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Tracking the path of carbon through ecosystems: modelling vegetation carbon dynamics at Australian flux sites

Assaf Inbar[1], Laura Williams[1], Drew Holzworth[1], Juergen Knauer[1,3], Clare Stephens[1], Stefan Arndt[2], Anne Griebel[3], Nina Hinko-Najera[2], Peter Isaac[4], Caitlin Moore[5], Elise Pendall[1], and Belinda Medlyn[1]

[1]*Hawkesbury Institute for the Environment, Western Sydney University, Richmond, New South Wales*
[2]*School of Agriculture, Food and Ecosystem Sciences, University of Melbourne, Creswick, Victoria*
[3]*School of Life Sciences, University of Technology Sydney, Broadway, New South Wales*
[4]*OzFlux Central Node, TERN-OzFlux, Melbourne, Victoria*
[5]*School of Agriculture and Environment, The University of Western Australia, Crawley, Western Australia*

Abstract: Understanding the carbon (C) balance of vegetation is key to confidently predicting future changes in terrestrial ecosystem function and its feedbacks to climate. It is therefore important that models of vegetation dynamics can capture the observed C fluxes in, out and within an ecosystem. Here we calibrate and evaluate the LPJ-GUESS-DAVE model against carbon budgets constructed for the OzFlux eddy covariance sites.

LPJ-GUESS is a process-based DVM that simulates climatically-driven ecophysiology, demography and disturbance regime, to estimate the composition, structure and function of different vegetation across the land surface. Here we present a revised version, LPJ-GUESS-DAVE (Dynamics of Australian Vegetation), that is intended to capture Australia's diverse climate and unique vegetation. The new version of the model includes updated ecophysiology, tree hydraulics, and a daily grass and tree C allocation scheme. Australian plant functional types have been explicitly represented in the model. We first describe the new version of the model and then evaluate its performance at the OzFlux eddy covariance sites. These are ecosystem-scale observatories measuring net ecosystem exchange (NEE). Using additional data at the sites, including leaf area index, leaf litterfall, tree inventory and growth data, we compiled carbon budgets at these sites, providing data-based insights into carbon allocation and fluxes within the ecosystems.

Results show that a relatively small fraction of gross primary productivity (GPP) is allocated to leaf and stem growth, with this fraction decreasing with site aridity. Model results agree with this finding, showing satisfactory estimates of C fluxes and stores within and across the sites when compared to the observed C balance analysis. This exercise strengthens the confidence in the ability of the model to predict the Australian C balance as a response to different future climate scenarios.

Keywords: *Dynamic Vegetation Model, Carbon budget, TERN-OzFlux, LPJ-GUESS, Carbon allocation*

