

## Determining the Extent and Direction of Relief Transformations Caused by Ski Run Construction Using LIDAR Data

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**Abstract :** Mountain areas are very often exposed to numerous transformations connected with the development of tourist infrastructure. In mountain areas in Poland ski tourism is very popular, so agricultural areas are often transformed into tourist areas. The construction of new ski runs can change the direction and rate of slope development. The main aim of this research was to determine geomorphological and hydrological changes within slopes caused by ski run constructions. The study was conducted in the Remiaszów catchment in the Inner Polish Carpathians (southern Poland). The mean elevation of the catchment is 859 m a.s.l. and the maximum is 946 m a.s.l. The surface area of the catchment is 1.16 km<sup>2</sup>, of which 16.8% is the area of the two studied ski runs. The studied ski runs were constructed in 2014 and 2015. In order to determine the relief transformations connected with new ski run construction high resolution LIDAR data was analyzed. The general relief changes in the studied catchment were determined on the basis of ALS (Airborne Laser Scanning ) data obtained before (2013) and after (2016) ski run construction. Based on the two sets of ALS data a digital elevation models of differences (DoDs) was created, which made it possible to determine the quantitative relief changes in the entire studied catchment. Additionally, cross and longitudinal profiles were calculated within slopes where new ski runs were built. Detailed data on relief changes within selected test surfaces was obtained based on TLS (Terrestrial Laser Scanning). Hydrological changes within the analyzed catchment were determined based on the convergence and divergence index. The study shows that the construction of the new ski runs caused significant geomorphological and hydrological changes in the entire studied catchment. However, the most important changes were identified within the ski slopes. After the construction of ski runs the entire catchment area lowered about 0.02 m. Hydrological changes in the studied catchment mainly led to the interruption of surface runoff pathways and changes in runoff direction and geometry.

**Keywords :** hydrological changes, mountain areas, relief transformations, ski run construction

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