Data fusion of dual geometry GNSS-Reflectometry measurements over the cryosphere from Spire's nanosatellite constellation

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Keywords *sea ice, grazing angle, near-nadir, geometry, spire*

Abstract

Spire Global operates a constellation of nanosatellites, with over 20 of these capable of GNSS-Reflectometry over the poles. These data are operationally processed from two different geometries, with dual frequency, coherently processed grazing angle data available from March 2020 and single frequency, incoherently processed near-nadir data from early 2021. Planned expansion of the GNSS-R constellation hopes to enable consistent, operational use of GNSS-R for Earth Observation into the future.

Grazing angle measurements from Spire's Radio Occultation satellites operationally produce over 2000 tracks per day of sea ice type classifications over the polar zones, as well as derived variables such as metrics of phase coherence and reflectivity. Here we will present results from the application of machine learning package XGBoost to these measurements to show the sensitivity of this grazing angle measurements to the youngest types of ice, and improvements upon binary thresholding in current automated ice type products. Further investigations into these valuable data with machine learning techniques will exploit the differences between the phase and amplitude variables for multi-class sea ice classification and responsiveness to different facets of the surface changes.

Combining these measurements with those from the near-nadir viewing geometries is facilitated by the wealth of historical data from these two data sources and will yield not only an increase in the coverage of the products (and thus the temporal and spatial resolution), but also the potential to more reliably distinguish the changing characteristics of the ice, as necessary for shipping, transportation and climate research.