

Seasonal and long-term phytoplankton trait dynamics during trophic change and a regime shift in phytoplankton biomass

1. Overview

The project focused on phytoplankton traits with special emphasis on the statistical distribution of trait values and the average values of different traits of the phytoplankton community. Temporal changes in the community average and in the distribution of the trait values within the phytoplankton community of Upper Lake Constance were investigated at different time scales. The project studied in detail the link between environmental conditions, i.e. trophic change, and average traits of the entire community and of taxonomic groups, to unravel potential mechanism responsible for the temporal changes in the average community traits. The analysis of the statistical distribution of the trait size within the phytoplankton community suggested that trait distributions are often not unimodal and typically not of Gaussian or lognormal type. Trait based modelling with adaptive traits assumes normal or lognormal distributions of the trait values. We therefore tested the potential and the limitations of adaptive trait based modelling for the description of the development of the traits light and nutrient affinity in a simplified phytoplankton community considering resource competition of phytoplankton for light and nutrients in a vertical water column.

The empirical results of the project are based on detailed statistical analyses of over 40 years of biweekly data on the phytoplankton community in Upper Lake Constance (data from the Internationale Gewässerschutzkommission für den Bodensee (IGKB) collected by the Institut für Seenforschung in Langenargen) and of ~100 years of data on the diatom community determined from diatom remains in a sediment core from Upper Lake Constance. The modelling results rely on numerical experiments using a computer code written in the programming environment MATLAB.

In the following, we first present results from the statistical analyses of the traits of the phytoplankton community, we then discuss long-term changes in the diatom community structure and traits based on sediment borne information, and finally we explain the conclusions from the numerical experiments investigating the potential of adaptive trait based modelling.