

1. PHD PROJECT DESCRIPTION (4000 characters max., including the aims and work plan, all in English)

Project title:

Low-altitude photogrammetry in studies of pedodiversity of moraine plateaus

1.1. Project goals

- 1) Elaboration of a algorithm and reinterpretation key linking morphometric parameters (relief) and the variability of surface soil horizon colors measured on orthophotomosaic together with their basic properties (pH, content of carbon, calcium carbonate, texture)
- 2) development of detailed maps of spatial soil variability and maps of basic properties of surface horizons
- 3) estimation of the impact of anthropogenic denudation on the pedodiversity of soil cover

1.2. Outline

Moraine plateaus are the most important agricultural areas within the many regions in the world - North and East European Plains and Laurentian Plateau in North America. Agricultural areas of hummocky and undulating moraine plateaus were strongly transformed by anthropogenic denudation. This phenomena leads to strong alteration of the soil cover and formation of wide range of different types of soils is formed - truncated in the upper parts of the slopes and accumulative - at the foot of slopes and in the depressions. The previous research proved that the change in texture and other properties of soils transformed by human-induced erosion leads to a change in their spectral properties, and thus to change their image (colour) on the aerial photo. Studies of this type with application of unmanned aerial vehicle (UAV) survey have not yet been carried out in the moraine areas.

Three research areas of approximately 30-50 ha (each) will be selected for detailed research. They will be located within the moraine plateaus of the postglacial areas of Northern Poland:

- 1) hummocky plateau with good drainage (predominance of autogenic soils)
- 2) undulating plateau with good drainage (predominance of autogenic soils)
- 3) undulating plateau with poor drainage (prevalence of semihydrogenic soils)

After UAV survey the detailed-resolution orthophotomosaic and a digital terrain model (DEM) using Agisoft Photoscan 1.4.5 software will be made. It will be used for determining soil sampling places based on surface horizon colors and terrain morphometric parameters. In soil samples taken, the basic properties will be determined in laboratory - pH, calcium carbonate content, organic carbon content, texture.

Results will give the opportunity to determine the spatial range of individual soil units e.g. eroded pedons – weakly developed calcareous soils and eroded clay-illuvial soils or colluvial soils. Development of a photo interpretation key will allow extrapolation of obtained results to other areas of moraine plateaus, which may be useful not only for scientists but also for users in many countries in the world.

1.3. Work plan

October – December 2020

Preliminary field work – reconnaissance. Selection 3 areas for research.

January – February 2021

Review of the literature on the subject under study

March – September 2021

UAV survey within research areas and preparation of detailed-resolution orthophotomosaic and a digital terrain model (DEM) using Agisoft Photoscan 1.4.5 software.

June – November 2021

Field works - Soil sampling (approximately 300 surface samples – all together) and 12 representative soil profiles

December 2021 – April 2022

Laboratory analysis (pH, soil organic carbo, nitrogen and calcium carbonate content, texture, Mansell color)

May 2022 – October 2022

Processing results, optional additional work in the field

November 2022 – February 2023

preparation of main articles based on the results obtained

March 2023 – April 2023

Determining the locations of field validation

May 2023 - September 2023

Field validation of the developed orthophotomosaic reinterpretation key in 1 additional research area

October 2023 - February 2024

preparation of article based on the validation results

1.4. Literature

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1.5. Required initial knowledge and skills of the PhD candidate

- The candidate should be a graduate of environmental studies (geography, geoinformation, spatial development) with basic soil science or soil geography course.
- Basic skills in laboratory works
- ability to use GIS (Arc GIS, QGIS) and graphic programs (Corel)

1.6. Expected development of the PhD candidate's knowledge and skills

- ability to use software to operate UAV
- elaboration of detailed-resolution orthophotomosaic and a digital terrain model (DEM) using Agisoft Photoscan program
- ability to interpret aerial photos in terms of soil cover properties
- ability to create soil properties maps