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Use of FT ICR MS to characterize seasonal and spatial variability of dissolved organic matter in a small forested catchment

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Inland water process large amounts of dissolved organic matter (DOM), representing an important component in the global carbon cycle. Locally, DOM has an important ecological and biogeochemical role that may vary according to its quality (e.g. composition). Land use, season and hydrologic regime are some factors that possibly will influence the changes in DOM composition. State-of-the art technique to study the molecular chemical composition of DOM is Fourier transform ion cyclotron resonance mass spectrometry (FT ICR MS). The analysis of changes in DOM quality by FT ICR MS allows conclusions to be drawn about the sources and mobilization processes of the organic material. In this study we investigate the changes in DOM quality over a period of 1.5 year in a small forested catchment composed of two different zones: wetland (zone A) and steep slope areas (zone B). The catchment is located in the National Park Bayerischer Wald in Southern Germany. This offers a natural environment unaffected by direct anthropogenic influence. Therefore, only indirect anthropogenic effects and natural vegetation disturbances and possible interactions between them can affect DOM dynamics. Monthly samples were taken along the rivers (1st and 2nd order) from September 2018-November 2018 and from April 2019-November 2019 with a total of 124 samples. The samples were analyzed by FT ICR MS, total organic carbon analyzer and UV/VIS spectrometer. Our results showed that the concentration of dissolved organic carbon between the sampling points is similar, but differs over the year at normal discharge conditions. FT ICR MS analysis indicated that the main molecular composition of DOM was CHO (38-47%), with the majority of the composition consisting of highly unsaturated compounds. Conversely, samples in zone A had more aliphatic compounds and nitrogen formulas than the ones sampled in zone B during the year. UV/VIS data also indicated that DOM is more aromatic in the zone B. The results suggest that DOM coming mainly from ground water is the dominant pool of organic matter in the wetland during the year, while in the steep zone a contribution from fresh-plant derived DOM is expected. We also found predominantly low averaged molecular weight DOM in summer in the catchment, suggesting that biological activity plays an important role during this season in DOM quality. We conclude that understanding the dynamic and mobilization mechanisms of DOM in catchments with low human impact are important for the conceptual understanding of natural DOM regulation mechanisms.