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Understanding the dynamics of stream water DOC across scales: New insights from linking hydrological processes, isotopic investigations and catchment characteristics.

H. Laudon
(Hjalmar.Laudon@seksko.slu.se)

Dissolved organic carbon (DOC) is an important constituent in surface waters. Although decades of research have been conducted to trace DOC in the aquatic environment its origin remains an open question. Here is a report from the interdisciplinary, multi-scale Krycklan Catchment Study (KCS) in northern Sweden that aims to elucidate the role of landscape characteristics, catchment scale and climate on the concentration and export of DOC. Detailed soil transect investigations together with 15 intensively monitored catchments ranging over three orders of magnitude in size, from 3 ha to over 6780 ha are included in this study. By using isotope hydrograph separation methods to define hydrological flow paths we have found that the majority of snow melt (~80%) reaches the stream via subsurface flow pathways in forested catchments. In contrast, flow pathways through the wetland dominated catchment has a larger component of snowmelt (<50%) caused by overland flow over frozen wetland surface. Although runoff generation in both catchments generally could be explained by the transmissivity feedback concept, the results suggest that there is a large spatial variability in the flow pathways. The contrasting flow pathways cause large variations in the dynamics of DOC. In forested catchments, the DOC concentration increase by a factor two to three during episodes as the subsurface flow pathways activated new soil DOC sources in the organic-rich riparian soil lining the streams in the region. In contrast the DOC concentration in the wetland dominated catchments decrease to approximately one third of the baseflow level because of the large overland flow component diluting baseflow DOC. No effect of catchment scale could be found for hydrological flow pathways but the DOC concentration during both base flow and peak flow decrease as the catchments became larger. The results suggest that the amount and timing of snow melt and the extent of soil frost have a large influence on the DOC concentration in small streams and rivers in the region. Most climate scenarios indicate that warming will be greatest in northern latitudes and especially strong during the winter months. A shift in the extent and timing of snow melt could thus affect the flux and concentrations of DOC from these northern landscapes.