Geophysical Research Abstracts, Vol. 9, 09719, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09719

Conceptual vegetation-soil model for arid and semiarid zones

D. Quevedo, F. Francés

Department of Hydraulic Engineering and Environment, Universidad Politécnica de Valencia, Spain

Plant ecosystems in arid and semiarid zones show a high complexity from the point of view of the water resource, since they depend on water availability to carry out their vital processes like germinating seed, growth and maintenance. In these climates, water stress is the main factor affecting vegetation development.

The available water in the system results from a balance where the soil, vegetation and the atmosphere are the key issues. The dynamic of each one of them is very significant for the determination of this balance, but is the vegetation which finally modulates (to a great extent) the total balance of water and the mechanisms of the feedback between soil and atmosphere. This is the way how it can be established the soil-vegetation-atmosphere continuum, where the knowledge about soil moisture is the key issue: it is quite relevant for the assessing of the available water and, as a consequence, for the growth and plants maintenance, and the final water balance in the system. As long as the soil moisture fluctuates in the long term, the vegetation biomass will change also.

We have developed a conceptual vegetation model for arid and semiarid zones, based in a bucket type conceptualization, which compiles and synthesizes available knowledge about soil-vegetation-atmosphere dynamic relations and represents in a suitable way, for Mediterranean climate, the vegetation responses to soil moisture fluctuations. In this model, we have considered three tanks interconnected among them, using the water balance equation at each tank and the appropriate dynamic equation for all considered fluxes. The first tank corresponds to interception process by vegetation, with a maximum interception storage which is a function of vegetation type and its biomass variable with time. The second tank represents the depression storage, which is characterized by terrain surface properties. The third tank models the upper soil moisture determination. In this tank the parameters are based on soil and vegetation properties. The vegetation transpiration is a function of the soil moisture and the vegetation type and its biomass variable with time. Once all water state variables are evaluated at each time step, the modifications in the biomass (growth and decay) are made as a function of the actual transpiration and the water stress.

We carried out simulations for monoculture of *Quercus Coccifera*, with an optimal water potential equal to -0.03 MPa, permanent wilting point of -3 MPa and root depth equal to 1000 mm; three conditions of climate are presented (as an rough approach to climate change scenarios) changing historical precipitation and temperature; and three different soil textures. Results show that the model is able to reflect the vegetation dynamic for each one of the different climatic scenarios, reflecting in each of them how the monoculture is stabilized around an average value of biomass (variation range is approximately a 15% of the mean biomass), with clear periods of adaptation (near to 10 years long) according to the fluctuations in the soil moisture in the long term. The model shows the vegetation adaptation to the variability of the climatic conditions, demonstrating how either in the presence or shortage of water, the vegetation regulates its biomass as well as its maximal and minimum rate of transpiration trying to minimizing the total water stress.