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Using meteorological seasonal ensemble in water resource management in Emilia-Romagna Region, Italy

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Global warming is an important phenomenon influencing the dynamics and severity of droughts, more and more frequent; in this context, the development and implementation of water management policies are a strategic opportunity and priority action to mitigate the effects of climate change and drought. Furthermore, whereas in recent years the territory of Emilia-Romagna Region has been increasingly affected by drought events, caused by marked reduction of snowfall and rain precipitations in periods of the year usually benefiting from these, the realization of a system was considered useful to model and simulate drought events, able to transmit to authorities all information needed for the organization, planning and management of water resources in order to deal with any emergency situation.

During dry weather periods water resource management is crucial for all of these factors, for that reason a prior analysis is needed to support and optimize decisions in order to reduce social and economical damages. Unlike flood events, drought events take place with a greater time scale, this requires a focused management and a larger forecast time.

Here a method is presented for generating forecast scenarios used in a system developed to support decision-making and alerting processes necessary for a good water management carried out by the river basin authorities. The system is composed of a hydrological model and a river basin management and planning model, both are used with real-time data provided by telemetry network and forecast data provided by deterministic and probabilistic seasonal model. The system is also composed by stochastic models capable to highlight meteorological and hydrological drought conditions evaluating return periods and drought indexes.

The deterministic modelling chain covers a 15 days forecast, while the probabilistic modelling chain covers 3 months forecast. As previously said, drought events models need great forecast lead-time, so the use of seasonal forecast became crucial. Unfortunately this forecast provides monthly data and management model requires daily data. For that reason a method to downscale seasonal forecast from monthly to daily time step was found out.

Using a weather generator named rainsim, based on Neymann Scott rectangular pulses model, synthetic daily rainfall series for a defined number of rainfall stations are generated, so daily precipitation scenarios for rainfall stations are also generated, hence sampling these scenarios with seasonal forecast an ensemble set of daily data compatible with the seasonal forecasts are produced. Regarding temperature data, one of the following models may be applied: AR model, Richardson model and Kilsby model.

This approach generates a spaghetti plot for each output point of both deterministic and stochastic models allowing the user to evaluate, not only the simulated scenarios, but also the uncertainty of the system towards the forecast, giving to the user a higher degree of sensitivity of the results.