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Integrated monitoring of nitrogen dynamics in contrasting catchments

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The research institute WESS (Water & Earth System Science) is monitoring three adjacent meso-scale catchments (72 – 140 km^2) in southwest Germany with respect to water quantity and quality. Due to their spatial proximity, the studied catchments are similar regarding climatic conditions and water balance. Geology is characterized by sedimentary rocks which are partly karstified. The catchments contrast strongly in land use and show a range from predominantly agriculture to almost exclusively forestry. In this context, a special focus of our research is the distinction of matter coming from the catchment area versus substances stemming from urban point sources. One important compound representing inputs from the catchment area is nitrogen.
Nitrogen is an essential nutrient governing plant growth. If available in excess it leads to eutrophication and is therefore one of the globally most widespread contaminants in aquatic ecosystems. Transport of human-derived nitrogen through landscapes including urban areas to the oceans predominantly occurs via river network systems. Hence, monitoring of nitrogen fluxes in streams and rivers reveals mechanisms and dynamics of its transport and gives also insight into hydrologic processes which influence the mobilization of nitrogen.
Presently, the catchments are equipped with online probes enabling high resolution monitoring of nitrate concentrations and other parameters. We found that average nitrate concentrations in stream water perfectly reflect the portion of fertilized arable land. The dynamics of N transport, however, largely depends on the hydrologic system and is driven by the dominating runoff generation processes. The interplay between different hydrological storages, which eventually also act as N pools, turns out to be decisive for the temporal variability of N concentrations in stream discharge. Inversely, the study of N transport dynamics can be used to infer the hydrologic mechanisms responsible for N mobilization.
Our results highlight drivers of N dynamics in river systems and will ultimately help to better understand and predict N budgets at catchment scales. The newly gained process understanding and the high resolution time series shall be used to setup and improve process models.