Title

The determinants of algal trait dynamics in phytoplankton communities over vertical, seasonal, and inter-annual gradients.

Summary

Planktonic communities can be very dynamic and are highly influenced by abiotic factors (physical and chemical) and by biotic interactions. Thereby, these factors select for specific combinations of algal trait values, which offer the best growth and/or lowest loss rates at the respective conditions. A knowledge of which factors and interactions select for which trait combinations provides a deep understanding and predictability of systems. So far, however, most studies analysing the combination of algal trait values and their drivers usually neglect the variability within pelagic systems. Particularly interesting from a trait based perspective is the variability along the vertical axis. Along this axis, opposing vertical gradients of light versus nutrient availability offer in many cases the possibility for a vertical trait separation. The aim of this study is to analyse the influence of abiotic factors and biotic interactions on the vertical algal trait distribution and the corresponding dynamics within and between years. We stress that the vertical dimension is a major determinant of algal community dynamics, which needs to be taken into account for a thorough understanding of these complex systems. We will statistically analyse a long-term dataset from the Rappbode Reservoir, a large and deep drinking water reservoir located in the Harz mountain area. This dataset provides vertically resolved data of the phytoplankton community and the corresponding water quality data for a period of more than forty years. Additionally, we will experimentally test the combined and separate effects of light and nutrient availability on the phytoplankton community by incubating water samples originating from three different depths in a reciprocal transplant design. To disentangle the effects of light and nutrients we will incubate the water using different treatments: dialysis tubes, bottles enriched with nutrients, and bottles without nutrients. We will conduct this experiment at three different dates during seasonal succession. Finally, we will use a vertically resolved mathematical model of the plankton dynamics (phytoplankton and zooplankton) in order to simulate the phytoplankton community composition based on trait selection. The model will be coupled with a physical model of Rappbode Reservoir and allows a realistic simulation of seasonal temperature stratification and mixing. This model allows to generalize the results found from our statistical and experimental work and will provide general and testable predictions about spatial and temporal patterns of trait distributions in algal communities.

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