

# GOES Data Collection System (DCS) RF Data as a Space Weather Data Source

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## What is DCS?

Since 1975 (GOES-1), NESDIS has managed the U.S. Data Collection System (DCS). DCS is a system consisting of in-situ data collection platforms (DCPs) that collect environmental information, transmit the data to NOAA GOES spacecraft over UHF, which then relays it back to Earth on L-band to NOAA and user direct readout ground stations. The system also supports platform commanding via a UHF downlink from GOES.

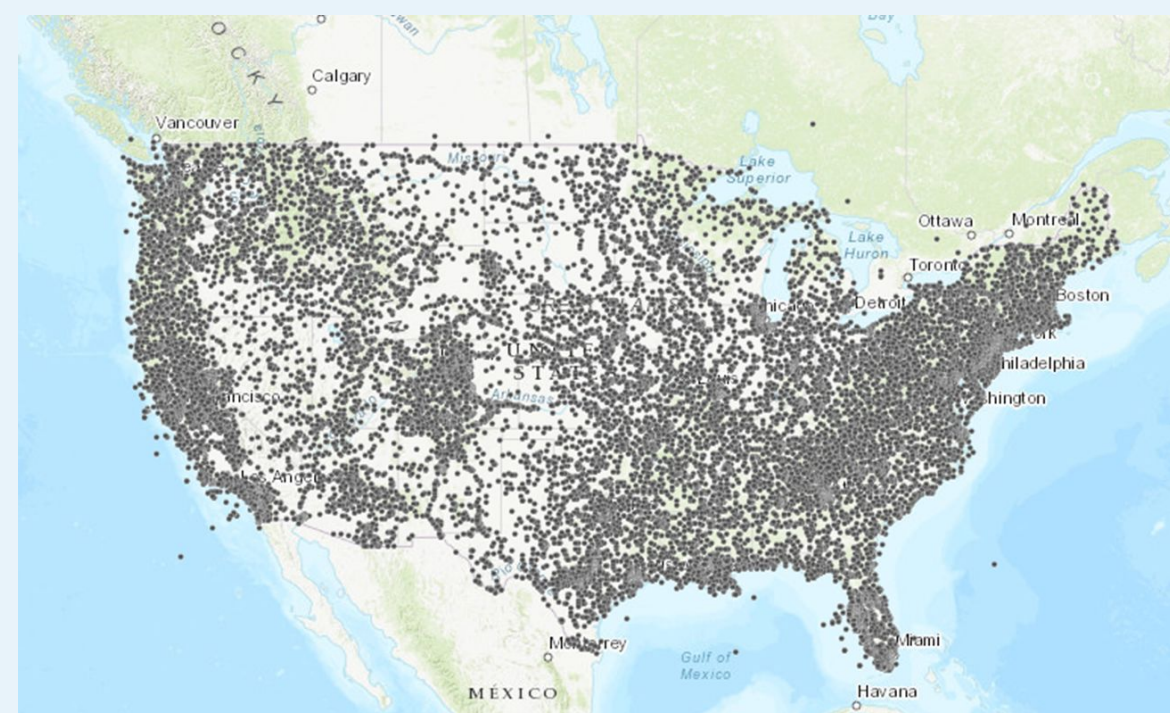
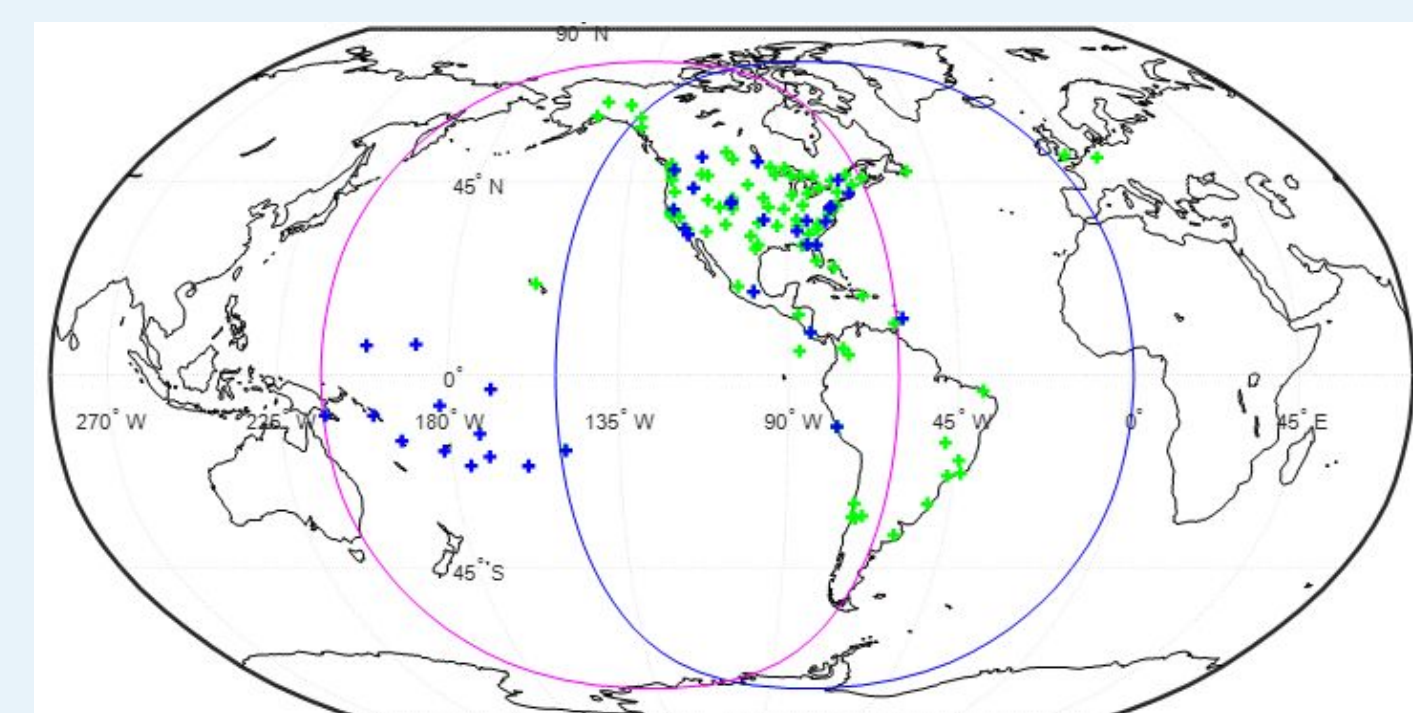
The DCS coverage area covers the majority of the Western Hemisphere with UHF receive/transmit and L-Band transmit supported down to a 5-degree elevation angle to each equatorial GOES East and West spacecraft.

## DCS Transmission Characteristics

- ~1 million messages per day
- Transmitters Meet NOAA Certification Requirements
  - 401.7-402.4 MHz Narrowband Channelized Transmissions
  - Nominal Channel BW: 750 Hz (300 bps) 2250 Hz (1200 bps)
  - EIRP: 37-41 dBm (300 bps); 43-47 dBm (1200 bps)
  - Timing Accuracy: Max 250ms deviation
  - Long Term Frequency Stability:  $\pm 125$  Hz (all conditions)
  - Short Term Frequency Stability:  $\pm 1$  Hz/s for 10ms - 110s
  - Short Duration Transmissions: 5-15 seconds, typically hourly
- Continuous Pilot Signal for Frequency & Amplitude Reference

Country Name	Active DCPs
US & Territories	22612
Canada	4596
Brazil	1522
Chile	781
Mexico	766

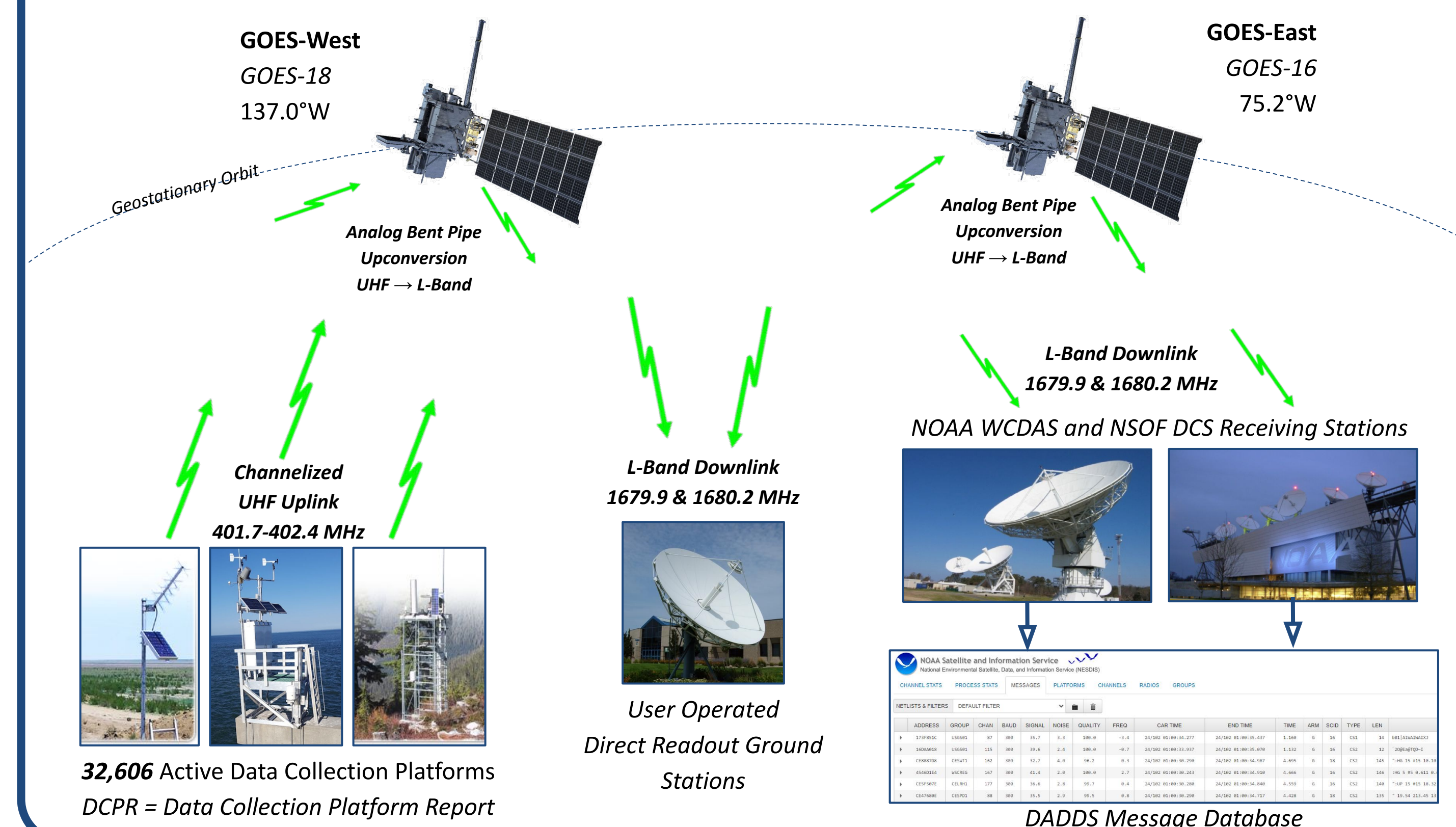
*Top 5 DCP Countries*



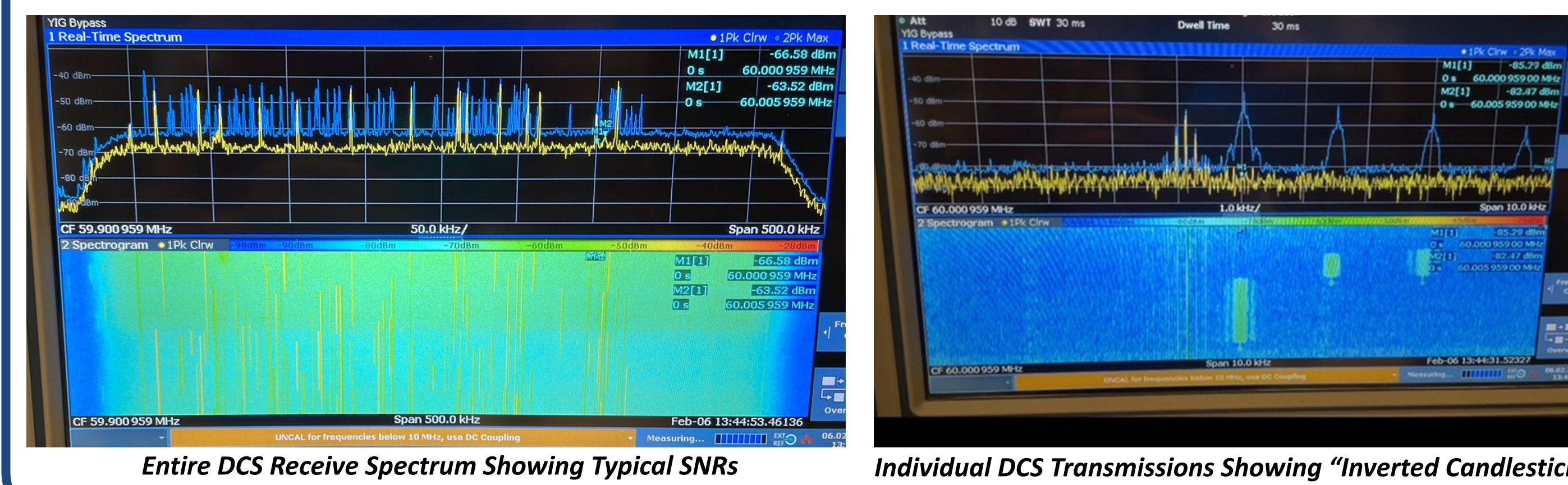
## DCS for Space Weather

- The GOES Data Collection System (DCS) could provide a new data source to support RF amplitude scintillation monitoring product by measuring DCS transmission signal & message characteristics (SNR, message loss, parity errors)
- Any DCP transmission could serve as a potential measurement path; Data is freely and openly available and will continue into the GeoXO era (2050s)
- DCP UHF transmissions could serve as an improved proxy compared to L-Band signals (i.e. GNSS) for VHF & HF scintillation effects to support future SWPC/ICAO aviation space weather product needs

## GOES DCS DCPR Architecture



## DCS Signal Receipt at NOAA



## DCS Administration & Data Distribution System

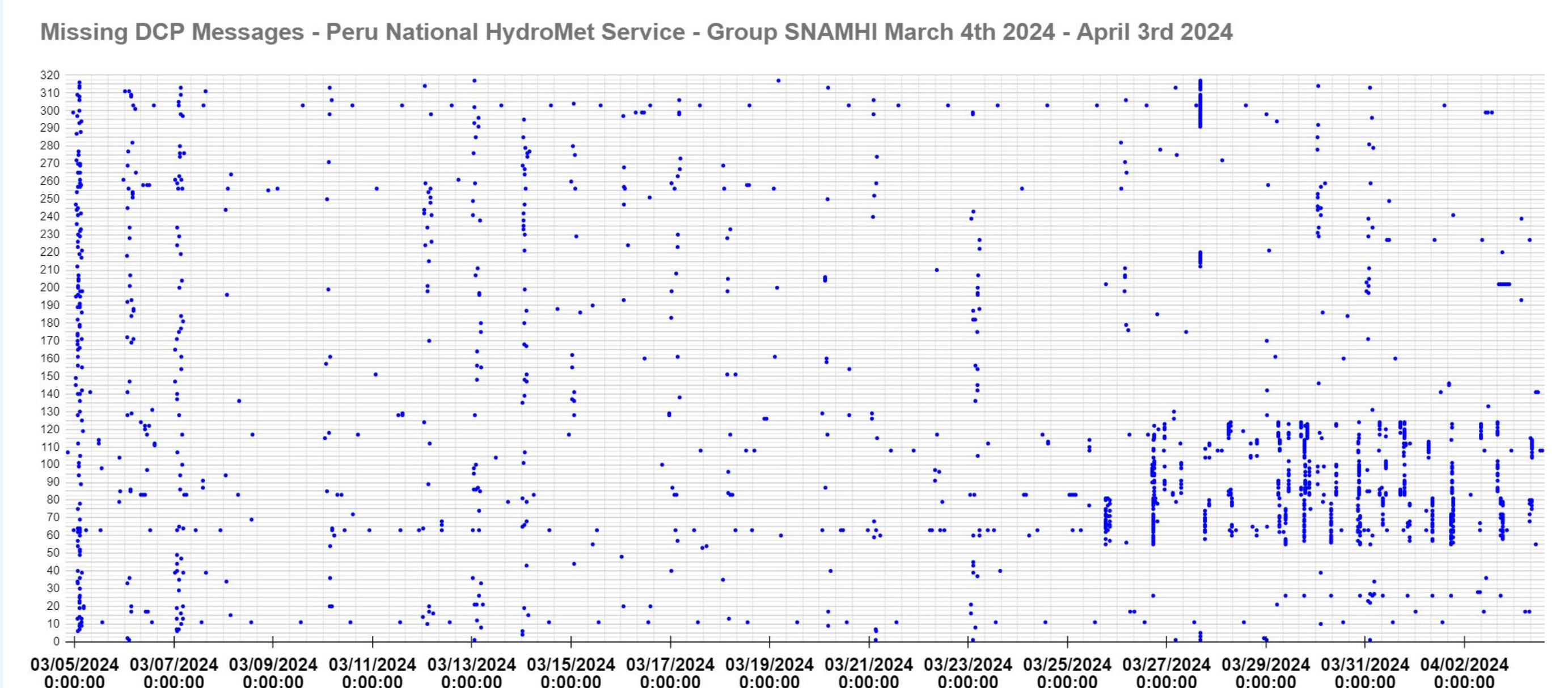
ADDRESS	GROUP	CHAN	BAUD	SIGNAL	NOISE	QUALITY	FREQ	CAR TIME	END TIME	TIME	ARM	SCID	TYPE	LEN
4721725E	SNAMHI	67	300	39.2	2.3	389.8	-8.1	24/281 00:18:00.328	24/281 00:18:04.527	4.287	G	16	CS2	327
4721725E	SNAMHI	67	300	39.8	2.5	39.8	-1.8	24/281 22:18:00.387	24/281 22:18:04.527	4.222	G	16	CS2	327
4721725E	SNAMHI	67	300	39.8	2.2	389.8	-3.0	24/281 22:18:00.133	24/281 22:18:04.527	4.233	G	16	CS2	327
4721725E	SNAMHI	67	300	41.2	2.2	389.8	-4.5	24/281 22:18:00.133	24/281 22:18:04.527	4.234	G	16	CS2	327
4721725E	SNAMHI	67	300	41.5	2.1	389.8	-4.8	24/281 20:18:00.800	24/281 20:18:04.527	5.000	H	8	N/A	369
4721725E	SNAMHI	67	300	41.1	2.0	389.8	-5.0	24/281 18:18:00.293	24/281 18:18:04.527	4.234	G	16	CS2	327

DCS Administration and Data Distribution System (DADDS) illustrating "Good" and "Missed" message statistics. DADDS will also report parity errors, timing errors, and other message and signal characteristics.

## DCS Message Dataset Example

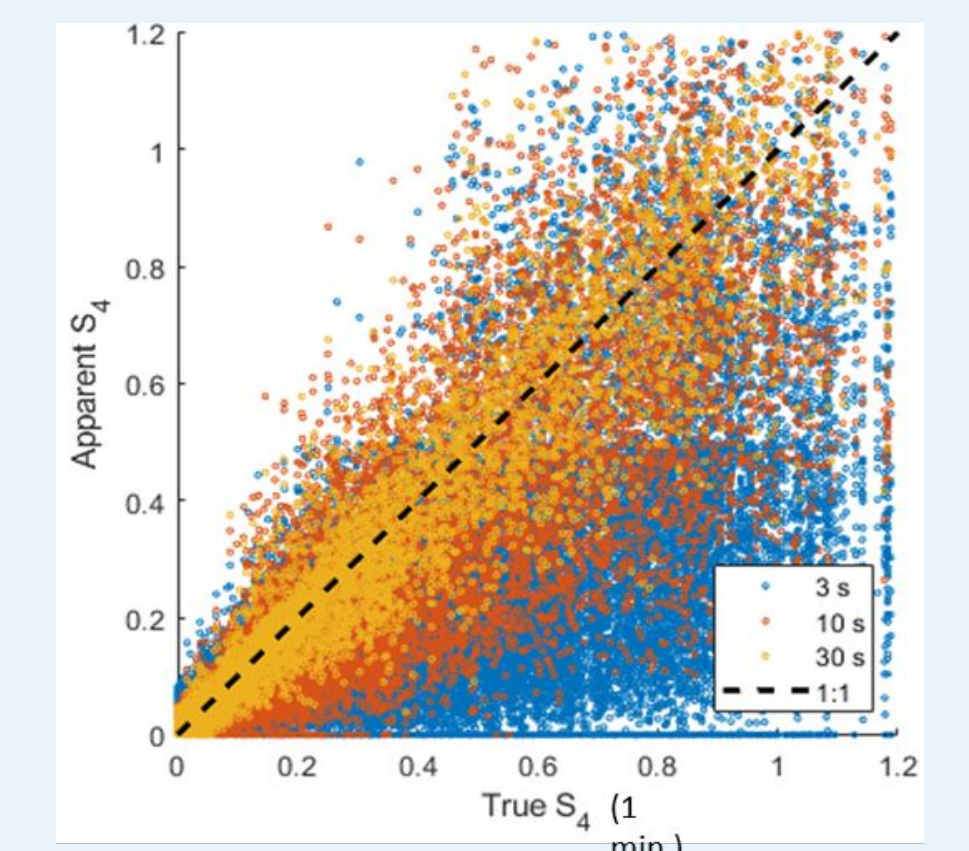
**Peru's SERVICIO NACIONAL DE METEOROLOGIA E HIDROLOGIA SENAMHI (Peruvian HydroMet Service)**

- > 300 DCPs Across Peru → 317 Pulled for Example
- March 4th - April 3rd 2024
  - 253388 Total Messages (5-10 Second Transmissions)
  - 7949 Missed Messages (Message Not Received)
    - Removed platform malfunctions → 1393 missed messages
- Plots show potential patterns visible in message statistic data
  - Platform IDs are not geographically ordered in plots
  - Parity error plots (not shown) illustrate similar patterns



## Challenges & Opportunities

- Short nature of DCS transmissions poses challenge for correlating apparent DCS signal scintillation to True amplitude scintillation effects ( $S_4$ )
  - May be overcome by temporal & spatial density of transmissions or new analytical methodologies
- GOES 'Bent Pipe' may complicate transmission to measurement correlations
  - Spacecraft telemetry & additional test data may help ground assumptions
- Other GOES RF 'Datasets of Opportunity' May Exist Beyond DCPR
  - DCS Commanding: Fixed Gain Hemispherical UHF (468 MHz) Transmission
    - Receiver is under development; Could consider monitoring functionality
  - L-Band Hemispherical Broadcasts for DCS, GOES Rebroadcast (GRB) and HRIT/EMWIN



Apparent vs. True  $S_4$  w.r.t. Transmission Length (Provided by Boston College Institute for Scientific Research - T. Beach 2024)

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