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Relationships between scenic values and GIS-based estimations of geomorphological and land cover diversity within the National Park Peneda-Gerês (Portugal)

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Quantitative assessment and internalisation of scenic landscape values into the decision-making (including i.a. natural capital accounting), would be one of the prerequisites to achieve sustainable landscape and geoheritage planning and management process. Geodiversity is widely recognised as an inherent attribute of landscape character, playing important role in the subjective feeling of landscape coherence (harmony, systematicity) and linked in this way with public scenic values and preferences. We define landscape coherence as a landscape attribute, emerging from both geomorphological and land cover diversity, namely the extent of organization and systematicity, inherent in the decomposed pattern of physiognomic landscape within a particular view or mapping neighbourhood.

In this study, we suggest a GIS-based indicator of landscape coherence, calculated for a GIS-based digital landscape model, composed of landforms and land cover raster grids. Hartley's entropy (a particular case of Shannon's diversity index for equiprobable data) due to its feature of additivity allows calculation of the degree, in which the diversity of landforms and land cover composite exceeds the cumulative diversity of landforms and land cover (landscape coherence degree in our context). We designed a digital elevation model based on the digitised hypsometric contours, drawn each 10 metres, and performed a landform classification based on slope steepness, solar exposition and general curvature classes; 66 elementary landforms were distinguished. The land cover model was designed based on the supervised classification of mosaics of satellite imagery SPOT and RapidEye. In total, we mapped 11 land cover classes and combined them with landform classification using overlay analysis to get a digital landscape model. Hartley's entropy was calculated for land cover and landforms separately, as well as for the digital landscape model. The ratio between the Hartley's entropy for the digital landscape model and the summarised Hartley entropy estimations for land cover and landform models was used as the indicator of landscape coherence.

We verified the performance of the proposed index within the National Park Peneda-Gerês (Northern Portugal, rich of geoheritage and geodiversity) as a study area with cumulative viewsheds based on Flickr and Panoramio geolocated content (as volunteered geographic information, indicating the provision of cultural geo- and ecosystem services) and the scores of visual landscape quality, surveyed in situ. Results demonstrate a scale-dependent, positive relationship between the proposed index of landscape coherence for the categorical models and the landscape values. Choice of the neighbourhood for mapping the landscape coherence affects the strength of the revealed positive relationship: landscape coherence extent calculated for generalised landscape classes performed better in explaining scenic values than landscape coherence mapped within the regular hexagonal grid. The findings of this study can be applied to landscape and geoheritage planning and management, providing an easy-to-use GIS-based indicator of landscape character assessment and transiting from diversity-driven approach in explanation of visual landscape quality towards the harmony- and systematicity-driven understanding of landscape appreciation.