Geophysical Research Abstracts
Vol. 21, EGU2019-7702, 2019
EGU General Assembly 2019

Effect of Anisotropy on Solute Transport and Phosphate Release from Peatlands

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Peat soils are heterogeneous, anisotropic porous media. To date, there is still limited understanding of contaminant transport in anisotropic and heterogeneous peat soils. In this study, we aimed to explore the effect of anisotropy on solute transport and phosphate release from peat soils. Undisturbed soil cores (vertical and horizontal directions) were collected from one drained and one restored peatland both in a comparable state of degradation. Saturated hydraulic conductivity (K_s) and chemical peat properties were determined for all soil cores. Miscible displacement experiments were conducted on soil cores under saturated steady state conditions using KBr as a conservative tracer. The results showed that (1) the K_s in vertical direction (K_{sh}) was significantly higher than that in horizontal direction (K_{sv}), indicating that $K_s$behavesanisotropic; (2) solute transport parameters (D and β) as derived from model optimization employing the mobile and immobile model exhibited likewise anisotropic behavior; (3) stronger preferential flow with a shorter relative 5% arrival time occurred in vertical direction, where higher K_s values were observed; (4) phosphate release was observed from drained peat only. Both anisotropy and soil heterogeneity influenced phosphate leaching. The soil core with the strongest preferential flow released the largest amount of phosphate. We conclude that the anisotropic properties of peat soils should be considered in peatland hydrology and biogeochemical models as well as in peatland restoration projects.