

Synoptic representation of horizontal and vertical phytoplankton distribution in Lake Mondsee, with a focus on potentially toxic filamentous cyanobacteria

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Lakes are of high regional ecological and touristic importance. Major changes in global climate in the last two decades directly result in a general increase of lake temperatures, longer vegetation periods and stronger thermal stratification. An additional increase in the nutrient loading during periods of heavy precipitation can increase the growth rate of phytoplankton, potentially resulting in a worst case scenario, i.e. so-called algal blooms. Associated with a number of problems are especially cyanobacterial blooms, which have become a worldwide problem due to their production of so-called cyanotoxins. These hepatotoxic compounds can cause diseases in animals and even humans. Despite the fact that the spatial distribution of cyanobacteria in freshwater ecosystems is variable and has important implications for both basic and applied purposes, little research has been devoted to this topic in the past. In this context, the description of spatial and temporal differences in the horizontal and vertical distribution of relevant variables is crucial to understand ecosystem reactions.

The objective of this project is the synoptic lake-wide representation of the phytoplankton distribution in different water layers of Lake Mondsee, with emphasis on cyanobacteria. The project is performed in an interdisciplinary collaboration of the Institute for Limnology (AAS) and the Institute for Geographic Information Science (AAS). The capabilities of Geographic Information Systems (GIS) for the 2D and 3D visualization and analysis of variations in the lake environment over time will be evaluated. The aim is to identify differences in the vertical and horizontal phytoplankton distribution and abundance in relation to ambient key variables (nutrients, temperature, light).

In order to collect specific input data lake-wide, the seasonal phytoplankton abundance is determined by biweekly to monthly field surveys using a multi-parameter fluorescence probe. Moreover, water samples for nutrient analysis are taken and the underwater light climate is assessed. All these data are then used in a GIS modelling approach, intended to visualize and evaluate the effects of these variables on the vertical and horizontal distribution of phytoplankton, respectively cyanobacteria biomass, in the lake. The impact of each variable and the synergetic effect of several variables are assessed using regression analysis tools for spatial data.

A future perspective of this project is the simulation of the physical, chemical and biological dynamics of Lake Mondsee. A fundamental base for adequate future modelling approaches (e.g. hydrodynamic modelling) is the availability of the bathymetry of Lake Mondsee. Therefore, another aim of this project is the development of a 3D view of the bottom of the water body using GIS capabilities.

This project develops a basis for future dynamic modelling of Lake Mondsee by providing high-resolution spatial measurements, bathymetry, and lake-wide, synoptic representation of key variables. This interdisciplinary approach is possible by combining the expertise from various domains such as general limnology, plankton ecology, and Geographic Information Science.