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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 has a great importance for the analysis of the geomorphological response to recent climatic changes.

Thanks to an organized existing archive of multitemporal aerial images (1935 to present) a photogrammetric approach has been applied to detect recent geomorphological changes in the Miage glacial basin. The research team provided:
a) 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;
b) to import digitized images into an appropriate digital photogrammetry software environment;
c) to manage images in order, where possible, to carried 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;
d) to produce multi-temporal Digital Elevation Models for glacier volume changes;
e) to perform orthoprojection of such images to obtain multitemporal orthoimages useful for areal an planar terrain evaluation and thematic analysis;
f) to evaluate both planimetric positioning and height determination accuracies reachable through the photogrammetric process. Users have to known 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.
The operational workflow allowed to the definition of changes occurred over the Miage glacier area and to the interpretation of related significant geomorphological processes. Particular attention has been paid to the identification of changes in the debris cove pattern, to the differences calculation of glacial mass volumes, to the natural instability phenomena (landslides, debris flows, glacier lakes).
Short-term climate trend has been evoked to the glacial expansion of mid 1980s quantified by remote sensing interpretation; contemporary activation of local glacial risks on the outer moraines has been mapped too. Glacial mass contraction of 1990-2000 has been traced and repeated rock falls accumulation over the Miage Glacier have been individualized. Later differential uplifts and subsidences of glacier topography have been interpreted as local intense differential ablation processes, recently associated to ephemeral epiglacial lakes formation.