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Eddy covariance flux and gradient measurements of acyl peroxy nitrates above a Ponderosa Pine forest

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Nitrogen is a key, often limiting, nutrient for forested ecosystems. In semi-arid regions, dry deposition from the atmosphere is likely to be a major source of fixed nitrogen. Atmospheric organic nitrogen represents a major fraction of the fixed nitrogen, especially in rural and remote forested regions. Direct measurements of the dry deposition flux of organic nitrogen species are lacking, with the only two reports being of nearly opposite sign for peroxy nitrates such as PAN. Rapid intra-canopy photochemistry has been suggested as the cause of such differences. We provide an analysis of speciated acyl peroxy nitrate (APN) measurements taken above a managed ponderosa pine forest via thermal dissociation chemical ionization mass spectrometry (TD-CIMS) during the six-week BEARPEX campaign August - October 2007. These measurements provide the longest continuous set of speciated APN flux measurements to date. Eddy covariance fluxes of PAN, PPN and MPAN are into the canopy, almost exclusively, with deposition velocities in the range of 0.4 - 1 cm/s. These values represent a much larger depositional flux than would be predicted based on current model parameterizations of APN dry deposition. Gradient measurements, however, suggest the presence of active photochemical production of some APN species within the canopy. We discuss these results in the context of meteorology, turbulence intensity, and plant physiology to allow extrapolation to larger scales.