Temporal trends in streamwater chemistry at Hydrologic Benchmark Network watersheds in the Northeastern United States, 1984-90

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The U.S. Geological Survey has been monitoring streamwater chemistry and discharge at a national network of medium-size headwater catchments (median area of 143 km2) since the mid-1990s through the Hydrologic Benchmark Network (HBN) program. Because the program is of national scope and the catchments are relatively pristine, the HBN provides a unique opportunity for researchers to evaluate regional or national trends in streamwater quality that may be related to changes in atmospheric deposition. In the current study, streamwater data from five HBN sites and precipitation data from seven nearby NADP sites in the northeast USA were used to determine seasonal Kendall's trend test. Despite the low sampling frequency at the HBN sites (mostly quarterly), a number of statistically significant trends were detected that were consistent among sites and between streamwater and precipitation data sets. There was a significant decrease (p<0.05) in sulfite concentrations at all of the tested headwater stream and precipitation monitoring sites, indicating that a decrease in atmospheric deposition of sulfate is being reduced in streamwater quality in the Northeast. Most of the decline in sulfite concentrations in precipitation (−0.9 to −1.0 ug/L/yr) were matched by decreases in hydrogen, which ranged from −0.7 to −0.8 ug/L/yr. Base cation concentrations showed more diversity in their decreasing trends, with no significant differences in their seasonal Kendall's trend test. With the exception of a slight increase in aluminum, trends in base cation concentrations did not show seasonal differences in the precipitation data. The significant decrease in hydrogen, as well as in cation concentrations, can be attributed to the decrease in atmospheric deposition of sulfate and nitrate in the northeastern USA. The decrease in hydrogen, along with its effect on pH, is contributing to the decrease in alkalinity, which is important for the buffering capacity of streamwaters. However, despite these decreases, the study did not find significant trends in major ion concentrations in streamwater or precipitation data sets.

The study also examined the residuals to regression, which showed that they are statistically independent and identically distributed. The results of the regression analysis indicate that the seasonal terms did not reflect the seasonal trends in the data. Instead, the residuals to regression were statistically independent and identically distributed. This suggests that the seasonal variations in streamwater chemistry are not driven by seasonal changes in atmospheric deposition. Instead, the seasonal variations in streamwater chemistry are likely driven by other factors, such as local hydrogeologic conditions and land use.

The study also found that the seasonal Kendall's trend test is sensitive to the sample size and the sampling frequency. The study concluded that the seasonal Kendall's trend test is a powerful tool for detecting trends in streamwater chemistry, but that it should be used in conjunction with other statistical methods to fully understand the trends in streamwater chemistry.

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