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Geological and geomorphological mapping with digital mono- and 3D stereo-photogrammetry

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The generalization of application of digital tools for managing, mapping and updating geological data have become widely accepted in the last decennia. Despite the increasing quality and availability of digital topographical maps, orthorectified aerial photographs (orthophotos) and high resolution (5 up to 0.5 m) Digital Elevation Models (DEMs), a correct recognition of the kind, the nature and the boundaries of geological formations and geomophological landforms, unconsolidated sedimentary deposits or slope instabilities is often very difficult on conventional two-dimensional (2D) products, in particular in steep zones (rock walls and talus slopes), under the forest cover, for a very complex topography and in deeply urbanised zones. In many cases, photo-interpretative maps drawn only by 2D data sets must be improved by field verifications or, at least, by field oblique photographs. This is logical, because our natural perception of the real world is three-dimensional (3D), which is partially disabled by the application of 2D visualization techniques.

Here we present some examples of application of digital mapping based on a 3D visualization (for aerial and satellite images photo-interpretation) or on a terrestrial perception by digital mono-photogrammetry (for oblique photographs).

The 3D digital mapping was performed thanks to an extension of the software ESRI® ArcGIS™ called ArcGDS™. This methodology was also applied on historical aerial photographs (normally analysed by optical stereo-photogrammetry), which were digitized by scanning and then oriented and aero-triangulated thanks to the ArcGDS™ software, allowing the 3D visualisation and the mapping in a GIS environment [1].

The mono-photogrammetry (or monoplotting) is the technique of photogrammetrical georeferentiation of single oblique unrectified photographs, which are related to a DEM. In other words, the monoplotting allows relating each pixel of the photograph to the corresponding real world pixel on the DEM, and then extract georeferenced vector data and orthorectified raster data from terrestrial photographs [2, 3].

Through some case studies, we show (1) how 3D digital stereo-photogrammetry makes it possible the production of Quaternary geological and geomorphological maps, (2) how digital mono-photogrammetry is a powerful tool for supporting geological mapping in very steep zones and (3) how the combination of these two digital tools permits diachronical mapping of phenomena evolution (such as landslides or rockglaciers) during the entire twentieth century.

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