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Abstract:

Experimental characterization of water flow and solute transport properties of floating fen root mats.

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Floating fens are valuable wetlands (found in North-West Europe) for nature conservation, as they host rare plants on floating root mats that developed in former turf ponds. These fens are threatened by contamination (e.g. salts) by intruding surface water. Under the mats, that contain roots and partially decomposed plant tissue, an organic suspension is found, that may form a preferential flow path under the root mat. This path may conduct base-rich surface water into the root zone.

A second zonation is due to increasing decomposition of different types of plant material deeper in the root mats. As the scale of this heterogeneity is of a comparable scale to the scale of flow, differences in hydraulic properties may influence solute transport significantly. We quantify the flow and transport properties of root mats, both in situ and in the laboratory, to find out if these properties depend on the zonation.

We monitored groundwater level and electrical conductivity (as a tracer) in cross-sections perpendicular to the surface water and vegetation zones and analysed soil samples from transects for material type, density and saturated water content in a floating fen in the Nieuwkoopse Plassen (the Netherlands), a habitat for many plant and bird species. We clearly observed the zonation due to increasing decomposition, that is related to the development history of the site. Hydraulic conductivity was measured with slug tests in the field and constant-head tests on columns in the laboratory. Saturated hydraulic conductivity differs up to two orders of magnitude (10 – 1000 m/d) with the location and the type of material. Solute transport parameters were obtained with salt tracer breakthrough curves in laboratory column experiments, as well as testing warm water as a thermal tracer in field settings. Preferential flow is more distinct in the horizontal directions. Thermal tracer experiments confirm preferential flow on a small scale (0.05 – 0.20 m). The field and laboratory measurements are tested for differences between material type and for correlation with location, depth, density and saturated water content.

The zonation in material, plant species composition, and physical properties imply that salt intrusion is a complex 3-dimensional transport process, that may pose elevated risks particularly for the rare plant species.