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Assessing the impacts of climate change in Mediterranean catchments under conditions of data scarcity

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According to current climate projections, Mediterranean countries are at high risk for an even pronounced susceptibility to changes in the hydrological budget and extremes. While there is scientific consensus that climate induced changes on the hydrology of Mediterranean regions are presently occurring and are projected to amplify in the future, very little knowledge is available about the quantification of these changes, which is hampered by a lack of suitable and cost effective hydrological monitoring and modeling systems.

The European FP7-project CLIMB is aiming to analyze climate induced changes on the hydrology of the Mediterranean Basins by investigating 7 test sites located in the countries Italy, France, Turkey, Tunisia, Gaza and Egypt. CLIMB employs a combination of novel geophysical field monitoring concepts, remote sensing techniques and integrated hydrologic modeling to improve process descriptions and understanding and to quantify existing uncertainties in climate change impact analysis.

The Rio Mannu Basin, located in Sardinia; Italy, is one test site of the CLIMB project. The catchment has a size of 472.5 km2, it ranges from 62 to 946 meters in elevation, at mean annual temperatures of 16°C and precipitation of about 700 mm, the annual runoff volume is about 200 mm.

The physically based Water Simulation Model WaSiM Vers. 2 (Schulla & Jasper (1999)) was setup to model current and projected future hydrological conditions. The availability of measured meteorological and hydrological data is poor as common to many Mediterranean catchments. The lack of available measured input data hampers the calibration of the model setup and the validation of model outputs.

State of the art remote sensing techniques and field measuring techniques were applied to improve the quality of hydrological input parameters. In a field campaign about 250 soil samples were collected and lab-analyzed. Different geostatistical regionalization methods were tested to improve the model setup. The soil parameterization of the model was tested against publically available soil data. Results show a significant improvement of modeled soil moisture outputs.

To validate WaSiMs evapotranspiration (ETact) outputs, Landsat TM images were used to calculate the actual monthly mean ETact rates using the triangle method (Jiang and Islam, 1999). Simulated spatial ETact patterns and those derived from remote sensing show a good fit especially for the growing season.

WaSiM was driven with the meteorological forcing taken from 4 different ENSEMBLES climate projections for a reference (1971-2000) and a future (2041-2070) times series. Output results were analyzed for climate induced changes on selected hydrological variables. While the climate projections reveal increased precipitation rates in the spring season, first simulation results show an earlier onset and an increased duration of the dry season, imposing an increased irrigation demand and higher vulnerability of agricultural productivity.