Flood hazard in mountain streams: the key role of geomorphic processes during high magnitude events

(*Proposer: Prof. Nicola Surian*)

Floods are one of the major natural hazards that affect highly populated countries. Although channel dynamics (i.e. channel lateral mobility, intense sediment and wood transport) are commonly dominant processes in mountain streams during high-magnitude floods, hazard assessment still mostly focuses on water flooding only. Therefore, there is a need to include river geomorphological hazard to produce reliable flood hazard mapping and define effective mitigation measures. The proposed project has two main goals: (i) to investigate channel response to floods of different magnitude, and in particular to extreme floods; (ii) to improve hazard assessment, that is our capability of predicting geomorphic effects of floods.

For hazard assessment it is crucial to document the type and magnitude of channel response, to identify controlling factors of such response, and to develop tools enabling channel dynamics predictions. Buraas et al. (2014) pointed out that there is still a general lack in the capability to predict where major geomorphic changes take place during an extreme flood event. In this respect, the integrated approach developed by Rinaldi et al. (2016) and results from Surian et al. (2016) and Scorpio et al. (2018) represent promising contributions for the analysis of channel response to extreme floods and identification of controlling factors. Notwithstanding this, there is a need for (i) understanding the spatial variability of geomorphic response to a single flood event; (ii) building a larger dataset, including a wide range of flood magnitude, channel morphologies, environmental conditions; (iii) testing and developing geomorphic tools (e.g. identification of "river morphodynamic corridors") that should improve our capability in forecasting channel response to floods. Although such forecasting is very challenging, this is crucial since ongoing climate changes are increasing flood frequency, specifically occurrence of extreme floods.

Methods used in this project include: geomorphological survey and recognition of different flow types (Brenna et al., 2020); GIS analysis using aerial photographs, satellite images, DTMs. Numerical modeling could be eventually used according to the skills and interests of the PhD student.

Possible collaborations: CNR-IRPI (Padova); University of Bolzano; ISPRA; Colorado State University (USA), Dartmouth College (USA).

Available funds: DOR funds; these funds will cover field work and workshop/conference attendance, while several data (e.g. remotely sensed images, DTMs) are already available.

References:

Brenna et al. (2020), Geomorphology, 371, 107413
Buraas E.M. et al. (2014), Earth Surf. Process. Landf., 39, 1778-1789.
Rinaldi M. et al. (2016), Earth Surf. Process. Landf., 41, 835-846.
Scorpio V. et al. (2018), Science of the Total Environment, 640-641, 337-351.
Surian N. et al. (2016), Geomorphology, 272, 78-91.