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Vegetation-climate feedbacks and landscape connectivity need consideration when forecasting hydrologic impacts of land use and climate change in forested catchments of South-West Australia.

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Interest in understanding the impacts of land use and climate change on ecosystem processes has emerged as a major area of research spanning the biological and physical sciences. In the hydrological sciences there has been a strong focus on understanding the impact of such changes on water resources.
South-West Australia faces a drying climate under all Global Climate Model (GCM) scenarios and over the last three decades there has already been a major decline in the volume of surface water resources available for metropolitan water supply. Climate change has been superimposed on major land use changes that have altered the water and salt balances of many catchments in this region.
Providing estimates for future surface water resource availability typically involves running an appropriate hydrological model with downscaled GCM rainfall statistics for a particular emission scenario. Such models do not generally incorporate any ecohydrologic vegetative feedbacks on key hydrological processes, or land use impacts on stream connectivity.
To incorporate feedback mechanisms between vegetation and hydrologic processes we propose that ecological optimality provides a first-order framework for understanding the relation between climate and leaf area index, which in turn influences catchment actual evapotranspiration (AET) and interception. Using satellite data from MODIS we examine annual and inter-annual variations in leaf area index of forested catchments and apply published algorithms to obtain estimates of river basin AET. We compare these estimates to annual AET obtained from the measured difference between basin rainfall and runoff and then develop future runoff and salinity scenarios for one basin to compare model results with and without ecohydrologic feedbacks.
We then contrast the magnitude of this natural response to runoff reduction arising from policies aimed at ‘droughtproofing’ rural properties. We show that construction of farm dams and surface water runoff diversion structures reduces both system and landscape connectivity, leading to significantly reduced flows at the basin outlet.