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Impact of landscape characteristics on the stream carbon and nitrogen export: example of a small agricultural catchment in Denmark

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Agriculture plays an important role on the environment, notably the quality of water draining cultivated soils. Understanding the relationship between landscape characteristics and stream quality is crucial to sustain a good quality of water and to develop adapted policies. Therefore, this study investigates the relative influence of different landscape characteristics on carbon (C) and nitrogen (N) losses into streams. It not only focuses on the "classical" agricultural nitrogen pollutants of nitrate (NO_3) and ammonia (NH4) but also hypothesises that dissolved organic nitrogen (DON) is an important pathways of N losses.
In the Bjerringbro area in central Jutland, Denmark, the landscape is dominated by intensively managed croplands draining into the Tyrebaekken creek. More precisely, one northern and one southern stream run through the catchment (842.7 ha) before converging to form a second order brook. Nine snapshot sampling campaigns were undertaken during the growing season of 2009 (April to September). On each sampling day, 20 points along the stream were sampled as well as eight directly contributing drainages and two groundwater wells. Total dissolved nitrogen (TDN), NO_3, NH4 and dissolved organic carbon (DOC) concentrations were measured whereas DON was calculated for each grabbed sample. Electrical conductivity (EC), pH and flow velocity were simultaneously measured during sampling.
Statistical analyses show significant differences in these water quality parameters between the northern, southern and converged stream parts, especially when considering NO_3-N concentrations with average values of 9.6 mg N/L, 1.4 mg N/L and 3.0 mg N/L, respectively. This is despite the fact that differences in land use were only minor between the two stream sections. Meanwhile, DON concentrations rose by about one order of magnitude from 0.1 mg N/L to 2.8 mg N/L and from 0.1 mg N/L to 0.8 mg N/L in the northern and southern streams, respectively, during the research period, eventually corresponding to a contribution of up to 81% to TDN. Multiple-linear regression analyses were performed at each sampled point between the chemical data and landscape characteristics (e.g. topography, land-use and soil type distributions) of the corresponding contributing area. Results show that, in spite of an overall little share, the influence of organic soil types seems to impact N losses to streams stronger than local land use by farming.