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Dissolved organic carbon dynamics in groundwater-dependent water ecosystems under the impact of climate change

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The proposed PhD project focuses on the dynamics of dissolved organic matter dynamics in surface water and shallow groundwater browning phenomenon driven by global warming.

Climate change is affecting the environment and water resources, causing changes in water biodiversity at an alarming level. Rising temperatures and changes in precipitation patterns are not only causing water scarcity and intense flooding but are also expected to destabilize organic carbon storage in soil and organic sediments by affecting biological and biochemical processes, resulting in a shift in the carbon balance. In recent years, an increase in the content of terrestrial dissolved organic matter (DOM), consisting primarily of dissolved organic carbon (DOC), has been widely observed in both surface water and shallow groundwater. In northern ecosystems, this is often reflected in the “browning” of the surface waters. In addition to the diffuse groundwater recharge, in many parts of the Estonian lowland, the DOM rich surface waters flowing from mire watersheds are rapidly infiltrating into shallow karst aquifers, which are the main source of drinking water in sparsely populated areas. Due to the complicated association with dissolved or colloidal DOM, the mobility of other pollutants in groundwater, including heavy metals and nutrients, will be enhanced. Moreover, water browning and rising DOM concentrations potentially increase the flux of greenhouse gases to the atmosphere. Numerous studies also reveal the strong impacts of browning on the organism structure and ecological processes in freshwaters.

The main tasks of the project are:

- to conduct thorough quantitative and qualitative research on selected study sites. Including monitoring of surface and groundwater hydrodynamics, water chemistry (DOC, major ions, Ntot, water isotopes, trace elements, artificial tracers, etc.);
- to evaluate DOC transport and mixing in surface water and shallow groundwater;
- to provide input data and take part in modelling the interaction between groundwater and surface water in coupled models;
- to assess the impacts of climate change on surface water and groundwater ecosystems;
- to compare the potential impact of different climate scenarios on the DOC balance in surface and groundwater.

Keywords: DOM, DOC, surface water-groundwater interaction, karst, shallow aquifers, groundwater-dependent ecosystems, hydrochemistry, ecohydrology,