Geophysical Research Abstracts
Vol. 12, EGU2010-5866-1, 2010
EGU General Assembly 2010

A Tree-based Approach for Modelling Interception Loss From Evergreen Oak Mediterranean Savannas

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Evaporation of rainfall intercepted by tree canopies is usually an important part of the overall water balance of forested catchments and there have been many studies dedicated to measuring and modelling rainfall interception loss. These studies have mainly been conducted in dense forests; there have been few studies on the very sparse forests which are common in dry and semi-arid areas. Water resources are scarce in these areas making sparse forests particularly important. Methods for modelling interception loss are thus required to support sustainable water management in those areas. In very sparse forests, trees occur as widely spaced individuals rather than as a continuous forest canopy. We therefore suggest that interception loss for this vegetation type can be more adequately modelled if the overall forest evaporation is derived by scaling up the evaporation from individual trees. The evaporation rate for a single tree can be estimated using a simple Dalton-type diffusion equation for water vapour as long as its surface temperature is known. From theory, this temperature is shown to be dependent upon the available energy and windspeed. However, the surface temperature of a fully saturated tree crown, under rainy conditions, should approach the wet bulb temperature as the radiative energy input to the tree reduces to zero. This was experimentally confirmed from measurements of the radiation balance and surface temperature of an isolated tree crown. Thus, evaporation of intercepted rainfall can be estimated using an equation which only requires knowledge of the air dry and wet bulb temperatures and of the bulk tree-crown aerodynamic conductance. This was taken as the basis of a new approach for modelling interception loss from savanna-type woodland, i.e. by combining the Dalton-type equation with the Gash's analytical model to estimate interception loss from isolated trees. This modelling approach was tested using data from two Mediterranean savanna-type oak woodlands in southern Portugal. For both sites, simulated interception loss agreed well with the observations indicating the adequacy of this new methodology for modelling interception loss by isolated trees in savanna-type ecosystems. Furthermore, the proposed approach is physically based and requires only a limited amount of data. Interception loss for the entire forest can be estimated by scaling up the evaporation from individual trees accounting for the number of trees per unit area.