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Field investigation of aero- and thermodynamically driven processes at reed-water interface zones in shallow lakes

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Shallow lakes and reservoirs often present extended reed cover with significant spatial complexity. These zones (mostly as littoral ones) differ significantly from pelagic areas as to their aerodynamic, hydro-, sediment as well as thermodynamic conditions, thus various, gradient-driven interaction and exchange mechanisms take place at the littoral-pelagic interface strongly affecting both zones and consequently the whole lake.

The aims of our ongoing research are to reveal the main interaction factors between the littoral and pelagic zones of Lake Fertő (Neusiedler See) as case study, and investigate the dynamics of the processes in the interface zones. In order to do so, two measurement stations have been deployed in both zones near the boundary, where high-frequency synchronised measurements have been conducted to systematically reveal the driving factors and the consequences of the interface zone mechanisms.

As the main driving factor of exchange processes is definitely the wind, to capture its effect, the wind speed and direction were measured with a number of 2- and 3D anemometers at both measurement stations, along with recording also the wind-driven lake currents at several characteristic points of the ambient lake water. Large-scale circulations as well as seiche motion were clearly present during the measurement period depending on the actual wind conditions. In addition, from the lake currents measured at the reed border it was possible to evaluate the water exchange across the interface of the two zones.

For further investigation of the driving effect of wind, the wind profile above the reed canopy was quantified. Friction velocity, aerodynamic roughness height and displacement height were derived and found to be in the order of magnitude of 0.3 m/s, 0.1 m and 3 m, respectively.

In long term, calm conditions, the exchange flow cannot be induced by the wind, in turn, it is thermally driven. In fact, the emergent reed causes different shading compared to the open water, which results in different heating of the surface layers of the water. The horizontal temperature differences developed in such a way cause then horizontal water density gradients thus generating convective motion across the interface zone. To investigate this process, air and water temperature measurements were conducted on multiple heights and depths, respectively, at both measurement stations, based on the data of which vertical thermal stratification and horizontal temperature differences could be analysed.

The data analysis of two measurement periods (May-July and October-November 2012) are expected to provide novel information on the development of occasionally strong horizontal gradients of the above mentioned features at the interface zone. Nevertheless, further measurement campaigns are also planned with modified sensor locations and arrangements, with hopefully even more completed instrumentation set-up.