of its self-recovery, the bioclimatic indicators are all influential factors. During the process of evaluative mapping various techniques were used: methods of statistical calculations, indicative signs, maps-indicators, scientific hypotheses, and extrapolations. The ecological indicators are based on expert estimates and rely on the long-term experience of regional research. Based on analysis of the chosen factors, we calculated the integrated indicator of their cumulative influence. This value can be either the simple sum of factor points, their geometric mean, or the calculated coefficient developed in the multiple regression equation. The formation of different ecological situations based on the consideration of the mechanical damage degree of the topsoil cover and the landscape resistance to these types of violation.

On local level two geoecological situations maps of Tyumen North test sites (compiled by the authors) are shown. In matrix table five-stage gradation of ecological situations is defined in the standards of the Russian Ministry of Natural Resources: satisfactory, tense, emergency, critical and catastrophic. Each situation is characterized by a specific set of cryogenic processes of different intensities. The critical situation is formed in the landscapes which are unstable in permafrost relation (such as peatlands with patterned vein ice) due to strong mechanical damage. The illustrations of the main situations categories are presented. Scientific and methodological approaches of this evaluation can be applied in engineering geocryology, at predesign stages of the research, and for strategy decision-making for cryolithozone development.

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Analyzing tundra vegetation characteristics for enhancing terrestrial LiDAR surveys of permafrost thaw subsidence on yedoma uplands

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Surface subsidence is a widespread phenomenon in Arctic lowlands characterized by permafrost deposits. Together with active layer thickness dynamics surface subsidence is an important indicator of permafrost degradation in climate warming conditions. Due to small changes of surface heights of several centimeters or less per year, high-resolution and high-accuracy data are necessary to detect thaw subsidence dynamics in tundra lowlands. An appropriate method to receive such data is repeat terrestrial laser scanning (LiDAR). However, for LiDAR data analysis, uncertainties connected with vegetation dynamics should be taken into account. The vegetation type and its succession reflect the microrelief features, resulting in an areal differentiation of surface heights changes. Depending on wetness, possible influences might result from moss-lichen cover and its thickness dynamics. In this study we present some results of the vegetation characteristics and dynamics in context of its impact on the terrestrial LiDAR investigations for thaw subsidence assessment on yedoma uplands.

During expeditions to the Lena Delta and the Bykovsky Peninsula in Northern Yakutia in 2015-2016, repeat terrestrial laser scanning was conducted on yedoma uplands formed by very ice-rich Yedoma Ice Complex deposits. On the Bykovsky Peninsula, detailed vegetation descriptions of the main vegetation types were done including all species projective cover, cotton grass tussocks height and area sizes, moss-lichen thickness and ALT measurements. Subsidence was about 3.5 cm on average and is mostly observed on drained inclined sites with dwarf-shrub graminoid, cotton-grass, moss-lichen tundra, representing initial baydzherakhs (thermokarst mounds). Surface heave is observed mainly within bogged depressions with sedge, moss tundra. The average ALT was 39±4.1 cm and 32±5.6 cm in 2015 and 2016, respectively. However, the ALT significantly varies locally and depends on the vegetation type and species.

Cotton grass leaves average length decreased from 14.4 in 2015 to 12.9 as well as tussock area size (0.32 m^2 in 2015, and 0.13 m^2 in 2016). This data can be used for the interpretation of LiDAR data for sites with cotton grass prevalence.

Less deep ALT and cotton grass size in 2016 indicate that climate conditions were less favorable for seasonal subsidence development in 2016. The sum of positive daily air temperatures was almost in the same order of magnitude in 2016 as in 2015 for the period until end of August (636 degree days in 2015 and 628 degree days in 2016). However, interannual surface subsidence was progressing, indicating a decreased resistivity of yedoma uplands in terms of thaw subsidence under current, generally warmer conditions.

The thickness of the moss-lichens layer in average is about 5 cm for the live part and 12 cm for both live and non-live parts. The lab drying in the 20°C conditions shows the decrease of moss-lichens layer samples thickness from 12,4 to 11,8 cm in average. The changes of moss-lichens thickness could be ignored as drying resulted in small changes it is very unlikely to have such drying in really tundra conditions

Our results show the importance of considering vegetation and their dynamics for the interpretation of repeat terrestrial LiDAR data for thaw subsidence estimation.

SESSION 5: PERMAFROST AFFECTED SOILS

Problems of Permafrost-Affected Soils Classification and Their Places in Different Taxonomic Systems

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Since 1978, when Cryosolic order has been established in the Canadian soil classification system the permafrost-affected soils are recognized as very important ones in several classification systems of the world. In the Canadian system and in the US Soil Taxonomy soils of the world are divided into those with permafrost and other soils. In WRB system permafrost-affected soils are also very high. In Chinese and national Russian classification systems the permafrost are recognized only on the 3rd-4th taxonomical levels. However since that time when all these classification systems came into being the community of soil scientists got new challenges for the classification of permafrost-affected soils. 1. The problem on the classification of soils in loose materials which have permafrost below 2 m, but this permafrost results in cryoturbations and accumulations of different soil materials in deep soil horizons and even subsoils because of impermeability of the deep permafrost. These soils are typical for regions of ultracontinental climates with very cold winter and hot summer (Saha (Yakutia), Transbaikalia). Traditionally for these areas, such soils are classified as permafrost affected, as they differ from non-permafrost soils by many features. 2. The problem of shallow soils of cold climates, whether we can accept them as Gelisols, as they theoretically have permafrost within 1 or 2 m of solid rock, or they should be classified as Gelorthents as nobody can see permafrost in the profile because of shallow lithic contact. 3. The problem of soils with well-pronounced cryoturbations but without permafrost. 4. The problem of division of cryoturbated soils to those with mineral horizons and ones enriched by organic material.