Environmental data and satellite images: information sources for the identification of illegal activities in the landscape on the example of Slovakia

Daniel Szatmári [a,*], Monika Kopecká [a], Ján Feranec [a], Tomáš Goga [a], Šimon Opravil [a], Michal Sviček [b], Róbert Fencík [c], Juraj Papčo [c]

[a] *Slovak Academy of Sciences – Institute of Geography, Slovakia, daniel.szatmari@savba.sk, monika.kopecka@savba.sk, feranec@savba.sk, tomas.goga@savba.sk, simon.opravil@savba.sk*
[b] *National Agriculture and Food Centre – Soil Science and Conservation Research Institute, Slovakia, michal.svicek@nppc.sk*
[c] *Slovak University of Technology in Bratislava, Faculty of Civil Engineering, Department of Theoretical Geodesy and Geoinformatics, Slovakia, robert.fencik@stuba.sk, juraj.papco@stuba.sk*

* Corresponding author

Abstract:

Illegal activities in the landscape (e.g. illegal waste dumping) may pose significant environmental and social risks in different areas, such as human health, economy, aesthetics, etc. Their identification and spatial localization are a basic prerequisite for solving potential problems; therefore, it is important to look for methodological procedures for monitoring these phenomena, including their cartographic visualizations. The number of satellite-based remotely sensed datasets available for land cover (LC) change identification has increased markedly since the launch of the first Landsat satellite in 1972. Many change detection techniques have been developed and applied during this period to assess LC changes. Several books and review papers have summarized and compared the various detection techniques (Giri 2012, Goga et al. 2019).

In general, human impact on landscape causes categorical changes in its use: change of one type of landscape to another, e. g. arable land to built-up area. As such changes may influence the condition of the landscape, it is important to determine where and to what extent they take place. Legal changes in landscape involve planning and recording in the Land Register, agricultural, forestry or water economic plans. However, the landscape is ever more frequently attacked by illegal human interventions, and their tracking may be difficult because of remoteness, difficult access, etc.

Nowadays, various methods of LC change identification are applied. The most progressive ones combine remotely sensed data (optical and radar) with data from environmental databases, thematic maps and field survey. This approach is also suitable for the identification of LC changes caused by illegal human activities. The solutions offered by this paper are based on the application of the above-quoted approach. They will document the possibilities of identifying three types of illegal human activities in the landscape: (i) illegal dumps (near roads and urban structures); (ii) illegally ploughed protected meadows (especially in cases of contact of protected meadows with agricultural land); (iii) illegal clear-cuts of non-forest tree vegetation in the agricultural landscape.

The following layers were used as input data: (i) mask of agricultural land (arable land, grasslands, orchards and vineyards) with a buffer around urban fabric, industrial areas, agricultural farm areas and along the roads (OpenStreetMap, Land Parcel Identification System – LPIS, Copernicus High Resolution Layers – HRL, map of legal waste dumps); (ii) mask of protected meadows with a buffer of farmland (LPIS, protected meadows); (iii) mask of non-forest vegetation (Copernicus HRL layers – small woody features) with a buffer of farmland, settlements and roads (Copernicus HRL layers, LPIS, OpenStreetMap).

The methodical procedure (Fig. 1) of identification of potential illegal activities includes the following steps: (i) overlay of the map of the legal dump sites and the satellite images of the referential time horizon T and time horizon T+1 by the mask of agricultural land; (ii) overlay of the satellite images of the referential time horizon T and time horizon T+1 by the mask of protected meadows; (iii) overlay of the satellite images of the referential time horizon T and time horizon T+1 by the mask of non-forest vegetation. Comparison and analysis of these data layers, which mediate the conditions of agricultural land/protected meadows/non-forest tree and shrub vegetation of two time horizons are identified: unchanged areas, changed areas and problematic (indistinct) change areas. Analyses of changed areas and those with

problematic changes to identify illegal dump sites, ploughed protected meadows and removed non-forest tree and shrub vegetation, respectively (incl. accuracy assessment).

The results of the identified illegal activities in the landscape are presented through thematic maps, which provide characteristics about occurrence and areas of illegal dumps, illegally ploughed protected meadows and illegal clear-cuts of non-forest tree vegetation in the agricultural landscape.
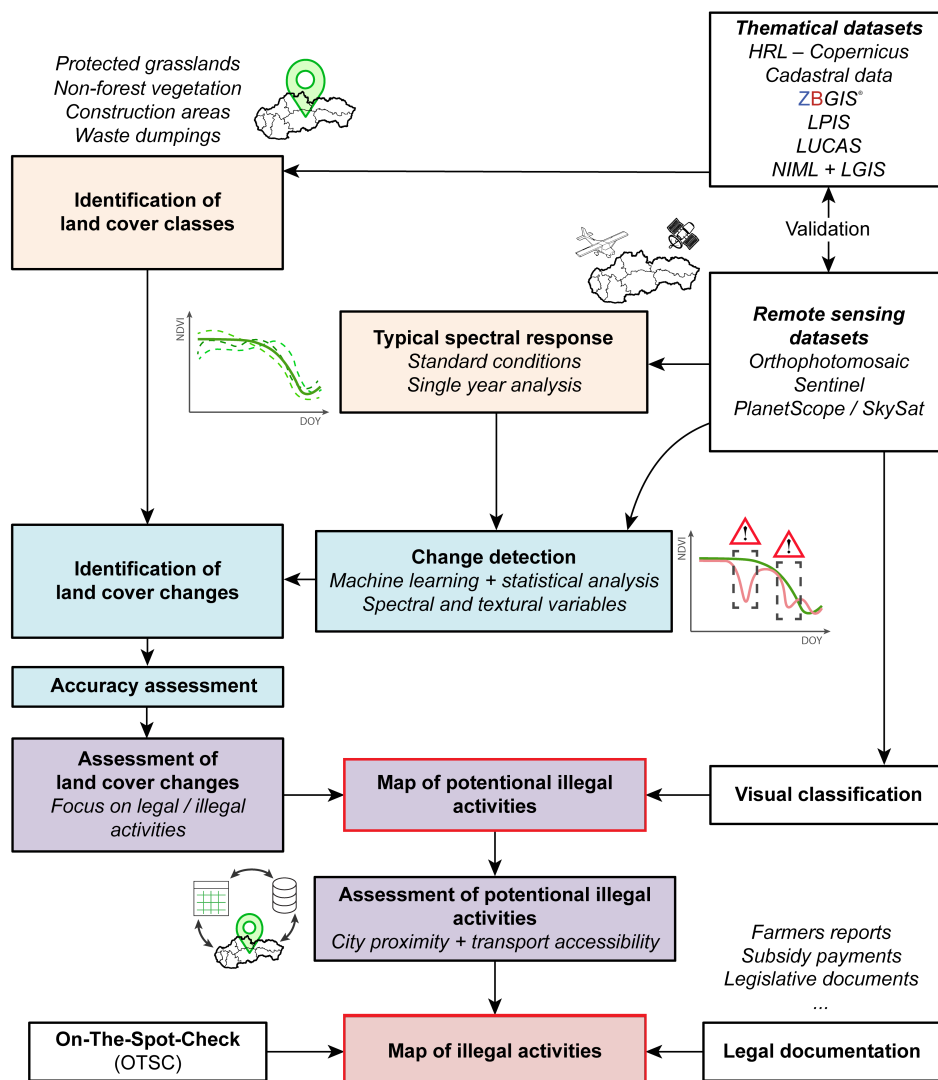

Figure 1. Methodical steps leading to the creation of a thematic map of illegal activities.

Acknowledgements

References

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