The European Association of Remote Sensing Laboratories

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Mario A. Gomarasca (Editor)

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SESSION 5

OTHER RELATED GEOHAZARDS: PERMAFROST, GLACIERS

Chair: Stuart Marsh

Friday, June 8, 2007
16:40 ? 17:40

Combining satellite and aerial remote sensing, field surveys and GIS analysis for assessing glacier and permafrost-related hazards. A case study in the Val Ferret area (Mont Blanc Massif, Italian Western Alps).

Luca Delle Piane, D. Fontan

SEA Consulting S.r.l., Torino, Italy

Natural hazards related to the evolution of high mountain glacial environment are presently a major factor influencing human activities in alpine regions; the Italian Western Alps are an example of such interaction, as testified by a number of case histories from historical and recent times. Among the most critical areas is the Italian Val Ferret, on the SE side of the Mont Blanc Massif (Aosta Valley), where glaciers are experiencing a dramatic retreat, accelerated by the hot 2003 summer. The results of a preliminary study concerning this area, performed by merging aerial and satellite remote sensing, GIS applications and field surveys are presented. The area is characterised by a high mountain environment with steep walls and objective risks reducing the possibility of direct access.

Natural hazards related to the glacial environment are mainly represented by: i) sudden flood waves and related mass transportation or debris flows, due to intra-, supra-and periglacial water reservoirs outbursts, ii) ice avalanches triggered by detachment of frontal ice mass or seracs, iii) rockfalls due to glacier and permafrost retreat, eventually impacting on glaciers surface and triggering large ice-rock avalanches, and vi) glacial surge. Factors i) to iii) presently characterise the study area: some case histories related to historical and recent events are presented.

The study aimed to preliminarily assessing natural hazards according to a downscaling process, from a first general overview of the area to detailed field surveys aiming to collect geomorphological and structural data, to final GIS modelling to define preliminary hazard maps; the main goal of the study was to identify on the field i) zones to be explored in greater detail and ii) critical sub-areas for a subsequent monitoring plan.

First-phase remote sensing was based on multispectral and multitemporal image data analysis, performed upon a 2001 Landsat ETM+ scene and on repeated ASTER imaging (summer 2003 / winter 2004 / summer 2004). Multispectral data processing aimed to automatic and supervised classification of glacier-covered areas; several methods have been tested and a critical comparative analysis is presented. Merging of satellite data and a 10-m grid DEM allowed for a preliminary hazard evaluation and planning of field campaigns.

Structural analysis over more than 2.900 remotely sensed and field collected tectonic lineaments allowed for the definition of geometric and kinematic models for the detachment of large rockfalls eventually impacting on the glaciers surface. End-of-summer 2003 aerial photographs, field data and direct helicopter inspection were the basis for assessing in detail the nature, characteristics and distribution of glacier-related hazards; an empirical relationship between mean annual air temperature and glacier stability was also used. GIS analysis based on simple and ready-to-apply criteria allowed for final hazard evaluation, concerning in particular the susceptibility to i) shallow landslides and debris flows, ii) large rockfalls (V>10.000 m3) and ice avalanches. A general and simple overview on possible snow avalanche distribution based on ASTER data is also provided.

In conclusion, GIS modelling highlighted, in good agreement with historical back-analysis, a potential instability for a number of major glaciers including the Col du Géant, Rochefort, Planpincieux, Grandes Jorasses and Triolet glaciers, as well as for some minor ones. Major rockfall-related hazard areas were localised in the Frébouge and Triolet basins.