Geophysical Research Abstracts
Vol. 21, EGU2019-18742-1, 2019
EGU General Assembly 2019

A coupled microeconomic Positive Multi-Attribute Utility Programming model and HEC-HMS to assess efficiency-environment tradeoffs in water reallocation policies

Héctor González López (1), Carlos Dionisio Pérez-Blanco (1), and Arthur Hrast Essenfelder (2)

(1) Department of Economics and Economic History, Universidad de Salamanca, Spain, (2) Centro Euro-Mediterraneo sui Cambiamenti Climatici and Università Ca' Foscari di Venezia, Italy

Water demand is increasing as a result of population growth and changing distributions of wealth (OECD,2015), while climate change impacts on water resources are reducing water availability (Bates et al.,2008). The combined effects of growing demand and shrinking supply will cause relevant impacts on the environment and the economy, particularly the agricultural sector, the largest water user and that concentrating the marginal uses (i.e. least valuable) of the resource. Water reallocation policies that redistribute resources among users according to water availability are necessary to mitigate economic losses and ensure sufficient resources are conserved for the environment. To this end, Spanish river basin authorities have developed Drought Management Plans (DMPs) aiming at minimizing the environmental, economic and social impacts of drought episodes. Under this current Plan, drought restrictions are based on the level of the reservoirs and streamflow. These indicators are used to obtain a state index that assesses the scarcity situation in accordance to four levels: normality, pre-alert, alert and emergency. When the indicator goes below a predetermined threshold, a predefined amount of water is relinquished from users, which can cause changes in the crop portfolio and related land uses. This response is assessed through a Positive Multi-Attribute Utility Programming (PMAUP) that simulates the behaviour of socioeconomic agents and their impacts on land uses (and related impacts on employment, gross margin, etc.) according to water availability in each drought scenario. On the other hand, the hydrologic semidistributed model HEC-HMS is used to assess the climatic, physical and ecological variables (e.g. precipitation, ground surface and vegetation) at a basin scale. The basin is divided into sub-basins, and streamflows are estimated at the outlet of each sub-basin. Sub-basins are divided into a smaller units that share a common land use. This subdivision allows the HEC-HMS model to mimic land use changes emerging from the simulation of water policies, such as DMPs, in the PMAUP model. While the HEC-HMS model is a popular tool for the development of hydrologic applications this is, to the best of our knowledge, the first study that uses the HEC-HMS model in concert with an agricultural economics module. The coupling between the PMAUP and HEC-HMS models occurs in a sequential, modular fashion through common spatial (land use and land use changes) and water availability variables (water yield and availability). The resulting coupled PMAUP - HEC-HMS model seeks to represent the feedback between the behavior of socio-economic agents and their impact on land use and water availability. The integrated model is illustrated by simulating the new Tagus River Basin DMP in the Upper Tagus Sub-basin in the center of the Iberian Peninsula.