Data4Safety

Partnership for Data Driven Aviation Safety Analysis

Led by EASA

COSCAP-SEA

Demo Sessions: Data4Safety

Geert Kinders, D4S IT lead

13th of March 2025

EASA European Union Aviation Safety Agency

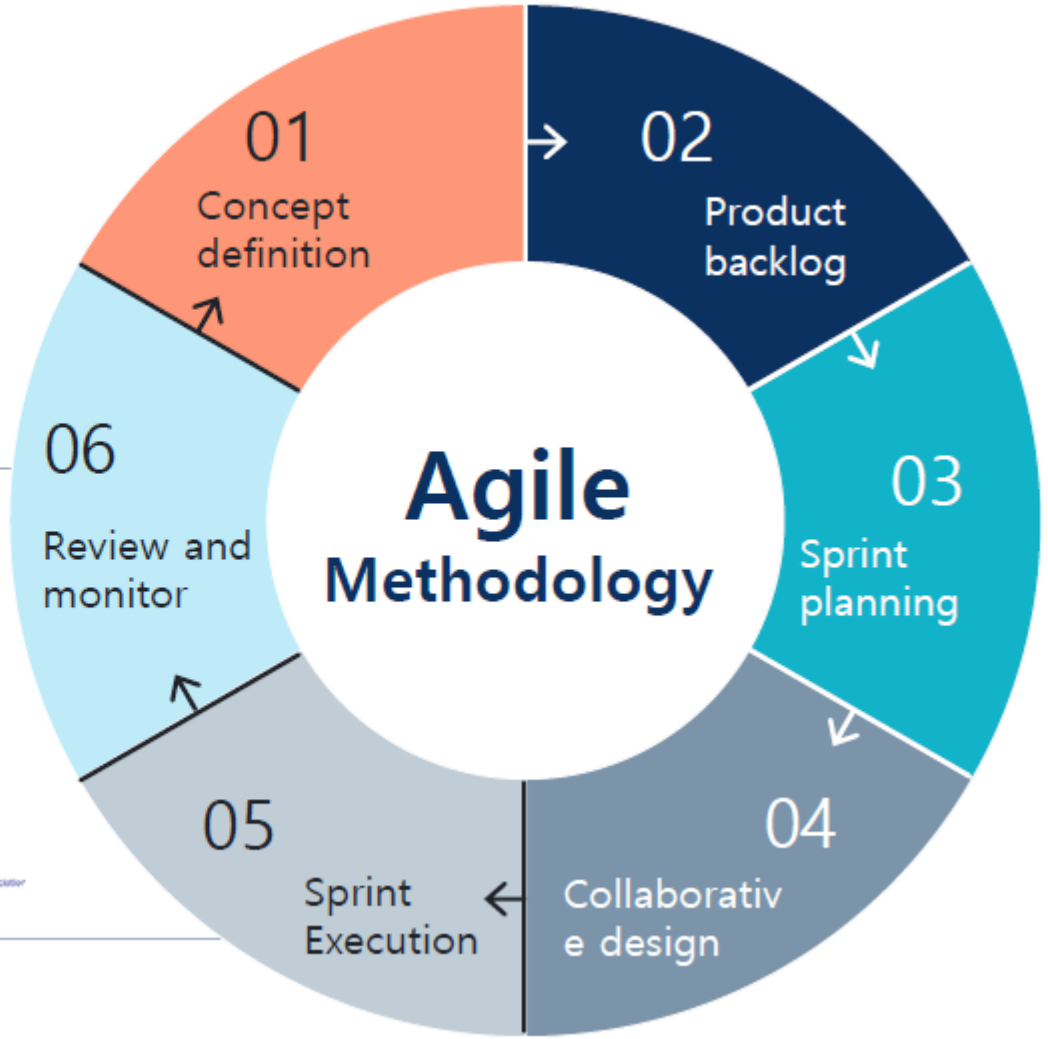
D4S is co-funded by the European Union

Directed Studies - Highlights

⇒ **Directed Study Approach Path Management**

Directed Study Approach Path Management

TT leadership	EASA European Union Aviation Safety Agency
Data Analytics Provider	ALG Transport & Infrastructure
Subject Matter Experts	EASA European Union Aviation Safety Agency, RYANAIR, IBERIA, KLM, BRITISH AIRWAYS, BOEING, TRAFICOM, EUROCONTROL, ECA European Cockpit Association

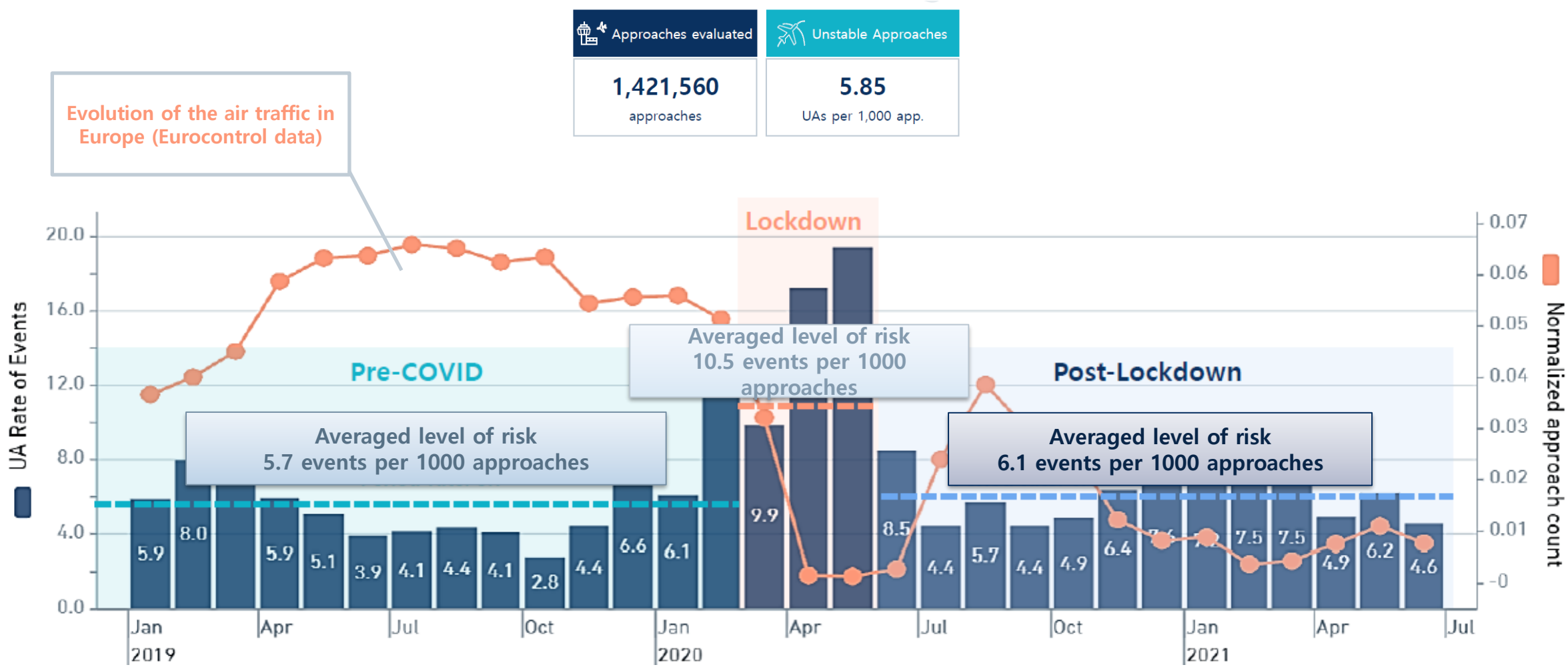


Directed Study Approach Path Management

	Volume of data	Data providers	Geographic scope	Time scope
FDM data	**1.3M / 2.5M** Flights FHs	**4** Major European airlines	**Global** Greater representativeness in Europe	Jan **2019** - Jul **2021**
ADS-B (traffic) data	**87.6M** Flights	**1** Flight data provider	**Global**	Jan **2019** - Jul **2020**
ECR data	**2.15M** Safety reports	ECR data repository	**Global**	**2008** - Dec **2020**
Weather	**39M** METAR reports	METAR data repository	**Global**	Nov **2019** - Jul **2021**

Directed Study Approach Path Management

Example of risk monitoring during approach and landings



Directed Study Approach Path Management

Figure XX: Share of instability conditions of UA events

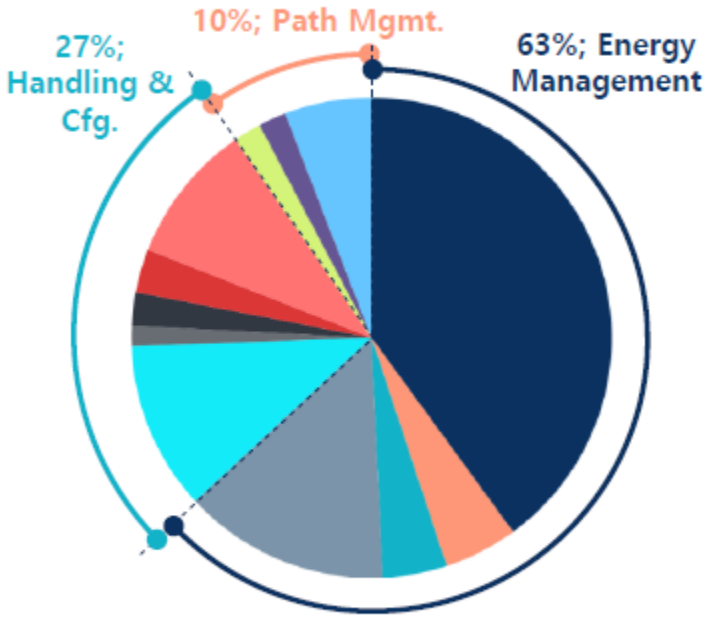
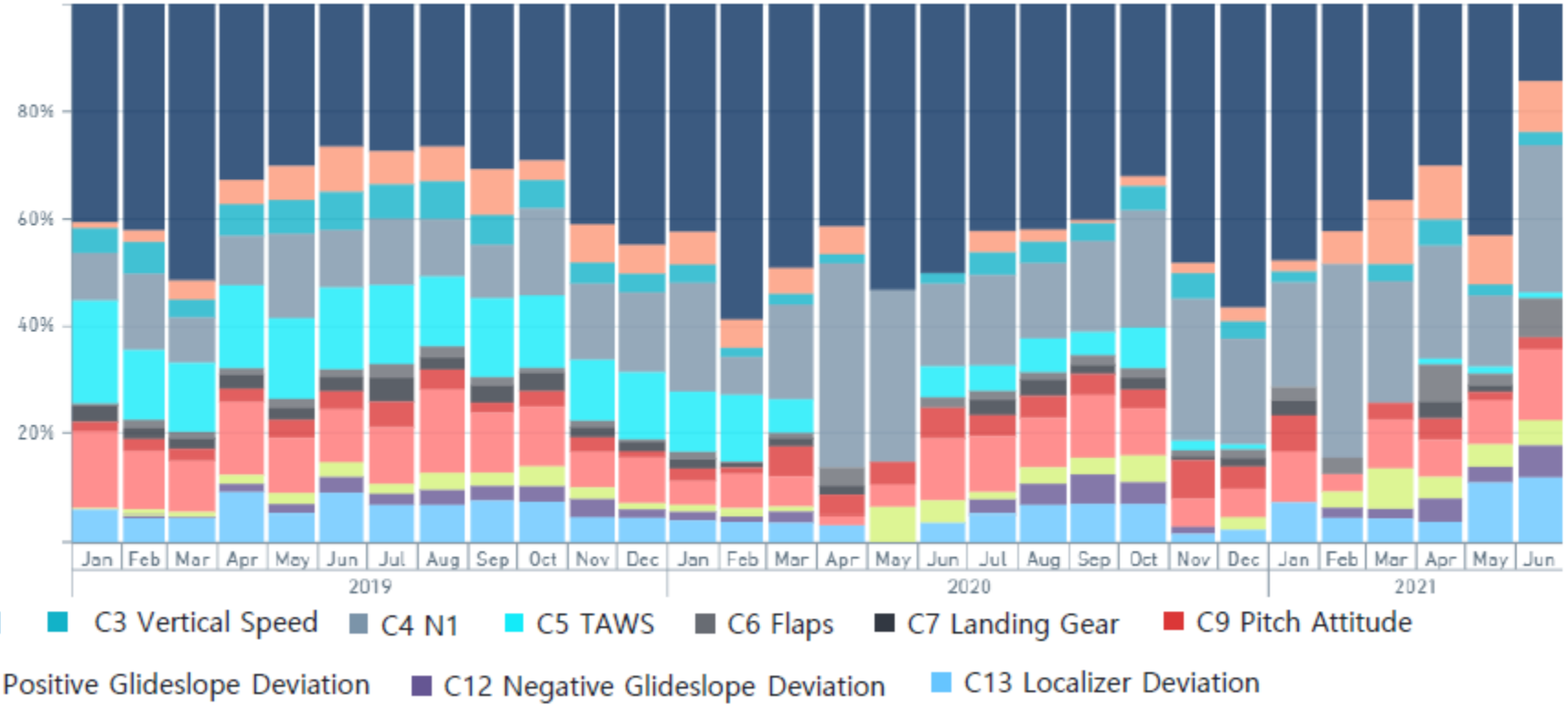


Figure XX: Share of instability conditions of UA events (from 2019 to Jun 2021)



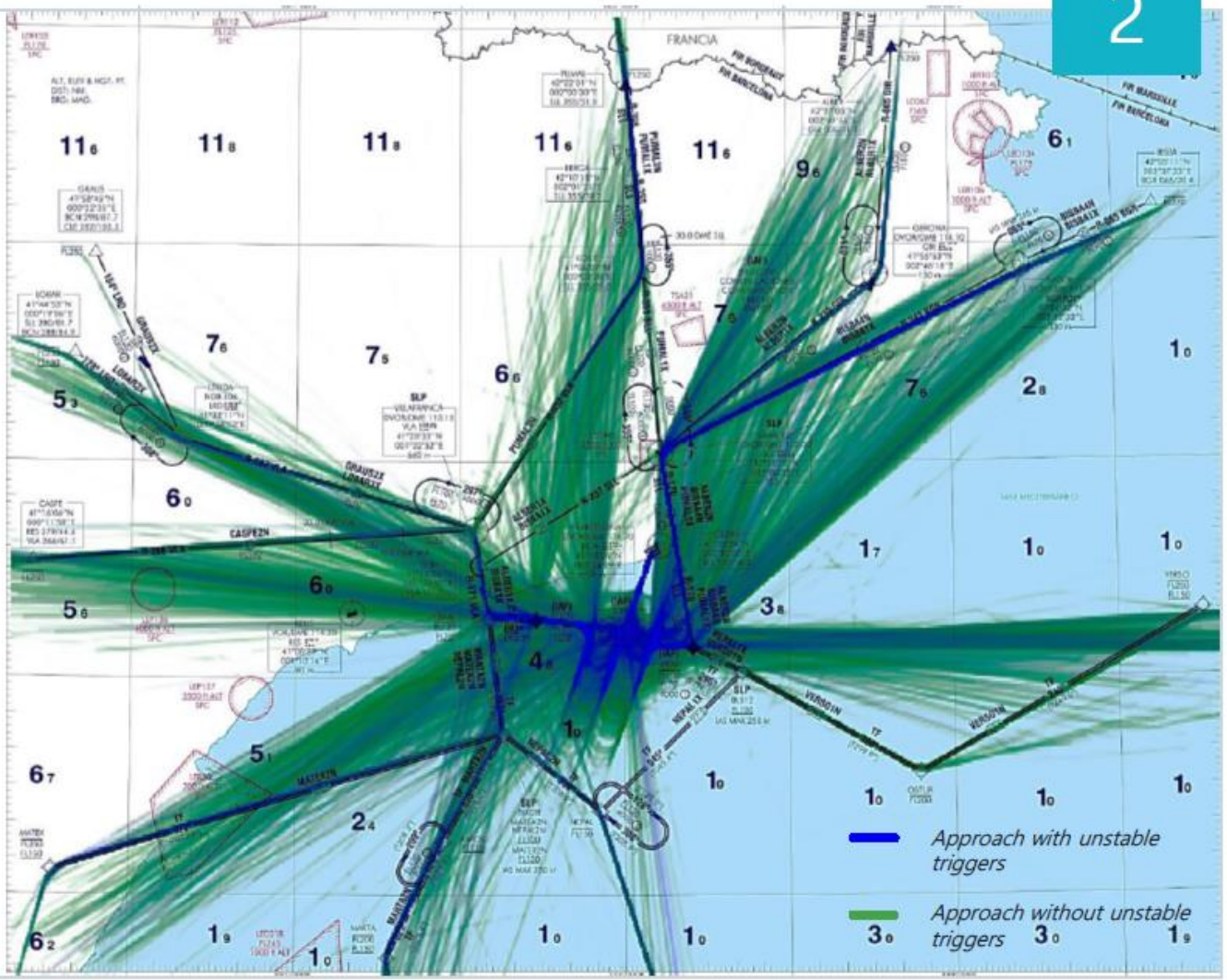
Directed Study Approach Path Management

Case Study 2

Analysis of Approach Track Management – *Horizontal view*

The figure in the right overlays the flight tracks of all approaches to RWY 02 that occurred before 15th of March of 2020 (date of start of the lockdown). Flight trajectories are depicted up to 20 min before the crossing of 50ft HAT. Flight tracks without any instability condition are colored in green while those that became unstable below the 1000ft threshold are colored in blue.

The figure reveals the nominal flight tracks followed by approaches to RWY 02 before the lockdown, highlighting flows following the designed tracks as well as others that meet in the IAF.



Directed Study Approach Path Management

Analysis of Approach Track Management – *Horizontal view*

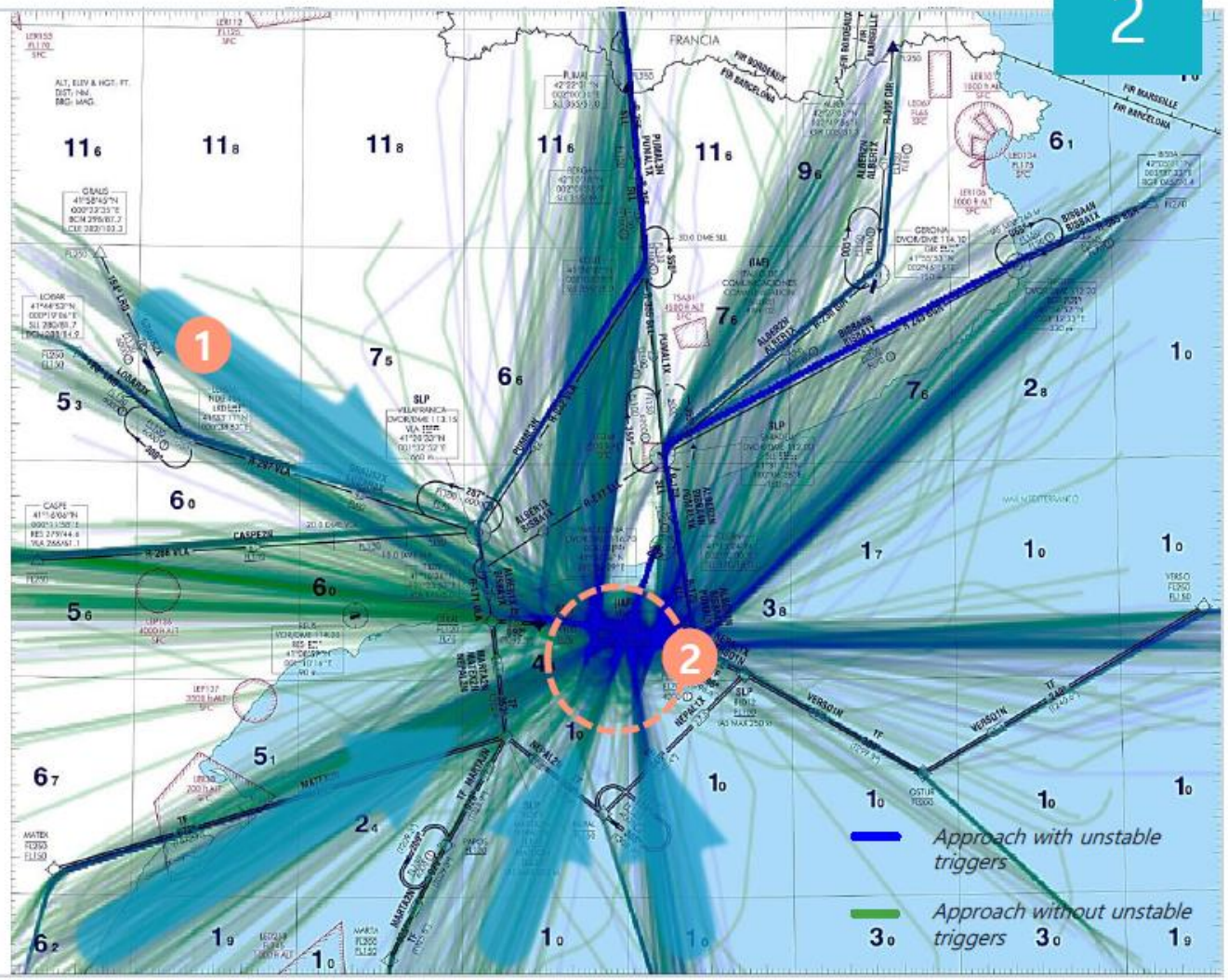
Case Study 2

The figure in the right overlays the flight tracks of all approaches to RWY 02 that occurred during the ramp-up of operations, considered as the time period between the 1st of June of 2020 to the 1st of December of 2020. Flight trajectories are depicted up to 20 min before the crossing of 50ft HAT. Flight tracks without any instability condition are colored in green while those that became unstable below the 1000ft threshold are colored in blue.

The figure reveals that flight tracks were during the ramp-up of operations **more direct towards the Intermediate Fix**, thus capturing potential flight track shortcuts enabled by ATC (see 1).

Furthermore, a **reduction in the length of the sequential inbound tracks** can be seen as well, as a direct consequence of the lower traffic levels (see 2)

Comparison of horizontal tracks proof that the new operational environment during the Covid-19 pandemic had an effect on the horizontal track of approaches. It is interesting now to analyse the changes on the vertical track as well.



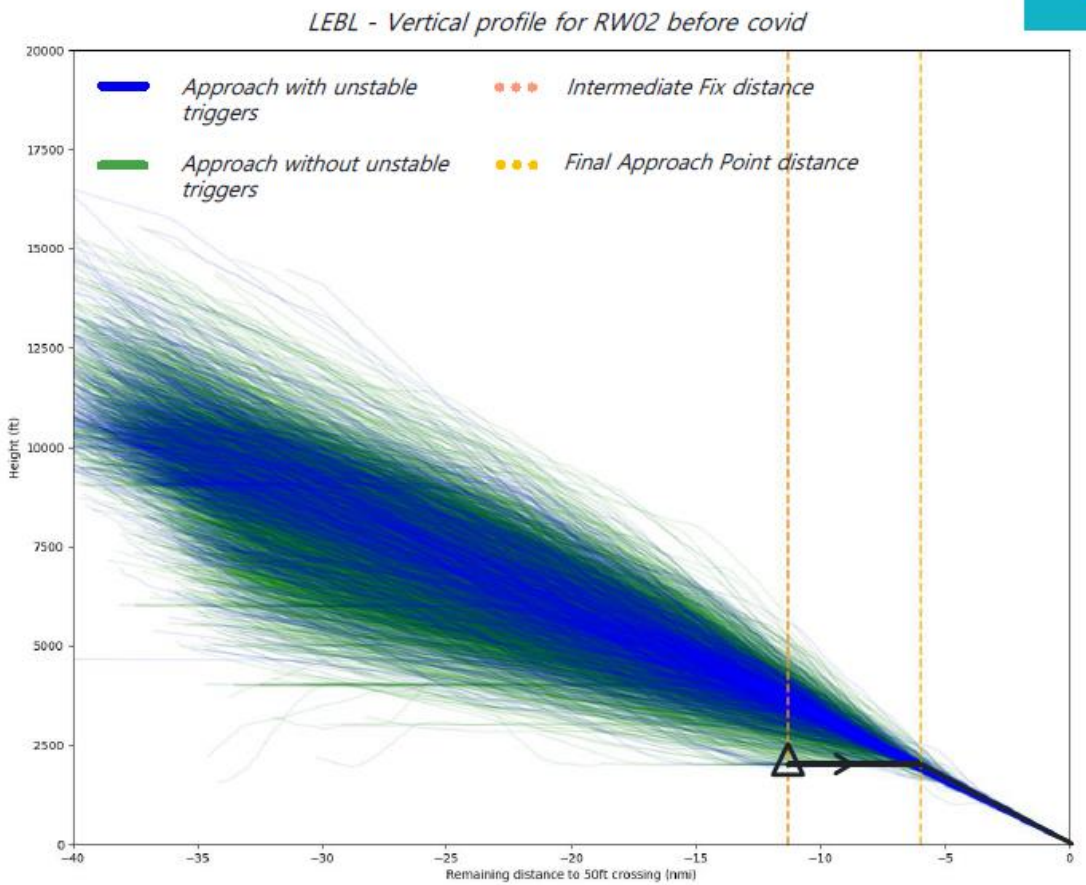
Directed Study Approach Path Management

Case Study 2

Analysis of Approach Track Management – *Vertical view*

The figure in the right shows the vertical flight tracks of all approaches to RWY 02 that occurred before 15th of March of 2020 (date of start of the lockdown). Flight trajectories are depicted up to 10 min before the crossing of 50ft HAT. Flight racks without any instability condition are colored in green while those that became unstable below the 1000ft threshold are colored in blue.

Once again, this first figure captures the nominal flight tracks followed by approaches to RWY 02 before the lockdown.



Directed Study Approach Path Management

Case Study 2

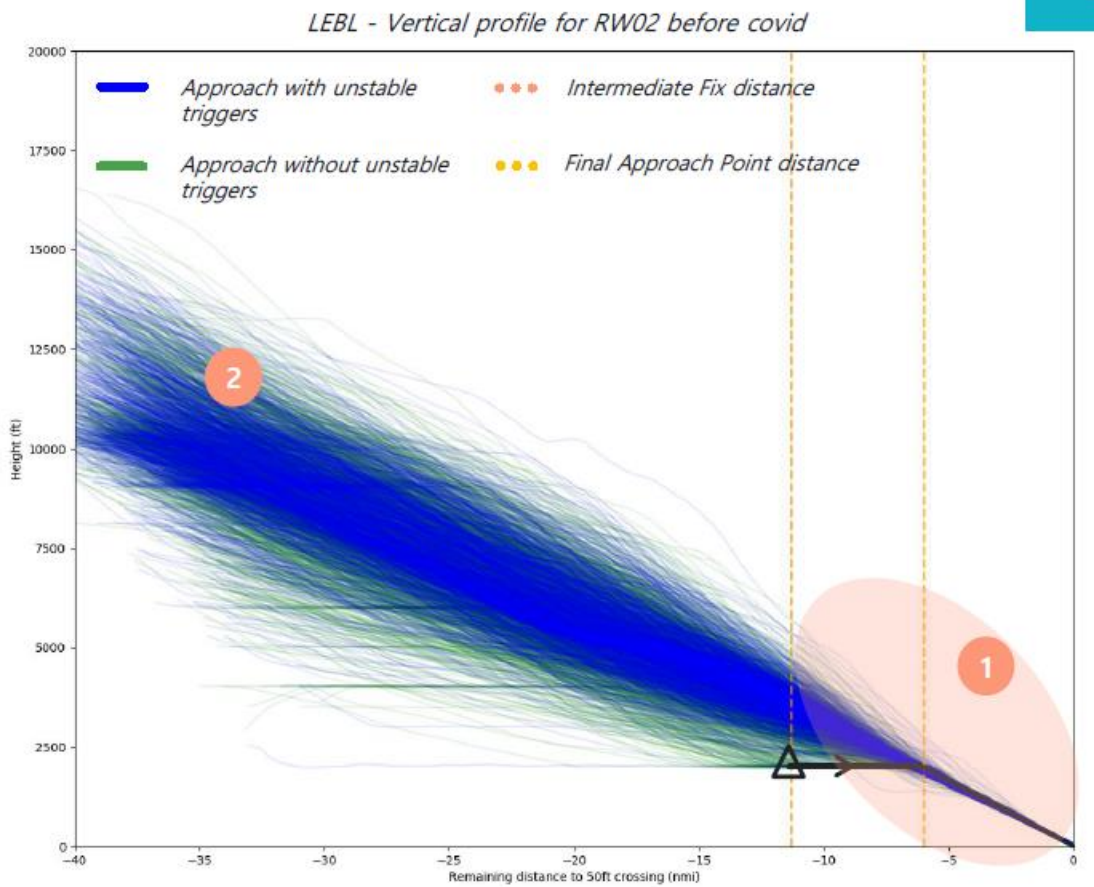
Analysis of Approach Track Management – *Vertical view*

The figure in the right shows an overlay of the vertical profile of flight tracks of all approaches to RWY 02 that occurred during the ramp-up of operations, considered as the time period between the 1st of June of 2020 to the 1st of December of 2020. Flight trajectories are depicted up to 10 min before the crossing of 50ft HAT. Flight tracks without any instability condition are colored in green while those that became unstable below the 1000ft threshold are colored in blue.

Looking at the highlighted zone, it can be spotted an **increase in the number of approaches with vertical deviations past the Intermediate Fix and Final Approach Point**. All of them in blue, thus capturing those flights that approached the FAF from above, most probably with energy management related instability conditions (see 1).

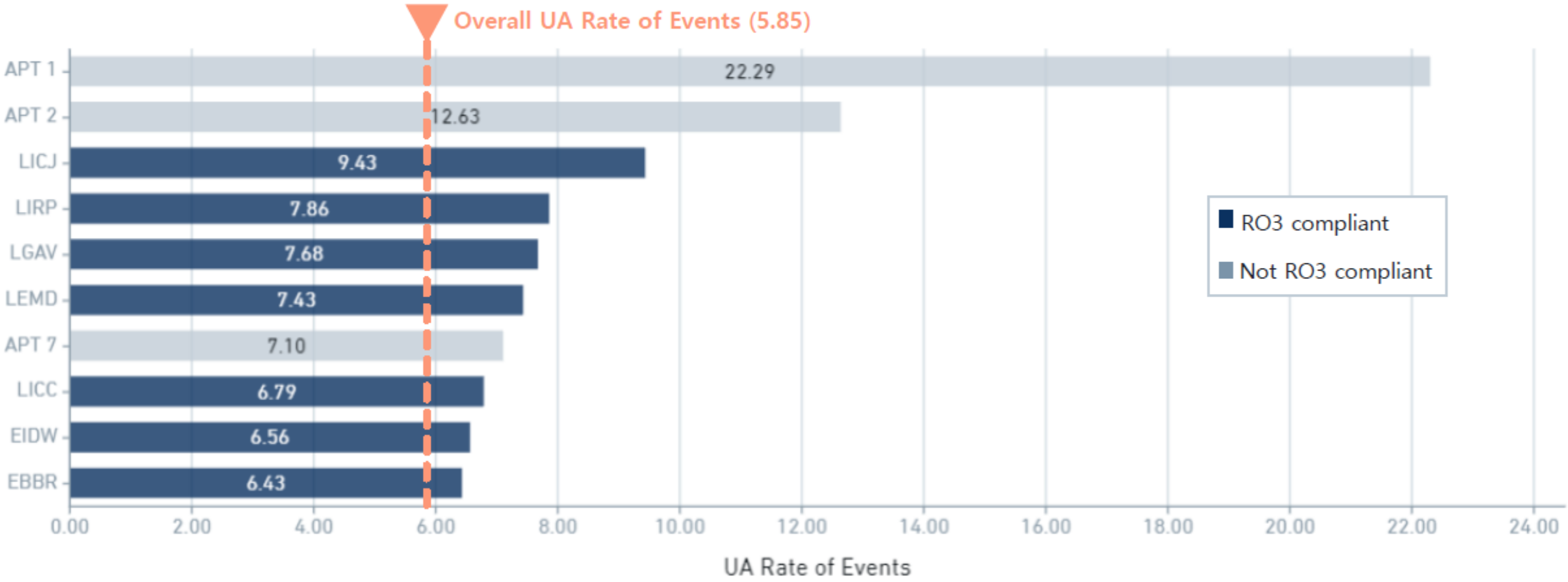
Moreover, a **higher density of flights with instability conditions** can be seen in the figure, when compared to the previous one, captured by the increase of blue-colored shaded cluster (see 2)

As a conclusion, the comparative analysis might show that low traffic levels coupled with operations in not preferred configurations during the pandemic may have eased flight shortcuts which, in turn, may have contributed in an increase of UA



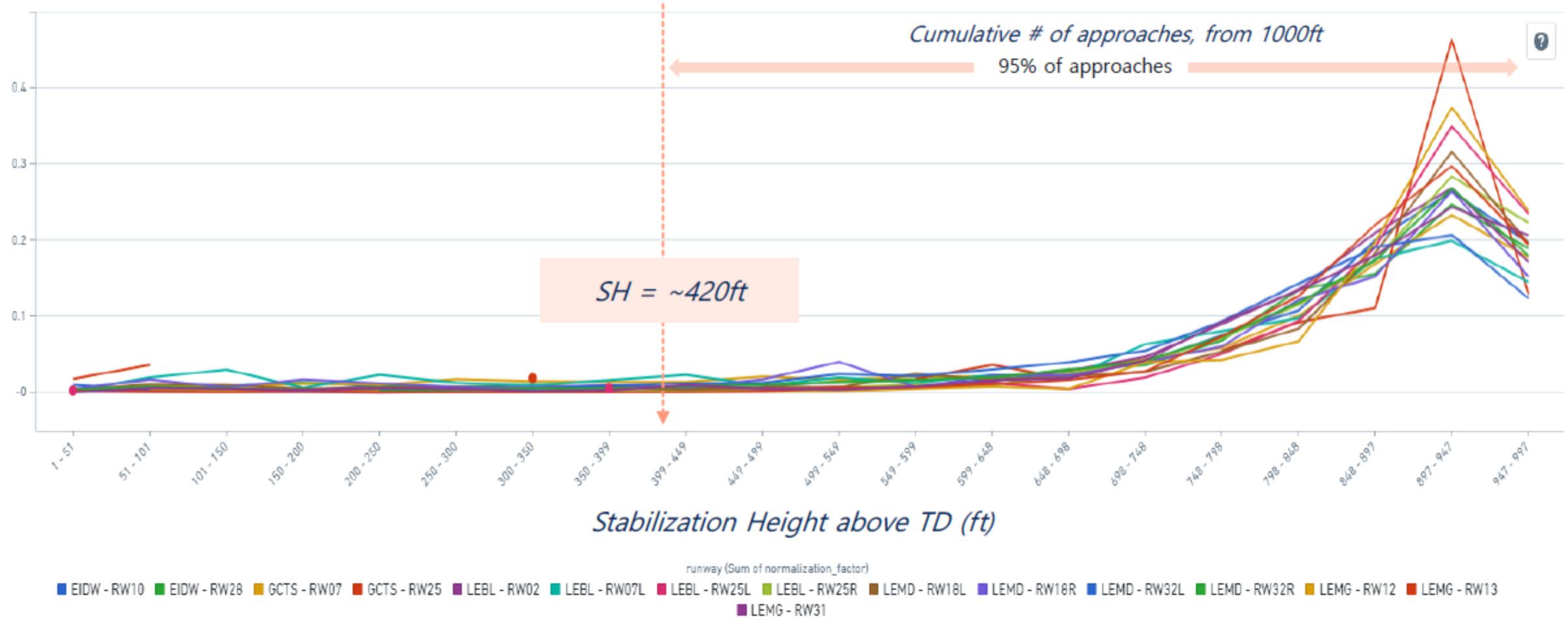
Directed Study Approach Path Management

Figure XX: Top 10 airports (>10k operations) by rate of Unstable Approach events ('000 approaches)



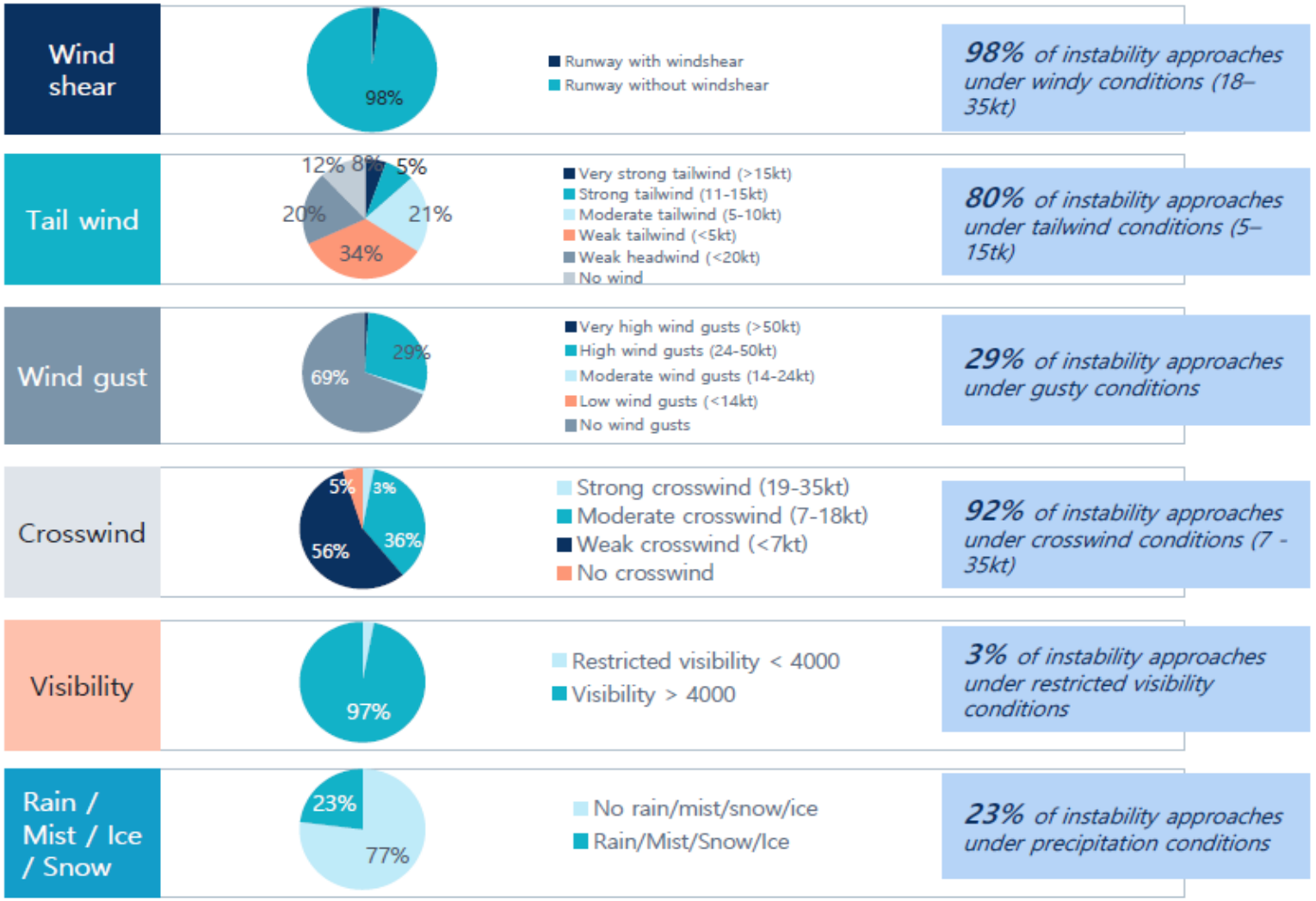
Directed Study Approach Path Management

Figure XX: Normalized number of unstable approaches that were stabilized by height band – segregated by Airport & RWY



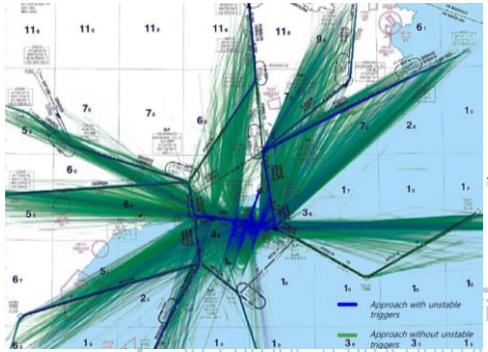
Directed Study Approach Path Management

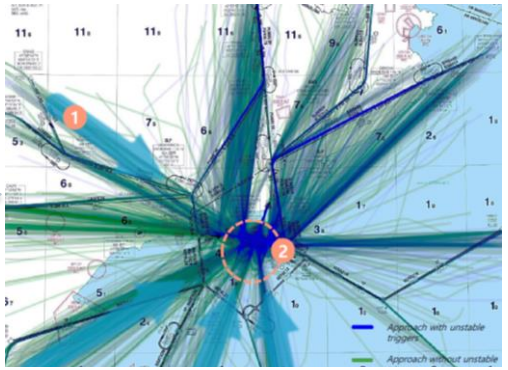
Figure XX: Share of Weather safety events during approach reported by Commercial passenger operations of Large Aircrafts in the European Central Repository, 2018 - 2021



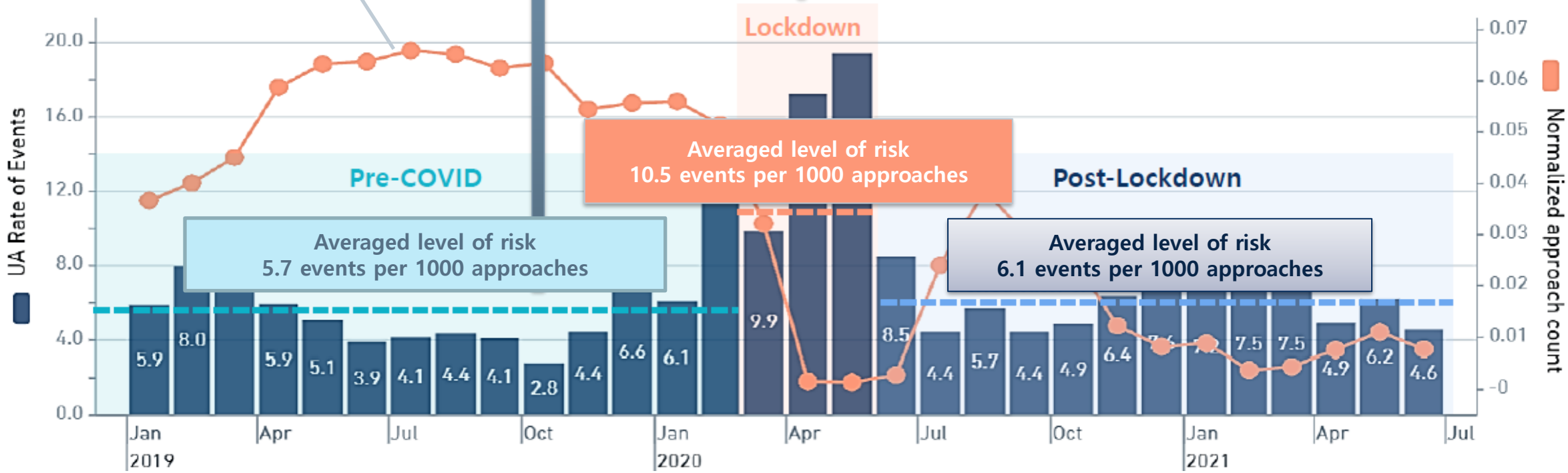
Directed Study Approach Path Management

Example of risk monitoring during approach and landings





Approaches evaluated	Unstable Approaches
1,421,560 approaches	5.85 UAs per 1,000 app.



Directed Studies - Highlights

⇒ **Noise analysis (“AirWax”)**

Noise analysis (“AirWax”)

Step 1

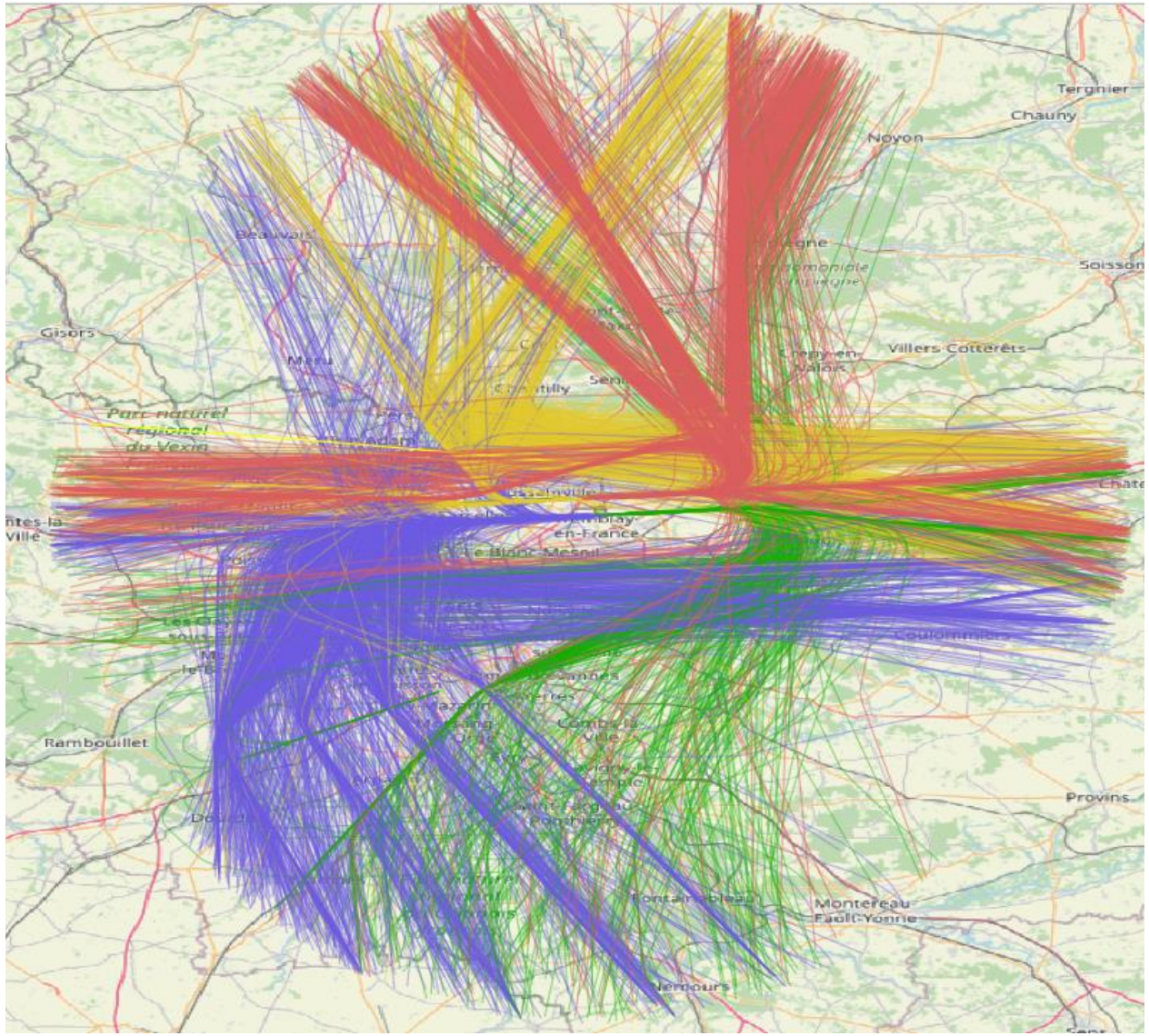
⇒ Reduce data!

From 136 million of flights and 32 billion of flight positions down to the operations at the top European airports

Step 2

⇒ Cluster approaches using Machine Learning (Artificial Intelligence)

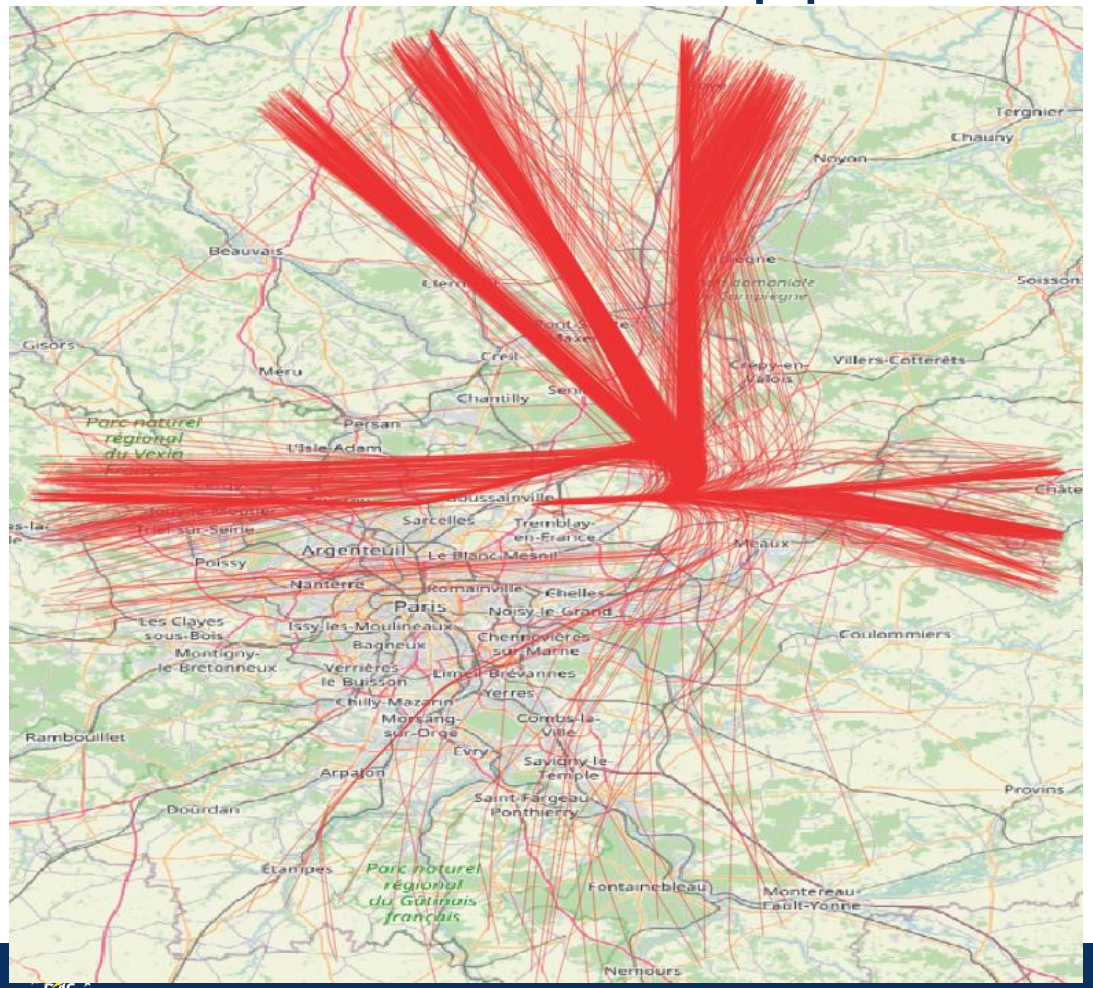
Identify all approaches for a given Runway

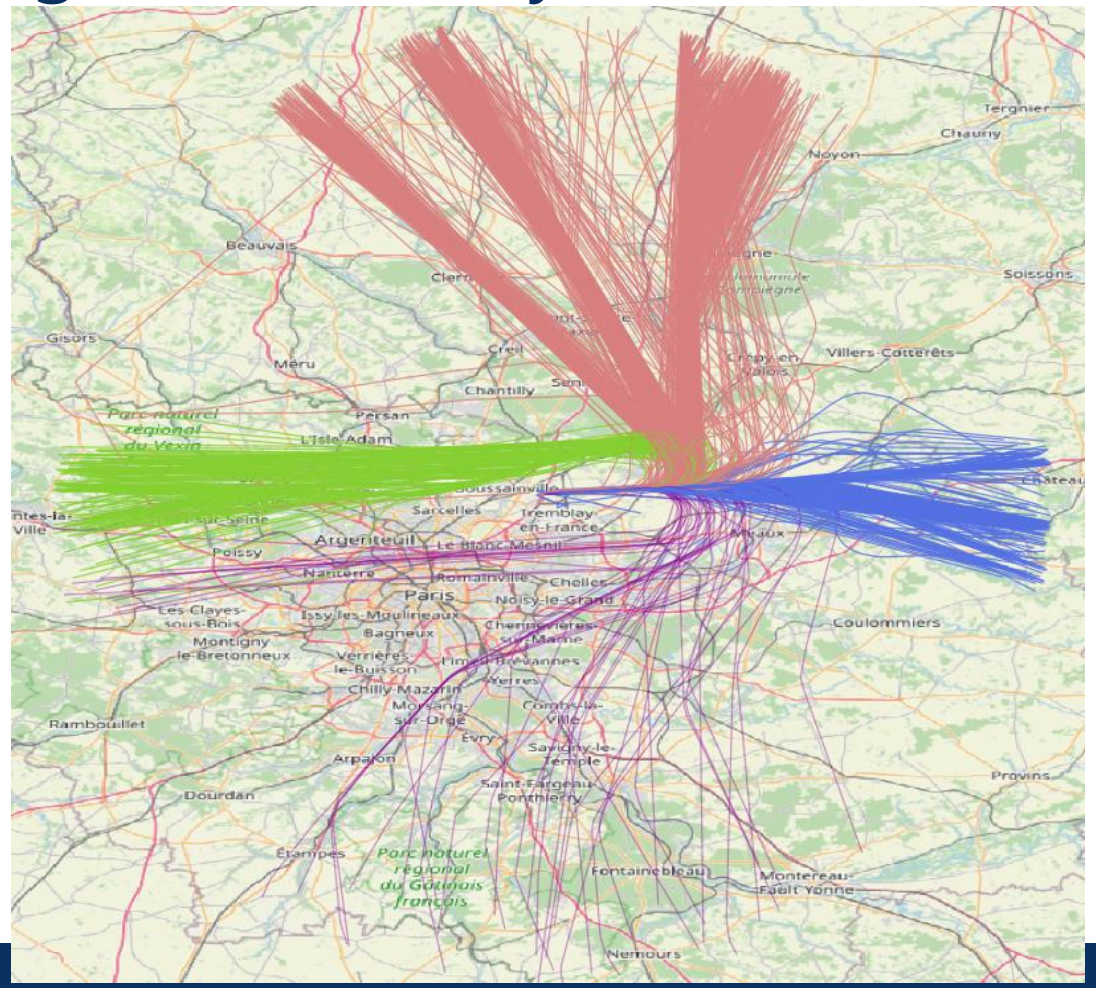


Noise analysis (“AirWax”)

Step 3

⇒Cluster further approaches for a given Runway

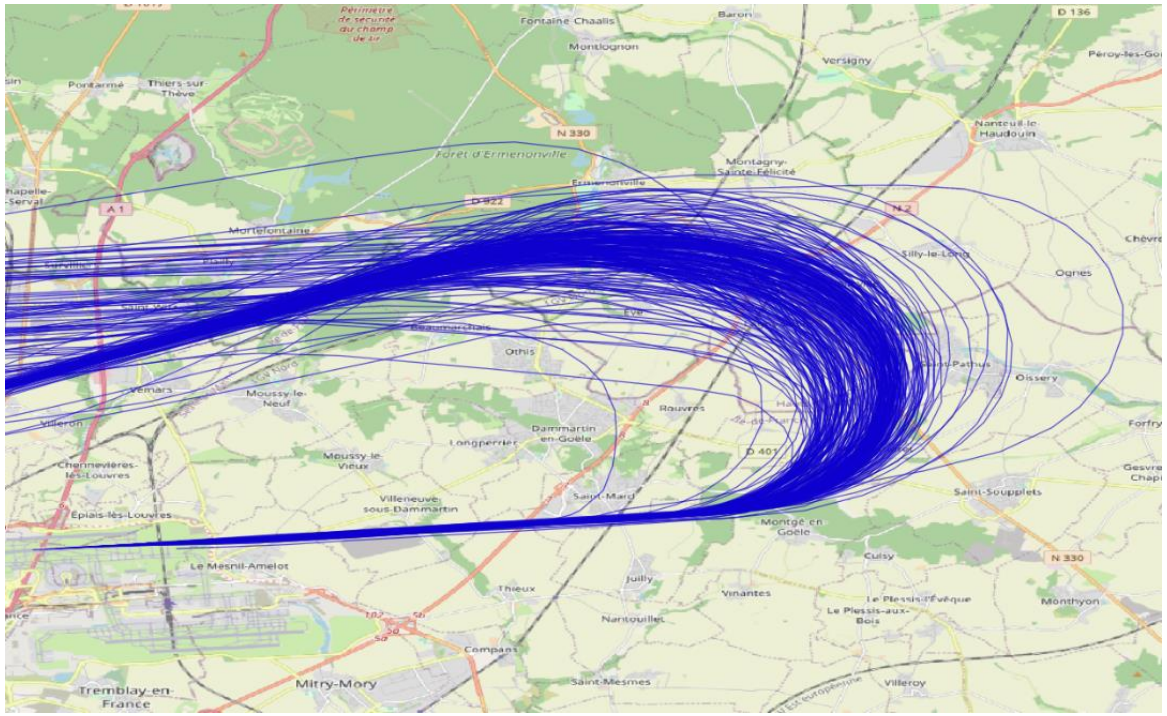


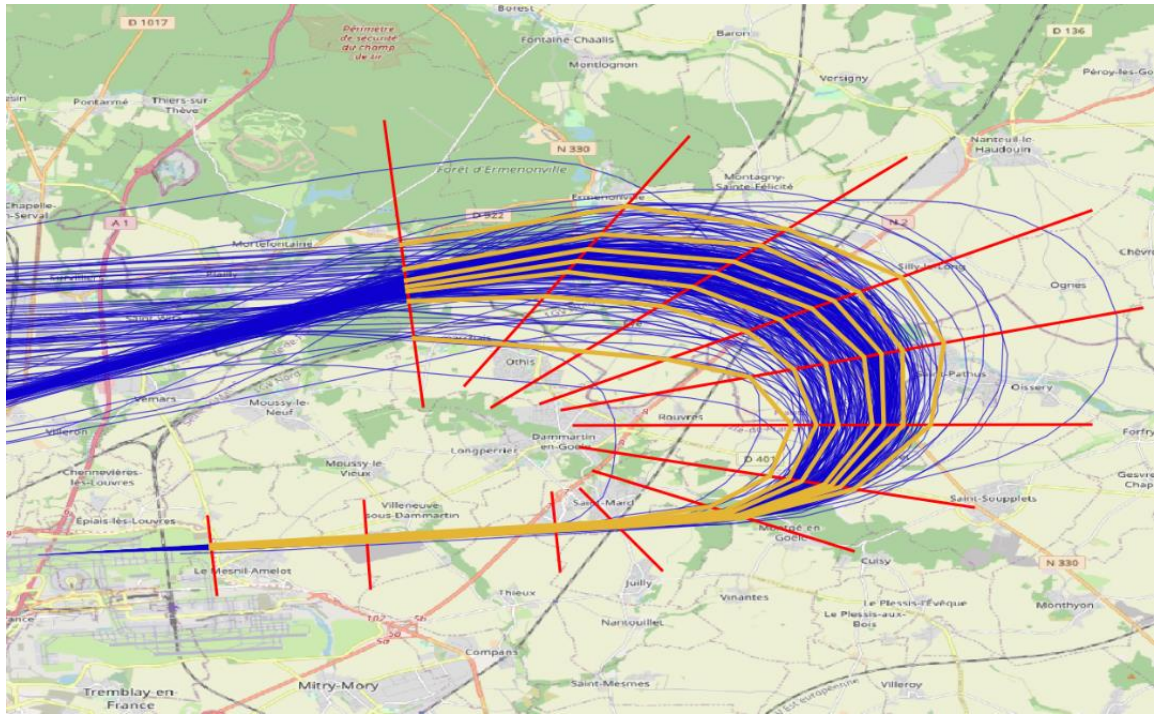


Noise analysis (“AirWax”)

Step 4

⇒ Statistical treatment for each cluster of approaches

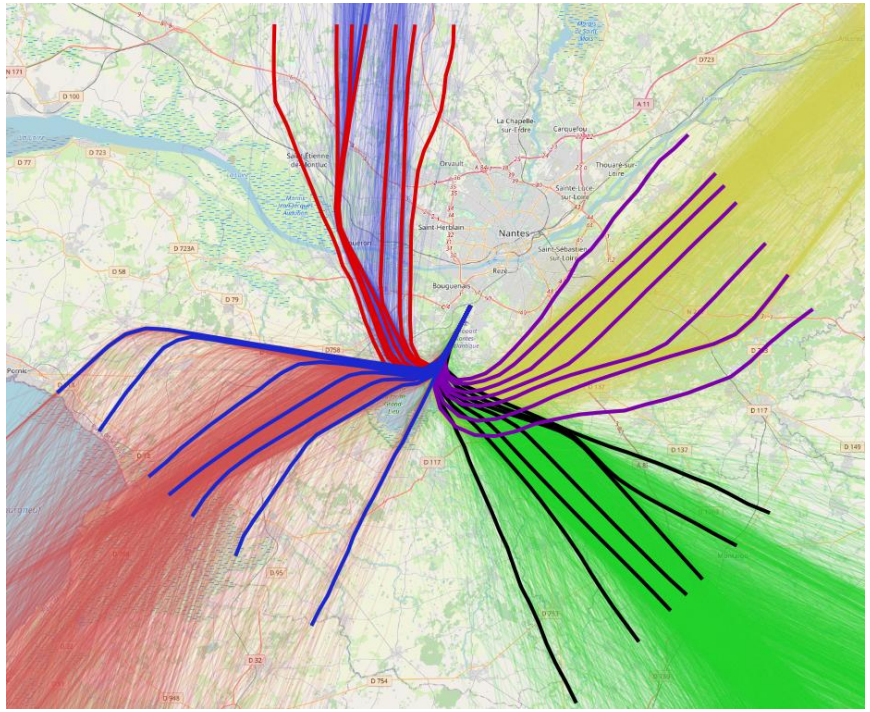


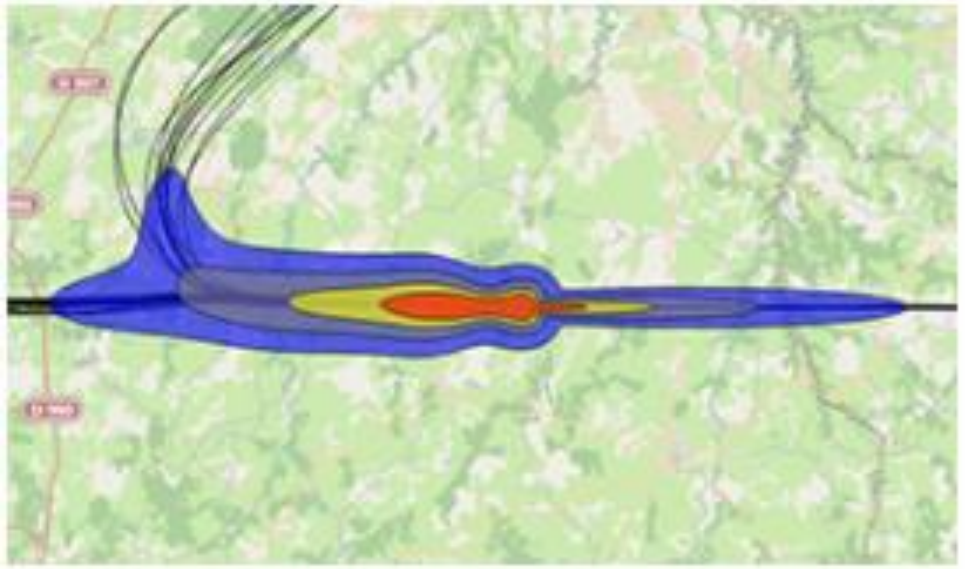


Noise analysis (“AirWax”)

Step 5

⇒ Apply noise models (STAPES) to the data and deduce noise footprints





EASA GNSS Monitor and Assessment Module

Data4Safety
Partnership for Data Driven Aviation Safety Analysis
Supported by EASA

Raw ADS-B data

ECR

Metadata
Airspace,
Airports...

FDM
(soon)

DATA
LAKE

Process
Nightly runs

Detect spoofing jamming

Analyse occurrences

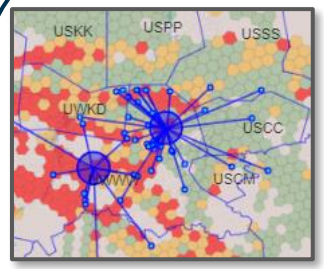
Elaborate statistics

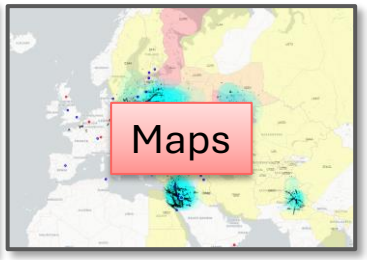
clusters

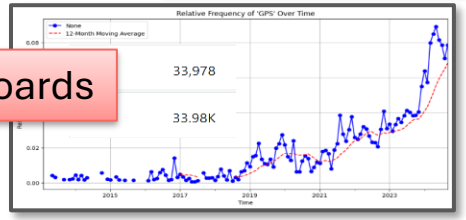
Statistical figures

Geolocated occurrences

Exploit

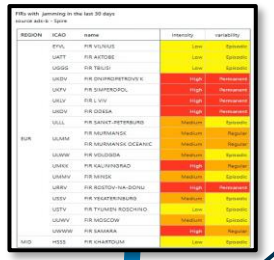






Dashboards

Alerts and reports

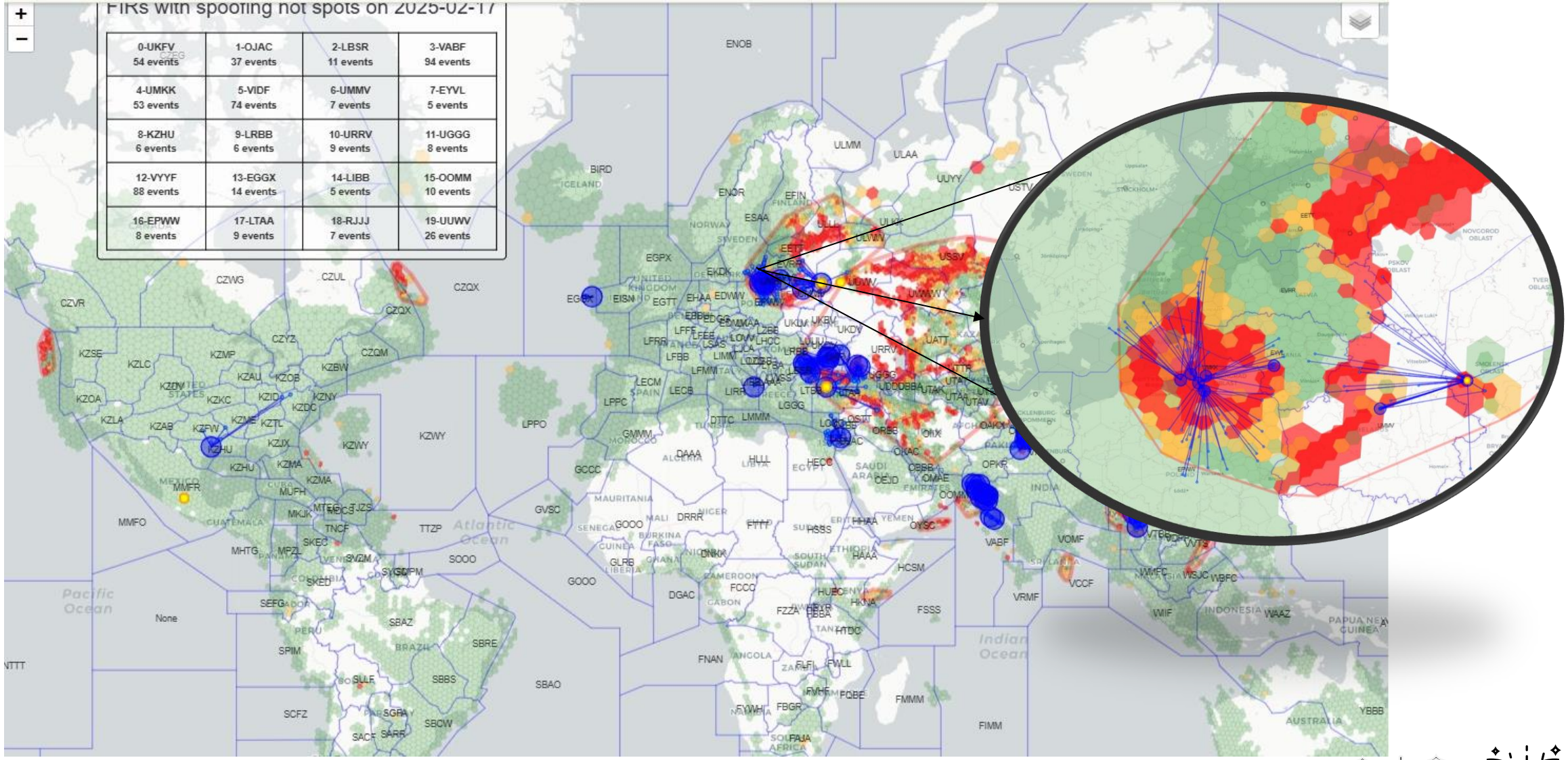


Serious Incident Reported!

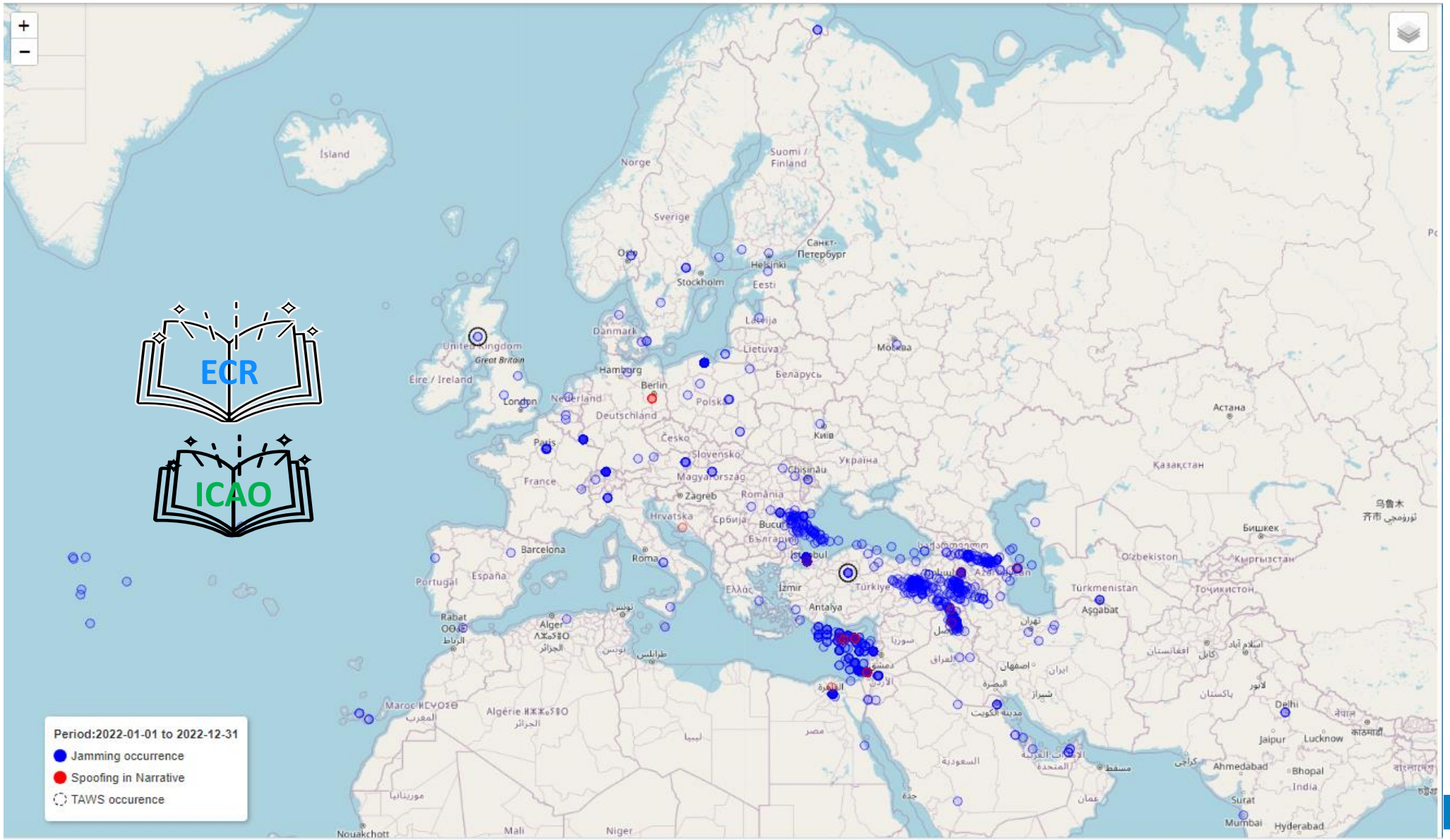
Sharp increase of spurious EGPWS!

EASA GNSS website

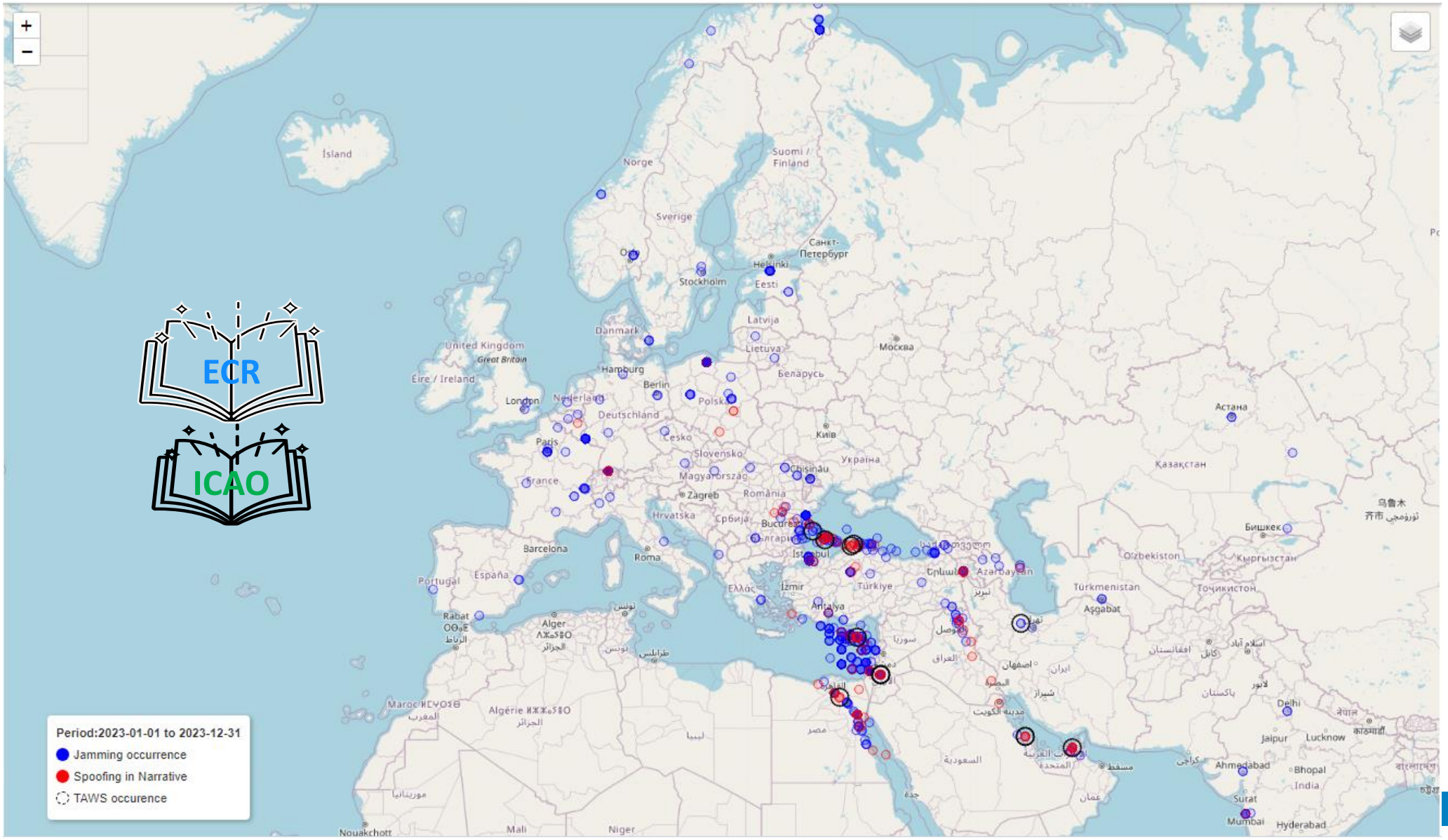
Exploit: charts



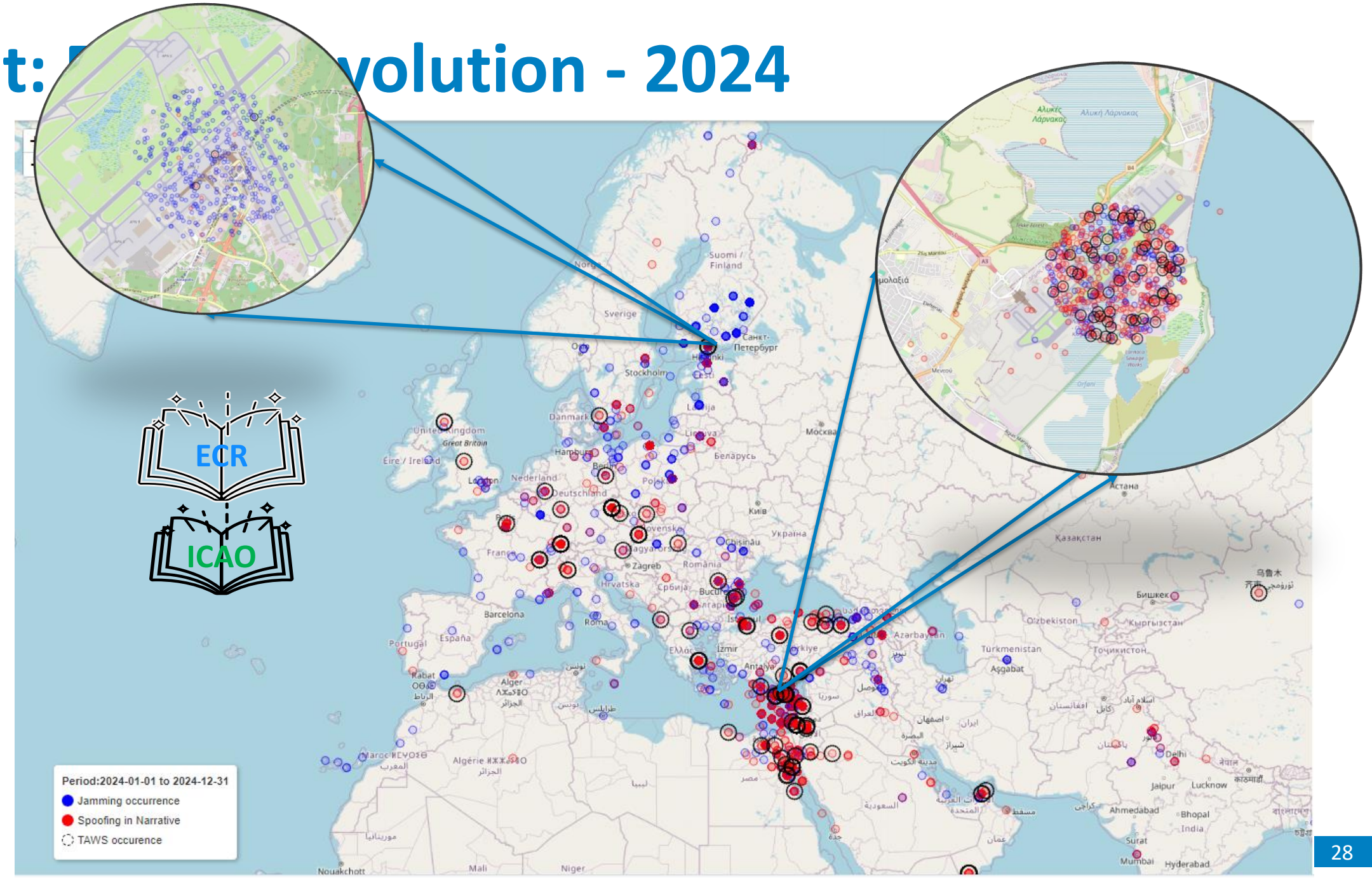
Exploit: EGPWS evolution - 2022



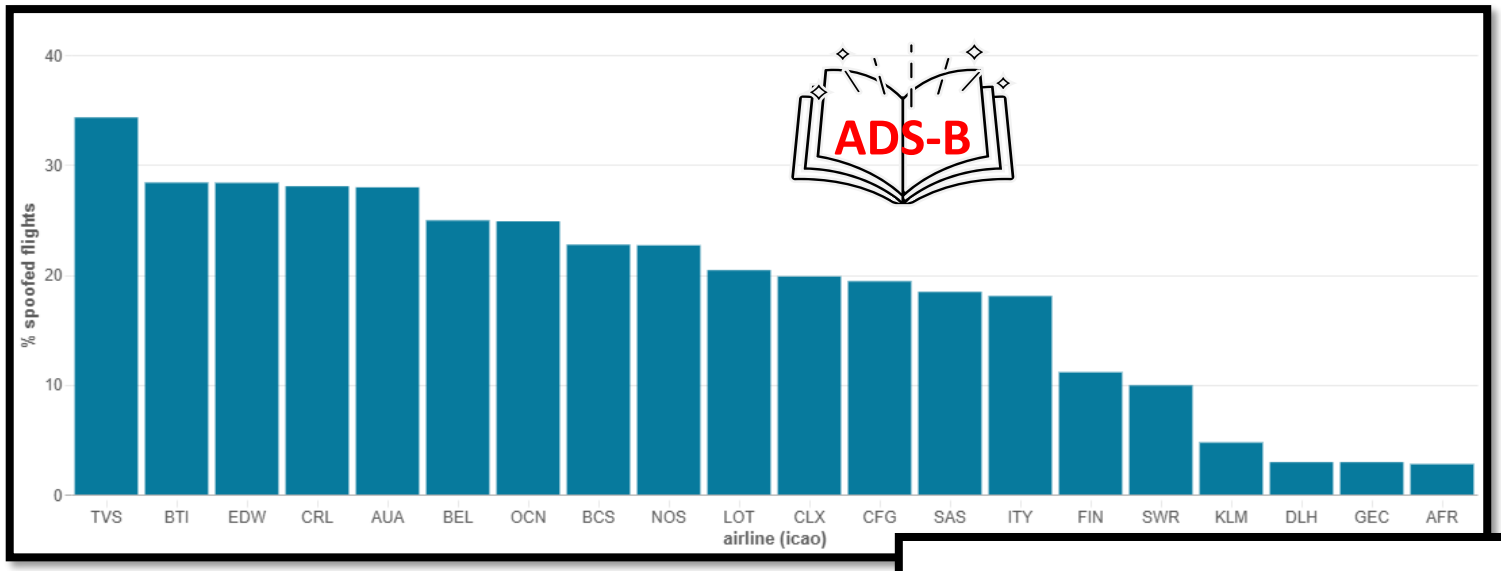
Exploit: EGPWS evolution - 2023

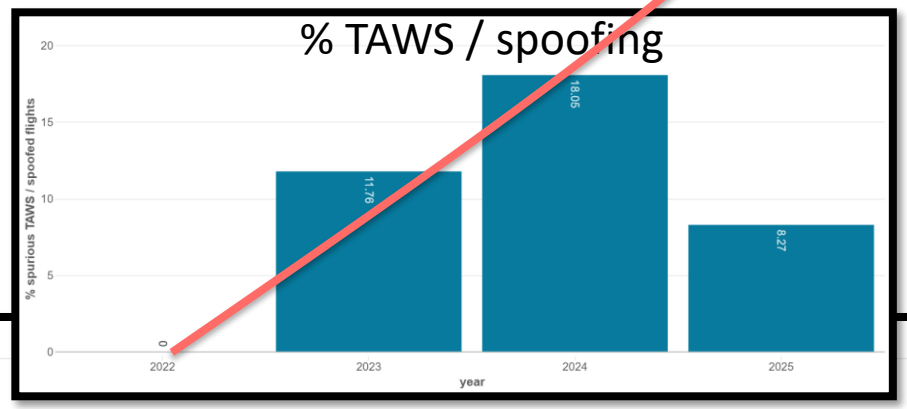


Exploit: E volution - 2024

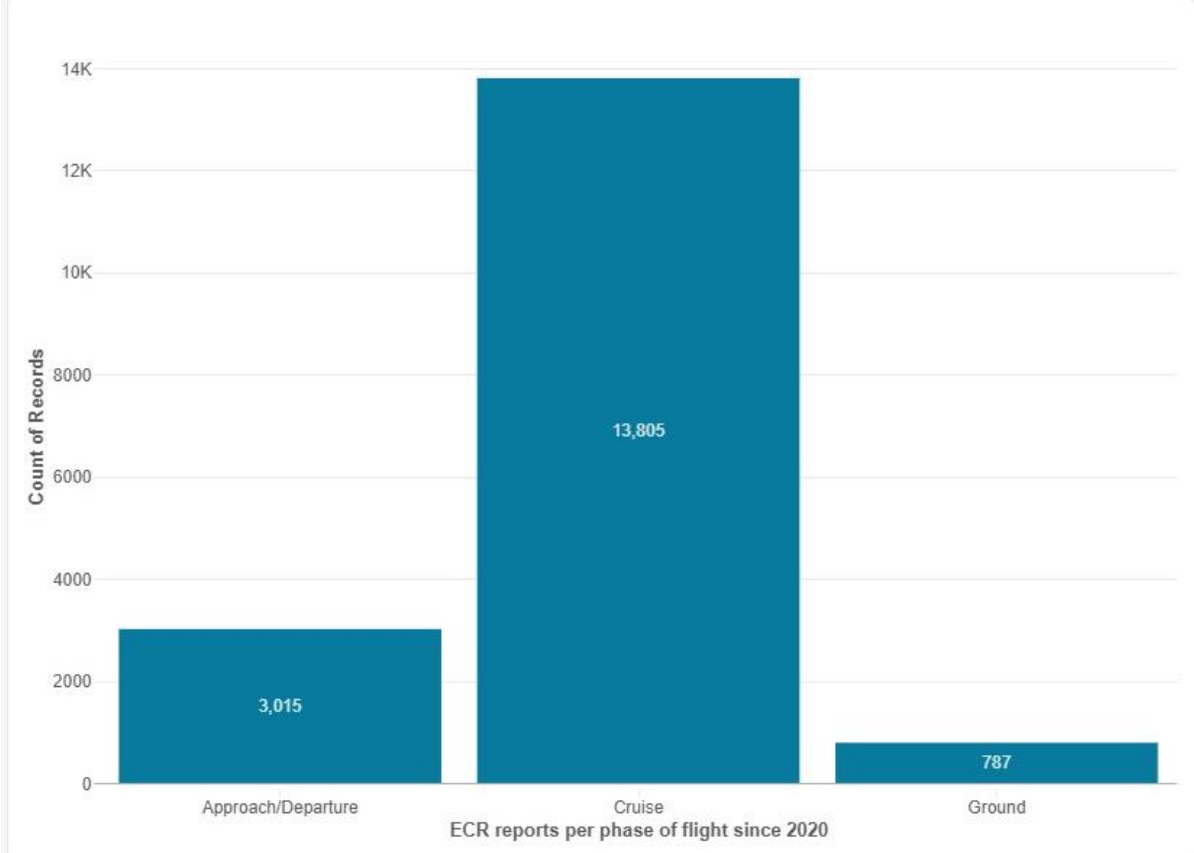


Exploit: Statistical figures

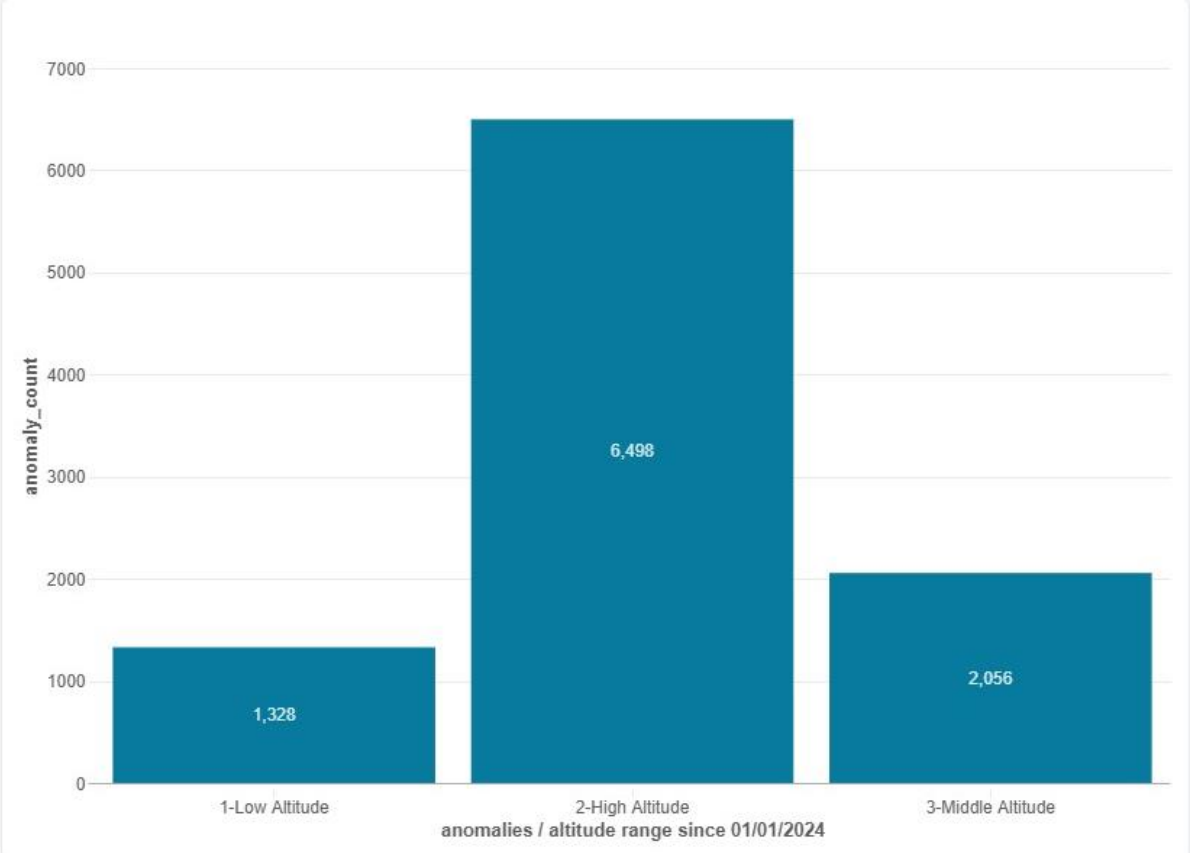




Year 2024 – reported phases of flight / ADS-B altitudes



Jamming and spoofing



Anomalies in speed (probable spoofing)

Data fusion: All 2024 events in one chart

ADS-B ICAO

Severe, permanent jamming

Regular medium jamming

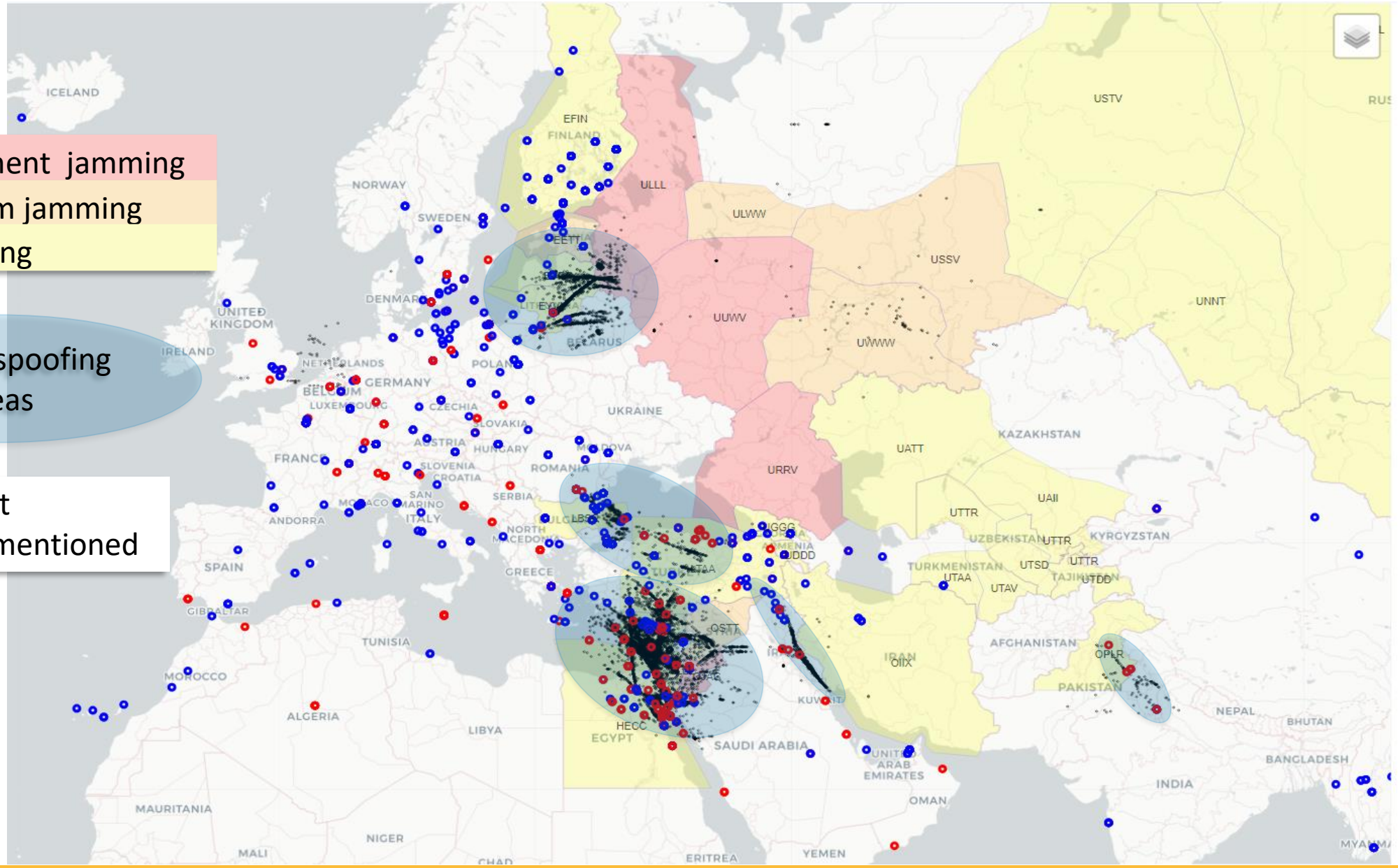
Episodic Jamming

ADS-B

Regular spoofing areas

ECR

- ECR report
- spoofing mentioned



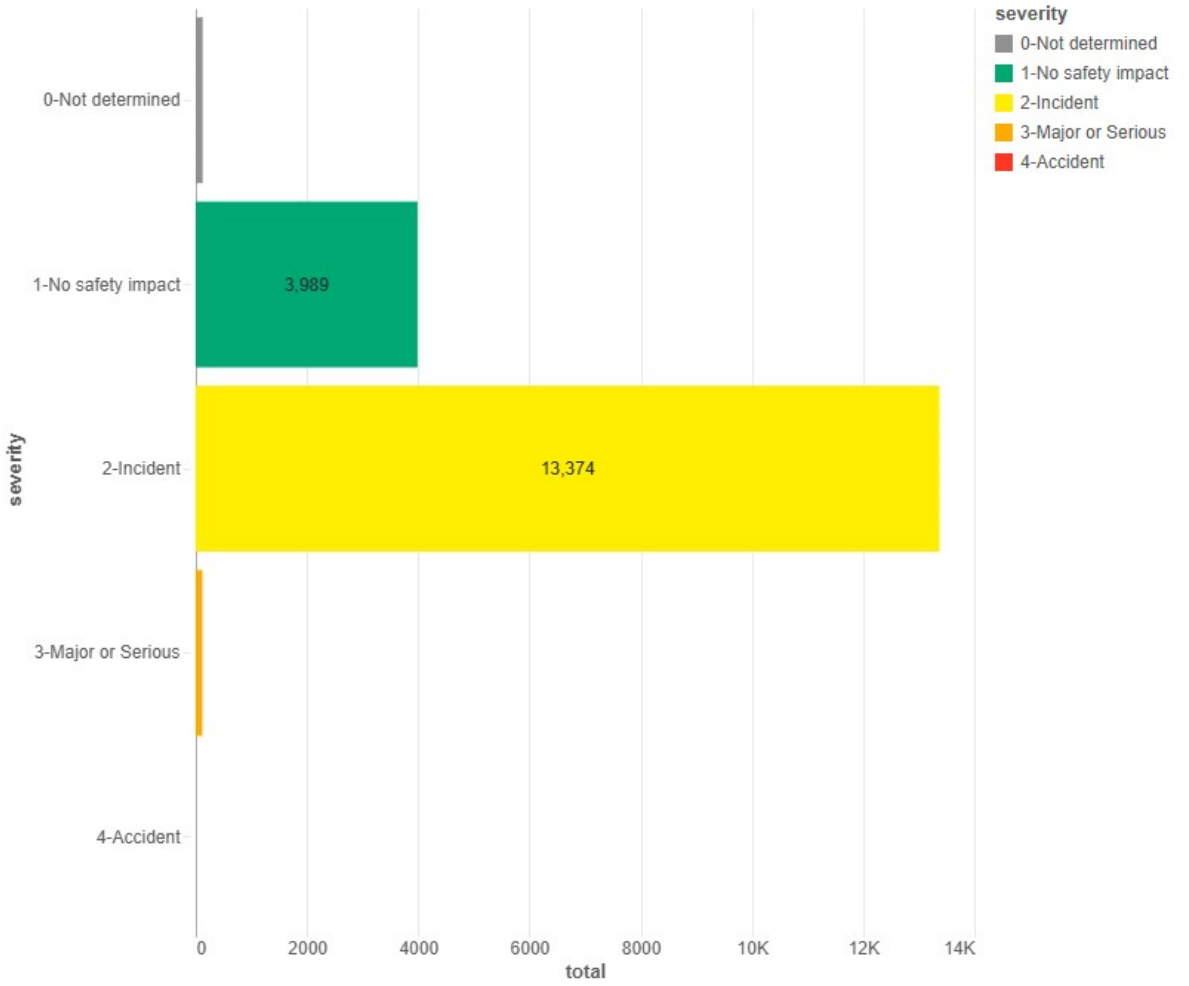
Year 2024 – reported occurrences

Léo: I have a doubt about the key message / added-value of this one. Would remove (also considering nber of slides in the presentation)

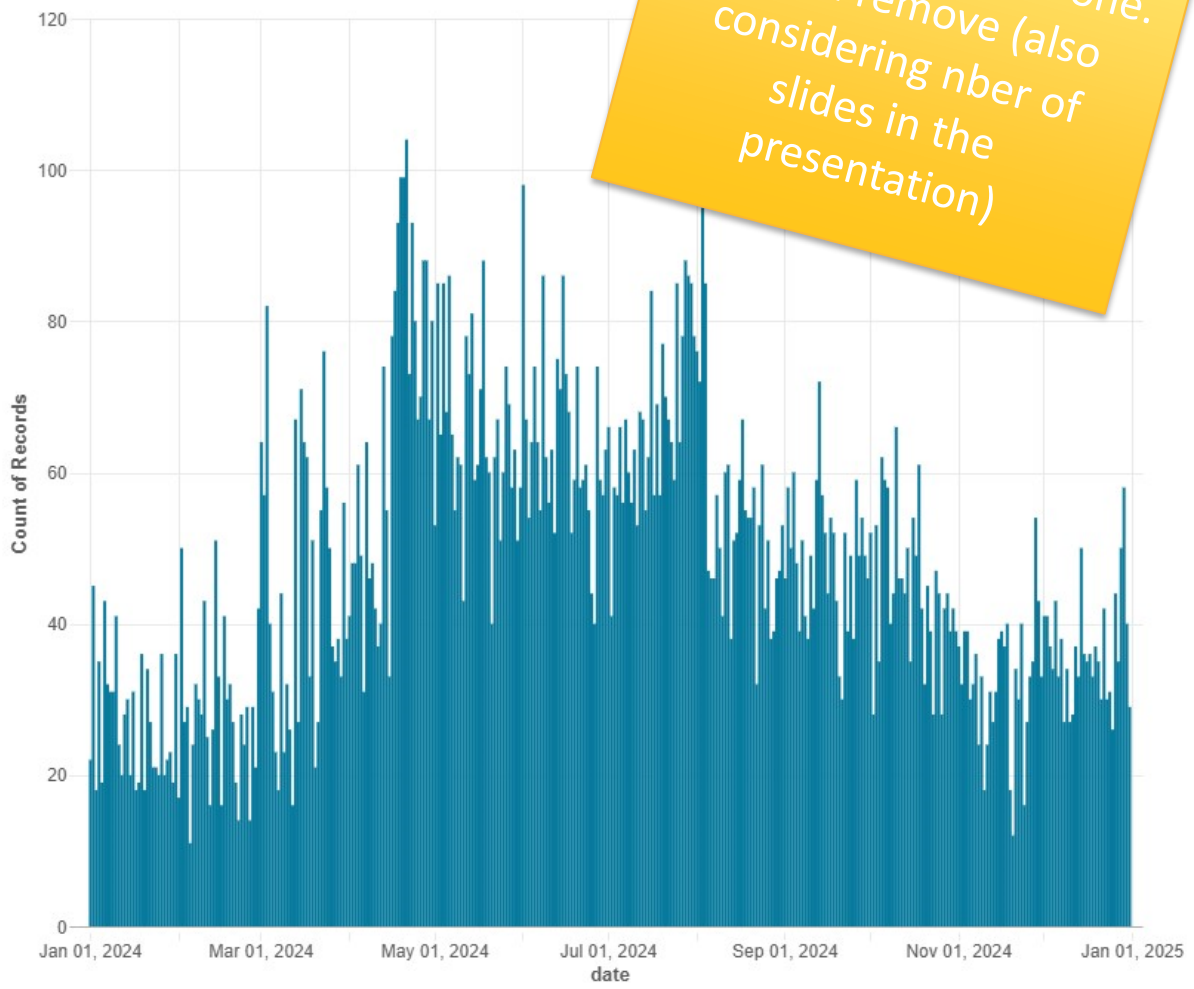
Period of analysis: Jan 01, 2024 → Dec 31, 2024

total count: 17,607

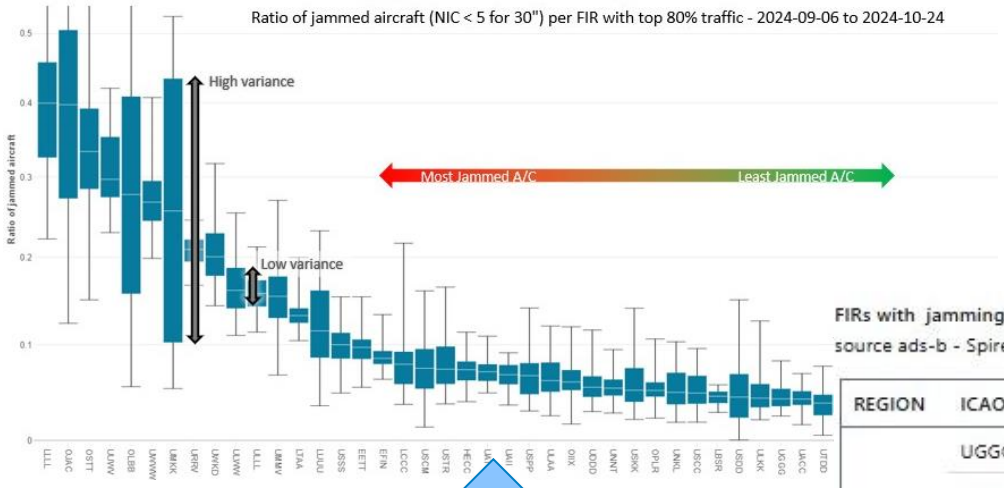
Severity as reported



occurence reports per week



Statistical figures: how bad FIR are jammed



computation

presentation

FIRs with jamming in the last 7 days
source ads-b - Spire

REGION	ICAO	name	intensity	variability
EUR	UGGG	FIR TBILISI	Medium	Episodic
	UKFV	FIR SIMFEROPOL	High	Permanent
	UKLV	FIR L VIV	High	Permanent
	UKOV	FIR ODESA	High	Permanent
	ULLL	FIR SANKT-PETERBURG	Medium	Episodic
	ULMM	FIR MURMANSK	Medium	Episodic
		FIR MURMANSK OCEANIC	Medium	Episodic
	ULWW	FIR VOLOGDA	Low	Episodic
	UMKK	FIR KALININGRAD	High	Permanent
	UMMV	FIR MINSK	Medium	Episodic
	URRV	FIR ROSTOV-NA-DONU	High	Permanent
	USSV	FIR YEKATERINBURG	Medium	Episodic
	UUWV	FIR MOSCOW	Medium	Episodic
	UWWW	FIR SAMARA	Medium	Episodic

FIRs with jamming in the last 30 days
source ads-b - Spire

REGION	ICAO	name	intensity	variability
EUR	EYVL	FIR VILNIUS	Low	Episodic
	UATT	FIR AKTOBE	Low	Episodic
	UGGG	FIR TBILISI	Low	Episodic
	UKDV	FIR DNIPROPETROVS'K	High	Permanent
	UKFV	FIR SIMFEROPOL	High	Permanent
	UKLV	FIR L VIV	High	Permanent
	UKOV	FIR ODESA	High	Permanent
	ULLL	FIR SANKT-PETERBURG	Medium	Episodic
	ULMM	FIR MURMANSK	Medium	Regular
		FIR MURMANSK OCEANIC	Medium	Regular
	ULWW	FIR VOLOGDA	Medium	Episodic
	UMKK	FIR KALININGRAD	High	Regular
	UMMV	FIR MINSK	Medium	Episodic
	URRV	FIR ROSTOV-NA-DONU	High	Permanent
	USSV	FIR YEKATERINBURG	Medium	Episodic
	USTV	FIR TYUMEN ROSCHINO	Low	Episodic
	UUWV	FIR MOSCOW	Medium	Episodic
	UWWW	FIR SAMARA	High	Regular
MID	HSSS	FIR KHARTOUM	Low	Episodic

ADS-B

ICAO

EASA