Reception of GOES-East Satellite Services: HRIT and GRB

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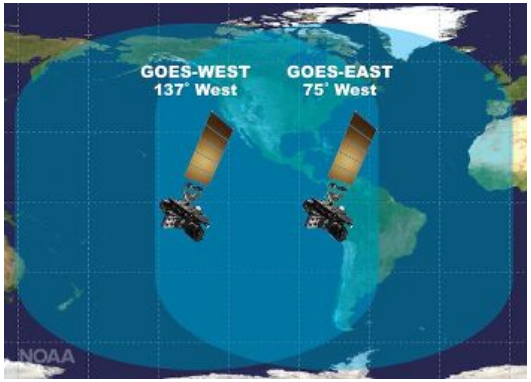
- HRIT Reception
- GRB Reception
- Conclusion and Future Work

Introduction

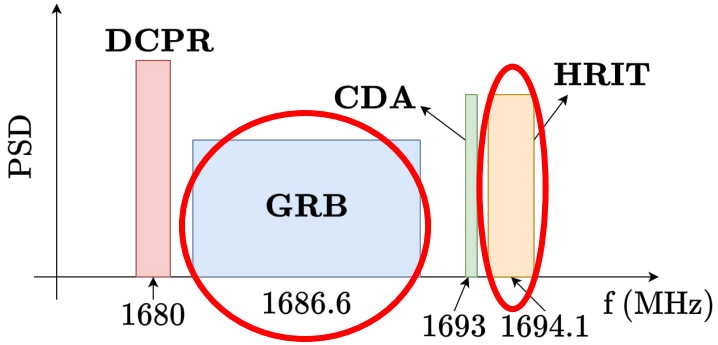
GOES Satellites

- Operated by NOAA.
- Two active satellites: **GOES-East** and GOES-West.
- Provide continuous monitoring of Earth's atmosphere, oceans, and environment.



Data Access

- There are three main ways to access GOES data:
  - Internet → via AWS.
  - Satellite rebroadcasts → through GEONETCast Americas.
  - Direct reception → from GOES-East using **HRIT** or **GRB**.



Introduction

Software-Defined Radio (SDR)

- Advantages:
  - Flexible and cost-effective alternative to proprietary systems.
  - Enables greater autonomy and adaptability.
- The implemented systems are SDR-based.

SatDump

- Open-source software for satellite data processing.
  - Compatible with a wide range of SDR devices.
  - Supports satellite broadcast decoding (with **GNU Radio** integration in some cases).
  - Provides tools for product generation and data manipulation.

HRIT Reception

High Rate Information Transmission (HRIT)

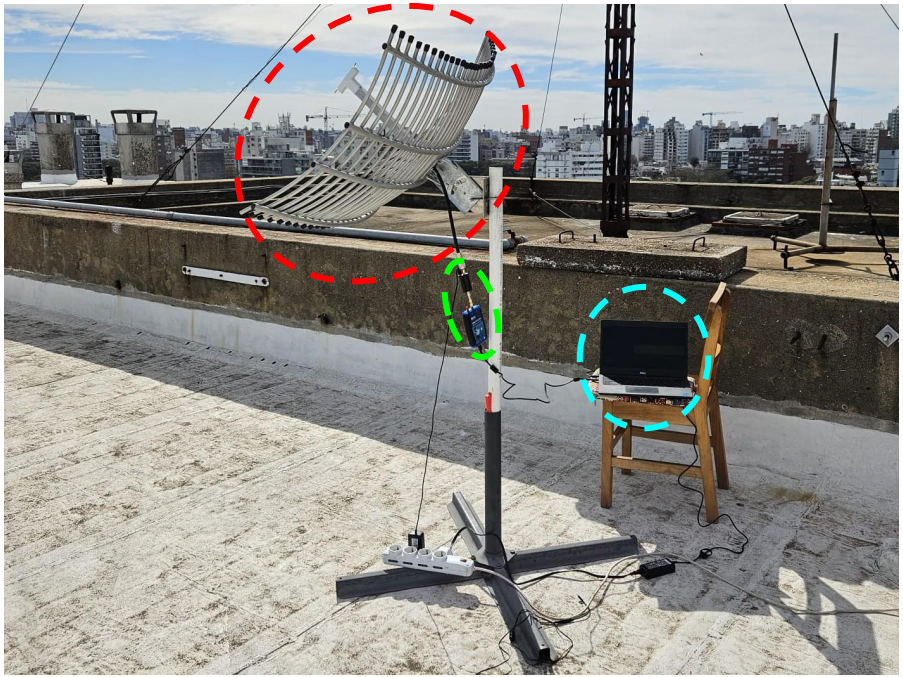
- Provides accessible alerts and forecasts with modest reception requirements.

Broadcast Characteristics:

- Frequency: 1694.1 MHz, Vertical Polarization.
- Bandwidth: 1.205 MHz.
- Constellation: BPSK.

Reception System

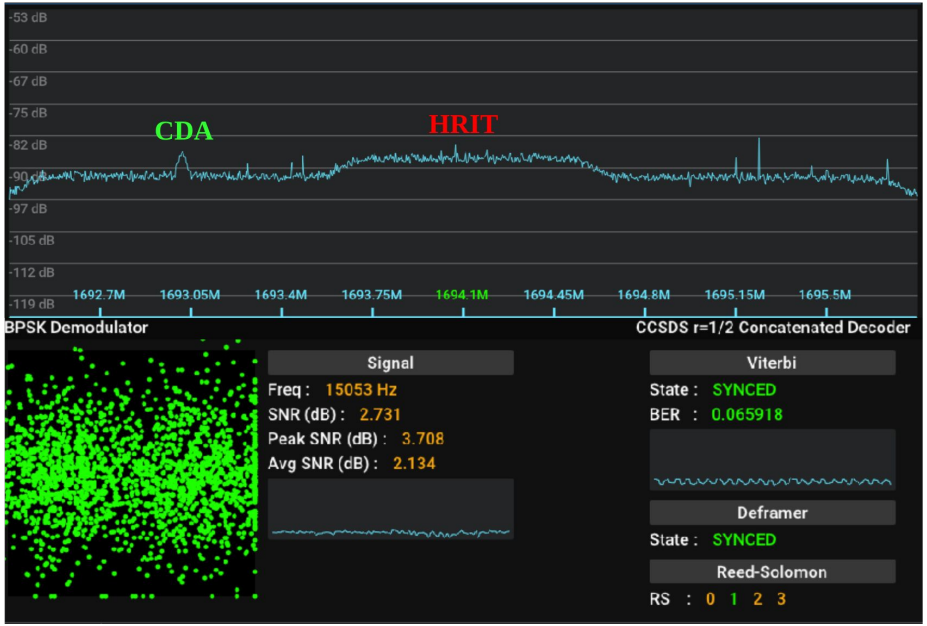
- Repurposed Wi-Fi antenna.
- LNA + bandpass filter (Nooelec SAWbird+).
- SDR: ADALM-Pluto.
- Software: SatDump on laptop.
- Link margin: **0.39 dB**.



HRIT Reception

Product Examples and Reception Results

- **SatDump** was used for data decoding and product generation



GRB Reception

GOES Rebroadcast (GRB)

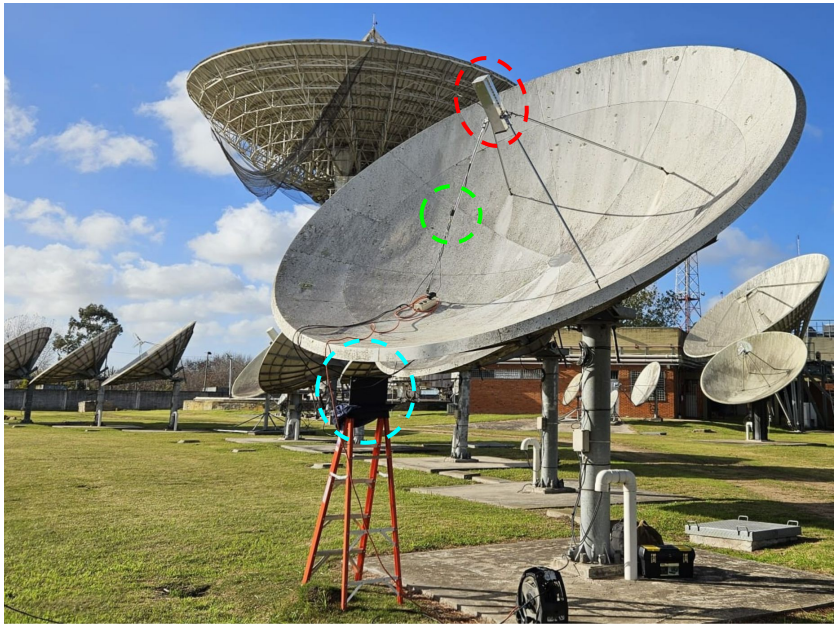
- Delivers the full GOES-East dataset.
- Designed mainly for institutional use → requires more complex infrastructure than HRIT.

Broadcast Characteristics:

- Frequency: 1686.6 MHz.
- Bandwidth: 10.9 MHz.
- Constellation: QPSK (using DVB-S2).

Reception System

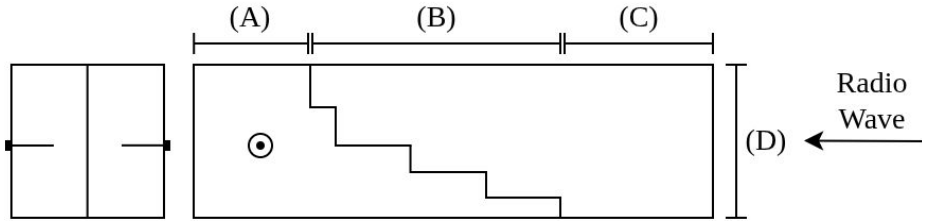
- 3.9 m parabolic dish.
- Custom-built Septum Feed.
- LNA + bandpass filter (Nooelec SAWbird+).
- SDR: USRP B200mini.
- Software: SatDump on laptop.
- Link margin: **4.77 dB**.

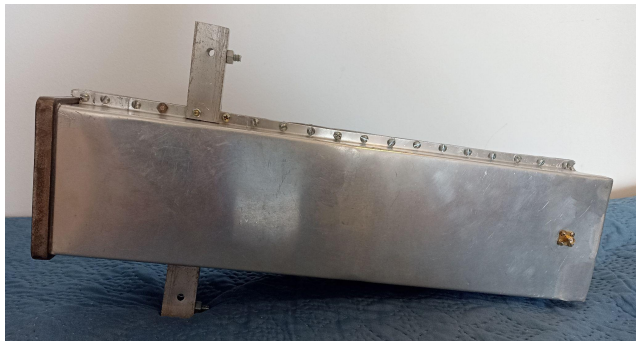


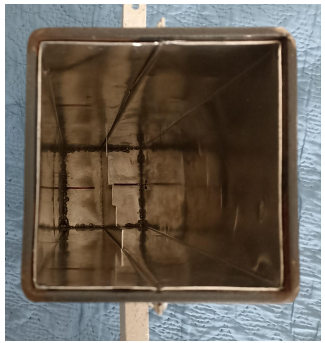
GRB Reception

Septum Feed

- The GRB broadcast uses two signals with opposite polarizations: LHCP and RHCP.
- An antenna feed capable of receiving both is required → **Septum Feed**.
- Septum Feed **prototype issues**:
  - Radiator asymmetry → Corrected by adding “mouth” structure.
  - Misaligned polarizer screws → New polarizer built with precise alignment.



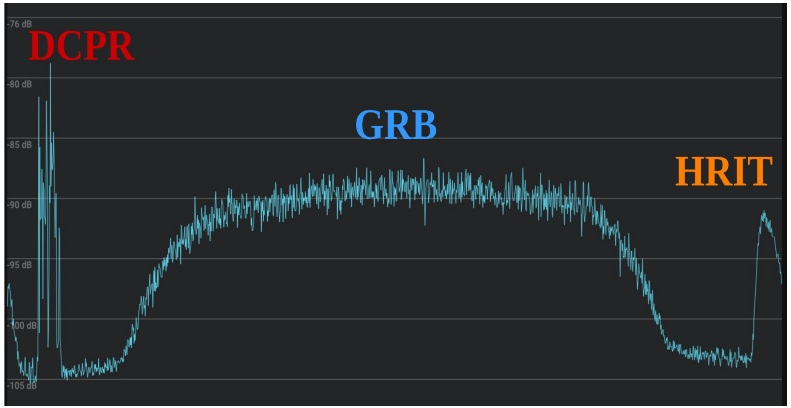


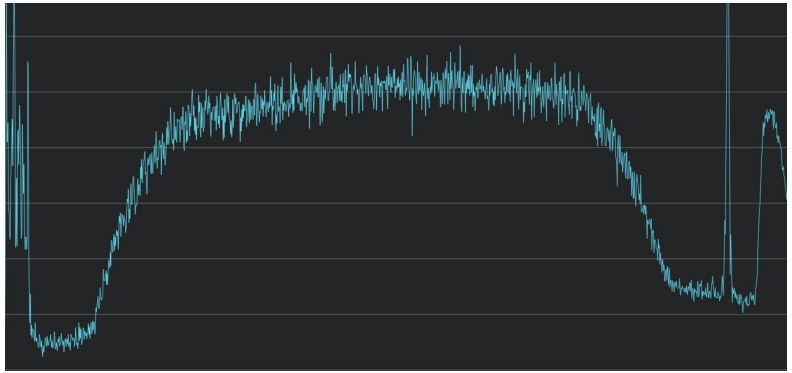


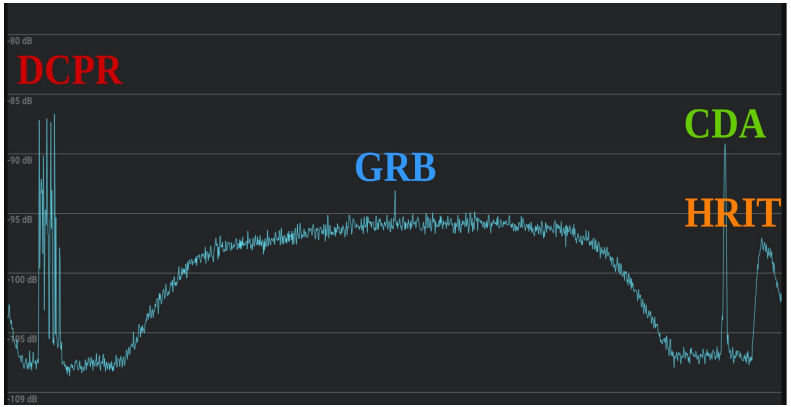
GRB Reception

System Mounting

- Initial **low SNR** due to asymmetrical noise floor.
- Fault traced to **LNA power supply** → replacement restored flat noise floor.
- **Decoding** possible after fixing LNA; confirmed **minimal cross-interference**.



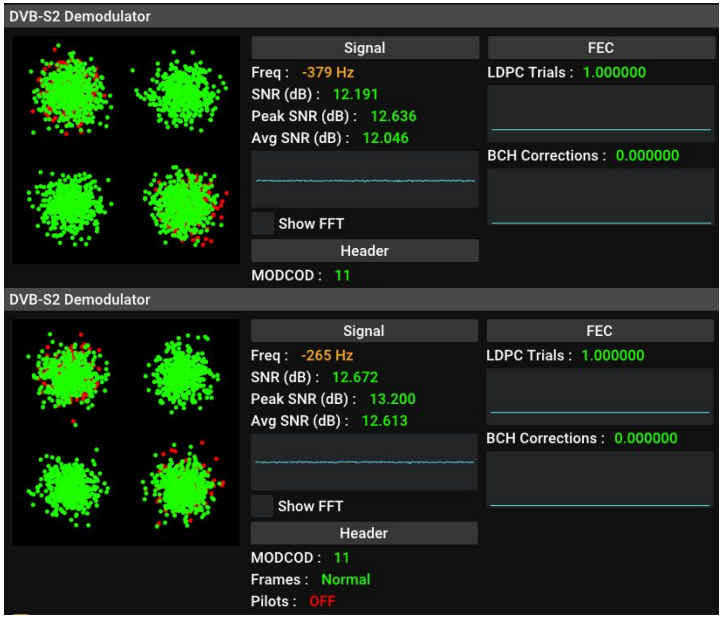


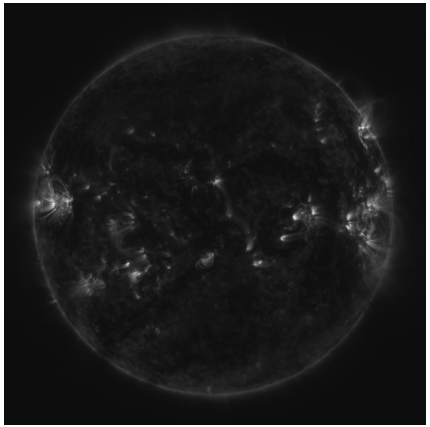


GRB Reception

Product Examples and Reception Results

- Successful reception of both RHCP and LHCP signals using **SatDump**.





Conclusions and Future Work

- **Practical SDR Reception:** The project successfully demonstrated SDR-based reception systems for both HRIT and GRB meteorological services from GOES satellites.
- **Educational Use of HRIT:** The system's simple implementation makes it well-suited for introductory engineering courses.
- **Permanent GRB Deployment:** The reception system is nearly ready for permanent operation. Key requirements include weatherproofing, server integration, dual-polarization capability for full meteorological product access, data storage strategies, and enhanced SatDump visualization for operational workflows.

Thank you!

Questions?