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Deciphering DOC export dynamics in a small catchment using high frequency monitoring and numerical modeling

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Concentrations of dissolved organic carbon (DOC) in stream water have been increasing across Northern Europe and in other parts of the world posing problems for the ecological health of aquatic systems and drinking water production from surface water. Elevated loads of DOC in reservoirs increase the costs for drinking water production and may result in the formation of toxic by-products during chlorination of the raw water. Understanding the dynamics and mechanisms of DOC export from catchments is an important prerequisite for a mitigation of these problems.

Developing robust quantitative models that can replicate observed current dynamics or even predict future trends is challenging as catchments are complex systems that integrate a large number of hydrologic and biogeochemical processes to generate an integral solute flux signal at the catchment outlet. Physically based numerical process models that try to represent all possible processes and simulate the system bottom-up are often unwieldy and difficult to parameterize (e.g. equifinality). Simpler conceptual models are typically based on a set of assumptions about the functioning of the system that are often not grounded in the "reality" or complexity of a specific site and which can constrain our ability to understand the system. New sensing technologies that provide highly resolved data sets (in time and space) can open a complimentary window to look at the system in a data-driven top-down approach.

Export of DOC from a small forested catchment in southern Germany is used as an example to illustrate how highly resolved concentration and discharge time series can help to decipher complex DOC export dynamics and challenge and/or support process representations and assumptions in a conceptual and a process-based numerical model for the catchment.