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Coherent responses of sulphate concentration in Norwegian lakes: relationships with sulphur deposition and climate indices

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Abstract. The coherence or synchrony in the trends in SO_4^{2-} concentration in a set of 100 lakes in Norway that have a long-term chemical record was evaluated. Using a statistical technique that compares patterns or trends that are not uni-directional, the lakes were grouped into 18 subsets or clusters, each with between 2 and 11 lakes that had similar trends. These temporal trends were strongly correlated with several climate indices, notably the Arctic Oscillation Index (AOI) measured in the autumn, and the annual North Atlantic Oscillation Index (NAOI). Because these clusters of lakes were spatially dispersed, they could not be compared directly with trends in wet S deposition, because S deposition varied substantially between lakes within each cluster. However, the average trend in SO_4^{2-} concentration was evaluated in each of 10 regions of Norway that were defined previously on the basis of pollution load, meteorological variables and biogeography. Although these regions did not match the statistically-selected clusters of lakes with equal trends very closely, there were similar, strong correlations between climate indices (the AOI and NAOI) and the 10 average SO_4^{2-} trends, although there were even stronger relationships with average wet S deposition in the regions. When subsets of lakes with coherent SO_4^{2-} trends were selected from within each of the 10 regions, both wet S deposition and the climate indices were strongly correlated with those SO_4^{2-} trends. Hence, lakes in Norway respond to changes in wet S deposition and are influenced by large-scale, i.e. global, climate signals. Future evaluation of recovery of lakes affected by acid deposition must therefore consider the confounding effects of climate and potential climate change.

Keywords: recovery, acid deposition, coherence, sulphate, climate change

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