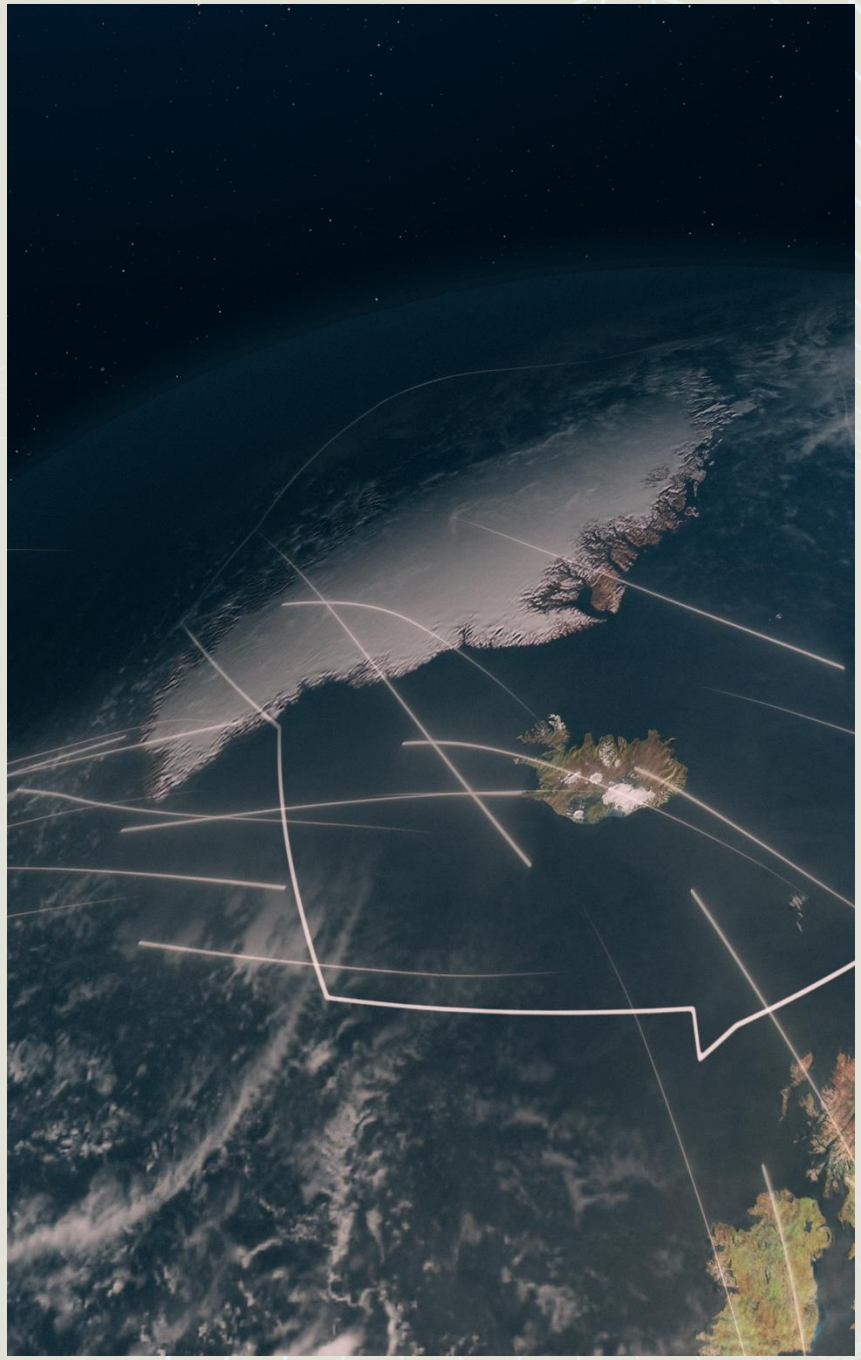
GNSS RFI effects in Reykjavik CTA

Analysis and observed effects

Guðmundur Karl Einarsson

Air Traffic Controller / ATM Systems Development



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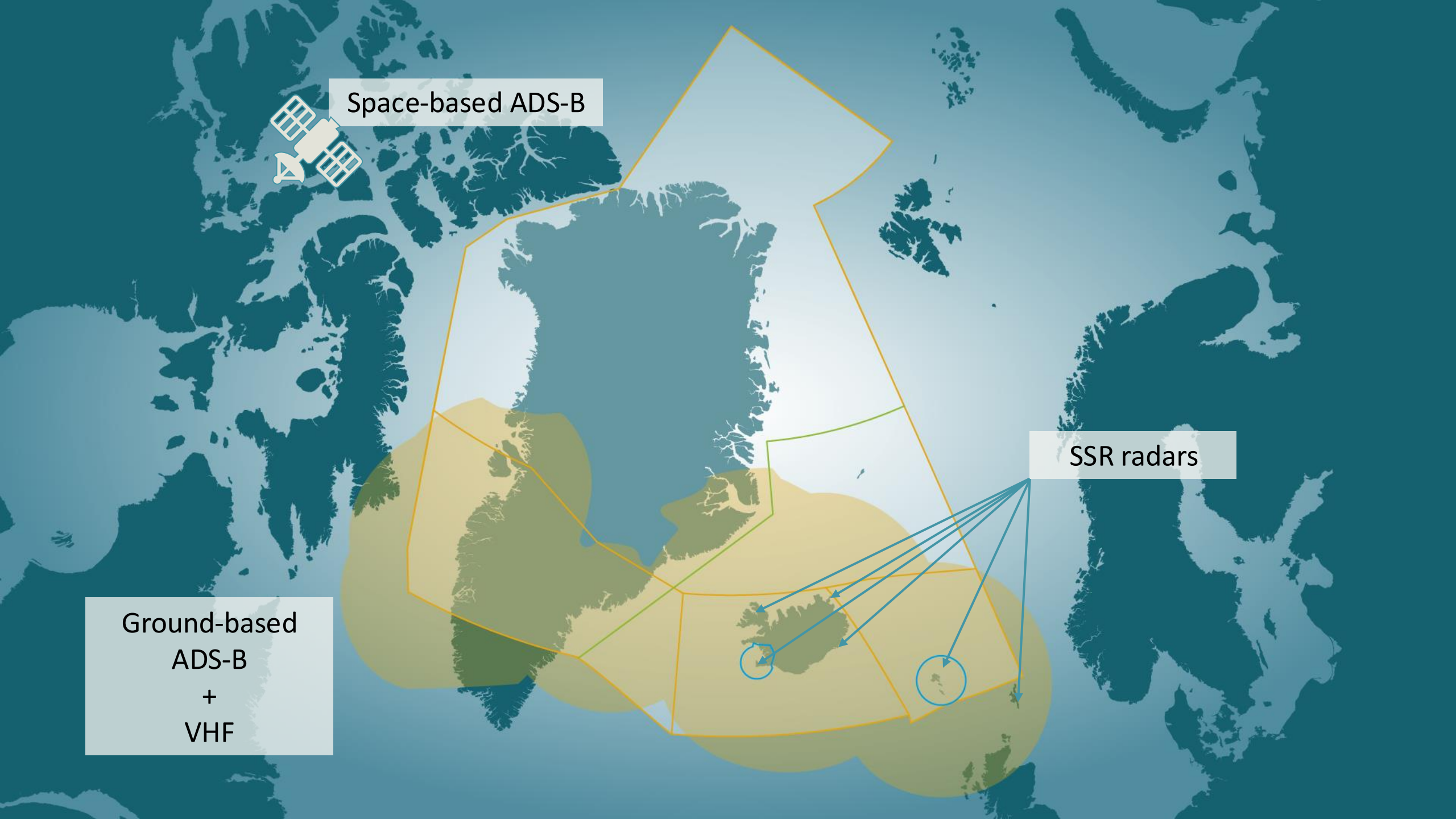
Reykjavik CTA

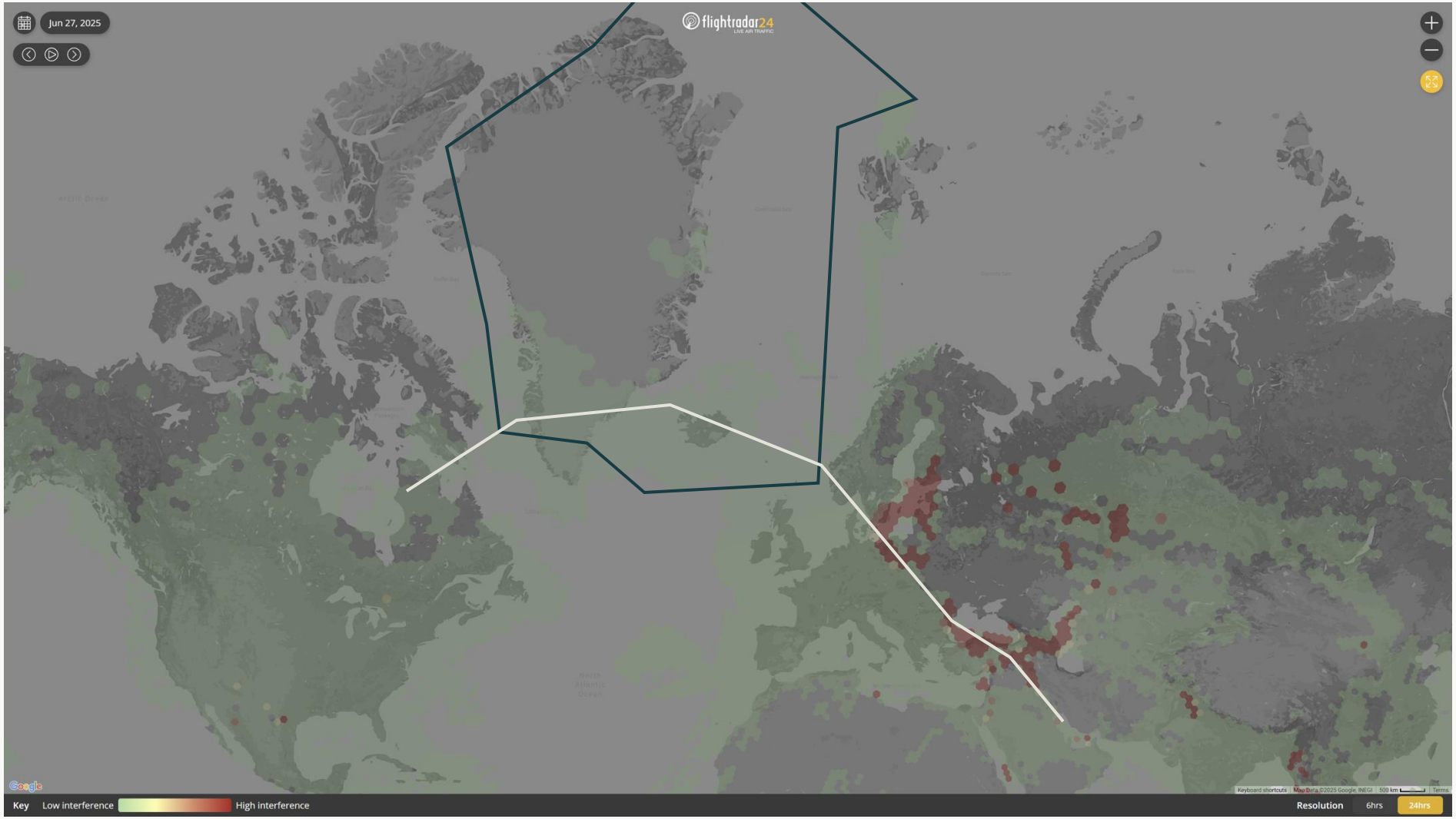
Nuuk FIR

F195 and above
north of 63°30‘N

Reykjavik FIR


Space-based ADS-B
SSR radars
Ground-based
ADS-B
+
VHF

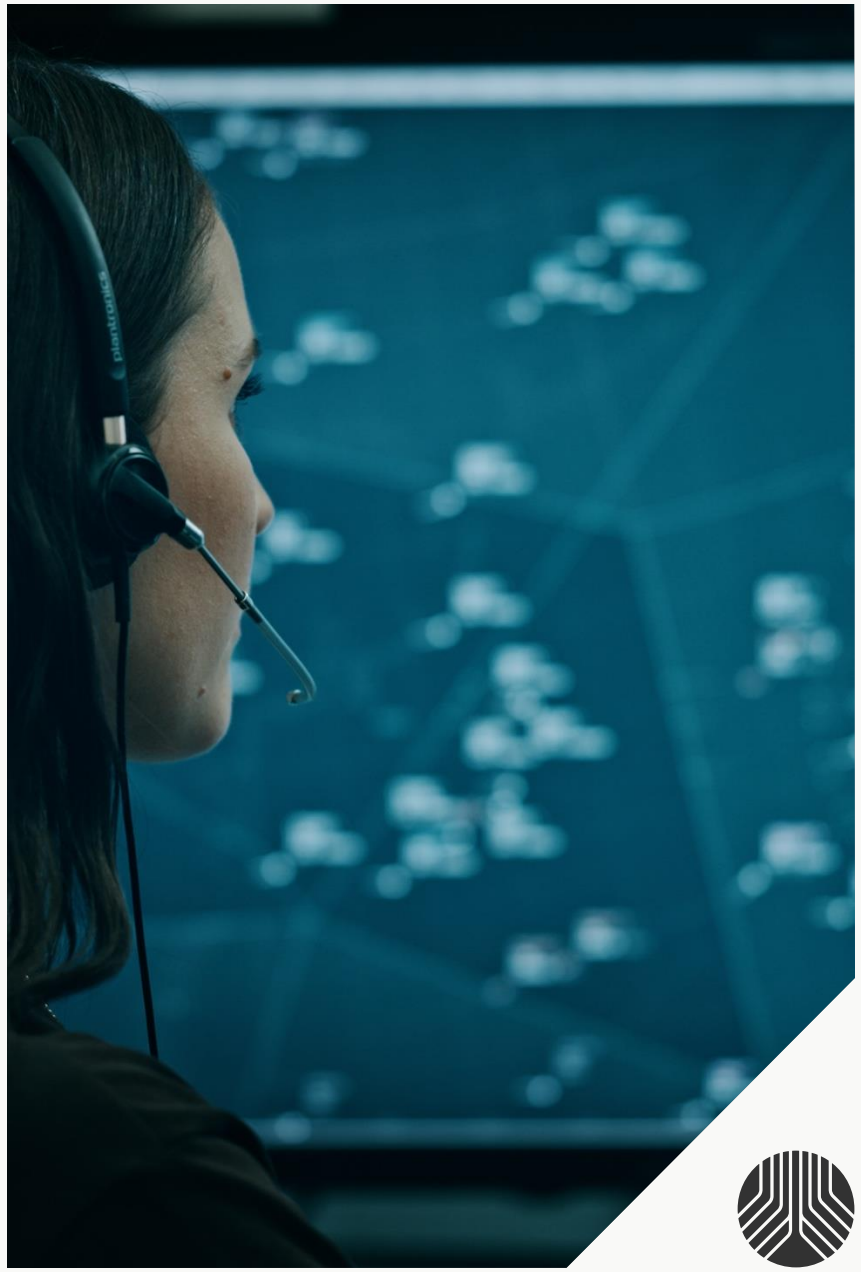
How does GNSS RFI far away affect Reykjavik CTA?



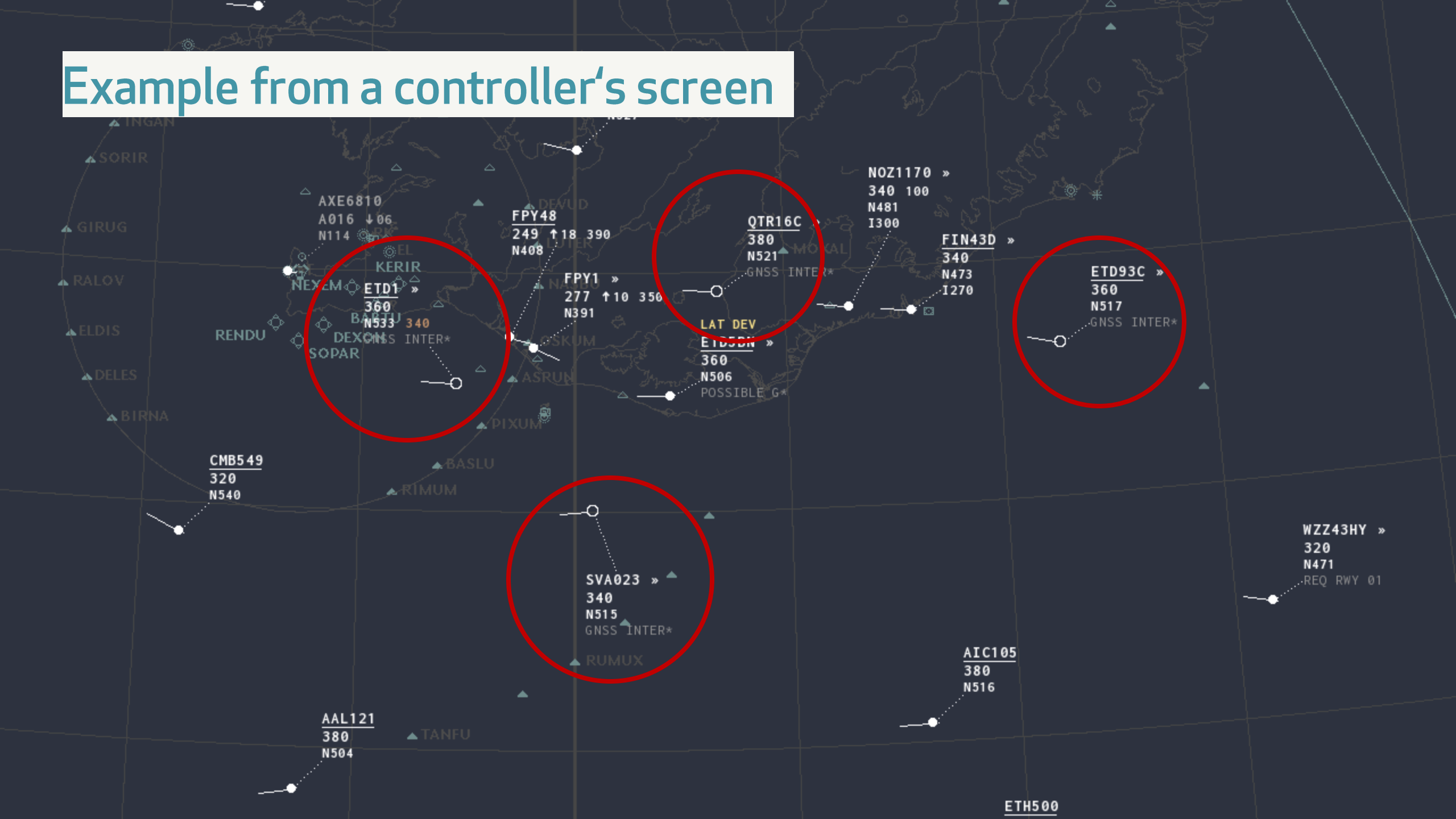
GNSS jammed/spoofed aircraft

What do the controllers in Reykjavik see?

- ADS-B unusable = aircraft not visible
  - *Not received, or*
  - *Quality indicator below minimum*
- ADS-C
  - *Figure of Merit (FOM) low*
- Data link connectivity and incorrect clock
  - *Clock incorrect results in some aircraft unable to log on while other aircraft send CPDLC messages with incorrect timestamp.*
- Pilot reports
  - *RNP4 or RNP10*
  - *One or both GPS out*



Example from a controller's screen

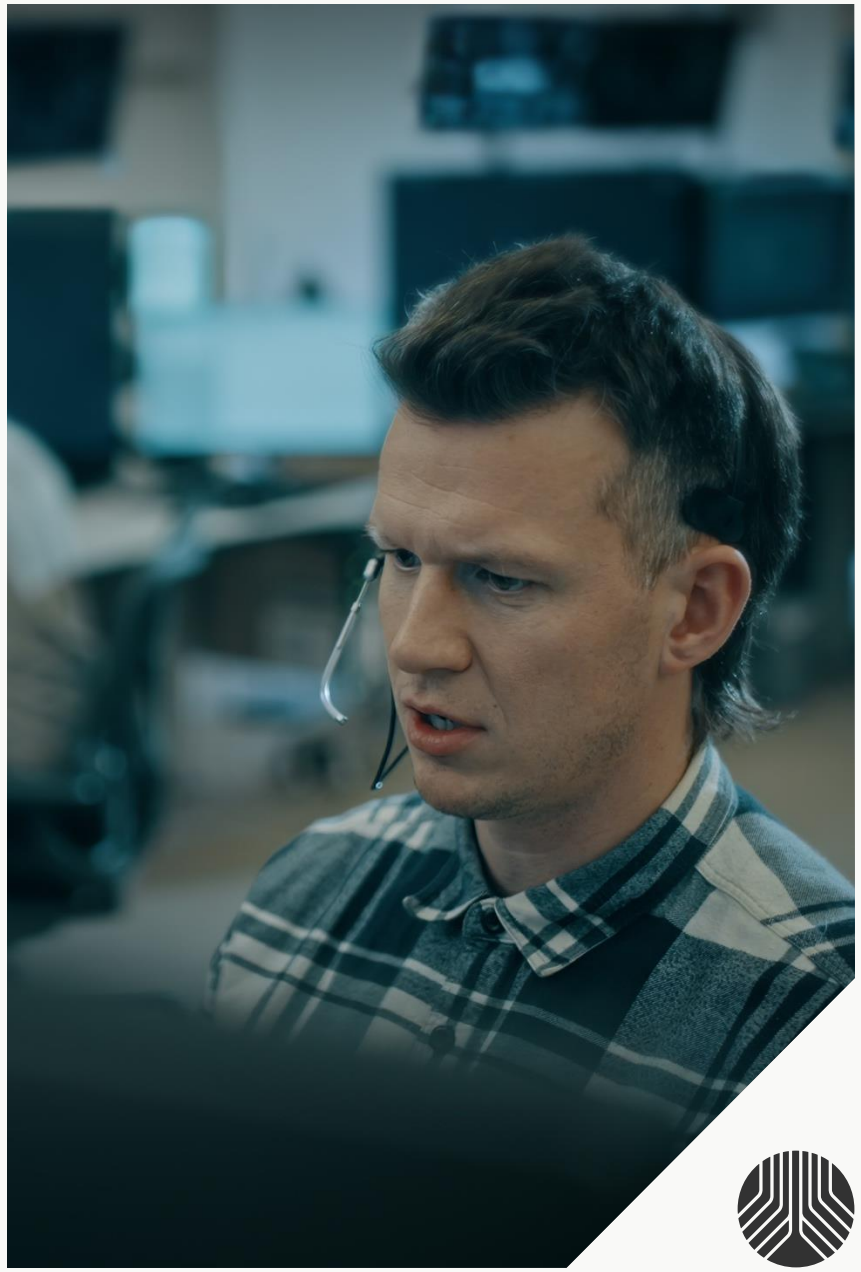


What happens to those aircraft in NAT?

Limited service

- Limited equipage means Air Traffic Controllers are not able to provide reduced separation based on:
  - *ADS-B*
  - *FANS 1/A Data Link (CPDLC and ADS-C)*
  - *RNP4*
  - *RCP240/RSP180*

- Aircraft often need to descend to a lower level before leaving radar coverage or exiting Reykjavik CTA.
- There are cases of aircraft having to divert to an alternate airport to refuel.



How common is this in Reykjavik?

Statistics on GNSS RFI

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Air Navigation Services

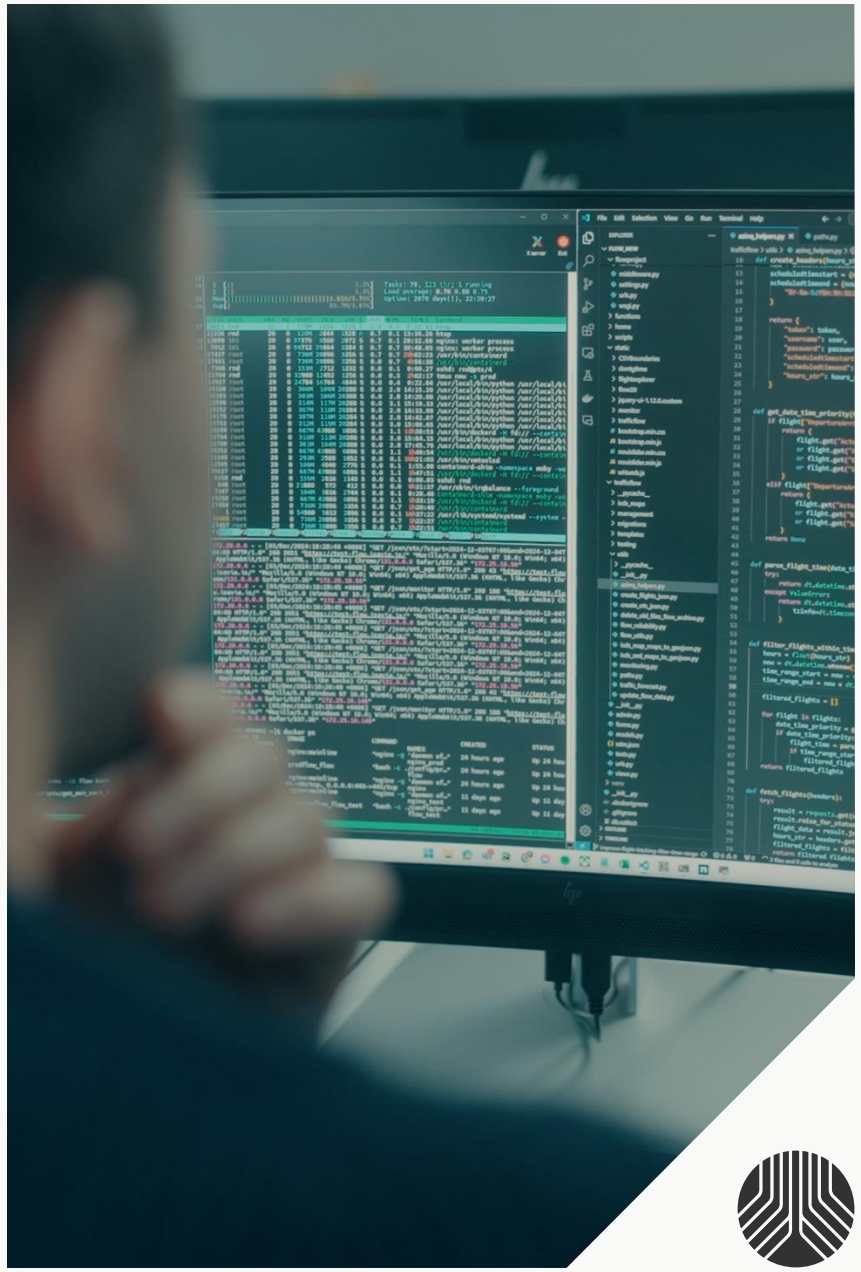
Criteria for analysis

Aircraft deemed possibly affected by GNSS RFI:

- ADS-B
  - *Not received, or*
  - *More than 5% of ADS-B reports with poor quality indicators*
- ADS-C
  - *Is received and more than 5% of ADS-C reports contain FOM 3 or lower.*
- Timestamp
  - *At least one downlinked CPDLC message with timestamp more than 1 second into the future.*

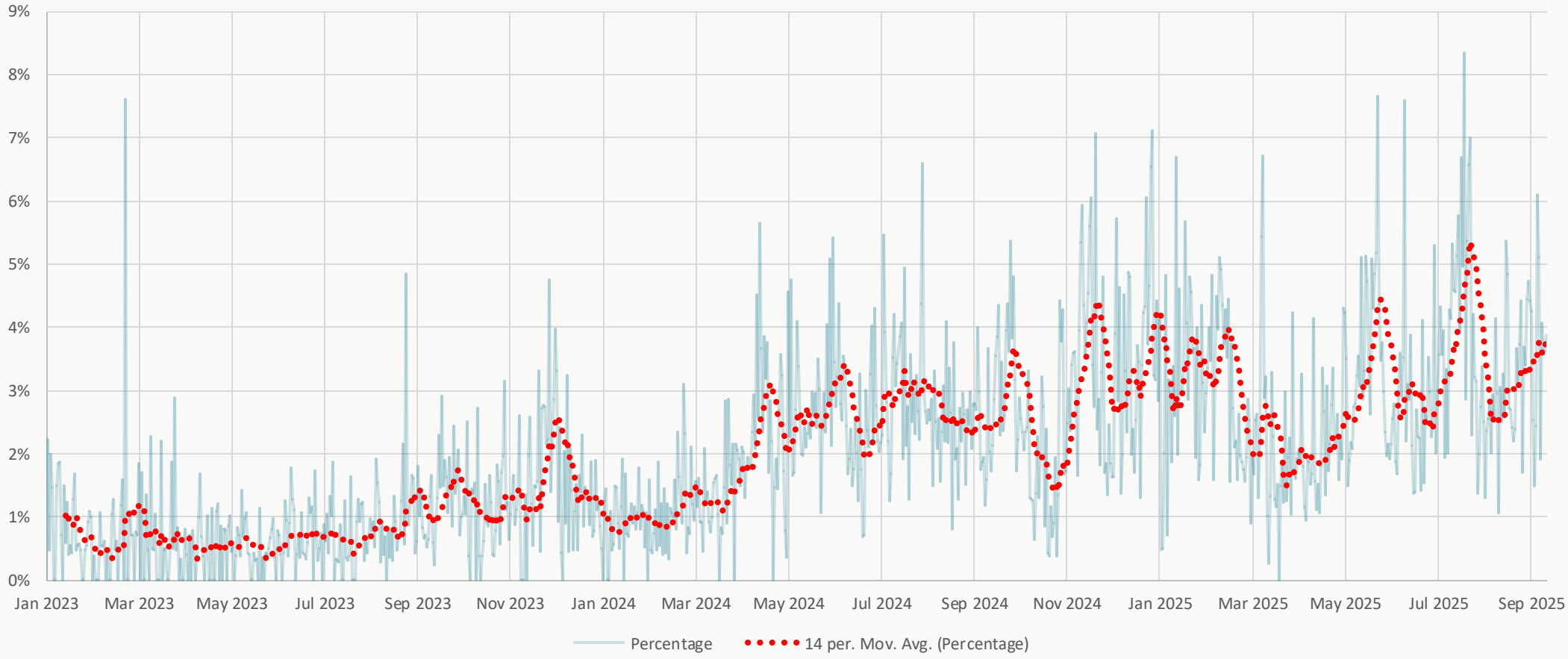
Excluded:

- Military flights
- To/from Iceland, Greenland or Faroe Islands
- Flights less than 60 seconds within Reykjavik CTA



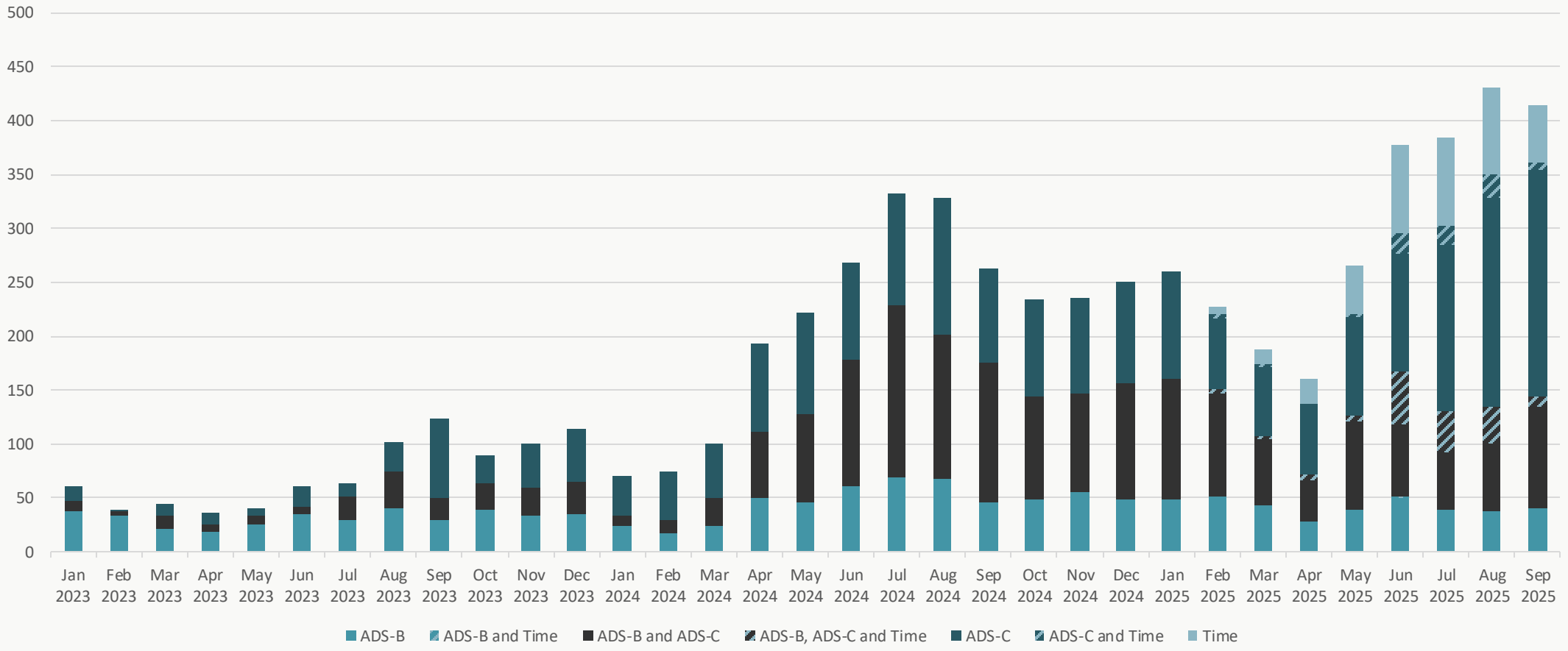
Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Percentage of overflights (1 Jan 2023 – 30 Sep 2025)



Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

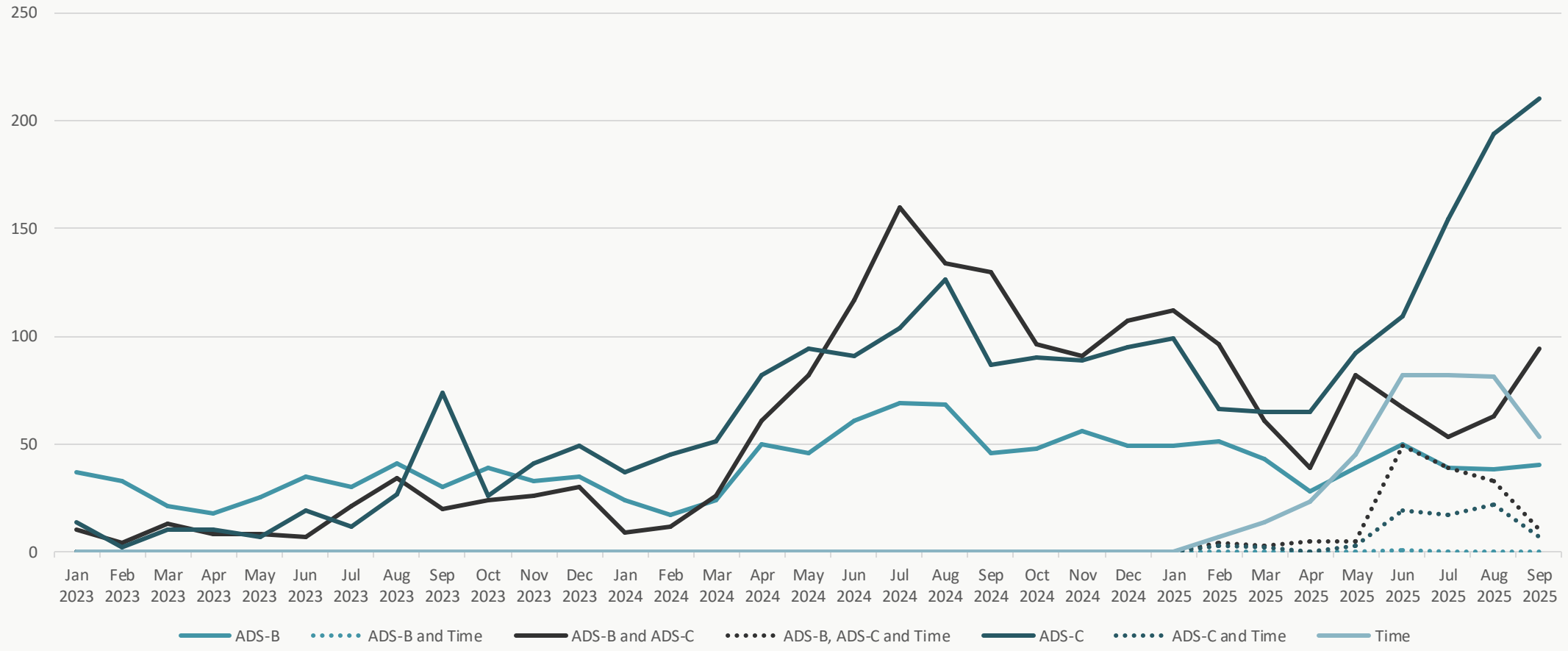
Number of affected flights (1 Jan 2023 – 30 Sep 2025)



*Time inconsistency only processed from 7 February 2025.

Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Number of affected flights (1 Jan 2023 – 30 Sep 2025)



*Time inconsistency only processed from 7 February 2025.

Most common departure airports

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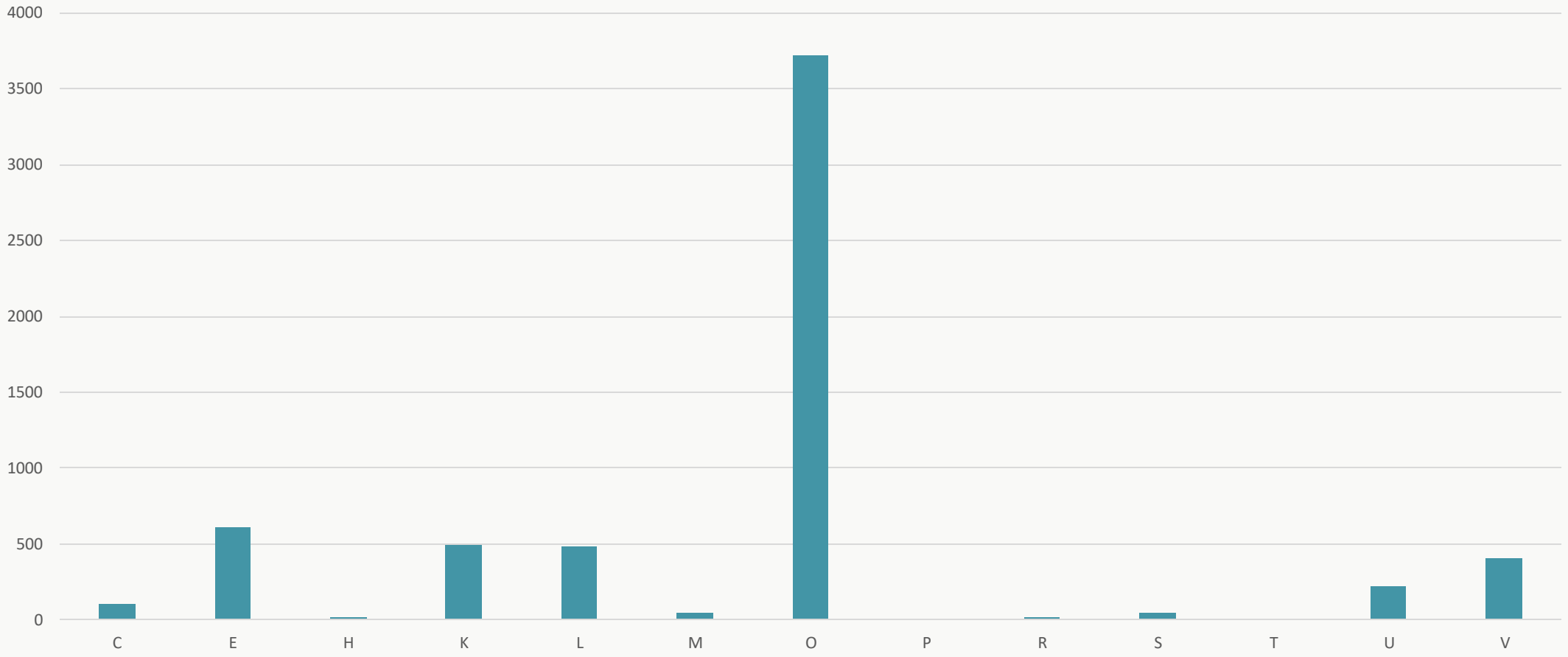
Air Navigation Services

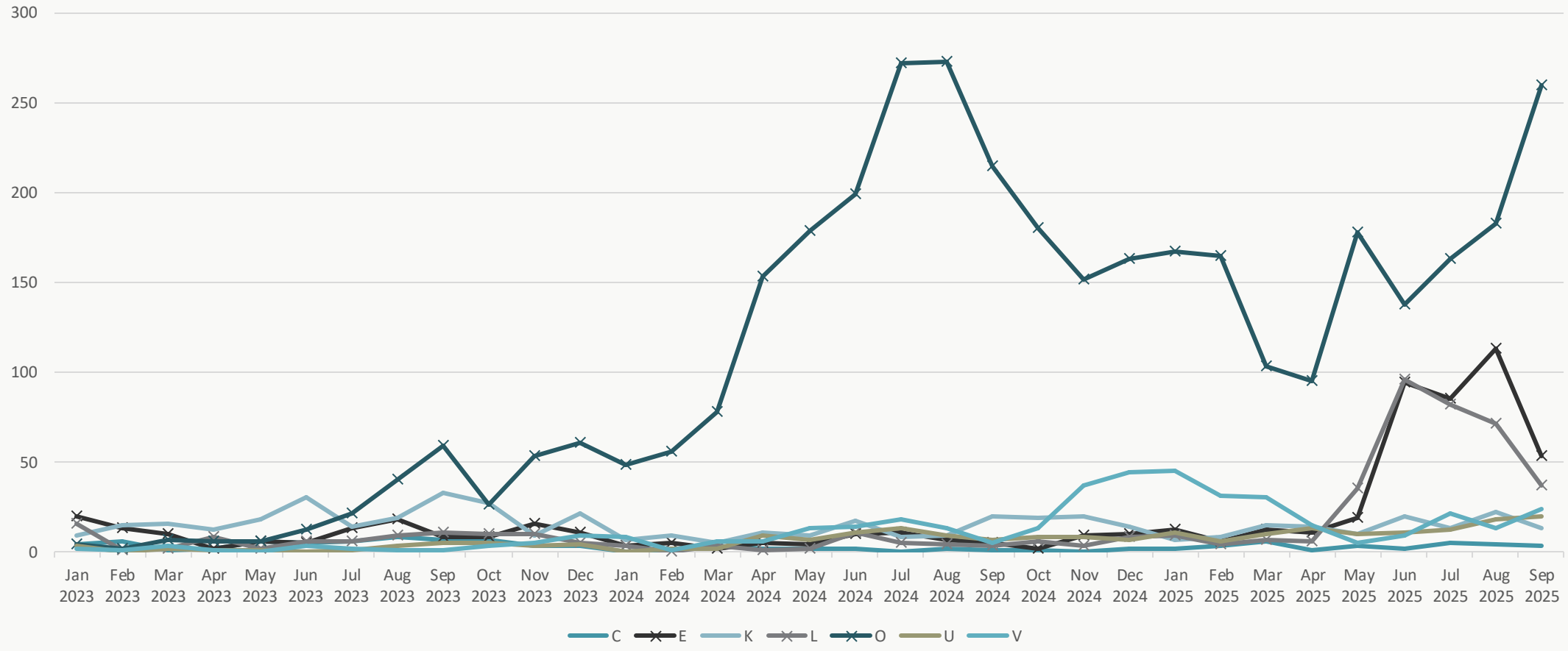
Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Number of flights from DEP region (1 Jan 2023 – 30 Sep 2025)



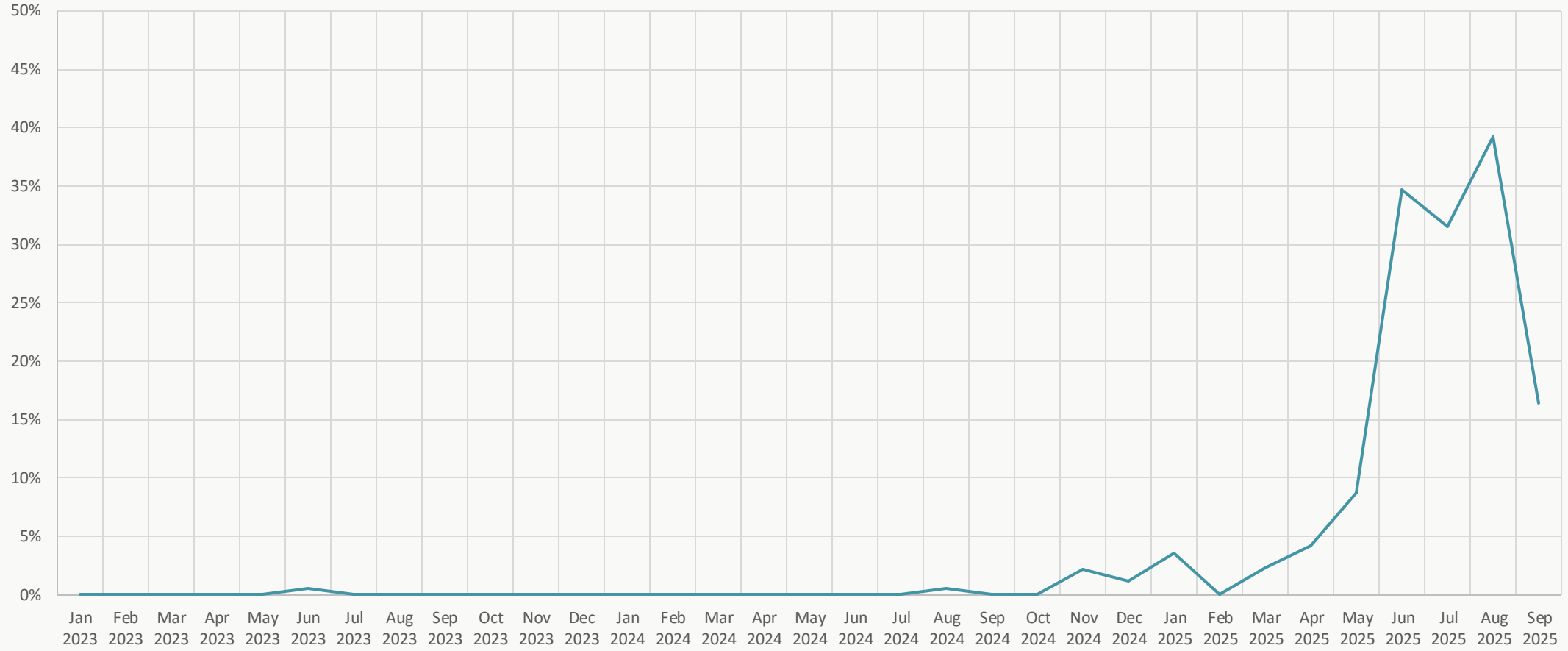
Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Number of flights from DEP region with over 100 affected flights (1 Jan 2023 – 30 Sep 2025)



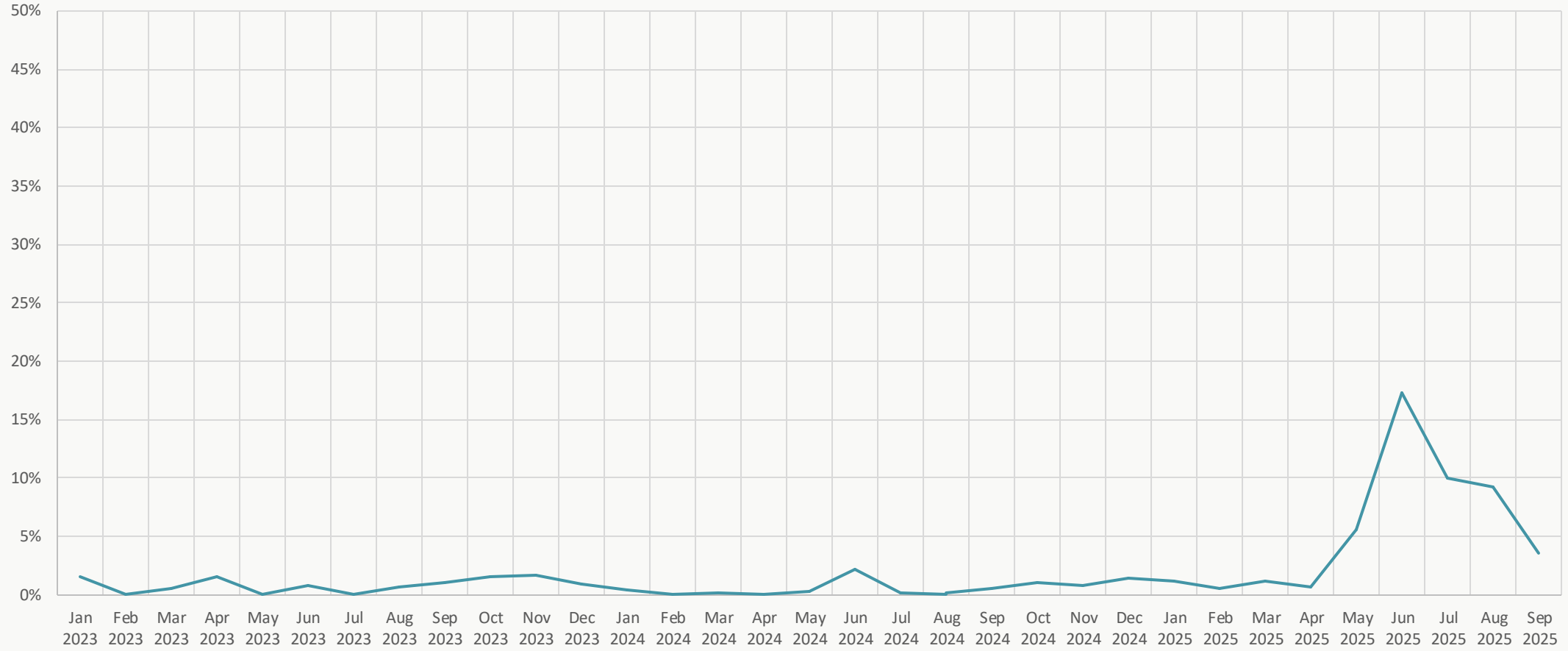
Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Percentage of DEP from EPWA – Warshaw (1 Jan 2023 – 30 Sep 2025)



Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Percentage of DEP from LTFM – Istanbul (1 Jan 2023 – 30 Sep 2025)

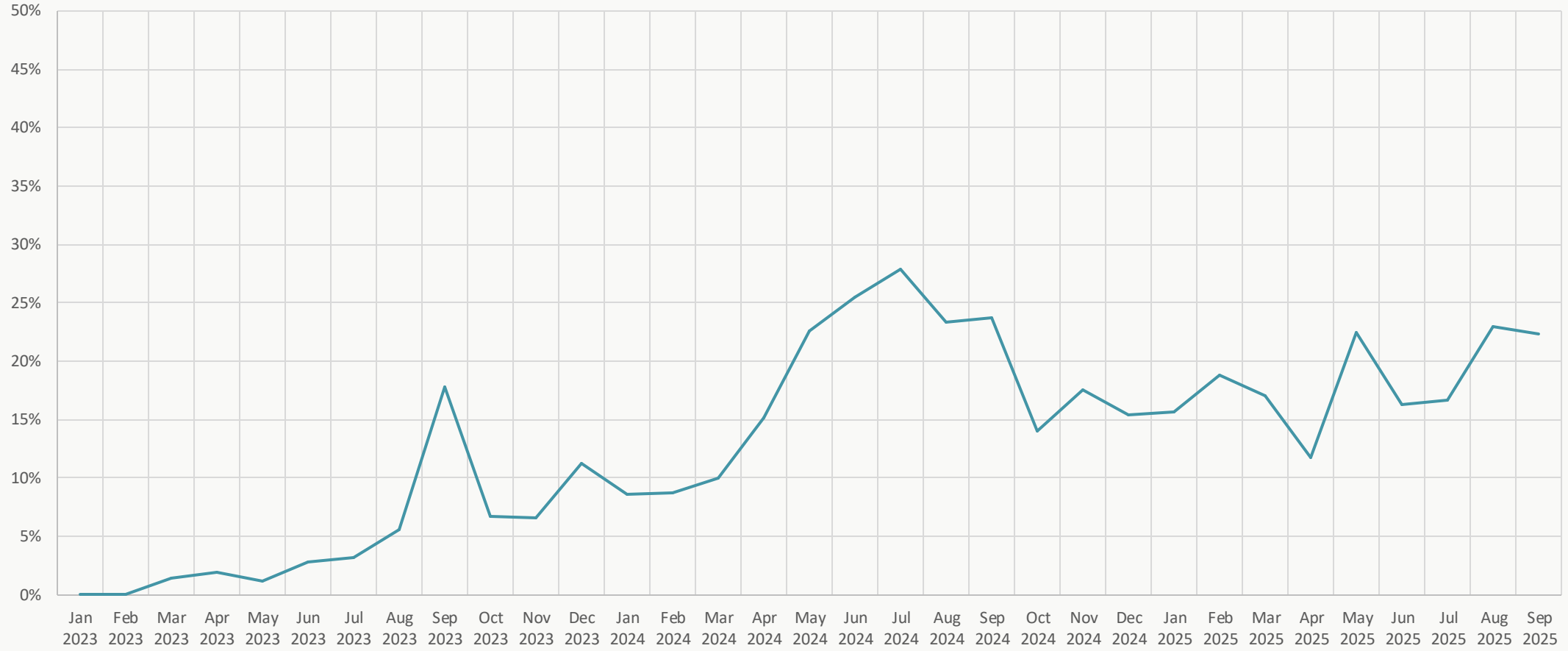


Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Percentage of DEP from OMAA – Abu Dhabi (1 Jan 2023 – 30 Sep 2025)

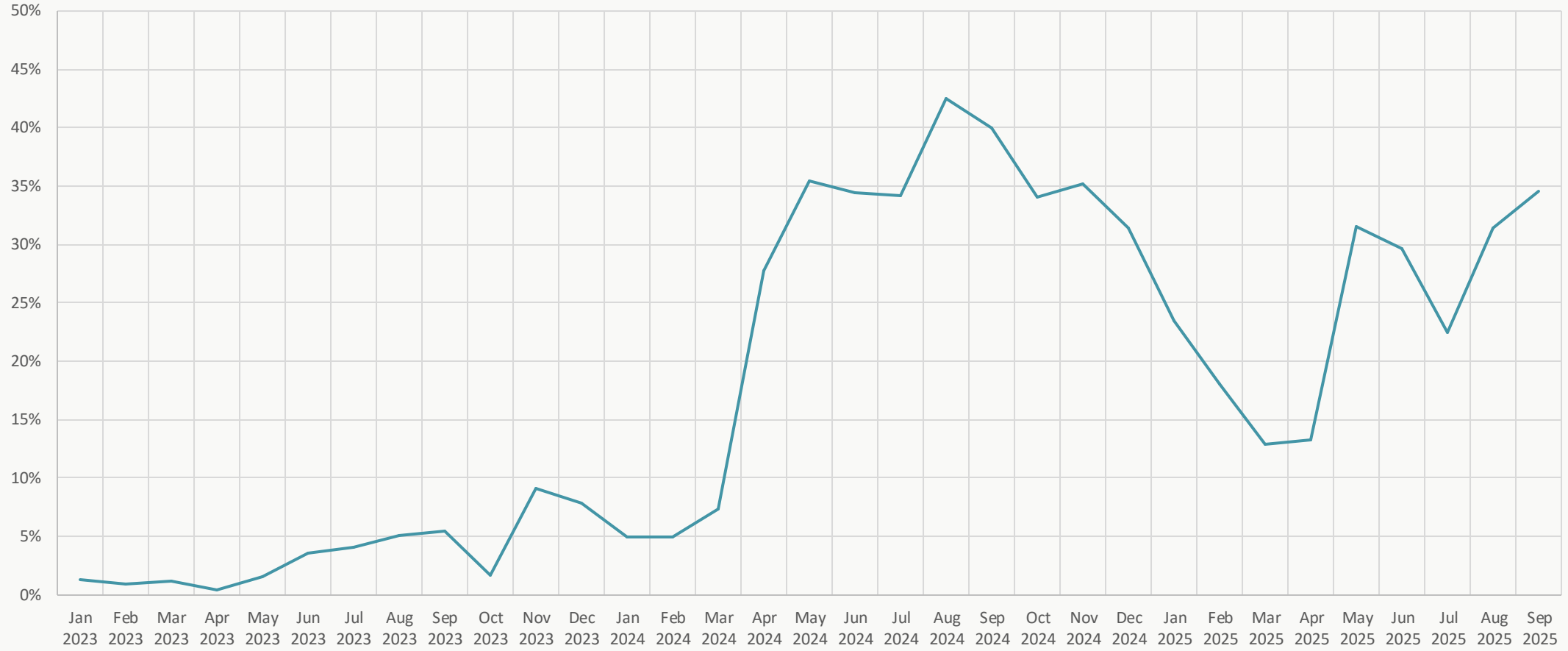
Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Percentage of DEP from OMDB – Dubai (1 Jan 2023 – 30 Sep 2025)



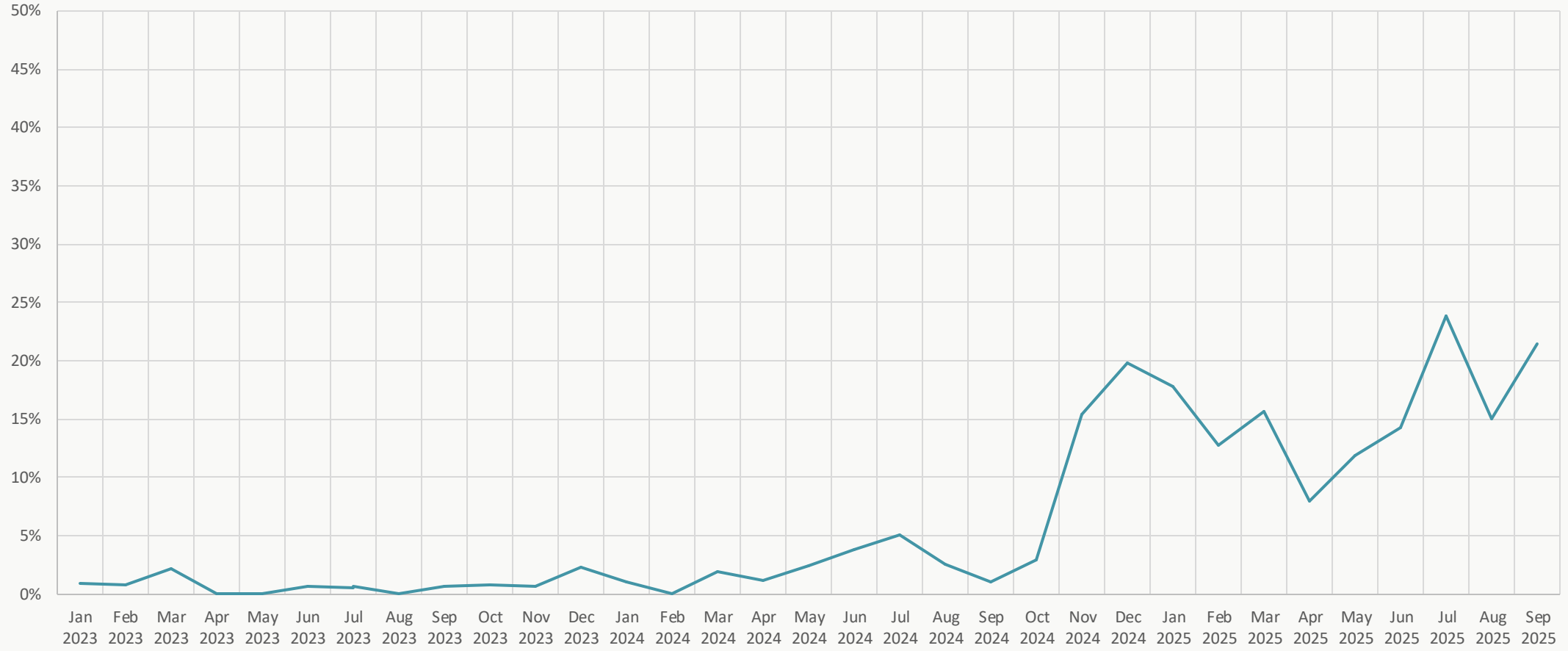
Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Percentage of DEP from OTHH – Doha (1 Jan 2023 – 30 Sep 2025)



Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Percentage of DEP from VIDP – Delhi (1 Jan 2023 – 30 Sep 2025)



Aircraft types

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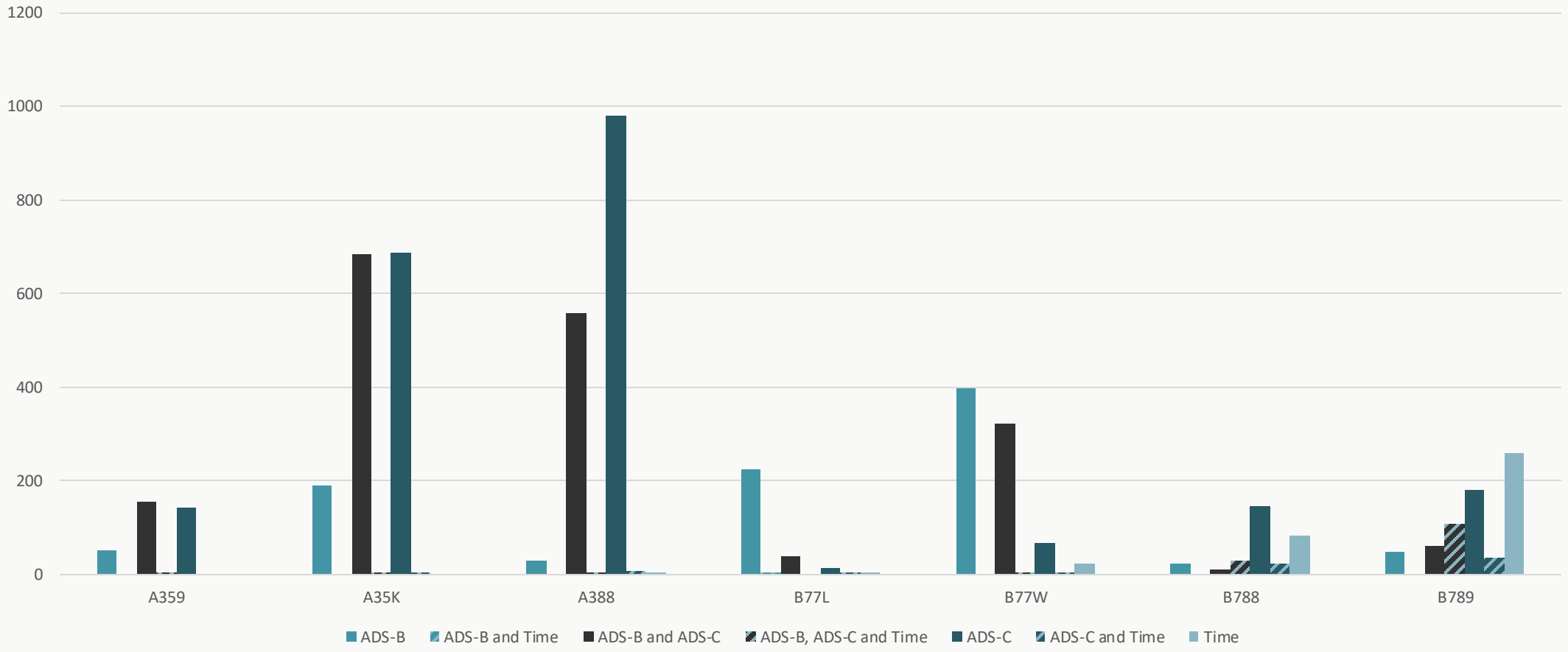
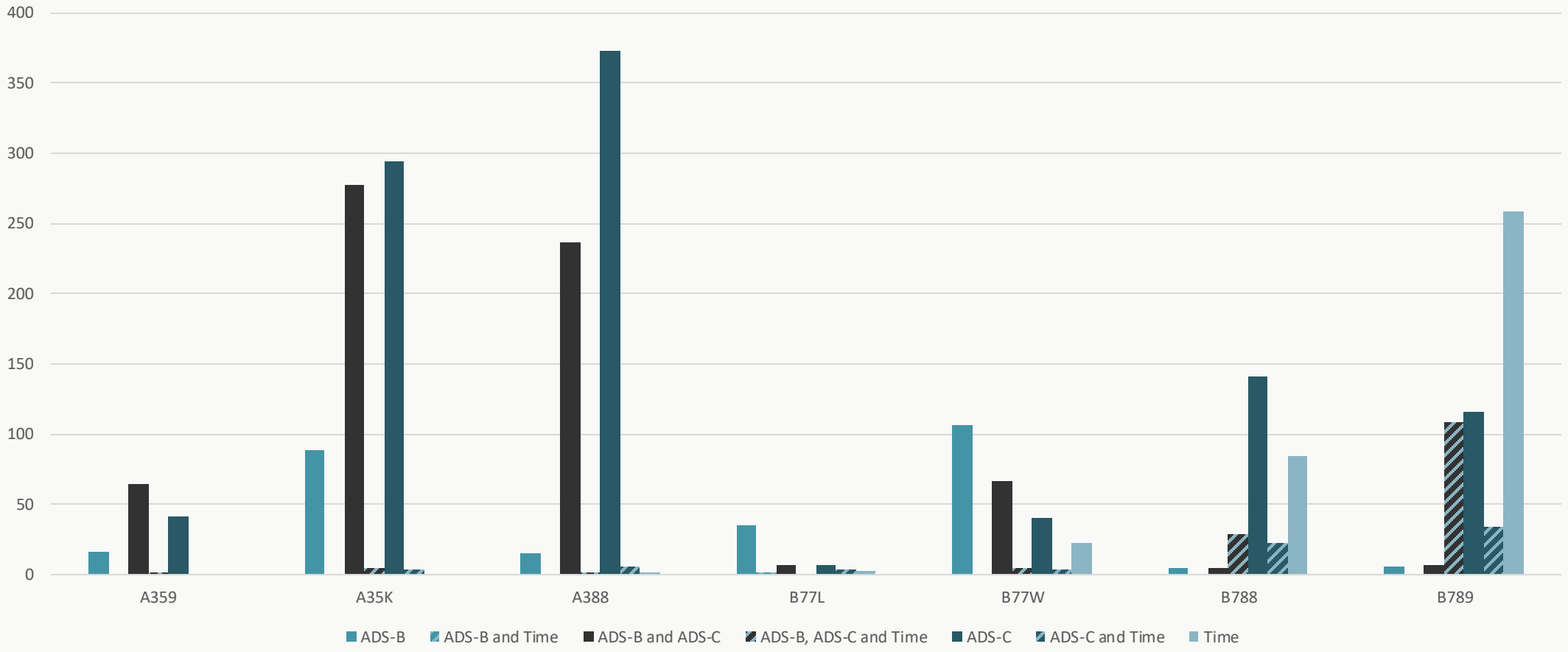
Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Aircraft types with more than 250 occurances (1 Jan 2023 – 30 Sep 2025)



Number of possible GNSS jammed/spoofed flights in Reykjavik CTA

Aircraft types with more than 250 occurances (1 Jan 2025 – 30 Sep 2025)



The time issue

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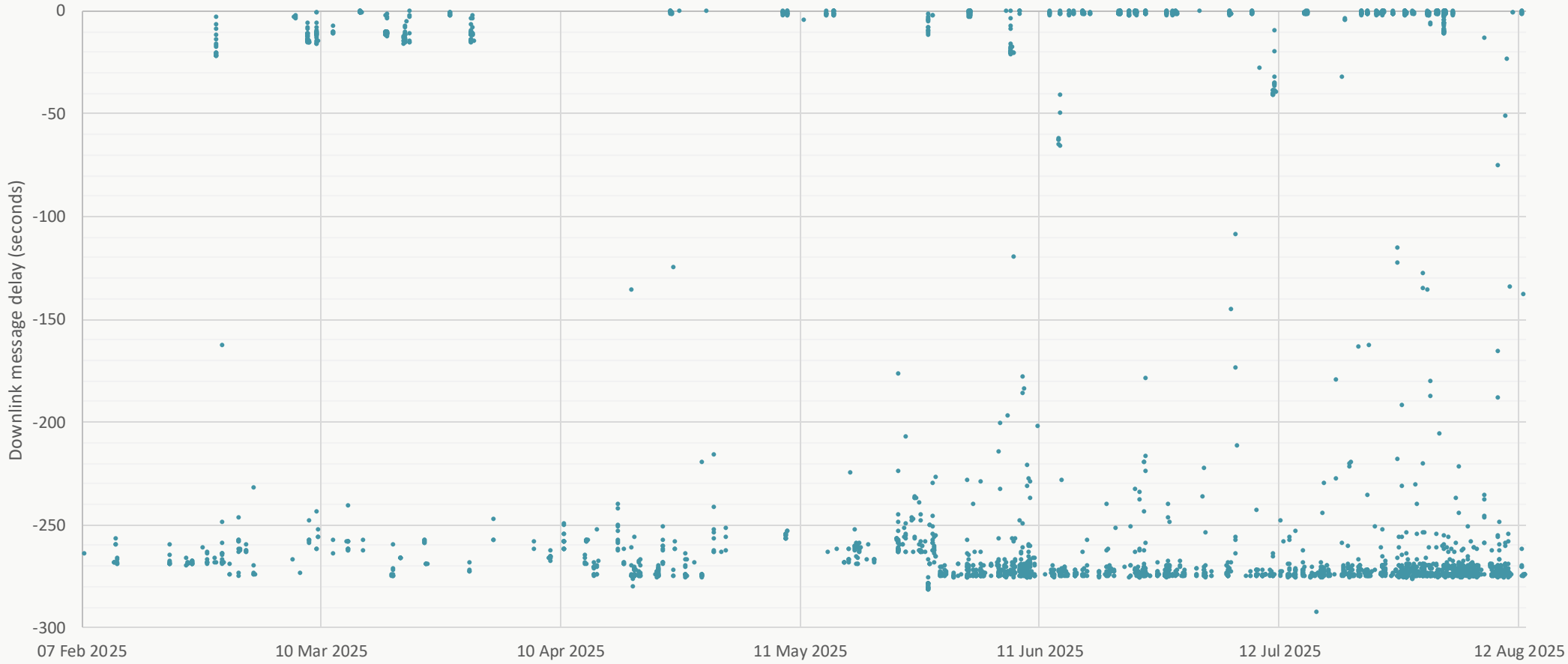
Time issue

Downlink messages with timestamp into the future

- Controllers started seeing an increase in downlink CPDLC messages being rejected by the FDPS (Flight Data Processing System) in May 2025.
- If a downlinked CPDLC message is timestamped more than 1 second into the future then the FDPS will reject the message.
- Most messages with incorrect timestamp are marked **275 seconds** into the future.
- It is common to see some messages with incorrect timestamp and other messages as expected.

Downlink messages timestamp into the future

7 FEB 2025 to 13 AUG 2025



Example of fluctuating clock

Boeing 787-900 (September 2025)

Received time	Message time	Delay	Message Text
03:02:51	03:02:49	00:00:02	[DM48] POSITION REPORT 6101.2N00008.9W 0303 F380 6200.0N01000.0W 0339 6200.0N02000.0W 0914 TEMP -63 C WIND 172 19 .84M REPORTED WPT GUNPA 0302 F380
03:03:22	03:03:21	00:00:01	[DM3] ROGER
03:04:05	03:08:36	-00:04:31	[DM40] ASSIGNED ROUTE VIDP 29R KJFK 22L APPROACH ILS22L ARRIVAL PARCH4 ENE 62N010W 62N020W 6130.0N030W 5930.0N040W 56N050W LOMSI N664A HULTN ENE TRAIT AT F240 CCC 250 IAS AT 12,000 FT ROSLY AT OR ABOVE 3,000 FT ZALPO AT OR ABOVE 1,800 FT RW22L AT 070 FT
03:04:07	03:08:39	-00:04:32	[DM0] WILCO
03:45:25	03:45:19	00:00:06	[DM9] REQUEST CLIMB TO F400 [DM66] DUE TO AIRCRAFT PERFORMANCE
03:47:21	03:47:15	00:00:06	[DM0] WILCO
03:50:27	03:50:21	00:00:06	[DM37] LEVEL F400
04:04:53	04:04:51	00:00:02	[DM0] WILCO
04:10:54	04:10:52	00:00:02	[DM3] ROGER
04:12:33	04:17:07	-00:04:34	[DM67] INDICATING RNP4 AT THIS TIME.
04:29:21	04:33:55	-00:04:34	[DM0] WILCO
04:30:48	04:35:22	-00:04:34	[DM3] ROGER
04:46:33	04:46:05	00:00:28	[DM37] LEVEL F310
04:47:16	04:47:04	00:00:12	[DM0] WILCO

Questions?