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Comparative measures of raster qualitative maps

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Abstract:

The collected field and remote data, including aerial and satellite imagery, are the fundaments of vector and raster modelling. This data, supplemented with descriptors and quantitative data, provide the basic geographical information on the studied area. One example of such modelling is the determination of similar elements of topography on the basis of morphometric variables obtained as a result of clustering using the k-median method. The authors focused on raster data, which resulted from stochastic modelling of a certain complexity of the environment. The use of unsupervised clustering methods resulted in different maps, as illustrated by the example of a fragment of the Stołowe Mountains in Poland (Fig.1), for which two relief maps were modelled (model 1 and model 2).

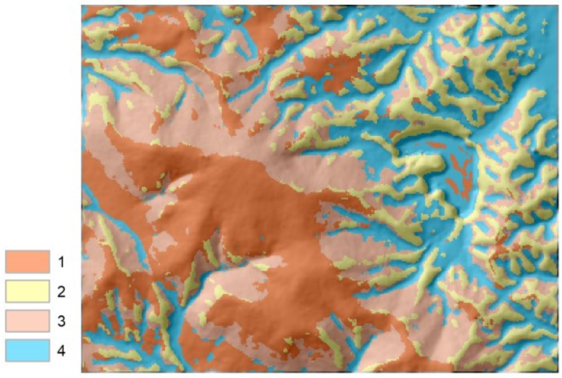

Figure 1. The Stołowe Mountains, Sudetes, Poland – study area (reference map with 4 clusters as relief forms).

It is, therefore, necessary to assess the compatibility of the obtained maps to answer the question: how significant are the differences between them. The use of filtering is yet another issue requiring the same analysis. Some filtration parameters, such as the size of the window, the filtration method used (either the median- or the majority method) need to be defined, as well as finally, how many times to run the filtering process to remove the information noise and still have the map statistically identical to the source one. To answer this question, we need objective measures indicating the significance of dissimilarities between two raster maps containing qualitative information. For this purpose, the similarity-difference distances between the generated maps were used as the measure of agreement, which were then compiled in the matching matrix. In this study we use majority filter with 8 neighbour cells. The process was run 5, 10 and 20 times.

Two methods were compared to determine individual distances. The first method was determined by the local indicators relating to individual groups of pixels representing the corresponding elements of landforms assigned to individual classes. The method was based on a set of shape indexes for these objects (e.g. circularity coefficient, Malinowska coefficient, Blair- Bliss coefficient). The second one utilizes global indicators, i.e. operating on data relating to complete maps which constitute a kind of object - texture, which is usually more preferred in the case of more complex raster data, and in this case, these maps were characterized by high detail reliefs.

The paper presents selected measures, i.e. Cohen's kappa coefficient, texture features according to Haralick determined based on the co-occurrence matrix and selected landscape measures included in the group of landscape indicators patterns analysis. The proposed measures were presented for selected areas in global- and in local terms. Two problems were considered. The first issue concerned the juxtaposition of the results of modelling landforms using the unsupervised *k*-median method with a varying number of input parameters. The second problem involves the filtration

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issue, i.e. after how many iterations (filtrations) the image smoothing (noise removal) ends and the "filter fiction" begins.

Table 1 and 2 show global measurements. It can be see, that model 2 is point as more similar to reference map according to similarity-difference distances matrix and kappa coefficient (the closer 1 value the better). Haralic's measure point model 1 as a better one (the lower value the better). Filtration did not introduce significant differences regardless of the number of filtrations performed. All measure have similar values.

	models		**filtering**		
	model 1 (4n)	model 2 (3n)	5 times	10 times	20 times
reference map	62.0%	**76.0%**	96.8%	96.4%	96.3%

Table 1. The percent of identity for reference map versus modelled and filtering maps.

	models		**filtering**		
	model 1 (4n)	model 2 (3n)	5 times	10 times	20 times
kapppa coeficient	0.71	**0.82**	0.964	0.950	0.956
Haralic's measure	**0.17**	0.21			

Table 2. The kappa coefficient and Haralic's measure for reference map versus modelled and filtering maps.

As a local measure we present here Haralic's measure calculated in particular clusters. Table 3 shows the results of these calculations. According to the data for clusters 1-3 the model 2 were pointed as the better one. Only for cluster 4 model 1 was more similar to reference map.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Model 1	0.173	0.057	0.189	**0.071**
Model 2	**0.115**	**0.003**	**0.040**	0.167
more similar	**model 2**	**model 2**	**model 2**	**model 1**

Table 3. The Haralic's measure for reference map versus modelled map in the clusters.

All this measure show that results can be depend on the measure we chosen to calculate global similarity and similarity is not necessary the same in all clusters. The authors are aware that the selected terrain model as the study area has a very clear relief. Completely different results and thus conclusions may be obtained in the case of moraine relief or other qualitative raster maps - which will be shown during the conference.

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