Geophysical Research Abstracts
Vol. 14, EGU2012-13352-1, 2012
EGU General Assembly 2012

Simulating the effect of meteorological variability on a lake ecosystem

M. A. Frassl (1), D. Schlabing (2), M. M. Eder (2), K.-O. Rothhaupt (1), and K. Rinke (3)

(1) Limnological Institute, University of Konstanz, Germany (marieke.frassl@uni-konstanz.de), (2) Institute for Modelling Hydraulic and Environmental Systems, University of Stuttgart, Germany, (3) Helmholtz Centre for Environmental Research – UFZ, Magdeburg, Germany

Water temperature is a main driver of phytoplankton development. On the one hand, temperature directly affects cell metabolism. On the other hand, the hydrodynamic regime with annual cycles of stratification and mixis affects the light and nutrient supply of the algae and thus governs cardinal events of phytoplankton development. This could be the timing of the spring bloom or the maximum biomass attained. However, the response of lake ecosystems dynamics to a changing climate is not only linked to a rising temperature, but also to inter-annual and -seasonal meteorological variability.

Ecological models have proven to provide a useful tool for quantifying effects of a changing climate on lake ecosystems. Especially lake models are convenient for climate change studies as the meteorological input data directly drive the hydrodynamics of the lake, which, in turn, govern ecosystem dynamics. To account for the effect of rising temperature and increased variability, different meteorological time series are needed. A Vector-Autoregressive Weathergenerator is able to provide reliable time-series that sustain dependencies between different meteorological variables. Furthermore, it offers the possibility to run Monte Carlo simulations with past climatic conditions in comparison to scenarios of possible future climatic conditions. It thus provides a tool for both, including statistical properties of meteorological data and assessing uncertainties inherent in deterministic models.

In this study, we applied a one-dimensional hydrodynamic-ecological lake model (DYRESM-CAEDYM) to a large monomictic lake. We ran Monte Carlo simulations with four different “what-if” scenarios (unchanged climate, increased mean temperature, higher variability and the combination of higher temperature and variability) and analysed changes in water temperature and cardinal events in phytoplankton dynamics.

A detailed study on the hydrodynamic response of Lake Constance to climate change is presented on the poster “Advances in estimating the climate sensibility of a large lake using scenario simulations" by Magdalena Eder in the same session “Lakes and Inland Seas”.

For further information on the Vector-Autoregressive Weathergenerator see “Stochastic Downscaling for Hydrodynamic and Ecological Modeling of Lakes” by Dirk Schlabing in Session “Hydroclimatic stochastics” (HS7.5 / NP8.3).