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# Modelling afforestation scenarios in SWAT: Towards an improved representation of evapotranspiration

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**Abstract:** The substitution of natural grasslands with forest plantations is linked to reductions in surface runoff. This reduction is directly related to the increase in evapotranspiration partly by the interception of the forest canopy and the deeper root exploration. Therefore, a realistic representation of the role played by the forest in the rainfall-runoff relationship is essential for predicting the effects of increased forestry areas on the water availability. To assess the impact, Uruguay has established an operational network of small experimental basins, which has been in place for over 20 years, based on a partnership between government, academics, forest companies, and national research programs. Currently, the main challenge is to effectively utilize the observed behaviours from these smaller experimental basins to inform water resource management strategies on a larger scale. This involves a multiscale approach combining monitoring and modelling in basins associated with the smaller and larger spatial scales. The SWAT model (Arnold et al. 1998) was implemented in an experimental small basin of 200 ha, 56% of which is planted with eucalyptus, and in the surrounding 7855 $km^2$ larger basin, in which the main land use is grassland. To create the HRUs in the large basins, national soil and land use information was used, while detailed information based on local surveys was used for the small basin. The operational forest management was based on the recommendations of forestry technicians who operate in the area. Before calibrating the models based on observed streamflow, the state variables of the model related to total biomass and LAI were examined, for which independent information was available. In the large basin the model calibration was carried out in two stages: one prior to the year 2000, when the planted area was minimal to adjust the parameters related to grass land use. The second stage covers the period after 2012, and the parameters related to forest land use were adjusted while keeping the grass parameters, obtained previously, unchanged. The calibration indicators demonstrate a satisfactory fit in both watersheds. Subsequently, the water balance throughout the simulated period was evaluated by contrasting the model results for pre-forestation land use conditions with those for post-forestation land use conditions. The model has difficulty in simulating actual evapotranspiration, as it remained almost constant despite an increase in forest cover, failing to reflect the increase in the interception and transpiration component. Surface runoff decreased in line with the calibration objective and recharge increases as expected for the proper closure of the water balance, but is most likely due to the change in runoff parameters. As a consequence of the increase in recharge and according to the formulation of the SWAT model, in the afforestation scenarios the underground flow that discharges into the channel increases, which contradicts the results obtained from the observed data in the small catchment (Silveira et al. 2016). It is evident that further efforts should be made to enhance the SWAT model parameterization of forest cultivation and growth structural characteristics affecting the canopy interception of rainfall.

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