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Modelling climate change, land-use change and phosphorus reduction impacts on phytoplankton in the River Thames (UK)

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In this study, we assess the impact of changes in precipitation and temperature on the phytoplankton concentration of the River Thames (UK) by means of a physically-based model. A scenario-neutral approach was employed to evaluate the effects of climate variability on flow, phosphorus concentration and phytoplankton concentration. In particular, the impact of uniform changes in precipitation and temperature on five groups of phytoplankton (diatoms and large chlorophytes, other chlorophytes, picoalgae, Microcystis-like cyanobacteria and other cyanobacteria) was assessed under three different land-use/land-management scenarios (1 - current land use and phosphorus reduction practices; 2 - expansion of agricultural land and current phosphorus reduction practices; 3 - expansion of agricultural land and optimal phosphorus reduction practices). The model results were assessed within the framework of future climate projections, using the UK Climate Projections 09 (UKCP09) for the 2030s. The results of the model demonstrate that an increase in average phytoplankton concentration due to climate change is highly likely to occur, and its magnitude varies depending on the river reach. Cyanobacteria show significant increases under future climate change and land-use change. An expansion of intensive agriculture accentuates the growth in phytoplankton, especially in the upper reaches of the River Thames. However, an optimal phosphorus removal mitigation strategy, which combines reduction of fertiliser application and phosphorus removal from wastewater, can help to reduce this increase in phytoplankton concentration, and in some cases, compensate for the effect of rising temperature.