International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)

WORKING PAPER

GREPECAS/23 — WP/8.38
22/01/26

Fifth GREPECAS–RASG-PA Joint Meeting (GREPECAS-RASG-PA/5) and Twenty-Third Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/23)

Virtual Phase (Asynchronous, 19 January to 17 February 2026)
In-Person Phase (Mexico City, Mexico, 4 to 6 March 2026)

Agenda Item 8: CAR/SAM Air Navigation Implementation

EVOLUTION OF GNSS EVENTS IN THE SAM REGION

(Presented by Argentina)

EXECUTIVE SUMMARY

This working paper describes the evolution in the detection of GNSS events, presenting a comparison of the pattern of cases detected in the South American region over a one-year period (January 2025 to January 2026) based on information available on websites. Besides, addressing the conclusion of the need to continue advancing in the tools for collecting information and mainly in developing preventive measures and mitigation proposals to make available to the States of the Region.

Action:	a) Take note of the information provided in this working paper; b) Request that consideration be given to the necessary actions for the development of a regional repository to standardize the collection of GNSS event information and to share recommended preventive measures and corrective actions applied; and c) Suggest any other action that is considered necessary to contribute to continuous improvement.
Strategic Objectives 2026-2050:	• Every flight is safe and secure • Aviation is environmentally sustainable • Aviation delivers seamless, accessible, and reliable mobility for all • No country left behind • The International Civil Aviation Convention and Other Treaties, Laws and Regulations Address All Challenges • The Economic Development of Air Transport Assures the Delivery of Economic Prosperity and Societal Well-Being for All
References:	• Resolution A42-7: Support for ICAO policy on radiofrequency spectrum matters.

	• •Resolution A42-8: Consolidated Statement of ICAO Standing Policies and Practices Concerning a Global Air Traffic Management (ATM) System and Communications, Navigation and Air Traffic Surveillance/Management (CNS/ATM) Systems Resilience of ICAO CNS/ATM Systems and Services. • Thirty-Third Workshop/Meeting of the SAM Implementation Group (SAM/IG/33) Lima, Peru, August 11-15, 2025 • Workshop on Air Navigation Systems for the NAM/CAR/SAM Regions Mexico City, Mexico, September 2-4, 2025 • Fifth and Sixth South Atlantic Implementation and Operational Safety Group Meetings (SAT/IMG and SAT/SOG) held in April and November 2025

1. Introduction

1.1 The use of the Global Navigation Satellite System (GNSS) continues to expand in air navigation, as more aircraft are equipped with the necessary avionics and PBN procedures are being developed and implemented, due to the already proven advantages of this type of air navigation over conventional navigation.

1.2 Interference with GNSS signals and its mitigation is a very present topic and is especially considered and studied by ICAO in its forums and documents, since at the international level there have been repeated incidents of interference in GNSS that affect the operational safety of international air navigation.

1.3 This prompts a request to all Member States to take measures to ensure that sources of interference signals in the GNSS are identified and mitigated in order to safeguard the integrity of international air navigation.

1.4 An important recommendation is to identify interference cases for analysis and resolution; for this, you can rely on the collection of reports received from crews and the information provided by avionics systems, especially the messages transmitted by ADS-B.

2 Analysis

2.1 ICAO Annex 10 – Aeronautical Telecommunications and related regulations establish the technical requirements for the characteristics of the signals and onboard equipment used for the Global Navigation Satellite System (GNSS). These parameters define the guidelines for the design and operation of GNSS-based aircraft. Radio interference to signals from the GNSS satellite constellation can be caused by various sources and represents a vulnerability to the safety of air operations.

2.2 ICAO and civil aviation organizations actively organize study forums, working groups, and develop technical documents that address the issue.

2.3 In this regard, Resolutions A42-7: *"Support for ICAO policy on radiofrequency spectrum matters"* and A42-8: *"Consolidated statement of ICAO standing policies and practices relating to a global*

air traffic management (ATM) system and communications, navigation and surveillance/air traffic management (CNS/ATM) systems" of the 42nd ICAO Assembly, express that aviation needs a comprehensive radiofrequency spectrum strategy to support the timely availability and appropriate protection of the appropriate spectrum; and to take measures to address the significant increase in interference events in satellite-based CNS systems and the Global Navigation Satellite System (GNSS).

2.4 In line with high-level recommendations and in support of ICAO's aeronautical spectrum protection policies, the regional technical groups addressed the issue of GNSS interference in meetings and workshops held during 2025. For example: the Thirty-Third Workshop/Meeting of the SAM Implementation Group (SAM/IG/33) Lima, Peru, August 11-15, the Workshop on Air Navigation Systems for the NAM/CAR/SAM Regions Mexico City, Mexico, September 2-4, and the fifth and sixth South Atlantic Implementation and Operational Safety Group Meetings (SAT/IMG and SAT/SOG) held in April and November 2025.

2.5 One point recommended by ICAO is the identification of interference cases for subsequent study and evaluation to inform decision-making for their resolution or mitigation. The IATA document Global Navigation Satellite System GNSS Radio Frequency Interference Safety Risk Assessment (September 2024 edition) presents data taken from the Global Aviation Data Management (GADM) program.

2.6 In addition, the following open information portals compile reports whose source is ADS-B systems; which allow the representation of daily maps of GNSS signal integrity events, jamming, and spoofing:

2.6.1 The GPSJAM website https://gpsjam.org/ , developed by John Wiseman in July 2022, displays a daily map of GPS interference reported by aircraft, using data provided by ADS-B Exchange. While not an official source, it can be used as a free reference to observe current cases and analyze trends in areas of interest.

2.6.2 Stanford University website allows you to view information on jamming, spoofing, and NOTAMs.

https://rfi.stanford.edu/?date=2025-08-01&mode=jamming&granularity=daily&heatmap=true

2.7 Representation of the evolution of GNSS event cases in the SAM region.

2.7.1 Below are screenshots of sites reporting the status of jamming/spoofing events for January 1, 2025 and January 1, 2026. Initially, images from GPSJAM are shown, followed by those from Stanford University for both dates, noting that the patterns presented are consistent.

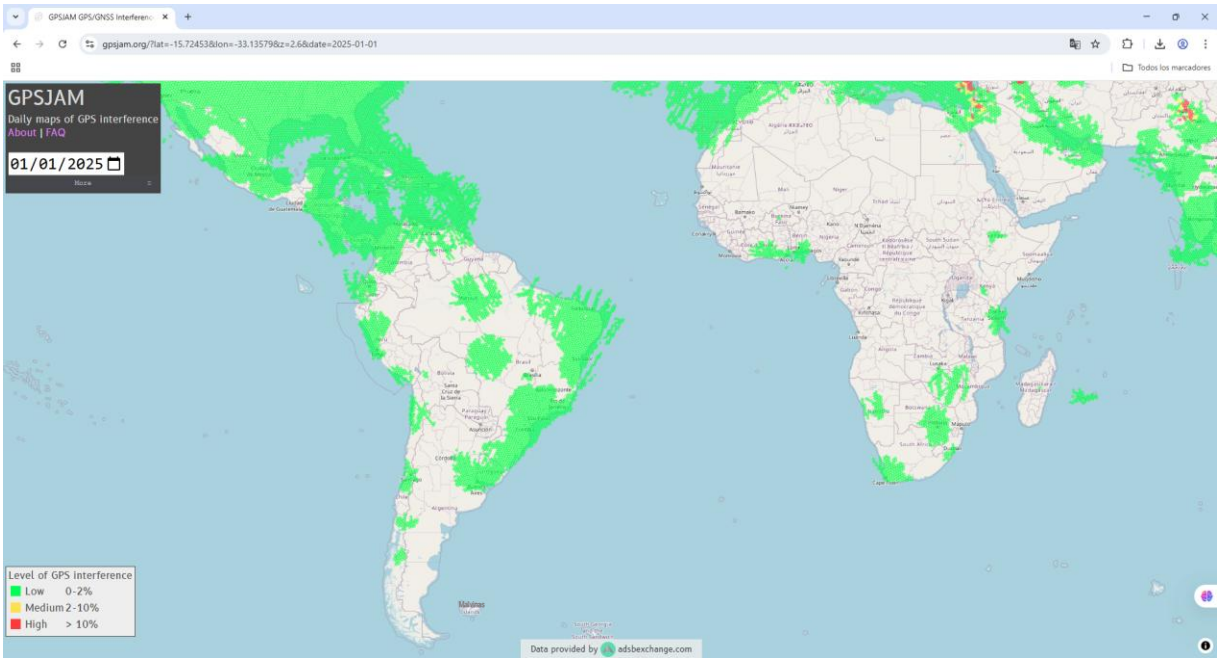
2.7.2 Additionally, the maps show the impact on the South Atlantic area, suggesting that this material be submitted for consideration to the SAT, SAT/IMG and SAT/SOG forums.

2.7.3 These sites collect information from all aircraft equipped with ADS-B systems, graphically representing the percentage of aircraft affected by jamming and spoofing based on the Navigation Integrity Category (NIC [1]) parameter value received, relative to the total number of aircraft in the sector. Specifically, the Stanford site presents analytical statistics on the types of aircraft affected by jamming and spoofing, the

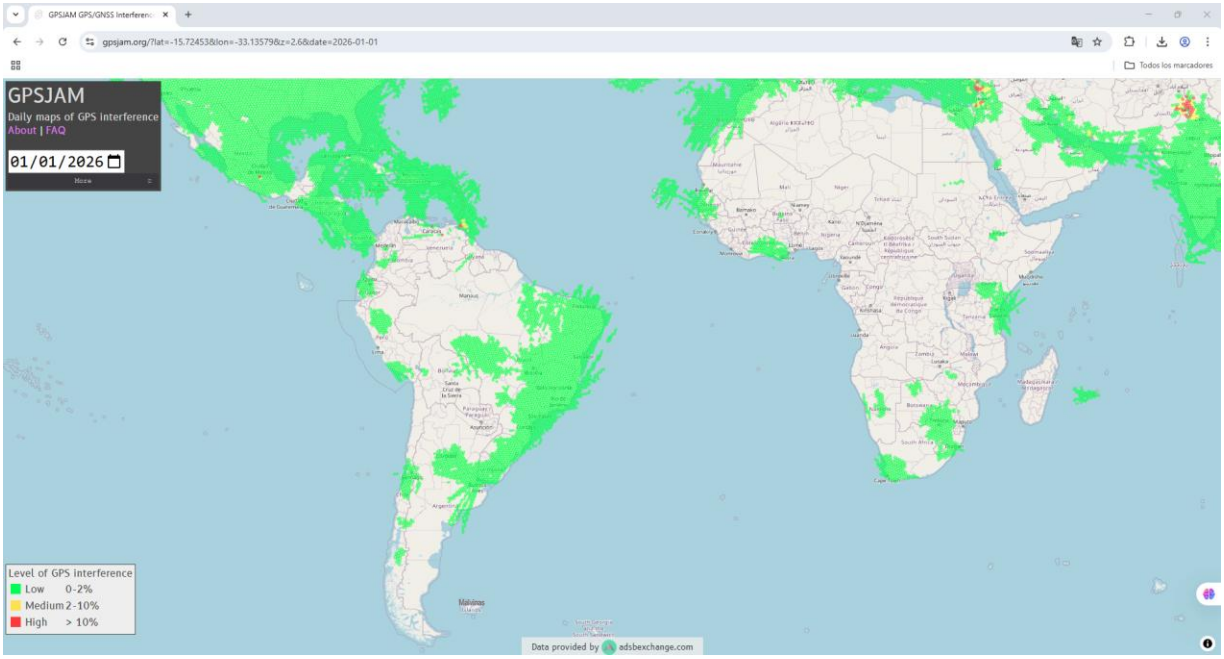
[1]The Navigation Integrity Category (NIC) is reported so that surveillance applications can determine whether the reported position has an acceptable level of integrity for its intended use. The NIC parameter value specifies an integrity containment radius, RC.

duration of the disruption, and monthly metrics. It also provides more detailed information on detected jamming and spoofing incidents.

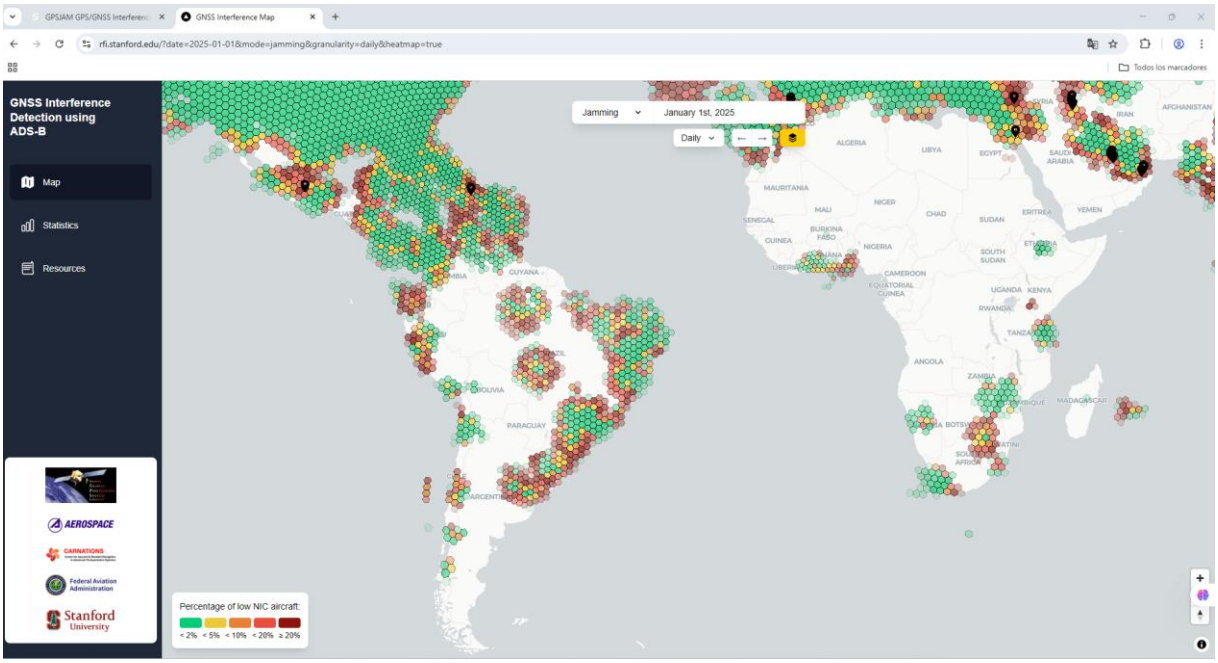
2.7.4 **Appendix** contains screenshots taken on the first day of each month from January 1, 2025 to January 1, 2026 to illustrate the evolution of the cases. A detailed example of a jamming case is also included.



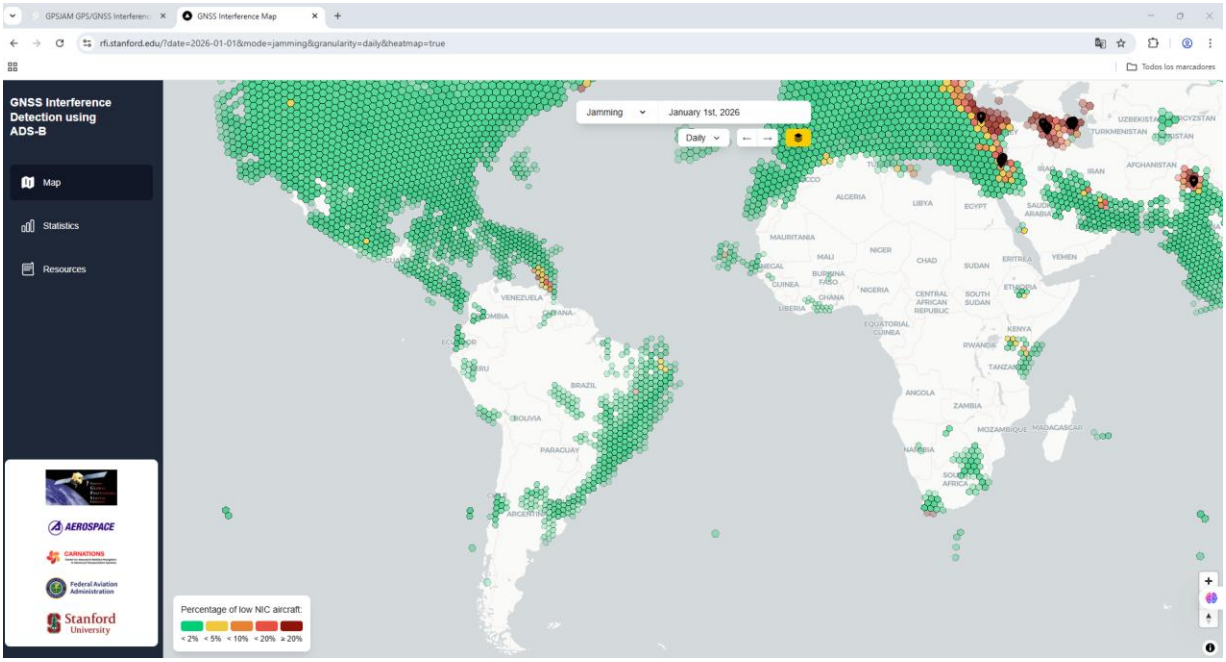
Screenshot of the GPSJAM website for 01/01/2025 https://gpsjam.org/?lat=-15.72453&lon=-33.13579&z=2.6&date=2025-01-01



Screenshot of the GPSJAM website for 01/01/2026 https://gpsjam.org/?lat=-15.72453&lon=-33.13579&z=2.6&date=2026-01-01



Screenshot of the Stanford University website for 01/01/2025 https://rfi.stanford.edu/?date=2025-01-01&mode=jamming&granularity=daily&heatmap=true

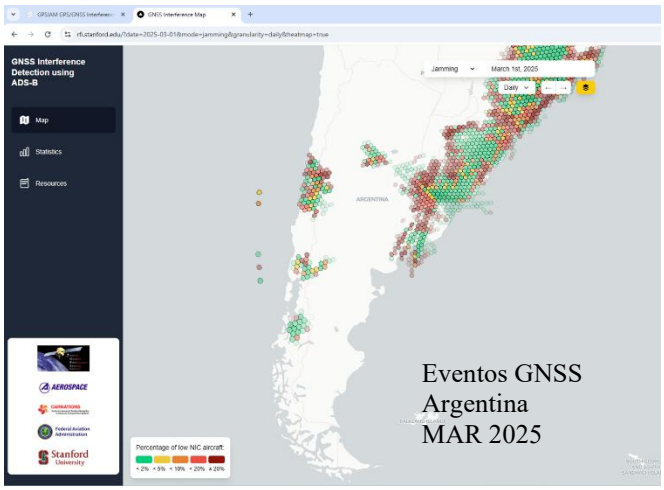


Screenshot of the Stanford University website for 01/01/2026
https://rfi.stanford.edu/?date=2026-01-01&mode=jamming&granularity=daily&heatmap=true

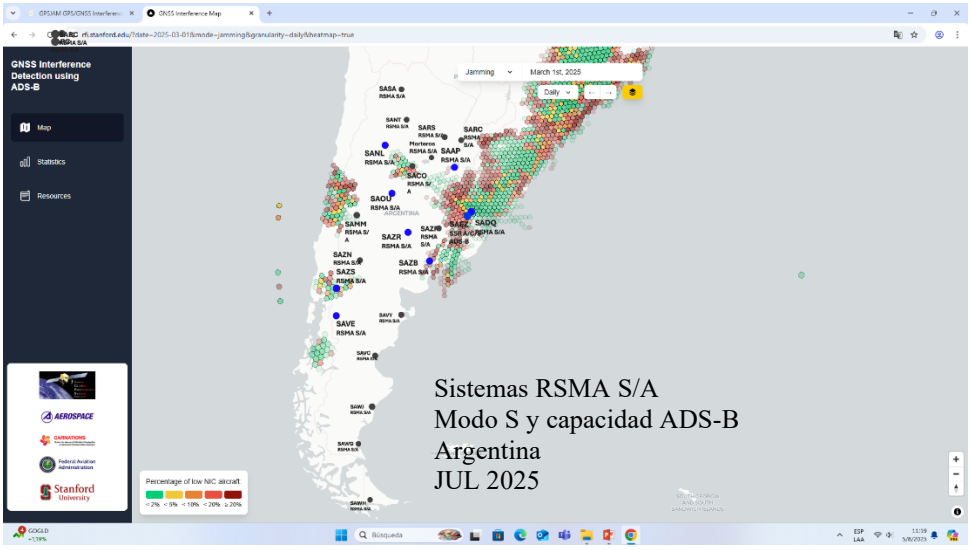
2.8 Considerations on CNS systems resilience

2.8.1 Many relevant planning documents in addition to ICAO resolutions and recommendations address the need to maintain conventional CNS systems, such as conventional radio navigation aids and surveillance systems, as a contingency. Given the evolution of the satellite navigation network and the need for contingency plans for DME-DME based operations, stakeholders can evaluate the application of EUROCONTROL's DEMETER tool for theoretical assessments.

2.8.2 As a demonstration, comparative illustrations of DME-DME coverage and performance with GNSS events are presented below, as well as a comparison of also maintaining radars as a surveillance contingency in Argentina.


GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
March 1st, 2025
Daily
Percentage of low NIC aircraft
Eventos GNSS
Argentina
MAR 2025


ARG FL290 Performance
Legend:
No Coverage
No Redundancy
Limited Redundancy
Full Redundancy
Excessive Redundancy
Cálculo Performance
DME-DME
Argentina
(software DEMETER)


GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
March 1st, 2025
Daily
Percentage of low NIC aircraft
Sistemas RSMA S/A
Modo S y capacidad ADS-B
Argentina
JUL 2025

3 Conclusion

3.1 As observed in the representation of integrity events in the GNSS signal, the pattern of events has extended in the last year and few cases of spoofing/jamming are observed at a regional level.

3.2 This pattern of events can be considered as input for studies on the rationalization of radio aids and radar systems in areas with more recurrent GNSS events as contingency support for the satellite navigation-based route network.

3.3 In conclusion, the need to continue the studies carried out in the regional technical groups on GNSS interference cases is identified, advancing the methodology to collect reports of events, share information on the corrective measures applied and determine preventive actions to avoid future interference situations considering the available tools as input.

4 Suggested Action

4.1 You are invited to the meeting:

a) Take note of the information provided in this working paper;

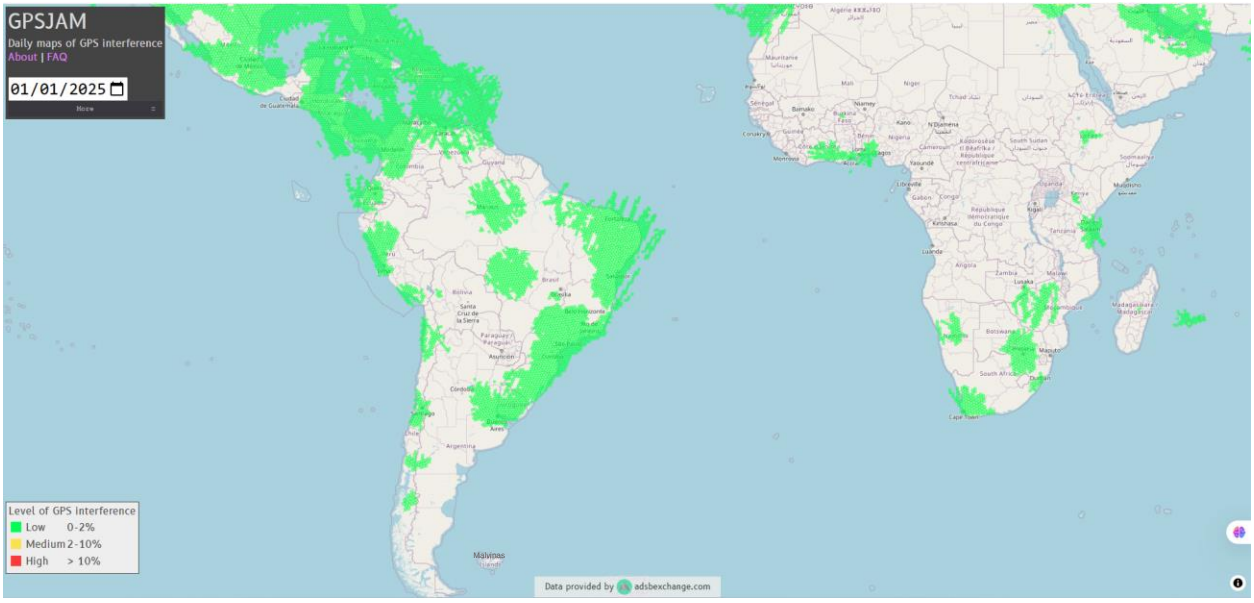
b) Request that the necessary actions be considered for the development of a regional repository to standardize the collection of GNSS event information and to share the recommended preventive measures and corrective actions applied;

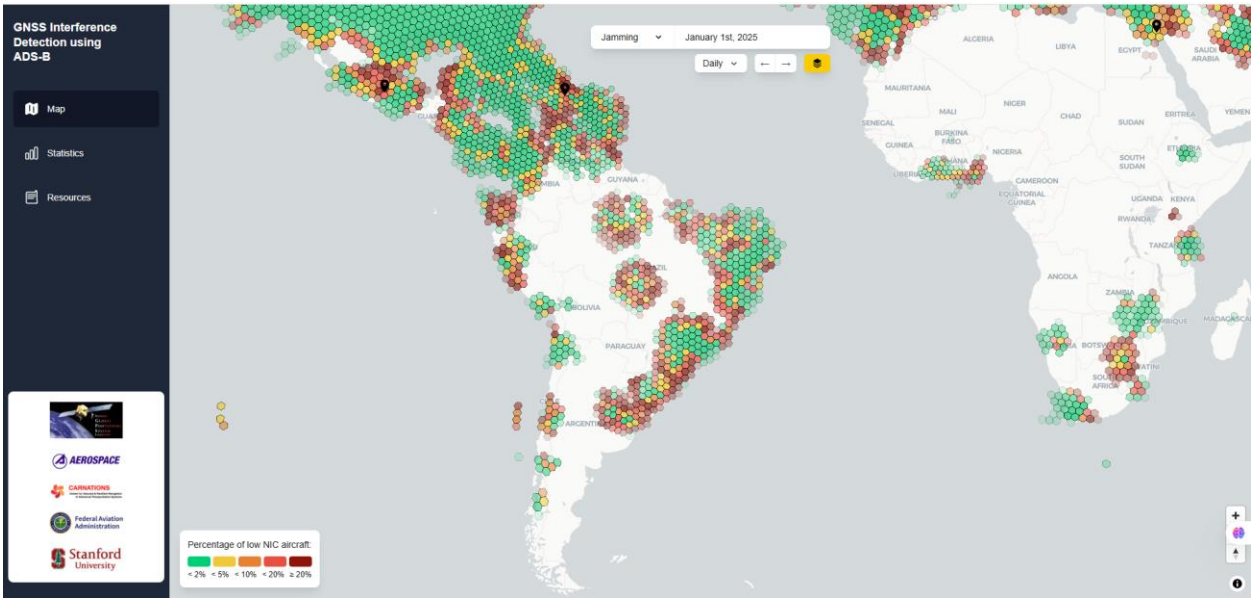
c) Suggest any other actions that are considered necessary to contribute to continuous improvement.

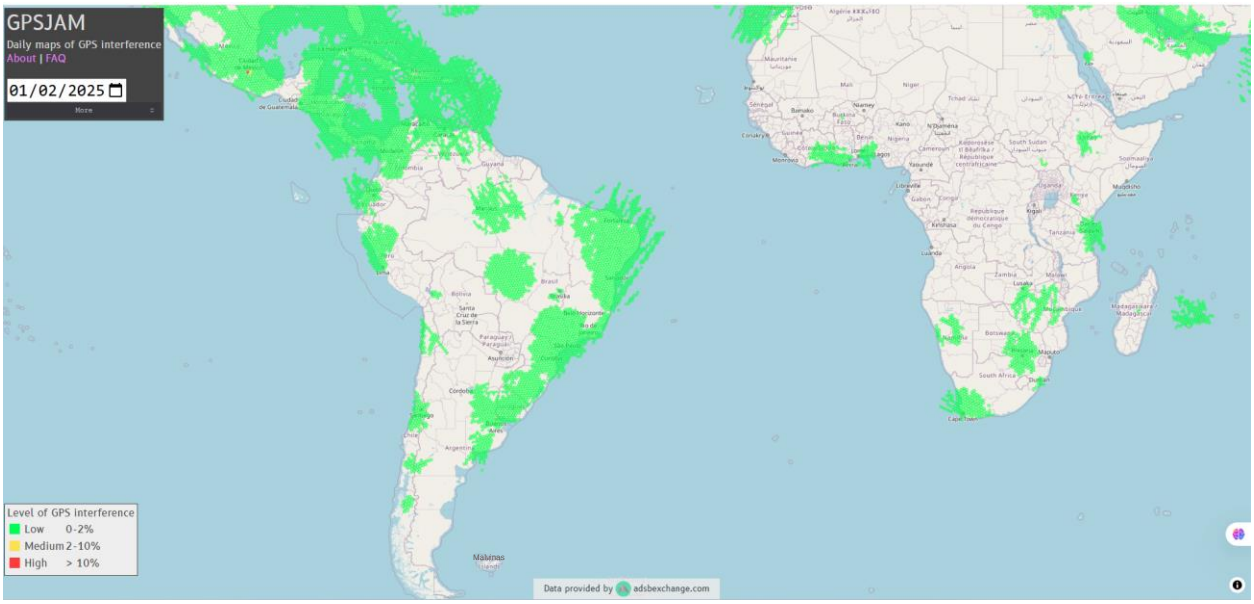
— END —

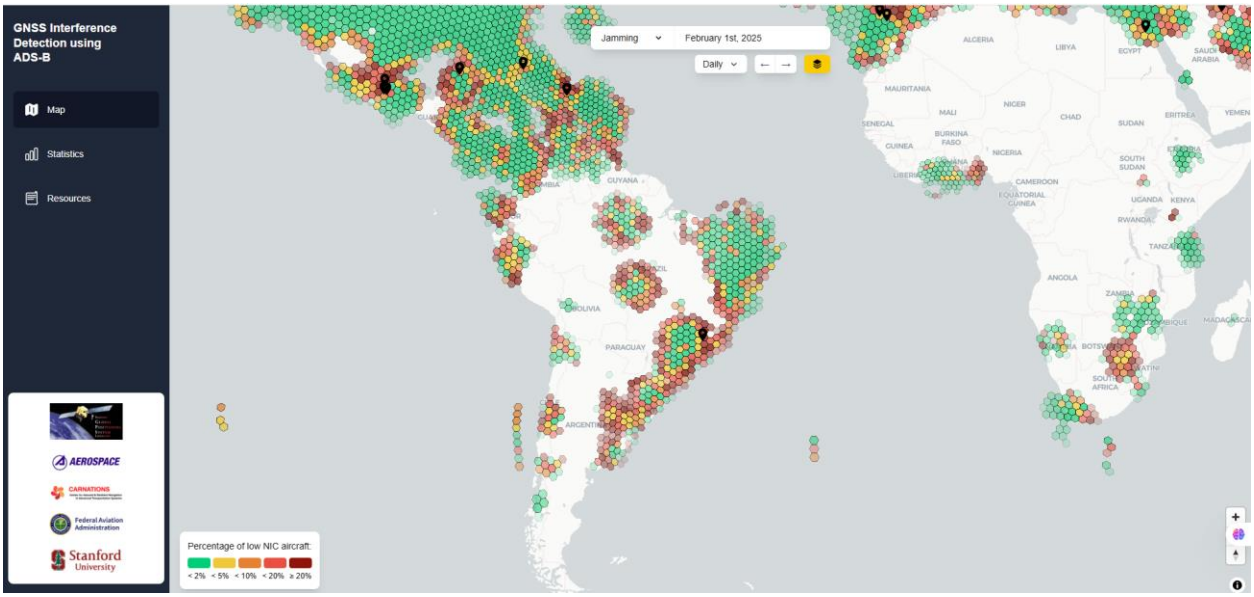
APPENDIX A
GRAPHIC REPRESENTATION OF GNSS EVENTS IN THE CAR SAM REGION

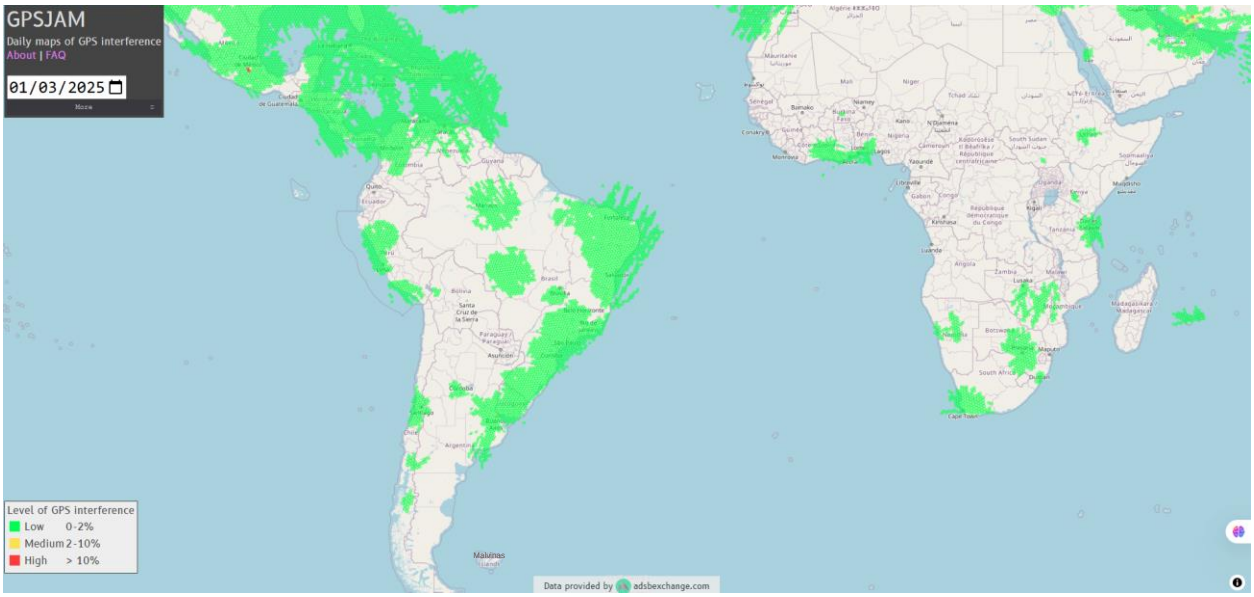
Screenshots

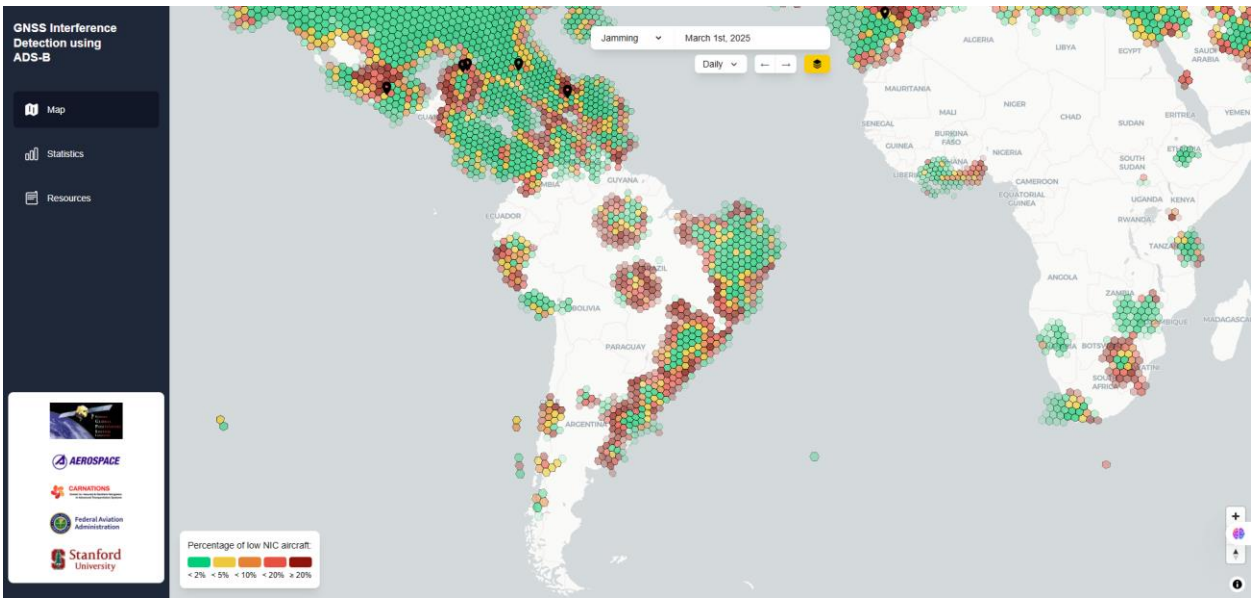


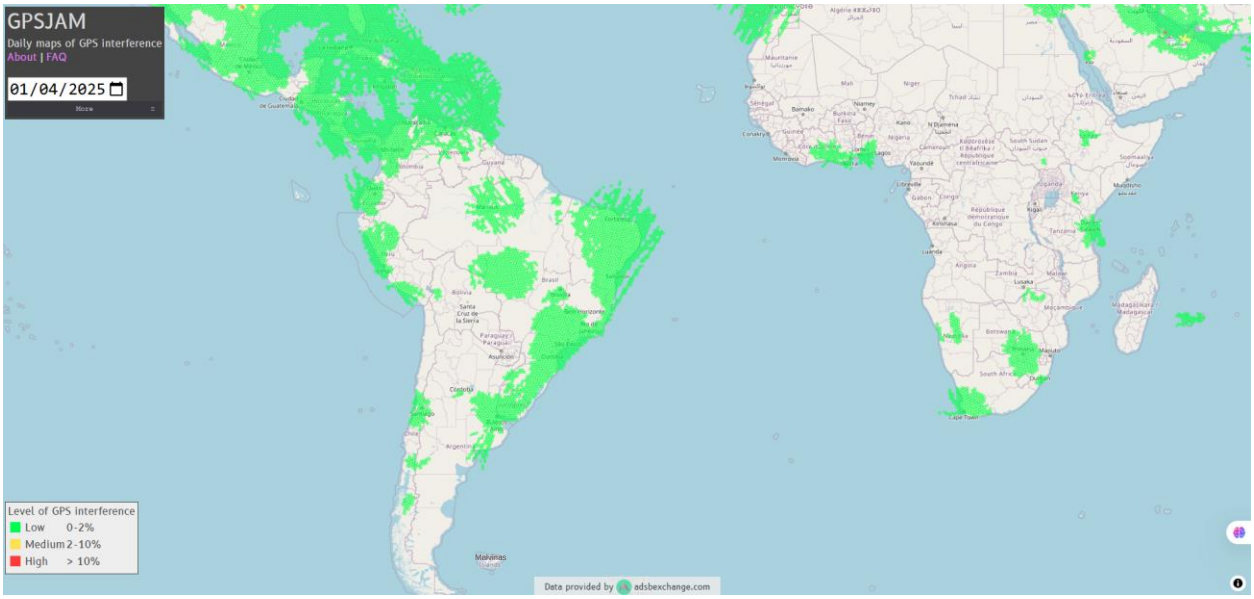


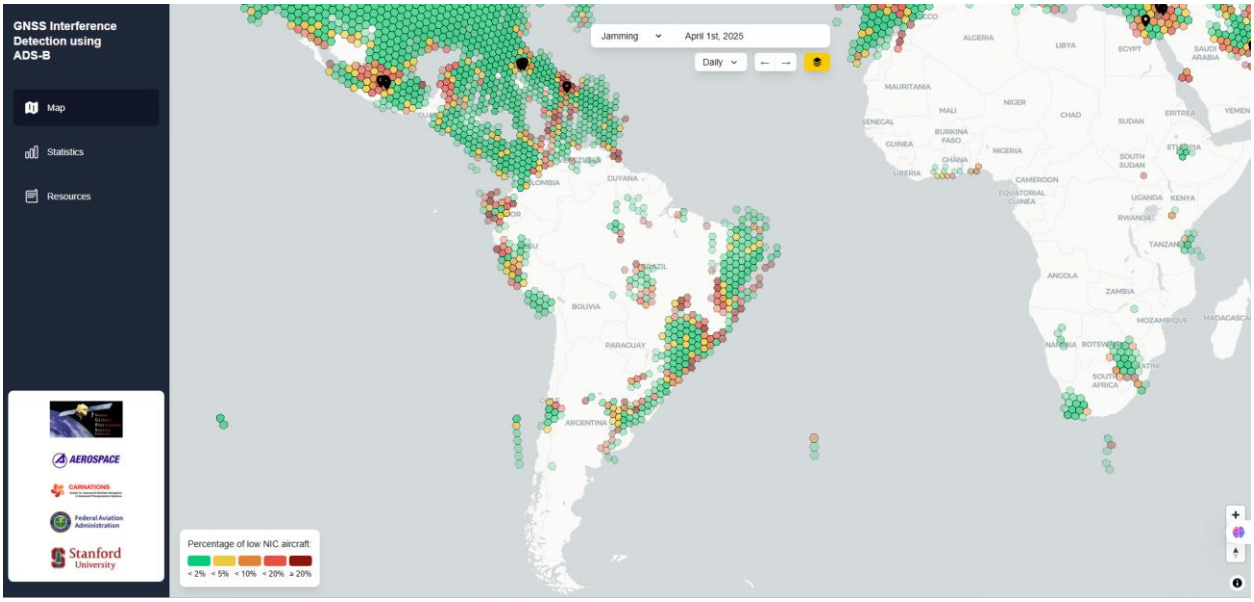

GPSJAM
Daily maps of GPS interference
About | FAQ
01/02/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

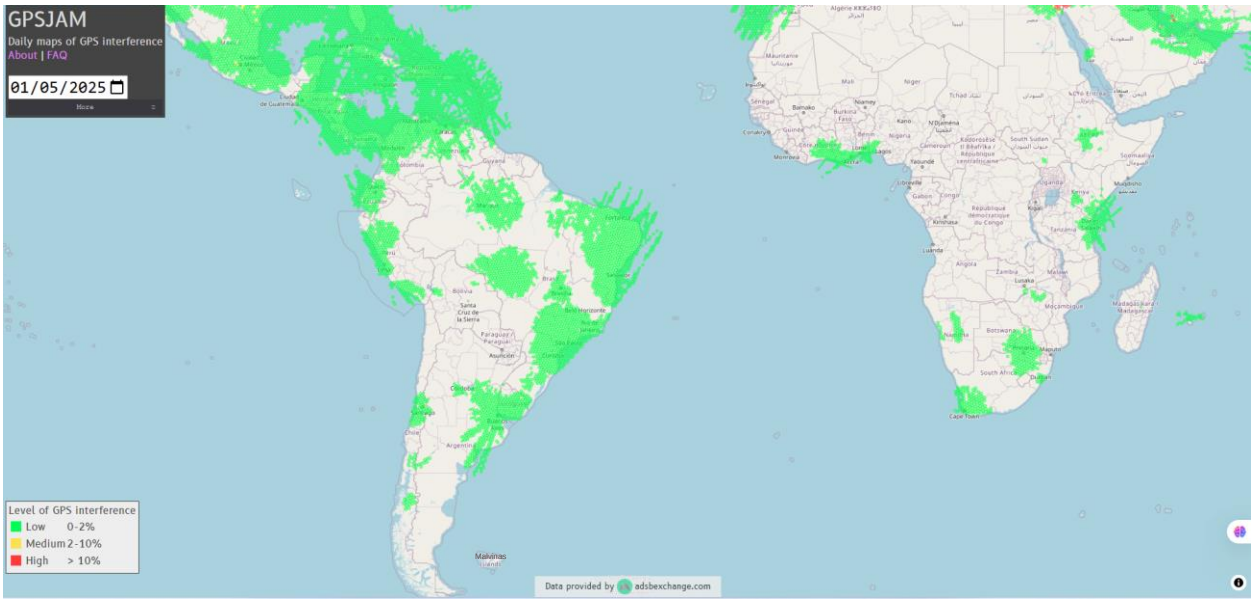

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
February 1st, 2025
Daily
AEROSPACE
Federal Aviation Administration
Stanford University
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%

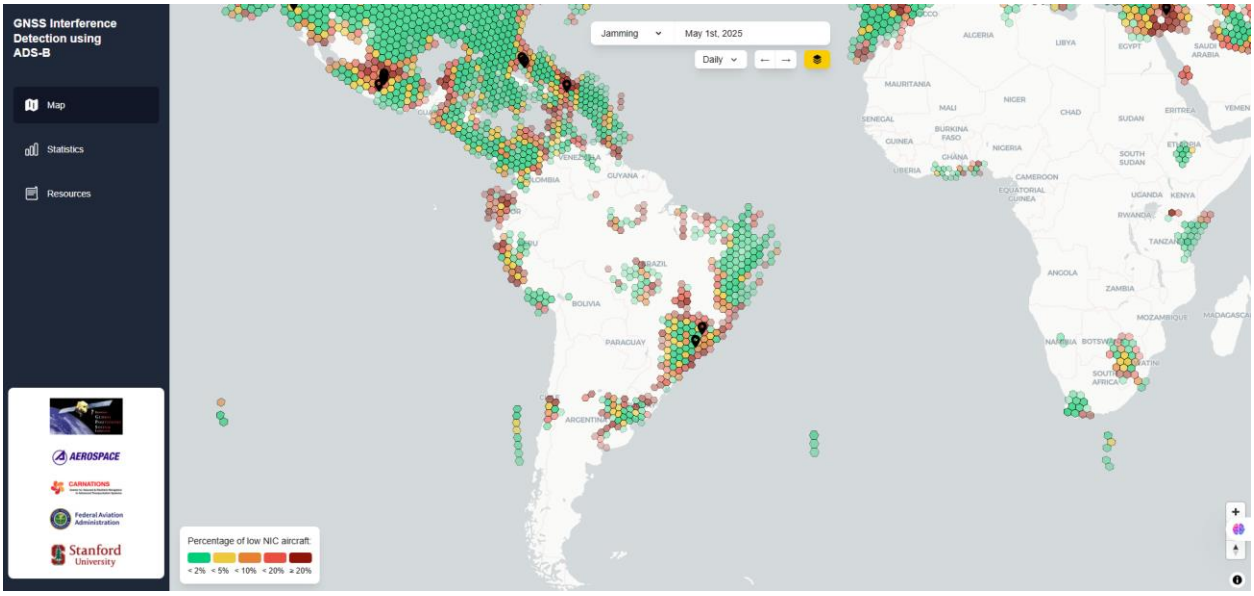

GPSJAM
Daily maps of GPS interference
About | FAQ
01/03/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

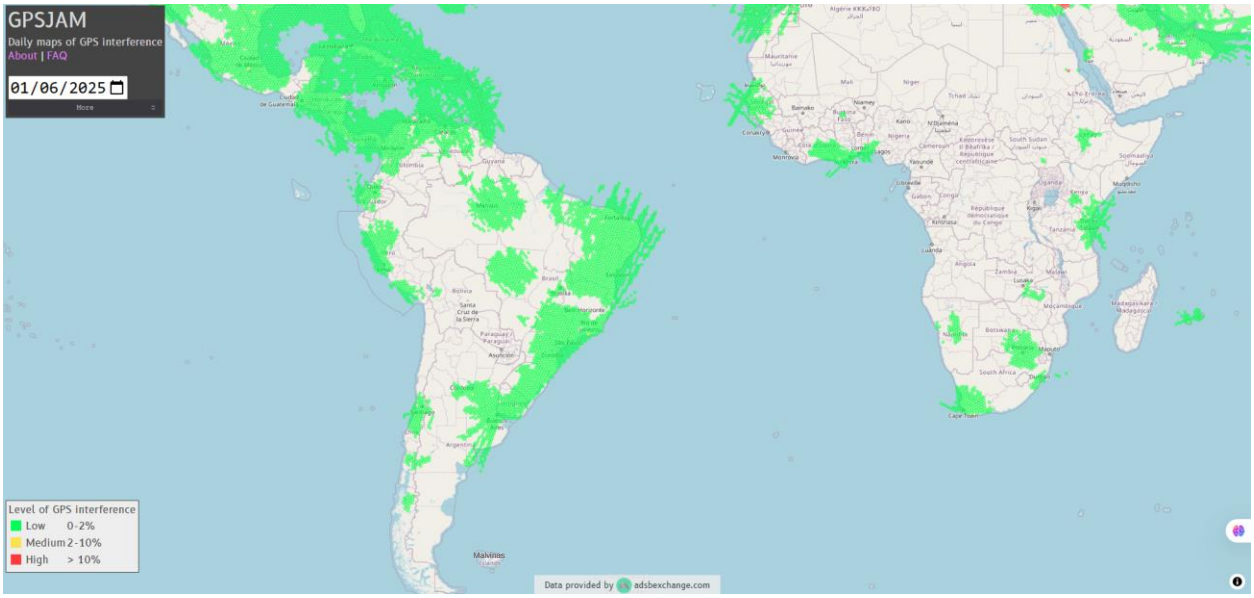

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
March 1st, 2025
Daily
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%


GPSJAM
Daily maps of GPS interference
About | FAQ
01/04/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

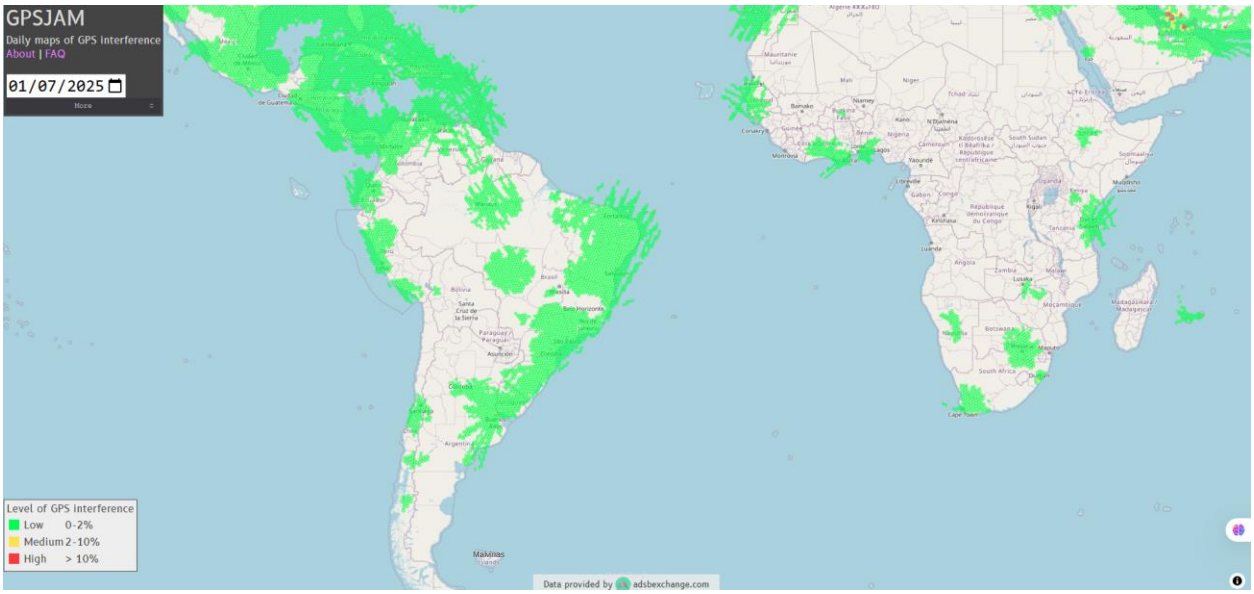

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
April 1st, 2025
Daily
AEROSPACE
CARNATIONS
Federal Aviation Administration
Stanford University
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%

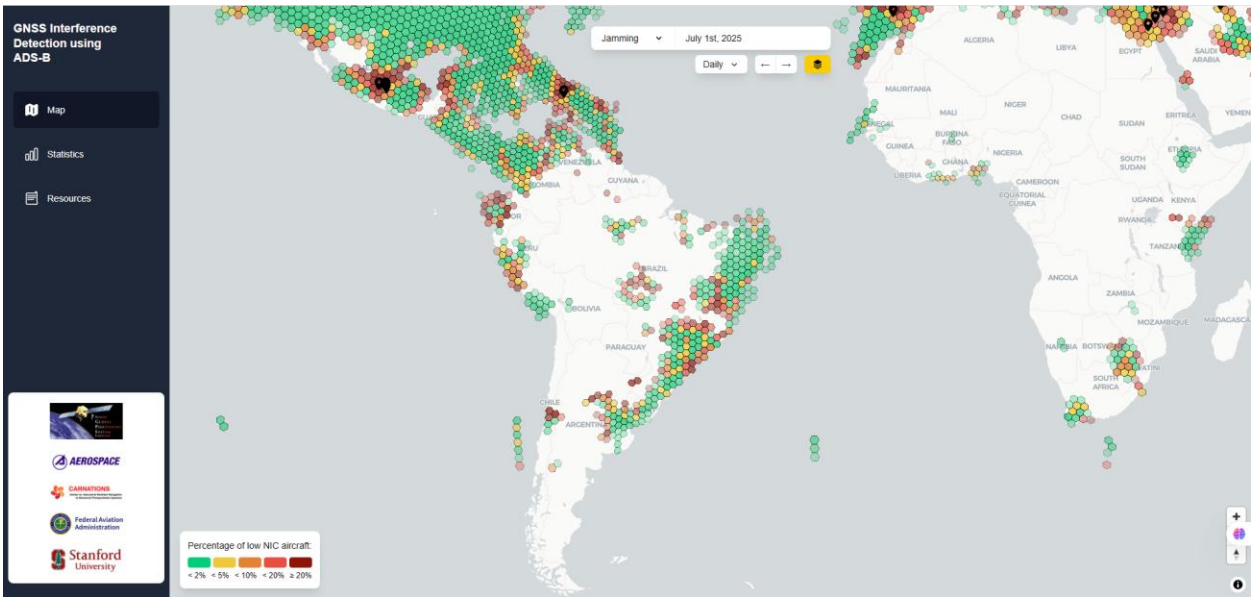

GPSJAM
Daily maps of GPS interference
About | FAQ
01/05/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

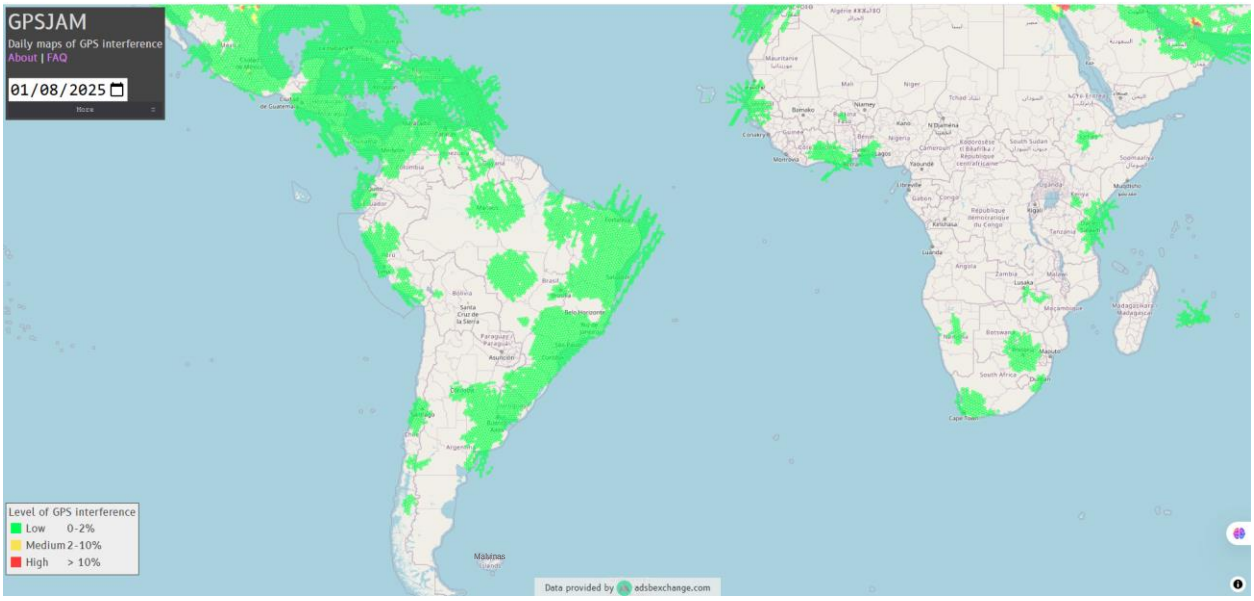

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
May 1st, 2025
Daily
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%

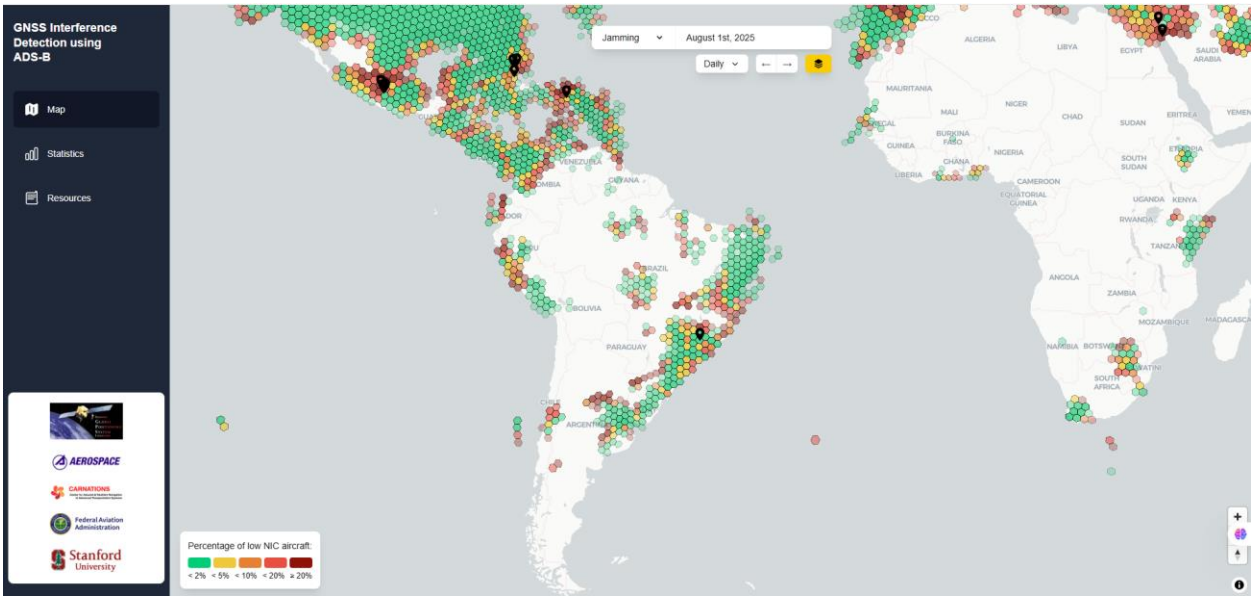

GPSJAM
Daily maps of GPS interference
About | FAQ
01/06/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

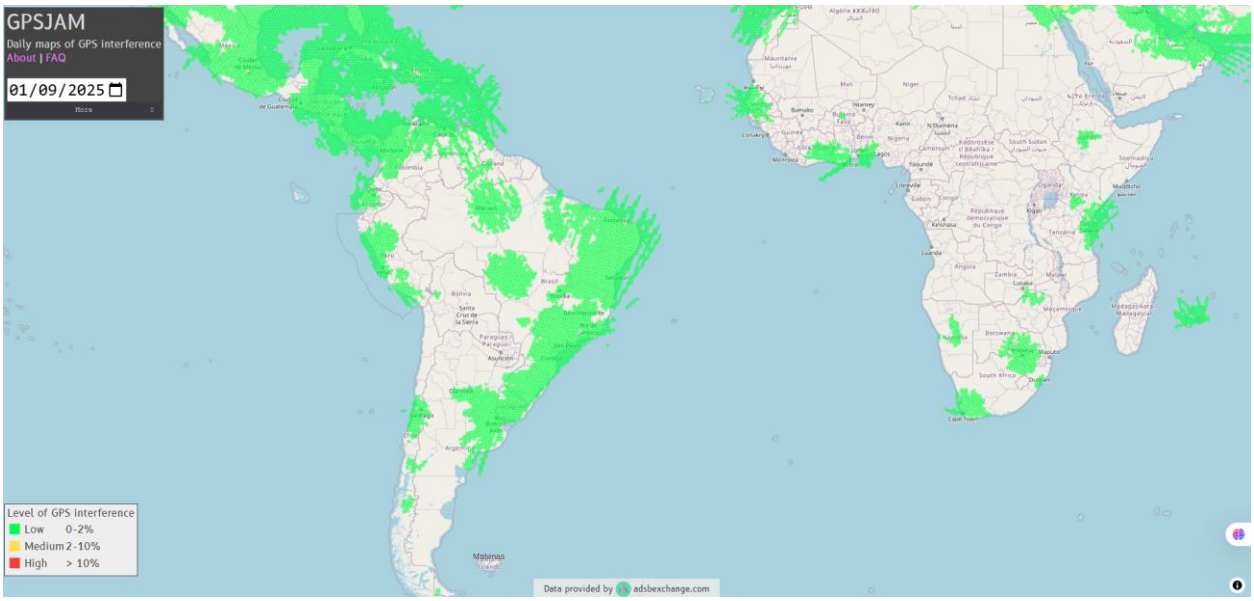

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
June 1st, 2025
Daily
AEROSPACE
Federal Aviation Administration
Stanford University
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%

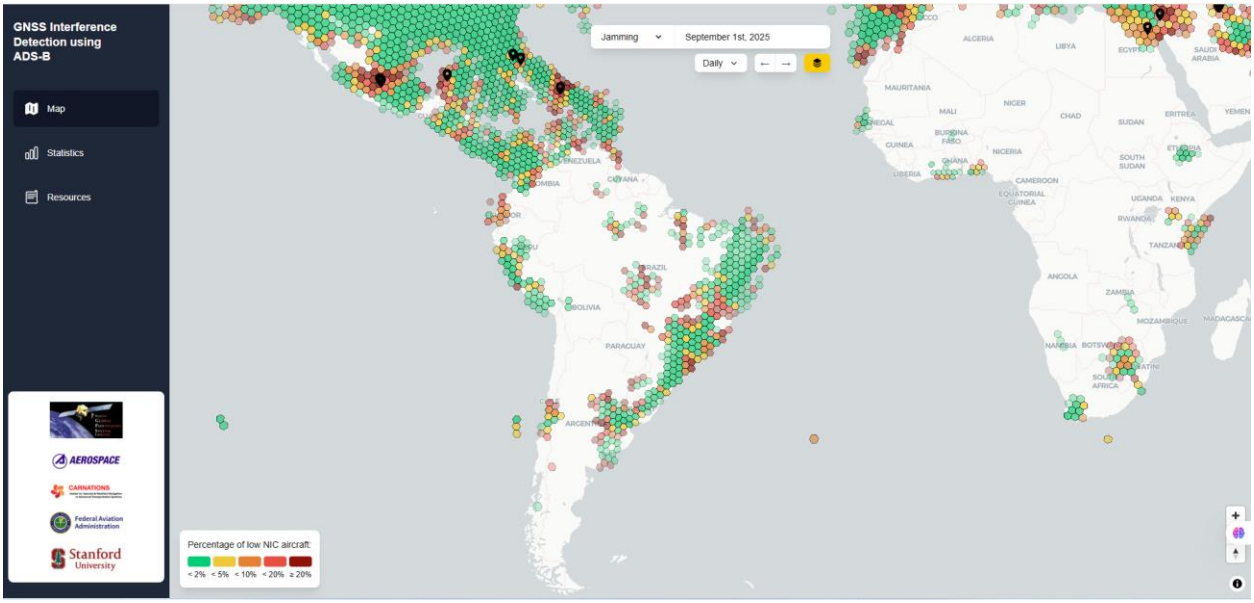

GPSJAM
Daily maps of GPS interference
About | FAQ
01/07/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

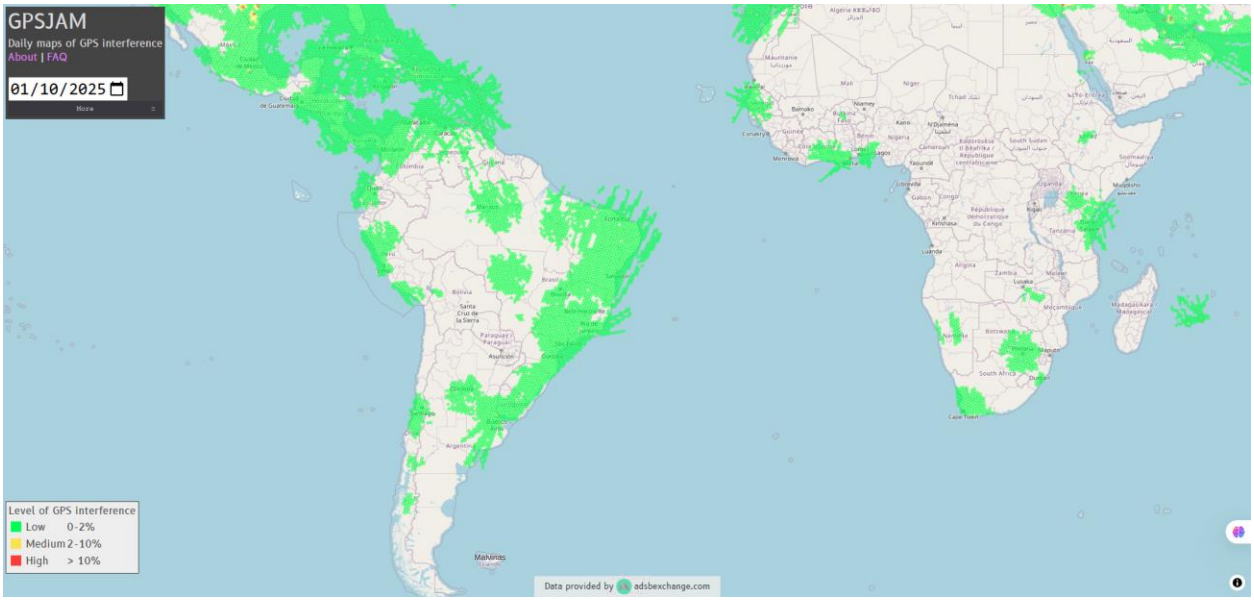

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
July 1st, 2025
Daily
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%

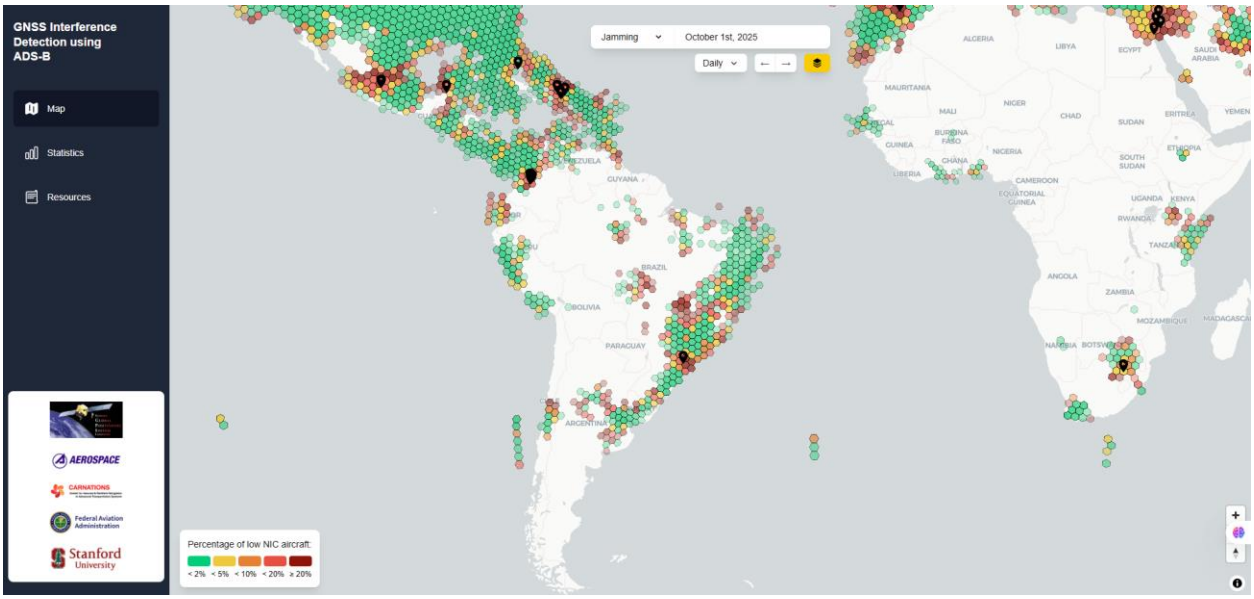

GPSJAM
Daily maps of GPS interference
About | FAQ
01/08/2025
Level of GPS Interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

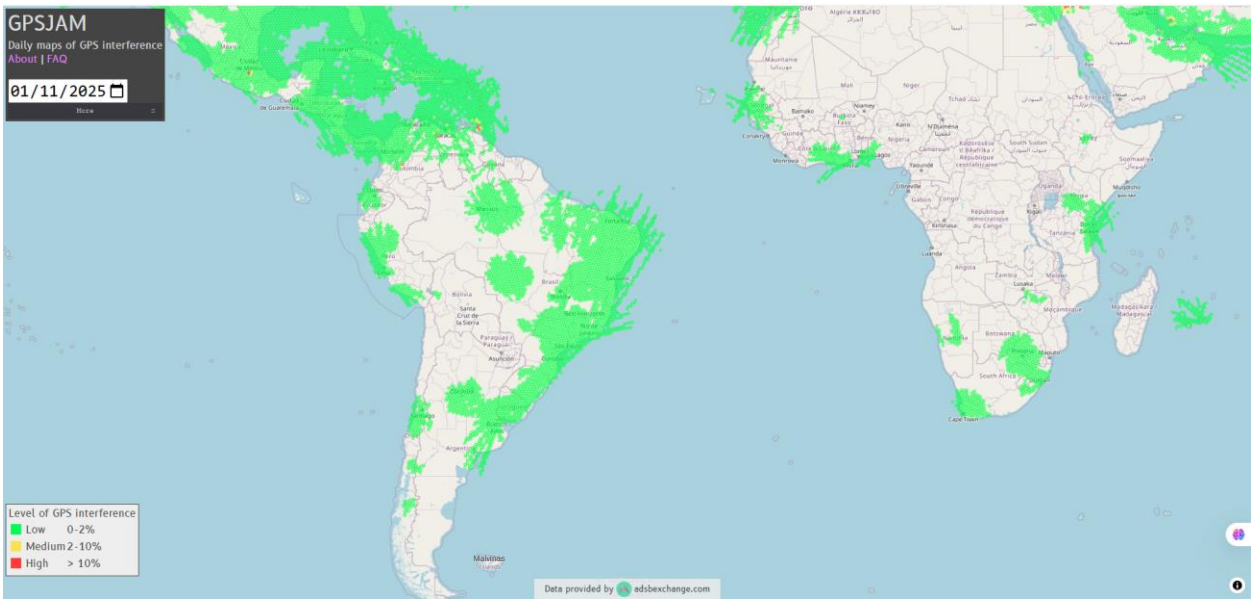

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
August 1st, 2025
Daily
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%

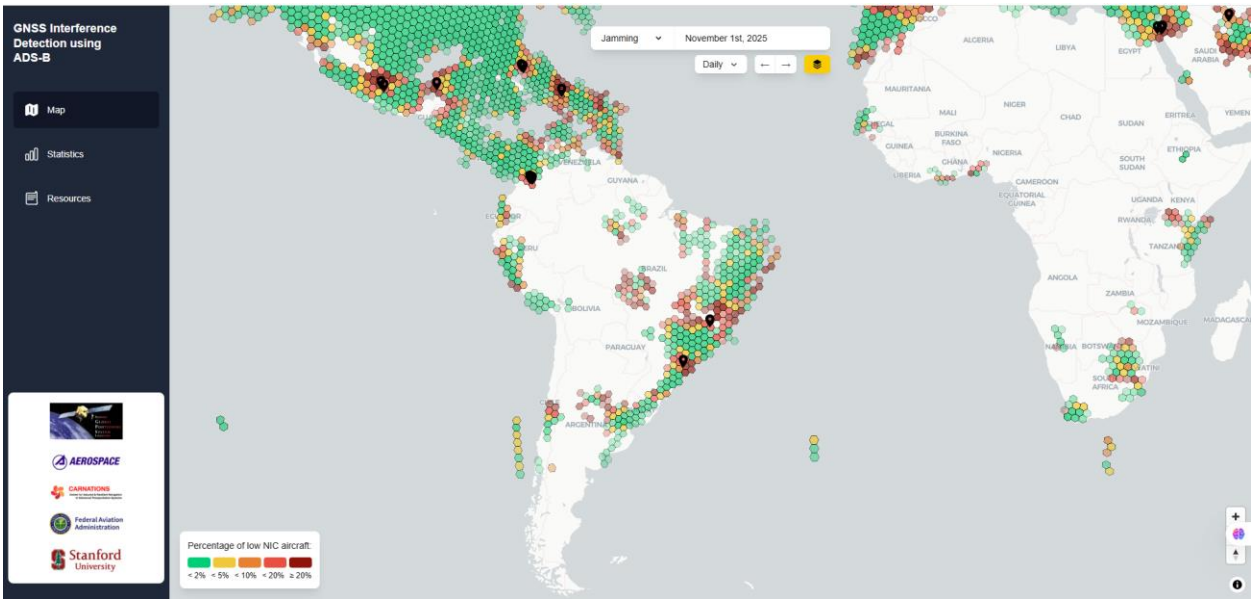

GPSJAM
Daily maps of GPS interference
About | FAQ
01/09/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

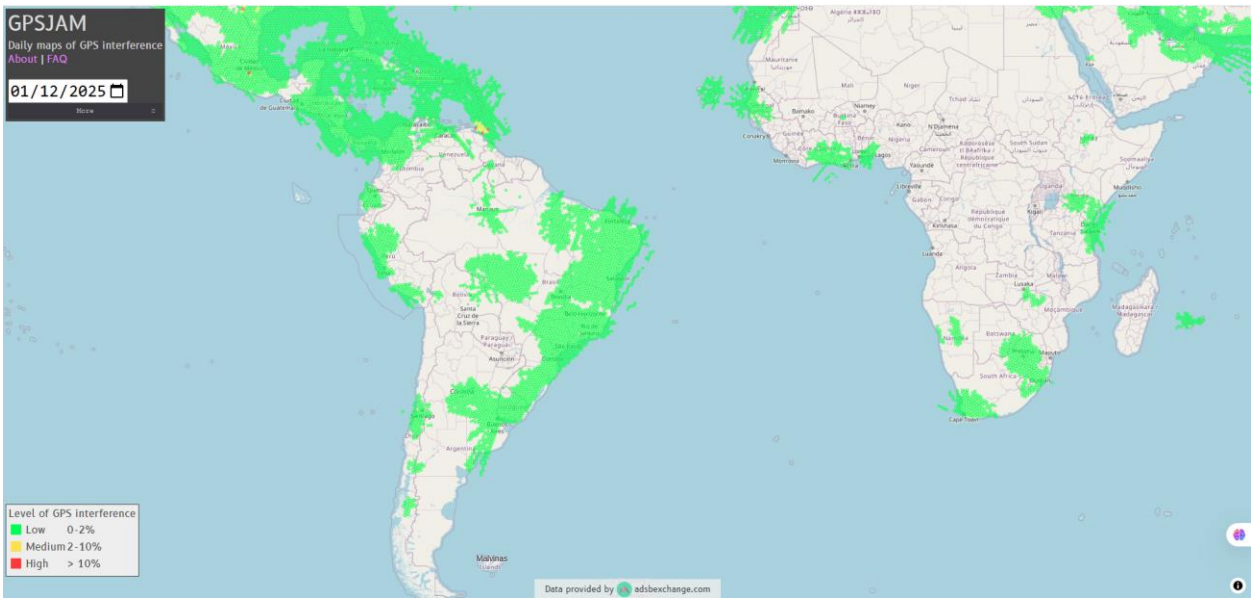

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
September 1st, 2025
Daily
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%

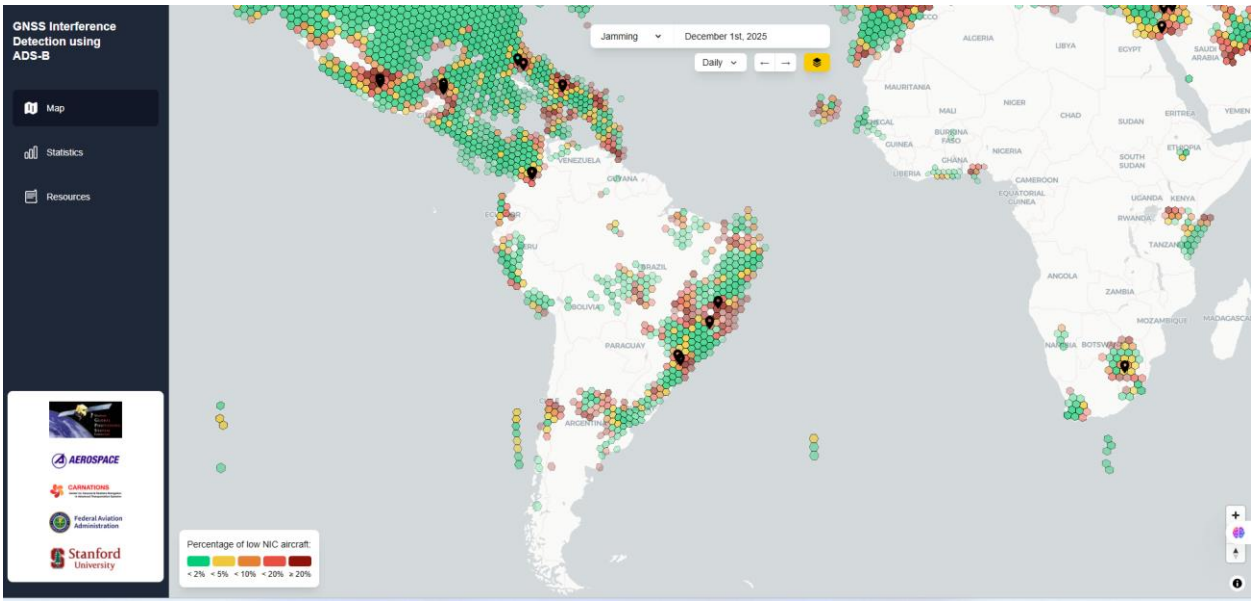

GPSJAM
Daily maps of GPS interference
About | FAQ
01/10/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com


GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
October 1st, 2025
Daily
Percentage of low NIC aircraft.
< 2% < 5% < 10% < 20% ≥ 20%

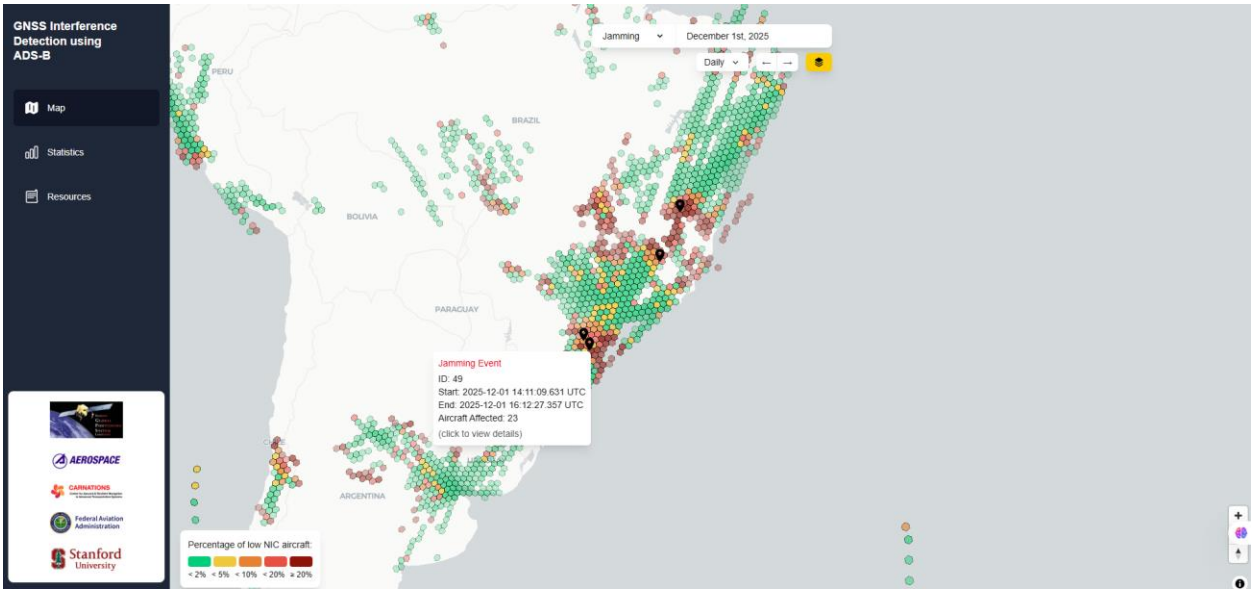

GPSJAM
Daily maps of GPS interference
About | FAQ
01/11/2025
Level of GPS interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com

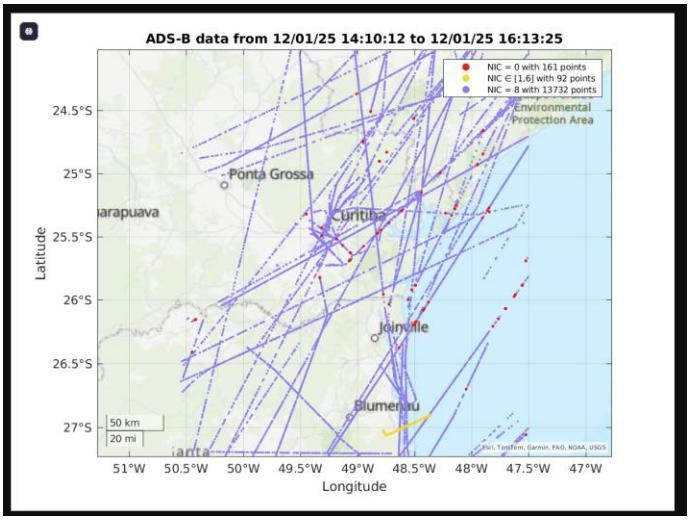

GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
November 1st, 2025
Daily
AEROSPACE
CARNATIONS
Federal Aviation Administration
Stanford University
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%


GPSJAM
Daily maps of GPS interference
About | FAQ
01/12/2025
Level of GPS Interference
Low 0-2%
Medium 2-10%
High > 10%
Data provided by adsbexchange.com


GNSS Interference Detection using ADS-B
Map
Statistics
Resources
Jamming
December 1st, 2025
Daily
Percentage of low NIC aircraft:
< 2% < 5% < 10% < 20% ≥ 20%

Below are screenshots of the details of Jammings observed on 01-DEC-2025, illustrating details of ID 49 (screenshot and link to video)





https://waas-nas.stanford.edu/data/jamming/2025/12/01/events/49/trajectories.mp4

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