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Error Assessment of DEM generated from Contours

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In the process of accuracy assessment of DEM Gaussian error distribution is usually assumed. Nonetheless the spatial data are often heterogeneous, they may contain locally systematic errors even if distribution of errors seems entirely normal. Furthermore, uncertainty of data quality is present, due to lack of information of the source data errors and data model quality. Because of its complexity it is difficult to uncover those errors, especially if quality reference data are not available. One of the possibilities for dealing with this problem is the use of simulation methods, such as Monte Carlo. Since high-resolution and high-accuracy DEMs generated from LIDAR data are becoming widely available, they can serve as a ground truth of the DEMs generated from other sources. Comparison with DEM generated from LIDAR data gives continues reference for error assessment.

A case study area of Koroška Bela, Slovenia was chosen. The aim was to describe error types and to analyze them. A DEM was generated from contour lines of Slovenian topographic map in scale 1:25,000. This dataset was compared to a DEM generated from LIDAR data which was assumed as a ground truth. Errors were assessed also by traditional statistical accuracy measures such as RMSE, mean, standard deviation and also by accuracy measures of the robust methods, e.g. median, 95% quantile. From the statistically assessed and visualized differences in heights it was obvious that errors are not randomly distributed and no significant patterns were easily recognized.

We propose three different methods. (1) Firstly we tried to reduce systematic and locally systematic errors by georeferencing. The idea behind was, that differences between both DEMs are the consequence of vertical and horizontal errors which can be reduced by georeferencing. Thus, the vertical errors may be partly separated from the horizontal ones in this way. (2) Secondly, we used the unsupervised classification to assign the areas with homogenous errors, assuming that error type within these areas is the same. Each class was than treated separately, depending on the type of error. The main problem in this case is defining the appropriate significant variables from the DEM. (3) Different visual methods on the base of the derivatives from the first and second methods were used to visualize errors for enhance understanding of the characteristic and spatial dependency of errors. The standard visualization methods used in cartometry(distortion grid, displacement, etc.) were applied to visualize processed data and results.

For the final description of errors we interpreted the results of all three methods using different standard approaches to integrate conclusions.