



Guidelines for drought management in Emilia Romagna Region

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Land use changes and global warming are considered factors of more and more frequent droughts and water scarcity events. In recent years Emilia-Romagna Region has been increasingly affected by drought events, caused by reduction of snowfall and rain precipitations. In order to accomplish the 2000/60 European water directive, an innovative hydrologic forecasting system, based on ensemble techniques, is developed to face drought risk and water scarcity and to define alert strategies in Emilia Romagna. The primary aim is to forecast the behaviour of the water resource system under different scenarios, taking into account alternative water management strategies. The system simulates hydrological cycle and water balance in the Appeninic tributaries of Po river and the Po itself, in the Reno Basin and finally in Romagnoli basins, starting from observed and forecast data. The modelling chain consists of a hydrological model, simulating the response of the basins, and a water balance model taking into account hydrological elements, reservoirs deliveries and water uses withdrawals. The modelling chain is implemented in a "medium term configuration" feeded by up to 15 days meteorological forecast and a "long term and seasonal configuration" feeded by up to three months seasonal forecast. The last is coupled with a Weather Generator to downscale forecast precipitations and temperatures. Particular emphasis has been dedicated to the linkage of meteorological forecasts and hydrological and water resources modeling in order to evaluate the performance and reliability of drought forecasts up to three months. In this way, the estimation of the uncertainty associated with the meteorological prediction is exported by the meteo-hydrological modelling chain into the drought forecast results.

The availability of forecasted sub basins response (i.e. water levels, humidity, ground water and surface discharge), informations on the programmed delivery and withdrawals and other informations from drought indicators (Standard Precipitation Index- SPI, Standard Flow Index -SFI, drought severity indicators, environmental indicators) allow to obtain a wide range of information both about the actual state, provided by the hydrological and meteorological observations from the real time monitoring system (meteorological stations, water level gauges, discharge monitoring, reservoirs and withdrawals gauges) and the future state provided by the input from the general circulation deterministic prediction and the monthly updated seasonal ensemble prediction.

The present paper describes the guideline for system management suggested for Emilia Romagna region, especially if emergency declaration for extreme drought events occurs, and the so called "Technical Director's Cabin" for decision support of Italian civil protection authority.

The methodological scheme is based on a "state approach" in which state changes are defined according to observed and predicted values of hydrometeorological indicators, water resources availability and demand. Focusing on the single state definition the methodology takes into account the analysis of input data and modeling system outputs, providing the evaluation of forecast performances (performance indicators).