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An ecohydrological modelling framework for the evaluation of the water balance at long temporal scales in semi-arid and disturbed Mediterranean landscapes

S. Contreras, J. Puigdefábregas, F. Domingo

(1) Estación Experimental de Zonas Áridas, CSIC (2) Depto. Biología Vegetal y Ecología, University of Almería

In semi-arid lands, vegetation play a major role in the water balance modulating infiltration and surface runoff rates and it could be regarded as a good proxy of the hydrological processes at any spatial resolution. Adopting ecological optimality principles, a conceptual model was developed to estimate the annual water balance at long-temporal resolutions incorporating the role of vegetation canopy density in the fractioning of precipitation into evapotranspiration and drainage. Initially, the estimates of drainage was computed assuming that at maximum observed vegetation canopy density, the annual precipitation is equal to actual evapotranspiration. However in Mediterranean landscapes the human activities along the history have an important impact on the natural vegetation making difficult to find non-degradated sites where the hydrological equilibrium assumption could be valid. At these degradated sites there is a drainage component which is controlled by the capacity of the soil to retain water. This control is added to the initial approach through the use of characteristic values of water holding capacity and after computing new reference evapotranspiration functions for bare soils and the maximum vegetation canopy densities observed. The model was run in the study area using water holding capacity values extracted from local soil maps. The inclusion of water holding capacity data makes improvements in the estimation of drainage rates. The prediction capability of the conceptual model was tested against observed evapotranspiration data measured by an Eddy Covariance system. At Llano de los Juanes field site (1600 m a.s.l., Sierra de Gádor, Southeast Spain), the estimated evapotranspiration over predicted in a 20% respect to observed values for the 2003-2004 hydrological year.