OrbitalSAR Reflex

Translating NASA NISAR L-band & Multi-SAR Earth rhythms into real-time surface-change visualizations fused with Meteomatics weather intelligence and 24-byte edge telemetry.

Team OrbitalSAR Reflex (Universal Event)

Volkan Dagli (Team Owner · @pCwOrM) · **Murat Emre ÖZKAYA** · **Prenses Metin** (@PrensesMTN)



Seeing Through Clouds — Without Drowning in Gigabytes

Earth's surface shifts continuously through floods, quakes, wildfires, and glacial surges. Radar penetrates darkness and storms, yet two gaps delay public action:

1. Perceptual Barrier

Raw SAR covariance matrices (`GCOV`) and unwrapped interferograms (`GUNW`) are hard for communities and emergency planners to interpret alongside weather drivers.

2. Downlink Bottleneck

1.8 GB → 24 B

Standard SAR scenes demand multi-gigabyte links. Critical flood or seismic trigger alerts wait hours unless distilled deterministically on the edge.

3. Ambiguous Backscatter

Radar drops occur in both quiet lakes and flash floods. Cross-checking SAR coherence loss with high-resolution precipitation removes false alarms.

Dual-Frequency SAR + Meteomatics Physical Fusion

Combining NASA NISAR L-band (~24 cm) canopy penetration with Sentinel-1 C-band (~5.6 cm) surface sensitivity and live meteorological telemetry.

Verified Data Ingestion Pipeline

- **NASA CMR NISAR L2:** `C2854338529-ASF` (GCOV) & `C2854335566-ASF` (GUNW InSAR)
- **NASA ASF Vertex:** Sentinel-1 GRD/SLC & Quad-Pol UAVSAR L-band
- **Microsoft Planetary Computer:** Public STAC `sentinel-1-rtc`
- **Meteomatics API:** `precip_24h:mm`, `t_2m:C`, wind & RH synced to pass epochs

Physical Scattering Signatures

- **Specular Flood Drop:** $\Delta\sigma^0 \leq -3.0$ dB & $\Delta\gamma \geq 0.35$ + rain verification
- **Canopy Penetration (L-Band):** Double-bounce trunk flooding & RVI burn scars
- **Repeat-Pass Deformation:** GUNW interferometric phase shift & coherence loss
- **Cryosphere Surge:** Sub-zero temperature gate isolating basal ice shear

From Gigabyte Granules to 24-Byte Verified Reflex Packets

Every anomaly is distilled into a fixed little-endian binary frame (`<IffffBBH>`) protected by CRC-16, achieving >$7.5\times10^{7}\times$ alert bandwidth compression.

```
Göksu Sample Frame (24 B): ab 89 d5 6a | ae 47 11 42 | 85 eb 07 42 | c1 a8 c0 c0 | 0a d7 23 3f | 01 | 91 | 19 71
```

Bytes 0–11 (Space-Time)

`uint32` epoch seconds + `float32` latitude & longitude pinpoint exact disaster footprint.

Bytes 12–21 (SAR Physics)

`float32` $\Delta\sigma^{0}$ (dB), `float32` $\Delta\gamma$ coherence drop, `uint8` anomaly code (0–5) & severity (0–255).

Bytes 22–23 (CRC-16)

Deterministic `zlib.crc32(body) & 0xFFFF` checksum blocks bit corruption across narrowband downlinks.

Storm Pulse × NISAR L-Band Flood Reflex (36.32°N, 33.98°E)

Our hometown basin connects Taurus mountain runoff to ecologically vital Göksu wetlands and coastal farms.

Verified October 2026 Multi-Sensor Sync

- **NASA NISAR GCOV:** `NISAR_L2_PR_GCOV_033_100_A_020...` (2026-10-19)
- **NASA NISAR GUNW:** 12-day pair `2026-10-07 → 2026-10-19`
- **Planetary Computer S1:** Live Mersin coastal `sentinel-1-rtc` swath
- **Meteomatics 24h Rain Peak: 42.59 mm/24h** logged inside window

OrbitalSAR Reflex Verdict

FLOOD_INUNDATION

$\Delta\sigma^0$ = **−6.02 dB** · Coherence Drop $\Delta\gamma$ = **0.64** · Severity = **145/255** · Weather×SAR Confidence = **74.5%**.

Interactive layer wipe compares NISAR `HHHH` / `HVHV` polarizations against `GUNW` and Sentinel-1 VV/VH.

Four Distinct Surface Physics Regimes Verified Live

Hayward Fault, CA (USA)

SURFACE_DEFORMATION (Sev 76)
NISAR `GUNW` (2026-10-09→21) + NASA Quad-Pol L-band **UAVSAR** track fault creep & Delta levees.

Central Amazon (Brazil)

WILDFIRE_SCAR (Sev 93)
NISAR L-band `DHDH` penetrates closed canopy (ΔRVI = −0.65) where optical clouds blind passive sensors.

Malaspina Glacier (Alaska)

GLACIER_SURGE (Sev 98)
Sub-zero Meteomatics gating (−3.8 °C) isolates Δγ = 0.78 basal ice shear in NISAR InSAR pairs.

Live Browser NASA + STAC Explorer

The live web observatory queries `cmr.earthdata.nasa.gov` & Planetary Computer STAC in real time via CORS for instant citizen-science verification.

Open, Reproducible & Tested for Spaceflight-Grade Clarity

Verification & Open Access

- **Live Web Observatory:** `https://orbitalsar.space/`
- **Team Contact Email:** `info@orbitalsar.space`
- **MIT Open-Source Code:** `github.com/pCwOrM/orbitalsar-reflex`
- **Automated Unit Tests:** `10/10 PASS` verifying CRC-16 framing, classification thresholds & JSON dataset integrity.
- **Live Downloadable Binary:** Export 24-byte `.bin` telemetry packets straight from browser sliders.

NASA & Global Collaborator Credits

- NASA Earthdata CMR (NISAR L2 Provisional GCOV / GUNW)
- NASA Alaska Satellite Facility (Sentinel-1 & UAVSAR)
- Microsoft Planetary Computer STAC (`sentinel-1-rtc`)
- Meteomatics Weather API (Global Offer Partner)

SI Disclosure: Mission patch & scaffolding AI-assisted; zero NASA logos in AI assets.