Spatiotemporal patterns of drivers of episodic acidification in Swedish streams and their relationships to hydrometeorological factors.

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Author: Martin Erlandsson
Hjalmar Laudon
Jens Fölster

Author Affiliation: Department of Environmental Assessment, Swedish University of Agricultural Sciences, Box 7050, 750 07, Uppsala, Sweden.

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Abstract: This study examined the spatiotemporal patterns of episodic acidification in 87 weakly buffered streams in Sweden at a monthly sampling frequency during a ten-year study period (1998-2007). Time series of pre-industrial pH (pH(0)) were reconstructed from the acidification model Meta(MAGIC), and the acidification impact was defined by the difference between the pH(0) and the contemporary pH (i.e., DeltapH=pH(0)-pH(t)). Acidification episodes were defined as observations for which the pH(t) was at least 0.4 units lower than average, in combination with a pH at least 0.2 units higher than average. Thus, only occasions in which the stream water was both more acidic and more acidified than average were characterized as acidification episodes. For each observed episode, the primary cause was identified from one of the following five possible drivers: dilution, increase in sulfate, nitrate or organic acids, or sea salt deposition. In total, 258 episodes were observed during the study period. The study showed that streams that were acidified during baseflow (DeltapH>0.4), but not chronically acidic (pH>5.2), were subjected to regular episodic acidification. Dilution was the single most important cause and the main driver for 58% of the identified episodes. Increases in sulfate concentrations were also relatively common (26% of episodes), whereas increases in nitrate and organic acids as well as sea salt deposition were of minor importance. The total number of dilution-related acidification episodes within a year had a significant (p=0.005) positive correlation (r=+0.83) with the average annual precipitation. Occurrences of sulfate episodes were related to droughts during the preceding summers. While the number of streams that are susceptible to episodic acidification will decrease as a consequence of recovery from acidification, the hydrological and meteorological consequences of future climate change may make episodic acidification more common.

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