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Similarities and differences in dissolved organic matter response in two headwater streams under contrasted hydro-climatic regimes

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Dissolved organic matter (DOM) concentration and properties in headwater streams are strongly shaped by hydrology. Besides the direct relationship with storms and high flows, seasonal variability of base flow also influences DOM variability. This study focuses on identifying the singularities and similarities in DOM – discharge relationships between an intermittent Mediterranean stream (Fuirosos) and a perennial Alpine stream (Oberer Seebach). Oberer Seebach had a higher discharge mean, but Fuirosos had a higher variability in flow and in magnitude of storm events. During three years we performed an intensive sampling that allows us to satisfactorily capture abrupt and extreme storms. We analysed dissolved organic carbon concentration (DOC) and optical properties of DOM and we calculated the specific ultraviolet absorbance (SUVA), the spectral slopes ratio (SR), the fluorescence index (FI), the biological index (BIX) and the humification index (HIX).

DOM in Fuirosos was significantly more concentrated than in Oberer Seebach, and more terrigenous (lower FI), more degraded (lower BIX), more aromatic (higher SUVA) and more humificated (higher HIX). Most of the DOM properties showed a clear relationship with discharge and the sign of the global response was identical in both streams. However, discharge was a more robust predictor of DOM variability in Oberer Seebach than in Fuirosos. In fact, low flow and rewetting periods in Fuirosos introduced considerable dispersion in the relationship. During snowmelt in Oberer Seebach the sensitivity to discharge also decreased (DOC and BIX) or disappeared (SR, FI and HIX).

The magnitude of the storm events (DQ) in Fuirosos significantly drove the changes in DOC, FI, BIX and SUVA. This suggests that the flushing/dilution patterns were essentially associated to the occurrence of storm episodes in Fuirosos. In contrast, in Oberer Seebach all DOM qualitative properties were unrelated to DQ and it significantly explained only the change in DOC. While the storms were behind the DOC oscillations, DOM quality change in Oberer Seebach was more coupled to basal flow conditions.

Finally, the biogeochemical analysis of two hydrologically different headwaters motivates to speculate about the impact of the hydrological regime alteration forced by atmospheric drivers on DOM quantity and properties.