

Space Forces – Space (S4S)

Joint Commercial Ops (JCO) EM Spectrum Operations: PNT Situational Awareness



CAO 4 Nov 2024

Dr. Steve Lewis

Distro A/Public Release approved.
FDO Release: SSC/SZ-BC, Barbara Golf
Date: Oct 10, 2024

Watch, Warn, Win



JCO EM Spectrum Operations



- **Background (JCO CONOP, 1 July 2024)**
 - JCO “Protect and Defend” mission includes monitoring and characterizing the electromagnetic operational environment (EMOE) for threats. The JCO conducts this through Electromagnetic Spectrum Operations (EMSO).
 - JCO EMSO includes:
 - **PNT Situational Awareness (PNT-SA): Ops Accepted on July 1, 2024**
 - **SATCOM-SA: SSC/SZII Prototyping FY25**
 - **Telemetry, Tracking and Control (TT&C)-SA: SACT Live Demo (Nov 2021)**
 - **PNT-SA is the use of systems and techniques to detect, identify, characterize, and/or locate intentional, unintentional, or naturally occurring threats to PNT services that utilize the EM Spectrum.**

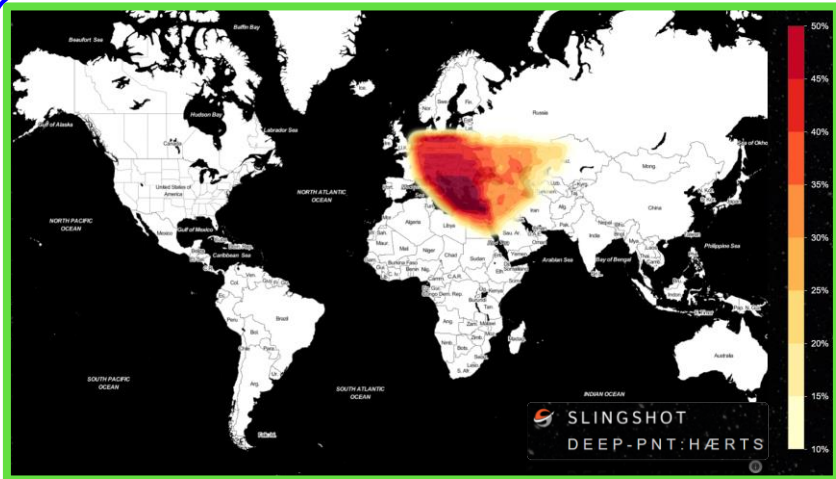


Example JCO PNT-SA Ops Products

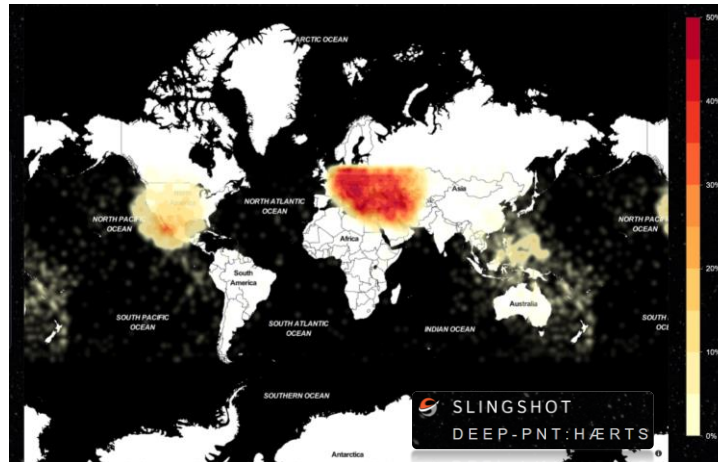


Crowd-sourced Sensors

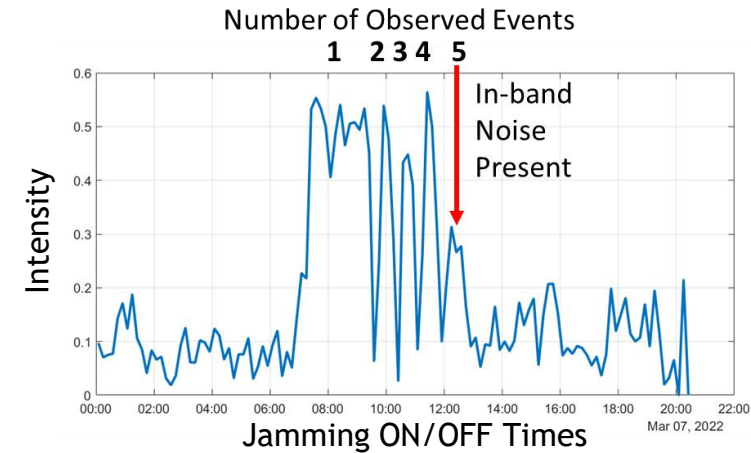
Most Persistent



Most Probable, Persistent
Manufactured Interference



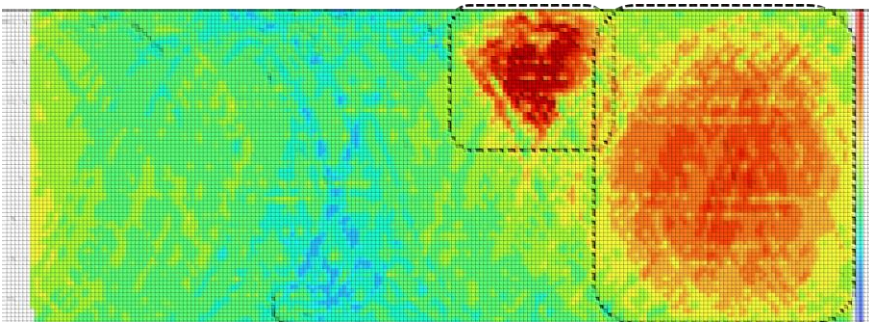
Increased Sensitivity



Pattern of Life

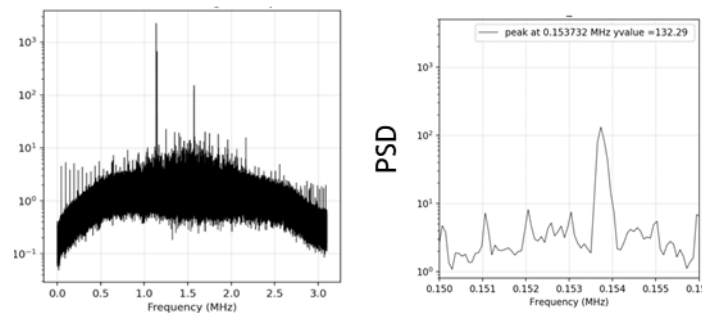
Informed Sensors

Less Persistent

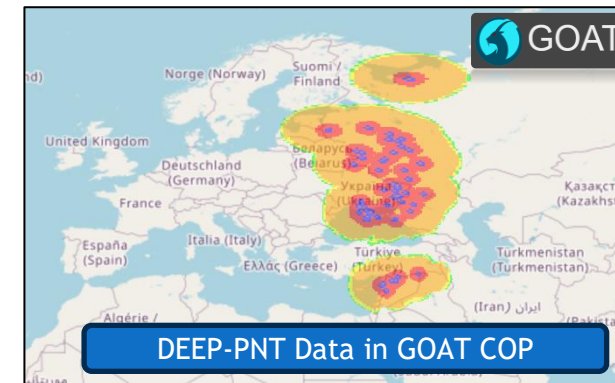


Characterized, Calibrated Signal Environment

Well-Informed / Exquisite Sensors



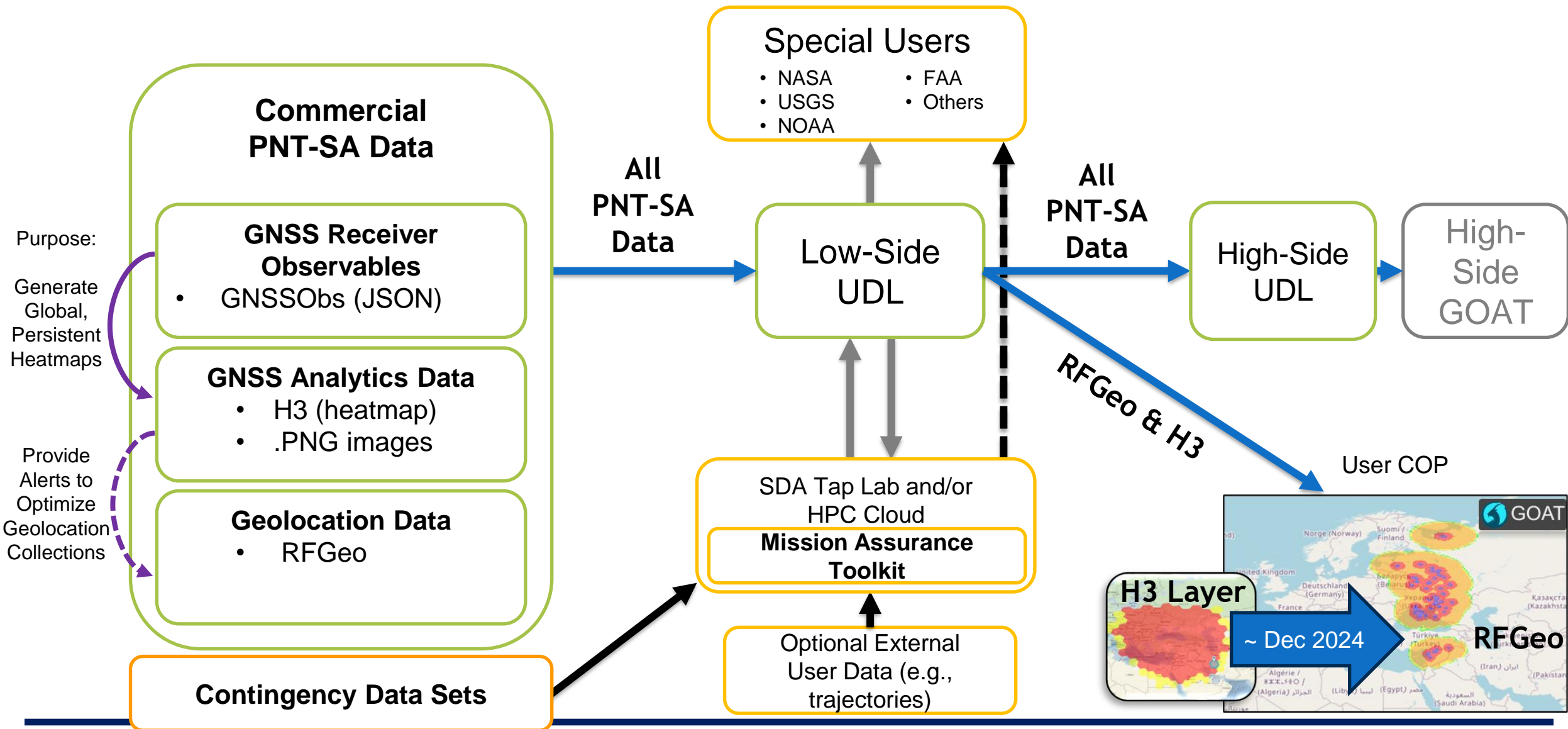
RF Signatures



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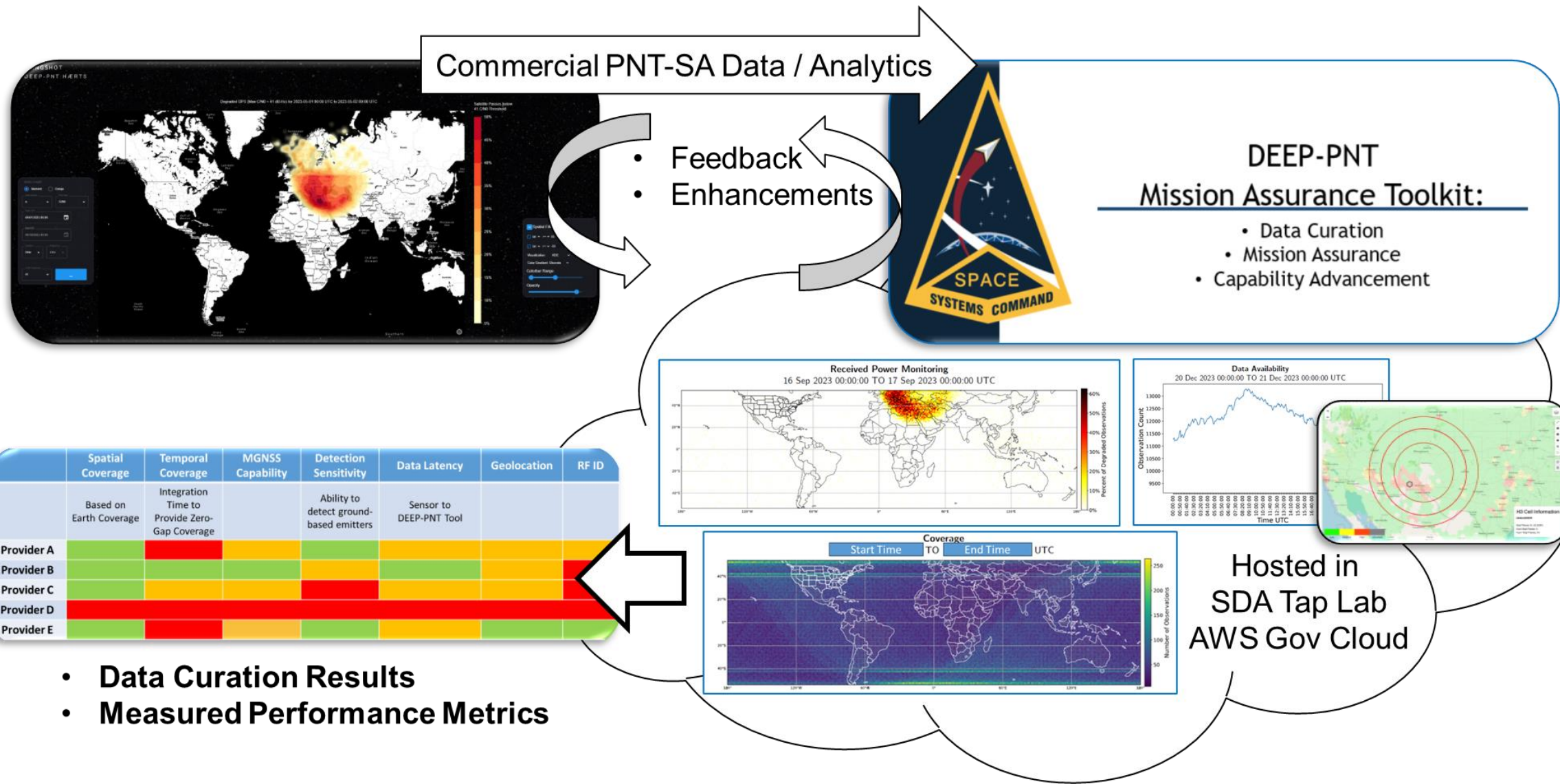
JCO EMSO PNT-SA Architecture



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DEEP Mission Assurance Toolkit



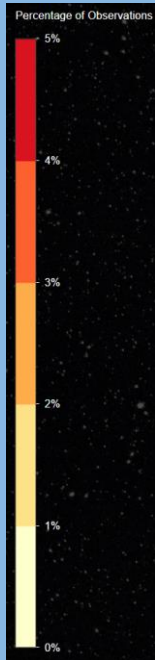


Current Baseline: Global, Persistent + Geolocation

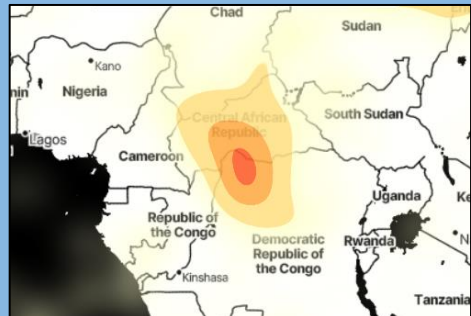
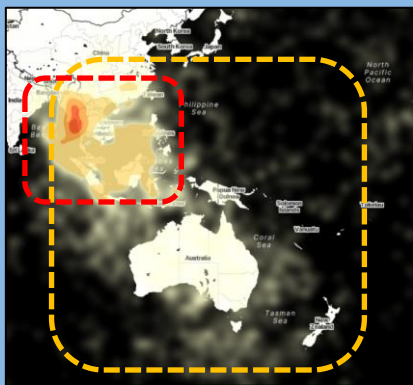


Degraded GPS from 2024-07-24 00:00 UTC to 2024-07-25 00:00 UTC

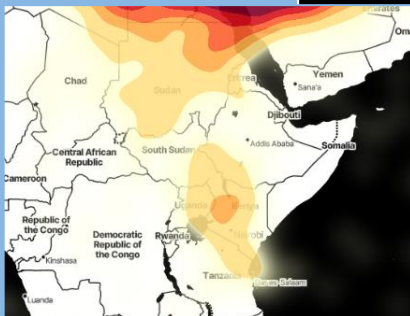
Approved
Test
Events



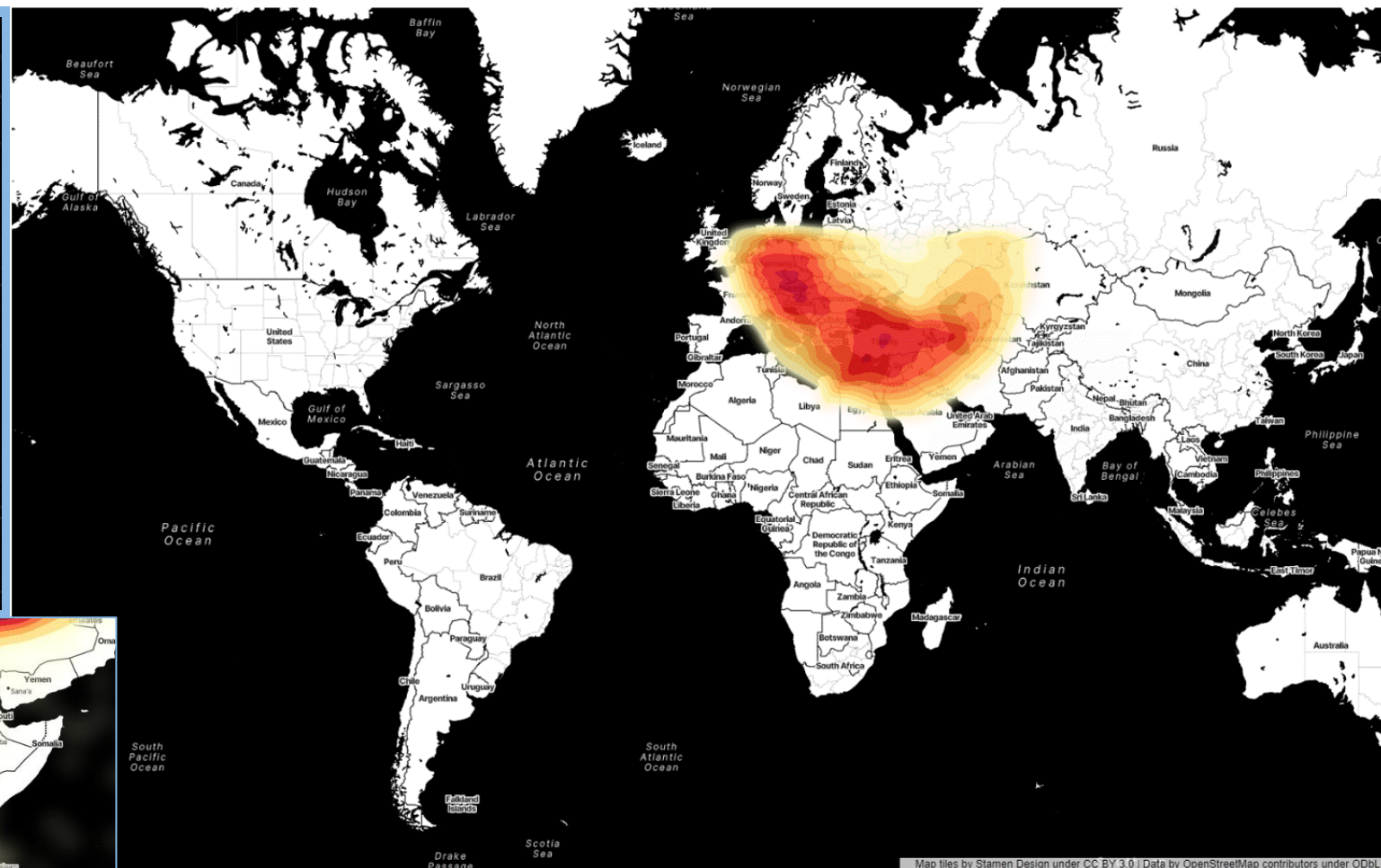
Lower
Powered
PMI



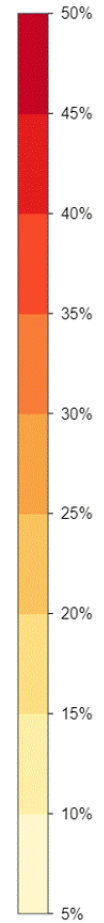
7/31 12:00 – 8/1 12:00



8/11 00:00 – 8/12 00:00



Percentage of Observations



Map tiles by Stamen Design under CC BY 3.0 | Data by OpenStreetMap contributors under ODbL



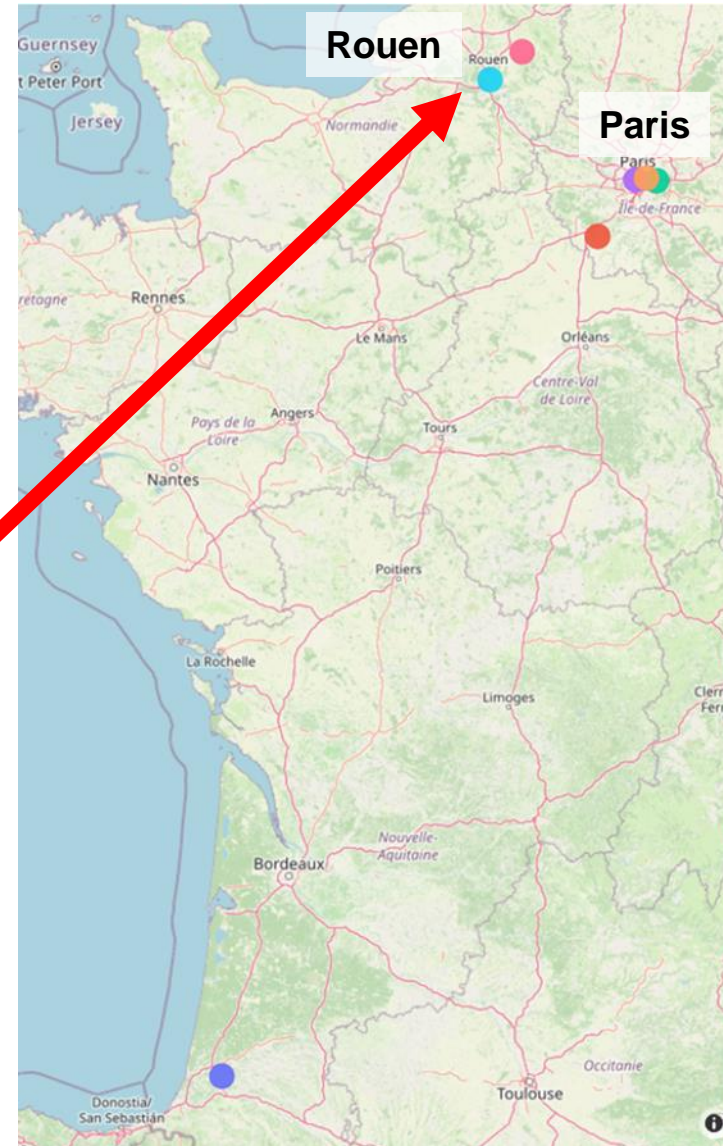
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JCO PNT-SA for Olympics



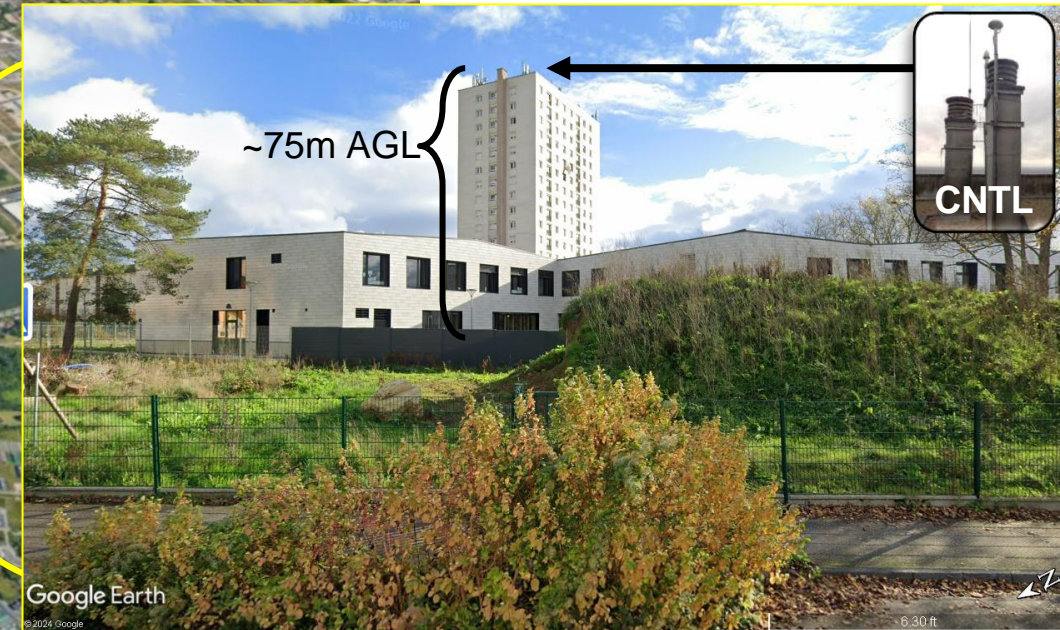
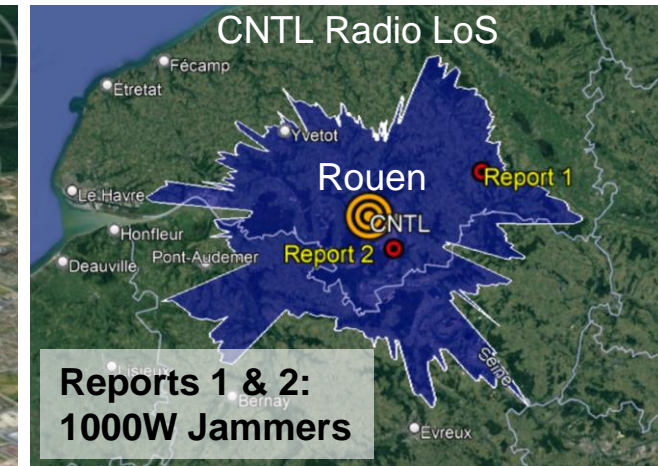
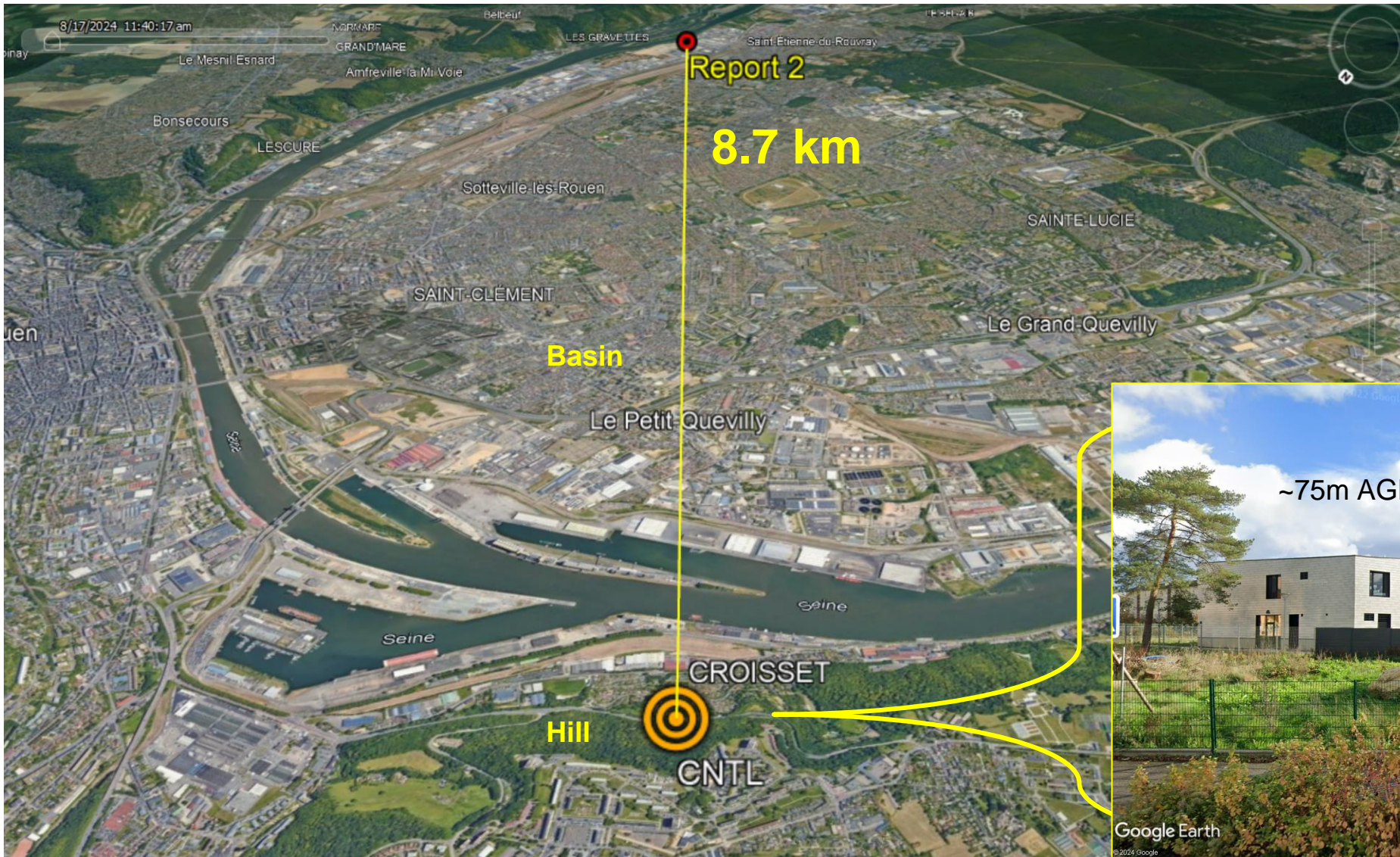
- No Space-based Reports
 - Continuously heatmap collections
 - Scheduled daily geolocations
 - Didn't align with any other reported events
- No HAB Reports
- 3 Aircraft / ADS-B Reports
- No Ship / AIS Reports
- 44 CORS Reports
- 2 External Reports
 - Uncorrelated



Event		
7/29/2024 10:57:59 to 11:04:56 SecureTrack		Air
8/1/2024 16:38:05 to 16:42:24 SecureTrack		
8/1/2024 08:30:59 to 08:31:06 SecureTrack		
7/29/2024 12:03 to 12:13 CORS (OP71, OPMT)		Ground
7/31/2024 14:56 to 14:58 CORS (OP71, OPMT)		
7/31/2024 16:56 to 17:03 CORS (OP71, OPMT)		
8/2/2024 20:13 to 20:14 CORS (OP71, OPMT)		
8/3/2024 19:39 to 19:44 CORS (OP71, OPMT)		
8/6/2024 15:19 to 15:21 CORS		
8/8/2024 15:25 to 15:33 CORS		
8/10/2024 18:53 to 18:58 CORS		
8/7/2024 5:56 CORS		
8/9/2024 08:49 to 08:50 CORS		
8/11/2024 18:43 to 18:50 CORS		
8/8/2024 05:13 to 05:21 CORS		
8/9/2024 19:38 to 19:41 CORS		
8/9/2024 08:35 to 08:37 CORS		
8/10/2024 09:48 to 09:50 CORS		
8/12/2024 09:54 to 09:55 CORS		
8/14/2024 18:39 to 18:42 CORS		
8/10/2024 07:55 to 08:01 CORS		
8/12/2024 08:09 to 08:12 CORS		
7/29/2024 11:20 to 11:40 CORS (IGNF)		
7/29/2024 12:03 to 12:13 CORS (IGNF)		
7/31/2024 14:56 to 14:58 CORS (IGNF)		
7/31/2024 16:56 to 17:03 CORS (IGNF)		
8/1/2024 04:33 to 04:33:5 CORS (IGNF)		
8/2/2024 09:13 to 09:14 CORS (IGNF)		
8/2/2024 20:13 to 20:14 CORS (IGNF)		
8/3/2024 17:30 to 17:32 CORS (IGNF)		
8/3/2024 19:39 to 19:44 CORS (IGNF)		
8/3/2024 20:05 to 20:06 CORS (IGNF)		
8/7/2024 15:19 to 15:21 CORS		
8/9/2024 15:25 to 15:33 CORS		
8/8/2024 5:56 CORS		
8/10/2024 16:06 to 16:09 CORS		
8/10/2024 19:38 to 19:41 CORS		
8/11/2024 09:48 to 09:50 CORS		
8/13/2024 09:54 to 09:55 CORS		
8/11/2024 07:55 to 08:01 CORS		
8/13/2024 08:09 to 08:12 CORS		
8/3/2024 05:57 to 06:16		External Reports
8/2/2024 07:53 to 09:44		



Uncorrelated Report (UCR) Resolution



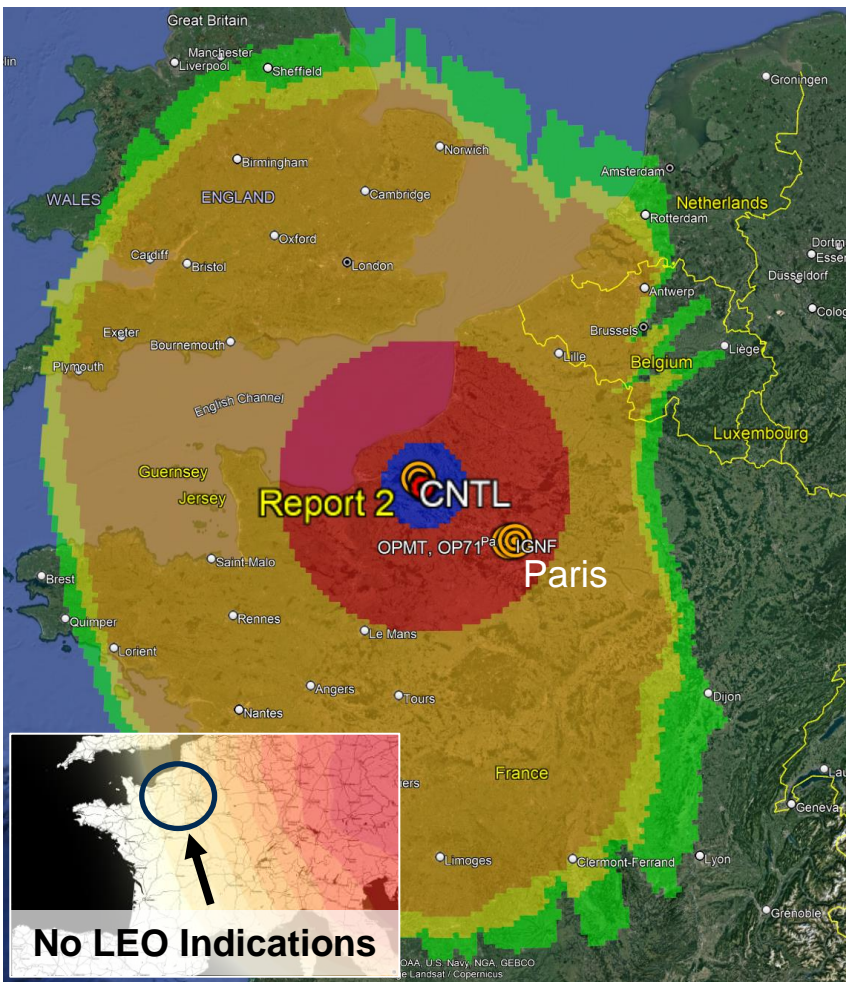
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JCO PNT-SA vs. UCRs 1 & 2

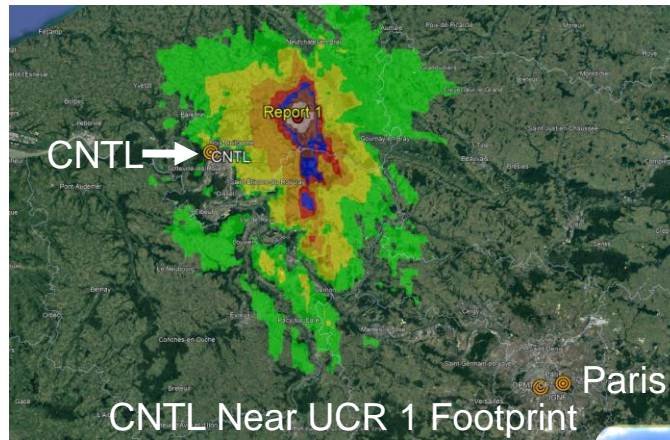


1000W (as reported) @ 60000 ft / 18288 m AGL

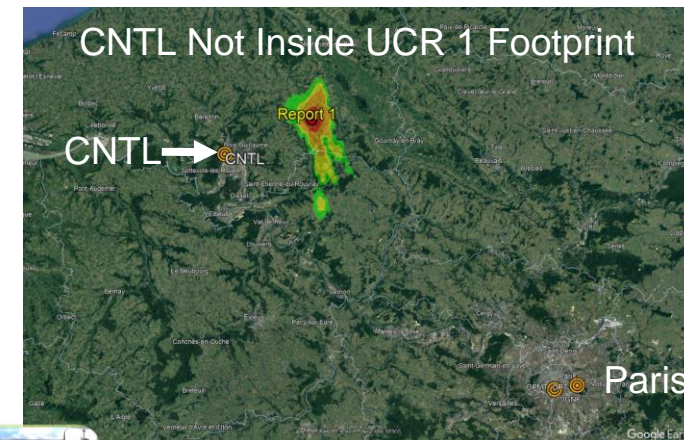


1000W @ 200 ft / 61 m AGL

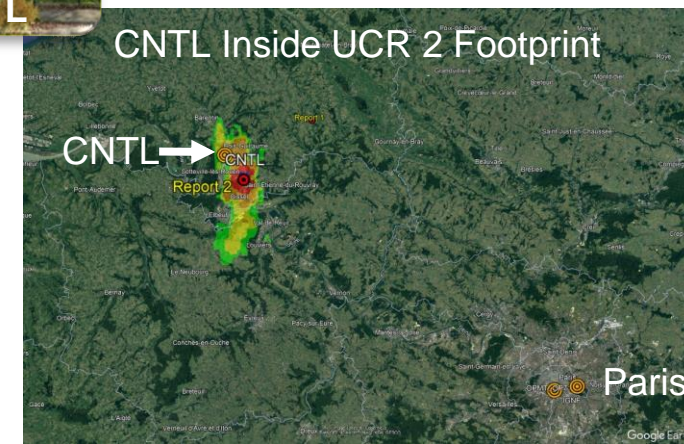
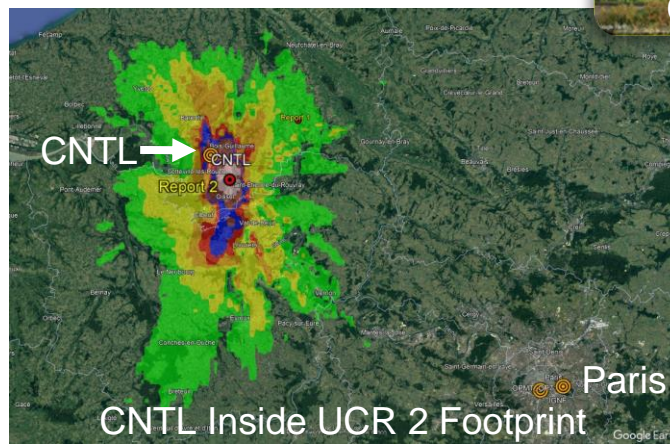
Uncorrelated Report (UCR) 1



0.7W @ 200 ft / 61 m AGL



Uncorrelated Report (UCR) 2



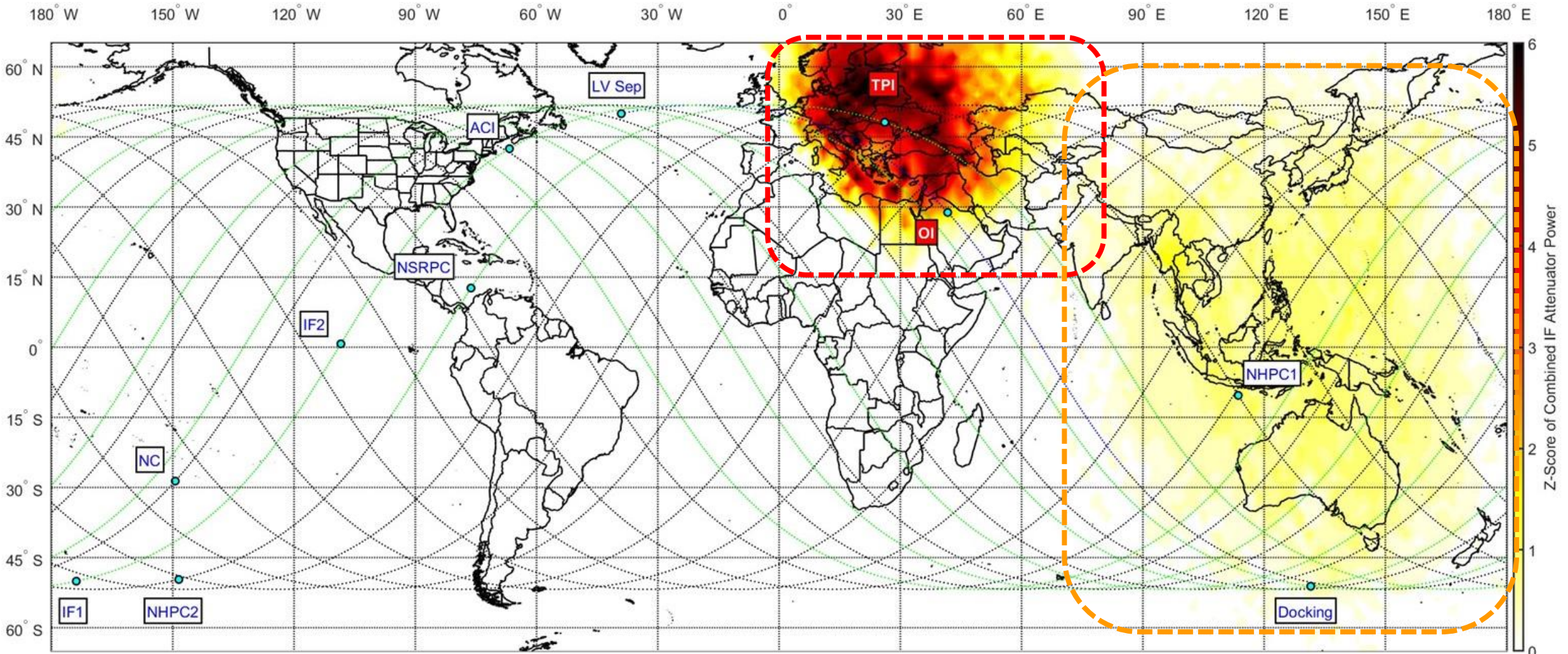
No PMI Indications from LEO. No PMI Indications at CNTL. PMI source(s) likely much less than 1000W.

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Acronym: Probable Manufactured Interference (PMI)



JCO PNT-SA for Special Users

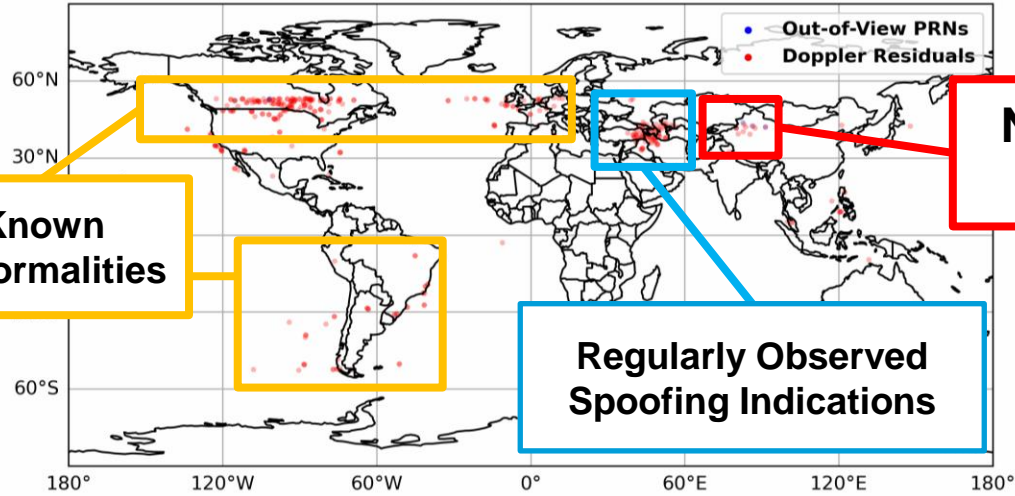


Watch, Warn, Win

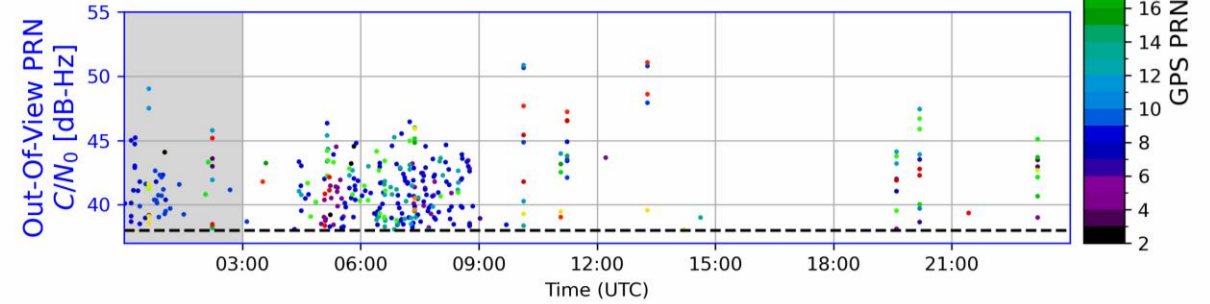
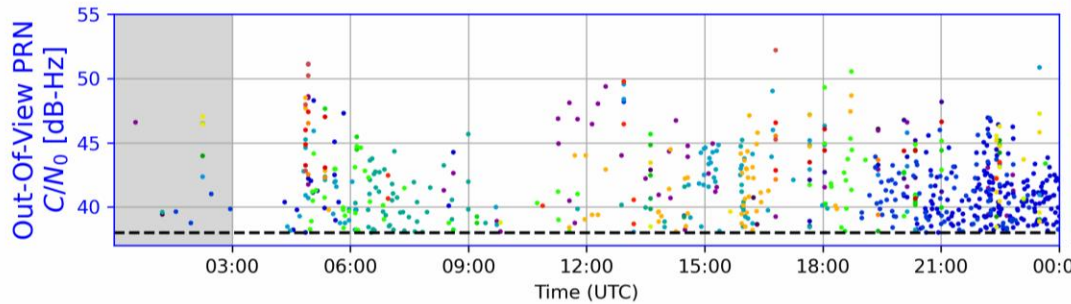
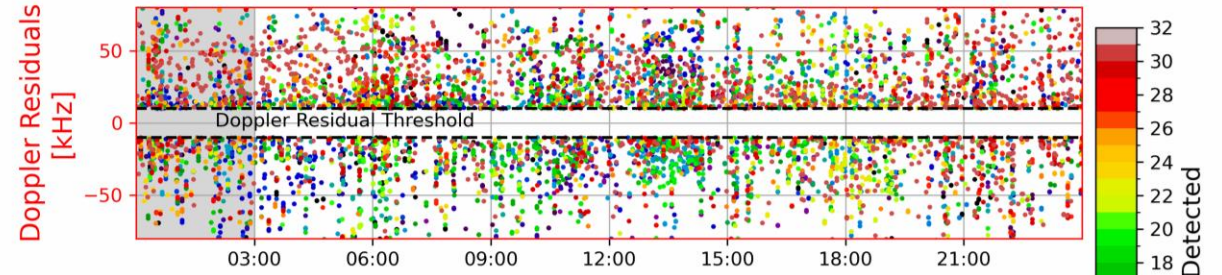
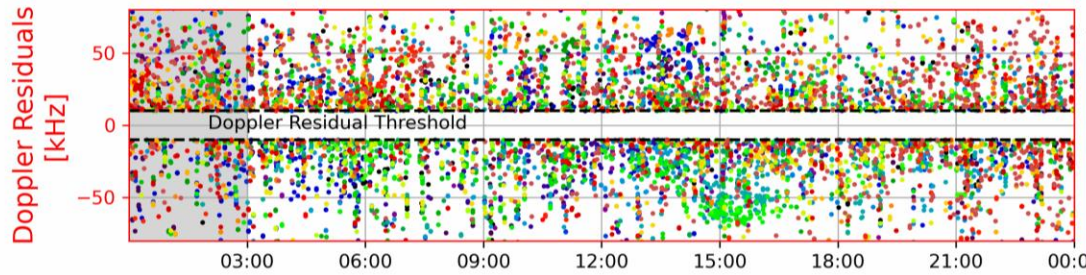
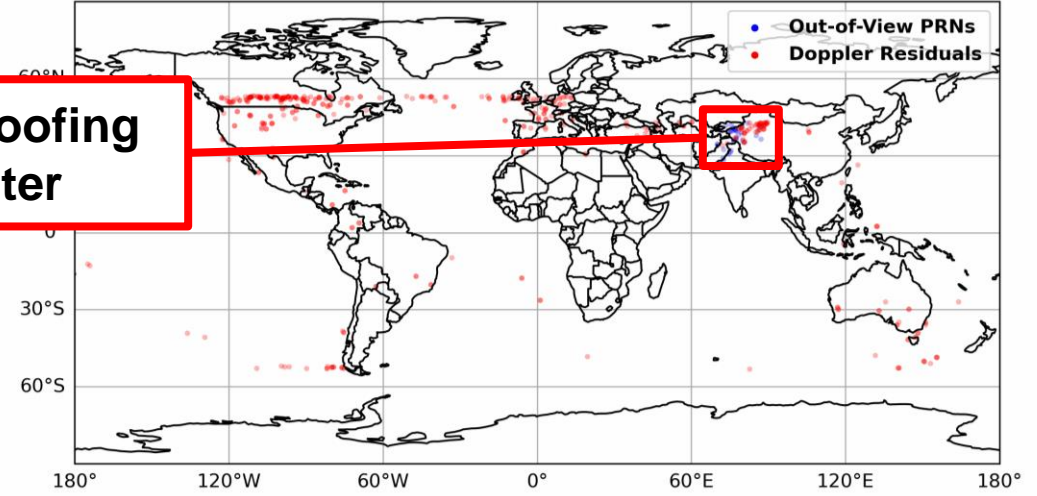


Probable Spoofing Summaries

2024-09-04 Spoofing Detection 00:00 - 02:59



2024-09-05 Spoofing Detection 00:00 - 02:59



September 4, 2024

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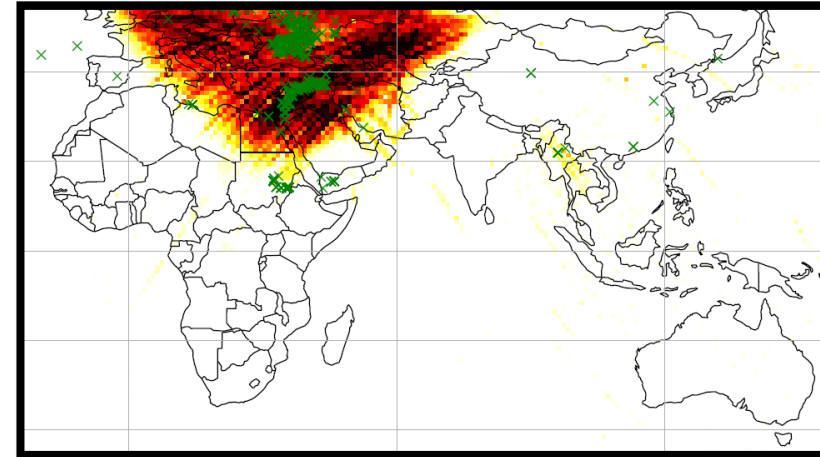
September 5, 2024



Summary



- **JCO PNT-SA is Operational, ID'd Initial Metrics to**
 - Ensure Performance meets needs
 - Coverage (space/air/land/sea); Temporal, Spatial, Spectral
 - Latency
 - Identify Commercial Data limitations
 - Line-of-Sight, Sensitivity, etc.
 - Detect and protect from data corruption
 - Maximize Value to the End Users
- **First-ever Unclass, Commercial PNT-SA that Maximizes Value & International Partner Sharing**
- **Uses existing COPs, NOT duplicating (GOAT, etc.)**
- **Expanding to SATCOM and TT&C / C2 Situational Awareness for EMI Detection & Characterization (Ku, C, Ka, S, X Bands)**



**Future Combined PNT-SA:
Global, Persistent (heatmap) +
Geolocation (x)**



JCO: Leading Commercial Integration for Space

The Joint Commercial Operations (JCO) provides diverse, timely, non-classified Space Domain Awareness (SDA) and alerting services throughout the globe to USSF/USSC and 18+ Allied/Partner Nations, 24 hours a day/5 days a week. For questions about JCO's mission, requests to visit the JCO Operations Floor, or requests for support, please contact us at JCO@dragonarmy.rocks.



QUESTIONS & COMMENTS?

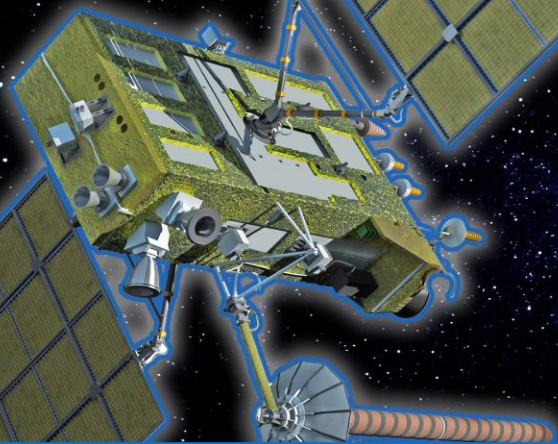
JCO PNT-SA Geolocation Data Already Available in GOAT (Requires DOD CAC):
<https://cognos-web.net/goat/gui/map>



JCO Electromagnetic Spectrum Ops Cell

Space-based Layer:

Global & Persistent Commercial Constellation(s)



Massless Payload software exploits unclassified telemetry data from commercial providers to detect & characterize EM Spectrum threats. "Buy, Build" Enabler.

SPECTRUM, EMI, Awareness & Response (SPEAR) Teams

- Provide expert analytics and response to disruptions
- Leverage Robust Tools
- Accelerate fielding of SA capabilities into Ops
- Augment JCO Cells & CCMDs
- Provide timely / accurate products

Commercial Data & Derivative Ops Products

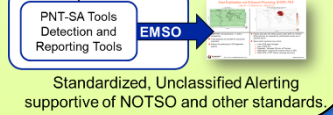
US Space Force
Joint Commercial Ops (JCO)

EM Spectrum Ops (EMSO) Cell

PNT-SA



End Users
PNT-SA Ops Products / Alerts



SATCOM-SA

TT&C / C2-SA

Space Wx-SA

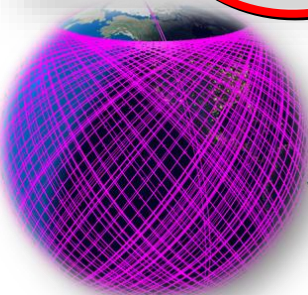
Cyber-SA



DEEP Massless Payloads for RF Threat Detection & Characterization

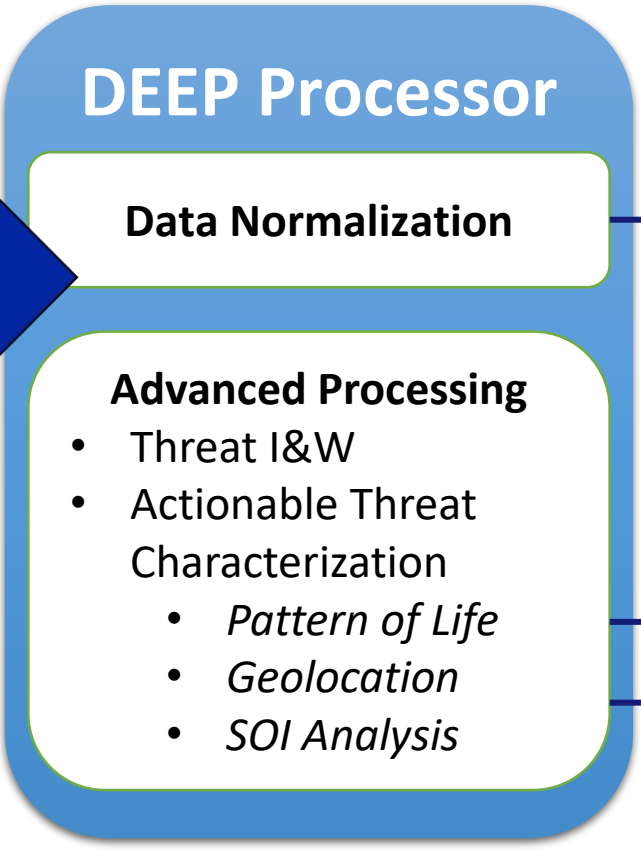


Operational Threat Detection and Actionable Characterization with Data Exploitation and Enhanced Processing (DEEP) of Unclassified Commercial Data.



Unremarkable Spacecraft Observables

Unclass Commercial and/or Other telemetry data



Watch, Warn, Win

SDA Marketplace Commercial Data Buy

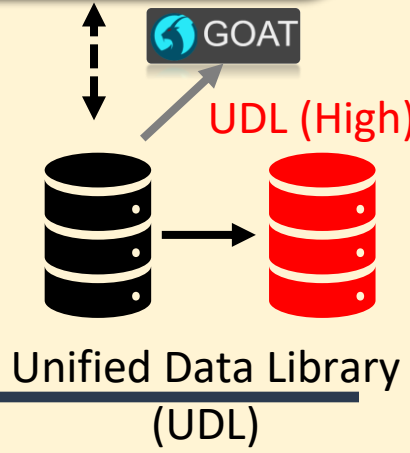
- DEEP Capabilities Line-up:**
- DEEP-PNT: PNT Situational Awareness (SA)
 - DEEP-RF: SATCOM-SA
 - DEEP-C2: TT&C-SA

SDA Tap Lab (US Gov Cloud)
DEEP Mission Assurance Toolkit

- Data Curation
- Mission Assurance
- Capability Advancements
- SPEAR Team

JCO EMSO Cell

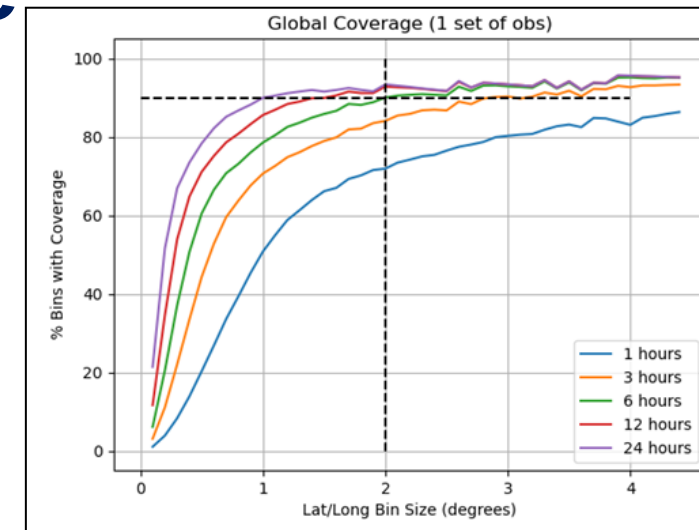
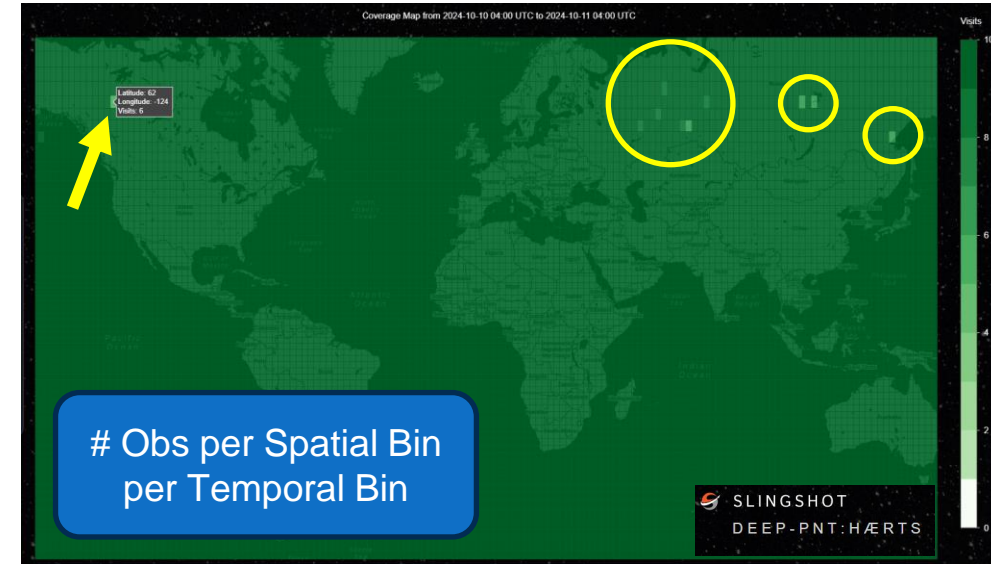
- 1) Normalized, Raw Data
- 2) Processed Data (H3, RFGeo)
- 3) Ops Products (e.g., Heatmaps, Plots, etc.)





Initial Metrics

- **Coverage**
 - Temporal: Persistence
 - Spatial: Global
 - Spectrum: Multi-GNSS, Multi-Band
- **Latency (across TCPED)**
- **Detection / Characterization Performance**
 - Detection Thresholds (Power Level / Waveform)
 - Geolocation Accuracy
 - Change Detection (PD, PMD & PFA)
- **# Ops Users and Requests vs. Deliveries**
- **PACE Plan Metrics**





PNT-SA for Paris Olympics

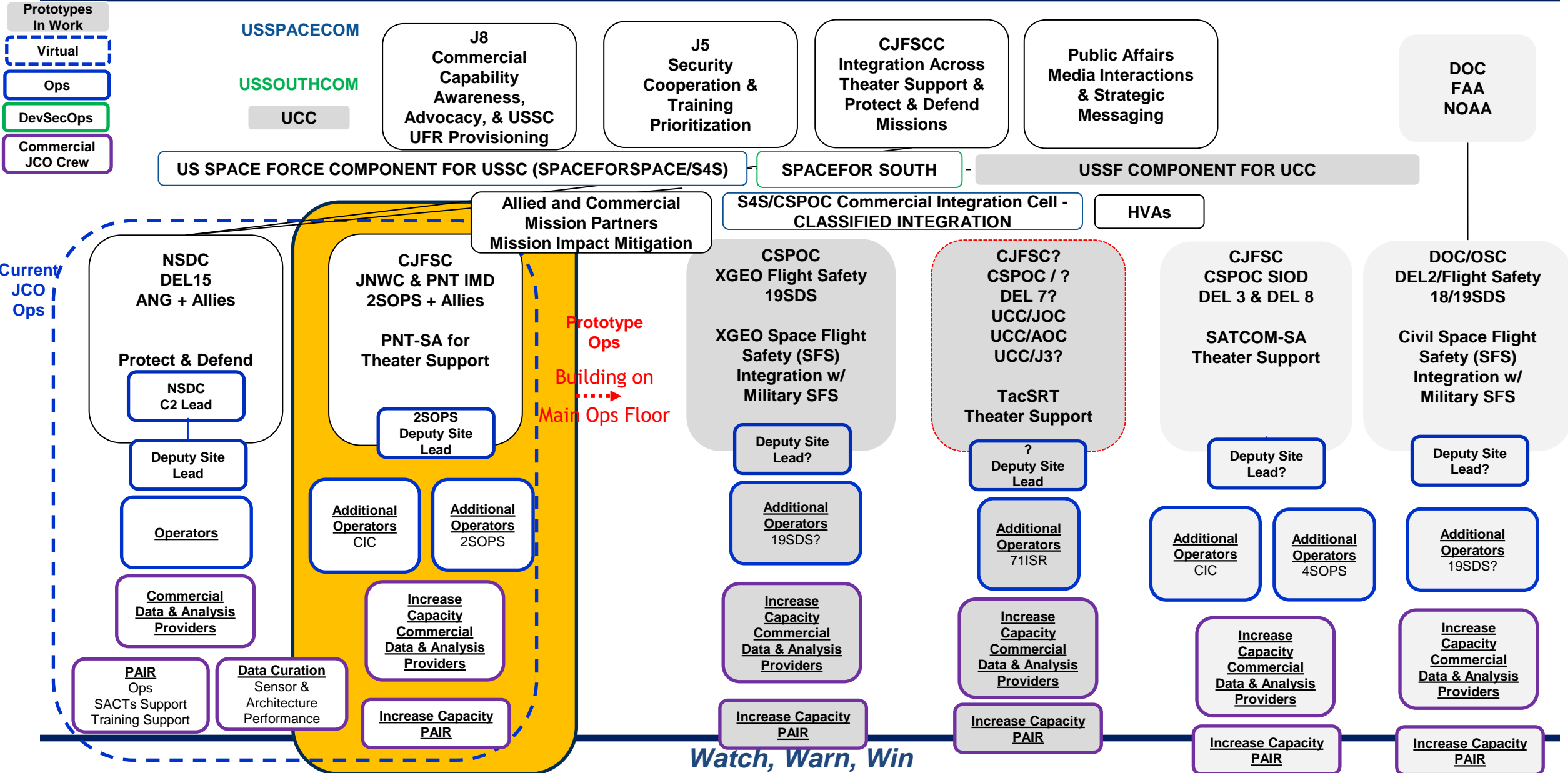


- **Who: JCO was requested to provide PNT-SA for the Paris Olympics & Paralympics**
 - DOD CIO, PNT Lead
 - Joint Navigation Warfare Center (JNWC)
 - 2d Navigation Warfare Squadron (2 NWS, formerly 2 SOPS)
 - Federal Aviation Administration (FAA) provided access/tasking to FAA Spectrum EMI, Awareness, and Response (SPEAR) Team
- **What: Monitor, Detect, Characterize any GPS disruptions affecting Olympics, Paralympics and host nation, France.**
- **When:**
 - Olympics: Jul 24 – Aug 11, 2024 (open ceremony Jul 26)
 - Paralympics: Aug 28 – Sep 8



Commercial Enterprise Operations

Now & Mid-Term





JCO PNT-SA Current Operations



- Operated 24/5/365 by JCO
 - Ops Products Requests
 - NOTSO / Alerts
- All-Domain EMI Support
 - USG, Allied Partners
 - Commercial Operators
 - Others



Joint Commercial Ops
EMSO Cell + SPEAR Teams

Ops Products & Alerting

- Requests for Support
 - Unexplained Interference
 - Mission Planning (e.g., launches, etc.)
- NOTSOs, Other reporting channels

