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Export of dissolved organic carbon and nitrogen from drained and re-wetted bog sites in Lower Saxony (Germany)

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Today, nearly all peatlands in Germany are drained for agriculture, forestry and peat cutting. The export of dissolved organic carbon (C) and nitrogen (N) may be important for the overall C and N balances and affects downstream ecosystems. While drainage generally increases solute losses, there is nearly no C and N export data of raised bogs in Germany which can be used to evaluate both the impact of drainage associated with intensive land use and the re-wetting of peat cutting sites.
In the "Ahlenmoor" (North-Western Germany), four sampling points were chosen. Three sampling points represent a deeply drained intensively used grassland at various scales ranging from a drainage pipe (DP, 0.08 ha) and a drainage ditch (DD, 6.8 ha) to a collector ditch (CD, 20 ha). The fourth sampling point (RW) is a former peat cutting site (23 ha) re-wetted 10 years ago. At this site, polder technique was used to establish water tables at the soil surface. Sampling and discharge measurements were conducted bi-weekly from June 2011 to June 2013. Water table levels were recorded with automatic pressure sensors, and rating curves between discharge and water levels were used to calculate continuous discharge values. Samples were analyzed for dissolved organic carbon (DOC), particulate organic carbon (POC), dissolved organic nitrogen (DON), ammonium (NH4+), nitrate (NO_3-), sulphate (SO42-), pH, electric conductivity (EC) and specific UV absorbance (SUVA).
The discharge did not vary strongly between the sampling points and was slightly lower in the second year. Concentrations of all measured solutes were higher at the intensive grassland (DP, DD and CD) than at the re-wetted site. Surprisingly, SUVA showed no difference between all sites, while the DOC to DON ratio was narrower at DP, DD and CD than at RW. This indicates an export of more degraded dissolved organic matter (DOM) from the drained area. At the grassland sites, no statistical differences were found between the three scales except for SO42-, NO_3- and pH. Thus, the grassland shows rather homogenous export patterns over various spatial scales, and there seem to be no fast mineralization or degradation of the exported DOM during the initial stage of export. In total, average losses of DOC (457 kg ha-1 a-1) and POC (40 kg ha-1 a-1) from the drained area were nearly thrice as high as from the re-wetted site (124 and 73 kg ha-1 a-1). The total nitrogen losses were even more reduced by re-wetting and dominated at all sites by DON (19.1 kg ha-1 a-1 at the grassland sites, 3.9 kg ha-1 a-1 at the re-wetted site). NH4+ (drained: 5.2 kg ha-1 a-1, re-wetted: 0.8 kg ha-1 a-1) and NO_3- (drained: 1.6 kg ha-1 a-1, re-wetted: not detectable) played a minor role. Overall, differences in the export could rather be explained by differences in solute concentration than in discharge.