

THE USE OF SWEPOS, THE NATIONAL CORS NETWORK, FOR GNSS INTERFERENCE DETECTION

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LANTMÄTERIET

SWEPOS® – A NATIONAL NETWORK OF CORS

- Provides:
  - realization and access to the national reference frame SWEREF 99.
  - GNSS data for scientific studies, crustal motion, meteorology, etc.
  - data to international organizations, such as IGS/EPN.
  - real-time and post-processing data for GNSS applications.
- Investments primarily covered by governmental funds.
- Operational costs, including future upgrades, funded through user fees.
- 30 years of GNSS operation.



- Owned and maintained by Lantmäteriet – The Swedish Mapping, Cadastral and Land Registration Authority

REFERENCE STATIONS

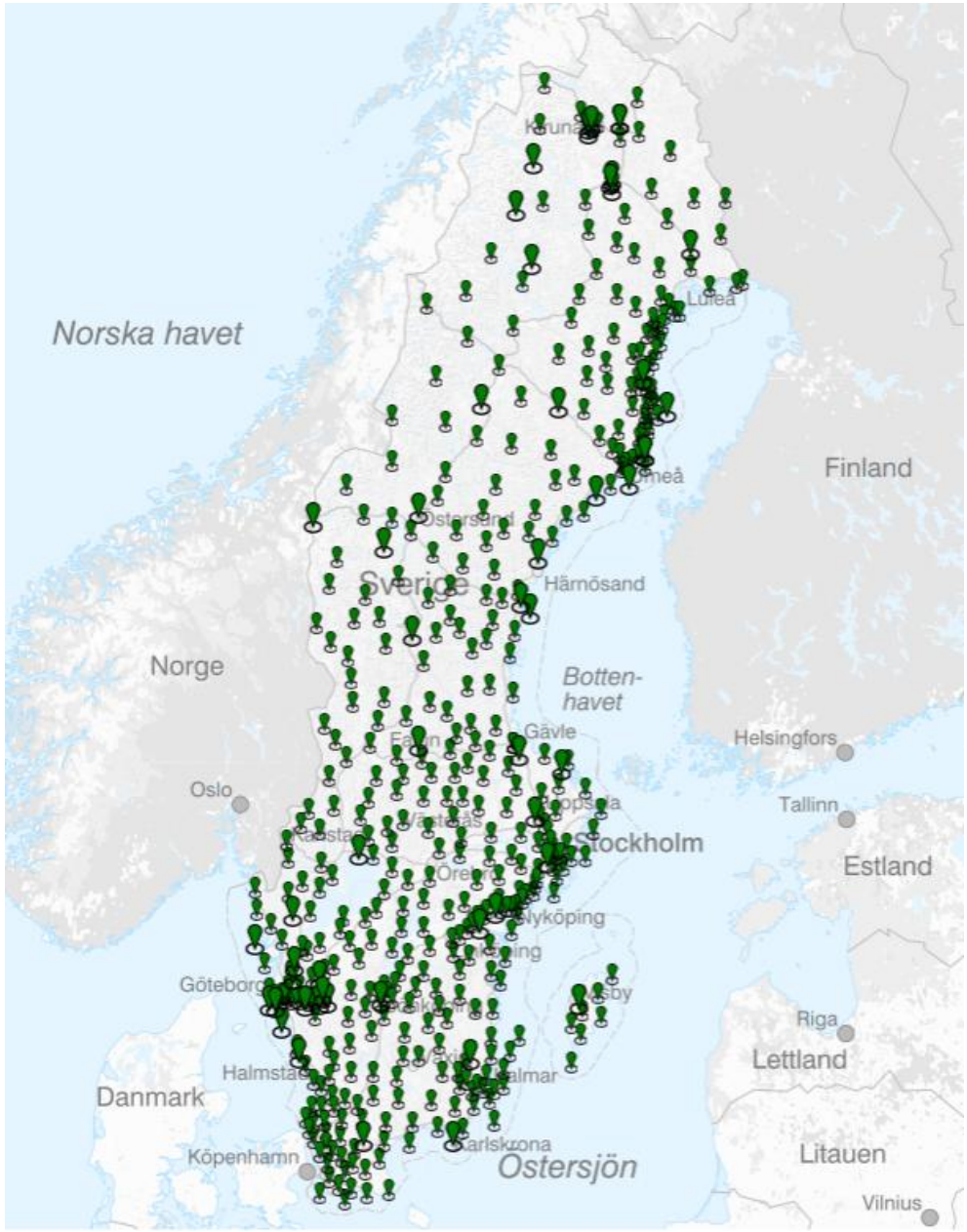
- 501 Reference stations
  - 55 Class A stations
    - Choke Ring antenna
    - Mounted on bedrock.
    - Redundant data communication.
    - Large battery backup.
    - Tempered cabins .

  424 Class B stations
  Choke Ring antenna
  Mounted on chimneys, roof ridges, etc.
  Some have redundant communication.
  Some have battery backup.

  22 Class C stations
  Geodetic production antenna
  Mounted on chimneys, roof ridges, etc.

13 Monitoring stations

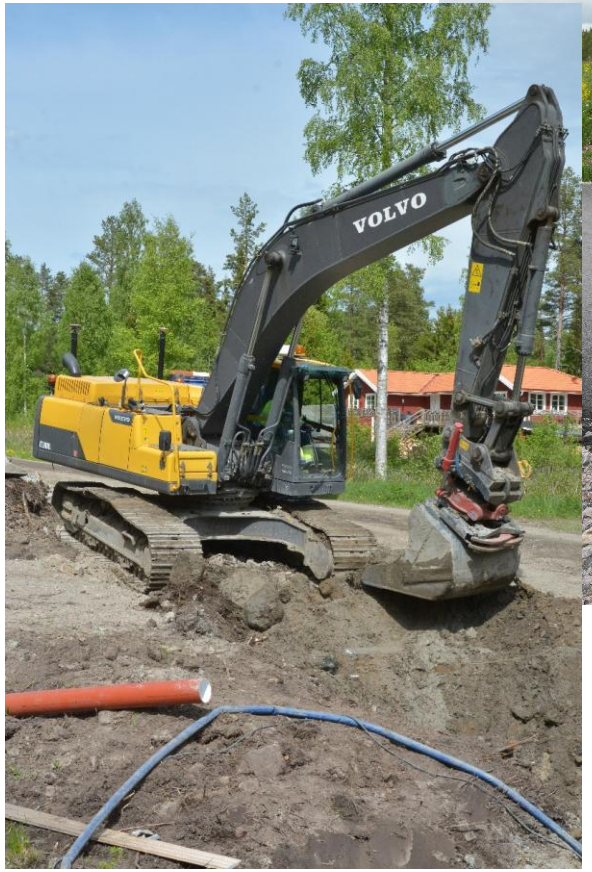
- Trimble Alloy or Septentrio PolarX5 receivers.



SERVICES

- Network-RTK: A real-time high-accuracy service with over 14,000 users.
- National Post-processing service based on Bernese software
- RINEX and virtual RINEX data.
- RINEX data (24-hour files): Free of charge.

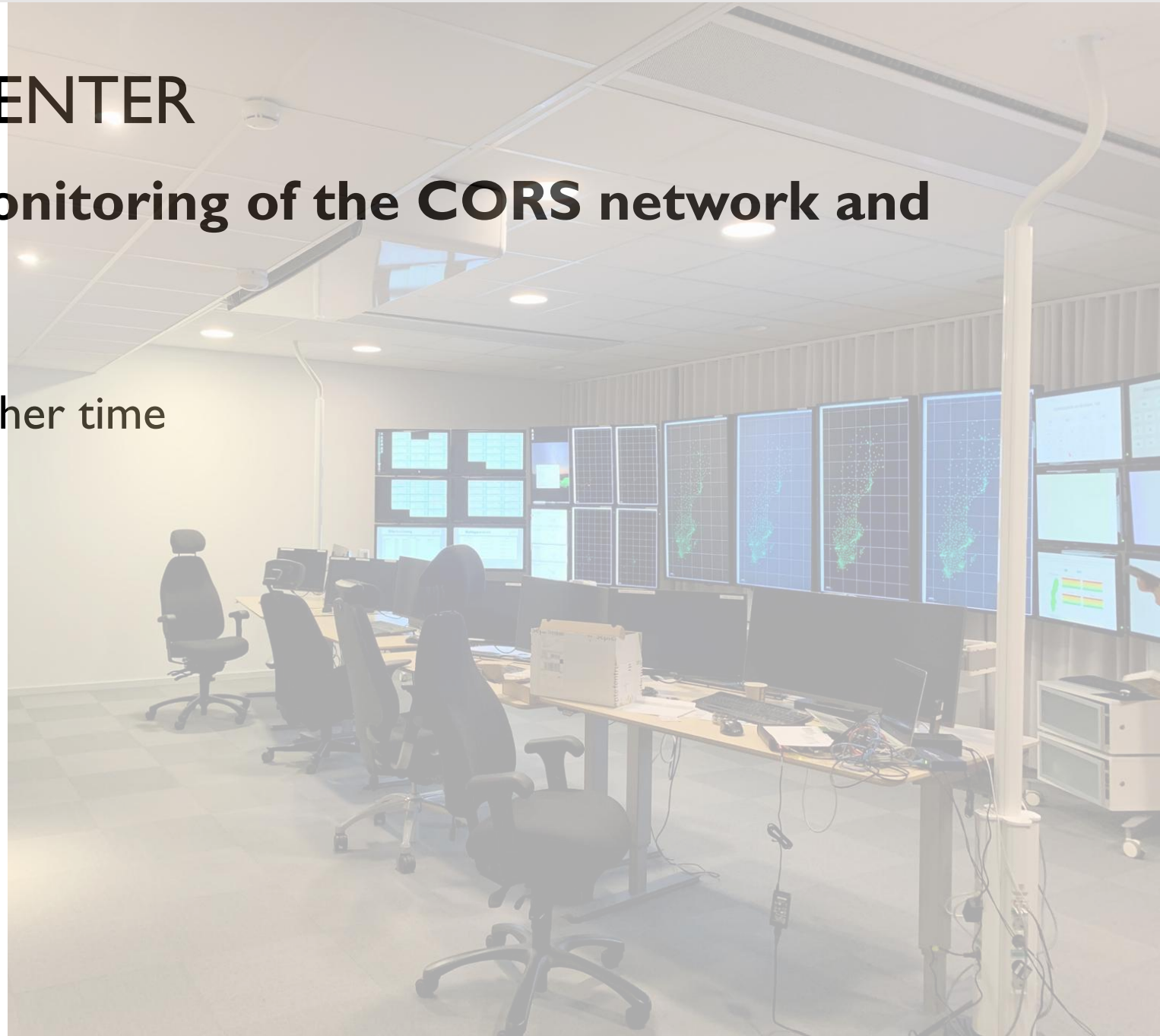




SWEPOS CONTROL CENTER

Customer support and monitoring of the CORS network and positioning services

- Manned between 6.30 – 17.00
- One operator on duty call all other time



SWEPOS GNSS disturbance monitoring – Motivation

Monitor

- Monitoring of anomalous events
- Using GNSS geodetic infrastructure – SWEPOS (not external monitoring system)
- Characterizing GNSS signals
- Monitoring signal strength
- Consistency check

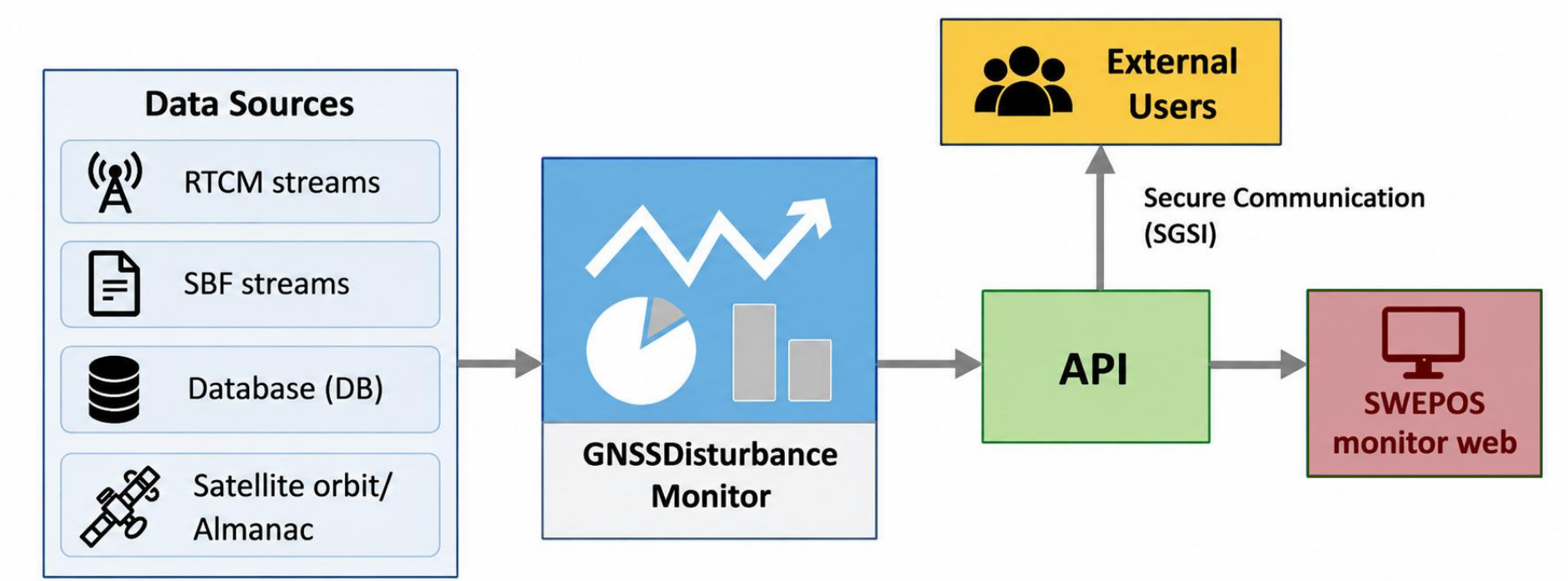
Detect

- Detect anomalous events
- Classify anomalous events
- Multipath? Equipment failure? RFI?

Respond

- Contain the event
- Geolocate the source
- Assess the impact and continuity of the event
- Mitigate it
  - Receivers, softwares
- Inform users

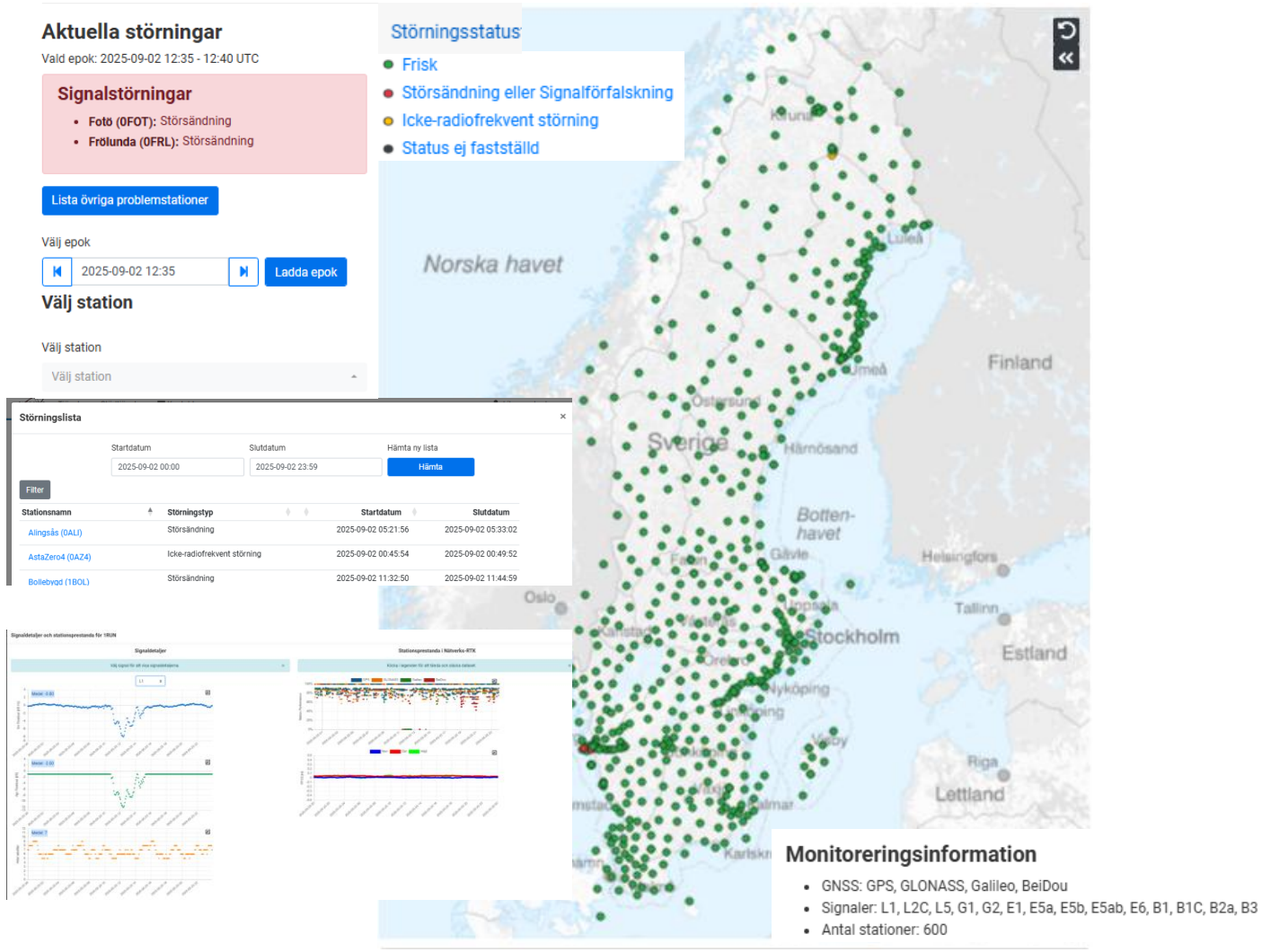
SWEPOS GNSS disturbance monitoring system



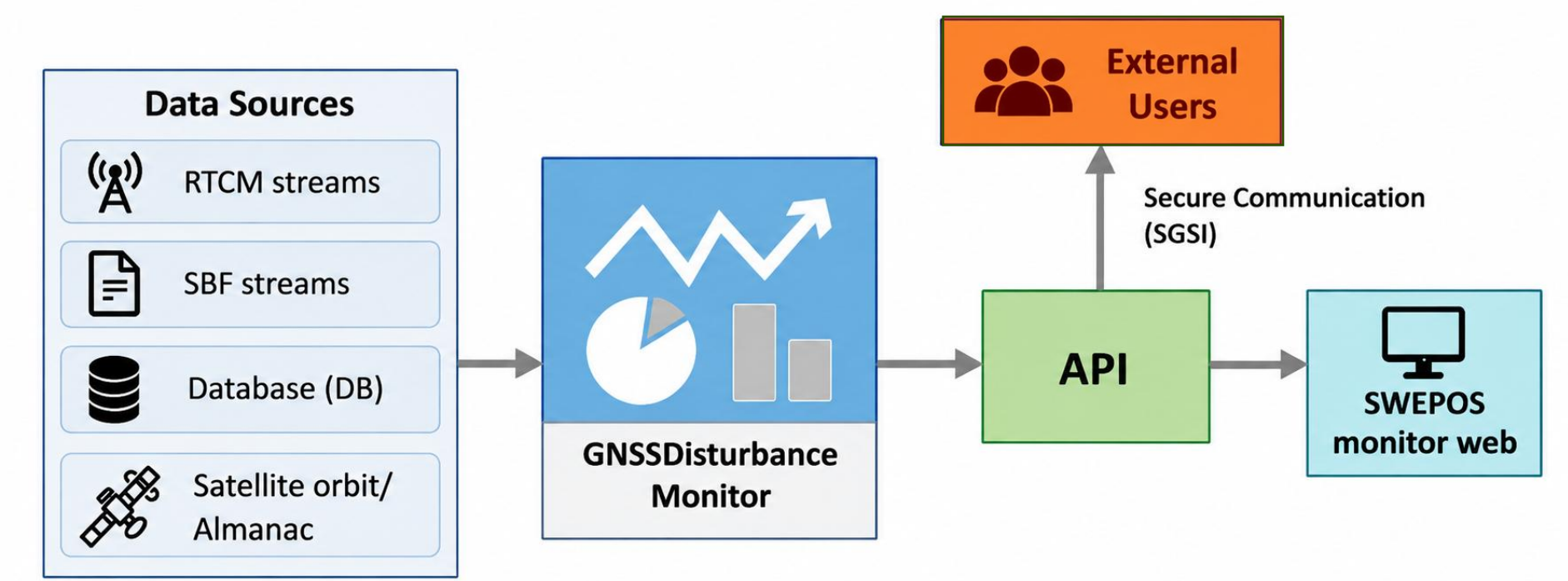
- Real-time monitor
- Alerts for disturbances
- API
  - Access to Realtime and history data
  - Requires authentication

GNSS Disturbance Monitoring WEB

- Web interface that provides a real-time overview of the current GNSS signal disturbance status
- Connected directly to the monitoring API to display disturbance data
- Visualizes data in interactive map and list formats for quick interpretation.
- User-friendly design for both internal technical use and potential external use
- All stations shown with color-coded status based on disturbance type
  - Green: No disturbance (healthy)
  - Red: Interference (jamming or spoofing)
  - Yellow: Possible non-RF disturbance
  - Gray: No status data available.
- Updates every 5 minutes to reflect the latest disturbance status.



SWEPOS GNSS disturbance monitoring



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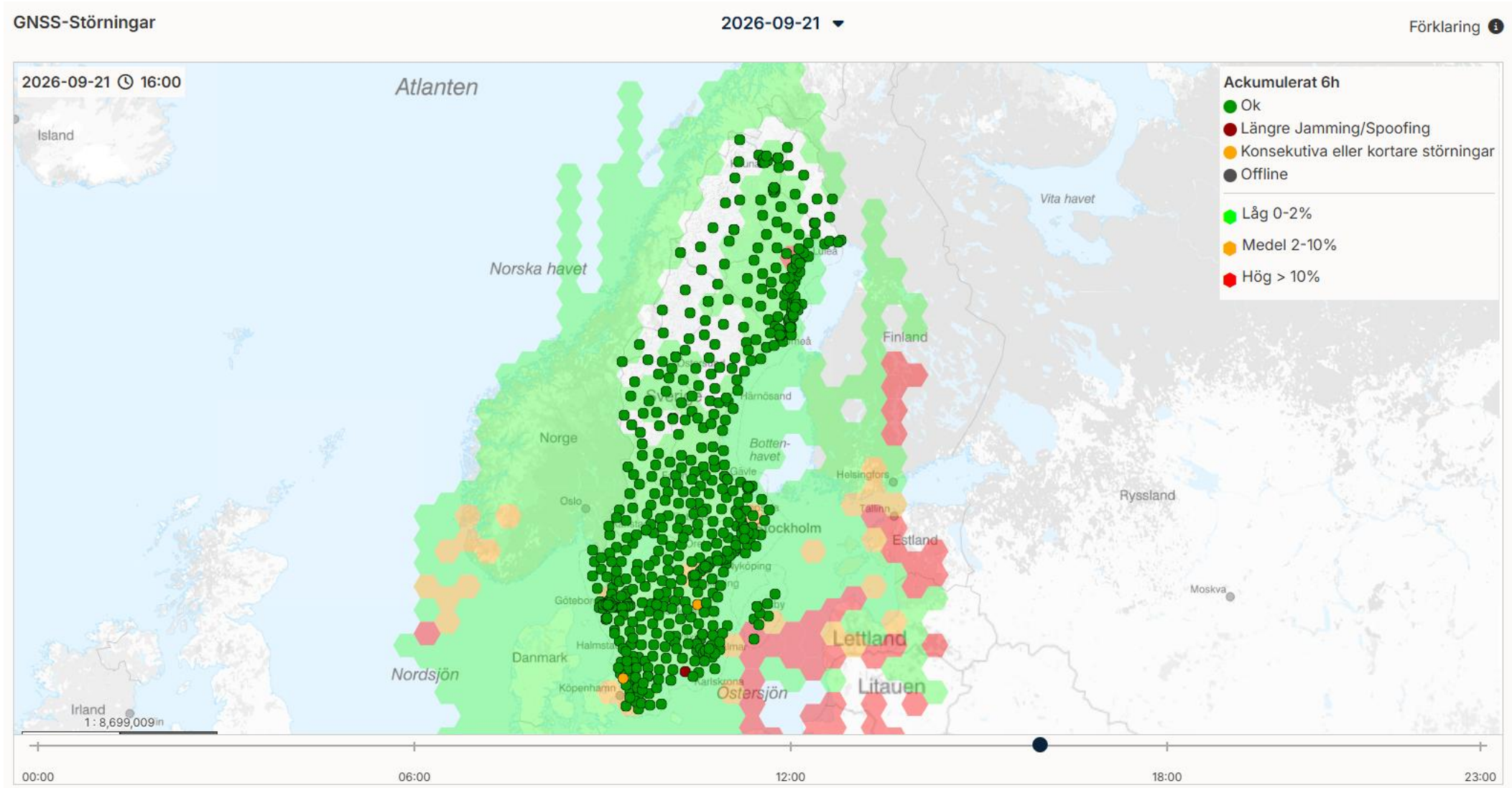
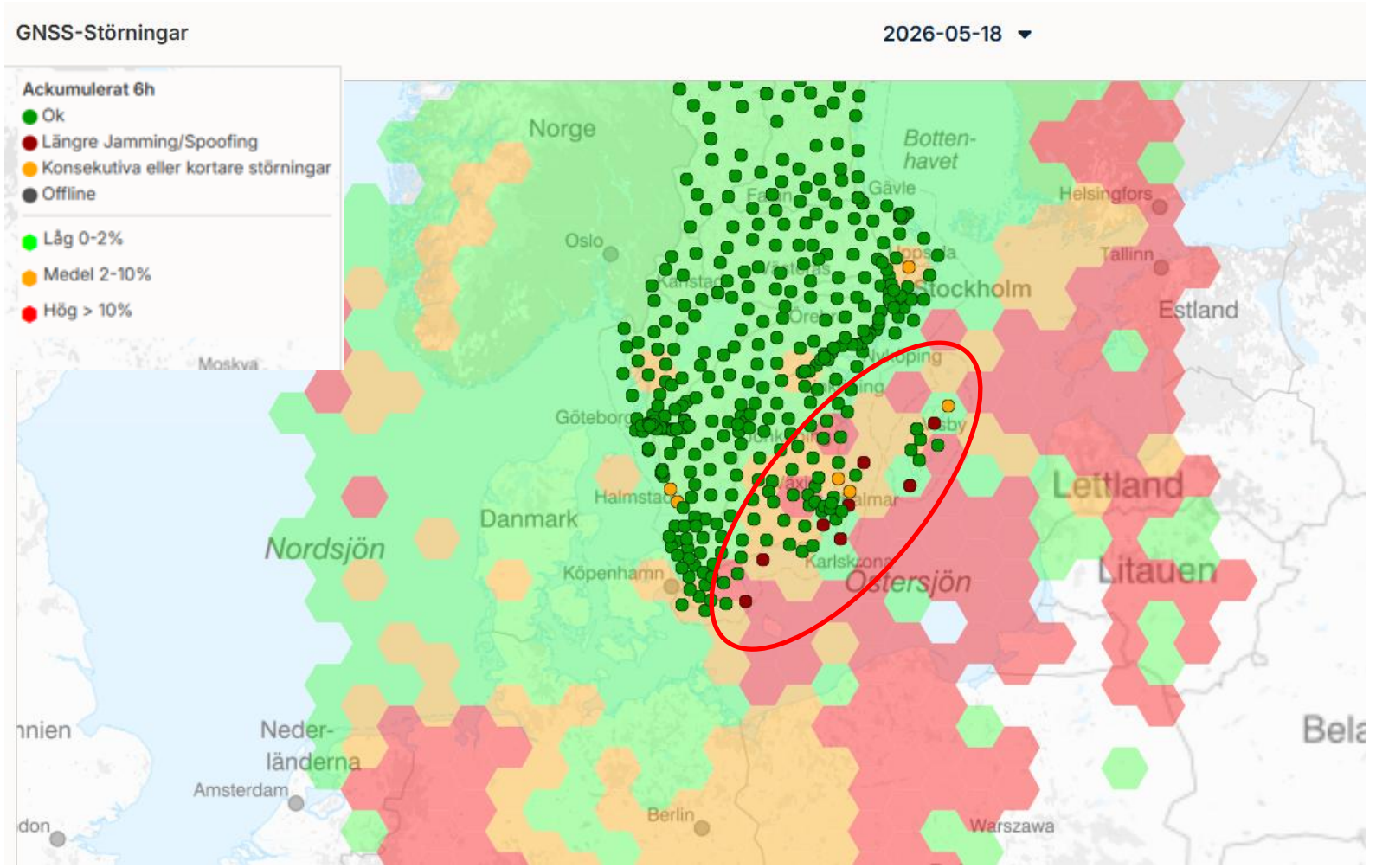
External user – MCF
Sweden's civil preparedness portal - WIS

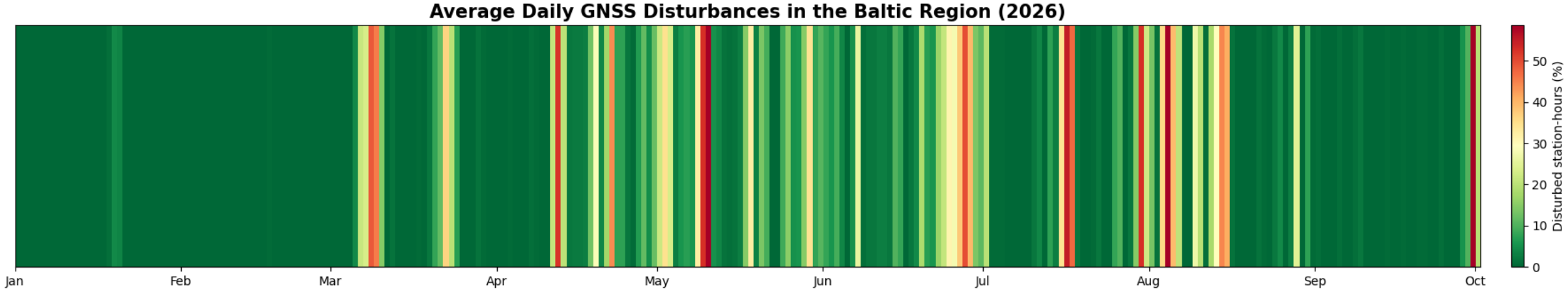


Recent major interference incidents – Baltic Region

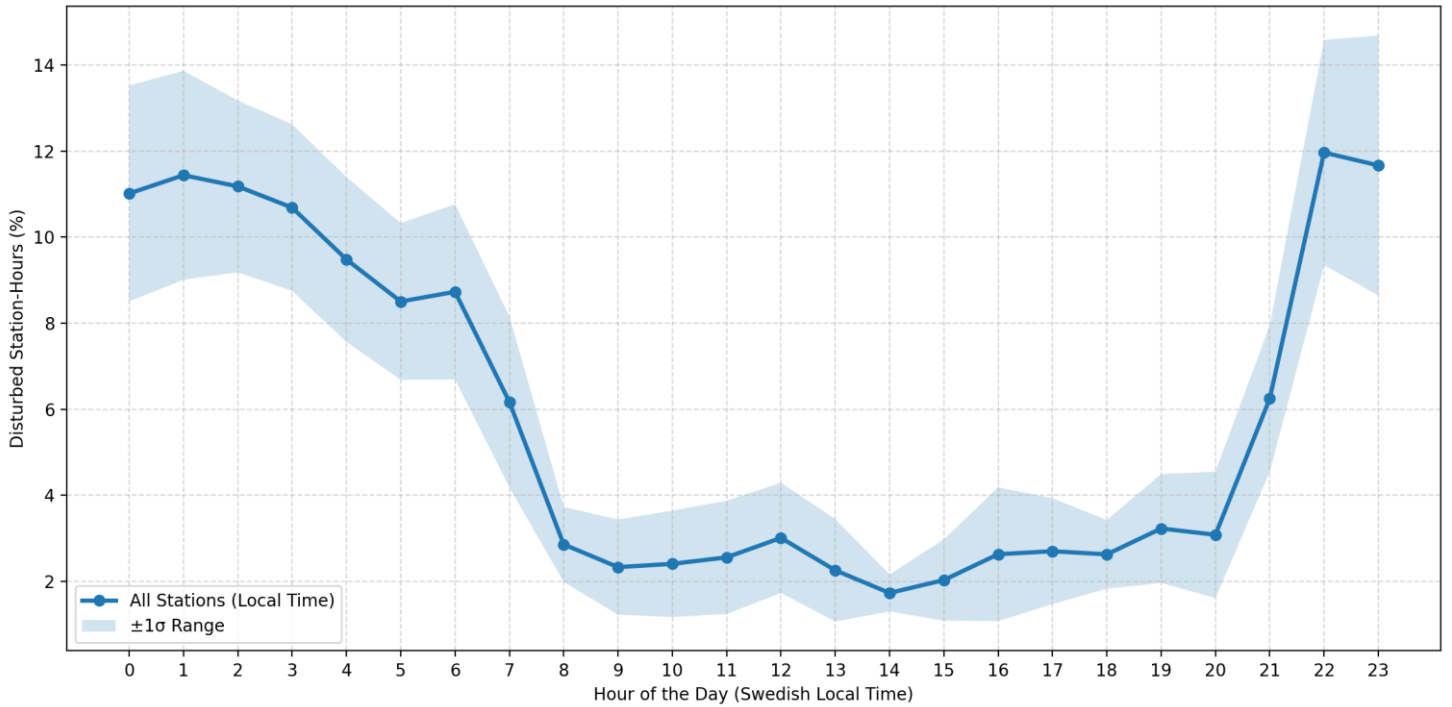
- GNSS disturbance in the Baltic region
  - Happens every year between march and September since 2024
  - Affects all GNSS signals
  - Strongly affects individual station performances
- SWEPOS
  - Monitors and flags-off affected stations
  - Tests shows users in the area may be impacted (see next slide)



Recent major interference incidents – Baltic Region



- Started in March
- Quite since end of August
- Most Disturbances happen in non-work ours
- Similar behavior in 2024 and 2025

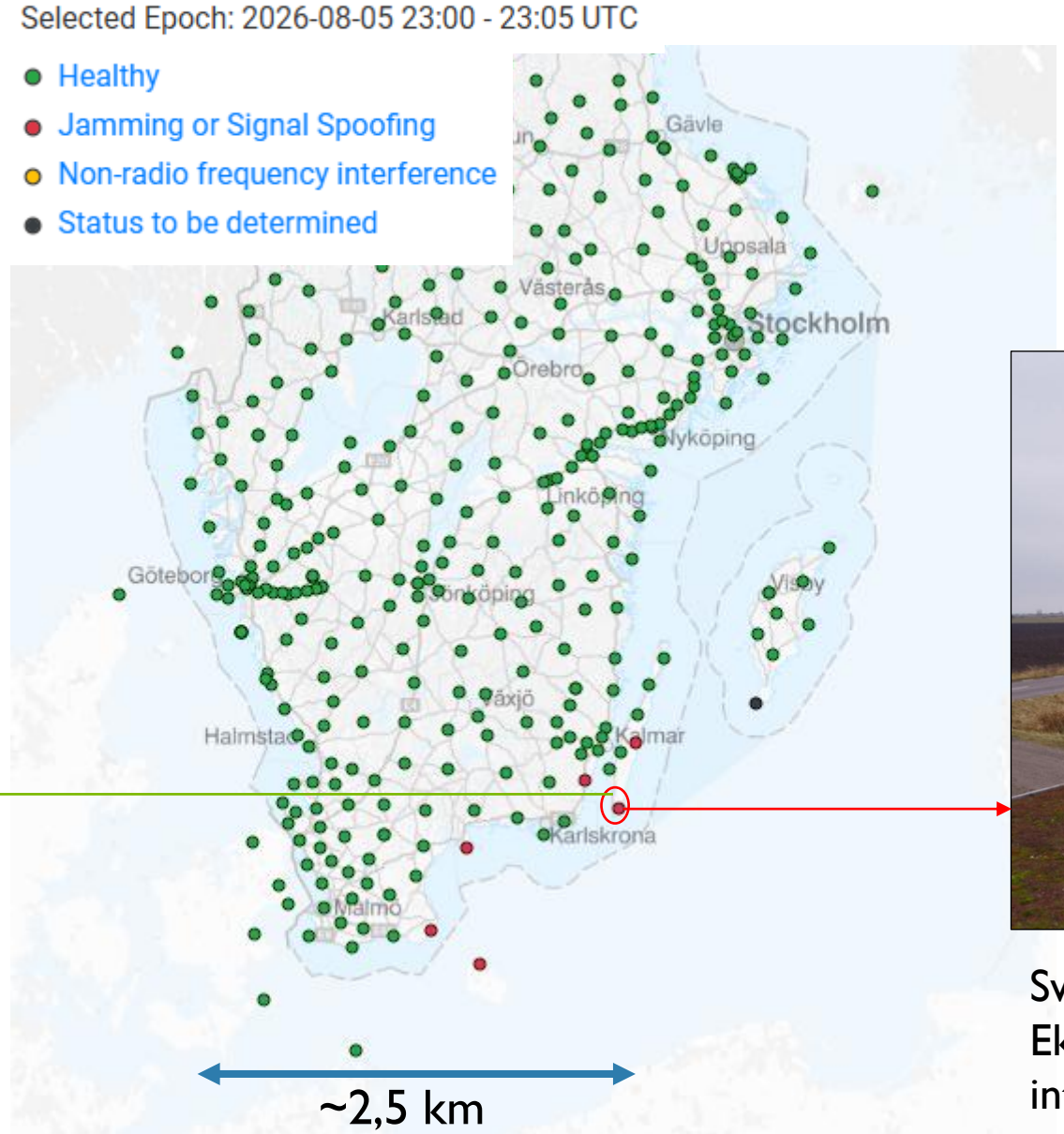


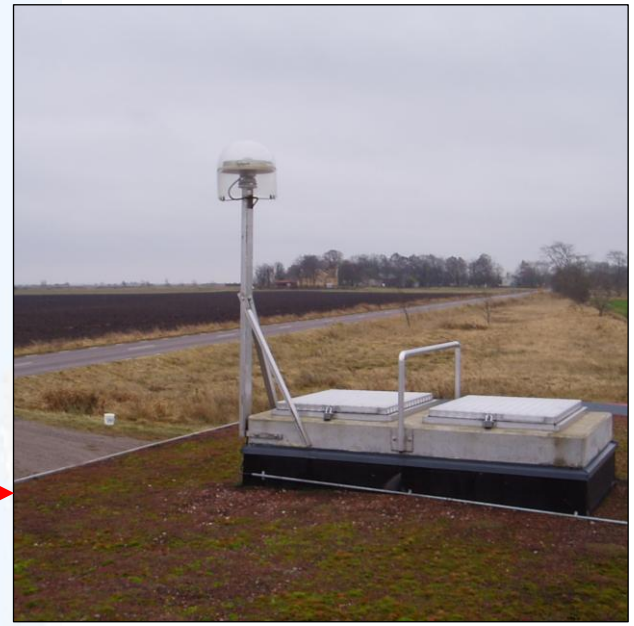
USER CLASS ROVER EXPERIMENT – ÖLAND

Case study of a conventional GNSS equipment for professional applications in construction and land surveying



Trimble R12i GNSS Rover
Measuring conditions, e.g. cadastral surveying

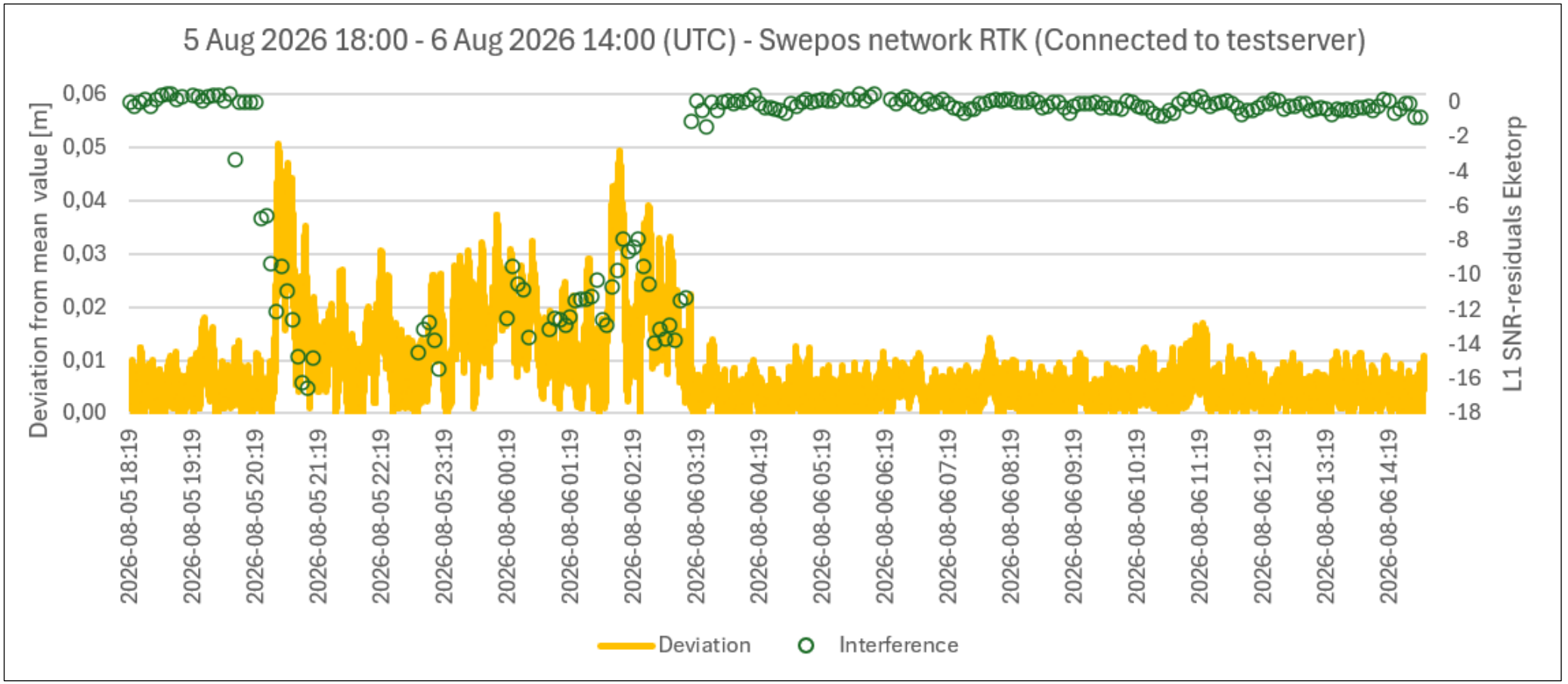




Swepos reference station in Eketorp, affected by RF interference

INTERFERENCE EFFECT ON GNSS NRTK POSITION

- Deviation from defined true value
  - Up to 0,05m during interference



SUMMARY

- **The GNSS disturbance monitor ensures our stations operate properly and deliver high-quality data.**
  It is an essential tool for preventing poor correction data from reaching Swepos positioning service users. By constantly monitoring for RFI, hardware malfunctions, and environmental changes, it helps us decide exactly when to take a station offline—and when to bring it back online once the issue is resolved. Furthermore, Swepos stations and this monitoring tool complement air traffic ADS-B data, offering a clear picture of how ground-level users are affected by RFI.

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TACK! VI FINNS PÅ…

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