



Rainfall and shallow landslides in the Middle Serchio Valley (Northern Tuscany, Italy): possible duration/intensity critical threshold curves

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This research is included in a wider project aimed at defining the critical rainfall thresholds for the North-Western Tuscany. Heavy and concentrated rainfall is often the cause of damage and death, owing to landslides, debris flow and debris torrents. This is particularly frequent in the Apuan Alps, one of the rainiest areas in Italy (more than 3000 mm/year) and commonly hit by downpours. The Serchio Valley is adjacent to the Apuan Alps and suffers their climatic conditions. This valley is located between the Apuan Alps to the west-southwest and Tuscan-Emilian Apennines to the east-northeast. The main peaks reach almost 2000 m a.s.l. while the valley bottom is about 50-100 m a.s.l.

In several cases, the storms that hit the area triggered many landslides, which exposed the population to serious risks: for example, during the 20 November 2000 rainstorm in the Middle Serchio Valley hundreds of landslides were triggered and 5 people died. The types of movement are mainly attributable to shallow landslides, soil slip-debris flows and hyperconcentrated flows.

The assessment of the rainfall thresholds is consequently very important in order to arrange efficient alarm systems in a mostly touristic, but also industrial area.

Aiming at contributing to the landslide hazard evaluation of the Serchio Valley territory, a detailed analysis of the main pluviometric events was carried out. The data recorded by the main raingauges (at Borgo a Mozzano, Mutigliano and Vinchiana) from 1935 to 2010 were analysed and compared with the occurrence of shallow landslides. The most important rainstorms triggering shallow landslides occurred in 1942, 1952, 1961, 1965, 1982, 1996, 2000 and 2009.

Many attempts were made in order to obtain possible correlations between rainfall features and occurrence of shallow landslides and to identify the local critical rainfall threshold for triggering landslides. Then, a rainfall threshold for triggering soil slip-debris flows was defined for the study area, in terms of mean intensity (I) and duration (D). Furthermore, rainfall intensity and duration were normalized by means of the mean annual precipitation (MAP).

The critical threshold curves obtained for the Middle Serchio valley were also compared with those proposed by various Authors for different areas of North-western Tuscany and Eastern Liguria. Furthermore they were compared with critical rainfall curves, which might have a general validity. This emphasized the high critical rainfall value for triggering shallow landslide in the study area. This high threshold may be probably linked to the high mean annual precipitation and to the high frequency of rainstorms hitting the study area, as consequence of the equilibrium which establishes between climatic conditions and slopes.