



Geomatics techniques applied to time series of aerial images for multitemporal geomorphological analysis of the Miage Glacier (Mont Blanc).

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The Miage glacier is the major one in the Italian side of the Mont Blanc Massif, the third by area and the first by longitudinal extent among Italian glaciers. It is a typical debris covered glacier, since the end of the L.I.A. The debris coverage reduces ablation, allowing a relative stability of the glacier terminus, which is characterized by a wide and articulated moraine apparatus. For its conservative landforms, the Miage Glacier have a great importance for the analysis of the geomorphological response to recent climatic changes.

Thanks to an organized existing archive of multitemporal aerial images a photogrammetric approach has been thought to carry out a change detection analysis of the Miage glacier. Archive is constituted by many images ranging from the II world war up today (Bonetto *et Alii*, 2001).

A research group, composed both by Geologists and photogrammetry experts, is working:

1. to digitize all the available images (still in analogic form) through photogrammetric scanners (very low image distortions devices) taking care of correctly defining the resolution of the acquisition compared to the scale mapping images

are suitable for;

2. to import digitized images into an appropriate digital photogrammetry software environment (ERDAS IMAGINE 8.6);
3. to manage images in order, where possible, to carry out the stereo models orientation necessary for 3D navigation and plotting of critical geometric features of the glacier. Recognized geometric feature, referring to different periods, can be transferred to vector layers and imported in a GIS for further comparisons and investigations;
4. to produce multi-temporal Digital Elevation Models for glacier volume changes;
5. to perform orthorectification of such images to obtain multitemporal orthoimages useful for areal and planar terrain evaluation and thematic analysis;
6. to evaluate both planimetric positioning and height determination accuracies reachable through the photogrammetric process. Users have to know reliability of the measures they can do over such products. This can drive them to define the applicable field of this approach and this can help them to better program future flights for glacier survey;

All produced data, differently from the original ones, can be considered as map products. All of them represent geocoded entity and maps that can be easily imported in a GIS for assessment and management.

In this work we show an example of workflow directed to the definition of changes occurred over the Miage glacier area between two test periods for which aerial stereo pairs were available. Particular attention has been paid to the identification of dangerous elements and volume differences calculation.

High resolution satellite images are being currently considered for future investigations, considering the possibility of ordering stereo acquisitions for different satellite missions (EROS A1, QuickBird, OrbView3, Ikonos).

A GIS, thought as management tools of all the data, has already been designed aimed to the integration of all the available information and to the documentation of this high mountain area.