Geophysical Research Abstracts
Vol. 20, EGU2018-14884, 2018
EGU General Assembly 2018

Novel framework to improve water management adaptation under climate change scenarios

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The impacts of projected climate change on freshwater resources are increasingly promoting the adoption of different approaches to water management, due to the likely occurrence of reduced water supplies and early-stage drought conditions in many river basins across Southern Europe. The traditional strategy to cope with water scarcity has largely relied on hard-path measures aimed at expanding the existing supply capacity by great investments in centralized, large-scale infrastructures such as dams and distribution systems. This approach is, however, becoming more and more unsustainable, giving way to effective soft-path solutions based on improved predictive capacities, optimal decision making and drought risk management. Given the need to ensure a more sustainable and efficient water management under current and projected scenarios, the study presents a novel decision-analytic framework to assist decision-makers in designing and assessing alternative soft-path measures in order to increase the adaptation of the system to a changing climate. The framework is being developed within the SO-WATCH project and it will be demonstrated on the Lake Como river basin (Italy) by implementing a four-stage procedure as follows: i) calibration and validation of a physical model comprising three sub-models simulating, respectively, the upstream catchment processes (TOPKAPI-ETH), the lake dynamics and water releases (DISTRILAKE) and the water balance in the irrigation system downstream the lake (IDRAGRA), ii) coupling of the hydrological model with a multi-agent systems model developed to reproduce human decisions and their effects on the system dynamics (e.g. dam operations and farmers practices), iii) definition and impact assessment of hydro-climatic and socio-techno-economic scenarios supported by the calculation of drought indicators and iv) design and evaluation of soft-path measures to improve the efficiency of the water system. Preliminary results based on different climate change projections for the time period 2096-2100 (ensemble of different Global Climate Models, Regional Climate Models and Radiative Concentration Pathways as of the IPCC Fifth Assessment Report) reveal a general reduction of the lake inflows in spring and summer, with an increasing frequency of drought conditions under the business-as-usual scenario. In order to design the most effective soft-path measures, a newly developed index, the Transpiration Deficit Index (D-TDI), will be applied along with other commonly used indexes. D-TDI takes into account the transpiration deficit (i.e. difference between potential and actual transpiration) computed by the IDRAGRA model on a daily basis and cumulated over a selected time span and allows an effective identification of drought prone areas.