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Climate control on sulphate and nitrate concentrations in alpine streams of Northern Italy along a nitrogen saturation gradient

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Abstract. The role of meteorology, hydrology and atmospheric deposition on the temporal pattern of SO_4 and NO_3 concentrations was investigated for three streams draining alpine catchments in Northern Italy.

The study sites lie on a gradient of atmospheric fluxes of SO_4 and NO_3 (from about 50 to 80 meq m^{-2} y^{-1}, and from 40 to 90 meq m^{-2} y^{-1}, respectively). As a consequence of the increasing N input, the three catchments are also representative of aggrading levels of N saturation. Different methods of statistical analysis were applied to monthly data for the period 1997 – 2005 to identify which variables (temperature, precipitation, hydrology, SO_4 and NO_3 deposition) were the main predictors of water chemistry and its change in time. Hydrological changes and snow cover proved to be the main confounding factors in the response to atmospheric deposition in the River Masino catchment. Its particular characteristics (small catchment area, rapid flushing during runoff and thin soil cover) meant that this site responded without a significant delay to SO_4 deposition decrease. It also showed a clear seasonal pattern of NO_3 concentration, in response to hydrology and biological uptake in the growing season.

The selected driving variables failed to model the water chemistry at the other study sites. Nevertheless, temperature, especially extreme values, turned out to be important in both SO_4 and NO_3 export from the catchments. This result might be largely explained by the effect of warm periods on temperature-dependent processes such as mineralization, nitrification and S desorption.

Our findings suggest that surface waters in the alpine area will be extremely sensitive to a climate warming scenario: higher temperatures and increasing frequency of drought could exacerbate the effects of high chronic N deposition.

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