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# Complexity of Numerical Modeling for Predicting the Mechanisms of Toxic Algae Bloom in Lake

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# Complexity of Numerical Modeling for Predicting the Mechanisms of Toxic Algae Bloom in Lake

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**Abstract:** A three dimensional hydrodynamic ecosystem coupled model was employed to simulate algae transition and toxin produced ability under the nutrients limited conditions in eutrophic Lake Kasumigaura, Japan. Numerical simulation was carried out for the four years of the period 2005–2009. Algae have shifted seasonally and annually between 2005 and 2009, among three major algal: *Microcystis, Planktothrix* and *Cyclotella.* The mathematical model reproduced well the transitions of dominant algae in the four years by calibrating ecological parameters. The biomass of *Planktothrix* suddenly increased in the summer of 2008, and *Planktothrix* became the dominant species. Longer periods of stratification, lower concentration of dissolved oxygen, and higher concentration of dissolved nitrogen were observed in 2008, while the sudden increase in *Planktothrix* biomass in 2008. The models also predicted that the toxins production are made by dominant species of *Microcystis* (*Microcystis aeruginosa,Microcystis viridis, Microcystis ichthyoblabe and Microcystis wasenberjii* (nontoxic) and is proportional to the growth of algae, while it depends on whether phosphorus or nitrogen limits the algal growth. The toxin remains in the cell for respiration. Harmful algae toxin is released with extracellular release and mortality, and advects and diffuses with the surrounding current and turbulence. The degradation of toxin was taken into account by the decay coefficient which crosses the concentration of toxin. Low dissolved oxygen (DO) enhances the release of nutrients from sediment and increase dissolved inorganic phosphorus (DIP) concentration. The models predicted that toxin production behaviors are affected by the dominant algae growth, nutrients limited condition and toxin decay coefficient.

***Keywords****:* Simulation; dominant species; *microcystin* toxin; nutrient limitation; Lake Kitaura, Japan.