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Geomorphic response to extreme flood events in alluvial rivers

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Abstract:
Extreme floods represent one of the major natural hazard that affect highly populated countries, such as Italy. Besides hydraulic hazard, geomorphological hazard due to channel dynamics should be taken into account, specifically in alluvial rivers. Channel dynamics (i.e. channel lateral mobility, changes in bed elevation and intense sediment transport) can cause severe damages to human properties and infrastructures. The main purposes of this work are to provide a quantitative assessment of geomorphic effects due to extreme events (recurrence interval > 100 years) and the development and application of new tools to asses and predict fluvial dynamics and related geomorphological hazard in Italian rivers in different physiographic and climatic settings. The research mainly focuses on (i) the evaluation of the main controlling factors affecting the geomorphic response to extreme floods (ii) the identification of relationships between controlling factors and channel changes and (iii) the development of conceptual and empirical models to be tested to a wider data set. The methodological approach is based on integration of field surveys with remote sensing, GIS and statistical analyses. In this work the analysis carried out in the Teglia and Geriola rivers, tributaries of the Magra River is illustrated. The Magra catchment (Upper Tuscany, Italy) was affected by an extreme flood on 25th October 2011. Planimetric morphological changes (i.e. changes in channel width) and their spatial distribution were investigated in detail using two sets of aerial photos. Width ratios (width after/width before the flood) were calculated for cross sections spacing of 10 m and then correlated with different controlling factors (e.g. width of the floodplain, channel slope, and unit stream power). In the Teglia River the width ratio ranged from 1.2 (i.e. change in channel width from 26 m to 32 m) to 14 (i.e. from 5 m to 67 m). The width ratio ranged from 1 to 23.8 (i.e. from 4 m to 83 m) in the Geriola River. Preliminary results of statistical analysis provide a good relationship between the width of the floodplain and the geomorphic response to extreme flood of alluvial rivers, especially at reach scale. At smaller scales other aspects (i.e. the presence of artificial structures or terraces) have to be considered in order to explain channel response to the flood event. Future steps of this research include (i) analysis of other extreme events and different type of streams; (ii) development and testing of a conceptual/empirical model to improve our capability of predicting channel dynamics during extreme events.