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Simulation Study about the Influence of Macrophytes on Hydrodynamics in an extreme shallow Water Lake – Lake Federsee

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Lake Federsee is formed primarily by ice age processes and was subjected to strong siltation processes in post-glacial times, while in the last two centuries anthropogenic impact due to amelioration projects became more important. It has a maximum length of 2.4 km with a maximum width of 1.1 km and an area of 1.4 km2. Lake Federsee is the third largest lake in the federal state of Baden-Wuerttemberg situated in the south of Germany. It is characterized by its very flat bathymetry with a maximum depth of about 3.15 m and an average depth of about 1 m.

In recent years Lake Federsee has undergone a strong reduction of the nutrient content, thus developing from hypertrophic states in the years 1980ies to eutrophic conditions in the years 2000ies. Since 2005 this development is accompanied by a change of the general habitus of the lake converting from a lake dominated by algae to a lake dominated by macrophytes.

Changing successions of aquatic plants have been observed in the lake with strong seasonal variations in the composition and density of the vegetation cover, however forming often an almost complete coverage of the lake.

In the present study the implementation of the hydrodynamic, three-dimensional model FLOW3D for this extreme shallow water lake will be presented. The impact of some numerical parameters will be investigated in a sensitivity study, which is aiming to set up the hydrodynamic model in an optimal way. The influence of the macrophyte population on general circulation processes and the vertical mixing processes in the lake will be discussed. It is shown by numerical simulations studies that both – circulation pattern and mixing processes - are influenced severely by macrophytes in the lake.