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# Tropical montane forest conversion affects spatial and temporal nitrogen dynamics in Kenyan headwater catchment

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Deforestation and land use change (LUC) are often stated as major contributors to changes in water quality, although other catchment characteristics such as topography, geology and climate can also play a role. Understanding how stream water chemistry is affected by LUC is essential for sustainable water management and land use planning. However, there is often a lack of reliable data, especially in less studied regions such as East Africa. This study focuses on three sub-catchments (27-36 $km^2$) with different land use types (natural forest, smallholder agriculture and tea/tree plantations) nested in a 1023 $km^2$ headwater catchment in the Mau Forest Complex, Kenya's largest closed-canopy indigenous tropical montane forest. In the past decades approx. 25% of the natural forest was lost due to land use change. We studied seasonal, diurnal and spatial patterns of total dissolved nitrogen (TDN), nitrate ($NO_3$-N) and dissolved organic nitrogen (DON) using a combination of high-resolution in-situ measurements, bi-weekly stream water samples and spatial sampling campaigns.

Multiple linear regression analysis of the spatial data indicates that land use shows a strong influence on TDN and nitrate, while DON is more influenced by precipitation. Highest TDN and nitrate concentrations are found in tea plantations, followed by smallholder agriculture and natural forest. This ranking does not change throughout the year, though concentrations of TDN and nitrate are respectively 27.6 and 25.4% lower in all catchments during the dry season. Maximum Overlap Discrete Wavelet Transform (MODWT) analysis of the high resolution nitrate data revealed a seasonal effect on diurnal patterns in the natural forest catchment, where the daily peak shifts from early morning in the wet season to mid-afternoon in the dry season. The smallholder and tea catchment do not exhibit clear diurnal patterns.

The results suggest that land use affects dissolved nitrogen concentrations, leading to higher N export in catchments under managed land use. Furthermore, the changes in diurnal patterns in the forest catchment and absence of similar patterns in the other catchments are an indication that biogeochemical processes such as nitrification and denitrification in areas under different land use are affected as well. This could have implications for regional N-cycling.