Geophysical Research Abstracts
Vol. 12, EGU2010-3177, 2010
EGU General Assembly 2010

Nonlinear and recurrence quantification analysis in extreme precipitation time series under present and future climatic conditions

DIONYSIA PANAGOULIA (1) and ELENI VLAHOGIANNI (2)

(1) NATIONAL TECHNICAL UNIVERSITY OF ATHENS, WATER RESOURCES, ATHENS, Greece (dpanag@hydro.ntua.gr), (2) NATIONAL TECHNICAL UNIVERSITY OF ATHENS, TRANSPORTATION, PLANNING AND ENGINEERING, ATHENS, Greece (elenivl@central.ntua.gr)

In this research, we provide a statistical framework based on the nonlinear dynamics theory and the recurrence analysis of dynamical systems with the main scope to quantitatively identify the temporal characteristics of the extreme (maximum) daily precipitation series in each year for present and 1xCO2 and 2xCO2 climate cases. The used maximum daily precipitation time series are conditioned on atmospheric circulation. An automated objective classification of daily circulation patterns (CPs) based on optimized fuzzy rules has been used to classify the observed CPs. The ECHAM4 GCM-generated scenarios of daily CPs have been also classified for 1xCO2 and 2xCO2 climate scenarios. The precipitation has been modelled as a stochastic process coupled with atmospheric circulation. The overall methodology was applied to the medium-sized mountainous Mesochora catchment in Central-Western Greece. The recurrent behavior of the precipitation patterns has pointed out a nonlinear deterministic (chaotic-like) behavior for present time series. When compared to 1xCO2 and 2xCO2 climates, a straightforward behavior has been exhibited with strong variability and non-stationary characteristics. In addition, the recurrent behavior of the precipitation has presented systematical decreases for the present climates and cyclic behavior for both 1xCO2 and 2xCO2 climates. In their temporal evolution all climate cases have exhibited shifts from deterministic to stochastic behavior. Nonlinear behavior and variable determinism denote periodic to chaotic and chaotic-to-chaotic transitions. All these results might be used to improve the process of constructing more efficient predictors, i.e., to choose the optimum modeling approach (neural networks, autoregressive stochastic models and so on) to match the statistical characteristics of extreme precipitation under present and particularly under altered climates.