CO-442

MULTISCALE HYPSOMETRIC MAPPING

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BACKGROUND AND OBJECTIVES

Multiscale mapping provides an advanced method for visualizing and studying geographic phenomena via automated scale-dependent adjustment of image detalisation. Despite the fact that Earth topography has strongly pronounced hierarchical nature, its representation on multiscale maps has not been elaborated. Most of allied scientific knowledge has been worked out in multiscale cartographic representations of non-surface objects, such as hydrography, city points, buildings, roads and so on. A lot of closely related research provided valuable results in digital (non-visual) multiscale surface representations, i.e. hierarchical/pyramidal models derivation, DTM generalization and so on. In this work a methodology of multiscale hypsometric mapping is proposed. To provide a background scale-dependent features of relief are analyzed and three main rules of its multiscale cartographic representation are formulated, which include scale-correspondent representation of relief forms, intensive generalization in scales of smaller than 1:100 000 and gradual change of symbology and detalisation with scale.

APPROACH AND METHODS

Map scales and projection are defined with respect to levels of detail needed and area of interest. A scale sequence of 2-2.5-times multiplication is substantiated and used for controlling map appearance (generalization and symbology). Database logical structure is developed to supply Levels of Detail (LoDs) for scales of the series. Data integration workflow and possible data sources for different scales (database levels of detail) are proposed. DEM generalization uses new algorithm, which is based upon stream network and watersheds generalization and subsequent triangulation of simplified framework. The resulting DEM is then processed via high and low quartile filters to widen valleys and watersheds for their better readability (Figure 1).

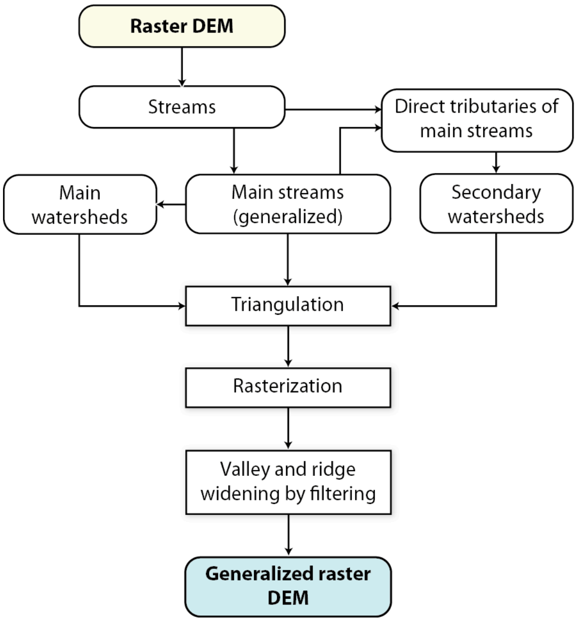

Figure 1. DEM generalization algorithm.

Testing of algorithm in different levels of detail and upon various morphological relief types is made and sample images are provided with their logical analysis revealing some advances and shortcomings of algorithm. It needs improvements because it does not take horizontal distance between relief forms into account, does not preserve contour bend character everywhere and slightly oversmoothes land profiles during valley and watershed widening. However generally it preserves main relief forms, structure lines, slope bends and characteristic heights. Finally multiscale map preparation is discussed with main topics being map layers structure, grouping and scale ranges (limits of applicability), multiscale relief representation using hypsometric tints, contours and hill shading.

RESULTS

The proposed methodology is demonstrated on creating multiscale hypsometric map of European part of Russia with scale range of 1:25 000 – 1:50 000 000. The multiresolution database for the map (Figure 2) was created using Russian topographic maps and freely available elevation models ASTER GDEM (30 m) and USGS GTOPO (1 km). Extensive generalization is made to fill all levels of detail.

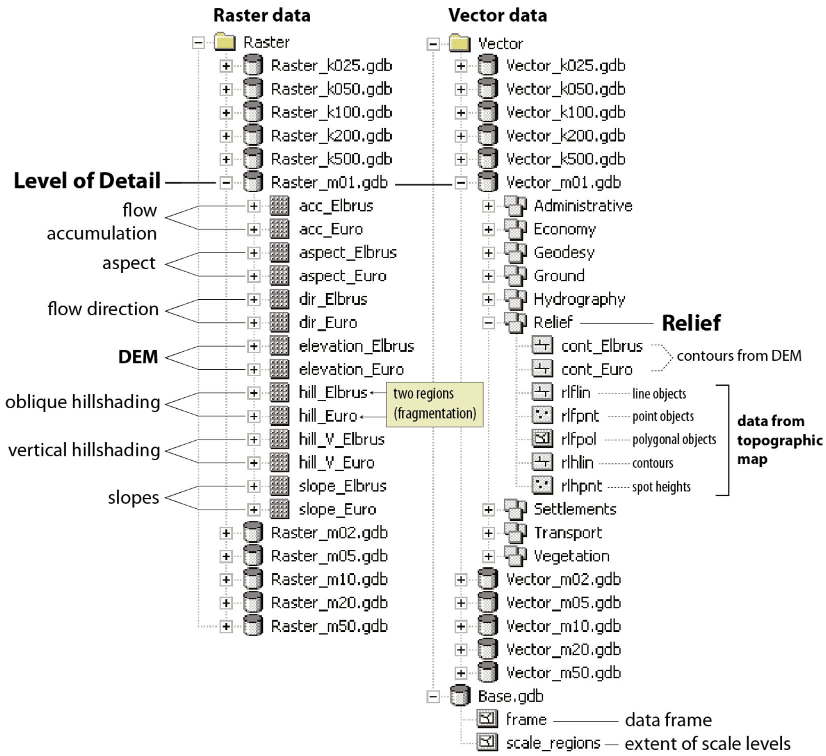

Figure 2. Multiresolution database for multiscale hypsometric mapping

Map layers are combined in scale groups, which are switched automatically. Relief image on the map is made using hypsometric tints (hypsometric "multiscale" is developed), contours and hillshading (Figures 3 and 4)

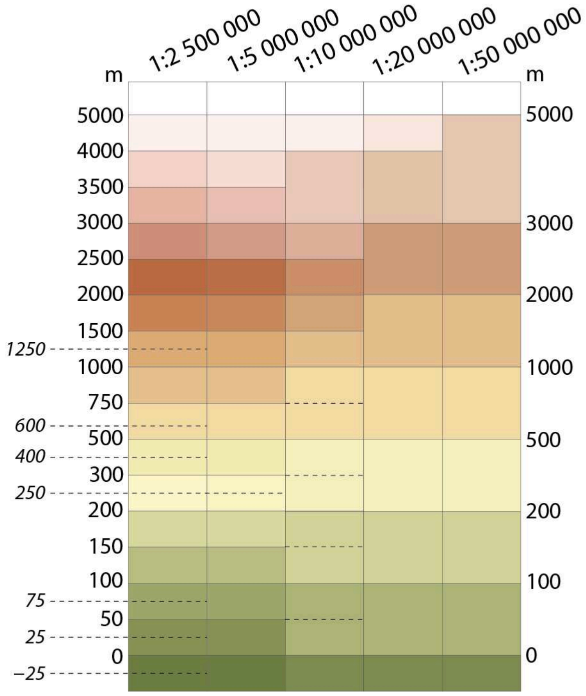

Figure 3. Hypsometric "multiscale" for small scales. Additional levels are shown as dashed lines.

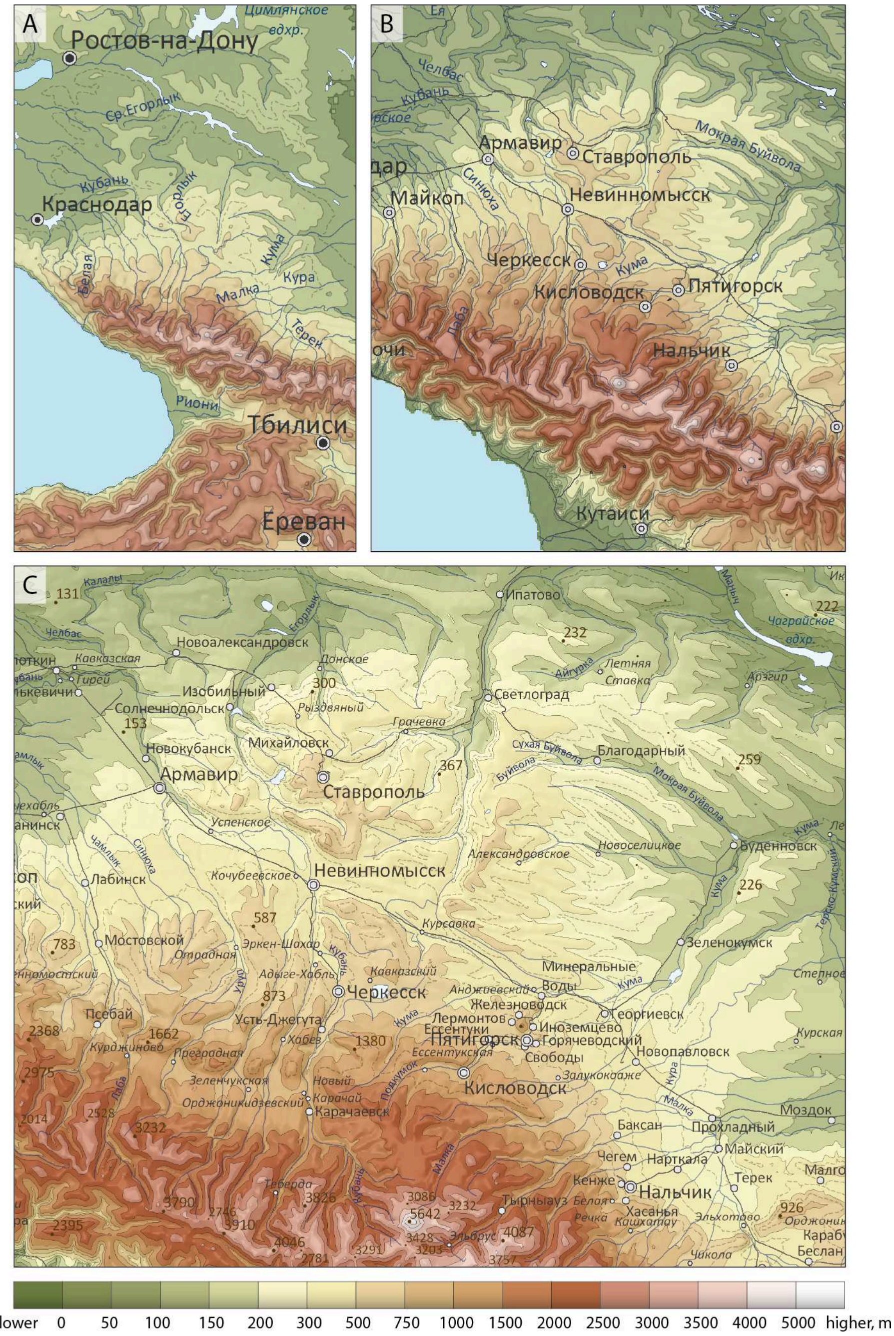

Figure 4. Map fragment (Great Caucasus). Scales: A – 1:10 000 000; B – 1:5 000 000; C – 1:2 500 000.

CONCLUSION AND FUTURE PLANS

The proposed methodology proved to be useful in large scale range of hypsometric mapping. The novel algorithm of DEM generalization is applicable for multiscale mapping purposes, although not being free of shortcomings The main direction of future investigations will be development of realtime methods of multiscale hypsometric mapping. This will potentially allow cartographer to control map appearance and generalization in continuous set of scales, not discrete and finite scale series.

ACKNOWLEDGEMENTS

This research was supported by RFFI grant #08-05-00126-a, Nauchnyie Shkoly grant NS-3405.2010.5 and Munobrnauki RF grant GK#14.740.11.0200.