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Seasonal patterns of nitrate concentration in forest streams: Hydrology or biogeochemistry?

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In recent two decades, the seasonal variation of nitrate discharge from forested ecosystems has been increasingly focused by ecologists and hydrologists as a diagnostic indicator of the nutrient status of ecosystems. Major factors controlling the seasonal patterns of stream nitrate concentrations include seasonal variations in (i) nutrient demands of plants and microbes, (ii) solute transport capability of the hydrological condition, and (iii) in-stream nutrient usage and supply. In this study, we attempted to show how case studies have helped to elucidate the dominant controlling factors by comparing data from Japanese catchments with previously compiled data from studies in North America and Europe, and explain the different influences of hydrological and biogeochemical controls exert in rainy summer regions (Japanese catchments under the Asian monsoon climate) and dry summer regions (sites in the northeast United States and Europe). The seasonal variation of hydrological conditions is a predominant controlling factor in Japanese forests, whereas it has been considered that nutrient demand may predominate in the northeast United States and Europe. We, ecologists and hydrologists have to recognize that it is important to compare seasonal patterns among different climate regions to obtain more universal explanations of the seasonal variation in stream nitrate concentration. In addition, multi-scale investigations will be strongly needed to provide insight into the relative contribution of hillslope biogeochemical effects and the influences of in-stream biological activities.

Keywords: forest ecosystem, streamwater, nitrate, seasonal variation