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Linking composition of dissolved organic matter and nutrient cycling in forest streams

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Dissolved organic matter (DOM) is an important component of the carbon (C) and nutrient cycles in terrestrial and aquatic systems. In rivers and streams draining forested catchments DOM often constitutes the largest component of organic matter, since particulate loads are often relatively low. Dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) play a prominent role in many biogeochemical processes and ecosystem functions. Recent studies reveal that the stoichiometry of DOM plays a crucial role in regulating nutrient cycling. For example, the nitrogen-rich fraction of DOM (i.e. DON) can have different ecological roles depending on ambient N and C availability. DON either serves as a C or N source for the microbial community. Here we present some initial results suggesting that DOM composition can control whether DON serves as N or C source. In order to determine this ecological function of DOM, we performed nutrient pulse addition experiments with NO_3^- and NO_3^- + acetate and analyzed DON-NO_3^- relationships. We studied five first order streams in forested catchments in the Czech Republic and New Hampshire, USA, characterized by different levels of inorganic N, DON and DOC. Three of five streams showed a positive correlation between DON and NO_3^- concentrations indicating that DON served as a source of N. For two streams an inverse DON–NO_3^- relationship was observed, indicating that DON was mainly used as a C source. Concurrently we investigated the chemical composition of DOM in these streams to link the ecological function of DOM with its composition. We used a variety of analytical tools including Fourier-transform infrared spectroscopy (FTIR), pyrolysis gas chromatography-mass spectrometry (pyrolysis GC-MS) and ^{13}C isotope analyses. The proportions of polysaccharides in total DOM as determined by pyrolysis GC-MS were high if DON served as N source and low if mainly served as C source. Decreasing proportions of N-containing compounds revealed by pyrolysis GC-MS correlated with increasing DOC:DON ratios in DOM (R^2 = 0.93 with p = 0.01). High DOC/DON ratios and low proportions of N containing compounds indicated that DON served as a source of N. However, other parameters did only partly explain whether DON was used as a source of N or C by microorganisms. In conclusion, our research indicates that DOM composition might control the role of DOM for the C and N cycle in first order streams in forested catchments.