

From theoretical fixed return period events to real flooding impacts: a new approach to set flooding scenarios, thresholds and alerts

Paola Parravicini, Matteo Cislighi, and Leonardo Condemi
Hydrometeo service, ARPA della Lombardia, Milan, Italy

ARPA Lombardia is the Environmental Protection Agency of Lombardy, a wide region in the North of Italy. ARPA is in charge of river monitoring either for Civil Protection or water balance purposes. It cooperates with the Civil Protection Agency of Lombardy (RL-PC) in flood forecasting and early warning. The early warning system is based on rainfall and discharge thresholds: when a threshold exceeding is expected, RL-PC disseminates an alert from yellow to red.

The conventional threshold evaluation is based on events at a fixed return period. Anyway, the impacts of events with the same return period may be different along the river course due to the specific characteristics of the affected areas.

A new approach is introduced. It defines different scenarios, corresponding to different flood impacts. A discharge threshold is then associated to each scenario and the return period of the scenario is computed backwards.

Flood scenarios are defined in accordance with National Civil Protection guidelines, which describe the expected flood impact and associate a colour to the scenario from green (no relevant effects) to red (major floods).

A range of discharges is associated with each scenario since they cause the same flood impact; the threshold is set as the discharge corresponding to the transition between two scenarios. A wide range of event-based information is used to estimate the thresholds. As first guess, the thresholds are estimated starting from hydraulic model outputs and the people or infrastructures flooded according to the simulations. Eventually the model estimates are validated with real event knowledge: local Civil Protection Emergency Plans usually contain very detailed local impact description at known river levels or discharges, RL-PC collects flooding information notified by the population, newspapers often report flood events on web, data from the river monitoring network provide evaluation of actually happened levels and discharges.

The methodology allows to give a return period for each scenario. The return period may vary along the river course according to the discharges associated with the scenario. The values of return period may show the areas characterized by higher risk and can be an important basis for civil protection emergency planning and river monitoring.

For example, considering the Lambro River, the red scenario (major flood) shows a return period of 50 years in the northern rural part of the catchment. When the river crosses the city of Milan, the return period drops to 4 years. Afterwards it goes up to more than 100 years when the river flows in the agricultural areas in the southern part of the catchment.

In addition, the knowledge gained with event-based analysis allows evaluating the compliance of the monitoring network with early warning requirements and represents the starting point for further development of the network itself.