Effects of Climate Variability and Change on Groundwater Impacts of Forestry Plantations

Richard Benyon[1], Tanya Doody[2], Jeff Lawson[3], Anthony Hay[4], and Baden Myers[3]

[1]The University of Melbourne School of Ecosystem and Forest Sciences
[2]CSIRO Environment
[3]University of South Australia - Mawson Lakes Campus
[4]Esk Spatial

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Abstract

Quantifying water use of various water consumers is an essential part of sustainable water management. Annual evapotranspirartion (ET) of plantation forests often exceeds that of dryland agriculture, which in South Africa and South Australia has resulted in restrictions on plantation development. In the latter case, water licenses are issued to commercial forestry plantations to account for higher ET compared to dryland pasture. Unlike irrigated crops, it is not practicable to measure water use of plantations directly and so a set of 'deemed' average water use rates has been applied based on species and depth to groundwater. Since the 'deemed' rates were calculated in 2013, additional plot-scale measurements of annual ET from plantations < 2 years old and post-canopy closure have been used to quantify various components of evapotranspiration (ET). This has enabled development of two empirical ET models for plantations in the region, and facilitated an advanced understanding of the effect of plantations on hydrological processes, particularly in relation to groundwater use. In this study, we applied these models to estimate rotation-averaged annual ET and net groundwater impacts (net groundwater extraction plus recharge reduction compared to pasture) of plantations, driven by climate and groundwater depth, for comparison with the deemed rates. The modelling suggests that the groundwater impacts of plantations vary in space and time and that the deemed rates over-estimate these impacts, on average. Accounting for variation in the effects of climate on the various components of ET, both spatially and temporally, may allow for more flexible rules for water resource allocation than using the current rule-of-thumb approach.

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