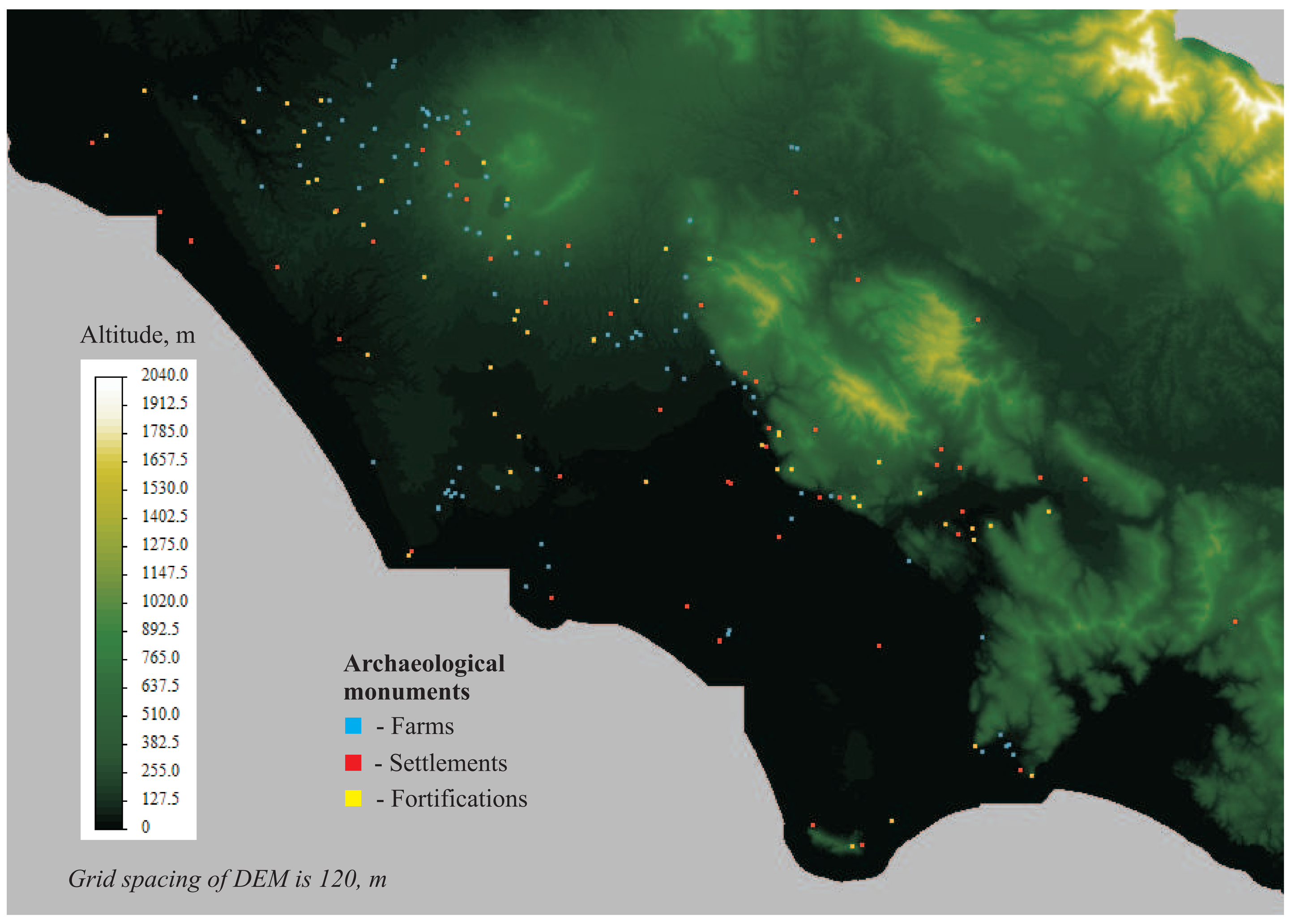
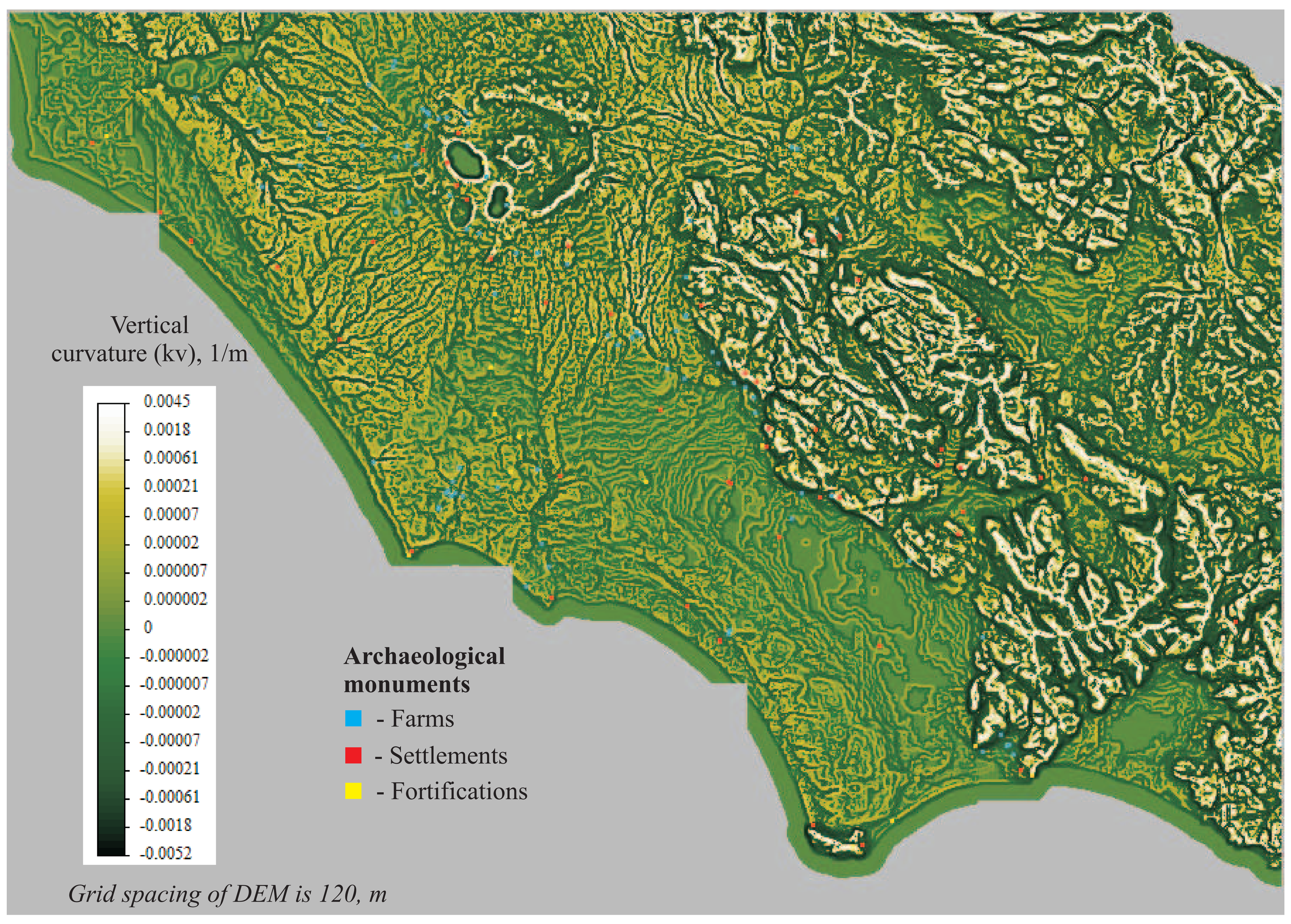
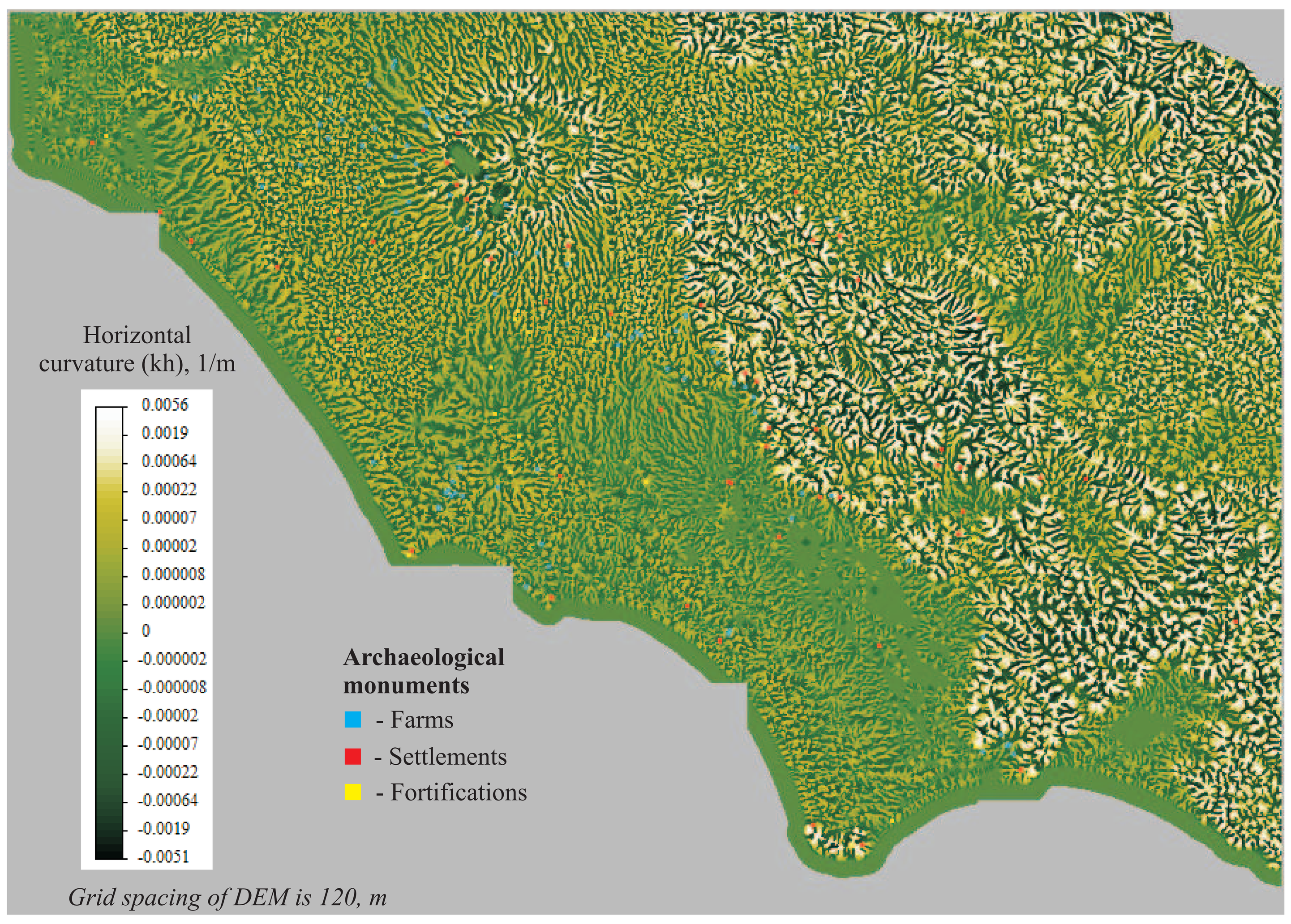
Selected research direction:

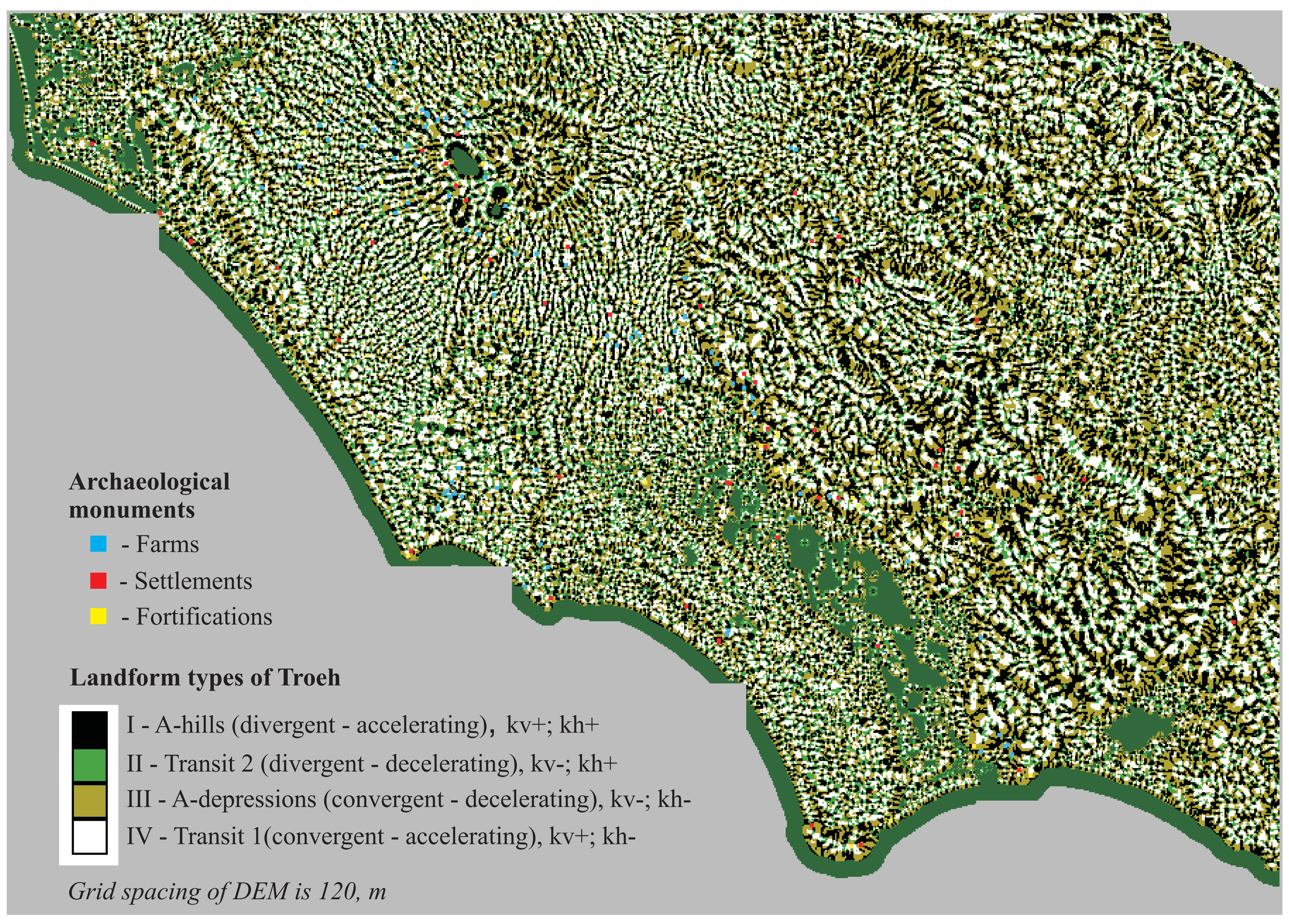
Landforms as a natural resource for different types of ancient human activities

Maps of the key region









Introduction

Human have always preferred different landscape elements for different types of land use due to natural, social and other reasons. However, identification of such elements in retrospective is a difficult task. Soils, hydrology and vegetation can be sufficiently transformed on a time scale of several hundred years. Only landforms on a regional scale are relatively stable in the time frame of the Holocene. In landscapes with extreme natural conditions (climate, orography etc.) borders of landscape elements are usually defined by land surface. In this case the task of identification of borders and areas of former landscape elements coincides with the task of identification of modern landforms.

The archaeological content generally reflects the former land use type in a given landform. If humans systematically selected one landform type for a given type of land use, it means that conditions in this landform type were useful for the given type of land use during the given time frames. Based on this hypothesis, a method for the statistical assessment of terrain usefulness for inhabitants was developed. The main idea of the calculation of usefulness of landforms focuses on a correct comparison of the occurrence frequency of landforms on a terrain and in an archaeological database for the same territory. If sampling points are randomly distributed on the land surface the occurrence of landforms in a final database should coincide with the natural background for a given terrain. Any selection of sampling points impacts on the occurrence frequency of a landform. For the case of archaeology, such selections were made by ancient people.

For the quantitative description of the intensity of selection of a given landform, the Priority Level (PL) was calculated.

Goals

- Detect spatial distribution of archaeological monuments according to landforms.

- Calculate the priority of landforms selection for different types of former constructions.

- Calculate the area of landforms for the given grid spacings.

Initial data

Indicators of former land use

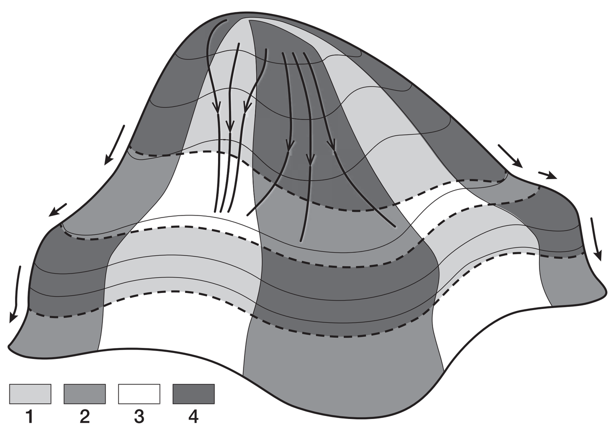
Three types of archaeological monuments were used for the investigation of their spatial distribution relatively to the modern landforms:
- Fortifications of Medieval - Modern times (50 objects)
- Farms of Roman times (86 objects)
- Settlements of Roman, Medieval, and Modern times (53 objects)

Land surface

Digital Elevation Model (DEM) was prepared for four grid spacings: 120, m; 240, m; 480, m; 960, m. In the poster the maps of altitude, curvatures and landforms of Troeh are shown with grid spacing 120, m.
The morphometrical analysis was made with the help of Analytical GIS „ECO".

Description of landforms by Troeh's classification

Relative locations of landforms of Troeh on the land surface



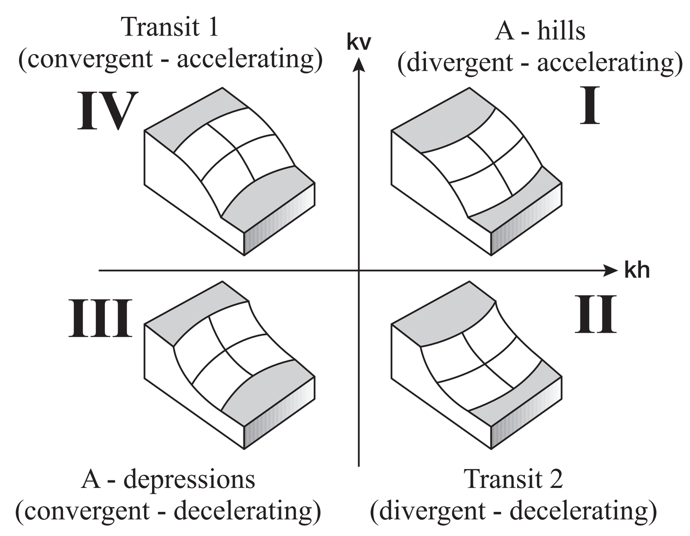
Landforms:
I - convergent-accelerating.
II - divergent-decelerating;
III - convergent-decelerating (relative accumulation);
IV - divergent-accelerating (relative erosion);

Troeh's (1964) classification is based on signs of horizontal (*kh*) and vertical (*kv*) curvatures:
- *kh* describes convergence and divergence of flow lines in plan;
- *kv* describes relative acceleration and deceleration of a flow along a slope profile.

Curvatures identify landform types at a given grid spacing of DEM. During increasing of grid spacing smaller landforms join larger landforms. In result, for one point of the land surface many landform types can be selected, but on different grid spacings (Shary et al., 2005).

The description of land form types defined by the signs of curvatures has to be included into grid spacing of DEM.

Troeh's (1964) classification by signs of horizontal (*kh*) and vertical (*kv*) curvatures



Priority level

Priority level (PL) shows how frequently a given landform type occurs in a sampling database in comparison with the DEM. Thus, the higher the PL, the more often was the given landform type chosen by humans.

Landforms of Troeh occupy 100 % of terrain. However natural occurrence of these landforms is different and it impacts on the distribution of these landforms in the data base of sampling points.

The first step for calculation of Priority Level (PL) is determination of deviations of landforms on DEM from equal probability (1). The second step is correction of the frequency of occurrence of the landforms in DEM and database of sampling points (2).

Bar charts show the priority level of landforms for construction of settlements, farms and fortifications relatively to the natural frequency of occurrence.

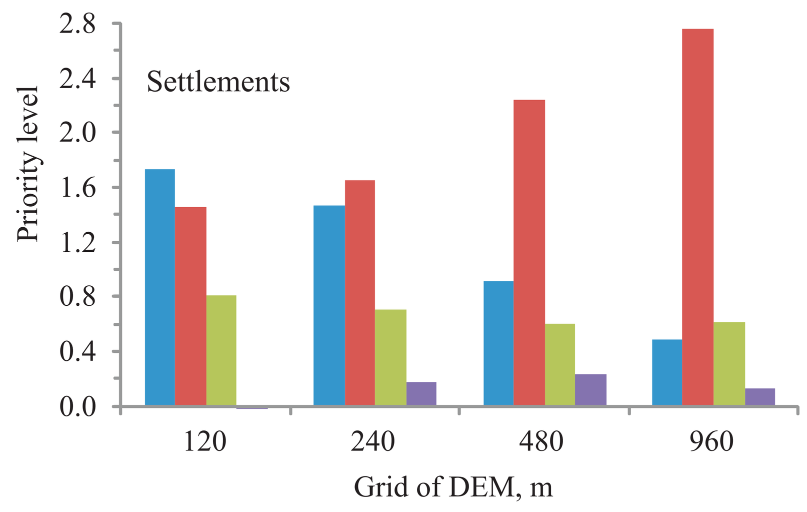
(1) $25 - FO_{DEM} = x$

(2) $(FO_{DB}+x)/(FO_{DEM}+x) = PL$,

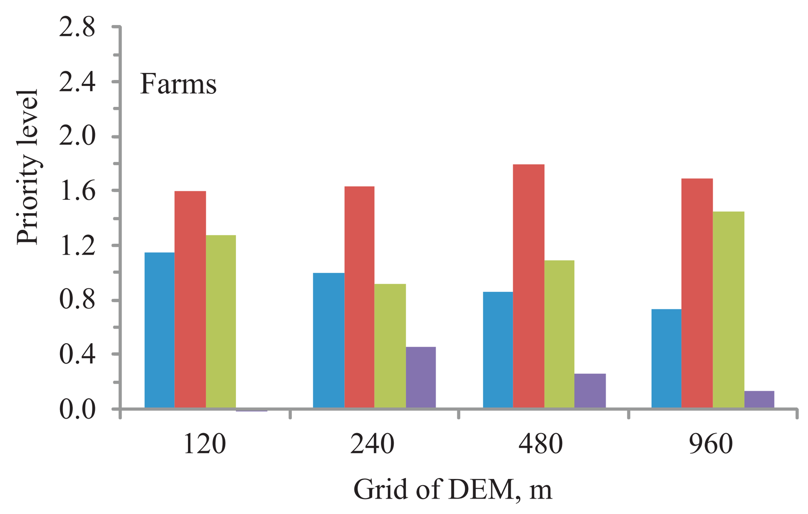
where:

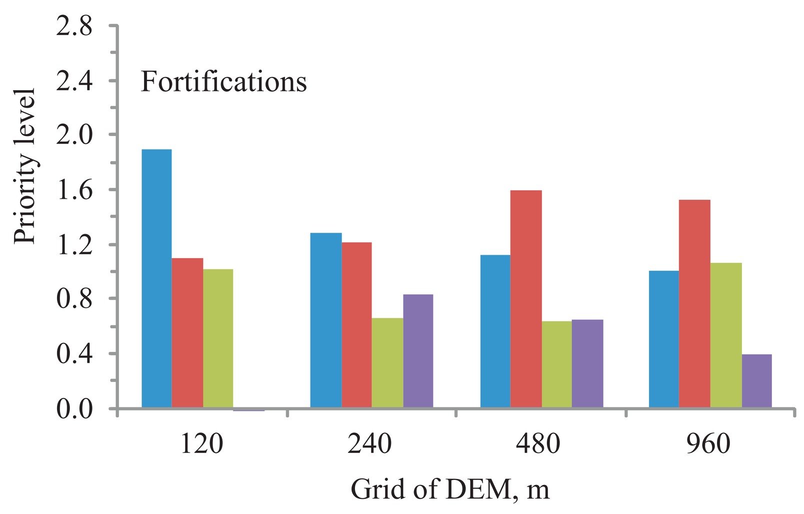
25, %	Equal occurrence of 4 landform types
FO_{DEM}, %	Frequency of occurrence of a given landform in DEM
FO_{DB}, %	Frequency of occurrence of a given landform in a sampling database
x, %	Deviation of FO of a given landform in DEM from 25, %
PL	Priority Level

Ranges of the priority level for a landform type considered:
- $1.2 < PL \leq 4$ - occurs more frequently in the database than in nature
- $0.8 < PL < 1.2$ - random occurrence in the database, near to the occurrence in nature
- $0.2 < PL < 0.8$ - occurs less frequently in the database than in nature
- $0.0 \leq PL < 0.2$ - nearly no occurrence in the database

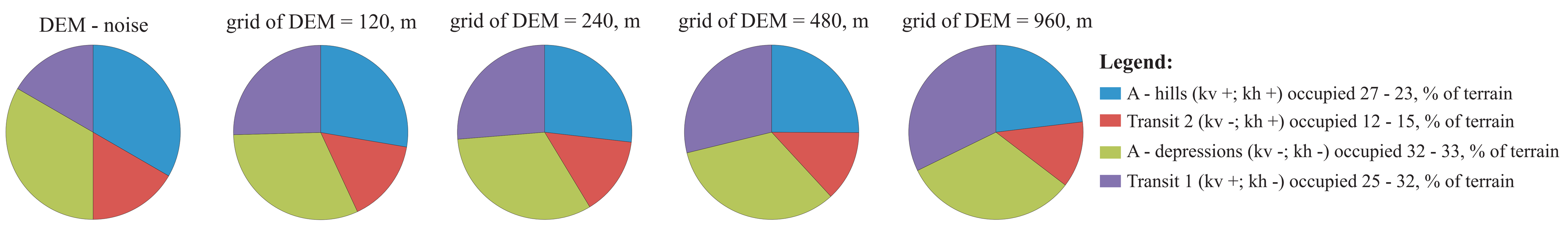


Legend:
- A - hills (kv +; kh +)
- Transit 2 (kv -; kh +)
- A - depressions (kv -; kh -)
- Transit 1 (kv+; kh -)





Area occupied by landform types of Troeh, %



Conclusions

- A quantitative coefficient „Priority level" was developed. This coefficient shows how suitable given landforms types are for the given type of land use. This coefficient allows correct comparison of the frequency of occurrence of objects on different types of landforms.

- A-hills have the highest priority level for the construction of settlements and fortifications at consideration on low grid spacing of DEM. At large grid spacing of DEM the Transit 2 has the highest priority level for these monuments. Transit 2 has the highest priority level also for establishing farms, and the priority level for farms is relatively stable for all grid spacing of DEM. Transit 1 is systematically ignored as a place for all kinds of monuments.

- Variation of priority level on different grid spacing is the result of „dissolving" of smaller landforms in larger ones.

- Probably, the highest priority level indicates the grid spacing which is close to the spatial scale at which humans perceived a landscape for the given type of activity.

- People systematically prefer certain types of landforms and ignore other. Based on this, it is possible to suggest that optimal conditions for the given human activity were present in the suitable landforms. For example, hydrological regime and soil fertility for farming or best strategic location from a military point of view.

- Landforms with a high priority level occupy less than one third of terrain. It implies that only a small part of landscape is optimal for the given type of land use. Optimisation of other parts of the landscape for the same type of land use needs more energy.

Literature

Troeh, F.R., 1964. Landform parameters correlated to soil drainage. Soil Science Society of America Proceedings, vol.28, no.6, p.808-812.

Shary, P.A., Sharaya, L.S., Mitusov, A.V., 2005. The problem of scale-specific and scale-free approaches in geomorphometry. Geografia Fisica e Dinamica Quaternaria 28, 81–101.

Contact person:

Dr. Andrey V. Mitusov, a_mitusov@mail.ru