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GEOMORPHOTECHNICAL MAPS - A CARTOGRAPHIC TOOL FOR THE RAILWAY INFRASTRUCTURE IMPROVEMENT. CASE STUDIES FROM ROMANIA

DOBRE R., MIHAI B., SAVULESCU I.
University of Bucharest, Faculty of Geography, BUCHAREST, ROMANIA

Romania is one of the recent European Union countries where the railway infrastructure is the subject of complex improvement works during the last decade. One of the main tasks is the improvement of the main lines which became a part of the European Traffic Corridors. Since the year 2001 the main investment priorities were focused along the IVth corridor, from which a small part was modernized (Bucharest to Campina was opened since 2003 and Bucharest to Constanta will be open this year).

Railway main lines improvements in Romania have a lot of technical limitations. A lot of railway line embankments are out of date and slope processes together with the floodplain dynamics usually meets along the railway infrastructure components.

Since the increasing number of critical points (featured by low speed limits, between 5-20km/h) within the geomorphic hazard prone areas along the national railway it is a real need for finding efficient tools for helping the decision in the framework of a sustainable development. One of them is the geomorphotechnical maps we propose.

Geomorphotechnical maps are detailed thematic maps (scale from 1:2000 to 1:5000) providing within the same format selected geomorphic features, engineering works, and transport infrastructure elements (together with their attributes). The maps have both analythic and synthetic significances because they are based on a scientific and practical selection of the mapped features. It represents a higher level in geomorphic cartography, focusing on the complex relationship between geomorphic processes (and their current evolution) and railway infrastructure. This interface is featured by the engineering works, which are an expression of the human impact upon the morphodynamics.

The main objective of our work is a comparative approach of the proposed method for a detailed mapping. The map legend is divided within three sections, morphodynamics, engineering works and railway infrastructure. Morphodynamic features are selected on the basis of their activity, together with the superficial deposits (slope and floodplain deposits). Mapping was done in a dynamic configuration, using multitemporal data derived for orthorectified aerial imagery interpretation. For example the floodplain configuration was mapped in more than two stages. This makes possible to understand the channel migration trends and even their average annual rates. A similar approach is applied to landslide scarps configuration and to gully networks configuration.

Engineering works were mapped in detail in vector format. The map is able to provide generations of works and also their maintenance state. For example, the map includes the old, abandoned or active railway tunnels together with the new engineering works emerged after the railway improvement process.

Railway infrastructure was mapped in detail. For a better map understanding a combination of a limited number of simple symbols includes both the railway and the overhead lines while traffic signals and rail signs are provided for orientation.

The provide also some quantitative features. Slope morphodynamics can be appreciated after the joining the map symbols together with special diagrams. An example can be the mapping of the rock slope seasonal erosion rates measured within the ring net areas above the railway line. Another example is the annotation of landslide scarp movement rates. There were selected two complementary case studies, covering a large spectrum of railway improvement problems: a landslide hazard area (Balota-Erghevita area) along the Bucharest-Timisoara main railroad, where traffic was cut between March and May 2010, because of the deep seated landslides; a sector from the Prahova River Defile on Bucharest-Brasov railway where steep slope processes together with stream erosion are subjected to complex engineering works since 2008, while traffic was limited to only one way. The both areas are located on important traffic lines with national and international train connections.

The GIS mapping was focused on the adaptation of the proposed legend for each of these three case studies. Using the geometric correction tools and the overlay procedures we obtained relevant maps which includes different processes along the last 30-40 years: landslide bodies and landslide scarps configuration changes (Balota-Erghevita case study), and active scarp-channel configuration relationship during (Sinaia-Posada case study).

These maps made necessary the adaptation of the legend through the creation of new symbols, more simple and easy to be understood by different specialists, from geologists to civil engineers and railway staff.

All the maps can offer different overviews about the critical engineering problems which can be exactly localized and then analyzed. For example it is easy to decide where is better to put the new tracks in order to improve the railway traffic speed and safety, or to build a bridge in the right place, or to defend the rail and the overhead against landslidings.

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