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The flood event of 10-12 November 2013 on the Tiber River basin (central Italy): real-time flood forecasting with uncertainty supporting risk management and decision-making

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The Italian national hydro-meteorological early warning system is composed by 21 regional offices (Functional Centres, CF). Umbria Region (central Italy) CF provides early warning for floods and landslides, real-time monitoring and decision support systems (DSS) for the Civil Defence Authorities when significant events occur. The alert system is based on hydrometric and rainfall thresholds with detailed procedures for the management of critical events in which different roles of authorities and institutions involved are defined.
The real-time flood forecasting system is based also on different hydrological and hydraulic forecasting models. Among these, the MISDc rainfall-runoff model ("Modello Idrologico SemiDistribuito in continuo"; Brocca et al., 2011) and the flood routing model named STAFOM-RCM (STAge Forecasting Model-Rating Curve Model; Barbetta et al., 2014) are continuously operative in real-time providing discharge and stage forecasts, respectively, with lead-times up to 24 hours (when quantitative precipitation forecasts are used) in several gauged river sections in the Upper-Middle Tiber River basin. Models results are published in real-time in the open source CF web platform: www.cfumbria.it. MISDc provides discharge and soil moisture forecasts for different sub-basins while STAFOM-RCM provides stage forecasts at hydrometric sections. Moreover, through STAFOM-RCM the uncertainty of the forecast stage hydrograph is provided in terms of 95% Confidence Interval (CI) assessed by analyzing the statistical properties of model output in terms of lateral.
In the period 10th-12th November 2013, a severe flood event occurred in Umbria mainly affecting the north-eastern area and causing significant economic damages, but fortunately no casualties. The territory was interested by intense and persistent rainfall; the hydro-meteorological monitoring network recorded locally rainfall depth over 400 mm in 72 hours. In the most affected area, the recorded rainfall depths correspond approximately to a return period of 200 years. Most rivers in Umbria have been involved, exceeding hydrometric thresholds and causing flooding (e.g. Chiascio river).
The flood event was continuously monitored at the Umbria Region CF and the possible evolution predicted and assessed on the basis of the model forecasts. The predictions provided by MISDc and STAFOM-RCM were found useful to support real-time decision-making addressed to flood risk management. Moreover, the quantification of the uncertainty affecting the deterministic forecast stages was found consistent with the level of confidence selected and had practical utility corroborating the need of coupling deterministic forecast and ‘uncertainty’ when the model output is used to support decisions about flood management.

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