# Operational flash-flood forecasting system for the Upper-Medium Tiber River (central Italy)

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The interest towards methodologies and models useful to flash flood risk evaluation and management is continually increasing, due to the more frequent events occurring in European regions. Over the last 15 years, the terrirory of Umbria region in Italy has been affected by significant events, at different spatial scales.

Following recent laws and regulations concerning extreme natural events management, and in the framework of the Italian national hydrometeorological early warning system, 21 regional offices (called "Decentralized Functional Centres" - CFD) are now operative. CFDs are coordinated by the Central Functional Centre (CFC) at the National Civil Protection Department (DPCN) in Rome. Moreover, these Functional Centres will have a crucial role for the implementation of the European flood directive 2007/60/EU due to the "linking" role between Civil Protection "real time" activities and environmental/planning "deferred time" ones. In fact, CFDs are in charge of acquiring and collecting both real time and quasi-static data: quantitative data from monitoring networks, meteo-radars, meteorological Quantitative Precipitation Forecasts (QPFs), Earth Observation data, hydraulic and hydrological simulation models, cartographic and thematic GIS data, flooding areas mapping, dam managing plans during flood events, non instrumental information from direct control of "territorial presidium" (especially Provinces, Reclamation Bureaus and Municipalities). Each CFD has to provide technical tools able to support decisions when significant flood/landslide events occur, furnishing 24h support for the whole duration of the emergency period. The alert system is formally based on a hydrometric and rainfall thresholds set of three different increasing critical levels according to the expected ground effects (for catchments wider than 400 km$^2$), together with a detailed procedure for the management of critical events in which the different role of various authorities/institutions involved is defined.

The Umbria region CFD is located in central Italy and fully operative since February 2010. Its pertaining area includes most of the Upper-Medium Tiber River characterized by a Mediterranean climate with the occurrence of flash floods and for which the role of the soil wetness conditions before a storm event is significant. To take account of the antecedent wetness conditions, the real time flood forecasting system, based on the classical hydrometeorological network, has been recently enhanced through an experimental activity for soil moisture monitoring through in-situ and satellite sensors. Moreover, following to the Flash Flood Guidance (FFG) approach, the Umbria region CFD carried out preliminary analyses about flash floods prediction and management in its territory, in order to minimize possible ground effects for population and public/private structures and goods. Firstly, a GIS-based activity addressed to identify regional areas where flash floods are prone to occur (in terms of slope, permeability, short and intense observed rainfall, catchment size, historical events with high damages) was done. Then, a distributed rainfall-runoff hydrological model was implemented in real-time to couple the expected soil wetness conditions and the rainfall thresholds to be used for FFGs estimation. On the basis of historical flood events, the FFGs were calibrated also by using recent high resolution rainfall data from the "Monte Serano" doppler meteo radar (operative since 2008). Finally, uncertainty assessment and a WebGIS-based hazard system for dynamic risk scenarios evaluation are going to be implemented.