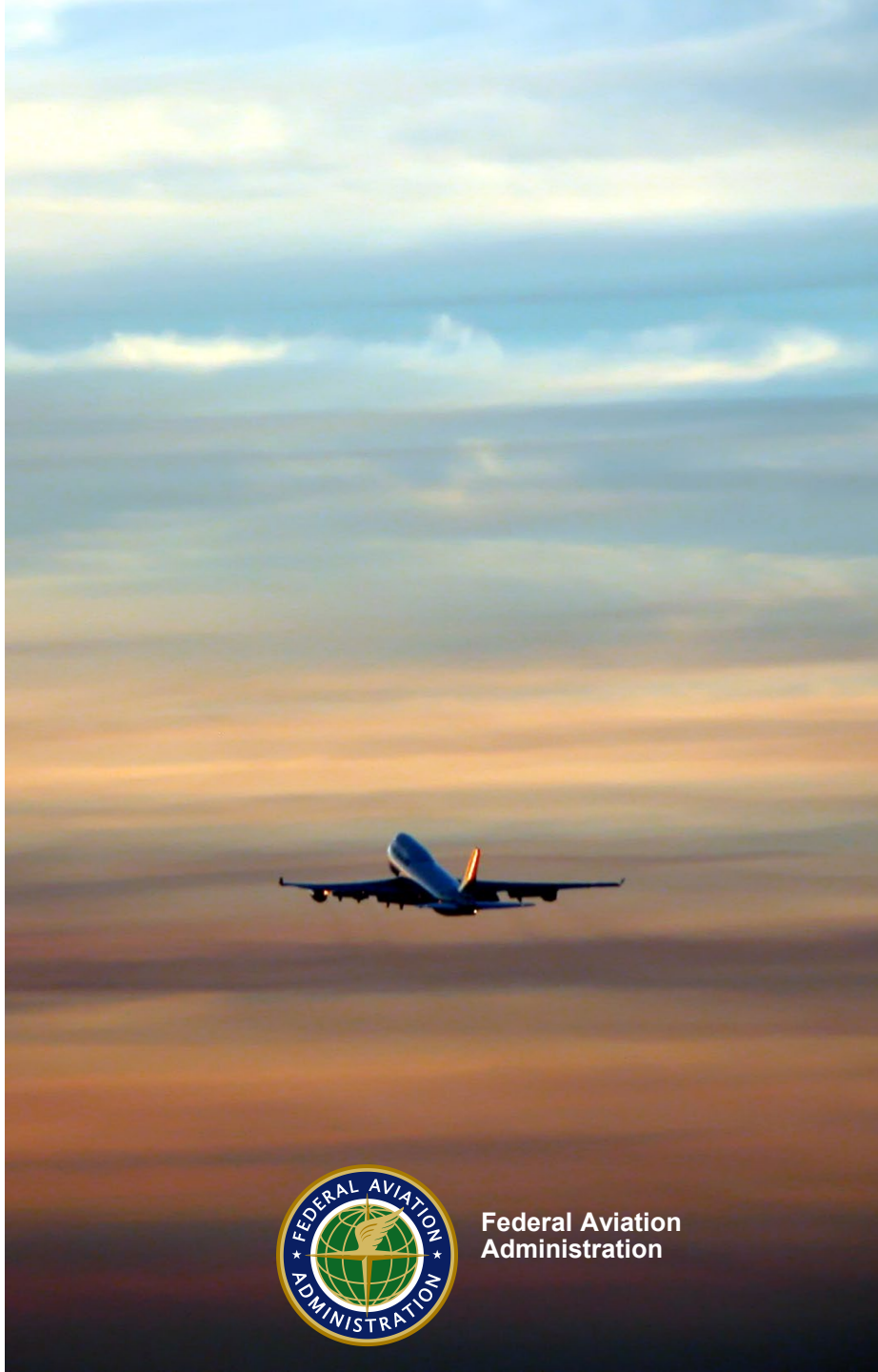
GPS/GNSS Jamming/Spoofing

Christina Clausnitzer
Office of Safety Standards

Apr 24, 2024



Why is civil GPS/GNSS vulnerable?

- **Signals are extremely weak and easily overpowered**
- **Public GPS/GNSS signals have no security protocols**
  - Unencrypted and unauthenticated digital data messages
- **Easily imitated (open public standards)**
- **Most devices "blindly" trust signals they receive**
- **Unlike computers/routers, GPS/GNSS has no firewall/virus protection**
- **Spoofing, tactics & techniques-widely available on the internet**
- **Low-cost devices have large area effect**

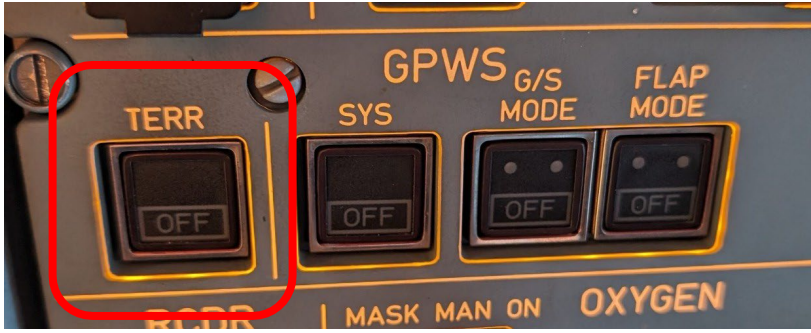
GPS/GNSS can be trusted, but how do you know what you're using is actually from GPS/GNSS?

Aircraft and ATC GPS/GNSS Dependencies

- **Comm:** Datacom, SATCOM, Networks
- **Nav:** RNAV, RNP & LPV
- **Surveillance:** ADS–B and ADS-C
- **Safety:** GPS/GNSS enables Terrain Awareness and Warning System (TAWS) forward-looking function
- **Automation & Aircraft Specific Functions**
- **Support Equipment:** Elec Flt Bag, etc.
- **FAA ATC & Industry Infrastructure**

May not be able to identify erroneous GPS/GNSS signal nor "deselect" the signal

False Alerts & Warnings



Two fundamental principles:

1. **Trust Your Instruments**
2. **Follow Standard Operating Procedures**

Pilot must either:

1. Ignore alerts/warnings; or
2. Follow required checklists & execute mandatory evasive maneuvers

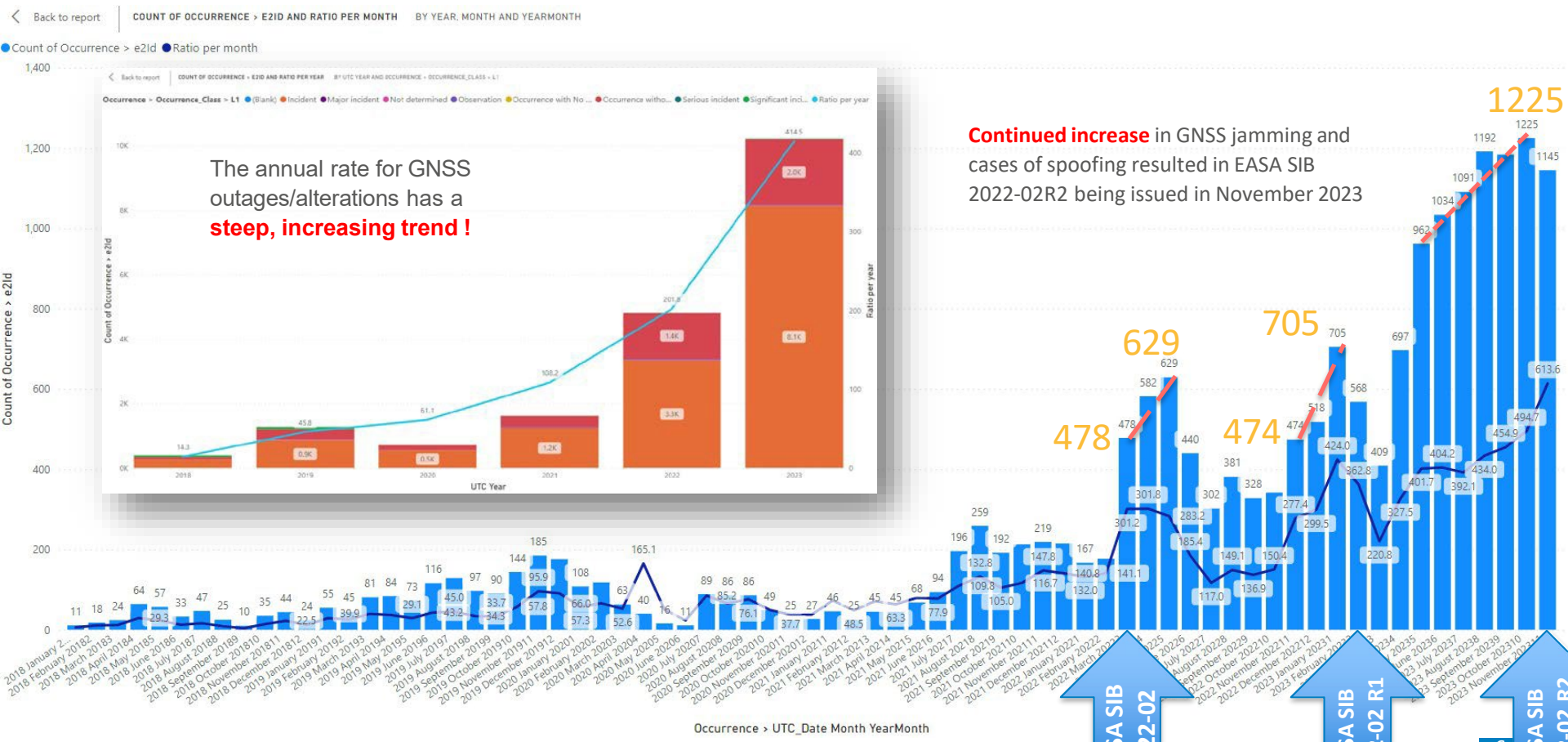
Representative Audio:

Spoofing can result in repeating TAWS alerts and other alerts

- Aural Warnings cannot be muted or turned down

Pilot workload and desensitization

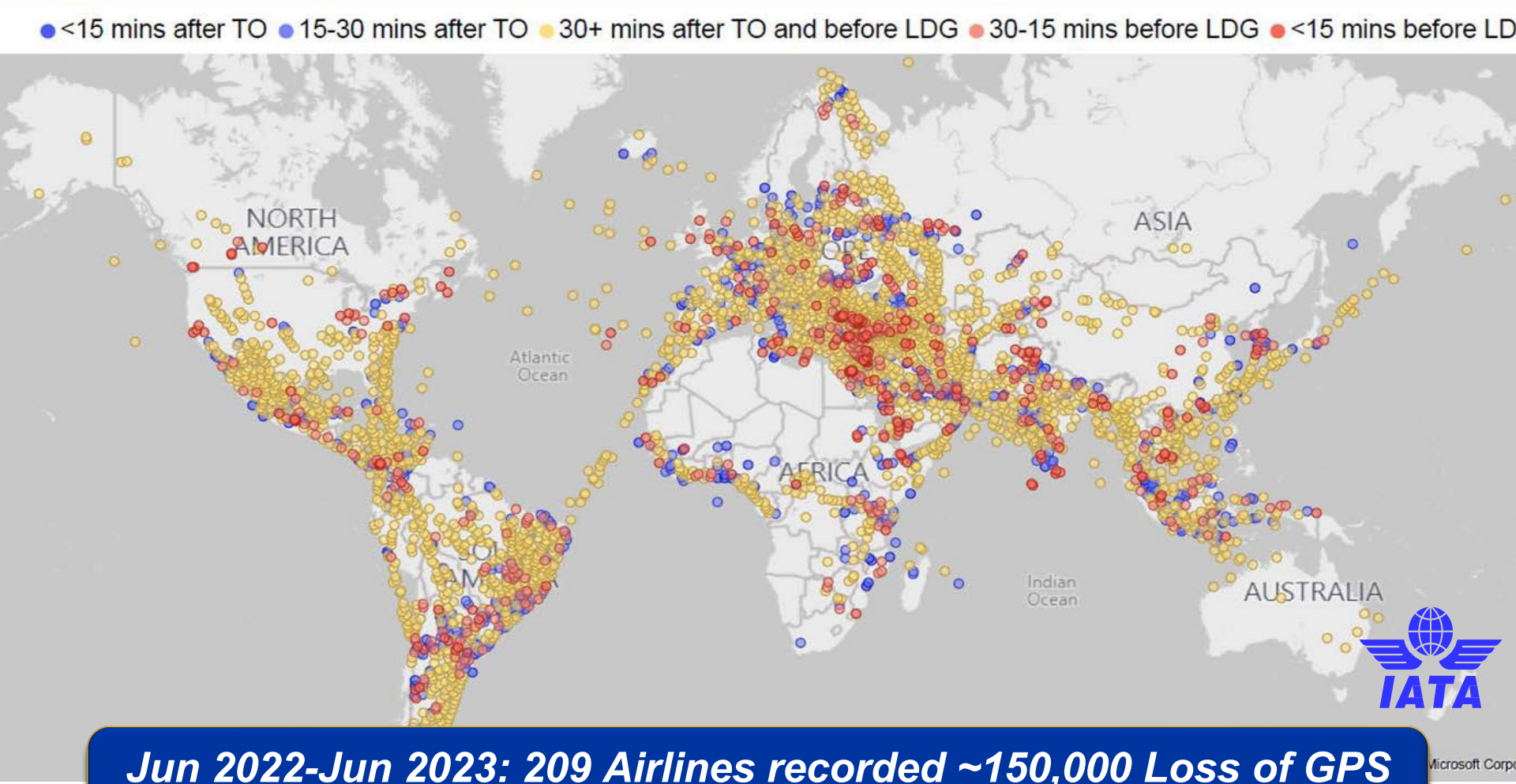
GNSS outage (ECR data)



Rates are per 1.000.000 flights

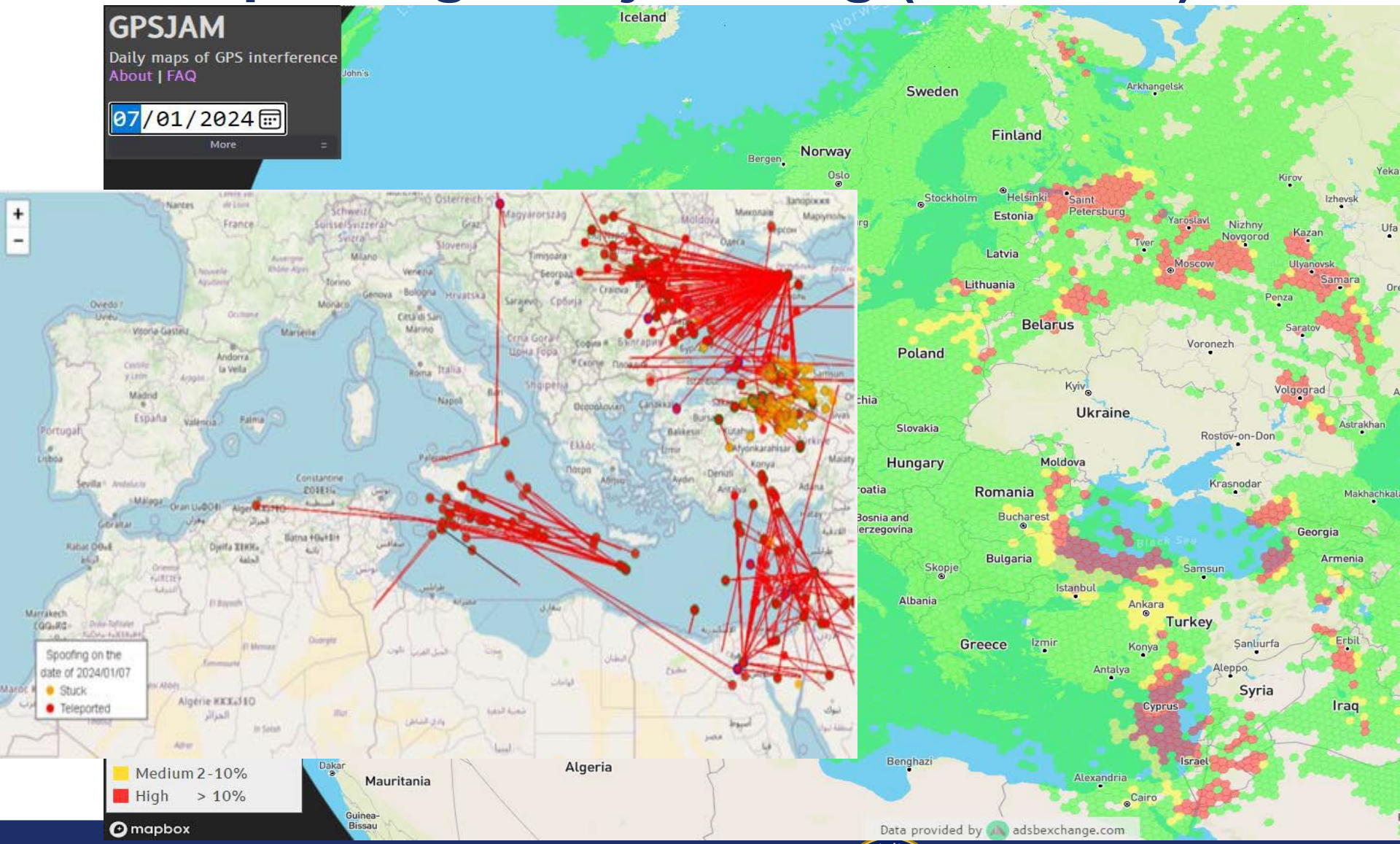
Federal Aviation Administration

GNSS Signal Loss Occurrence by Phase of Flight



Jun 2022-Jun 2023: 209 Airlines recorded ~150,000 Loss of GPS Events in ~5 million flight operations

Spoofing and jamming (EUR/MID)



FAA Jamming / Spoofing Activities

- SAFO (25 Jan 24) provides information and guidance to operators and manufacturers for operations in a disrupted environment
- Performance Based Navigation (PBN) Aviation Rulemaking Committee (PARC) GPS Disruption Action Team coordinating with stakeholders to ensure safe and efficient continuity and recovery of aircraft
- Leveraging industry and international partners and RTCA to identify and implement both operational & technical mitigations
- Developing integrated FAA/Industry “Playbooks” for future events
- FAA working with RTCA to improve DME PBN Navigation capability
- Evaluating situational awareness tools for display and decision making
- FAA researching jam and spoof resistant antennas for civil aircraft

Takeaways

- **Enriching NOTAM language when GPS disruptions occur**
  - **Possible update to Order 7930.2T**
  - **NOTAMS publish as soon as jamming/spoofing has been corroborated (e.g., airport-specific or area/ region wide impacts)**
- **Reviewing GPS resiliency programs with a 2024 lens**
- **Reviewing routes/procedures for "GPS required" as necessary**

REPORT! REPORT! REPORT!

Questions?