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FLUVIAL DYNAMICS, EXTREME FLOODS AND GEOMORPHOLOGICAL HAZARD

Nicola SURIAN [1]

[1] ***Department of Geosciences - University of Padova, nicola.surian@unipd.it***

Floods are one of the major natural hazard affecting highly populated countries such as Italy. Besides hydraulic hazard, geomorphological hazard due to channel dynamics should be taken into account. Channel dynamics (i.e. channel lateral mobility, changes in bed elevation, intense sediment and wood transport) may cause severe damages to human properties and infrastructures. Analysis of such dynamics, in particular during extreme events, is crucial to reach an overall assessment of flood hazard and an effective implementation of the EU Floods Directive (2007/60). The talk deals with: (i) geomorphic response to extreme floods, with specific focus on the 2011 flood in the Magra River catchment; (ii) IDRAIM, a methodological framework for geomorphological assessment, analysis and monitoring of streams developed recently in Italy.

The Magra River catchment (northern Apennines, Italy) was affected by a flood with a recurrence interval up to 300 yr on 25th October 2011. An integrated approach was deployed to study this flood, including analysis of channel width changes, estimate of peak discharges in ungauged streams, detailed mapping of landslides and analysis of sediment connectivity with channel network. Channel widening occurred in 35 reaches out of 39. In reaches with moderate slope (< 4%) average and maximum width ratio was 5.2 and 19.7 (i.e. channel widened from 4 m to 82 m), respectively; in steep reaches (slope ≥ 4%) widening was slightly less intense (i.e. average width ratio = 3.4). The relationship between channel widening and seven controlling factors was explored at sub-reach scale by using multiple regression models. In the steep sub-reaches, stream power, unit stream power, and lateral confinement showed good relationships with channel widening, while regression models provided a lower explanation of widening variability for the moderate slope sub-reaches. Results pointed out that hydraulic variables are not sufficient to explain channel response to extreme floods and inclusion of other factors, e.g. lateral confinement, is needed to increase explanatory capability of models and, therefore, capability of predicting channel dynamics.

IDRAIM has been developed with the specific aim of supporting the management of river processes by integrating the objectives of ecological quality and flood risk mitigation. IDRAIM incorporates three tools to assess channel dynamics: the Morphological Dynamics Index and the Event Dynamics Classification, to provide information on the expected magnitude of channel dynamics in a given reach on a one-dimensional scale, and the river morphodynamic corridors, to define the areas of the fluvial corridor that will be affected by such dynamics. Strengths and limitations of these tools are analyzed. In conclusion, this talk underlines that geomorphic approaches are needed for integrating the standard hydraulic analyses for flood mapping and obtaining more robust and reliable flood risk assessment.