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Amount, composition and seasonality of dissolved organic carbon and nitrogen export from agriculture in contrasting climates

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Agricultural catchments are potentially important but often neglected sources of dissolved organic matter (DOM), of which a large part is dissolved organic carbon (DOC) and nitrogen (DON). DOC is an important source of aquatic microbial respiration and DON may be an important source of nitrogen to aquatic ecosystems. However, there is still a lack of comprehensive studies on the amount, composition and seasonality of DOM export from agricultural catchments in different climates. The aim of our study was to assess the amount, composition and seasonality of DOM in a total of four streams in the wet-temperate and subtropical climate of Denmark and Uruguay, respectively. In each climate, we investigated one stream with extensive agriculture (mostly pasture) and one stream with intensive agriculture (mostly intensively used arable land) in the catchment. We sampled each stream taking grab samples fortnightly for two years and measured DOC and DON concentration, as well as molecular composition by size-exclusion chromatography. We used absorbance, fluorescence and parallel factor analysis to gather additional information on the sources and composition of the DOM. The results were coupled to measurements of precipitation, water temperature, discharge, water residence time and physicochemical data measured at each study site to investigate the effects these environmental variables have on the amount and composition of DOM in the streams. Average annual DOM concentration and seasonality were highest in the stream with intensive agriculture in Uruguay and lowest in the stream with extensive agriculture in Denmark. In all streams, the molecular-size composition of DOC and DON were similar and most DOC and DON were exported as humic substances with low C:N ratio, which indicates high bioavailability. Moreover, DON was of higher relative importance in the Uruguayan streams than in the Danish streams, as can be seen from the lower dissolved inorganic to total dissolved nitrogen ratios. The high seasonality of DOM, especially in the Uruguayan streams implies high influence of variation of the environmental conditions, both temperature and precipitation. Our study shows the importance of agriculture as DOM source in both climate zones, with a high seasonality particularly in Uruguayan streams. Future investigations and models of DOC and DON export in agricultural catchments need to include this seasonality to give correct information on the catchment export. Moreover, our results clearly show that DON is increasingly important for the nitrogen export from agricultural catchments when moving from a temperate to a warmer climate.