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# Sustainability of landscapes in the zone of the current distribution of permafrost

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## Problematic

Sustainability of landscapes defined as the ability of the landscape to self-regulate and self-restore after the effects tested on them, as well as the ability to resist these influences [Myachina, 2011]. This important indicator determines the state of the environment and the changes occurring it under the influence of natural and anthropogenic factors.

The zone of modern permafrost distribution is characterized by extreme vulnerability and instability of the natural system, which causes an immediate response to external influences. Determining the sustainability of permafrost landscapes, taking into account the global trend of climate warming and active economic development, it is one of the pressing problems of physical geography. We assume that the development of integrated indicators of sustainability of permafrost landscapes with the possibility of modeling the behavior when the intended impact, will help to understand the processes of transformation of the landscape in the short and long term.

Figure 1. Batagayka - thermo-denudation depression result of disturbance of the permafrost landscape in Yakutia. Russia. Drone image. M. Zakharov S. Gadal 2017



## Permafrost landscape

The Republic of Sakha (Yakutia) is the largest federal district of the Russian Federation, the size of which determines the presence of various geosystems (landscapes), while almost the entire territory falls within the zone of continuous distribution of permafrost. The zone is characterized by the proliferation of many forms of permafrost and, at present, we are witnessing many instances of disturbance to the sustainability of permafrost landscapes.

And to determine the sustainability parameters of such complex systems, a fundamental role will be on the accuracy of the distribution areas of certain types of landscapes. We intend to apply for this analysis of remote sensing data based on the classification of cross-discrete (data with different resolutions) images of interperpetual components of the landscape (relief, temperature, vegetation and soil)

Figure 3. The method of cross-discrete classification of data of distant sensing for categorization of permafrost landscapes. M. Zakharov

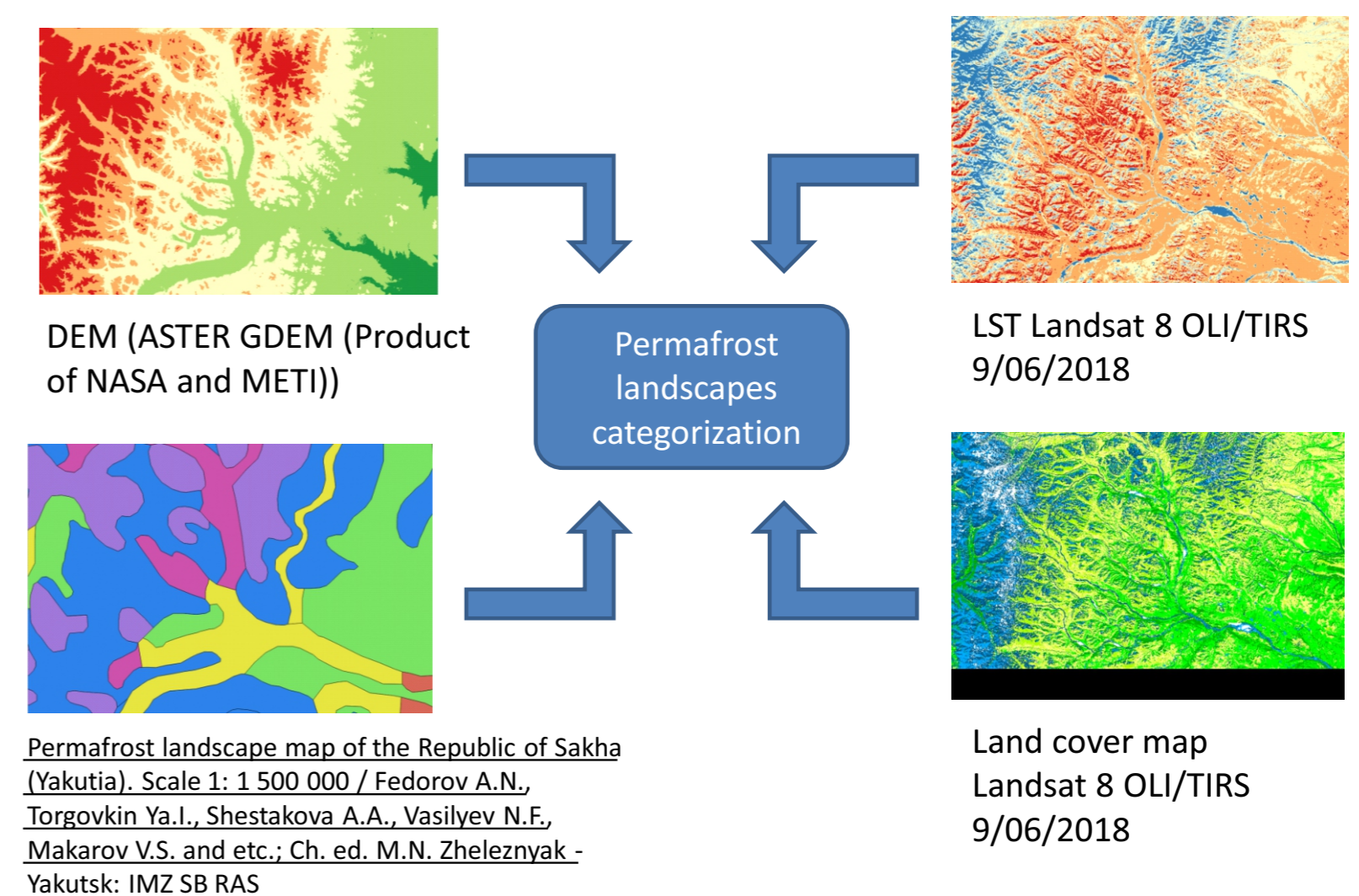
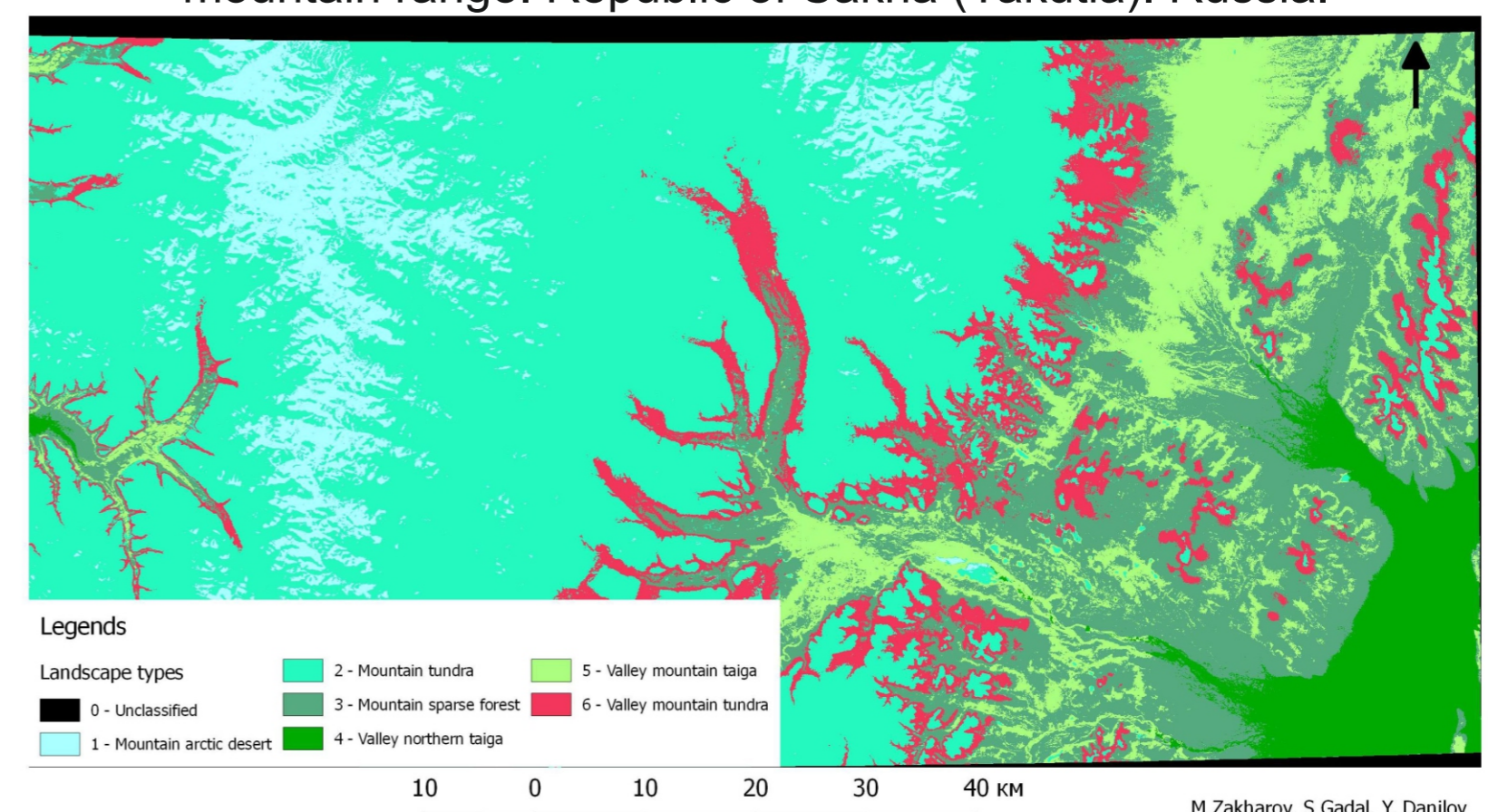


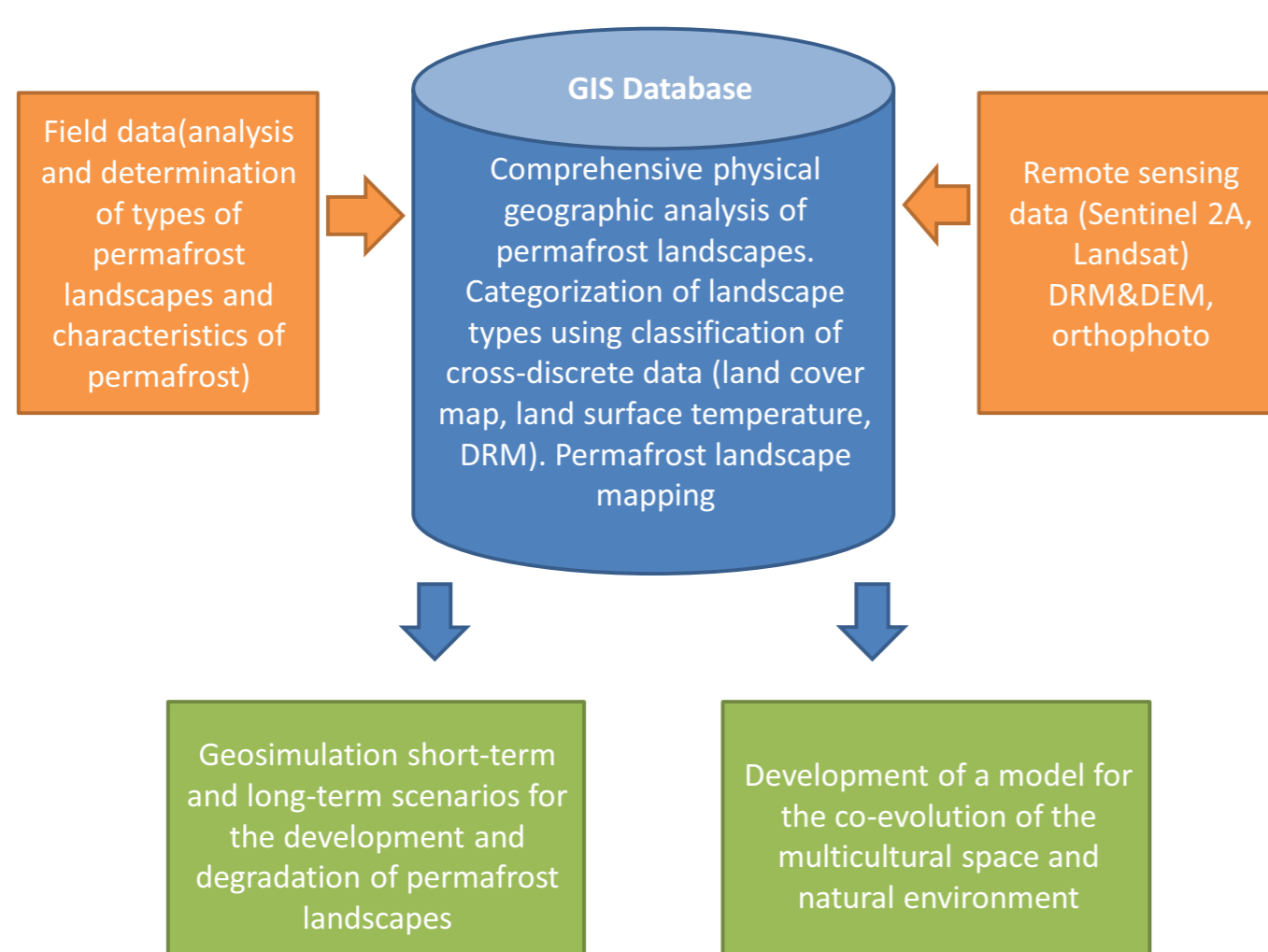
Figure 4. Permafrost landscapes categorization of Verkhoyansk (Orulgan) mountain range. Republic of Sakha (Yakutia). Russia.



## Methodology

The aim of the research is to develop integrated indicators of the sustainability of landscapes in the zone of modern distribution of permafrost. To achieve this goal, we apply an approach that combines a method of integrated physical-geographic analysis of landscapes and methods of spatial-GIS analysis. Comprehensive physical-geographic analysis is expressed in the assessment of the parameters of the soil, plant, climate and hydrological components of the landscape. That will allow us to develop indicators of each of these parameters. The results will be integrated into the GIS environment for conducting spatial analysis and using the developed methods for applying remote sensing data (classification methods of multispectral and thermal images) to obtain a holistic integrated sustainability indicator.

Figure 2. General schema of research approach. M. Zakharov



## Results an future work

The approach developed is especially important in the study of hard-to-reach high-mountainous areas and large territorial surfaces, such as the Verkhoyansk mountain range in North-East Siberia with over 2500 meters an altitude and about 1200 km in length. Six landscapes categories have been identified and its will be validated after field data collected during the summer expedition. The following work steps: Improve the method of determining of LST and land cover classification. Defining sustainability indicators of permafrost landscapes of Verkhoyansk mountain system. Field data collection.

## References

- V.V. Kunitsky, I.I. Syromyatnikov, L. Schirmerster, Yu.B. Skachkov, G. Grosse, S. Wetterich, M.N. Grigoriev (2013) Ice-rich permafrost and thermal denudation in the Batagay area (Yana upland, East Siberia) Криосфера Земли, 2013
- S.A. Rakita The stability of geosystems: approaches to practically realizable assessment // Geography and natural resources. 1980. №1. Pp. 136-142
- O.N. Nikolae, D.D. Pinigin To the question of the stability of natural complexes of the development zone Elgin coal deposit // Известие 2016
- J. Wu (2013) Landscape sustainability science: ecosystem services and human well-being in changing landscape Springer Nature 2013 Landscape Ecol (2013) 28: 999. URL <https://doi.org/10.1007/s10980-013-9894-9>
- K.V. Myachina Stability and geocological density landscapes of the steppe zone of the Volga region and the Urals ВЕСТНИК ВГУ, СЕРИЯ: ГЕОГРАФИЯ. ГЕОЭКОЛОГИЯ, 2011, № 1 URL <http://www.vestnik.vsu.ru/pdf/geograph/2011/01/2011-01-23.pdf>

