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Long-term inorganic N turnover pattern along a southern Chinese forested catchment

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Since early 1990s, atmospheric nitrogen (N) deposition in China has been greatly enhanced due to elevated emissions from anthropogenic activities. As a consequence, a majority of forests in South China has been found to be severely N-saturated, with significantly nitrate (NO_3^-) export via soil leaching. More recently, under continuous efforts in nationwide abatement of reactive N, atmospheric loads of N to southern Chinese forests are likely to stabilize or decline, which may exert shift in N turnover pattern and alleviation in inorganic N loss by hydrological export.

Here, we present a decadal of inorganic N budget from a subtropical forest catchment in SW China, with also isotopes measurements to infer the turnover process. Our N-balance observation suggests that, with clear decline in atmospheric N deposition, soil NO_3^- leaching showed a gentle decrease while stream export was even somewhat higher. During 2009-2013, the simultaneous enrichment of dual nitrate isotopic signatures indicated significant N removal (i.e., denitrification) along the groundwater discharge zone in the lower catchment; by contrast, in most recent observation during 2023, isotope signatures were much dampened (< 0‰), pointing to the less contribution by denitrification. Further, by analyzing long-term trends in N fluxes and isotope signatures, we found that climatic anomalies can significantly affect catchment-scale N retention pattern, which may likely mask the trend in N turnover under declined N input via deposition. Therefore, our work highlights the value of long-term field observations of forest ecosystem response, and pinpoints the importance of Climate-N interactions in future research.