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Geostatistical Study of Precipitation on the Island of Crete

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Abstract

Understanding and predicting the spatiotemporal patterns of precipitation in the Mediterranean islands is an important topic of research, which is emphasized by alarming long-term predictions for increased drought conditions [4]. The analysis of records from drought-prone areas around the world has demonstrated that precipitation data are non-Gaussian. Typically, such data are fitted to the gamma distribution function and then transformed into a normalized index, the so-called Standardized Precipitation Index (SPI) [5]. The SPI can be defined for different time scales and has been applied to data from various regions [2]. Precipitation maps can be constructed using the stochastic method of Ordinary Kriging [1]. Such mathematical tools help to better understand the space-time variability and to plan water resources management.

We present preliminary results of an ongoing investigation of the space-time precipitation distribution on the island of Crete (Greece). The study spans the time period from 1948 to 2012 and extends over an area of 8 336 km^2. The data comprise monthly precipitation measured at 56 stations. Analysis of the data showed that the most severe drought occurred in 1950 followed by 1989, whereas the wettest year was 2002 followed by 1977. A spatial trend was observed with the spatially averaged annual precipitation in the West measured at about 450mm higher than in the East. Analysis of the data also revealed strong correlations between the precipitation in the western and eastern parts of the island. In addition to longitude, elevation (masl) was determined to be an important factor that exhibits strong linear correlation with precipitation. The precipitation data exhibit wet and dry periods with strong variability even during the wet period. Thus, fitting the data to specific probability distribution models has proved challenging. Different time scales, e.g. monthly, biannual, and annual have been investigated. Herein we focus on annual precipitation which are fitted locally to a three-parameter probability distribution, based on which a normalized index is derived. We use the Spartan variogram function to model space-time correlations, because it is more flexible than classical models [3]. The performance of the variogram model is tested by means of leave-one-out cross validation. The variogram model is then used in connection with ordinary kriging to generate precipitation maps for the entire island. In the future, we will explore the joint spatiotemporal evolution of precipitation patterns on Crete.

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