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Winter climate affects long-term trends in stream water nitrate in acid-sensitive catchments in southern Norway

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Abstract. Controls of stream water NO_3 in mountainous and forested catchments are not thoroughly understood. Long-term trends in stream water NO_3 are positive, neutral and negative, often apparently independent of trends in N deposition. Here, time series of NO_3 in four small acid-sensitive catchments in southern Norway were analysed in order to identify likely drivers of long-term changes in NO_3. In two sites, stream water NO_3 export declined ca 50% over a period of 25 years while in the other sites NO_3 export increased with roughly 20%. Discharge and N deposition alone were poor predictors of these trends. The most distinct trends in NO_3 were found in winter and spring. Empirical models explained between 45% and 61% of the variation in weekly concentrations of NO_3, and described both upward and downward seasonal trends tolerably well. Key explaining variables were snow depth, discharge, temperature and N deposition. All catchments showed reductions in snow depth and increases in winter discharge. In two inland catchments, located in moderate N deposition areas, these climatic changes appeared to drive the distinct decreases in winter and spring concentrations and fluxes of NO_3. In a coast-near mountainous catchment in a low N deposition area, these climatic changes appeared to have the opposite effect, i.e. lead to increases in especially winter NO_3. This suggests that the effect of a reduced snow pack may result in both decreased and increased catchment N leaching depending on interactions with N deposition, soil temperature regime and winter discharge.

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