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C, N, P export regimes in rivers from headwater to downstream catchments

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Excessive amounts of nutrients and dissolved organic matter in freshwater bodies affect aquatic ecosystems. In this study, the spatial and temporal variability of nitrate (NO_3), dissolved organic carbon (DOC) and soluble reactive phosphorus (SRP) was analyzed along the Selke river continuum from 1 – 3 km^2 headwater catchments to 184 – 456 km^2 downstream catchments, within the TERENO Harz/Central German Lowland Observatory. Three headwater catchments were selected as archetypes of the main landscape units (land use x soil type) present in the Selke catchment. Export regimes in these catchments were interpreted in terms of NO_3, DOC and SRP land-to-stream transfer processes. Differences between export regimes in headwater and downstream catchments were interpreted in terms of in-stream processes and contribution of point source emissions. The results showed that the NO_3 seasonal dynamics were opposite compared to DOC and SRP in all three headwater catchments. These dynamics were interpreted as the result of the interplay of hydrological and biogeochemical processes, for which riparian wetlands were hypothesized to play a determining role. In the two downstream catchments, NO_3 was transported almost conservatively, except during the summer period where in-stream retention could exceed 50%. Allochtonous DOC was consumed in the upstream river section (with low light and nutrient availability) and autochthonous DOC was produced in the downstream river section (with high light and nutrients availability); the natural export regime of SRP mimicked a point source signal, which may lead to misattribution and thus overestimation of domestic contribution to phosphorus loads in rivers. Monitoring the river continuum from headwater to downstream rivers proved effective to investigate jointly land-to-stream and in-stream transport and transformation processes.