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Geodiversity of landforms within morphoclimatic zones of the Earth

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The aim of the paper is trying to calculate and classify geomorphometric parameters and on the basis of their values describe geodiversity of landforms within morphoclimatic zones. Morphoclimatic zone classifications by Büdel (1963), Tricart, Cailleux (1965) and Hagedorn, Poser (1974) were evaluated. Zonal morphological and climatic variation of the Earth reflects the spatial distribution of the nature and intensity of the ancient and modern processes of erosion, denudation and accumulation. Therefore, can be observing variation of landforms within particular zones.

Morphoclimatic zones we digitized to get polygon vector layers with consistent coverage for the whole world. Elevation data we obtained from the Shuttle Radar Topography Mission (SRTM Version 4). The coverage of elevation data are between 56˚S and 60˚N. In order to look at maps of morphoclimatic zones multiple parameters were calculated. Primary parameters consisted of relative heights, slope, plan and profile curvature. We used in the analysis also the secondary parameters i.e. Topographic Wetness Index and Convergence Index. Within the analyzed zones we also compared automatic landform classification methods based on Topographic Position Index, Hammond's classification, unsupervised nested-means algorithm and a three part geometric signature: slope gradient, local convexity, and surface texture. For the primary and secondary parameters descriptive statistics such as minimum, maximum, range, mean, standard deviation within each morphoclimatic zone were calculated. Then the parameter maps have been classified on the basis of the natural distribution of Jenks method (1967). Within each morphoclimatic zone, area percentage was calculated for the derived classes of parameters, as well as the percentage of surface forms generated on the basis of automatic classification methods.

Iwahashi, Pike (2007) obtained terrain class values, as well as terrain series values for the entire world (see the first row in Table I). The table also contains newly calculated data for terrain classes and series, for average morphoclimatic zones according to the classifications of Büdel, Tricart, Cailleux and Hagedorn, Poser. Differences for the entire world data between the original Iwahashi, Pike data and the three classifications are relatively small and fall in the range of -3.1 to 2.4%. This means that at the scale of the entire world — regardless of the morphoclimatic zone classification method — the results are similar, despite the fact that glacial zones are not allowed for in the calculations. Extremely interesting information is provided by the analysis of data for the 16-fold terrain classes, which show significant differences in morphoclimatic zones according to different classifications (Table I). They show obvious differences in the morphological development of morphoclimatic zones, regardless of classification.

Maps prepared for the primary and secondary geomorphometric parameters constitute the next series of results. Not all the parameters have proven to be fully useful for the characteristics and differentiation of morphoclimatic zones. However, in many cases the analysis of the special layout of these parameters allows discovering interesting morphogenetic observations. The unquestionable benefit of many geomorphometric parameters is the possibility to indicate the morphometric relief circumstances fostering the presence of geomorphological hazards such as flooding or landslides.

The obtained preliminary data confirm the sense of the undertaken research problem. The possibility to use big data in the calculation of geomorphometric characteristics for selected classifications of morphoclimatic zones at the scale of the entire world opens new ways of interpreting the landforms. Budel's proposal (1963) should be considered the least useful of the three morphoclimatic classifications analysed. Generally, it may be assumed that the more complex the morphoclimatic classification, the better it adjusts to the spatial geomorphometric diversification of the topographic surface of the world.

References

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TABLE 1. TERRAIN CLASSES AND SERIES ACCORDING TO IWAHASHI AND PIKE (2007) FOR THREE MORPHOCLIMATIC CLASSIFICATIONS OF THE EARTH [%]

Author	***Iwahashi, Pike (2007)***	**Büdel (1963)**	**Tricart, Cailleux (1965)**	**Hagedorn, Poser (1974)**
16-fold terrain classes				
1	13.2	12.9	14.9	12.8
2	0.9	1.2	1.2	0.8
3	9.0	8.9	10.0	9.0
4	2.1	2.2	2.4	2.1
5	14.3	15.2	15.5	14.5
6	1.8	2.3	2.0	1.7
7	9.1	8.5	9.0	9.6
8	3.3	3.3	3.4	3.2
9	10.9	11.9	11.2	11.2
10	1.9	1.9	1.6	1.8
11	5.2	4.7	4.6	5.5
12	3.0	2.6	2.4	2.8
13	7.2	8.0	7.2	7.3
14	4.0	4.0	3.2	3.8
15	3.2	2.9	2.8	3.2
16	10.9	9.7	8.7	10.7
4-fold terrain series				
I: 1+5+9+13: fine texture, high convexity	45.7	48.0	48.8	45.7
II: 2+6+10+14: coarse texture, high convexity	8.7	9.3	8.0	8.2
III: 3+7+11+15: fine texture, low convexity	26.4	24.9	26.3	27.3
IV: 4+8+12+16: coarse texture, low convexity	19.3	17.7	16.9	18.7