



Landslide monitoring data: WebGIS application and analysis tools.

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In mountainous areas, such as the Canton Ticino region (Southern Switzerland), landslide processes are particularly frequent and have a strong social impact being responsible of life losses and expensive damages. The assessment of landslide behaviour is usually undertaken by means of monitoring scheme. Usually, the measurement of superficial displacement is the simplest way to observe the history of a landslide and to analyse the kinematics of the movements. Unfortunately these observations are often stored in text files or paper sheets and do not allow a fast evaluation of the state of activity nor any fast analysis: more efficient data storage and interface are needed. Geographical Information System (GIS) is a powerful set of tools for collecting, storing, retrieving at will, displaying, and transforming spatial data (Burrough and McDonnel, 1998), therefore it can certainly be useful for improving fast data retrieval and analysis. The development of a Web-GIS interface (i) allows for a larger audience to benefit from GIS and avoids the need for non-geoscientists to purchase expensive GIS software; (ii) enables the use of spatial data, and the map browsing becomes easier because only one window provides all the necessary functionalities; (iii) does not ask for any training or experience with GIS, which is usually a requirement with commercial GIS software. Thus this work concerns the design and development of a Geo-database and a Web-GIS application for monitored landslide analysis in the Ticino area (Southern Switzerland). The geo-database organizes data concerning the landslide delimitation, landslide information, monitored points with series of observed coordinates, and other base maps (e.g. orthophoto, national maps, elevation, landuse, etc.). The Web application is the graphical interface for dynamic map generation, navigation, query, and analysis. Some new tools have been developed to improve landslide analysis; they include (i) dynamic plot generation of the monitored point velocity based on a time

filter, (ii) dynamic mapping of the displacement vectors, (iii) multivariable plots (e.g. displacement and precipitation intensity Vs time), (iv) general statistical analysis and (v) time of rupture. For the realization of the system we used technologies belonging to the Free and Open Source Software (FOSS) world such as Mapserver, Chameleon, Mysql and GRASS. The choice is due to the high configurability and accessibility of the codes that allow the development of these new tools. The Web-GIS presented here constitutes an efficient solution for landslide hazard evaluation.