sediment regeneration modeled as a function of TP loading. | No. | | |
| Comment | | Chloride used as a tracer of Maumee River transport plume. | Provides boundary conditions for Cladophora models. Weakness in calibration approach? Cyanobacteria predicted to remain a small fraction of the phytoplankton biomass, despite the known occurrence of cyanobacterial outbreaks in the western basin. It was argued that these blooms tend to be episodic and spatially limited events "whilst the available data support the model predictions of a normally low cyanobacterial contribution to biomass". | Dreissenid filtering is modeled as a forcing function. 2-D structure creates difficulties representing Dreissenid density distribution and precludes modeling of nearshore regions of lake. | | Relatively small sample size (n = 10) used for their derivation may be an impediment for their forecast performance and broader application. | Water column transport includes entrainment due to vertical displacement of thermocline. | Water column oxygen demand (WCOD) is calibrated each year of simulation. | Boundary and forcing functions input from data or other models: Light, light extinction, water temperature, shear stress, SRP concentration. | Boundary and forcing functions input from data or other models: Light, light extinction, water temperature, shear stress, SRP concentration. |