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ADVANTAGES OF HIGH-RESOLUTION DIGITAL TERRAIN MODEL (DTM) ANALYSIS IN GEOLOGICAL CARTOGRAPHY

J. Dzierżek, J. Kaczorowski, M. Szymanek
Faculty of Geology, University of Warsaw, Poland

Light Detection and Ranging (LIDAR) becomes common and ideally suited method for geological and geomorphological investigations. Its principles are close to radar's mode of action; however, the light is being used instead of microwaves [1]. This technique may be applied twofold as a terrestrial (TLS) and airborne (ALS) scanning based on the point placement of a measuring system on the ground surface and making the measurement from a flying plane or a helicopter [2], respectively. In both methods the impulse of the laser beam send from the transmitter and the time of signal reflection from the surface to the receiver are measured. Received data, known coordinates (XY) and elevation (Z) of broadcasting device allows to determine coordinates and elevation points from which the reflection took place [3], including several reflections from objects which come across the line of the laser beam. It is extremely important at vegetated areas, where it is possible to obtain the reflection from the surface beneath the plant cover. Replicate measurements allow achieving high-resolution cloud of points with known XYZ parameters representing terrain surface with land cover. The cloud of points is automatically classified and filtered on an account of object types by computer software of a specialist [4]. As the result of these process clouds of points representing different classes are obtained, like a class of soil, low, medium and high vegetation, buildings, roads etc. Single points located beneath and above ground surface should be marked as noise. Preparing set of points could be used to generate Digital Surface Model (DSM) and Digital Terrain Model (DTM). In DSM points from the first reflection are used and a terrain surface with the land cover is projected. It causes that usage of DSM in geological and geomorphological studies is limited. A considerably better source of data for analysis is DTM which is generated from ground class points representing a ground level without the land cover.

A lack of the vegetation cover and man-made constructions which mask the terrain relief is the main advantage in applying high-resolution LIDAR-based DTMs to geological mapping. The models of airborne scanning with 4 points per square meter density, usually presented in a grid cell of 0.5 × 0.5 m are often used in geomorphological analyses.

In mountains the DTM analysis is successfully used in the investigation of landslide areas. It allows to identify and describe the forms inside the landslide containing main and minor scarps, the toe and the landslide forehead often covered and it is rather hard to identify it in the field. The occurrence of minor secondary scarps allows distinguishing the following phases of development and rejuvenation of landslides, which is indispensable in monitoring of the intensity of slope processes. This method is successfully used in the Polish governmental Project SOPO – System of Anti-landslide Protection in the Polish Carpathians, where the DTM analysis is a great support of standard geomorphological mapping. In high mountains the DTM reveals the relief of mountain valleys with marks a glacial exaration being an useful tool in palaeogeographical reconstructions. DTM images are also used in morphotectonical investigations: in recognition of the style of geological structures, fold axes identification, inclination of the layers or faults zones. Computer programs allow indirect and simple way for determination of morphometric parameters of features, e.g. the slope angle, a relative height, cross-section creation in the whichever direction and scale. Analysis in 3D in any angle of exposure is a great advantage in the detailed recognition of small landscapes elements.

Besides studies on mass movements and slope processes, the DTM analysis is priceless in the characteristic of glacial and periglacial landforms. It enables recognition of drumlins, eskers, moraines, subglacial basins, outwash plains, subglacial and ice-marginal meltwater channels, and the interpretation based on high-resolution digital terrain models allows to wide

geomorphological correlations (e. g. [5]. In many cases (e.g. in areas inaccessible for field geological reconnaissance) the DTM analysis is the only possibility to determination of geological borders on the map.

The DTM is widely used in geoarchaeological studies for the determination of locations of objects, ancient roads, remains of prehistoric steelworks and mines.

The digital geomorphological mapping is a very fast method and at least as accurate as traditional mapping, thus its combination with conventional geological filed works offers perspectives for wide and detailed geomorphological and palaeogeographical analyses. In spite of unquestioned advantages the high resolution DTM analyses cannot substitute the field work and conventional geological mapping.

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