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# USDA-NRCS Snow Survey and Water Supply Forecasting Program

## SSWSFP Program and GOES Telemetry Upgrade Overview


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# Snow Survey and Water Supply Forecasting Program – Telemetry Update Review

**What is the Snow Survey and Water Supply Forecasting Program's (SSWSFP) Network Composed Of?**

- The USDA-NRCS SSWSFP operates a network of over 1200 weather stations across the United States.
- There are 3 primary weather station types operated:
  - SNOwpack TELemetry (SNOTEL): 900 stations
  - SNOLITE: 47 stations
  - Soil Climate Analysis Network (SCAN): 212 stations
- Data from these weather stations is used operationally by forecasters and water managers across the country to monitor and forecast water supply driven by snowmelt runoff and mountain precipitation.
- Data is telemetered hourly from weather stations utilizing GOES, Iridium, and cellular communications.

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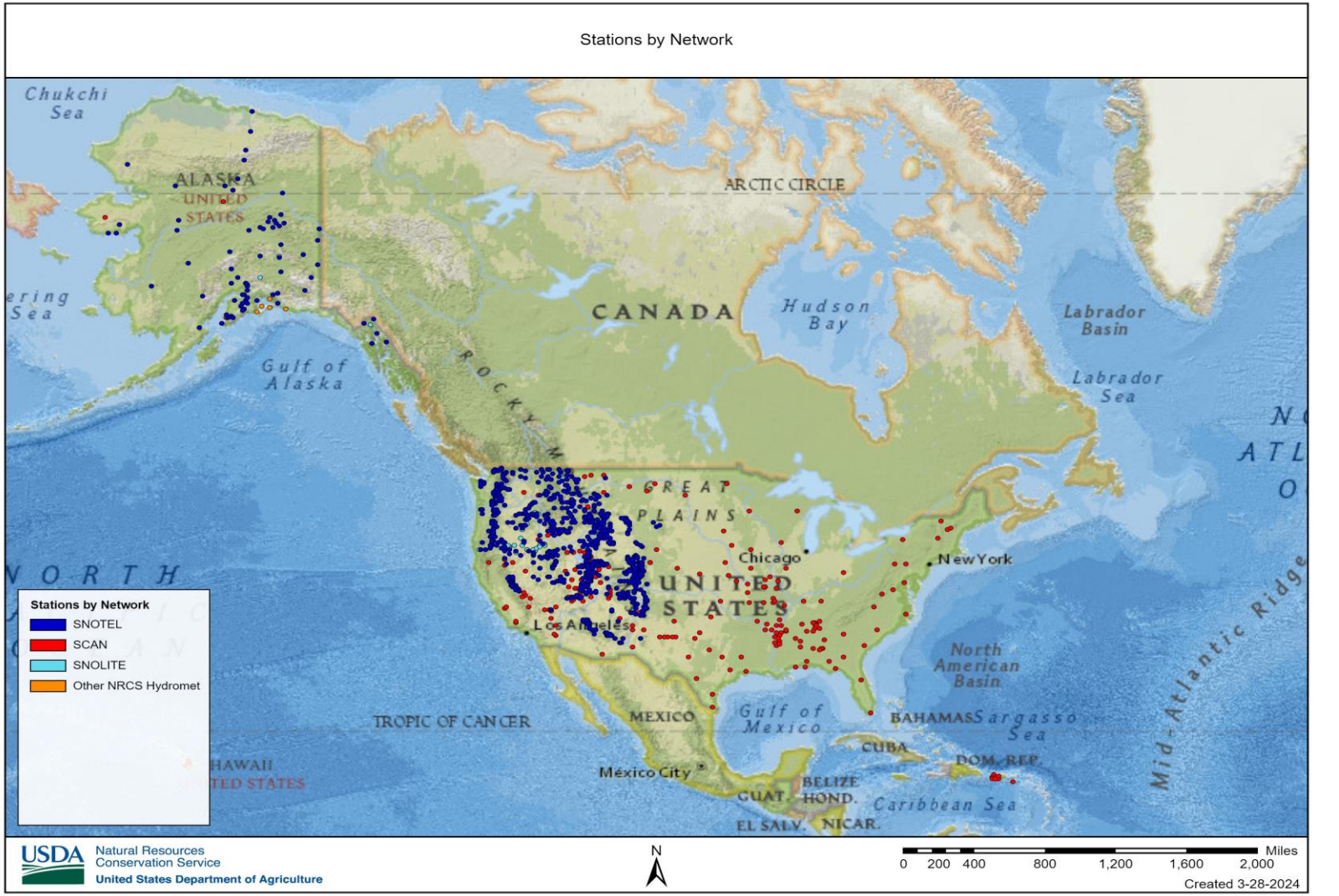

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## SNOTEL Telemetry History

- Initial communications (early 1960's) with mountain stations was done using line-of-sight radios and repeaters. Data was collected individually by the local Data Collection Office (DCO) and stored locally for regional forecasting.
- The first true system-wide telemetry utilized by the SSWSFP was MeteorBurst communications. Development of this system began in the early 1960's with the first Meteorburst radios coming online in 1969.
- To start, each station transmitted data daily from mountain locations and collected in a centralized database.
- The network consisted of slave radios at each weather stations, with master stations located across the Western U.S. and Alaska.
- In the early 2010's the license held by MCC was sold to Burlington Northern Santa Fe, ending support for radio development by the primary supplier. A solution was needed.

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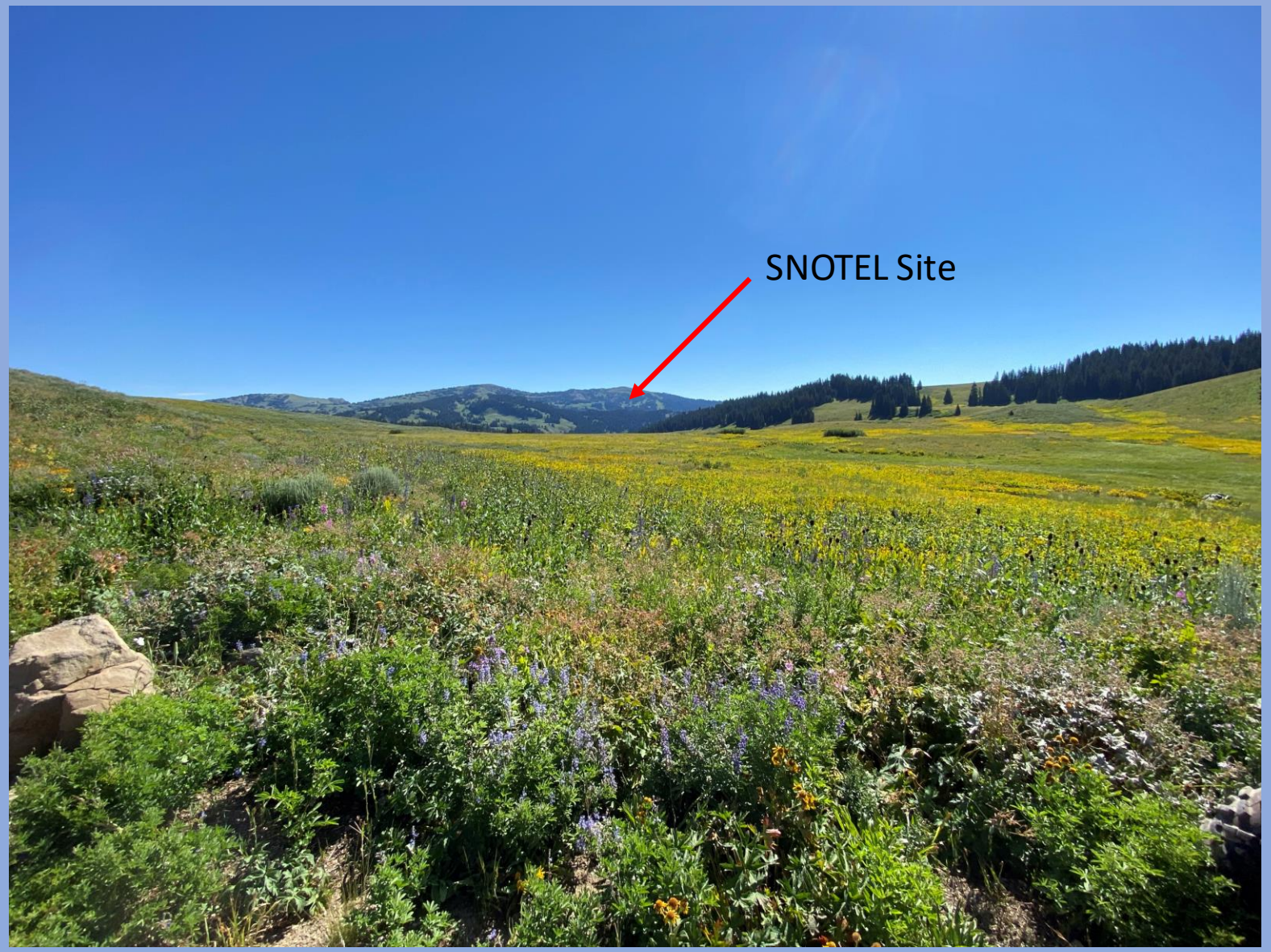

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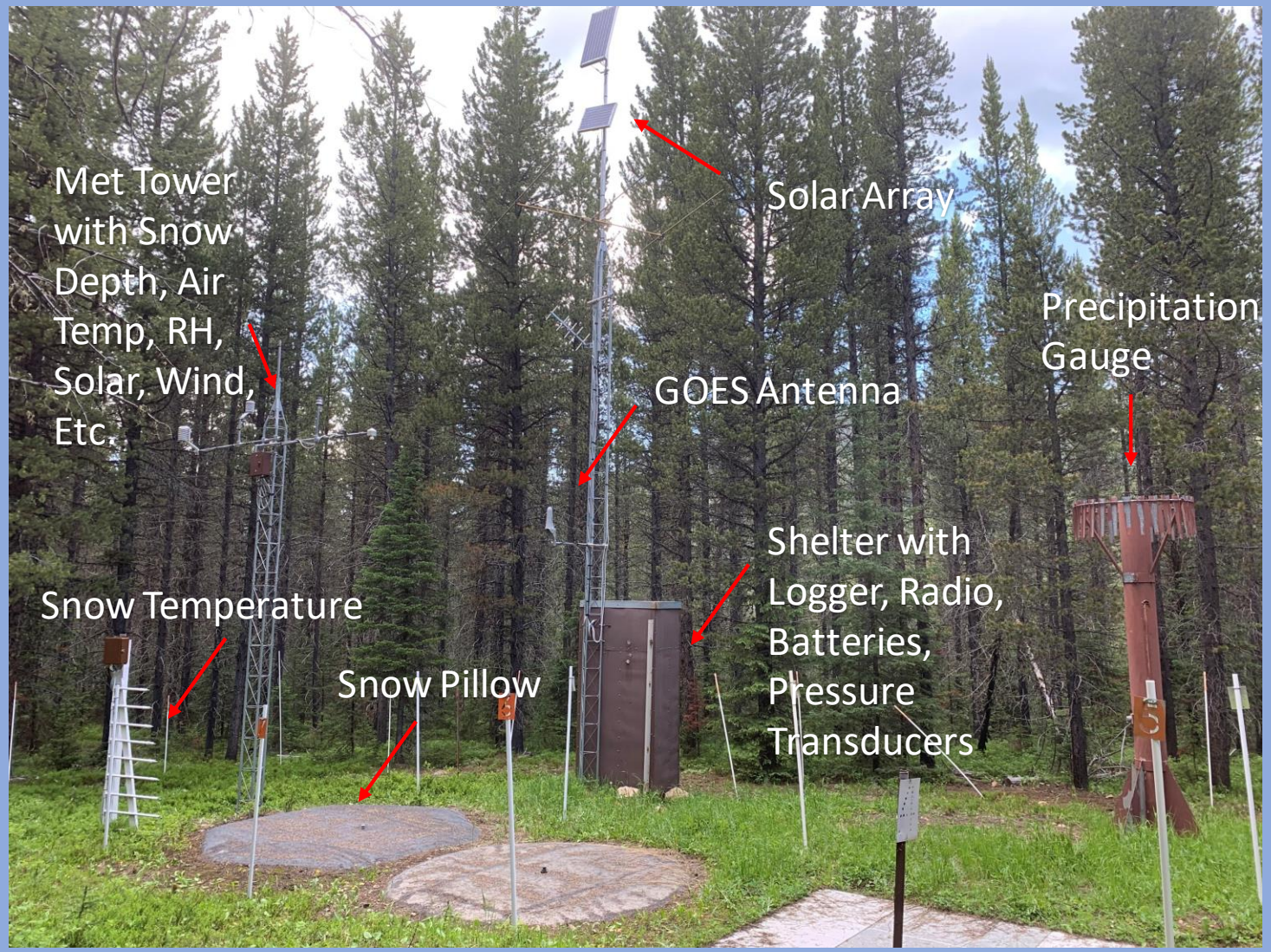

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**Telemetry transition timeline**

- **Early 2000's through Mid-2010s** - Data Collection Offices began looking into alternative telemetry methods which could replace Meteorburst. GOES decode Python script written, converted to Java for ingestion via NOAA DCS.
- **2010** - First GOES installs at 3 SCAN weather stations, and 2 SNOLITE stations in Montana. Mixed performance with equipment selected.
- **2010 to 2018** – Continued program R&D on new telemetries. Cell modems made available which worked within power requirements, Iridium installed at some remote sites.
- **2018** – Montana Data Collection Office deploys new dataloggers with Campbell TX321 GOES radios at 28 sites as a beta test.
- **2019 to 2020** – Beta Test in MT is successful. All stations in MT converted to cell, where available (<20 sites), and GOES elsewhere.
- **2020** – Work with Developer Team and Cove Software integrates a sub-component of OpenDCS (Decodes) into existing data acquisition structure.
- **2020 to 2023** – Remainder of Data Collection Offices make the move to alternate telemetry. GOES is now the primary telemetry method used in the SSWSFP.
- **2023/2024** – Demo completed of Meteorburst Master Stations.

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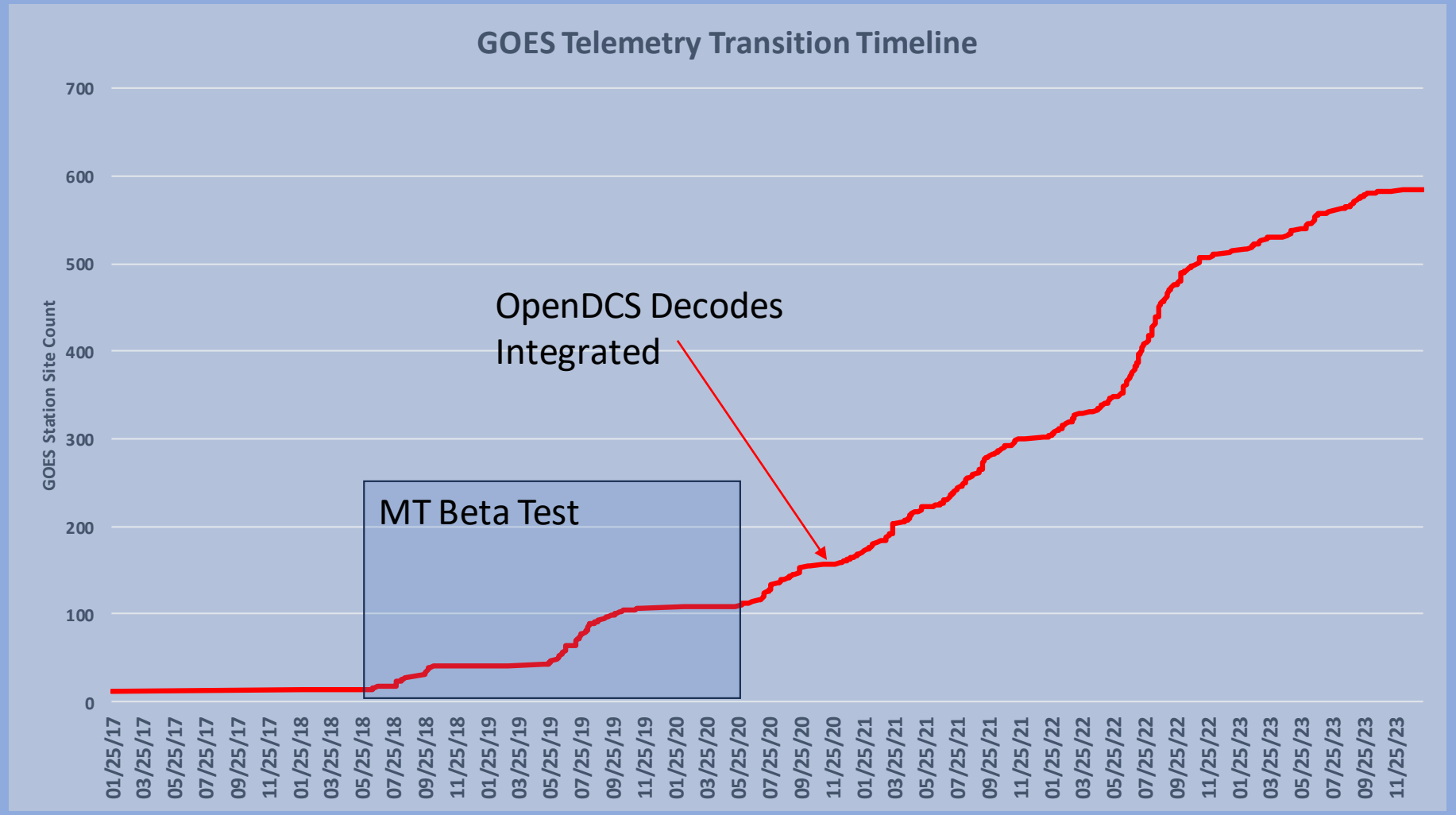

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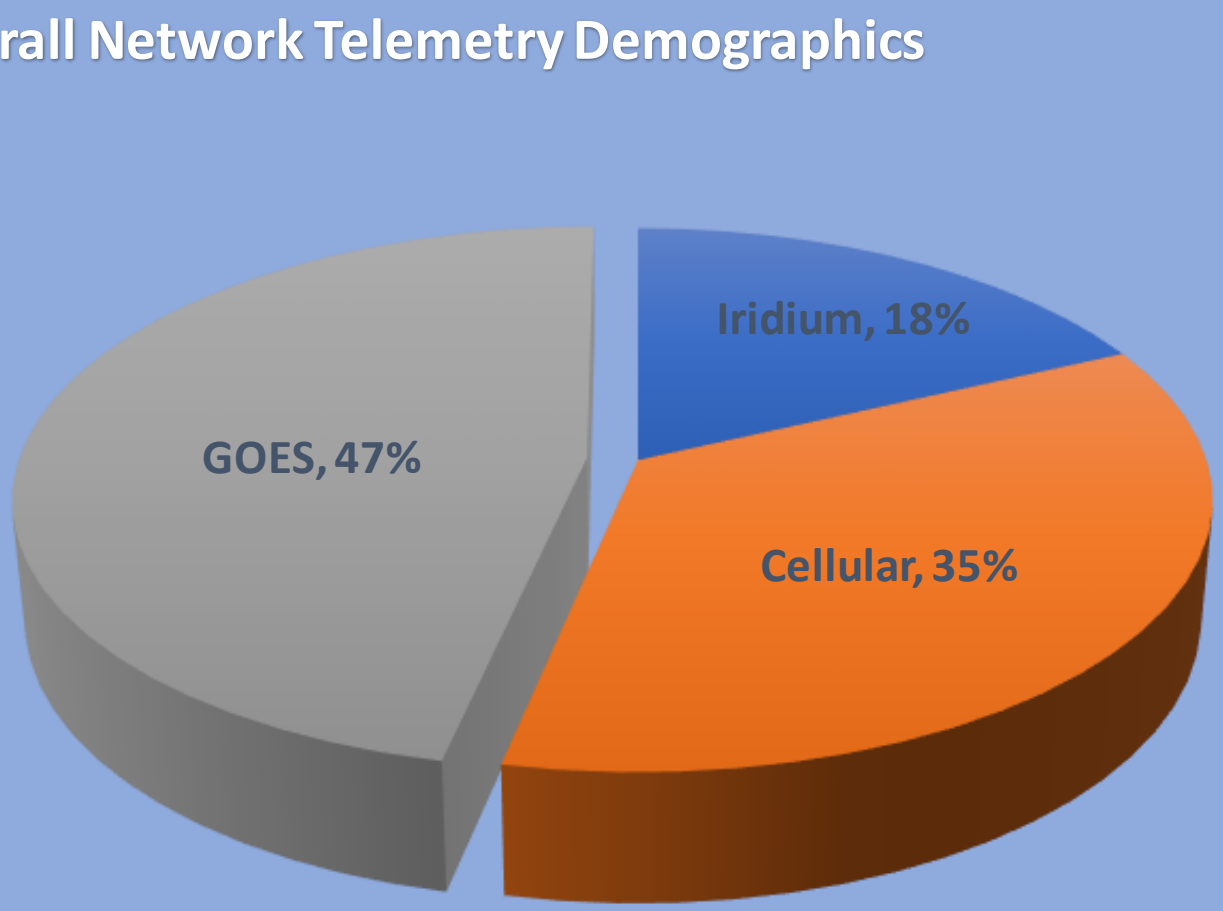

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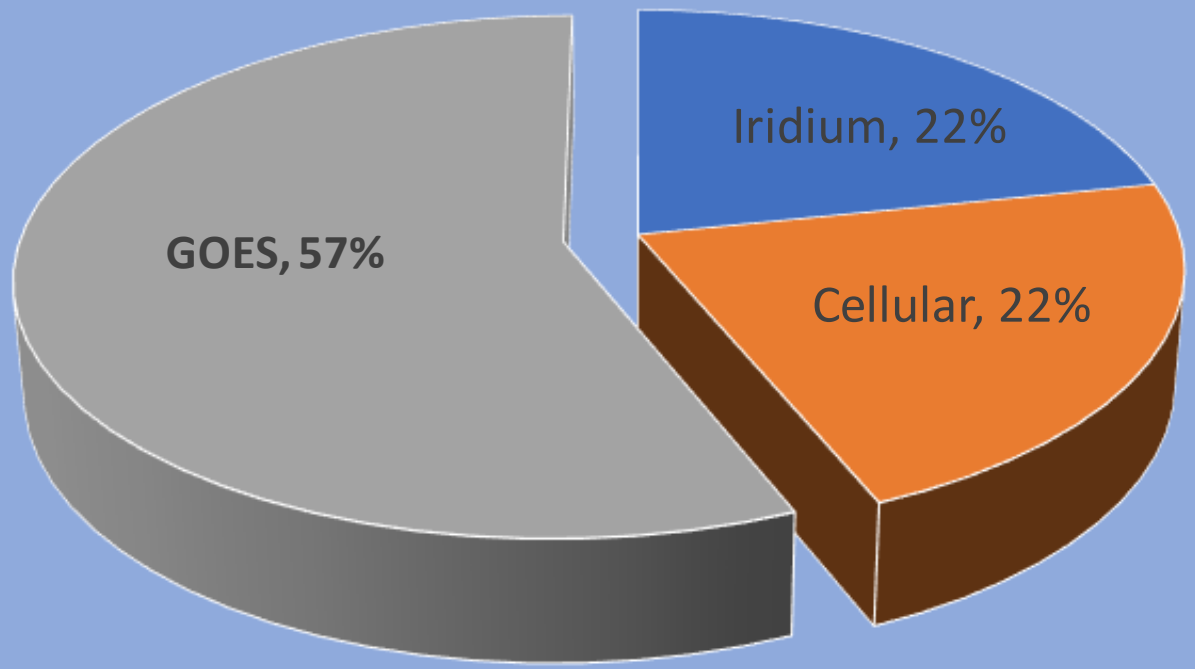

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## Equipment Use Overview

### Current Radios Deployed

- Campbell TX320/321
- Sutron Satlink 3 XMTR (Transmitter Only)

### Current Antennas Used

- High-Gain Directional Yagi (+11dB Gain)
- High-Gain GPS Antenna
- Sutron 2:1 Geo-Satellite Antenna

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## Data Telemetered

### Current Data Transmission

- Data is sent via 300 baud with a ten second window.
- Some R&D Platforms and SNOTEL "Supersites" utilize 1200 baud transmissions and a ten second window due to data size requirements.
- One to Five hours of data can be sent in each message via 300bd/10s, depending on number of channels/sensors.
- Data is sent in CSI FP2 16-Bit Floating Point format for maximum compression. 3 bytes per value/channel sent.

Llama Removing the Mt. Haggin (MT) Repeater

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## ID Management

- DCP IDs are managed by the USDA-NRCS National Water and Climate Center's Water and Climate Monitoring (WCM) Branch for the SSWSFP under agreement with NOAA.
- The WCM staff request all IDs from NOAA on behalf of the basin-level Data Collection Offices on an as-needed basis.
- DCO staff are required to input the needed metadata metrics when requesting IDs so that Platform Data Tables can be updated bi-annually.
- As of 2023, all PDTs are updated with required information – SHEF codes were added for all active DCPs.
- If errors, or conflict occurs, the WCM staff will intervene with the responsible parties and remedy the situation as quickly as is feasible.

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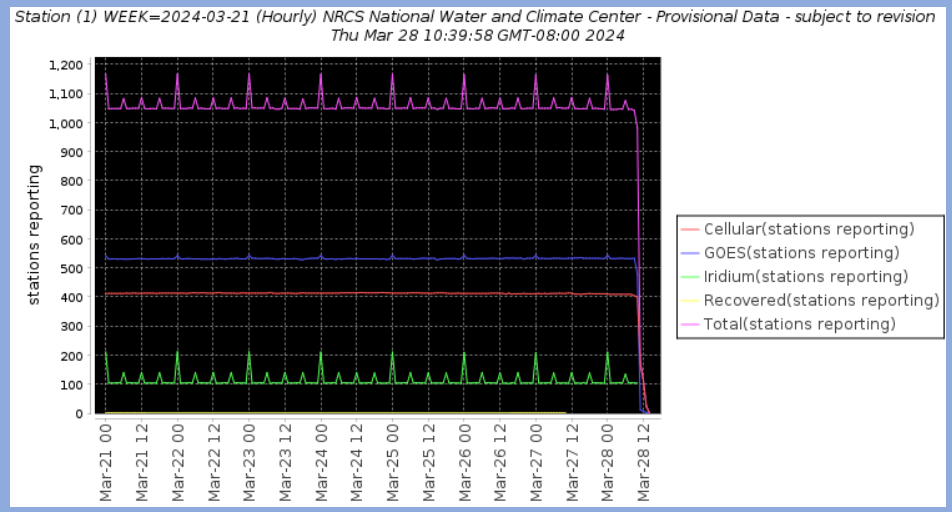
## Site Monitoring

- The SSWSFP data stream is monitored 7 days a week by SSWSFP Duty Officers using in-house tools.




- GOES data stream issues have been minimal but have generally been resolved by changing the source to backups (CDABACKUP or EDDN). No data (if present in servers) has been lost since implementation in SNOTEL

  ****This does NOT cover missing transmissions

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## Major Telemetry Upgrade – Lessons Learned

- The GOES System has proven to be incredibly reliable for transmission of critical mountain snowpack and meteorological data. It is much more reliable, and less power hungry than the legacy Meteorburst Communications previously used.
- The Decodes portion of OpenDCS has suited our needs well, but as options of direct importing of Iridium data is explored (currently done through a 3rd party), a more complete version, or more sub-components, of OpenDCS may be integrated.
- A network-wide upgrade can be challenging. Close coordination was needed during 2021 to 2023 to ensure there were no issues which could impact other DCS users. On some days, up to six sites were being added to the network per day. Overall, it was a major success with only 1 significant issue – which was technician error.
- Operating in mountain environments with heavy snowfall can prove challenging. High-gain directional antennas, with exposed elements, have proven unreliable during the winter due to snow load signal attenuation.
- Multi-hour transmissions, and different antennas, have helped to solve some of the signal attenuation issues and has improved the hourly reporting at trouble sites, yielding more serially complete records.

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## Questions?

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