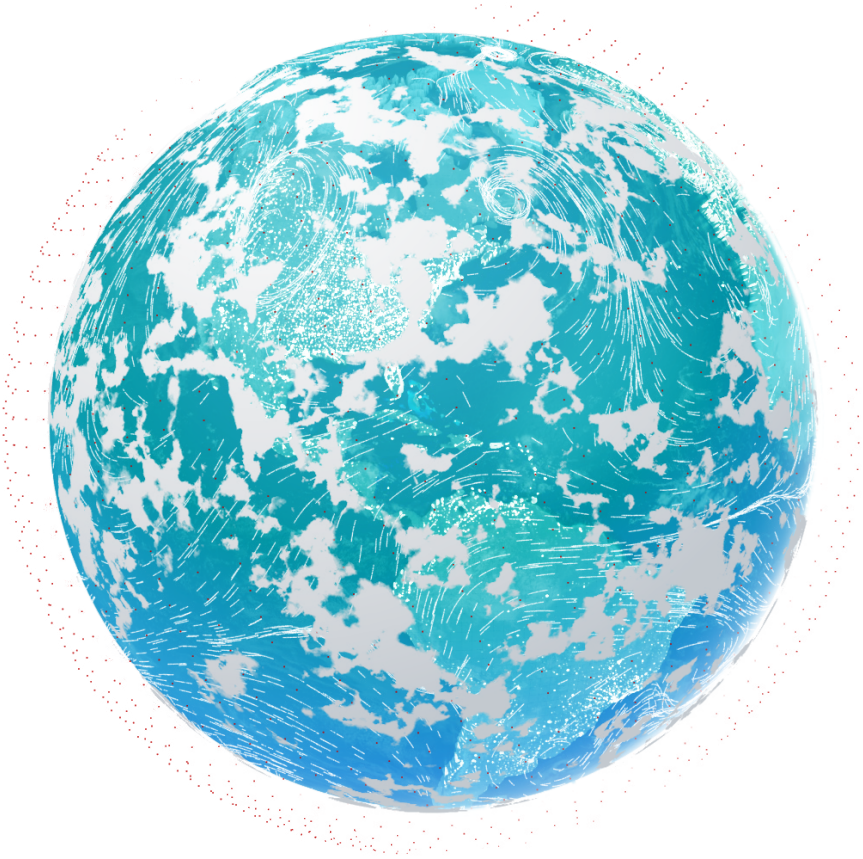
NASA CSDA Program

Frequently Asked Questions



Spire Global, Inc.

Frequently Asked Questions, NASA CSDA Program

1 MAR 2022

What types of data do Spire satellites collect and what data are being made available under this NASA Commercial Smallsat Data Acquisition (CSDA) Program?

Spire satellites primarily collect data using a science-grade, dual-frequency GNSS receiver. The Spire GNSS receiver collects both rising and setting radio occultation observations using fore and aft facing "RO" antennas. A third dual-frequency zenith antenna collects observations for precise orbit determination (POD). Typical RO data products include:

- Low-level 50 Hz data (opnGns format)
- Excess phase (atmPhs)
- Atmospheric profile (atmPrf and bfrPrf)
- Slant TEC (podTec)
- Ionospheric density profile (ionPrf)
- Raw GNSS pseudorange and phase measurements (podObs)
- Precise orbit determination (leoOrb)
- Scintillation indices (scnLv1)

Grazing angle GNSS reflections from the Earth's surface are also observed in the fore and aft RO antennas, generating a new type of GNSS-Reflectometry data. These observations include both the direct and reflected signals, which enable sea ice detection/classification and altimetry under conditions of coherent reflections. These data are derivations of and similar to traditional 50 Hz RO data.

A limited number of low-level, raw intermediate frequency (IF) data collected by both GNSS-RO satellites (for grazing angle reflections) and GNSS-R satellites are also available.

Each Spire satellite also collects attitude (leoAtt) and raw magnetometer data from the attitude determination and control system (ADCS).

New data types created by Spire will undergo evaluation by NASA prior to their inclusion into the CSDA Program Spire Data Catalog.

What is the time period of the data provided to the CSDA Program?

Spire is supplying data from 01 NOV 2019 through 17 MAY 2022. Select Spire data is available prior to 01 NOV 2019, but certain data types are limited. Please refer to the latest

Spire Data Product Catalog (available on the NASA CSDA Program website) for the latest on available Spire data types.

What are the characteristics of the Spire constellation?

Spire launches 3U and 6U satellites into a variety of orbits, including sun synchronous polar orbits with varying local time sampling and orbits of various inclinations (e.g., 83 deg, 51.6 deg (ISS), 37 deg). Orbit altitudes range from approximately 450 to 600 km. At any given time, many satellites are producing data and the satellites which are used in production vary over the course of the CSDA Program. The constellation produces over 10,000 RO profiles per day and over 2,000 grazing angle reflection arcs (an arc is about 3 to 5 minutes in length) each day using only a subset of the available satellites. As Spire continues to grow and expand their constellation, these data production values will grow.

Do the satellites and/or payloads change significantly over time?

Over the period of the CSDA Program, Spire satellite and payload configurations have not changed significantly. The chief exception is the addition of a larger solar array and a second RO antenna (where early satellites had only one RO antenna). A list of bus and payload changes is available upon request..

What is the geographic and temporal distribution of Spire data?

Due to the variety of satellite orbits, Spire data sample the entire Earth with varied temporal sampling.

What GNSS signals are used in RO and GNSS-R observations?

Spire produces RO using GPS, Galileo, GLONASS, and QZSS signals. Grazing angle reflections are currently produced using GPS, Galileo, and GLONASS signals. Raw IF data contain all signals observed by the antennas.

What applications can be addressed or studied with Spire data?

POD GNSS navigation data (e.g., RINEX or leoOrb):

- Estimation of LEO satellite drag and derivation of thermospheric density

- High-low ranging for satellite gravity and reference frame studies

RO data:

- Atmospheric soundings
- NWP data assimilation
- Ionospheric anomalies
- Space weather monitoring
- Climate monitoring

Grazing angle GNSS-R

- Sea surface altimetry (where coherent)
- Sea ice classification and detection