New online water quality monitoring techniques for improved hydrological and water quality modelling

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Process-based understanding of short and longer-term behaviour of catchments is important to our ability to predict hydrologic system response. The time scale of many processes is on the order of minutes to hours, not weeks to months, and understanding the linkages between catchment hydrology, hydrochemistry and in-stream turnover requires measurements on a time scale consistent with these processes. We introduce a new online water quality monitoring system as part of the UFZ TERENO Hydrological Observatory "Bode" and show how this new information can improve process understanding and water quality modelling. The water quality monitoring system, comprising seven online monitoring stations, will provide long-term continuous and temporally high-frequency data on selected water quality variables. The monitoring system encompass chlorophyll, nitrate and SAK (as surrogate for DOC), DO, electric conductivity, turbidity and temperature sensors for 10 minute measurement intervals as well as high frequency sampling with automatic samplers for validation purposes and analysis of further chemical compounds and stable isotopes. Using continuous, high frequency data from multiple sites, we demonstrate the dynamic hydrologic and hydrochemical response in the Bode river as well as the importance of sampling frequency in the estimation of water quality constituent fluxes. It will be explained how a sound monitoring concept can be used in combination with process based hydrological and water quality modelling to improve our knowledge on flow and matter pathways and in-stream nutrient retention.

The presentation will give examples of how high-frequency concentration data can be used to improve identification of runoff components (surface runoff, sub-surface flow) and hydrological model calibration. Qualitative hydrological flow path characterization based on discharge-concentration data clusters are used as additional input for a multi-objective calibration (with the NSGA-II tool) of a hydrological model. The multi objective calibration helps to choose a reasonable compromise between hydrograph simulation and modeling of flow components. Furthermore it is explained how a sound monitoring concept can be used in combination with process based river water quality modelling to improve our knowledge on in-stream nutrient turnover. To fully explore the additional new measurement information on water quality constituents for model identification a further development of current hydrological and water quality models is suggested.