

117. Water uptake in deep soil layers by tropical eucalypt plantations: consequences for water resources under climate change

Christina M.¹, Laclau J.-P.^{2,3}, Nouvellon Y.^{2,3}, Bouillet J.-P.^{2,3}, Lambais G.R.⁴, Stape J.L.⁵, Le Maire G.¹

¹CIRAD, UMR Eco & Sols, Montpellier, France

²Forest Science Department, UNESP, Botucatu, Brazil

³Forest Science Department, USP, ESALQ, Piracicaba, Brazil

⁴CENA, USP, ESALQ, Piracicaba, Brazil

⁵Department of Forestry and Environmental Resources, NCSU, Raleigh, NC, USA

Climate models predict that the frequency, intensity and duration of drought events will increase in tropical regions. Questions such as how planted forests will adapt to future constraints on water availability have broad implications for the supply of wood at low cost that contributes to decreasing the pressure on native forests. Although water uptake by deep roots is generally considered as an efficient adaptation to drought in tropical planted forests, the role of very deep roots to supply the water requirements of trees is still poorly known. Fine roots have been observed in Eucalyptus plantation down to a depth of 16m 5 years after planting in Brazil. The contribution of water stored in deep soil layers to stand evapotranspiration has been quantified using a process-based model over 5 years after planting. Daily simulations of latent heat fluxes and soil water contents down to a depth of 10m satisfactorily matched with measurements over the study period. Our results show that deep roots play a major role in supplying tree water requirements during extended dry periods in Eucalyptus plantations. The fast exploration of deep soil layers by roots provides access to large amounts of water stored in the soil after clear cutting. The water table is no more recharged after canopy closure and the primary production is highly dependent on rainfall amounts as well as on the ability of trees to withdraw water in the water table. Water uptake by tree roots progressed towards deep soil layers during dry periods. On average 20% of tree transpiration was withdrawn below a depth of 10m during the dry seasons. The withdrawal of water in the water table, between the depths of 12 and 18m, occurred during dry periods from age 2 years onwards. Although the amounts of water withdrawn in the water table were small (~1-3% of total transpiration over the study period), this process can be of paramount importance for tree survival in tropical regions in a context of climate changes.