While cyano-HABs are strongly influenced by temperature and nutrient loading, the influences of many other environmental parameters are not well understood. Rapid changes in land use, the effects of climate change on precipitation quantity and distribution, and increasing human population pressures on agriculture, energy production, and water use create an interconnectedness that structures ecosystems and increases hydrocomplexity.

High-temporal resolution sensor infrastructure has been installed at strategic sites in Kentucky Lake, the Ohio River, and in agricultural tributary systems in eastern KY and in WV. Sensors are now monitoring a suite of water chemistry parameters (including innovative NO3 and PO4 sensors), weather conditions, and algal pigment concentrations (e.g., chlorophyll *a*, phycocyanin). These data allow for novel predictive watershed-scale model development. We will then be able to better evaluate simulations of nutrient fate and transport dynamics during events (e.g., precipitation, flooding) on smaller streams. The long term goal is to eventually explain and forecast conditions in larger water bodies that are responding rapidly to changing human pressures and perturbations from agriculture, urban development, and energy production.