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Pyroclastic cover deposit thickness spatial modelling in peri-volcanic areas

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Ash-fall pyroclastic deposits mantle the peri-volcanic areas indifferently to the type of bedrock and depending only on the geomorphology of the area and the direction of prevailing wind during the eruption. The spatial distribution of the pyroclastic cover deposit thickness (PCDT) is a relevant factor for the slope instability in peri-volcanic mountain areas. The PCDT is considered a fundamental parameter in assessing landslide susceptibility as well as volume potentially involved and inherent landslide run-out. In the international literature, different simple or more complex models to predict spatial variability of PCDT are known. Nevertheless, peri-volcanic areas have peculiar characteristics and several existing models result difficult to apply or they give back high overestimation or underestimation.
Different existing methods were applied in the mountain ranges surrounding the Somma-Vesuvius volcano, southern Italy, to estimate the PCDT due to the high susceptibility of these areas to landslide. The poor results obtained by the application of known approaches led to develop a new empirical Slope Exponential Pyroclastic Thickness (SEPT) model. In particular, the SEPT is a simple method based on the exponential function of the slope gradient, the key geomorphological factor controlling the landslide triggering and evolution along the slope, and the initial total thickness of tephra-fall pyroclastic soil erupted by the Somma-Vesuvius volcano (z0), estimated by the sum of isopach maps derived by volcanological studies of the principal eruption products.
The obtained distribution map of PCDT was validated by the comparison with about 300 field direct, e.g. penetrometer tests, and indirect, i.e. H/V approach, measurements of pyroclastic cover deposit thickness, as better as possible distributed in the area of interest. The residuals among the modelled and the measured values were calculated, and statistically analysed, by means of the maximum underestimation and overestimation, the standard deviation and the root-mean square error, in order to estimate the efficiency of the resulting PCDT map.
The result obtained by the SEPT approach designed for the mountain areas surrounding the Somma-Vesuvius volcano can be considered applicable to the assessment of susceptibility and hazard of shallow landslides involving the ash-fall pyroclastic soil mantles and the estimation of volumes of potential unstable volcaniclastic material in possible run-out scenarios. Moreover, results obtained advance the knowledge about mass wasting processes acting in ash-fall pyroclastic soil mantled slopes of the investigated areas as well as of other peri-volcanic mountain areas of the world.