Cyanobacteria blooms exceed WHO thresholds in Midwest lakes

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As of late, the U.S. Midwest has been experiencing harmful algal blooms, such as the one pictured here that formed in Lake Erie in October 2011. Credit: NASA Worldview

The U.S. Midwest is known for its rolling agricultural fields, its many lakes, and, as of late, its harmful algal blooms.

Fertilizer-laden waters running into lakes, rivers, and coastal areas feed

sludgy blooms of algae, some of which are highly toxic. When the nutrients arrive, algae thrive—at the expense of all else. Thick algae mats can block out the Sun, use up the oxygen, choke out the ecosystem's natural aquatic life, and create dead zones. The blooms can also degrade water quality and pose public health hazards, as exemplified by a particularly harmful Lake Erie bloom in 2014. Much remains unknown about when and where the blooms will form on a broad scale, yet these insights are imperative for mitigation strategies.

In a new EPA-led study published in *Water Resources Research*, scientists studied 369 lakes across 15 states in the Midwest during the 2011 "algal bloom season," which typically lasts from July to October in that region. Using a suite of data from the European Space Agency's Envisat satellite as well as on-the-ground observations and measurements, Iiames et al. analyzed variables that affect a lake's risk of developing cyanobacteria blooms such as lakes' shape and depth, land use and vegetation, and soil type and nutrients. Proximity to agriculture emerged as a key risk factor.

Lakes in predominantly crop-cultivated areas "were more likely to be anthropogenically affected than lakes within more natural land cover, like forests," said John Iiames, a research scientist at the EPA's Center for Public Health and Environmental Assessment and lead author of the study. Lakes in agriculturally dominated areas had more severe cyanobacteria blooms, with 56% exceeding original World Health Organization (WHO) thresholds for concentrations of cyanobacteria, the main organism associated with harmful blooms and toxin release. Only 41% of lakes in areas with natural land cover exceeded the threshold. But for both groups of lakes, the average cyanobacteria concentration was above WHO's original "high" threshold (100,000 cells per milliliter) for cyanobacterial concentrations.

In addition to identifying proximity to anthropogenic landscapes like

agriculture and municipalities as a key risk factor, the team presented its overall results as a much-needed tool for land managers and public health officials to help plan water resource management.

"These data can be used by someone at regional or local scales to identify dominant drivers for a particular lake and to see what mitigation efforts could possibly be made," said Iiames.

Although the study was limited to 2011, Iiames said that land cover and land use across the study region between 2011 and 2021 have not changed significantly, suggesting that the risks—and solutions—to these algal blooms have also been consistent.

"This kind of analysis is valuable because it can tell you, even for highly complex ecosystems at a large scale, what the big drivers of pollution are," said Nandita Basu, an ecohydrologist at the University of Waterloo who was not involved in the study. "That makes it easier to go back and really deal with the problem and figure out ways to address them better."

More information: J. S. Iiames et al, Modeling Anthropogenic and Environmental Influences on Freshwater Harmful Algal Bloom Development Detected by MERIS Over the Central United States, *Water Resources Research* (2021). DOI: 10.1029/2020WR028946