

## **Recovery from chronic and snowmelt seasonal acidification at the Hubbard Brook Experimental Forest: Long-term trends in stream and soil water chemistry**

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We investigated long-term chemistry trends in stream water (1982-2011) and soil water (1984-2011) along an elevation gradient to evaluate the progress of recovery of these drainage waters from chronic acidic deposition at the Hubbard Brook Experimental Forest in the White Mountains of New Hampshire, USA. Deposition of sulfate and nitrate has declined throughout the study period due to controls on emissions from electric utilities. Decreases in the concentrations of acid anions have decreased the leaching of base cations from the soil. Stream water pH has increased at a rate of 0.01 units yr<sup>-1</sup> and the acid neutralizing capacity (ANC) has gained 0.69  $\mu\text{eq l}^{-1} \text{yr}^{-1}$ . While the changes in stream water chemistry broadly reflect changes in soil water chemistry, we found variation by landscape position in the magnitude and significance of changes in the chemistry of soil water draining the organic (Oa) and mineral (Bs) soil horizons. Snowmelt waters are generally characterized by the lowest ANC values during the annual cycle. To test whether the episodic acidification associated with spring snowmelt is improving along with the rest of the annual cycle, we analyzed the data from the samplings representing the peak snowmelt period for comparison with the overall record. Stream water during the snowmelt period has had very similar gains in ANC as for the overall time series (0.69 and 0.78  $\mu\text{eq l}^{-1} \text{yr}^{-1}$ , respectively). Additionally, we found that for both the overall stream chemistry record and for the snowmelt period, the trends showed similar increases in pH, decreases in sulfate, and decreases in nitrate. The similarity between the overall time series and the snowmelt periods is an important finding that demonstrates the recovery from chronic acidification of drainage waters that travels via shallow flowpaths as well as the deeper mineral soil flowpaths that contribute to stream baseflow. This finding indicates that episodic acidification associated with snowmelt is declining in severity.

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