Geophysical Research Abstracts
Vol. 16, EGU2014-8001, 2014
EGU General Assembly 2014

Modelling natural grass production and its spatio-temporal variations in a semiarid Mediterranean watershed

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Natural grasses are found in semiarid rangelands with disperse tree cover of part of the Iberian Peninsula and constitute a resource with high ecologic and economic value worth, being an important source of food for livestock, playing a significant role in the hydrologic cycle, controlling the soil thermal regime, and are a key factor in reducing soil erosion and degradation. However, increasing pressure on the resources, changes in land use as well as possible climate variations threaten the sustainability of natural grasses. Despite of their importance, the spatio-temporal variations of pasture production over whole watersheds are poorly known. In this sense, previous studies by other authors have indicated its dependence on a balance of positive and negative effects brought about by the main limiting factors: water, light, nutrients and space. Nevertheless, the specific weight of each factor is not clear because they are highly variable due to climate characteristics and the structure of these agroforestry systems.

We have used a physical spatially-distributed ecohydrologic model to investigate the specific weight of factors that contribute to pasture production in a semiarid watershed of 99.5 ha in western Spain. This model couples a two layer (canopy and understory) vertical local closure energy balance scheme, a hydrologic model and a carbon uptake and vegetation growth component, and it was run using a synthetic daily climate dataset generated by a stochastic weather generator, which reproduced the range of climatic variations observed under mediterranean current climate.

The modelling results reproduced satisfactorily the seasonality effects of climate as precipitation and temperatures, as well as annual and inter-annual variations of pasture production. Spatial variations of pasture production were largely controlled by topographic and tree effects, showing medium-low values depending of considered areas. These low values require introduction of feed to livestock. Valley bottoms, areas with low slopes, and spaces with low tree density are characterized by higher pasture production. Temporal variations of pasture production largely depended on the availability of soil moisture, which in turn depended on the temporal distribution of rainfall. This ecohydrologic model constitutes a valuable tool to investigate water and energy fluxes, as well as vegetation dynamics in semiarid rangelands, as was proved by a quantitative assessment of the quality of the simulations. The range of applications and possibilities contained in the model opens a wide field for future research.