NOAA Western Lake Erie HAB Early Season Forecast: Model Recalibration

2026-04-22

The NOAA Lake Erie Harmful Algal Bloom (HAB) Early Season Forecast is released weekly from May-June and provides an estimate of cyanobacterial HAB severity for the upcoming summer bloom season. Prior to the 2026 bloom season, the statistical models used for the Early Season forecast were recalibrated to reflect updates to the Lake Erie cyanobacteria HAB satellite time series. The early season forecast relies on two statistical models developed using historical relationships between bloom severity and either total bioavailable phosphorus (TBP) or freshwater discharge (Q) from the Maumee River during the spring loading season (Mar. 1-Jul. 31). Forecasts use TBP or Q loads based on phosphorus concentrations measured by the Heidelberg University National Center for Water Quality Research and USGS at Waterville, OH (Mar. 1-Forecast Date) plus forecasts (Forecast Date-Jul. 31) of Maumee River discharge from the National Weather Service - Ohio River Forecast Center. The NOAA ensemble model combines two statistical models (Stumpf et al. 2016): 1) a logarithmic relationship between spring TBP loading (Mar.-Jul.) and the maximum annual satellite observed cyanobacterial intensity (CI Max); and 2) a logarithmic relationship between spring Q loading and observed CI Max. From 2016-2023, model coefficients from Stumpf et al. 2016 were used for both the TBP and Q models. A conversion factor (Theil-Sen coefficient) was used to convert CI Max to the 30-day average CI (CI Avg) prior to calculating the annual bloom severity (SI; Stumpf et al. 2016). After the 2023 bloom season, the Stumpf et al. (2016) models were re-calibrated using data from 2012-2023 (Hounshell et al. 2023). SI was then calculated on a logarithmic scale by normalizing the observed CI Avg to the highest (2011) and lowest (2005) annual observed CI Avg following:

$$\mathrm{SI} = \frac{10 * (\log_{10} \mathrm{CI\ Avg}_{\mathrm{Current}} - \log_{10} \mathrm{CI\ Avg}_{2005})}{(\log_{10} \mathrm{CI\ Avg}_{2011} - \log_{10} \mathrm{CI\ Avg}_{2005})}$$

After the 2024 bloom season, NOAA conducted a substantial reprocessing of its satellite imagery to generate a continuous time series from 2000-present across three different satellite missions (MERIS: 2002-2011; MODIS: 2000-2018; OLCI: 2016-present). The updated time series included: 1) New machine learning methods to better align MODIS satellite imagery with MERIS/OLCI (Mishra et al. 2026) and address inconsistencies in the processing of the previous MODIS data set; 2) Updated calibration and atmospheric correction methods for OLCI (NASA CyAN Ver. 6, 2025); and 3) recompilation of the MERIS data set. Ultimately, these updates resulted in the most consistent and complete satellite imagery time series for Lake Erie across multiple satellite missions. Following the new time series, we re-calibrated the two statistical models (TBP and Q) used in the early seasonal forecast to reflect the 2025 time series updates, as well as the CI Max to CI Avg conversion factor using data from 2011 and 2013-2023. The updated timeseries and re-calibrated statistical models are displayed below.

Updated Timeseries

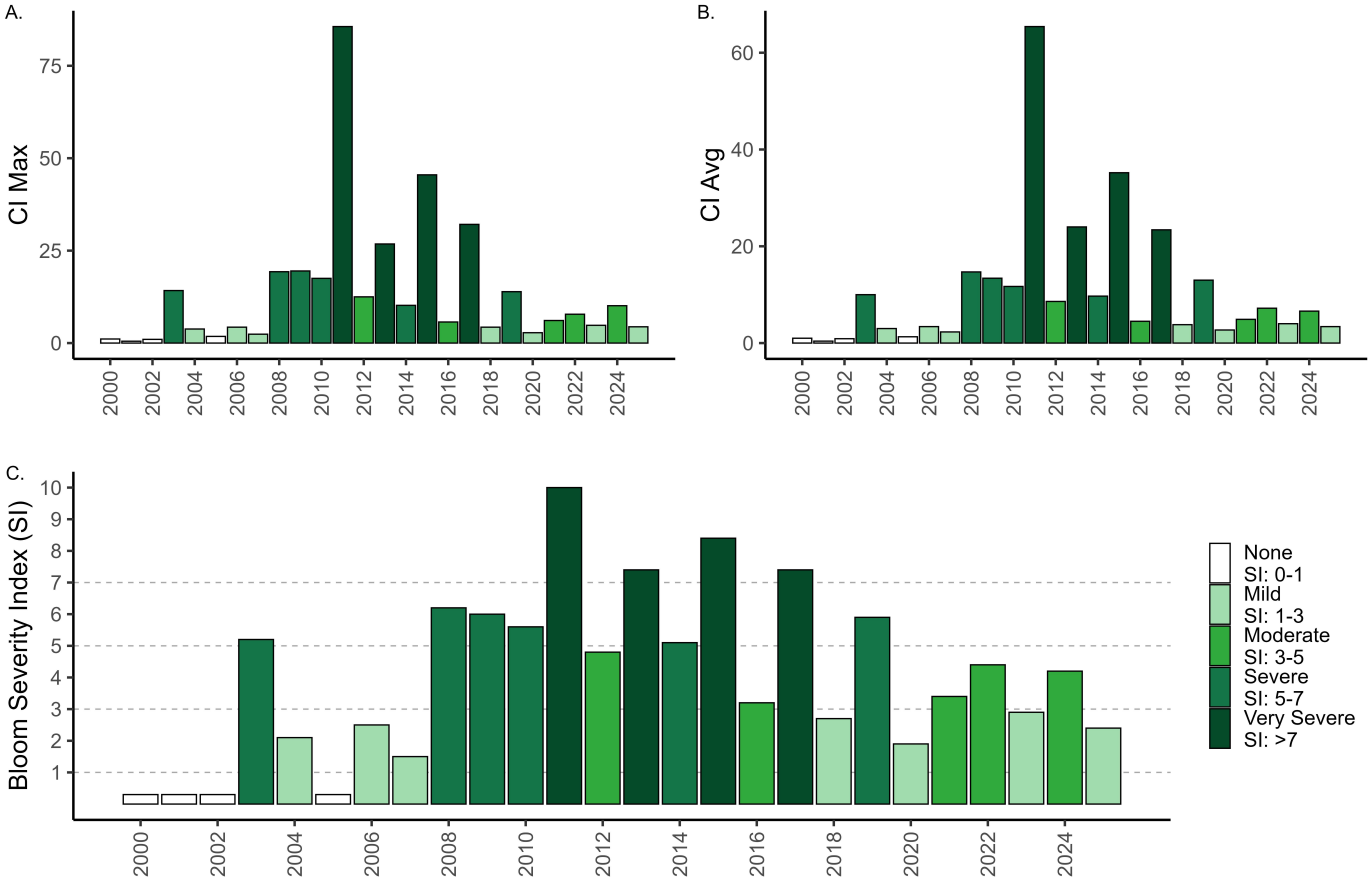

Figure 1. Observed Lake Erie A. Annual maximum CI (CI max), B. 30-day CI average (CI), and C. bloom Severity Index (SI) from 2000 to 2025. Each year is categorized into 'none', 'mild', 'moderate', 'severe' or 'very severe' bloom based on the SI range.

For more information visit: coastalscience.noaa.gov/science-areas/habs/hab-forecasts/lake-erie/

Questions? Contact: hab@noaa.gov

Lake Erie Statistical Model Calibrations

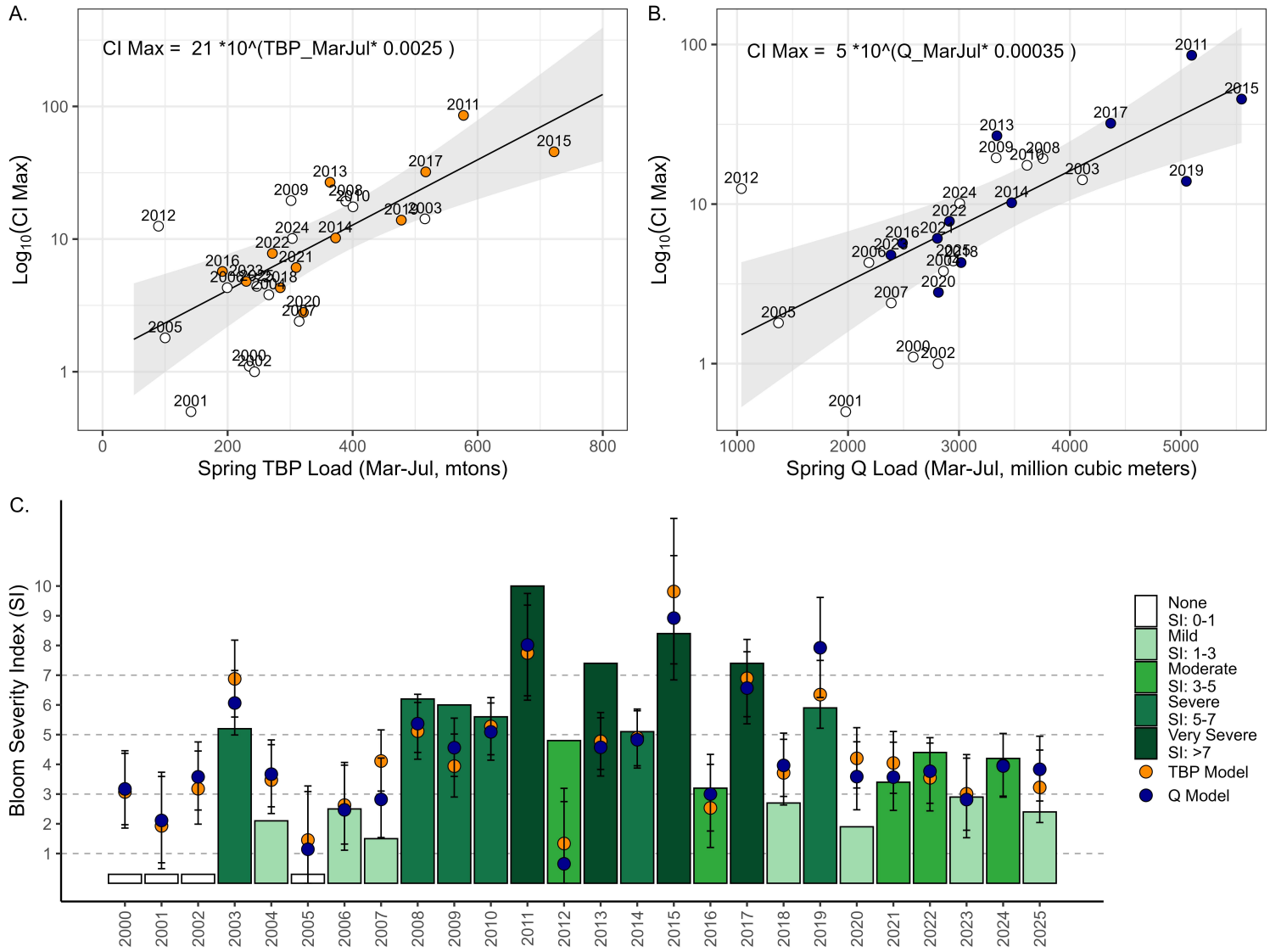

Figure 2. Model calibrations following Stumpf et al. (2016), for both the A. TBP and B. Q statistical models using the updated timeseries (2000-2025). Filled points (orange and blue, for TBP and Q respectively) correspond to years used for model calibration (2011, 2013-2023); white points correspond to years used for model validation (2000-2010, 2012, 2024-2025). The black line represents the model and the gray area corresponds to the 95% confidence intervals. Model equations are displayed on each graph. C. Observed bloom severity (green bars, categorized by annual bloom severity) with the modeled bloom severity for the TBP (orange) and Q (blue) models. Error bars represent 95% confidence intervals based on model uncertainty.