Retrogressive thaw slumps (RTS) are a common thermokarst landform along arctic coastlines. They mobilize large amounts of organic carbon rich material. Especially in the western Canadian Arctic their length, width and frequency are particularly great. RTS are strongly characterized by rapidly changing topographical and internal structures and they are highly sensitive to various external factors, e.g. changing climate conditions. We aim for a better understanding of the life cycles of retrogressive thaw slumps. We investigate different phases, their stabilization, regeneration, and reactivation. To monitor their internal structures, we use electrical resistivity tomography (ERT) in combination with geomorphological mapping. Our field campaigns in 2011, 2012, 2019 and 2022 were carried out on Herschel Island – Qikiqtaruk, a highly active and well-studied area in the Yukon, Canada. The two biggest RTS on Herschel Island were investigated to gain a better understanding of the changing system over time. Numerous ERT profiles were carried out crossing the RTS parallel to the coastline as well as horizontally. We calibrated the ERT data by measuring the bulk sediment resistivity under fixed temperature conditions on sediment samples from Herschel Island. Also we conducted active layer probing to detect the frozen-unfrozen transition in the field.
This study leads to an improved comprehension of long-term processes in retrogressive thaw slumps and therefore a better predictability of their future behaviour. We show that ERT can be used to detect thermal and mechanical disturbances in RTS and gain a better understanding of their long term behaviour and different stages.

12:00 – 12:20h

Nitrogen isotopic inventory of the Lena River Delta

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Permafrost-affected soils around the Arctic Ocean contain a large reservoir of organic matter including nitrogen, which partly reach the river after thawing, degradation and erosion of permafrost. After mobilization, reactive remineralised nitrogen is either used for primary production, microbial processing or is simply transported to coastal waters.
We have analyzed soil, suspended matter and dissolved inorganic and organic nitrogen for their contents and 15N stable isotope composition to create a baseline for a nitrogen inventory of the Lena River Delta in 2019/2020. We used samples from two transect cruises through the delta in March and August 2019, a monitoring program at Samoylov Island in the central delta (2019/2020), and different soil type samples from Samoylov Island.
Our data shows that the nitrogen transported from the delta to the Laptev Sea were dominated by dissolved organic nitrogen (DON) and nitrate, which occur in similar amounts of approx. 10 µmol/L. DON was available during the whole year. Nitrate showed a clear seasonal pattern: increase from late summer until the spring flood, during summer the nitrate concentration are close to zero. During the spring flood the nitrogen concentration are higher with up to 100 µmol/L.

The nitrogen stable isotope values of the different nitrogen components ranges mainly between 0.5 and 4.5‰, and were subsequently enriched from the soils via suspended particulate matter (SPM)/sediment and DON to nitrate. During the spring flood, the stable isotope signature of nitrate suggested a strong source of atmospheric deposition. The 15N values are depleted with appox. -8‰ and the 18O values are enriched up to 60‰.
Our data provides a baseline for isoscape analysis and can be used as an endmember signal for modeling approaches.

12:20 – 12:40h
Long-term geoelectrical monitoring of bedrock permafrost in the Kammstollen, Zugspitze (Germany/Austria)

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In the last decades, electrical resistivity tomography (ERT) became the standard technique for permafrost monitoring. Changes in resistivity allow to quantify the response of permafrost to the recent climate change. In high alpine environment, especially in steep bedrock walls, consequences can be critical, putting infrastructures and people at high risk. Numerous locations are monitored along the Alps, mainly installed at the rock surface, and measured once a year. In a few cases, automatic systems have been installed to monitor changes all-year around, but this often implies bad coupling of electrodes, high costs and/or repeated failures. In 2007, we instrumented a former touristic tunnel at about 2800 m asl on the Mount Zugspitze (D/A) in a unique setup for ERT and temperature measurements. (i) The location can be easily reached by cable car and is accessible all year around, independently from weather conditions. (ii) Measures are taken from the inside towards the rock surface. (iii) An ideal compromise between continuous automatic systems and single annual measurements is achieved with monthly repeated measurements: this allows detailed interpretation of bedrock permafrost reactions to seasonal variations as well as of long-term changes, without the burden of fix costs and the complications of automatic setups. (vi) Standard procedures and permanently installed electrodes allowed the collection of a unique dataset of consistent monthly measurements since 2014. (v) Resistivity-temperature calibration from Krautblatter et al. (2010) enable an advanced quantitative interpretation of the results.

Results from 25 rock temperature loggers show an increase of rock temperatures in the last decade, with a gradient decreasing with depth - in good agreement with other locations in the Alps. Inversion results from the ERT fit well to this trend, especially in the summer months where a steady decrease of resistivities is measured. Winter months are strongly influenced by the duration and depth of snow cover, showing therefore more variations.
Krautblatter, M., S. Verleysdonk, A. Flores-Orozco, and A. Kemna (2010), Temperature-calibrated imaging of seasonal changes in permafrost rock walls by quantitative electrical resistivity tomography (Zugspitze, German/Austrian Alps), J. Geophys. Res., 115, F02003, doi:10.1029/2008JF001209.