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Short and long-term impacts of different groundwater regimes on water balance components of shallow groundwater sites

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Water management of shallow groundwater table sites is often the subject of discussions between different interest groups. In many cases these sites have a protection status but at the same time they are important for agricultural land use. The most controversial subject is the manipulation of the water tables which is done by a complex system of streams, ditches and weirs. The target water levels that the interest groups aim for differ in height and in time. The groups present different arguments to justify their targets. However, knowledge about the effects of the different water levels on the water budget components is still limited but it is of great importance to find compromises in water resources management that are satisfying for the different groups involved.
We used groundwater lysimeters to investigate the impact of different water level regimes on the water balance. The lysimeters are installed directly within a typical shallow water table site. In contrast to common groundwater lysimeters they can use the inflow and outflow to the lysimeter to control the lower boundary condition. Compared to standard groundwater lysimeters, this enables the simulation of additional groundwater management options and results in a more natural behavior of the groundwater level and the water balance components in the lysimeter. Our results show that the groundwater regimes have different effects on the water balance components, both in the short-term and the long-term. Evapotranspiration (ET) increases with higher water levels but only if the vegetation is adapted to these conditions. The abrupt increase of the groundwater level resulted in lower ET values in the first year. After the transition of the vegetation to more wetland typical species in the following years the variants with the highest water levels had always the highest ET. It is a typical long-term effect of the groundwater regime. In the short-term the meteorological conditions have the largest impact on the water budget. Short term changes of the groundwater level like higher water levels in spring as part of a management option increase the water storage of shallow water table sites and can help to compensate higher ET for some weeks but not for the complete season. But the effects are superimposed by the meteorological conditions and long-lasting dry or wet spells have a more pronounced impact on the groundwater level. Our results underline the complex eco-hydrological dependencies at such site conditions. The understanding gained can help to find compromises for water management options and can be an important basis for the development or improvement of eco-hydrological models.