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Eco-hydrological and climatic drivers of fuel moisture dynamics in complex terrain

Petter Nyman, Thomas Duff, Craig Baillie, and Gary Sheridan
University of Melbourne, Faculty of Science, School of Ecosystem and Forest Sciences, Parkville, Australia
(nymanp@unimelb.edu.au)

Fuel moisture is a critical parameter for predicting fire behaviour and for planning prescribed burning operations. Moisture content in fuels located on or near the forest floor is particularly important because this fuel source 1) can comprise a large component of the overall fuel load, 2) can have a strong impact on fire spread, and 3) it can in many cases be effectively managed with prescribed burning. Being able to predict surface fuel moisture content is therefore an important research topic. Moisture dynamics in surface fuel are a function of microclimate above the litter layer, rainfall, interception, soil moisture and the hydraulic properties of the fuel itself. Process-based fuel moisture models include these factors in their predictions. However, the data needed to parametrise and test such models at landscape scales are often lacking. The relative importance of various components of the water balance in the litter layer is therefore unknown. In this research we seek to quantify how climate, vegetation and eco-hydrological feedback contribute to variation in net radiation and potential evaporation at the forest floor. Research sites were established at 16 locations in eucalyptus forests in south-east Australia with variable elevation, solar exposure, and drainage areas. Forests ranged from open woodland to tall temperate forests. At these sites we measured solar radiation, air temperature, relative humidity, throughfall, litter moisture, soil moisture, and litter temperature. Forest structure was characterised using hemispherical photos. Using these data on microclimate and vegetation structure we develop and parametrise a Penman-Monteith model of potential evaporation on the forest floor at daily timescales. Using this model of potential evaporation alongside landscape-scale information on the long term water and energy balance we quantify the effects of topography, long-term climate and eco-hydrological feedback on the energy and water balance at the air-litter interface. The implications of these effects for fuel moisture dynamics are evaluated using fuel moisture time series that were collected simultaneously at the 16 sites. The results from the study are used in the development of a general framework for incorporating vegetation and topographic effects into landscape-scale fuel moisture models.