Microplastic particles in lakes: CFD study of the variables affecting their spatiotemporal distributions

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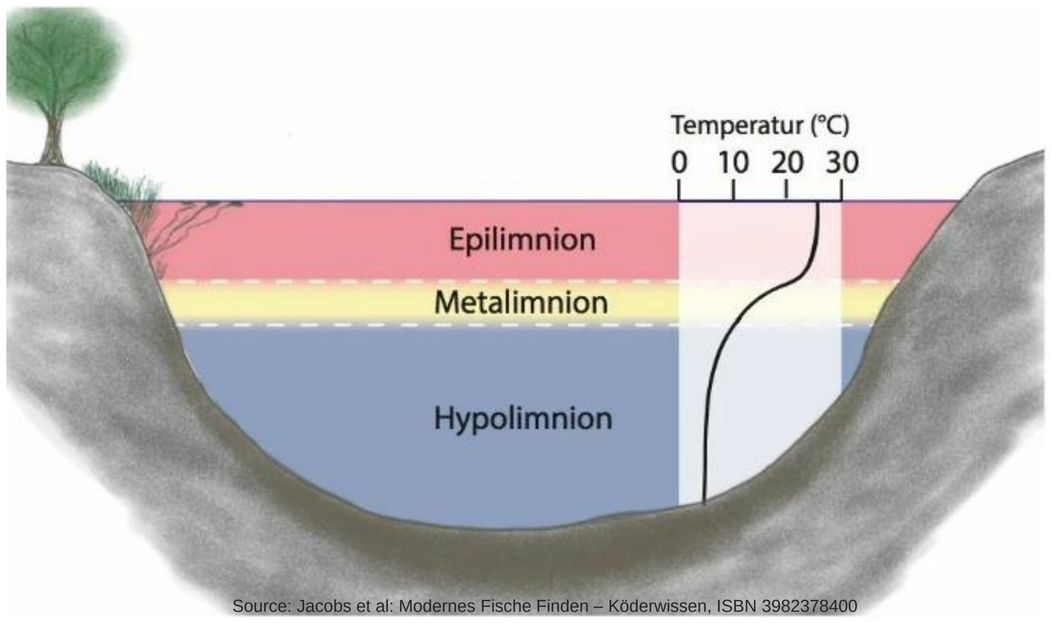
Introduction

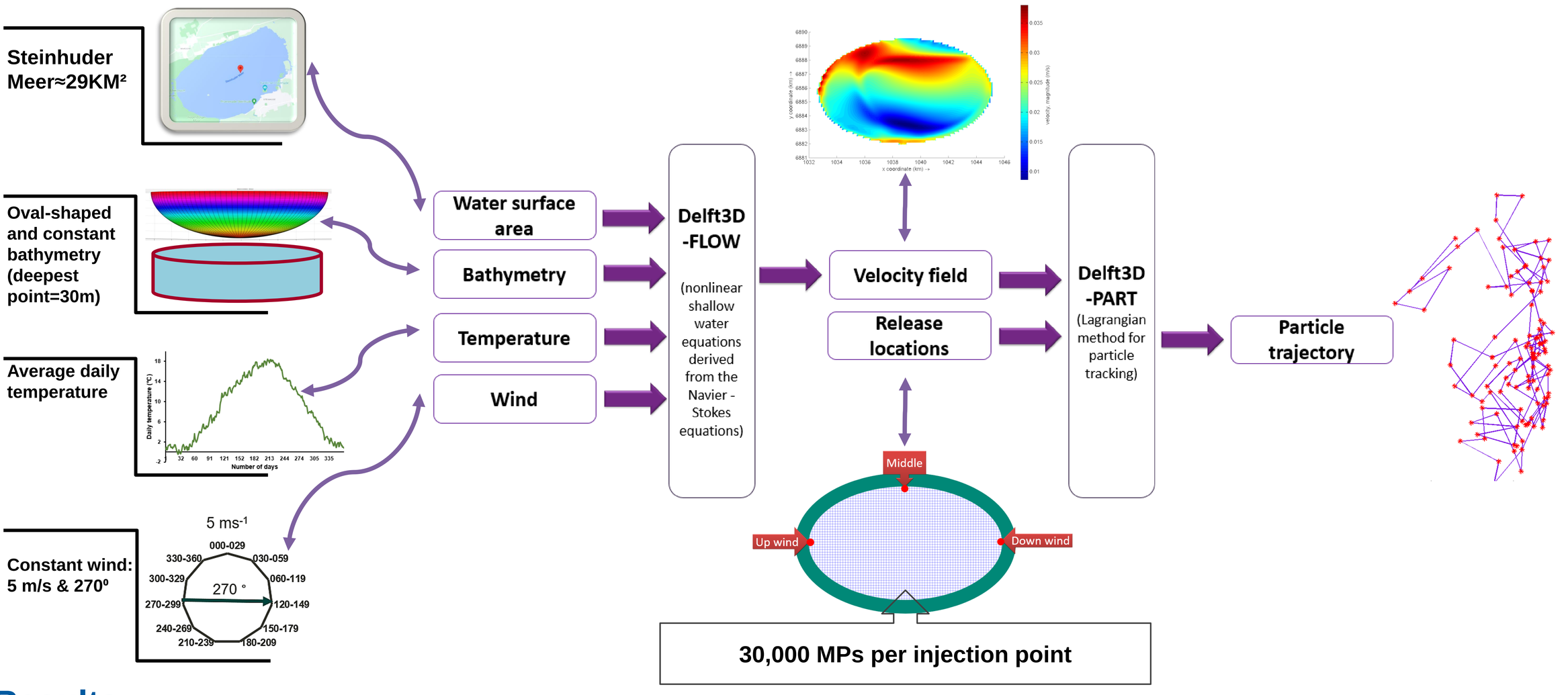
The presence of Microplastic particles (MPs) in lakes, which provide a source of freshwater for both aquatic animals and human beings, is a serious concern. The MPs entering a lake pose a risk of uptake and digestion by aquatic organisms, and consequently threaten the food chain. Lakes in regions with temperate climates are usually stratifying into three main compartments of Epilimnion, Metalimnion and Hypolimnion during summer. The resulting lake hydrodynamics lead to an increased exposure of organisms to MPs.

In this study we investigated the spatiotemporal distribution of the light MPs with terminal velocity of 0.5 $mday^{-1}$ for an elliptical lake with water surface area equal to the lake Steinhuder Meer (Germany, 52.4734°N, 9.3377°E) and constant and oval shaped bathymetries. The simulations were performed using the Delft3D suite and the results were compared in the three main compartments for the whole year of simulation.

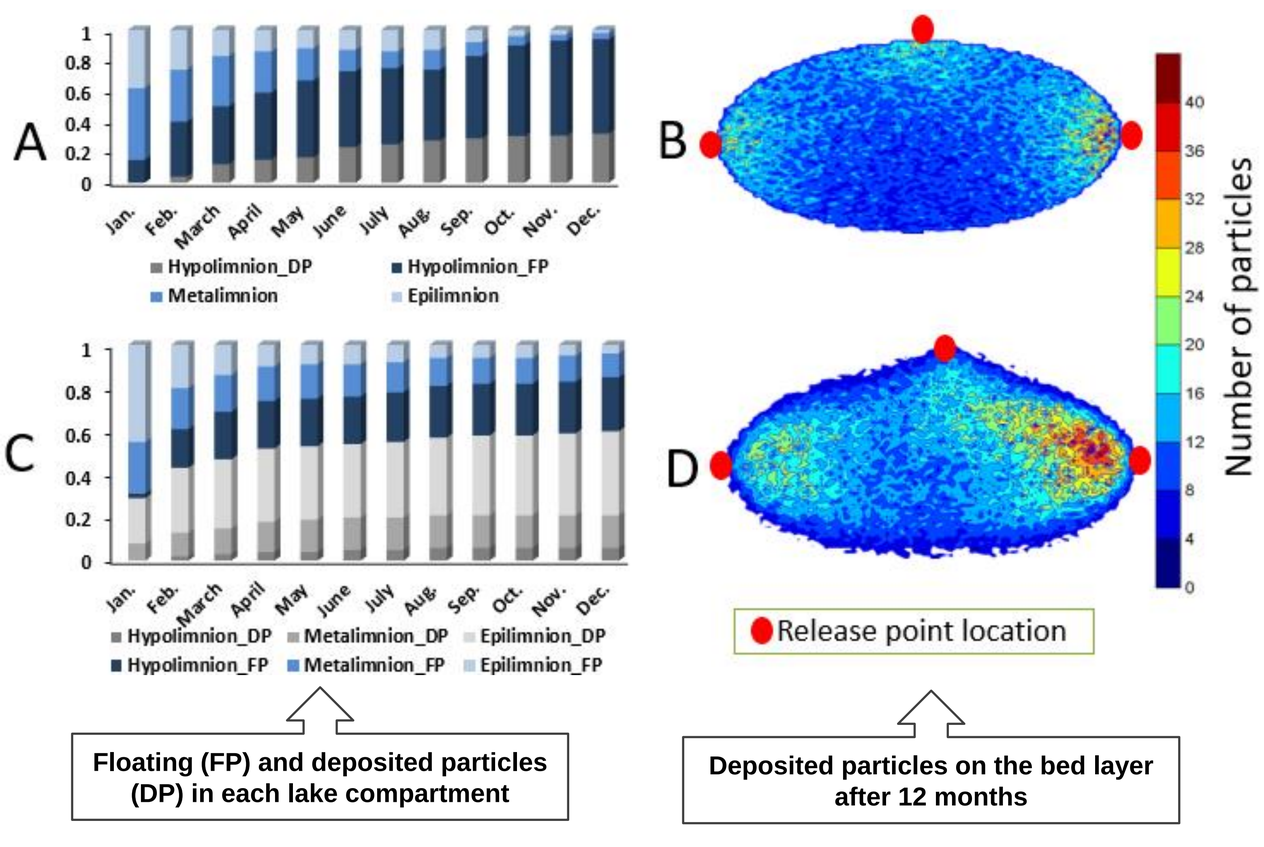


Source: Jacobs et al: Modernes Fische Finden – Köderwissen, ISBN 3982378400

Methodology



Results



The simulation results are depicting the deposited MPs and Floating MPs for the constant (A&B) and oval-shaped (C&D) bathymetries, respectively.

The simulations show that floating and settled particles are more prevalent near injection points and tend to accumulate in the direction of the wind. Therefore, the direction of the wind could also influence the way the particles are deposited on the bed layer. An oval bathymetry favors decreased settling times for the MPs, leading to intensified deposition rates.

During the thermal stratification in summer, the MP settling rates in the Epilimnion and Metalimnion decrease. This effect is more pronounced in the lake with constant bathymetry.

Further scenarios will be explored to determine the role of other physical parameters on MPs distribution in the lakes and will be presented in the near future.

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