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Searching for a transpiration signal in precipitation using stable isotopes of water

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Evapotranspiration is an important contributor of vapour for continental precipitation but the relative contributions of evaporation and vegetation transpiration are difficult to separate. Most studies that examine this issue use complex numerical models and report varying magnitudes of a transpiration effect on precipitation. Stable isotopes of water, deuterium (^{2}H) and oxygen-18 (^{18}O), have been used to successfully partition evaporation and transpiration, yet the overall effect on precipitation has not been clearly shown. This study compared the composition of the stable isotopes in precipitation from a forested and an agricultural catchment, the Cotter catchment and the Muttama catchment respectively, in south eastern Australia, to evaluate if there is a transpiration effect on local precipitation. The isotope composition was compared to local meteoric water lines, vapour transport and synoptic patterns, and published geospatial and climatic stable isotope in precipitation relationships. Bulk samples of rainfall were collected spatially across the catchments from March 2016 to June 2017 at 2-3 monthly intervals and were analysed for δ^{2}H and δ^{18}O. There were strong differences in the measured isotope composition of precipitation for the Cotter catchment and Muttama catchment, with the Cotter found to be significantly more depleted in δ^{2}H and δ^{18}O than Muttama for all but one sample collection in the sample period. Values for the Cotter catchment ranged from $\delta^{2}\mathrm{H} = -60.91‰$, $\delta^{18}\mathrm{O} = -9.83‰$ to $\delta^{2}\mathrm{H} = -21.37‰$, $\delta^{18}\mathrm{O} = -3.79‰$ and for Muttama from $\delta^{2}\mathrm{H} = -63.42‰$, $\delta^{18}\mathrm{O} = -9.92‰$ to $\delta^{2}\mathrm{H} = -6.99‰$, $\delta^{18}\mathrm{O} = -1.77‰$. Analysis of vapour transport and synoptic patterns did not show conditions that would result in large differences in moisture sources between the two catchments. However, the residuals from the Cotter relative to Muttama after fitting the geospatial and climatic prediction equations did not suggest a strong vegetation transpiration effect in the rainfall.