



Heavy rainfall triggering flash floods and shallow landslides: the case study of a Ligurian event (4th October 2010)

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According to many authors climate variations are leading to an increasing number of flash floods at medium latitudes. In Liguria heavy rainfalls and floods occurred several times in the second half of the past century, triggering many landslides and causing damages and victims. Only in the last decade we can remember such events in Ceriana (2000), Chiavari and Fontanabuona Valley (2002), Recco (2007) and Magra Valley (2010). The last event occurred at Varazze and Genoa-Sestri Ponente on October, 4th, 2010. Anyhow heavy rainfalls with precipitation more than 100 mm / h occur in Liguria every years. Liguria is characterized by steep Alpine and Apennine southward slopes with the watershed at distance of 5-30 km from the sea. Brief streams characterized by very short runoff times, wind across urban areas in their lower part. In addition geological complexity and a particular atmospheric circulation determine a high flood hazard, above all between September and November when the Ligurian Sea is hotter. In October 4th 2010, at 00:00 a disturbance associated with a deep trough centered near the Biscaglia Gulf approached the Western Mediterranean. An anticyclonic block in the Middle Mediterranean, leading African air with 15°C at 850 hPa between Corsica and Sardinia, stopped this barocline system on the Ligurian Sea. Together with warm temperature of the sea, these are the typical meteorological conditions triggering heavy rainfalls in Liguria. The intensive wet and hot southern air flux in the warm sector of the disturbance develops strong stationary thunderstorm activity around the sea-land border accentuated by the orographic effect of the Alpine and Apennine chain. Around 6:00 a.m. a supercell system developed on Varazze and determined rainfall of almost 100 mm in an hour and about 220 mm in 3 hours. Between 09:00 and 12:00 a.m. the same regenerated system hit Sestri Ponente, about 20 km westward Varazze, with a rainfall peak of 125 mm in 1 hour and 385 mm in 5 hours. All streams of the above locations flooded urban areas and a lot of shallow landslides triggered causing heavy damages, while a man died in a quarry near Sestri Ponente. Analysing the Basin Master Plans of the most hit catchments we observed that flooded areas had been well individuated by this planning tool. On the contrary, most of the instability phenomena occurred in areas that had been designated high, medium or low-risk areas during land planning (never very high) and in sectors that were defined as stable because they lacked accepted indicators of potential landslide hazard. The above considerations highlight some problems in Master Plans as a tool to prevent geological risks in such meteorological situations that are more and more recurrent. Therefore, to update this land planning tool, it is necessary to extensively investigate local geomorphological features and to study a different method for assigning weights to the geohazard map.