Upside-down fluxes Down Under: Net CO\textsubscript{2} uptake in winter in a temperate eucalypt woodland

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Broadleaved evergreen forests and woodlands are widespread in warm temperate to tropical climates, but are poorly represented in ecosystem carbon cycle research. Some of these forests have the potential to be year-round carbon sinks due to their evergreen phenology and the mild climates where they occur. In order to assess when gross photosynthesis (GPP) overcomes ecosystem respiration (ER) in one of these forests, we evaluated climatic drivers of surface-atmosphere CO\textsubscript{2} and H\textsubscript{2}O exchange using eddy covariance techniques in a dry sclerophyll woodland near Sydney, Australia. The warm, temperate climate is characterized by aseasonal precipitation (mean annual precipitation of 800 mm); occasional incursions of hot and dry air masses in summer, and mild winters with rare frosts (mean annual temperature of 18 °C). In the three-year study (January 2014 through December 2016), the ecosystem annual C budget was a small sink in 2014 (89 gC m\textsuperscript{-2} y\textsuperscript{-1}), a stronger sink in 2015 (244 gC m\textsuperscript{-2} y\textsuperscript{-1}) and even stronger sink (343 gC m\textsuperscript{-2} y\textsuperscript{-1}) in 2016. Across all years, daily net C uptake was detected during the winter months (1\textsuperscript{st} May through 31\textsuperscript{st} August), while net C loss occurred during the summer months (1\textsuperscript{st} October through 28\textsuperscript{th} February). Ecosystem respiration was highest during summer, in particular when soil was wet, and lowest during cooler winter months. In summer, canopy conductance and GPP were limited by high vapor pressure deficit (VPD) in the afternoon. Net C losses in summer resulted from regular strong stomatal limitation of C uptake, enhanced by ongoing C losses from soils and vegetation. The canopy phenology explained 30\% of the photosynthetic capacity seasonal variability. The seasonal pattern of CO\textsubscript{2} and H\textsubscript{2}O cycles presented in this study give some insights into potential feedbacks to climate change of this ecosystem.