Increasing temperature decreases aluminum concentrations in Central European lakes recovering from acidification

Veselý, Josef, Vladimír Majer, Jirí Kopácek, Stephen A. Norton

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ABSTRACT: As acidic water percolates through mineral soils, Al is mobilized and transported into streams and lakes. We evaluate the effect of increasing temperature (climate warming) on Al concentrations in four strongly acidified lakes in the Bohemian Forest, southwestern Czech Republic, over a 17-yr period (1984-2001). Pronounced decreases in atmospheric S and N deposition resulted mainly in a sharp monotonic decrease in lake water concentration of total Al (-0.49 to -1.38 μmol L^{-1} yr^{-1}). Residuals from the linear relationship between total Al concentrations and the sum of strong acid anions were inversely correlated with air temperature and the North Atlantic Oscillation index. An increase in the average annual air temperature of +1.27 ± 0.49° C between 1984 and 2001 was correlated with decreases in toxic Al^{3+} and explained, on average, 13% of the total Al decrease in three lakes and 11% of the Al^{3+} decrease in Cerné Lake. The inverse relationship between Al solubility and temperature caused lower Al mobilization in soil horizons and/or enhanced precipitation of Al in the lakes at higher temperature but otherwise similar conditions. As a consequence, the recent period of warmer years and mild winters significantly contributed to the trend of decreasing Al in lakes recovering from acidification.