Geophysical Research Abstracts
Vol. 13, EGU2011-6660, 2011
EGU General Assembly 2011
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Real-time hydro-meteorological forecasts: re-analysis of some operational case studies

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Nowadays coupling meteorological and hydrological models, it is recognized by scientific community as a necessary way to forecast extreme hydrological phenomena, in order to active useful mitigation measurements and alert systems in advance.
In order to quantify uncertainty of flood prediction, the hydrological community is increasingly looking at the use of Ensemble Prediction System (EPS) instead of single (deterministic) forecasts for flood warning. From hydrological perspective, the use of EPS, as input to a hydrological model, is an important tool to produce river discharge predictions and to assess uncertainty involved in forecasting precipitation.
The development and implementation of a real-time flood forecasting system with a hydro-meteorological operational alert procedure is described in this study.
In this analysis the hydrological ensemble forecasts are based on the 16 meteorological members, provided by COSMO-LEPS model (by ARPA Emilia-Romagna) with 5 day lead-time, while the hydrological model used to generate the runoff simulations is the rainfall-runoff distributed FEST-WB model, developed at Politecnico di Milano. The observed data to run the control simulations were supplied by ARPA-Piemonte, which uses the same model every day for nowcasting monitoring and as a civil-protection tool.
The goal is to evaluate how the uncertainty of meteorological forecasts influences the performance of hydrological predictions in terms of Quantitative Discharge Forecast (QDF) over different catchments. The introduction of alert codes appears to be another useful tool for decision makers to give them a spread of forecasted QDFs, coming from different weather and hydrological models with the probability of event occurrence.
In this study we present a hindcast for some precipitation events, occurred between 2007 and 2010 in Piemonte and in Lombardia regions, North-West of Italy.
We investigate how the meteorological forecasts are efficient into hydrological forecasting system at different days in advance, focusing the attention on key role of air temperature, which is a crucial feature in determining the partitioning of precipitation in solid (snow) and liquid phase (rainfall) that can affect the river discharge prediction in autumn and winter seasons over Piemonte watersheds. Further we try to understand how the effect of meteorological model spatial resolution and the soil moisture initial conditions can influence discharge forecasts and warnings over mountain basins. Last but not least, we show a re-analysis of a recent event occurred in September 2010, where severe rainfall in few hours hit Milan urban area, causing the Seveso River overflowing in the Northern part of the city.