



Seasonal transpiration source water and ecohydrological connectivity with streamflow sources in the Maimai M8 Catchment

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Transpiration significantly depletes terrestrial subsurface water stores and plays a crucial role in the hydrological cycle. While extensive research has been conducted in the Maimai M8 catchment (New Zealand) and across many catchments on streamflow generation processes and streamflow sources, we still know little about the sources of transpiration and when transpiration and streamflow sources are hydrologically connected. Here we leverage M8, a long-term studied catchment with well-described streamflow generation mechanisms, to investigate the transpiration

source water of *Pinus radiata* and its connectivity to streamflow sources. We combined monthly observations of isotopic signatures ($\delta^{18}\text{O}$ and $\delta^2\text{H}$) of xylem, bulk soil water, mobile water, subsurface flow, and stream water with continuous monitoring of tree water stress across a hillslope to answer: (1) What is the seasonal source of transpiration at Maimai? And (2) how does transpiration source water interact with streamflow sources? Our data showed that transpiration sources across the hillslope were not distinct but changed seasonally. During summer, when trees showed greater periods of water stress, trees relied on shallow soil water. In contrast, during the winter, trees' isotopic signatures plotted along the local meteoric water line (LMWL), overlapping with mobile soil and stream water. Xylem isotopic signatures were not statistically distinct from stream signatures in the winter, contrasting with distinct isotopic signatures during the summer. Our results showed that transpiration source water in the Maimai M8 catchment changes seasonally, influenced by tree water stress and wetness conditions. Overall, our findings suggest an ecohydrological connectivity between transpiration and streamflow sources during winter months in this wet temperate climate.