Long-term patterns of DOC concentrations in soil water at catchments with contrasting acid-base chemistry

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Surface waters in Europe often shown increase in dissolved organic carbon (DOC) concentrations during the last decades. It could be driven by decline in acidic deposition, leading to a decrease in ionic strength (IS) of precipitation and soil water and subsequently to increase in the solubility of humic substances in forest soils (Monteith et al. 2023, Science Advances, 9, 3491). More than three decades of monitoring at two catchments in the Slavkov Forest documented enormous reduction in atmospheric load, especially of sulfur (S). Deposition of S decreased from 34 kg/ha/yr in 1993 to less than 3 kg/ha/yr in 2022. Two Norway spruce catchments were investigated: Lysina (LYS, 0.27 km^2), with prevailing Podzol developed on acidic leucogranite and Pluhův Bor (PLB, 0.22 km^2), with mostly Cambisol on ultrabasic serpentinite. Acidic streamwater at LYS showed an annual DOC increase of 0.3 mg/L and even larger annual increase was observed in circumneutral PLB streamwater (0.9 mg/L) over 30-year period (Hruška et al., this vol.).

About fourty zero-tension and tension lysimeters were installed in five depths at LYS and PLB during the period 1989-2011. This abstract is focused on evaluation of samples collected by zero-tension lysimeters situated in uppermost mineral soils (E or A horizons) which offer the longest time series, from 1990 at LYS and from 1994 at PLB. DOC was measured there since 1993, later in comparison to inorganic constituents. Most DOC measurements were performed by Techman-Dohrmann Apollo 9000. Changes in soil water quality were driven by decrease of sulfate concentrations at both sites (1.1 at LYS and 1.3 mg/L/yr at PLB, $p<0.01$). Decrease of IS of the soil waters was correlated with SO_4 (R^2 0.82 and 0.87, at LYS and PLB, respectively, $p<0.01$). IS decreased significantly in the uppermost mineral soils, 26 µeq/L/yr (LYS) and 36 µeq/L/yr at PLB ($p<0.01$). Soil water annual mean values of pH increased significantly at PLB, from 5.4 to 6.4 ($p<0.01$) but stayed around 3.5 at LYS due to properties of humic and fulvic acids, which are highly acidic and effectively prevent pH rise. The most pronounced increase of DOC was observed in organic horizon at LYS (1.26 mg/L/yr, R^2 0.61, $p<0.01$). Increase of DOC in uppermost mineral soil was 1.25 mg/L/yr (R^2 0.31, $p<0.01$), from 30 to 70 mg/L at PLB and 0.85 mg/L/yr (R^2 0.15, $p<0.05$, from 50 to 75 mg/L) at LYS. Climate change could be a confounding factor in future DOC trends.