Geophysical Research Abstracts
Vol. 16, EGU2014-9798, 2014
EGU General Assembly 2014

A new eco-hydrological distributed model for the analysis of the climate change impact on water resources of Mediterranean ecosystems: the Flumendosa basin case study in Sardinia

Alessio Sarigu, Clorinda Cortis, and Nicola Montaldo
Dipartimento di Ingegneria Civile-Ambientale-Architettura , Università di Cagliari, Italy (alessio.sarigu@unica.it)

In the last three decades, climate change and human activities increased desertification process in Mediterranean regions, with dramatic consequences for agriculture and water availability. For instance in the Flumendosa reservoir system in Sardinia the average annual runoff in the latter part of the 20th century was less than half the historic average rate, while the precipitation over the Flumendosa basin has decreased, but not at such a drastic rate as the discharge, suggesting a marked non-linear response of discharge to precipitation changes.
With the objective of analyzing and looking for the reasons of the historical runoff decrease a new ecohydrological model is developed and tested for the main basin of the Sardinia island, the Flumendosa basin.
The eco-hydrological model developed couples a distributed hydrological model and a vegetation dynamic model (VDM). The hydrological model estimates the soil water balance of each basin cell using the force-restore method and the Philips model for runoff estimate. Then it computes runoff propagation along the river network through a modified version of the Muskingum –Cunge method (Mancini et al., 2000; Montaldo et al., 2004). The VDM evaluates the changes in biomass over time from the difference between the rates of biomass production (photosynthesis) and loss (respiration and senescence), and provides LAI, which is then used by the hydrological model for evapotranspiration and rainfall interception estimates.
Case study is the Flumendosa basin (Sardinia, basin area of about 1700 km2), which is characterized by a reservoir system that supplies water to the main city of Sardinia, Cagliari. Data are from 42 rain stations (1922-2008 period) over the entire basin and data of runoff are available for the same period. The model has been successfully calibrated for the 1922 – 2008 period for which rain, meteorological data and discharge data are available.
We demonstrate that the hystorical strong decrease of runoff is due to a change of rainfall regime, with a decrease of rainfall during the winter months, and a little increase of rainfall during spring-summer months. Indeed, the higher Spring rainfall produced an increase of transpiration mainly, whithout any impact on runoff. Instead the decrease of rainfall in winter months produces a strong decrease of runoff. This trend impacts significantly on monthly runoff production, and, more important, on yearly runoff production, because most of the yearly runoff contribution comes from the winter months. Yearly runoff is more important in Sardinia water resources systems, because runoff is accumulated in dam reservoirs, and is the main water resources of the island. Hence, due to the change of rainfall regime in last decades we are observing a dramatic decrease of runoff, which is reaching to impact on the water availability of the Sardinian major city, Cagliari.