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An early warning drought system for operational drought management

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In this study an early warning drought system is developed for spatiotemporal forecasting and monitoring of drought. The methodology is based on the integration of artificial intelligence techniques with geostatistical interpolation methods. The distributed raster-based integrated drought monitoring and forecasting system is demonstrated for operational drought management using a meteorological drought index the Standardized Precipitation Index (SPI). The basic elements of the system are determined, and important issues and processes are analytically discussed, such as the representation of the spatial and temporal simulation error, extraction of optimal design solution in machine learning methods for reliable and accurate spatiotemporal drought forecasting. The aforementioned elements are integrated algorithms combining various computational intelligence techniques such as artificial neural networks, genetic algorithms and geostatistical methods. The early warning system uses previous SPI values calculated at various timescales and analyzes the drought level based on the lead time of SPI for operational use via a hybrid spatiotemporal drought forecast model. To identify more clearly the hazard, advanced spatial interpolation methods are incorporated in the forecasting system to produce raster drought forecast maps. Comparison of the forecasted drought maps with selected historical drought maps show that reliable and accurate predictions of drought characteristics (severity, duration and area) are estimated for medium term prediction intervals at larger timescales of SPI and for short term prediction intervals at smaller SPI timescales in Pinios river basin, Thessaly, Greece. It is believed that implementation of the early warning drought system with real-time rainfall data will help to judge if this region is a potential drought prone area. If the danger indicator is reached, the water managers and relevant civil protection agencies shall be properly informed to take preventive measures and minimize the possible loss according to the drought severity level.