The potential of using Sentinel-1 and ALOS PALSAR-2 data for characterizing West Siberian lake ice backscatter anomalies

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Millions of lakes and ponds occupy large areas of the Arctic discontinuous and continuous permafrost zones. During most of the year, the surfaces of these lakes remain covered by a thick layer of ice. Synthetic Aperture Radar (SAR) data have shown to be useful for studying the ice on Arctic lakes, especially for monitoring lake ice phenology and the grounding state of the ice (ice frozen to the lakebed versus floating lake ice). Significant backscatter is often observed from the floating ice regime in C-band due to scattering on a rough ice-water interface.

Recent research has revealed features of anomalously low backscatter in Sentinel-1 C-band SAR imagery on some of the West Siberian lakes that likely belong to the floating ice regime. These anomalies are characterized by prominent shapes and sizes and seem to expand throughout late winter and/or spring. It is currently assumed that some of these features are related to strong emissions of natural gas (methane from hydrocarbon reservoirs), making it important to assess their origin in detail and understand the associated mechanisms. However, in-situ data are still missing.

Here, we assess the potential of the combined use of C-band Sentinel-1 (freely available) and L-band ALOS PALSAR-2 data (available through JAXA PI agreement #3068002) to study the backscatter anomalies. We highlight the differences between observed backscatter from the two sensors with respect to different surface types (ground-fast lake ice, floating lake ice and anomalies) and investigate backscatter differences between frozen and melting conditions. Further, polarimetric classification is performed on L-band PALSAR-2 imagery, which reveals differences in scattering mechanisms between anomalies and floating lake ice.