Title: Geomorphological contribution to flash flood hazard evaluation

Tutor: Nicoletta Santangelo

Co-tutors: Antonio Santo (DiCEA-Unina), Niki Elvepidou (Univ. Atene)

Research program

Flash floods are a frequent natural hazard in many parts of Europe, including Italy. Due to the particular orography and climate of the country, they occur in many different settings, from mountain valleys to coastal and inland plains, in volcanic areas, and in semiarid and/or karst environments.

Such floods are of limited areal extent and may occur in small catchments drained by torrential streams feeding alluvial fans (basin/fan systems). They may display highly variable magnitudes due to the size of the basins, the concentration times and extent of possible channel filling. These phenomena induce highly erosive flows and impact forces due to the mix of water, soil, boulders, trees and debris, but they also have a very high rate of aggradation due to the deposition of large particles.

In many areas of Italy and Europe, a wide urbanization occurred in this type of geomorphological settings since the 1960s, which has produced a considerable increase in exposure to such hazards. Moreover, the return period of these events is very high (larger than twenty years) and there is limited awareness of the actual hazard conditions by the local community. In the light of the projected climate change scenarios, in these settings an increased probability of major economic and social impacts is also expected as the century progresses.

Geomorphological analysis may provide significant contribution in flash flood hazard studies. Results of the researches carried out at DISTAR in the last years by Prof. Nicoletta Santangelo and her group on these topics allowed:

- To define a methodology to recognize the areas prone to this phenomenon
- To analyse the basin/fan system by means of a morphometric approach aiming at distinguish between debris flow vs water flood dominated fans (collecting information about flood magnitude)
- To study recently occurred events in order to better define the main hazard/risk scenarios.

Collecting such data represents a fundamental tool for several studies, mainly aiming to define hydraulic models of flow propagation.

In particular, these contributions can be useful to:

- Better understand the disaster processes and further improve flood prediction and hazard map
- Plan monitoring, early warning and risk mitigation strategies
- Test and calibrate hydraulic models
- Enhance local and regional capacity to mitigate against such events in the future.

Proposal for a PhD position

Starting from the experience gained within cases studies in Campania (Southern Italy (Santangelo et al., 2006; 2011, 2012, 2015; Vennari et al., 2016), we intend to study similar geomorphological

contexts in Greece. The selected areas will be characterized by piedmont units with extensive urbanization and subject to substantial human impact.

As main tools, we will use detailed geological and geomorphological field surveys with elaboration of thematic maps, coupled with analysis of remotely sensed data and GIS applications (DEM elaboration etc.) and numerical modeling.

More in detail, we will investigate:

- Basin/fan morphometry by means of ArcGis application
- Main stream longitudinal profile and cross-sections
- Bedrock and cover deposits geology aiming at define potential sources of debris for the flow
- Fan stratigraphy, aiming at defining areas with the most recent deposits
- River network pattern in the urban zones aiming at identifying the main critical points for flood/flow propagation

The main aim is to export the method elaborated for the carbonate basin/fan systems of Southern Italy and test it in similar geomorphological context.