WATER RESOURCES EVALUATION UNDER CLIMATIC TREND EFFECTS IN MEDITERRANEAN CATCHMENTS

G. Annicchiarico, C. Comolli, A. Anguiano, S. Alonso, R. Romero

1Università di Messina, Dipartimento di Ingegneria Civile, Messina, ITALY
2Group of Meteorology at University of the Balearic Islands

Introduction

The availability of water in the Mediterranean areas is subject to frequent droughts. The climatic changes are associated to a significant increase in rainfall in summer seasons and of a significant decrease in winter rainfall. This implies a significant decrease in the available water resources in rainy seasons and a significant increase of the dry season availability. The impact of climatic changes is different depending on the catchment hydrological properties and discharge regime. The Mediterranean conditions, together with the specific hydrological characteristics of the Mediterranean area, lead to a significant impact on the water resources availability. For this reason, it is necessary to evaluate the impact of climatic changes on water resources availability in the Mediterranean area.

Case study area

For the application of the models data from:
- 13 pluvimeter stations,
- 1 hydrometric station (Belice at Belice),
- 4 thermometric stations
have been used.

Available data:

Unstreamed daily time series of average discharge at each streamgauges, rainfall and temperatures
The calibration period is 5 years long ranging from 1970-1975 for all series.

Stochastic rainfall generator

The model applied is a well known chain-dependent non-stochastic model for daily precipitation (Kliewer, 1998) that is structured in a two-step architecture: a first order non-stationary Markov chain for modeling the rainfall occurrences, and a probability model for modeling the rainfall amounts. The model is capable to incorporate trend effects in rainfall and temperature and to generate a series with similar properties to those of the historical record. The first order Markov chain model for X follows from the assumption that probability of wetday is fully defined if precipitation occurred or did not only on the previous day (3-1).

The model was calibrated against 5 years long daily rainfall series available from the 13 rainfall stations used for the study. The agreement between the model and observed monthly rainfall depths, number of dry and wet days is shown in Figs. 5.6 and 7.

Stochastic temperature generator

For the generation of synthetic temperatures, a classical Auto Regressive Moving Average model (ARMA) has been used (Maslard, 1991). The model was calibrated against a 5 years long daily mean temperature series observed at 5 thermometric stations within the Belice catchment. The model was calibrated using the length of the Belice station (1971-2000) and three 11-years future time-slices 2020-30, 2045-55 and 2075-85 have been simulated (Figs. 1,2,3,4). The monthly precipitation and temperature changes in mean value and variance are applied to the observed daily rainfall series at Belice river catchment to obtain the future rainfall and temperature series.

The rainfall-runoff model - The INHCRIS

In the INHCRIS simulation of Hydrographs And Components from Rainfall, Evapotranspiration and Steamflow data, (Jalalinejad, 1999) the rainfall-runoff processes are represented by two modules: a non-linear loss module that simulates the infiltration and effective rainfall from considering the influence of the rainfall and temperature, and a (2) a linear module based on the classical convolution between effective rainfall and the unit hydrograph to derive the streamflow.

The analysis of results showed that the rainfall-runoff model INHCRIS fits the observed hydrological response of the Belice river catchment with a number of cases other in 0.54.

Conclusions

A robust model framework for the evaluation of changes in water resources availability under climate change scenarios as been set up. The rainfall, temperature and runoff series generated by the models under current scenario showed a robust capability of the models to perform synthetic generation. The same series were used under the climate change future scenarios. To achieve the hierarchical structure, future scenarios has been defined by the Inter-Governmental Panel on Climate Change (IPCC) and these scenarios has been applied to the trend parameters (i.e. mean and variance) of monthly rainfall and temperature series from now to 2080.

Future scenarios consider the impact of climate change due to increase temperature trend and interannual variance in average temperature leading to a negative trend of total water resources.

These results point out the need to perform climate scenario analysis for any planning or management purpose in the field of water resources engineering.

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