Geophysical Research Abstracts
Vol. 13, EGU2011-6453-1, 2011
EGU General Assembly 2011

Modelling flows duration curves in Mediterranean river basins through an ecohydrological approach

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The flow duration curve, representing the relationship between magnitude and frequency of streamflows in a basin, provides an important synthesis of the relevant hydrological processes occurring at the basin scale. It is typically obtained from field observations and, since most of the geographical areas of the world still lack suitable streamflow observations, its reconstruction in ungauged river basins is certainly an open and relevant issue in the hydrological literature. Different theoretical approaches have been developed in recent years, and in particular, a novel ecohydrological framework has provided considerable results.
The aim of this study is to test with field data, a recent analytical model for the probabilistic characterization of base flows in river basins using few climatic, ecohydrologic and geomorphologic parameters.
The base flow is the slow, subsurface contribution to runoff that in many circumstances, such as in the case of relatively flat, vegetated catchments, represents the major runoff component in terms of discharged volumes. The model, coupling soil moisture balances with a simplified scheme of the hydrological response of the basin, provides the probability distribution function of the daily streamflows and the corresponding flow duration curves. The temporal dynamic of the soil water content is seen as the result of deterministic, state dependent loss processes (e.g., evapotranspiration, leakage) and stochastic increments driven by intermittent rainfall forcings. The episodical exceedence of a certain critical level, comprised between the field capacity and complete soil saturation, for the catchment-averaged soil moisture is seen as the triggering mechanism for water release from soil toward the catchment outlet. According to this approach the derived probability density function of slow component of runoff is well described by a Gamma distribution.
In this work the original approach, that was structured in a spatially lumped framework by assuming average properties, is considered and opportunely modified to adapt it to the peculiarities of some Mediterranean regions, where catchments are often relatively small and characterized by significant periods with absence of water discharge, especially during the summer. The model is tested using long daily streamflows series recorded in a small catchment located in southern Italy. A sensitivity analysis of the model to the most relevant parameters is also carried out. After performing a procedure to determinate appropriate model parameters, the flow duration curve predicted by the model is compared to the empirical one. Important implications arising from this comparison are here presented and discussed.