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Temporal and spatial variations in the isotope biogeochemistry of surface waters from the land–sea at southern Baltic Sea interface

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The exchange of water and dissolved elements between the continents and the oceans takes place via different routes in the hydrological cycle, e.g. via rivers, atmospheric exchange (sea spray), and submarine groundwater discharge (resp., salt water intrusion). All of these pathways may be associated with anthroposphere-hydrosphere-biosphere-lithosphere interactions with dynamics on different time scales. Coastal peatlands that are partly connected to seawater may act as temporal reservoirs for precipitation, soil solutions, (re)cycled sea and ground water. Sources and physical processes impacting the respective water balances as well as (bio)geochemical element transformations may cause specific (isotope) hydrobiogeochemical signatures.

In the present study, we have investigated the temporal dynamics in the composition of fresh water springs emerging at the beach zone, river and ground waters. In addition, we investigated the spatial composition of a coastal peatland that is under temporal impact by seawater during two seasons. Besides major, minor and trace elements, we characterized the stable isotope composition of water (2H, 18O), DIC (13C), and sulfate (34S, 18O). Spring water compositions indicate their origin from modern meteoric waters, modified by the dissolution of soil carbon dioxide and marine carbonates as well as oxygen/nitrate driven pyrite oxidation. The composition is similar to ground water developing near the coast of Mecklenburg-Western Pomerania. Minor dynamics of coastal Baltic Sea water were controlled by varying impacts of North Sea water on the composition of surface waters in the southern Baltic Sea. It was found, that the Warnow river showed temporal dynamics depending on the season and associated discharge/mixtures of water sources in the recharge area. As a function of the meteorological and hydrography conditions, the lower part of the Warnow river estuary was impacted by mixtures with Baltic Sea water even at distance from the coast.

The surface waters in the coastal peatland (Huetelmoor) indicate the enhanced impact of evapotranspiration on the water cycle and an impact from anaerobic carbon-sulfur cycling due to high organic matter contents and relictic sulfate from previous Baltic Sea water intrusions, both reflected by the C and S and O isotope signatures of DIC and sulfate, respectively.

Summarizing, the composition of the some of the investigated surface water systems are partly affected by the water coming from the Baltic Sea. The carbon-sulfur cycles associated with water development differs and leads to characteristic isotope signatures.

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