Geophysical Research Abstracts
Vol. 15, EGU2013-8250, 2013
EGU General Assembly 2013

Modeling the role of climate change on small-scale vegetation patterns in a Mediterranean basin using a Cellular Automata model

Domenico Caracciolo (1,3), Simone Fatichi (2), Erkan Istanbulluoglu (3), and Leonardo Valerio Noto (1)
(1) University of Palermo, DICAM, Palermo, Italy (leonardo.noto@unipa.it, +39 091 6657749), (2) Swiss Federal Institute of Technology - Zurich (ETH Zurich), Switzerland, (3) Department of Civil and Environmental Engineering, University of Washington, Seattle, WA 98195, USA

Predicting vegetation response in regions of ecotone transition under a changing climate is a among grand challenges in ecohydrology. In a small basin (1.3 sq km) in Sicily, Italy, where north-facing slopes are characterized by Quercus (tree), and south-facing slopes by Opuntia ficus-indaca (evergreen perennial species drought tolerant) and grasses we use an ecohydrological Cellular-Automaton model (CATGraSS) of vegetation coexistence driven by rainfall and solar radiation with downscaled future climate to examine the role of climate change on vegetation patterns. In the model, each cell can hold a single plant type or can be bare soil. Plant competition is modeled explicitly by keeping track of mortality and establishment of plants, both calculated probabilistically based on soil moisture stress. Topographic influence on incoming shortwave radiation is treated explicitly, which leads to spatial variations in potential evapotranspiration and resulting soil moisture and plant distribution. The influence of the soil thickness on the vegetation distribution is also introduced. The model is calibrated first using a representation of the current climate as a forcing and comparing the vegetation obtained from the model with the actual vegetation through statistical techniques..

The calibrated model is then forced with future climate scenarios generated using a stochastic downscaling technique based on the weather generator, AWE-GEN. This methodology allows for the downscaling of an ensemble of climate model outputs deriving the frequency distribution functions of factors of change for several statistics of temperature and precipitation from outputs of General Circulation Models. The stochastic downscaling is carried out using simulations of twelve General Circulation Models adopted in the IPCC 4AR, A1B emission scenario, for the future periods of 2046-2065 and 2081-2100.

A high sensitivity of the vegetation distribution to variation of rainfall and temperature has been observed. The simulations suggest that the observed vegetation pattern can exist only in the current climate while the changes in the future storm characteristics could lead to a dramatic reorganization of the plant composition based mainly on the topography. Moreover the model analysis underscores the importance of solar irradiance in determining vegetation composition over complex terrain.