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Water retention and runoff retardation in a drained wetland after heavy rainfall events

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Wetlands are often described as a sponge; they are believed to buffer surplus water coming from precipitation or inflow from the catchment and to emit it slowly to the downstream part of the river basin. However, in Middle or Western Europe anthropogenically influenced wetlands outnumber natural ones. In the last 200 years many wetlands have been drained to use the land for agriculture or forestry. Their water balance is nowadays regulated by water management systems consisting of ditches, weirs and sometimes pumping stations. Still, typical wetland characteristics are maintained: Groundwater levels only a few decimeters below the land surface, small surface slopes, high evapotranspiration, the domination of peat soils and extensive grasslands as the prevailing form of land use. Two main issues arise and are discussed in different contexts: (i) the extent to which the behavior of anthropogenically influenced wetlands differs from that of natural wetlands and (ii) their buffering capacities.
The objective of our study was to investigate how a drained, agricultural wetland reacted to heavy rainfall events and to determine the influencing factors. In total 29 rainfall events with amounts greater than 10 mm were selected in the period between April 2010 and October 2012. The reactions of groundwater and ditch water levels were analysed, as well as the water balance of the rainfall events. The latter was determined using a weighable groundwater lysimeter installed in the Spreewald wetland in northeast Germany, whose groundwater level was adjusted to the surrounding grassland site. Our measurements showed that on average 70% of the rainfall was stored in the wetland, while only 10% was discharged. In dry periods, when sub-irrigation was present at the beginning of the rainfall event, more water was stored (83%) than in wet periods (51%) while the share of runoff was nearly halved. Evapotranspiration played an important role during the runoff process. The wetland had a high retardation effect, since in most cases the maximum ditch water level lagged several hours behind the peak in groundwater level. Besides a multitude of process-influencing factors, it was shown that in flat areas even drained wetlands can display a marked retention effect.