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Medium-scale unsupervised landform mapping of the Yamal Peninsula (Russia) using 2D Fourier decomposition of the ArcticDEM

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The supervised mapping of landforms last years got high levels based on classic classification methods and new artificial intelligence techniques. However, it is often difficult to create train data for large and diverse areas, and we can face up with differences between expert-to-expert landforms interpretation. It can be solve using unsupervised classification - a less effective in general case, but more objective. The way to make more effective classification - to create special input variables (to account local specificity of landforms) aimed to show real terrain structure. Study region - Yamal Peninsula (Arctic coast of Russia), covered sea accumulative and erosional plains, reshaped by some cryogenic processes, especially thermokarst, with many lake hollows. We used ArcticDEM 32m and decomposition of DEM with 2D FFT by moving windows with sequence of sizes from 1.5 to 3 km (by the interval of 0.3 km) and with lag around 150 m (overlapping - 90-95 %). The 9 variables were computed: 1) magnitude of the main wave in the height field, 2) wavelength of the main wave, 3) importance (share of the height variation) of the fix pool of biggest harmonic waves, 4-6) orthogonal (N-S and W-E) components of the general direction of the height fluctuations (and the significance of the direction), 7-9) coefficients of the exponential trend equation for approximation wave's frequencies/magnitudes distribution. We then trained the model of landforms clustering for the study area using Kohonen network and the hierarchic clustering was used for additional generalization. The medium-scale (750 m / pix, it is matched to maps at the scale 1:500 000 - 1:1 000 000) map of Yamal Peninsula landforms was created. Seven classes of landforms were recognized. The study was supported by Russian Science Foundation (project no. 19-77-10036).