Measuring elevation change in arctic permafrost landscape using SAR interferometry

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Here we aim to measure summer thaw subsidence as well as inter-annual elevation change in tundra permafrost landscape using Synthetic Aperture Radar interferometry (InSAR). We select two study areas, Barrow, the northernmost point of Alaska and Bykovsky Peninsula, southeast of Lena Delta, Siberia. Thick permafrost underlines both areas with large ice volumes in the upper layer. Barrow has a relatively flat topography while Bykovsky has a hilly tundra landscape.

Information on summer and inter-annual subsidence of permafrost is valuable and yet rare information limited to a few spots in these regions. We use SAR satellite images to estimate elevation change of permafrost landscape across large areas and with a high spatial resolution. The SAR data used in this study includes an extensive collection of images acquired by German TerraSAR-X, Japanese ALOS, and European Sentinel-1 satellites. Using the available SAR data, we perform InSAR analysis to obtain time series of elevation change from beginning to end of the thaw season as well as elevation change between different years.

The elevation change maps from different datasets are in general agreement and reveal cm-scale subsidence from the beginning of summer to the end of the thaw season and slightly lower rates of long-term elevation change. In both study areas, the magnitude of subsidence correlates with vegetation cover and microrelief. In particular, comparison of InSAR results with satellite optical images, confirm the wetter depressions basins show a higher magnitude of subsidence and the drier areas show a lower magnitude of subsidence.