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Interdisciplinary approaches to recognition, analysis and flowslide-debris flow hazard assessment in the pyroclastic soil-mantled carbonate hillslope: experiences in Campania Region (Southern Italy).

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The hillslopes of the carbonate ridges surrounding volcanic complexes of Somma-Vesuvius and Phlegrean Fields in Campania Region (Southern Italy) constitute singular landscapes due to widespread, very thick and weathered pyroclastic soil-mantled covers stacked up from subsequent plinian and sub-plinian air fall deposition, along which soil slips and flow-slides are triggered, evolving in destructive flow-like landslides and hyper-concentrated flows. From a geomorphological point-of-view, since post-last glacial un-vegetated carbonate hillslopes drastically transform from weathering-limited (bedrock) to transport-limited (soil cover) slope evolution model (Kikby, 1972). A repetitive sequence of basic geomorphic processes (so called “5F geomorphic sequence”, as modified after Cascini et al., 2000) occurs spatially and temporally distributed along the open slopes and channels: i) Falling of the pyroclastic materials (ash, pumice and scoriae); ii) Filling (or Refilling) of pre-existent bedrock hollows in the zero order basins or morphological shelves by dominant diffusive transport mechanisms; iii) Fracturing of pyroclastic cover by pre-failure mechanisms and, if some conditions occur, iv) Failing, as rupture, detachment and downslope movement of one or more layers of the stacked up pyroclastic cover, normally on slope up to 25°; v) Flowing by soil cover liquefaction and remoulding. Based on such general geomorphic model, at each process sequence or sub-sequence above cited, complex interactions of geomorphic, geotechnical, hydrologic, pedogenical, and bio-

logical mechanisms correspond, spatially expressed as landforms. The latter must be recognized, analyzed and monitored as a whole and, then, using a very comprehensive and true interdisciplinary approach in assessing and managing debris flow hazard at site, basin and regional scale. Scientific debate on such a matter is still in progress and experienced assessment is not fully shared yet. Nevertheless, public awareness and managing and control institutions need optimized answers, based on existent data, as well as scientifically experienced methods and comprehensive scientific and handling procedures. Based on experiences from the scientific management of the May 1998 Campania Region Emergency (Cascini et al., 2005) and on regional landslide hazard planning (Regional Basin Authorities), this paper illustrates a state-of-art in assessing flow-like landslide hazard in the Campania Region and it proposes, following and modifying Aleotti et al. (2003), a semiquantitative and interdisciplinary GIS-based method, applied in the Nocerino-Sarnese hillslopes. The step-by-step GIS-based method identifies the landforms prone to flow-like mass movements, characterizes each of them in term of geological, geomorphometric, hydrological, pedological (andisols), geomorphic and land use factors, indexing them in term of Susceptibility Index (SI). By intersection of historical landslide maps, which consider triggering, transport and invasion susceptibility, each step uses a coupled self-adapting procedure and finally produces a Triggering Geomorphological Susceptibility Map (TGSM) to flow-like landslides. Independent quantitative analysis, based on distributed slope stability models, are carried out, firstly using SINMAP (Pack et al., 1998) on triggering training areas, and then on entire study area, using Shalstab (Montgomery & Dietrich, 1994, 1998), producing a Triggering Hydro-geotechnical Stability Map (THGSM), taking also into account the root strength due to the vegetation classes and a simple hydro-pedo-geomorphic zonation. The comparison between TGSM and THGSM results in a Success Index Maps (SIM), adjusting progressively the comparative GIS-based procedure in a iterative self-validation. Analogously, Run-out Susceptibility Map are obtained by comparison of geomorphological and stratigraphic records in the alluvial fan system, geomorphic methods (Melton, 1965; Marchi & D'Agostino, 2002, Santangelo et al., 2006) and a physically-based model used for invasion susceptibility (Flow-2D). The Angle of Reach Method (Corominas, 1996; Budetta & De Riso, 2004) can be applied in appropriate situations, in order to further self-validate the procedure. In this way, Success Indexes Map (SIM) up to 80% was found for channelized debris-flows and less than 40% for open slope flow-slide scenarios.