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Dynamic modelling of five different phytoplankton groups in the River Thames (UK)

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Phytoplankton play a vital role in fluvial ecosystems, being a major producer of organic carbon, a food source for primary consumers and a relevant source of oxygen for many low-gradient rivers, but also a producer of potentially harmful toxins (e.g. cyanobacteria). For these reasons, the forecast and prevention of algal blooms is fundamental for the safe management of river systems. In this study, we developed a new process-based phytoplankton model for operational management and forecast of algal and cyanobacteria blooms subject to environmental change. The model is based on a mass-balance and it reproduces phytoplankton growth and death, taking into account the controlling effect played by water temperature, solar radiation, self-shading and dissolved phosphorus and silicon concentrations. The model was implemented in five reaches of the River Thames (UK) with a daily time step over a period of three years, and its results were compared to a novel dataset of cytometric data which includes community cell abundance of chlorophytes, diatoms, cyanobacteria, microcystis-like cyanobacteria and picoalgae. The model results were satisfactory in terms of fitting the observed data. A Multi-Objective General Sensitivity Analysis was also carried out in order to quantify model sensitivity to its parameters. It showed that the most influential parameters are phytoplankton growth and death rates, while phosphorus concentration showed little influence on phytoplankton growth, due to the high levels of phosphorus in the River Thames. The model was demonstrated to be a reliable tool to be used in algal bloom forecasting and management.