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Mass Movement Hazards in the Mediterranean; A review on applied techniques and methodologies

R. Ziade (1), C. Abdallah (2), and N. Baghdadi (3)

(2) National Council for Scientific research, Remote sensing Center, Natural Hazard, Beirut, Lebanon (chadi@cnrs.edu.lb, +961 4 409 847), (1) PhD student , Agro Paris Tech, (3) Directeur de Recherche CEMAGREF UMR TETIS Maison de la Télédétection 500 rue Jean-François Breton 34093 Montpellier Cedex 5, France

Emergent population and expansions of settlements and life-lines over hazardous areas in the Mediterranean region have largely increased the impact of Mass Movements (MM) both in industrialized and developing countries. This trend is expected to continue in the next decades due to increased urbanization and development, continued deforestation and increased regional precipitation in MM-prone areas due to changing climatic patterns. Consequently, and over the past few years, monitoring of MM has acquired great importance from the scientific community as well as the civilian one. This article begins with a discussion of the MM classification, and the different topographic, geologic, hydrologic and environmental impacting factors. The intrinsic (preconditioning) variables determine the susceptibility of MM and extrinsic factors (triggering) can induce the probability of MM occurrence. The evolution of slope instability studies is charted from geodetic or observational techniques, to geotechnical field-based origins to recent higher levels of data acquisition through Remote Sensing (RS) and Geographic Information System (GIS) techniques. Since MM detection and zoning is difficult in remote areas, RS and GIS have enabled regional studies to predominate over site-based ones where they provide multi-temporal images hence facilitate greatly MM monitoring. The unusual extent of the spectrum of MM makes it difficult to define a single methodology to establish MM hazard. Since the probability of occurrence of MM is one of the key components in making rational decisions for management of MM risk, scientists and engineers have developed physical parameters, equations and environmental process models that can be used as assessment tools for management, education, planning and legislative purposes. Assessment of MM is attained through various modeling approaches mainly divided into three main sections: quantitative/Heuristic (1:2.000–1:10.000), semi-quantitative/Statistical (1:25.000–1:50.000) and qualitative/Deterministic (1:100.000 to 1:250.00).The scale of study is usually chosen on the basis of the purpose of assessment, the extent of the study area and data availability. Despite the operational and theoretical limitations due to an extent of data uncertainty where geomorphologic data for instance remains basically subjective and descriptive in addition to unpredictable climatic factors, MM hazard evaluation may constitute a suitable, cost-effective aid to land-use planning. The objective of this paper is to provide a holistic understanding of the nature of different MM, parameters affecting their occurrence and to put forward the wide range of MM detection, modeling and zoning techniques that would eventually serve as prediction and warning systems for communities at risk.