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THURSDAY, APRIL 4, 2019

TIMOTHY DULY

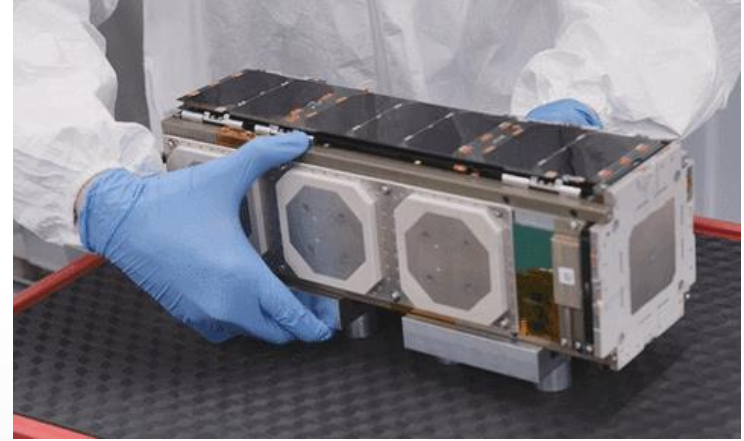
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# **OPPORTUNITIES WITH SPIRE'S GROWING GNSS RO/SPWX CUBESAT CONSTELLATION**



# SPIRE CUBESAT CONSTELLATION

Spire is a satellite and data analytics company, collecting and analyzing a wide range of remote sensing observations from **a growing constellation of 76 operating LEO 3U CubeSats**:



3U LEMUR CubeSat

## 1. GNSS

- a. Radio Occultation (RO)
- b. Ionosphere (**TEC, S4 indices**)
- c. Surface reflections (GNSS-R)

## 2. Hosted payloads / Custom

3. AIS (ship tracking)

4. ADS-B (airline tracking)

- **Collecting ~2,000 RO per day and growing each launch**
- Rising & setting occultations (**2 RO antennas**)

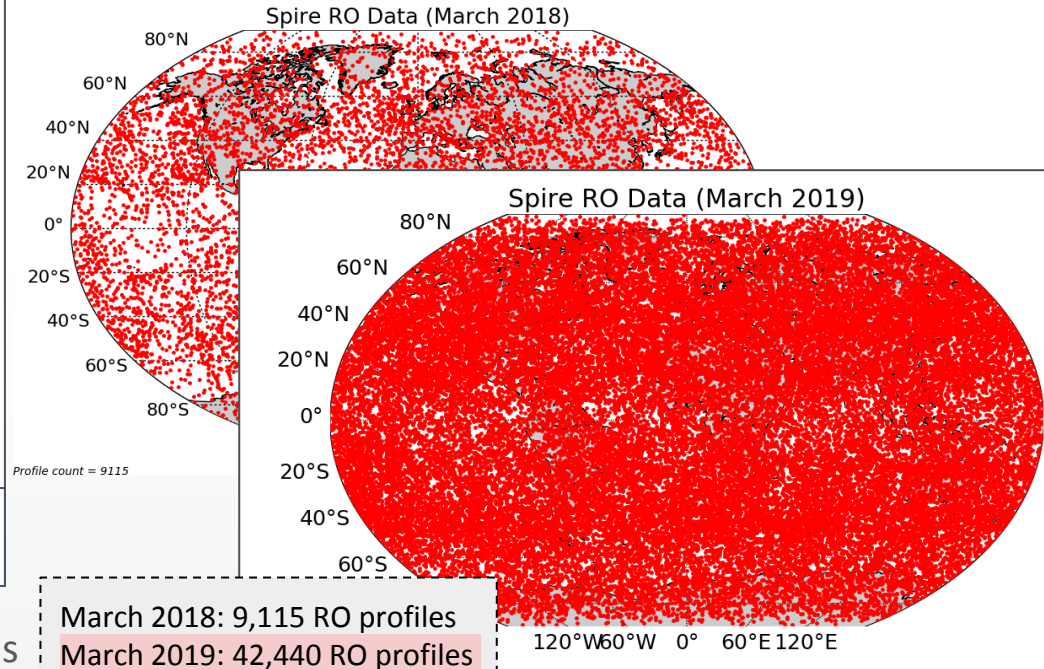
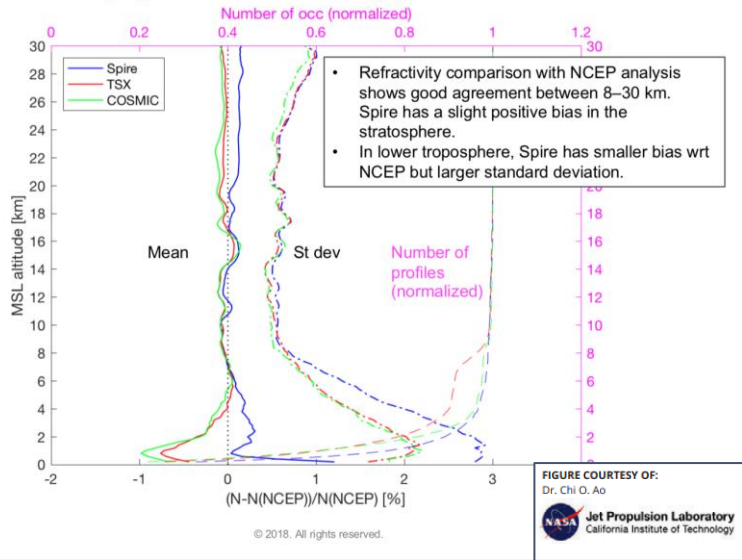
GNSS constellations tracked:

- GPS
- **GLONASS**
- **Galileo** (first commercial producer)
- **QZSS**
- **(BeiDou in 2019)**



# SPIRE GROWING DATA VOLUME

## Refractivity (Global, Monthly)



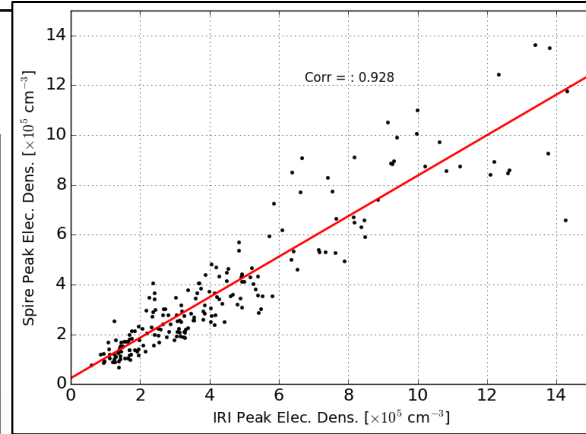
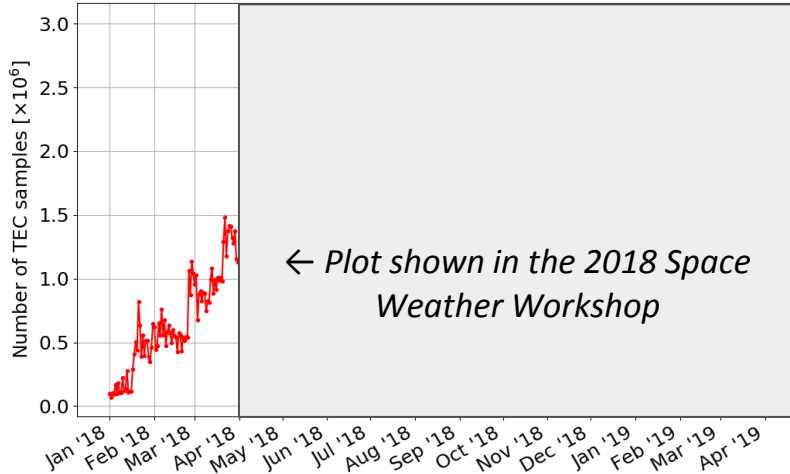
- Constellation planned of > 100 satellites
- RO performance equal to COSMIC-1 at fraction of the cost

- Ongoing data pilots with NOAA, NASA, USAF, UK Met Office, EUMETSAT and numerous SpWx customers



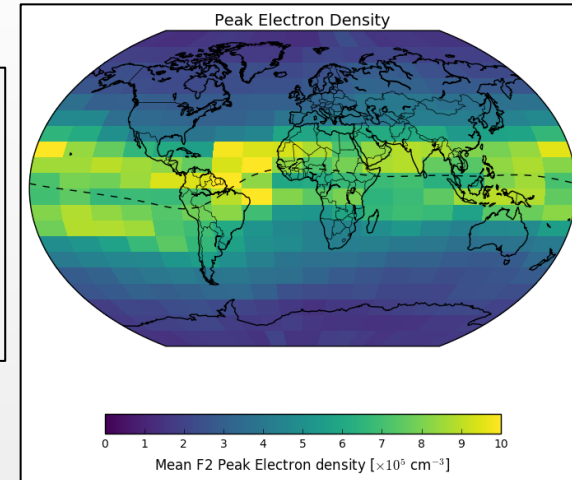
# TEC ANALYSIS STUDIES

Spire Daily TEC Data Volume



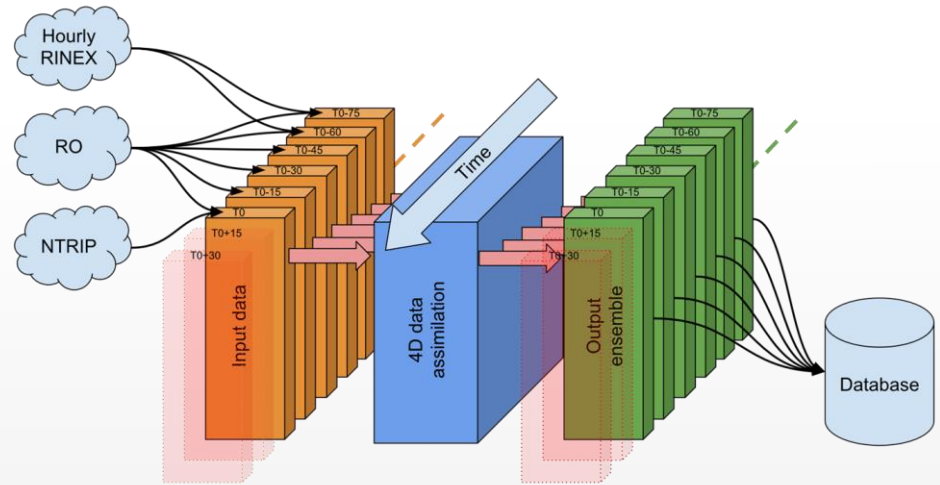
Developed software to produce electron density profiles from low elevation TEC values using Abel Inversion (Schreiner et al., 1999)

Mean peak ionospheric electron density over one month shows indication of Appleton anomaly



# SPIRE IONOSPHERIC MODELING

- Spire in-house ionospheric data assimilation modeling group headed by **Matthew Angling**
- Utilizes a 4D local ensemble transform Kalman Filter
- **Targeting real-time SpWx applications**
- See poster number "I3" for more information





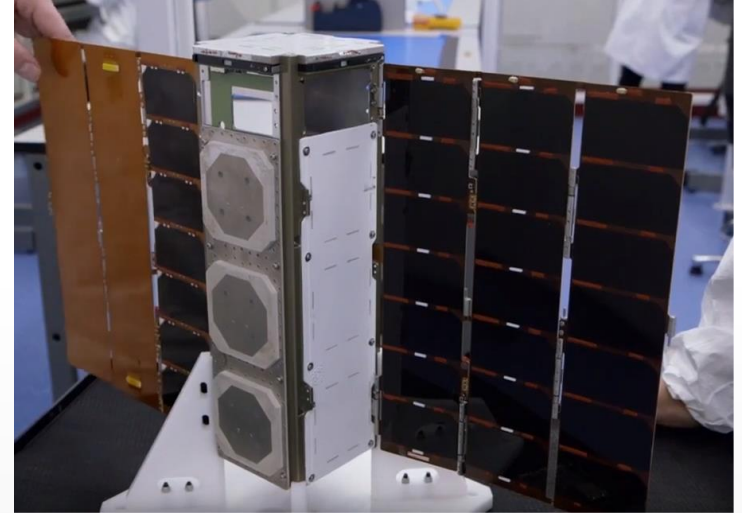
# DATA & PAYLOAD OPPORTUNITIES

Data available to researchers and operations via:

- Current NASA Bulk Purchase Agreement (BPA):
  - NASA PIs can request Spire RO/SpWx data  
*(contact Spire or your NASA PMs for info)*
- Data samples available upon direct request
- Near real-time access via cloud-based API

Spire is offering “Space-as-a-Service” for rapid, cost-effective R2O of hosted SpWx payloads

- 1U available or dedicated mission
- 6-12 months from idea to launch
- Launches every 6 weeks on average
- Pursuing energetic charged particle or other in situ SpWx sensors



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