



Geomorphic response to an extreme flood in two mountain rivers (northeastern Sardinia, Italy): the role of geomorphic and hydraulic controlling factors

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The investigation of geomorphic effectiveness of extreme floods is crucial to improve tools for assessing channel dynamics and our capability of forecasting geomorphological hazard. This work deals with geomorphic response of two mountain rivers in the Posada catchment (northeastern Sardinia, Italy), considering a range of morphological (i.e. lateral channel confinement, channel gradient, channel sinuosity, sediment sources, and vegetation) and hydraulic variables (i.e. cross-sectional stream power, unit stream power, flow duration and total energy expenditure) as possible controlling factors. On November 18th 2013, northeastern Sardinia was affected by an extreme meteorological event with hourly rainfall intensities up to 100 mm/h and a peak in rain accumulation up to 450 mm in 24 hours, with 18 casualties and damages to infrastructure and buildings. In the Posada and Mannu di Bitti Rivers, the geomorphic response (i.e. bank erosion, channel aggradation and incision, vegetation and wood dynamics, hillslope failure) was analyzed at different spatial scales. The observed dominant geomorphic change was channel widening. Therefore, channel width changes have been analyzed in detail by remote sensing and GIS tools integrated by field surveys.

The study focuses on reaches (i.e. 22.5 km in the Posada River, upstream of Maccheronis dam; 18.2 km in the Mannu di Bitti River) affected by evident and significant geomorphic responses in terms of channel widening, which occurred along most of the confined, partly-confined and unconfined reaches. These reaches are also characterized by the alternation of alluvial and bedrock channel segments. Channel widening was expressed as a width ratio (i.e. channel width after/channel width before the flood) and analyzed at reach (i.e. ranging between 2 and 7 km) and sub-reach scales (i.e. ranging between 0.7 and 1 km). The maximum width ratio in both the Posada and Mannu di Bitti Rivers was 6.2 at the sub-reach scale (i.e. channel widened from 18 to 108 m and from 12 to 76 m, respectively) and the average width ratios were 3.7 and 3.2, respectively. On the basis of correlations between the width ratio and controlling factors, it has been possible to identify the main geomorphic and hydraulic variables driving channel widening and to identify the best predictive model including the most explanatory variables. Results indicate that hydraulic variables are not sufficient to explain satisfactorily the channel response to the extreme flood and inclusion of other factors, e.g. lateral confinement, is needed to increase explanatory capability of models.