

# GNSS Grazing Angle Level 2 Sea Ice and Altimetry Products from Spire Global, Inc

As part of the CSDA sustained purchase agreement with Spire Global, Inc., Spire has delivered two Level 2 GNSS-R Grazing Angle Products

- Integration into SDX is forthcoming
- These data can be directly requested from the CSDA program under the same licensing and restrictions as the other Spire products
- Further description of these data is provided on the following slides

To acquire the Sea Ice and Altimetry Products:

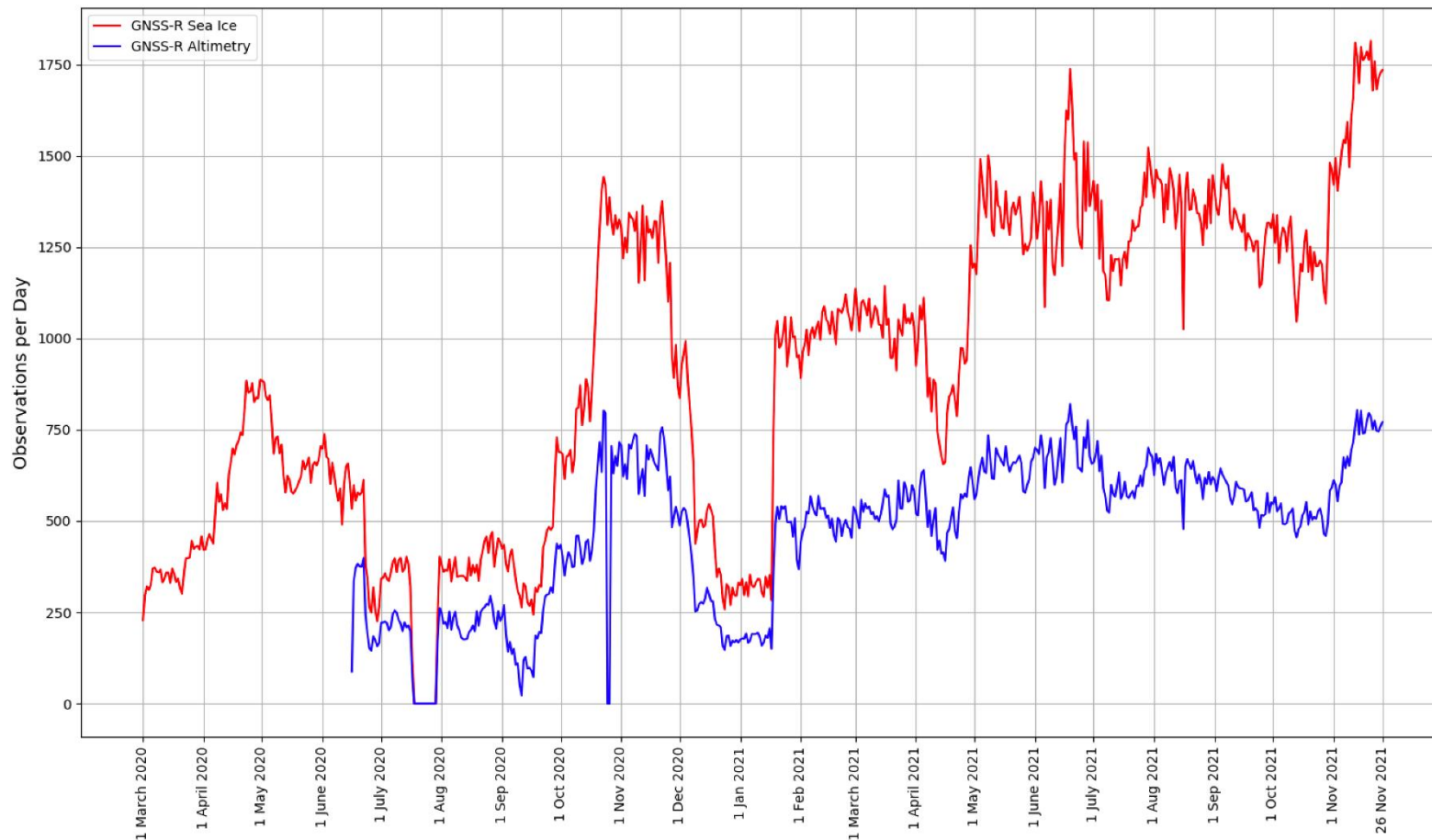
- If not already authorized to use Spire data, request authorization and access via NASA Earthdata
  - [CSDA Program Authorization Request Form \(nasa.gov\)](#)
- Once approved, request the data from the CSDA Program Data Management Team by emailing [csdap@uah.edu](mailto:csdap@uah.edu)

Questions or Issues: Contact the CSDA Project Manager at [Alfreda.A.Hall@nasa.gov](mailto:Alfreda.A.Hall@nasa.gov)

# Observation Availability

(as of 30 Dec 2021)

## Spire Level 2 Grazing Angle Reflectometry Products



# The use of Spire Level 2 Grazing Angle GNSS-R for sea ice presence, altimetry, and age

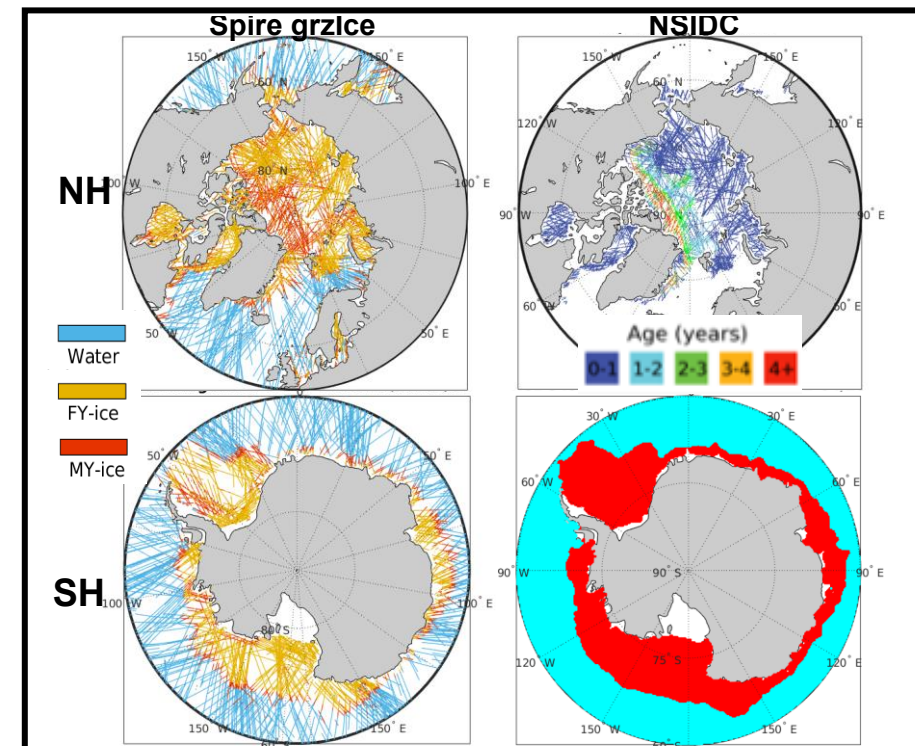
Jade Morton, Univ. of Colorado Boulder

**Purpose:** Derive a high temporal resolution sea ice presence, height, and age product from the Spire Level 2 Grazing Angle L2 data.

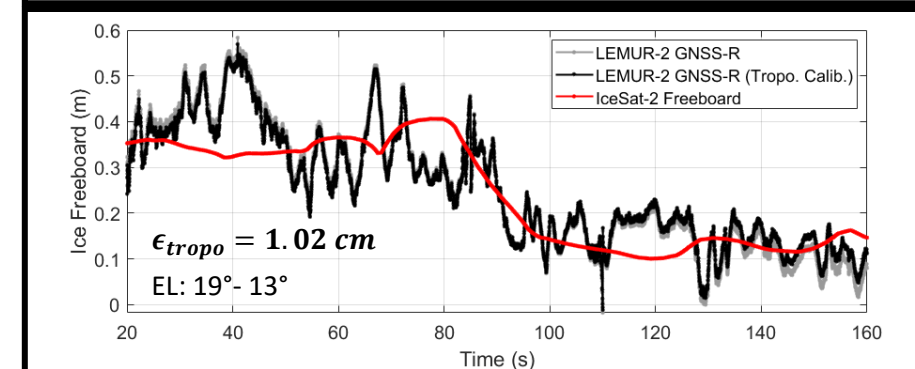
**Study Objective:** Evaluate Spire Grazing Angle measurement quantity and quality.

**Data:** Spire Level 2 (L2) Grazing Angle (grzIce) data from March to May 2020 above 50°N and below 50°S.

**Findings:** The Spire L2 grzIce data can provide accurate surface type classifications: water, first year (FY)-ice, and multi-year (MY) ice, and demonstrated potential for relative surface height measurements over sea ice. An example one-week reflection surface type classification is shown by the maps generated by data from April 20-28, 2020. The sea ice coverages for both the northern hemisphere (NH) and southern hemisphere (SH) are in agreement with the NSIDC data over the same period. For the NH coverage, the distinction between FY-ice and MY-ice identified by the Spire data corresponds well with that defined by the NSIDC map where 0-1 and 1-2 year old ice appear to correspond to the FY-ice region identified by Spire L2 grzIce data. The retrievals are well distributed over the Arctic sea and in the areas surrounding the Antarctic. The retrieved sea ice surface heights are relative (bottom figure) due to the high noise level of the Spire measurements. The figure on the bottom compares the Spire retrieval with the IceSat-2 measurements over the same track. It is clear that the Spire data follows the same trend as that of the IceSat-2 but shows larger variations. Troposphere delay poses a significant error sources for the relative altimetry retrieval, especially for low elevation signals.



Left: Spire grazing angle specular reflection tracks color-coded according to coherent detection indicators to show water, first-year (FY) ice, and multi-year (MY) ice during the week of 4/22-4/28, 2020 in northern (NH) and southern (SH) hemisphere. Right: NSIDC data over the same period.



An example relative sea ice surface height retrieval using Spire data and comparison with IceSat-2 freeboard data.

# The use of Spire Level 2 Grazing Angle GNSS-R for sea ice presence and altimetry

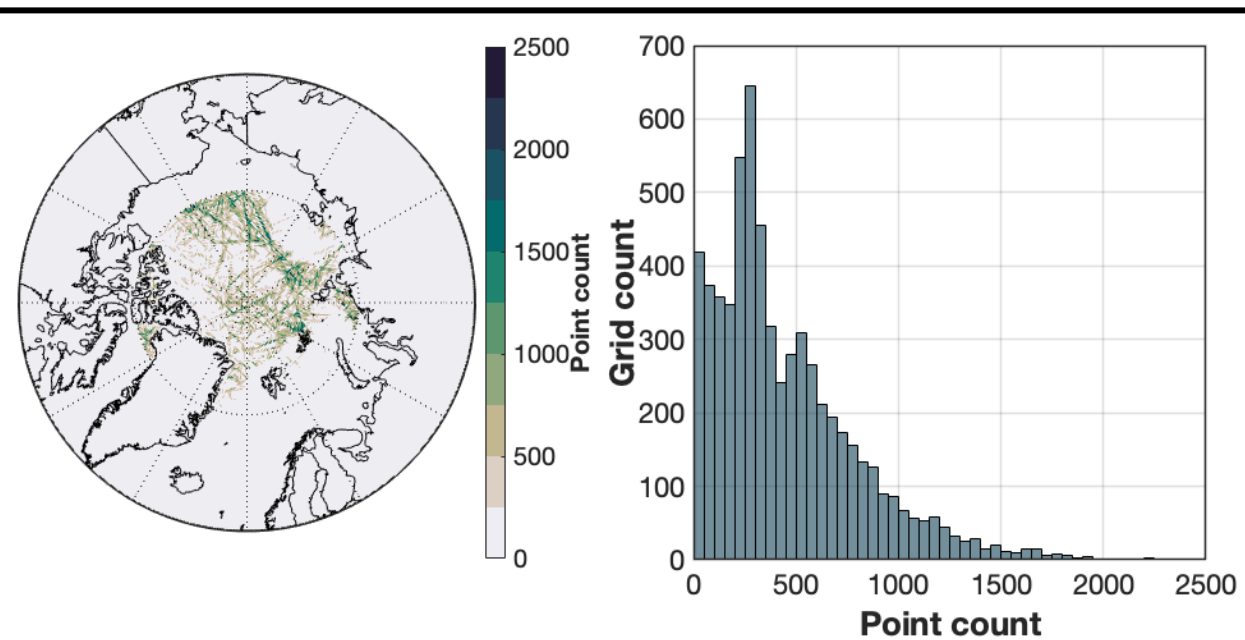
*Lauren Andrews, NASA Goddard Space Flight Center*

**Purpose:** Derive a high temporal resolution sea ice height product from the Spire Level 2 Grazing Angle sea ice presence and altimetry products in order to produce a sea ice height dataset at higher spatial and temporal resolution than from ICESat-2 and CryoSat-2 alone.

**Study Objective:** Evaluate the Spire Grazing Angle Altimetry product data quantity and quality to determine if a gridded product is feasible.

**Imagery:** Spire Level 2 Grazing Angle retrievals.

**Findings:** The Spire altimetry retrievals can provide extensive additional surface height measurements over the Arctic Ocean. Though coverage is variable, there are a high number of quality returns that are useful in the development of a gridded product (top figure). The nature of these retrievals generally ensure that the observations are well distributed within a chosen grid cell. However, the recorded heights are relative (bottom figure), thus require correction with absolute observations. Such correction is possible with laser or radar altimetry, though further work is needed to assess the number of cross-overs needed to maintain acceptable data accuracy. The Level 2 altimetry product can be used in conjunction with the Spire Level 2 sea ice presence product in order to ensure that the retrievals used for a sea ice height product accurately classify sea ice presence at the same resolution.



Spire grazing angle retrievals north of 75°N for 1-3 November 2020 gridded at 25km. The number of retrievals varies both spatially and temporally, but higher signal phase coherence over sea ice results in a higher number of returns in regions with extensive sea ice coverage.

Relative heights from 4 different acquisitions between 1-3 November 2020 for an arbitrary sea ice covered grid cell (above). Relative height differences can exceed 1m and require correction with an absolute height measurement.

