

Evolución de Eventos GNSS en la Región SAM

Periodo: ENE 2024 – JUL 2025

Taller sobre Sistemas de Navegación aérea para las regiones
NAM/CAR/SAM

Ciudad de México, México, del 2 al 4 de septiembre de 2025

ANAC | AVIACIÓN CIVIL
ARGENTINA



Secretaría
de Transporte
Ministerio de Economía

Evolución de eventos GNSS en la Región SAM



Las interferencias a las señales GNSS y su mitigación es un tema muy presente y especialmente considerado y estudiado por OACI en sus foros y documentos, ya que a nivel internacional se han presentado reiterados incidentes de interferencia en el GNSS que afectan a la seguridad operacional de la navegación aérea internacional.

Por lo que se requirió a todos los Estados miembros que tomen medidas para asegurar que se identifiquen y mitiguen las fuentes de señales de interferencia en el GNSS con el objeto de velar por que se mantenga la integridad de la navegación aérea internacional.



Evolución de eventos GNSS en la Región SAM

Una recomendación importante es identificar los casos de interferencias, para eso se puede contar con la recopilación de reportes.



Representación de mapas diarios de eventos de spoofings y Jamming:

- Sitio GPSJAM <https://gpsjam.org/> desarrollado por John Wiseman en Julio 2022 con datos provistos por ADS-B Exchange.
- Sitio de la Universidad de Stanford <https://rfi.stanford.edu/?date=2025-08-01&mode=jamming&granularity=daily&heatmap=true>

Documento de IATA “Global Navigation Satellite System GNSS Radio Frequency Interference Safety Risk Assessment” (edición septiembre 2024) que presenta datos tomados del programa Global Aviation Data Management (GADM).



Evolución de eventos GNSS en la Región SAM

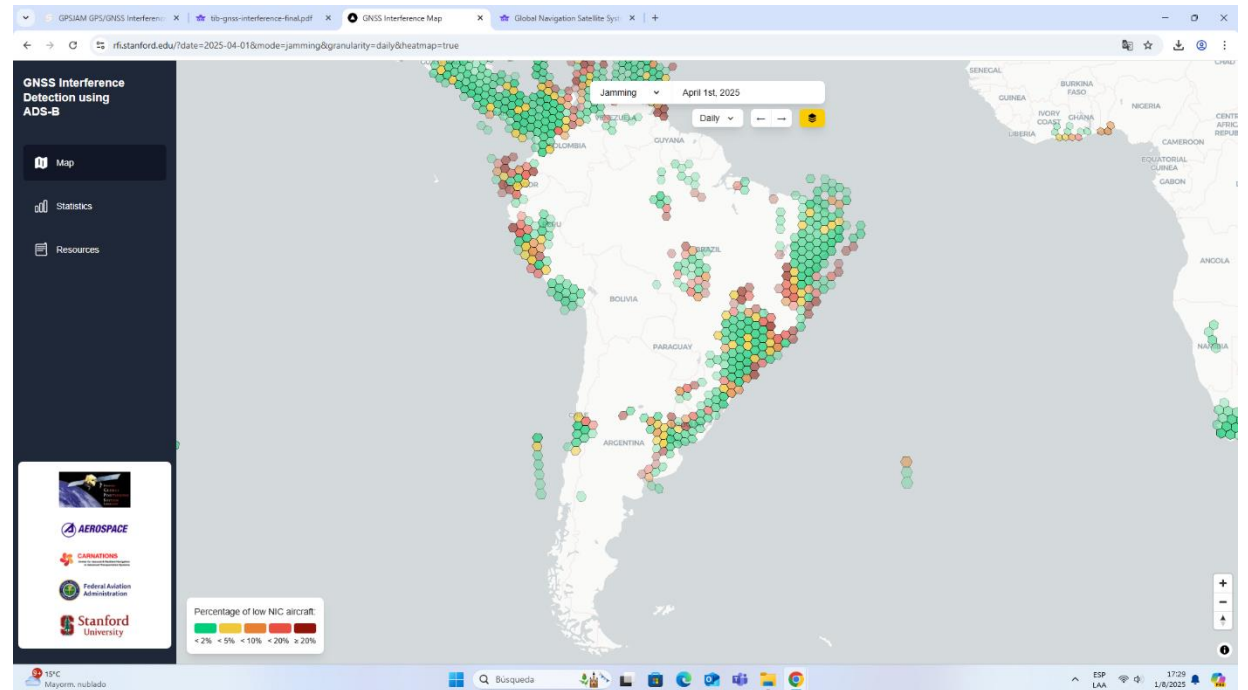
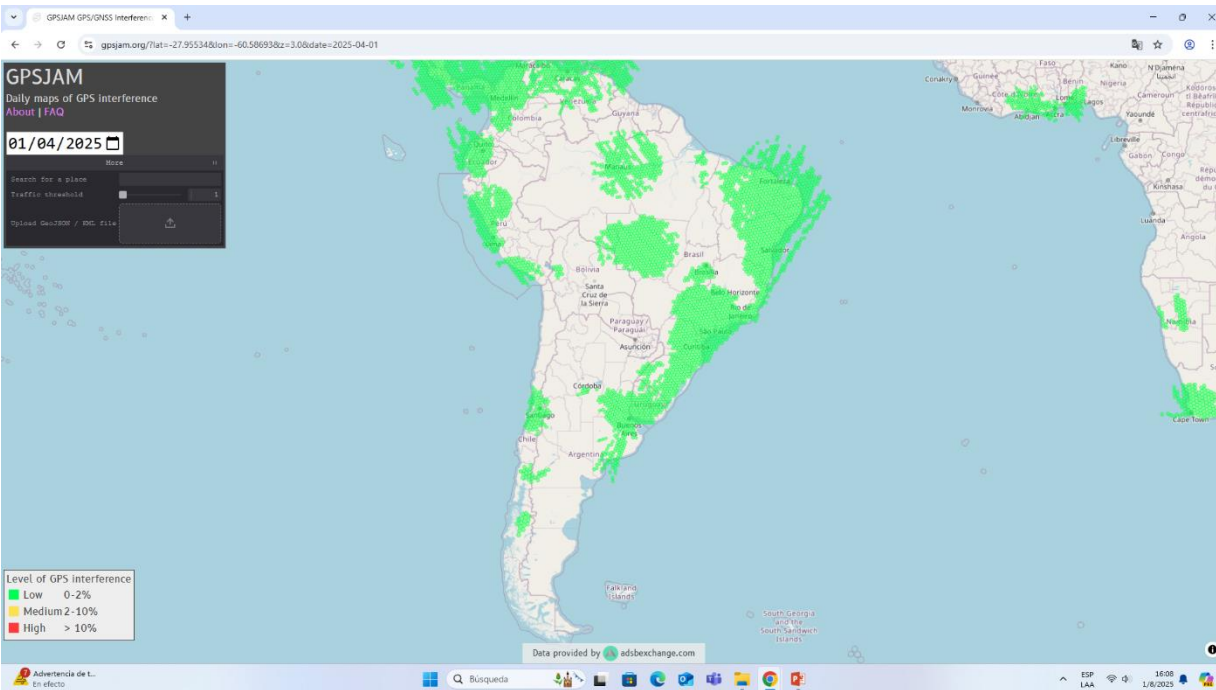


A continuación se presenta las capturas de pantalla de los sitios que reportan el estado de eventos de interferencias (jamming/spoofing) en un periodo de ENE 2025 a JUL 2025 .

Inicialmente se muestran las imágenes de GPSJAM y luego las de la Universidad de Stanford, observando que los patrones coinciden



Evolución de eventos GNSS en la Región SAM



GPSJAM

Daily maps of GPS interference
[About](#) | [FAQ](#)

01/01/2024

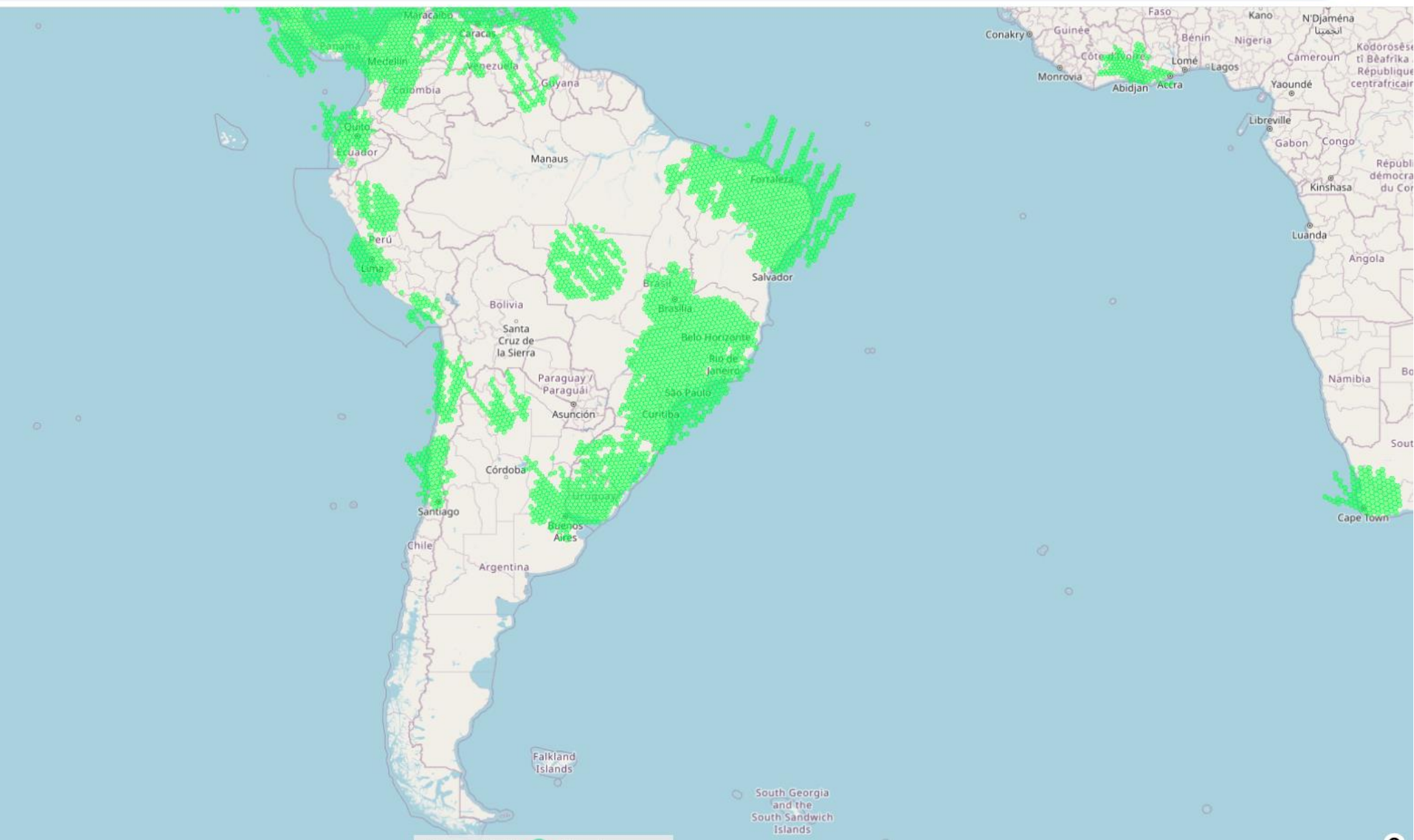
Search for a place

Traffic threshold

Upload GeoJSON / KML file

Level of GPS interference

- Low 0-2%
- Medium 2-10%
- High > 10%



Data provided by [adsbexchange.com](#)

GPSJAM

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01/02/2024

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Daily maps of GPS interference

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01/04/2024

Search for a place

Traffic threshold 1

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01/05/2024

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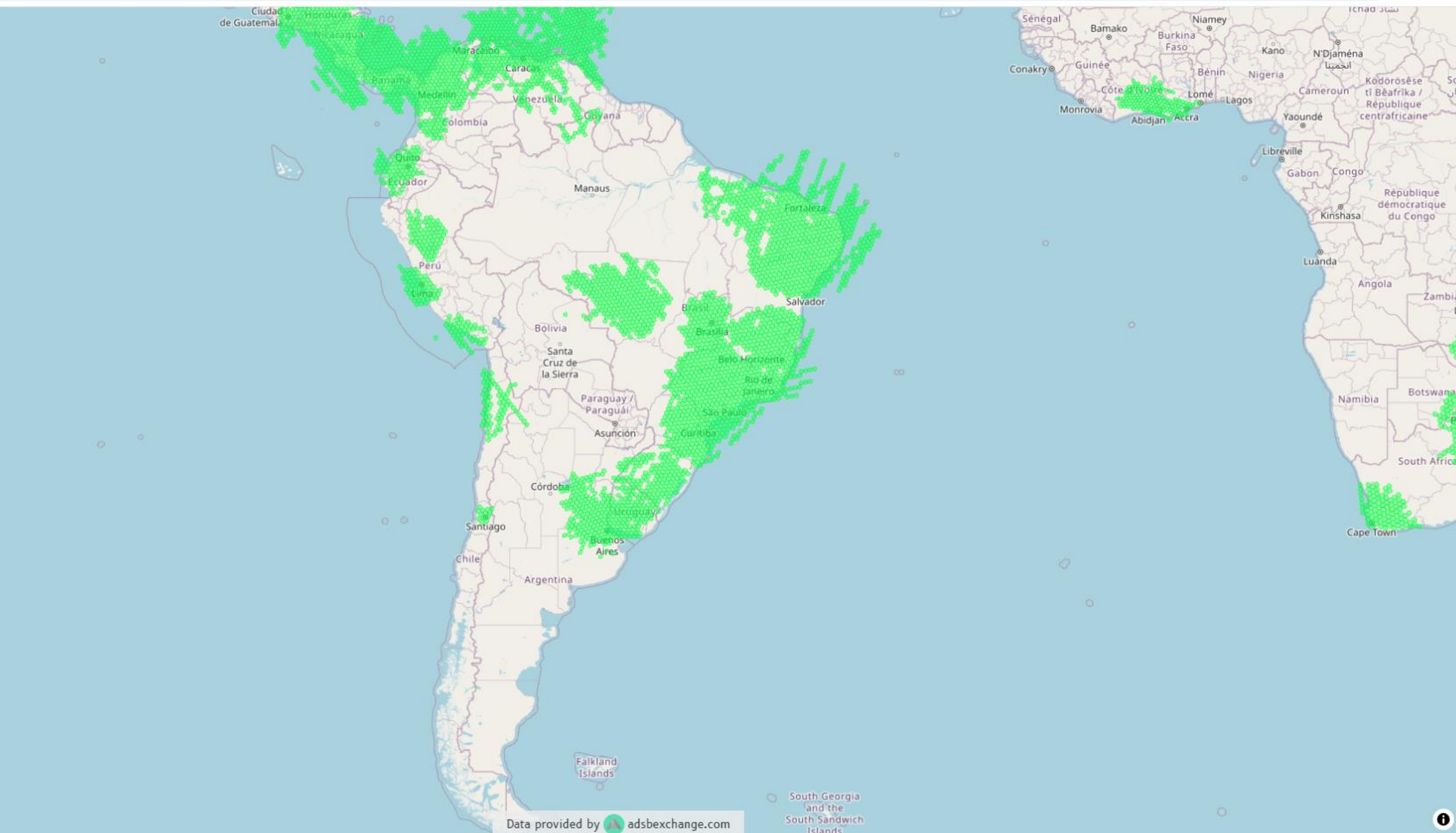
GPSJAM
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01/06/2024

More

Level of GPS interference

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- High > 10%



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GPSJAM

Daily maps of GPS interference

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01/07/2024

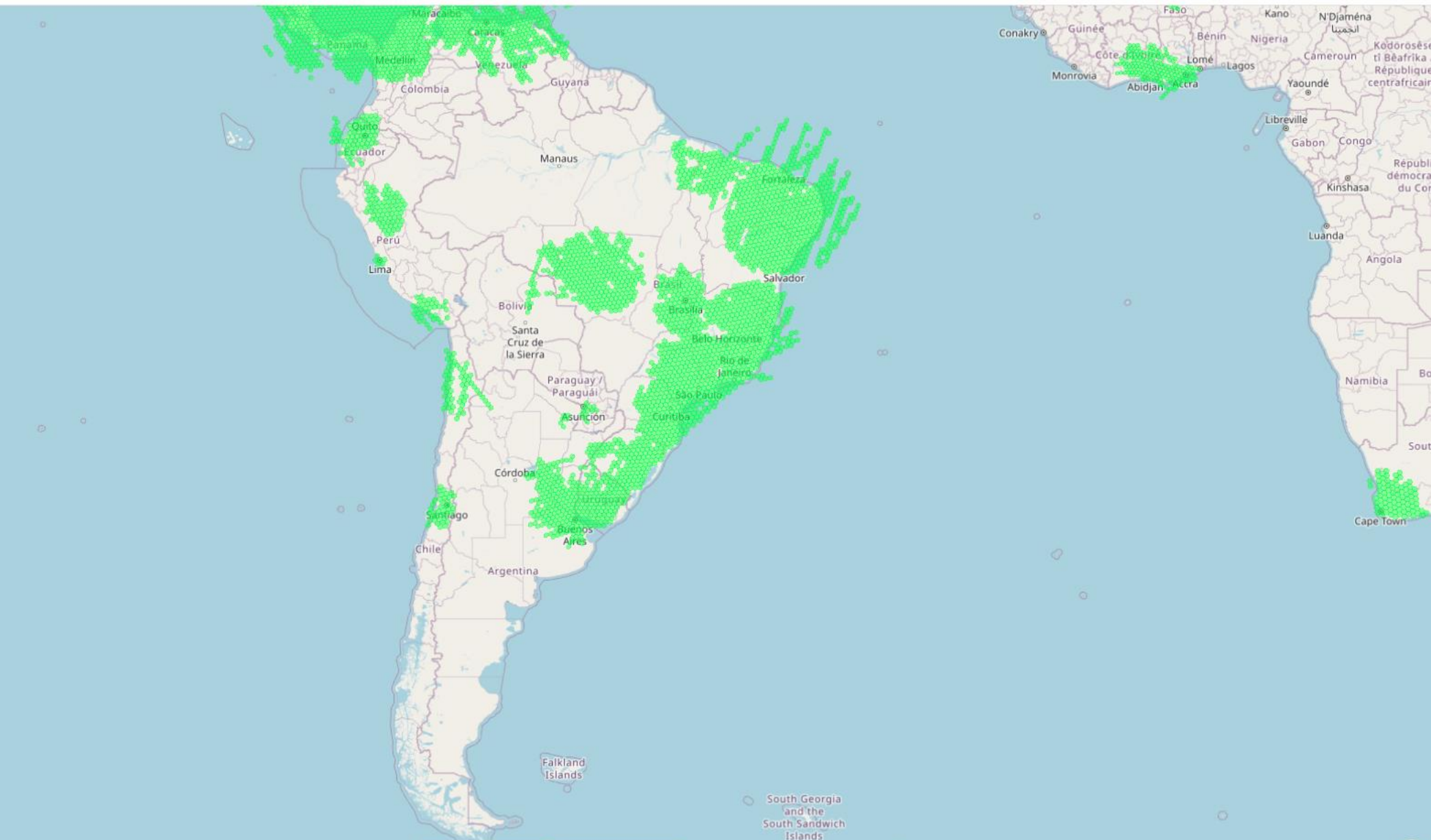
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01/08/2024

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01/09/2024

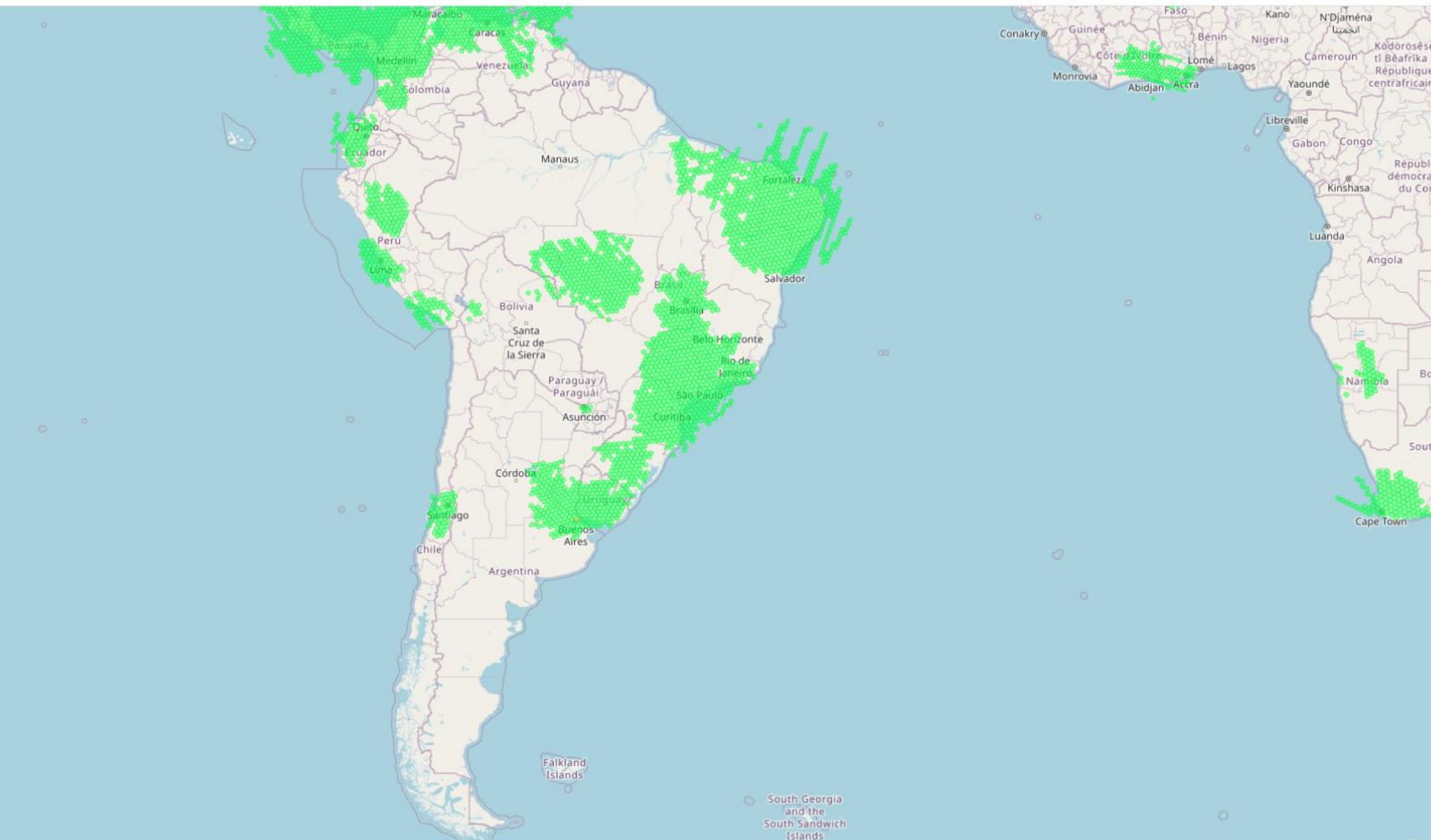
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01/10/2024

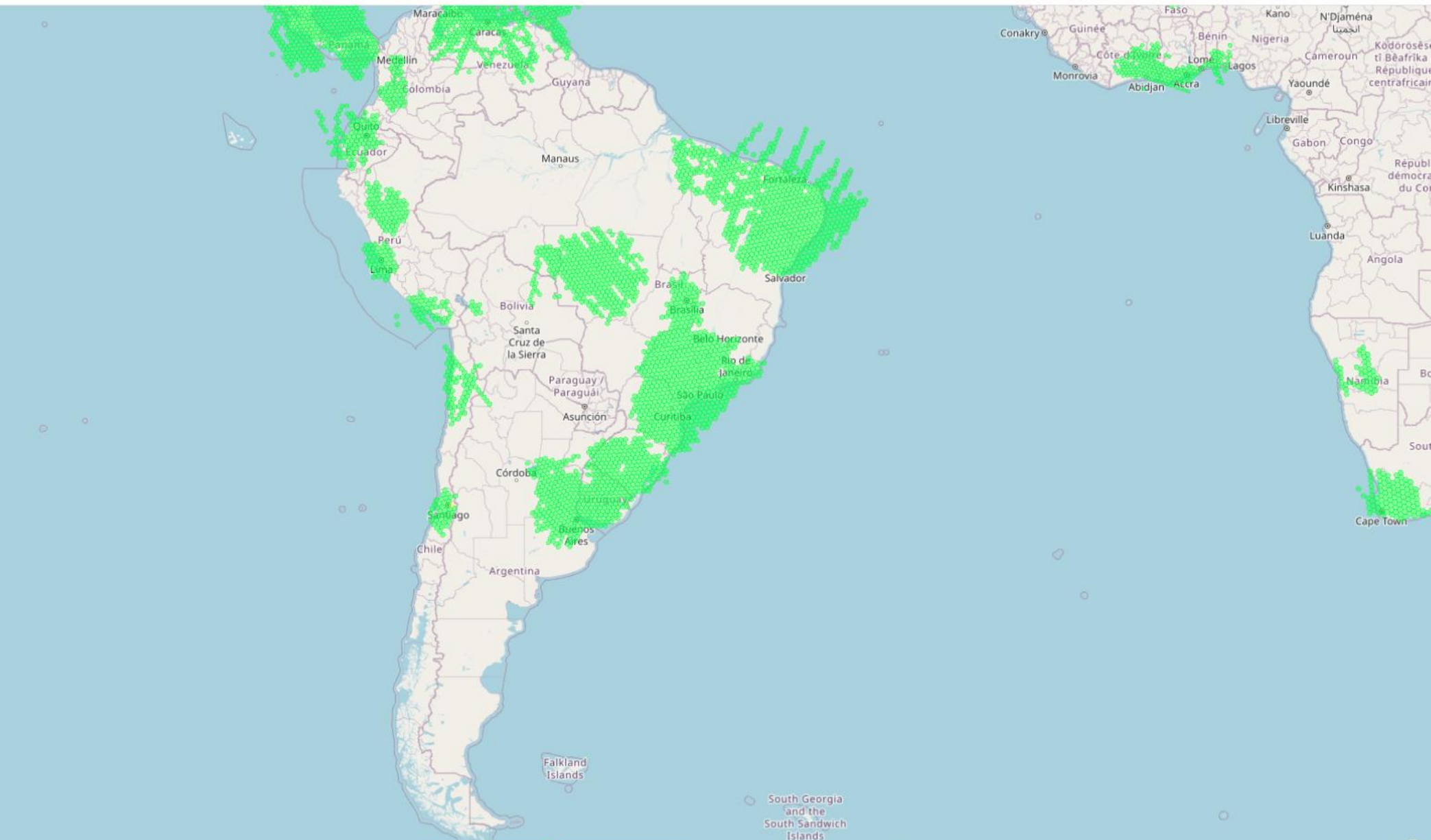
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01/11/2024

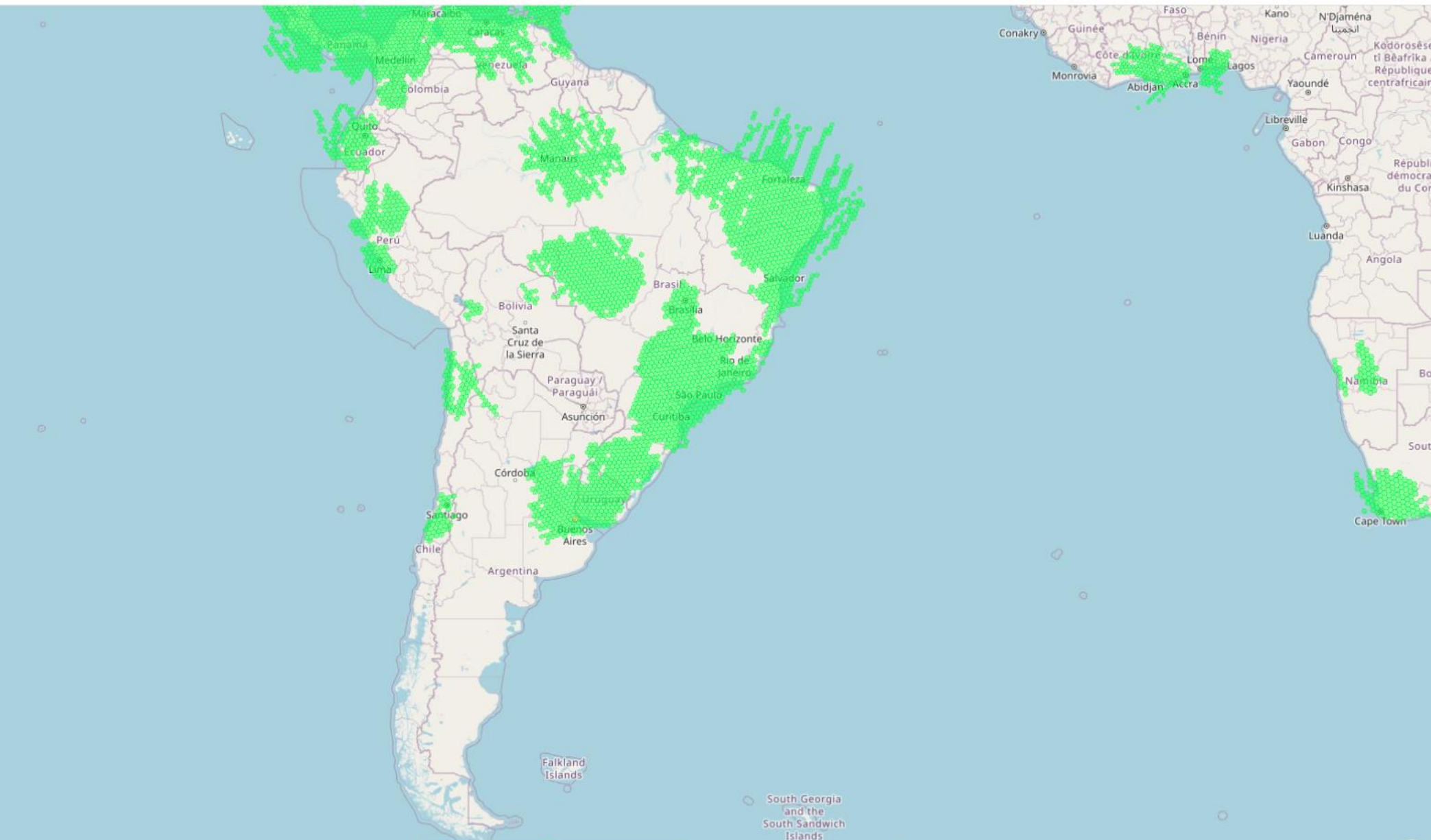
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Daily maps of GPS interference

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01/12/2024

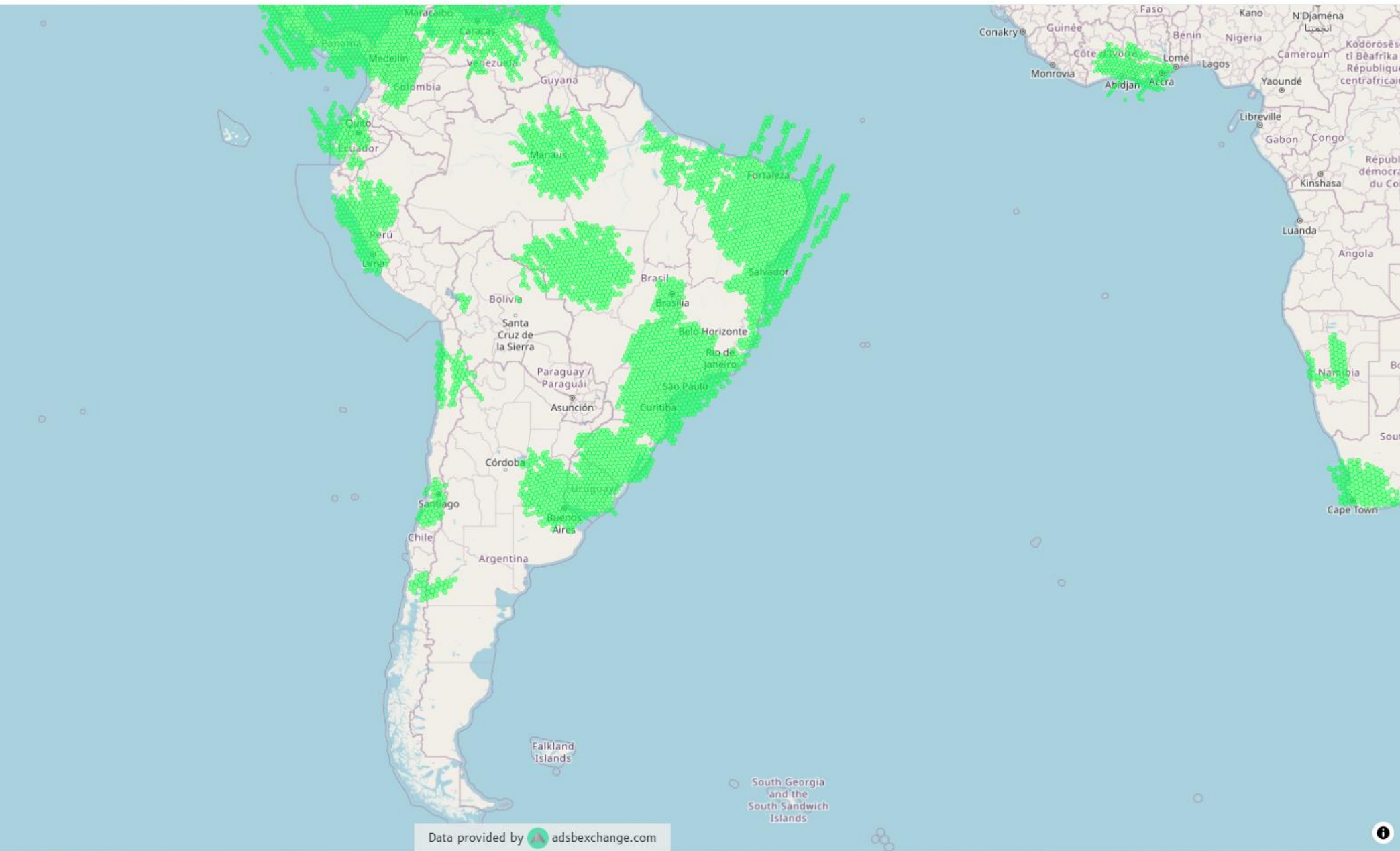
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01/01/2025

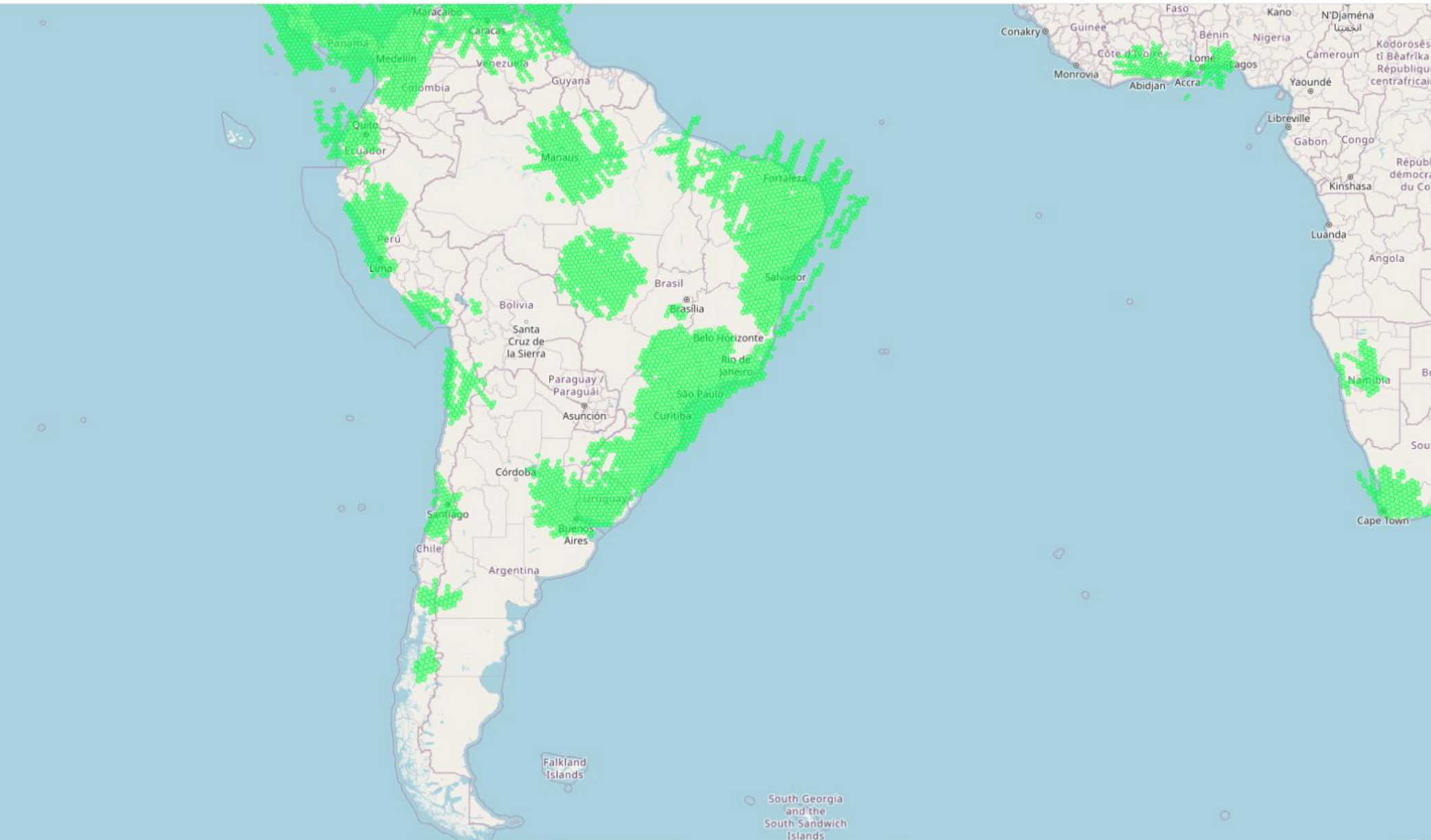
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01/02/2025

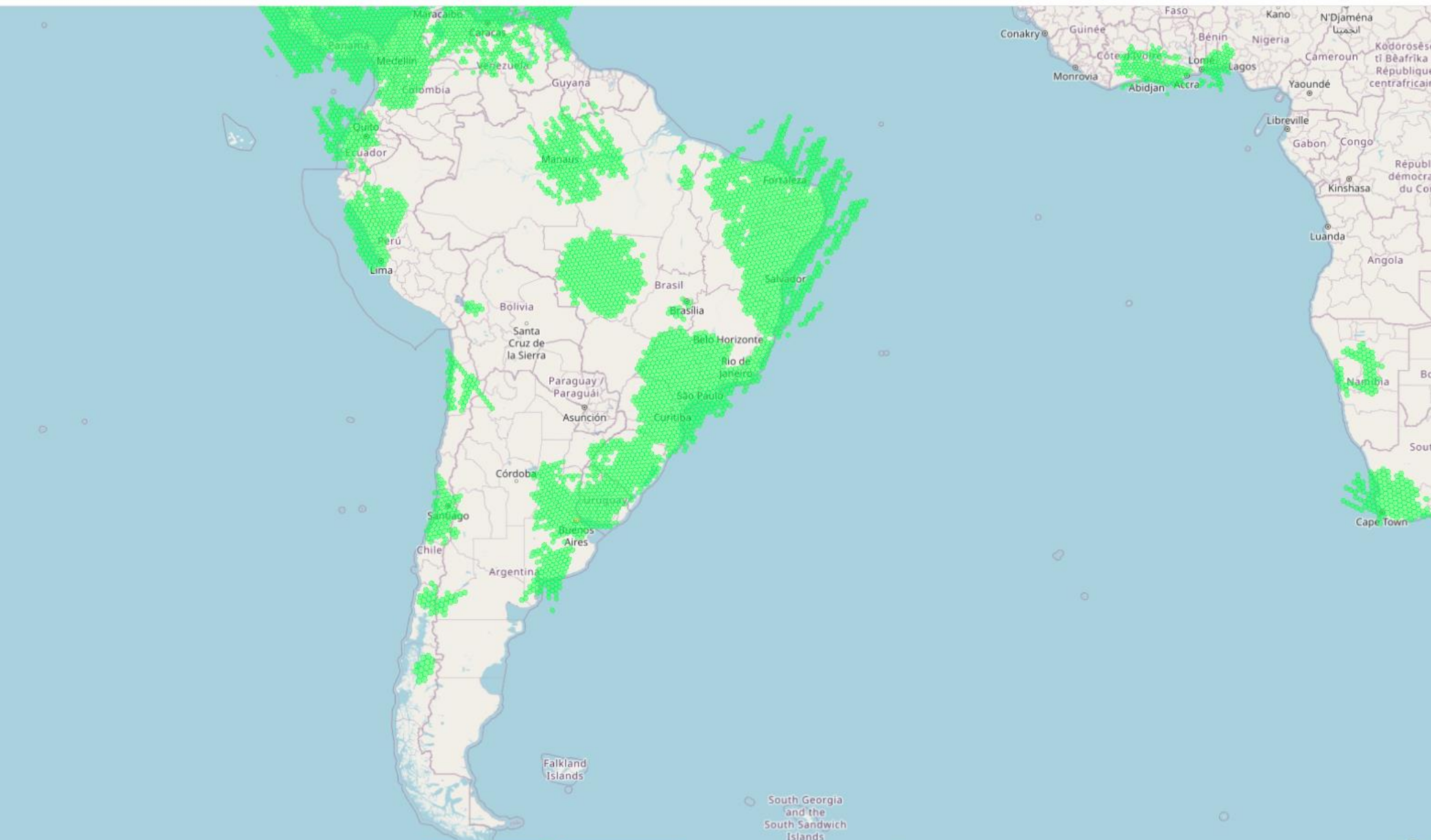
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Daily maps of GPS interference

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01/03/2025

More



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01/04/2025

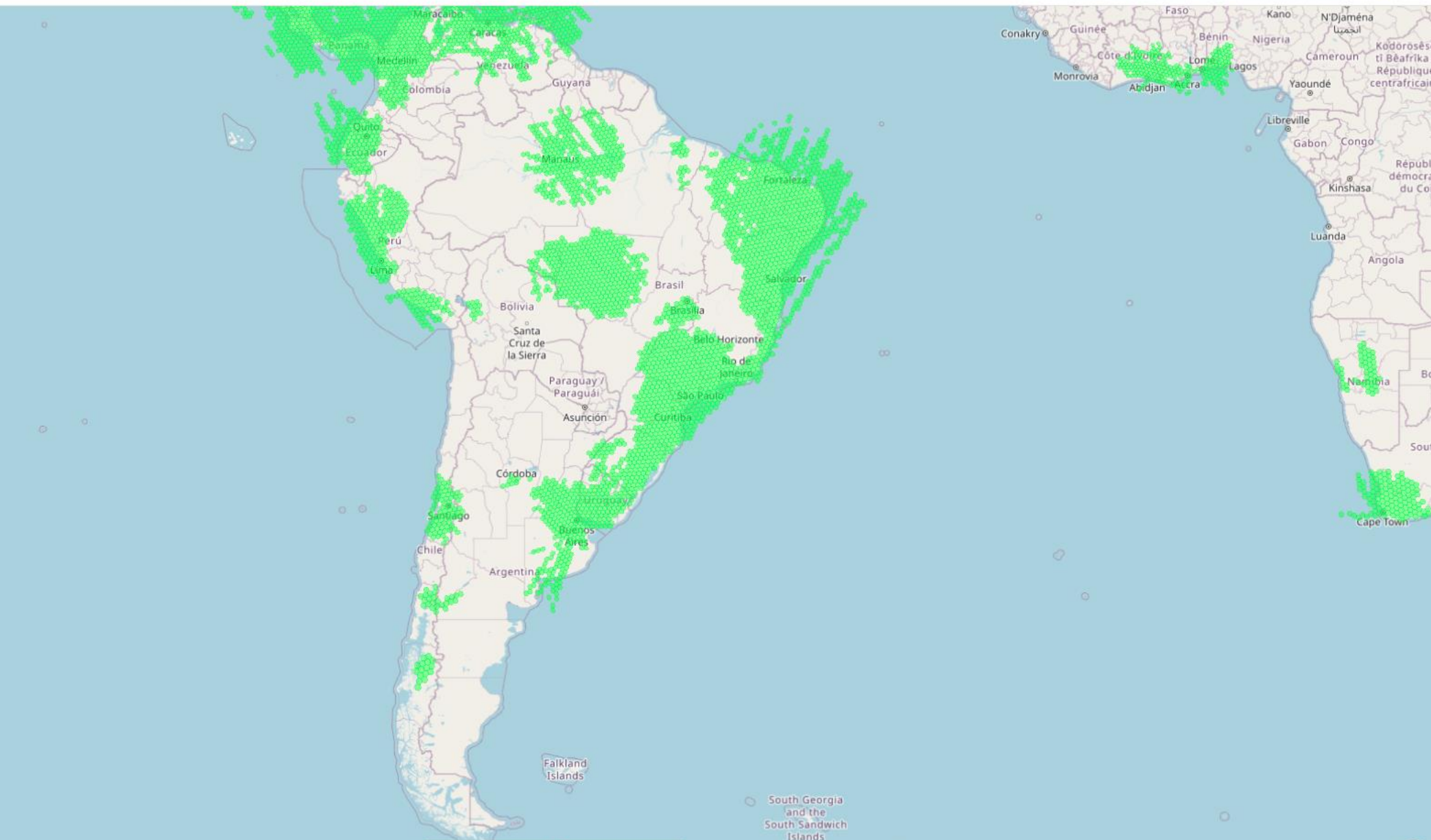
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01/05/2025

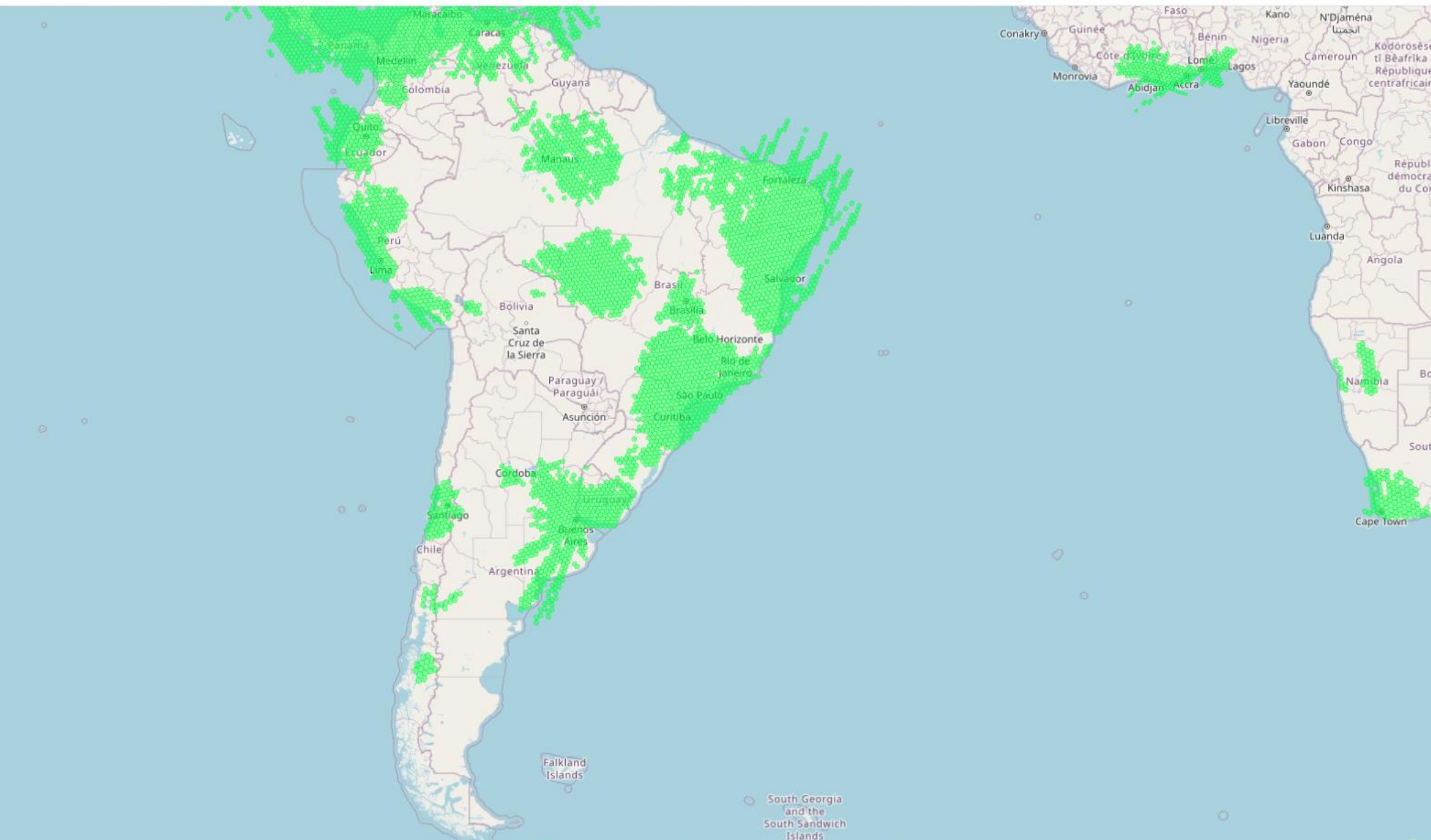
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GPSJAM

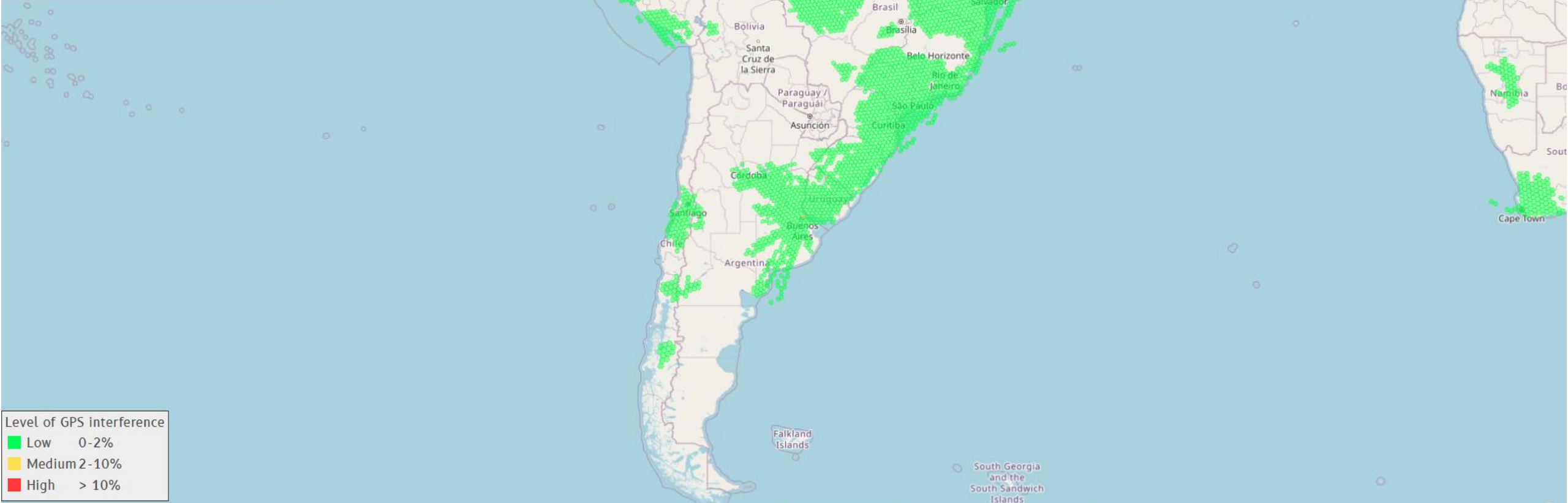
Daily maps of GPS interference
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01/07/2025

Search for a place

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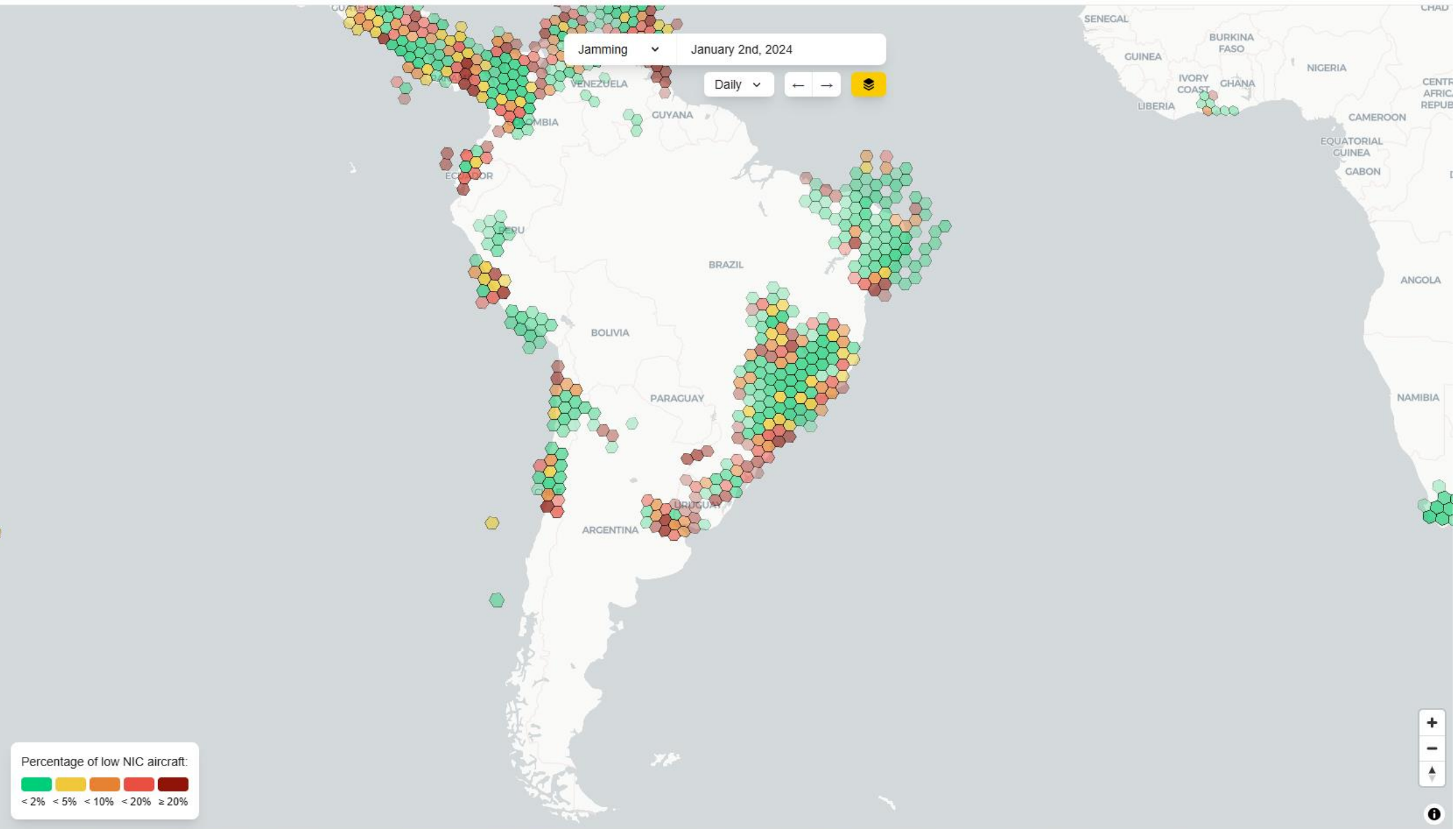
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Data provided by adsbexchange.com

GNSS Interference Detection using ADS-B

- Map
- Statistics
- Resources



GNSS Interference Detection using ADS-B

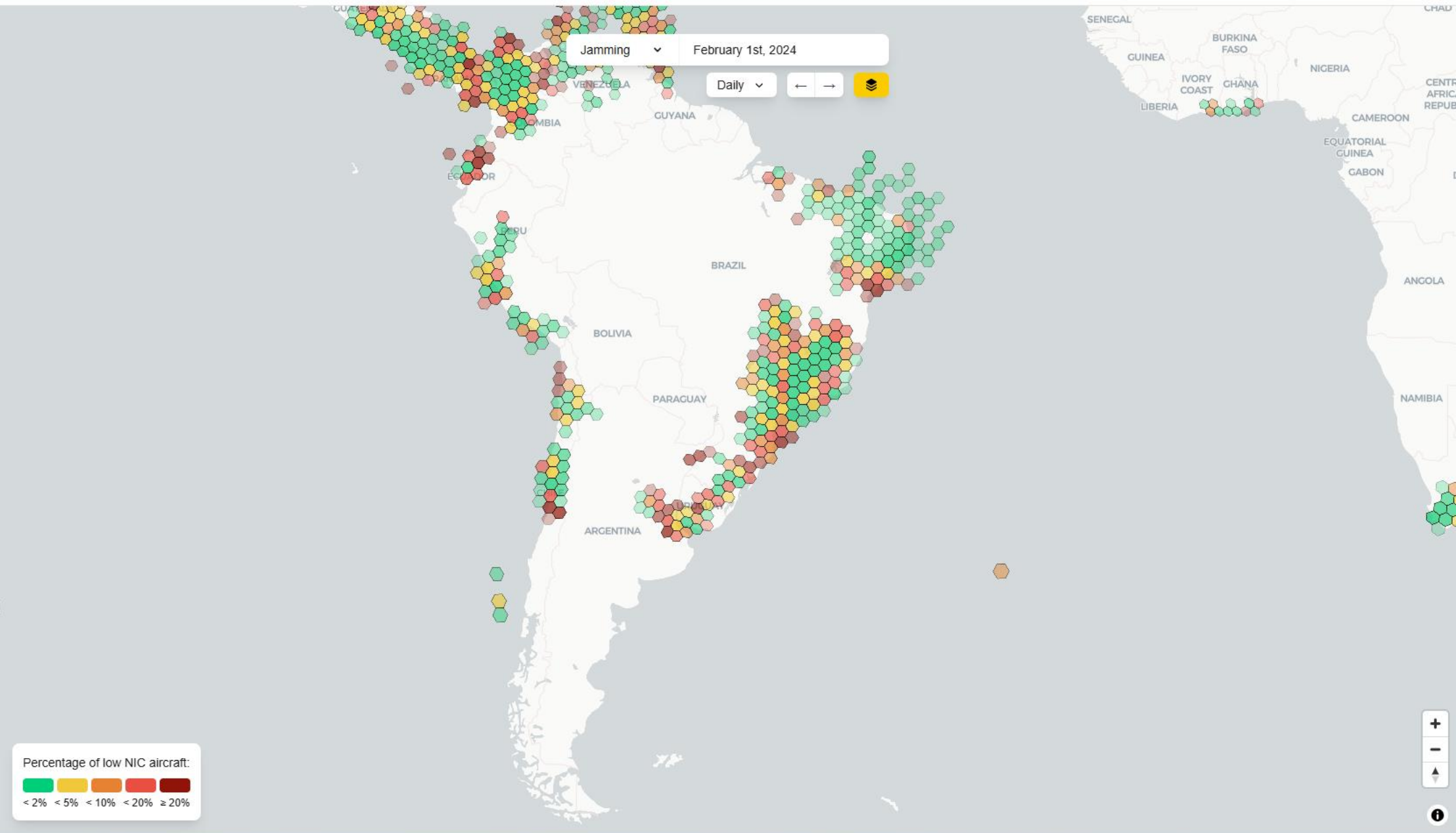
- Map
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GNSS Interference Detection using ADS-B

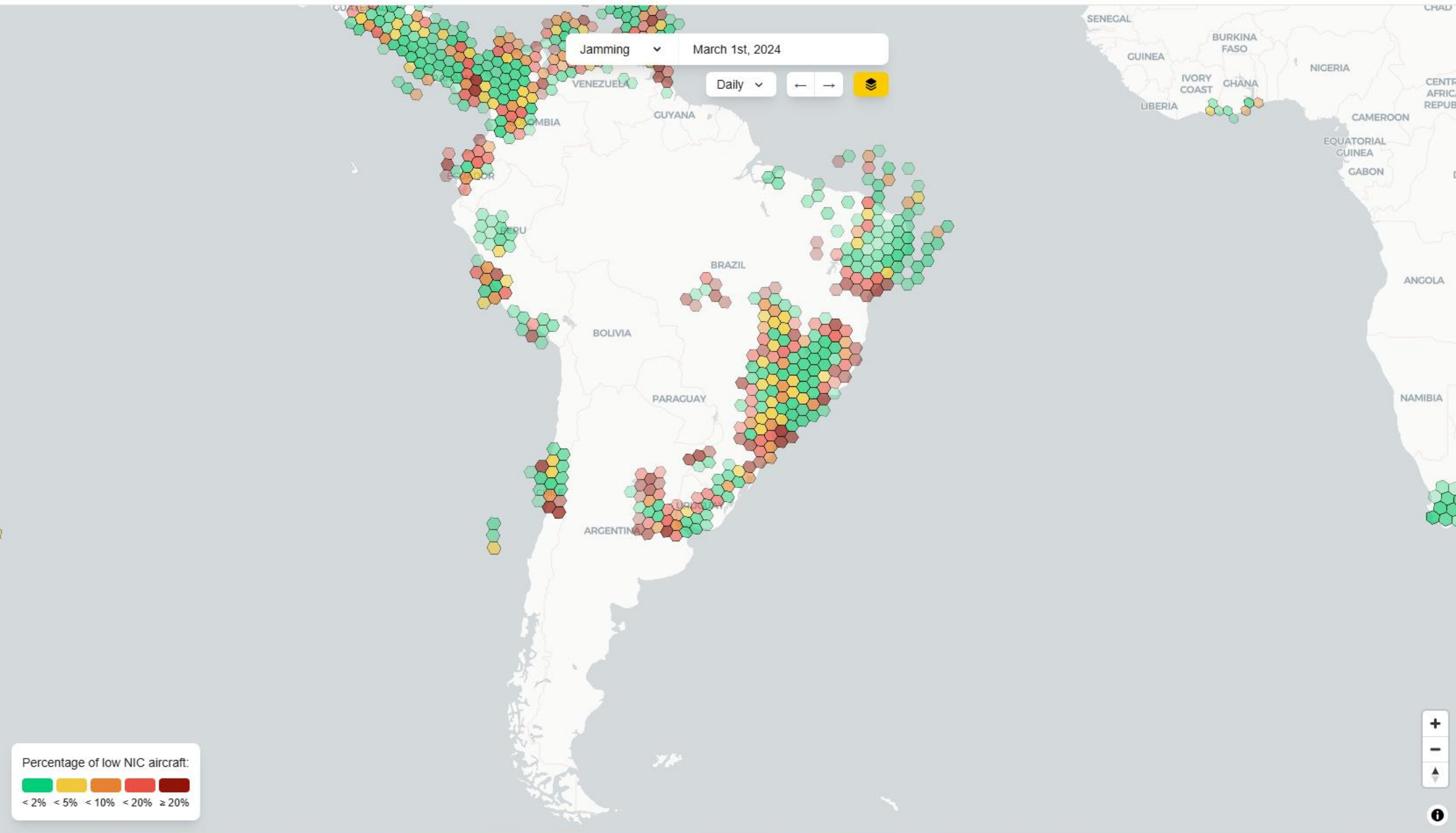
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GNSS Interference Detection using ADS-B

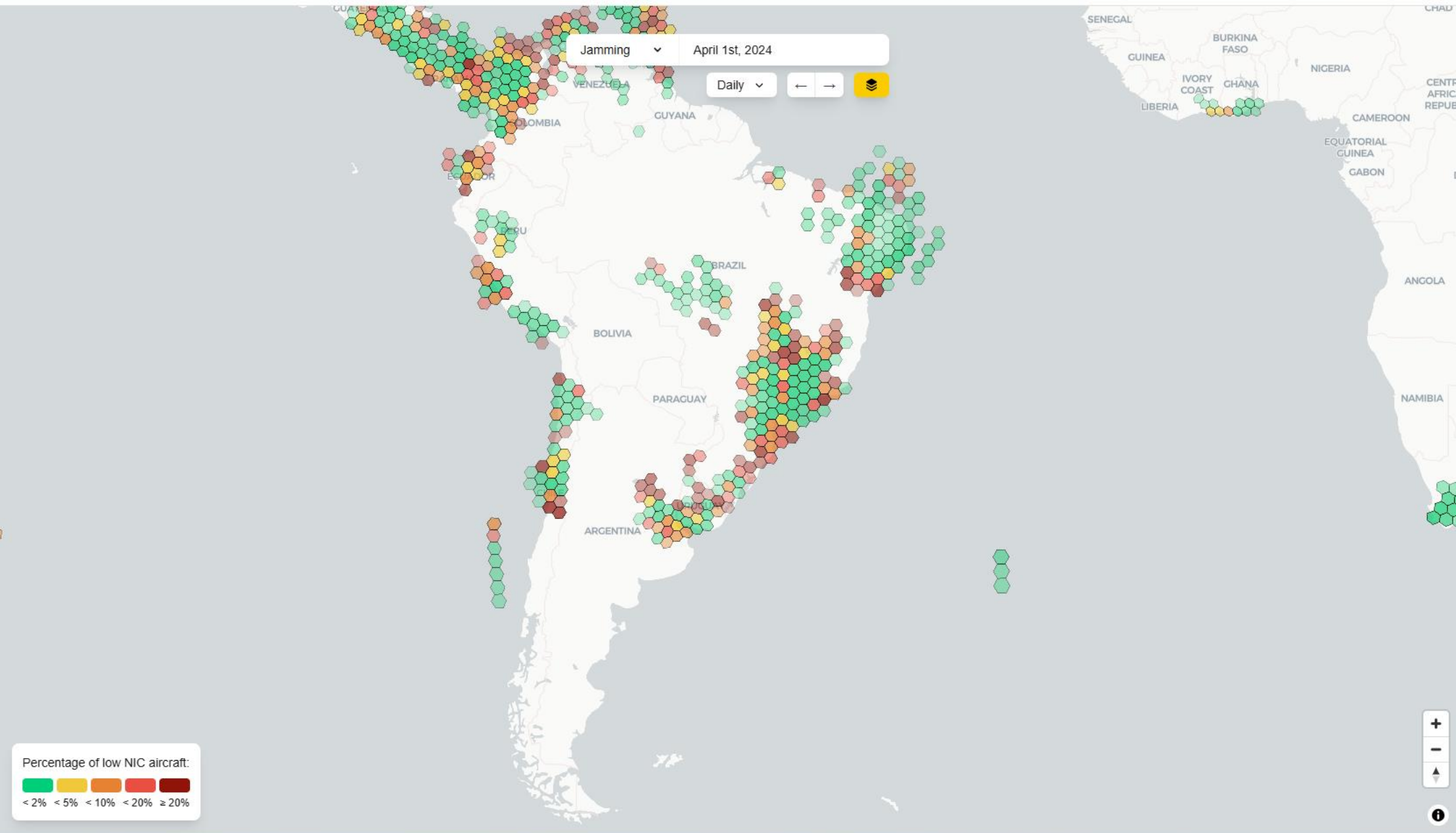
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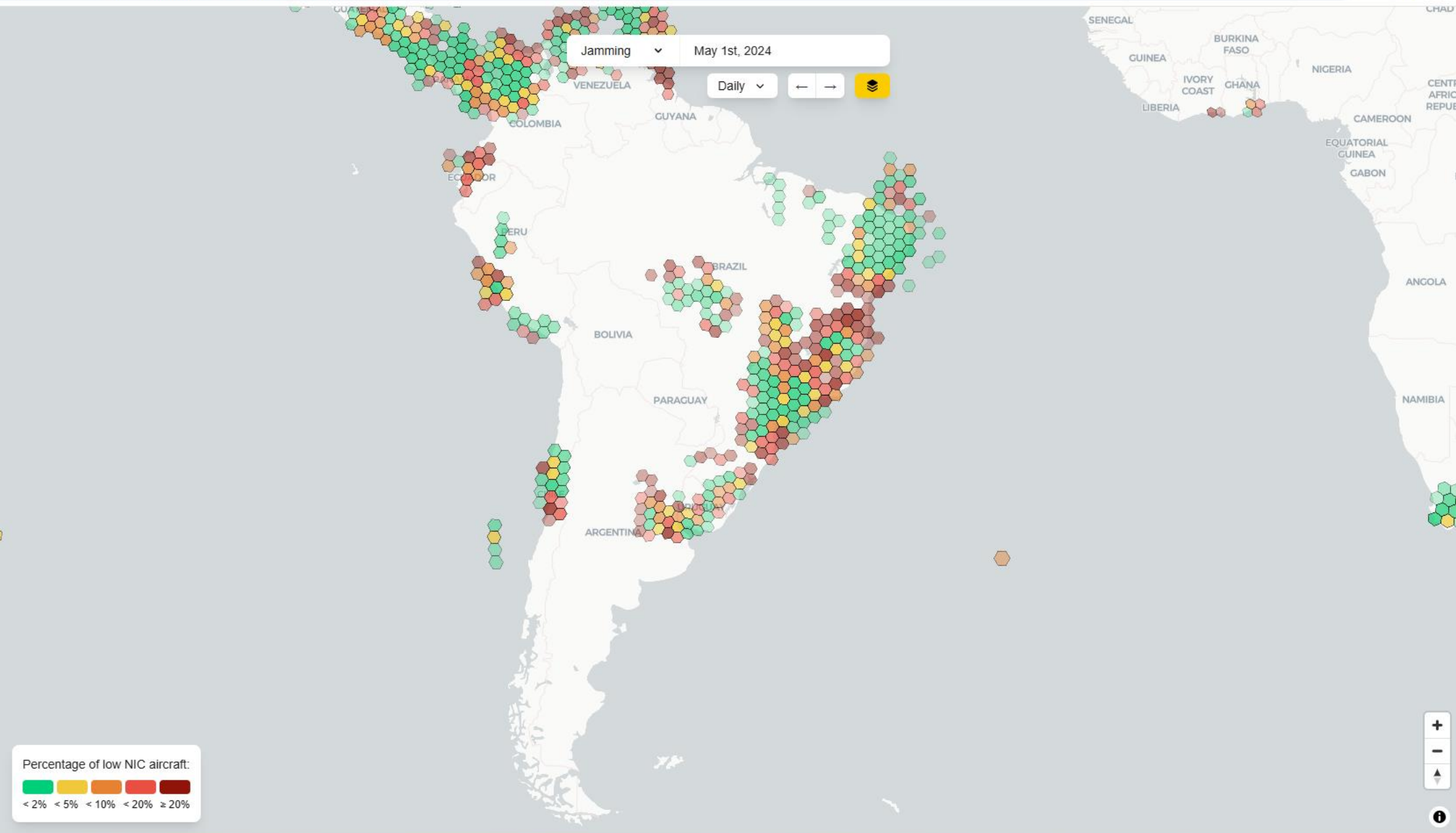
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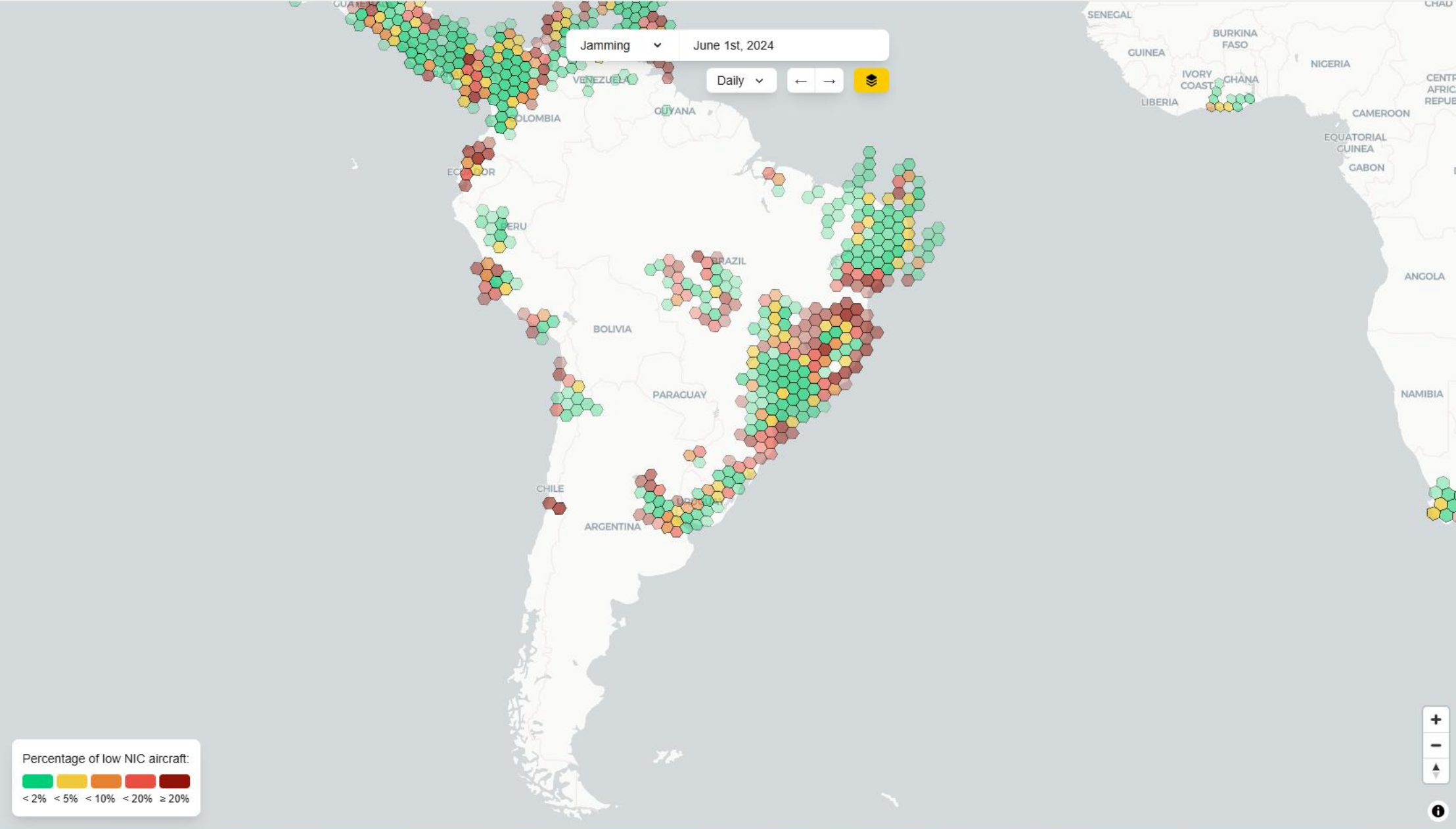


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GNSS Interference Detection using ADS-B

Map

Uso de memoria: 419 MB

Statistics

Resources

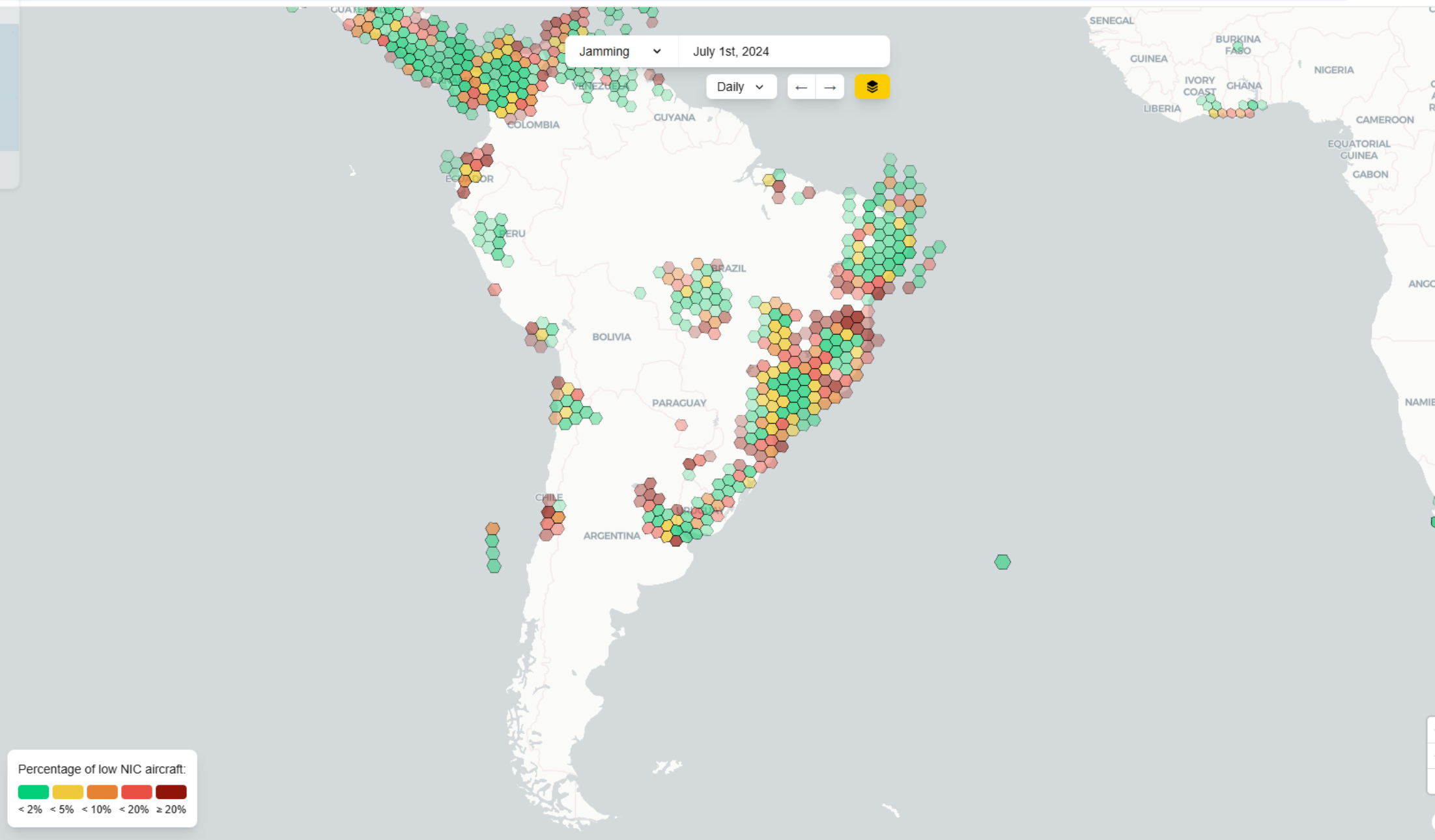


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GNSS Interference Detection using ADS-B

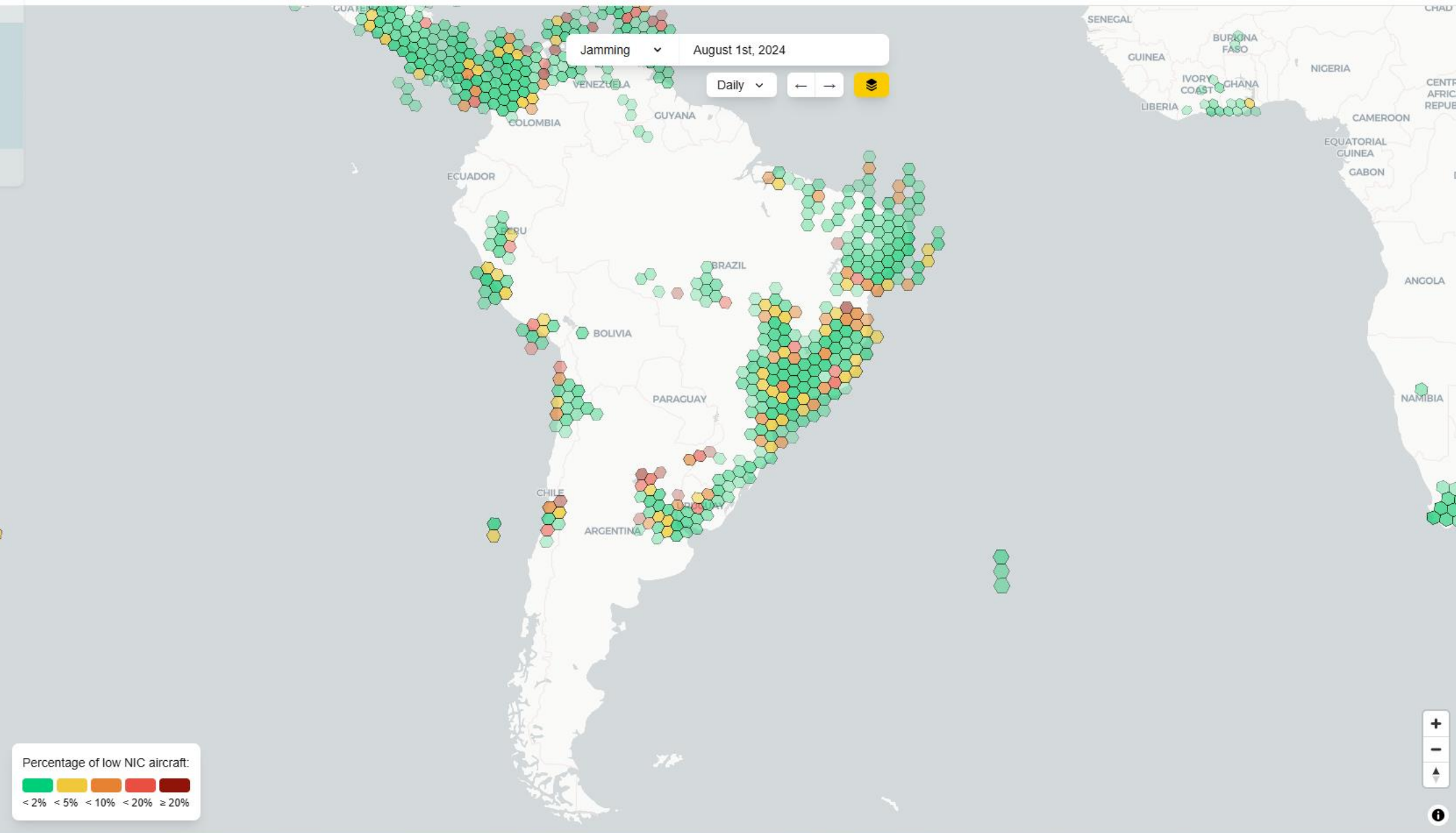
Map
Usado de memoria: 419 MB

Statistics

Resources



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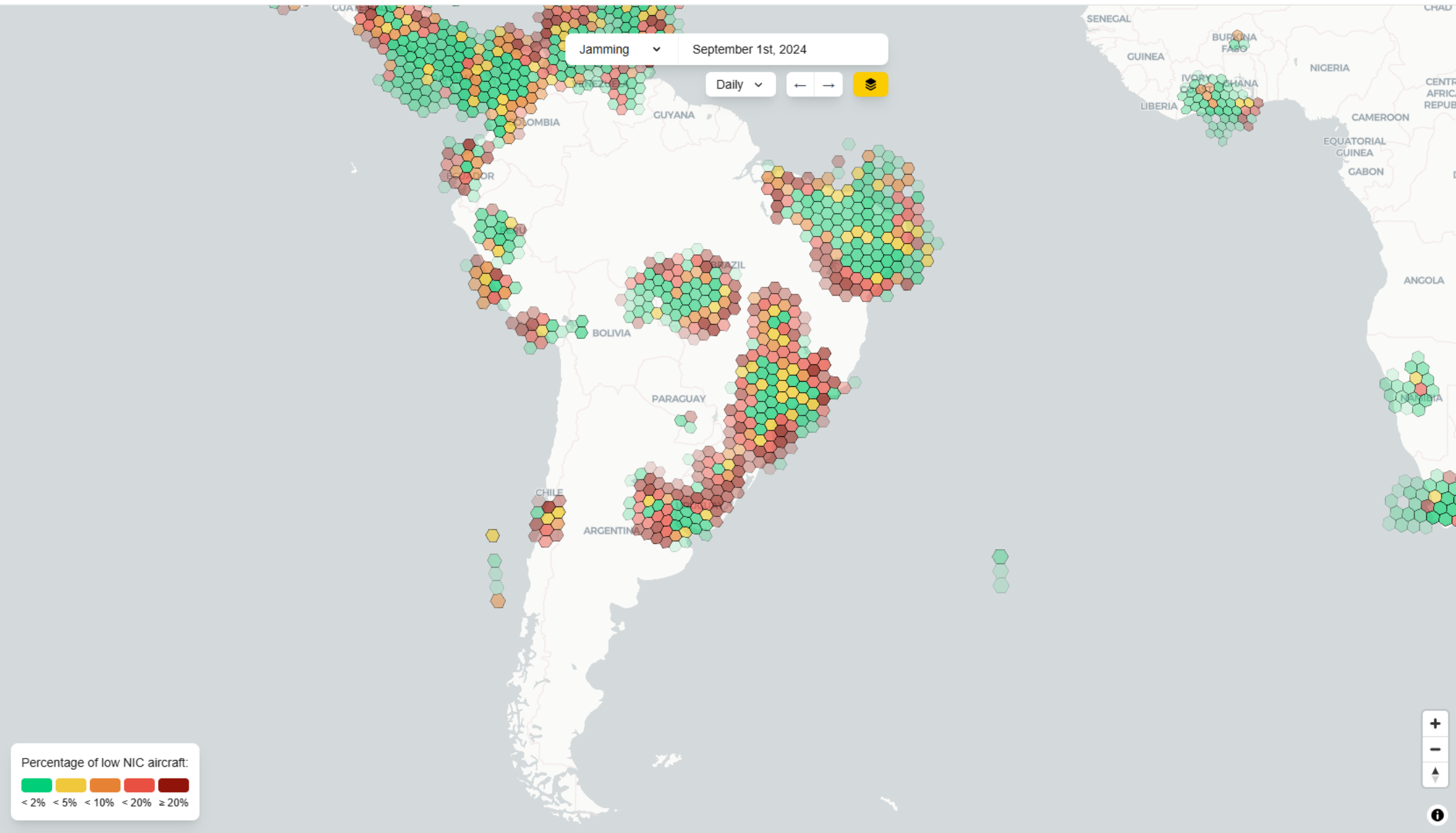


GNSS Interference Detection using ADS-B

- Map
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GNSS Interference Detection using ADS-B

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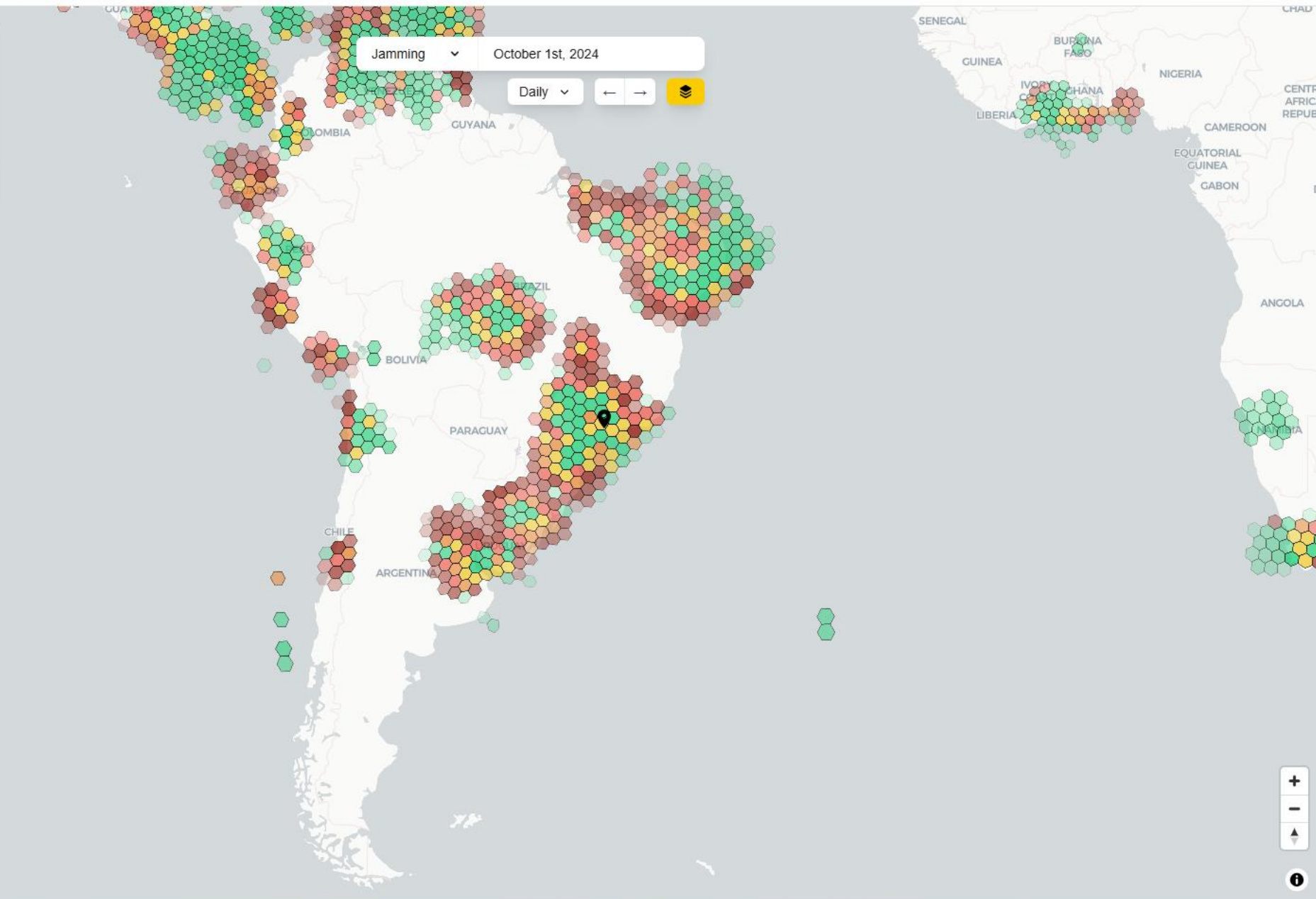
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Usage de memoria: 18,6 MB

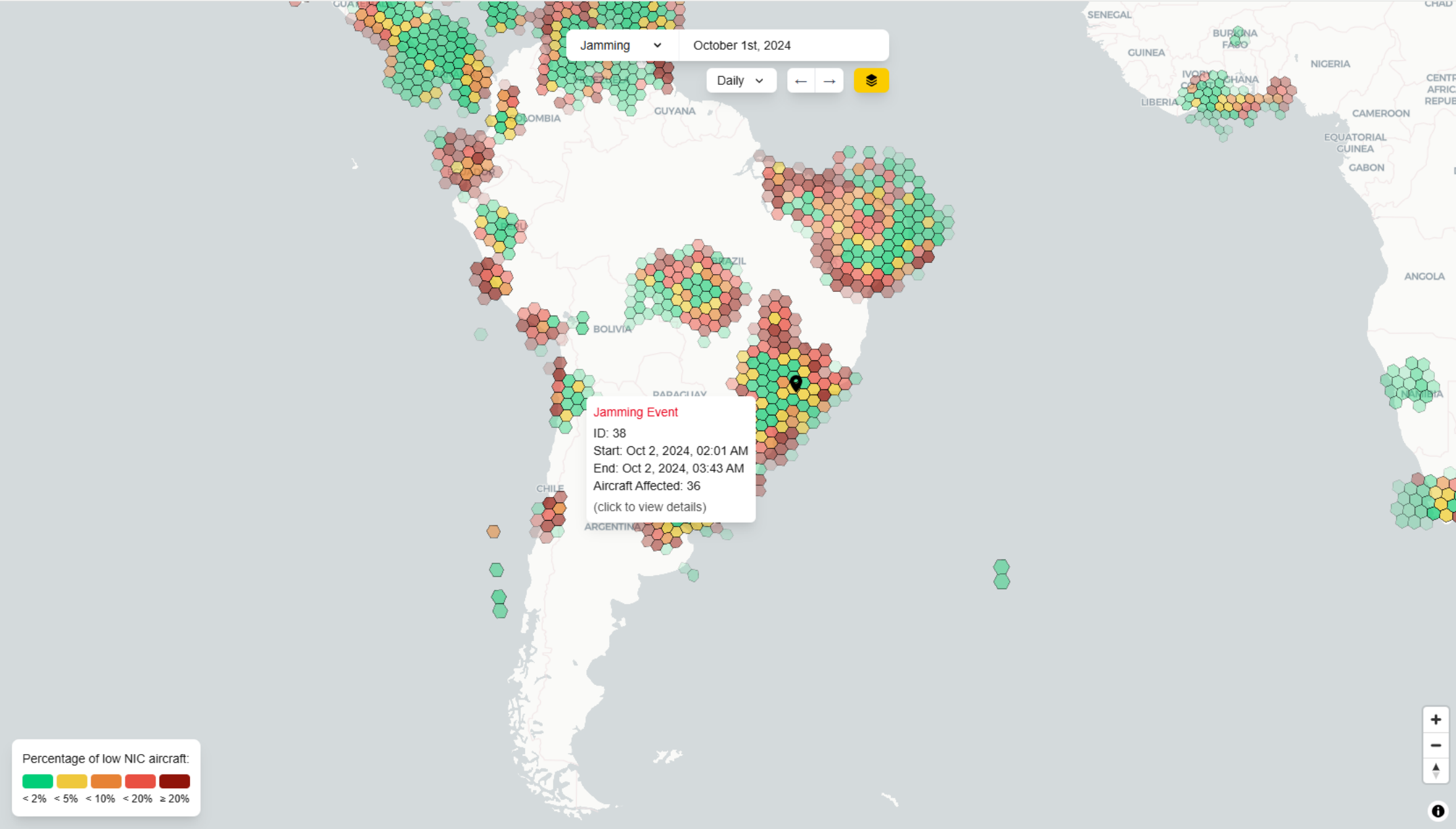


GNSS Interference Detection using ADS-B

- Map
- Statistics
- Resources



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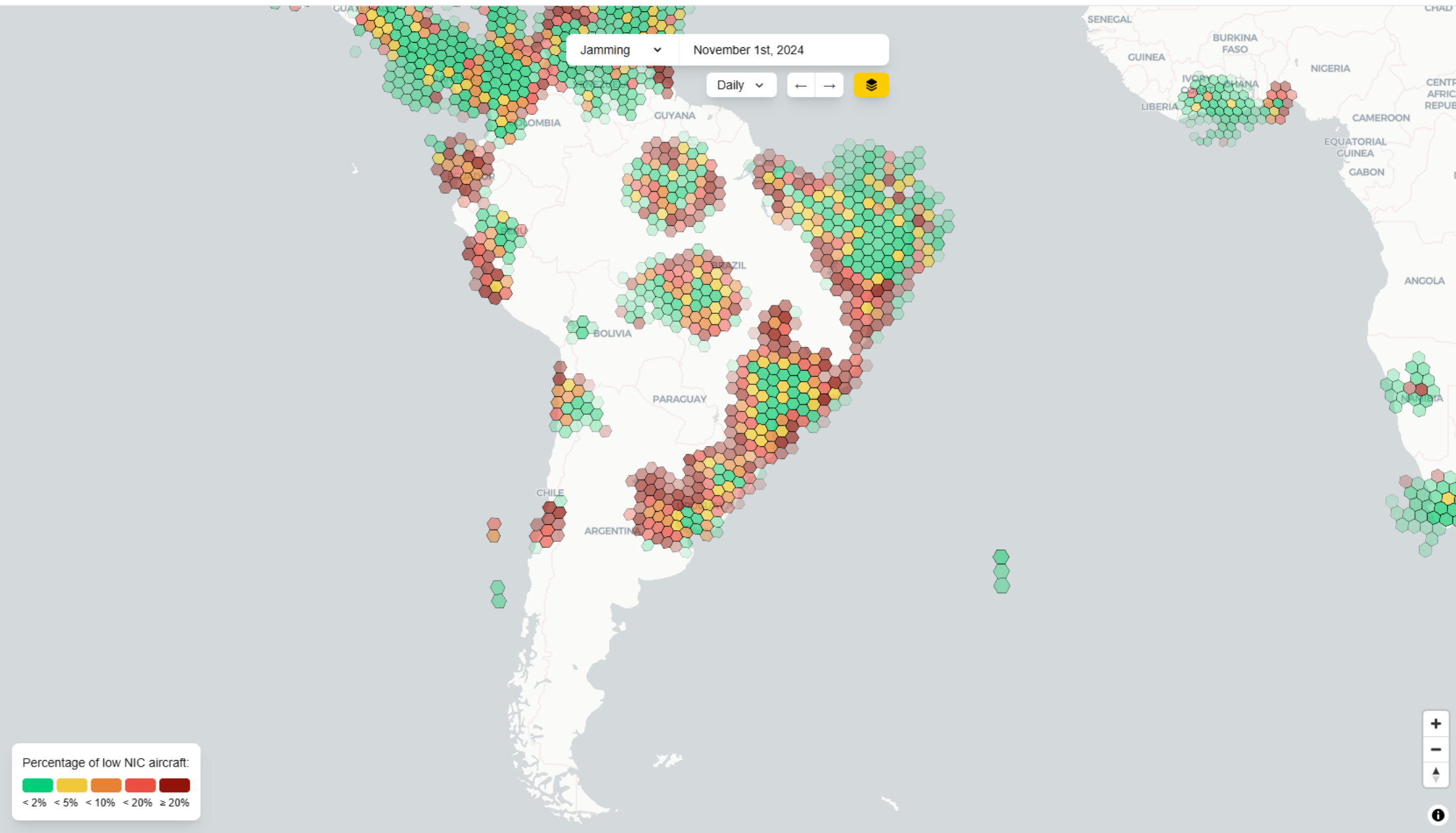


GNSS Interference Detection using ADS-B

- Map
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GNSS Interference Detection using ADS-B

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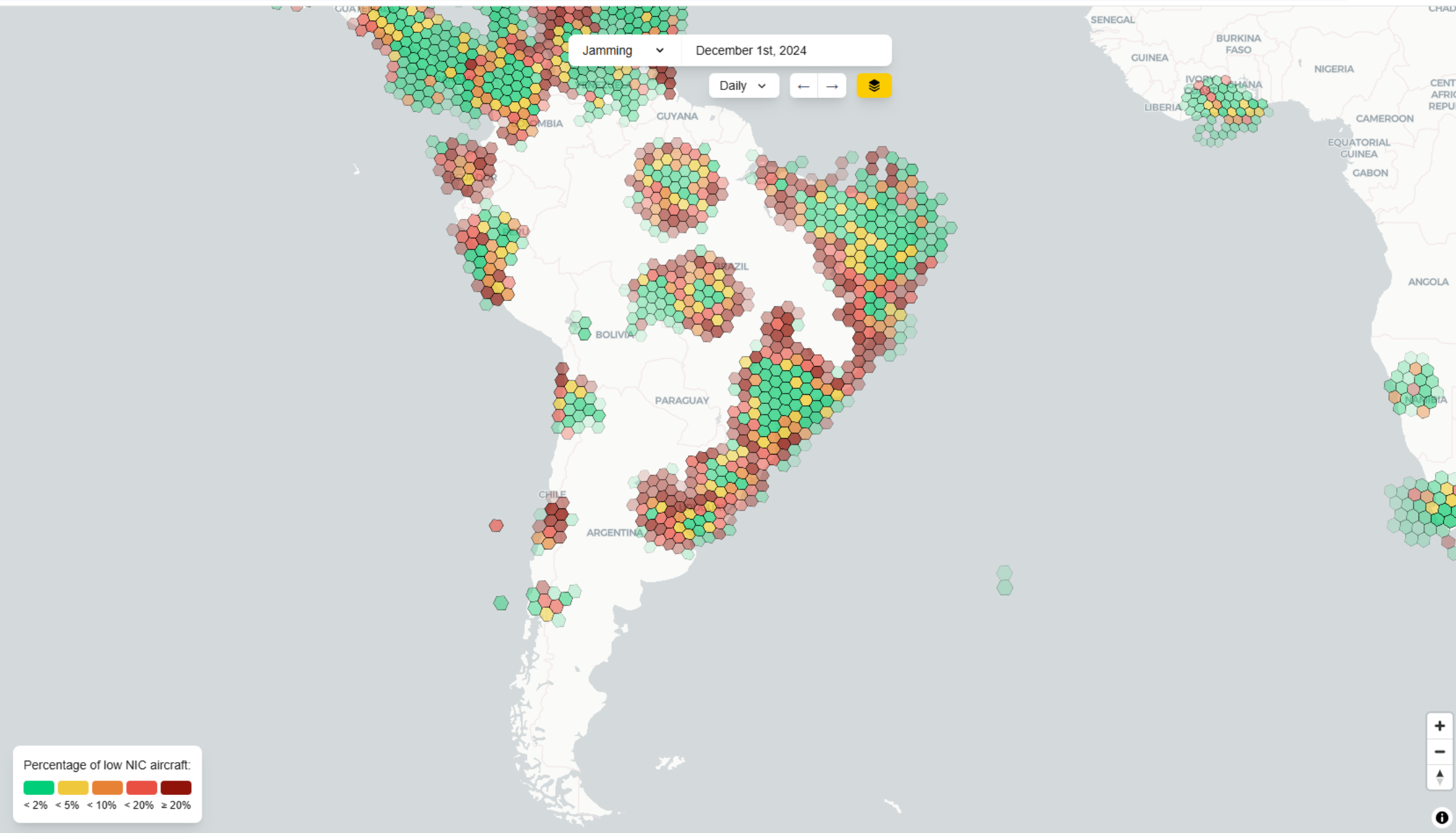
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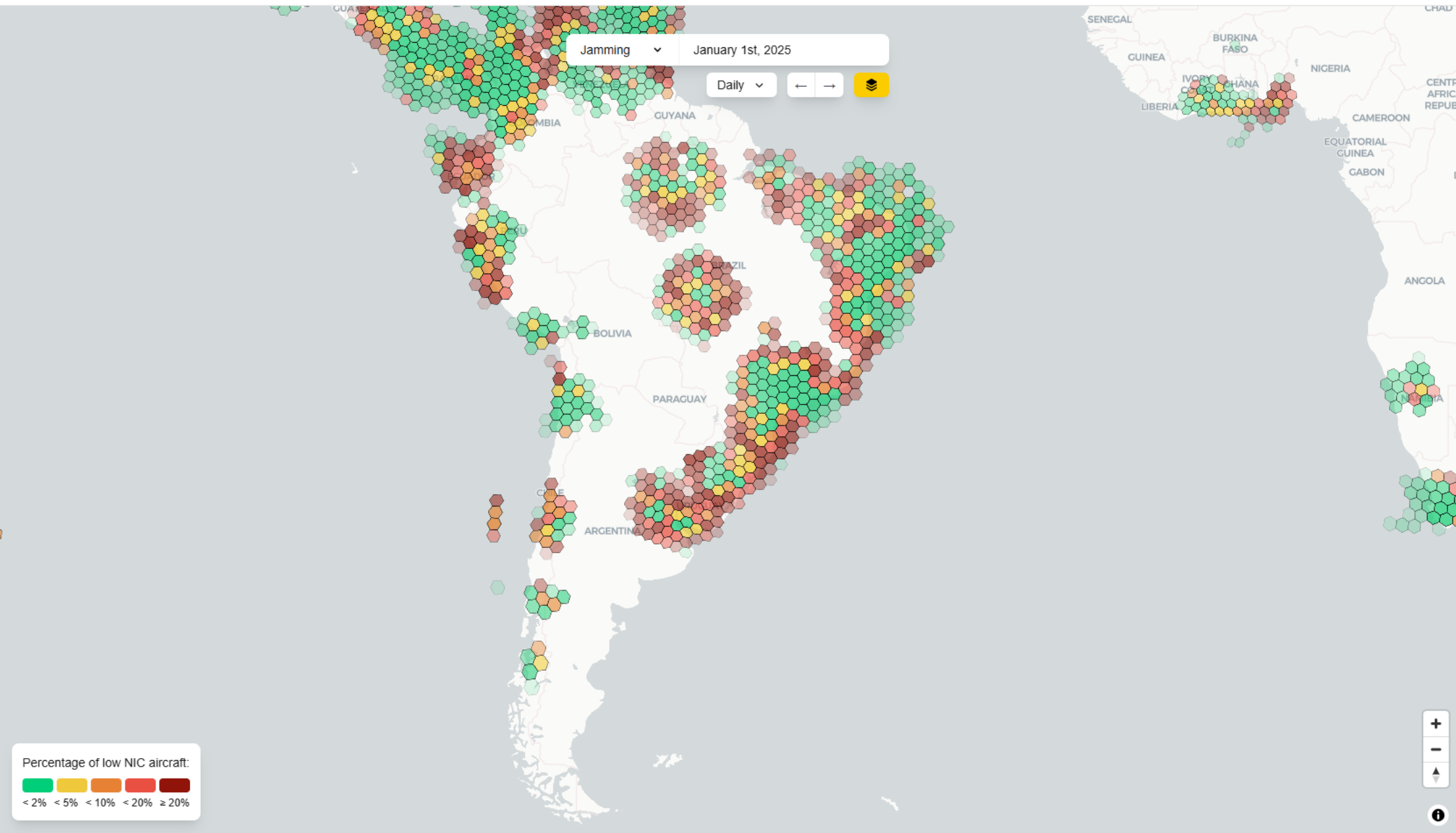


GNSS Interference Detection using ADS-B

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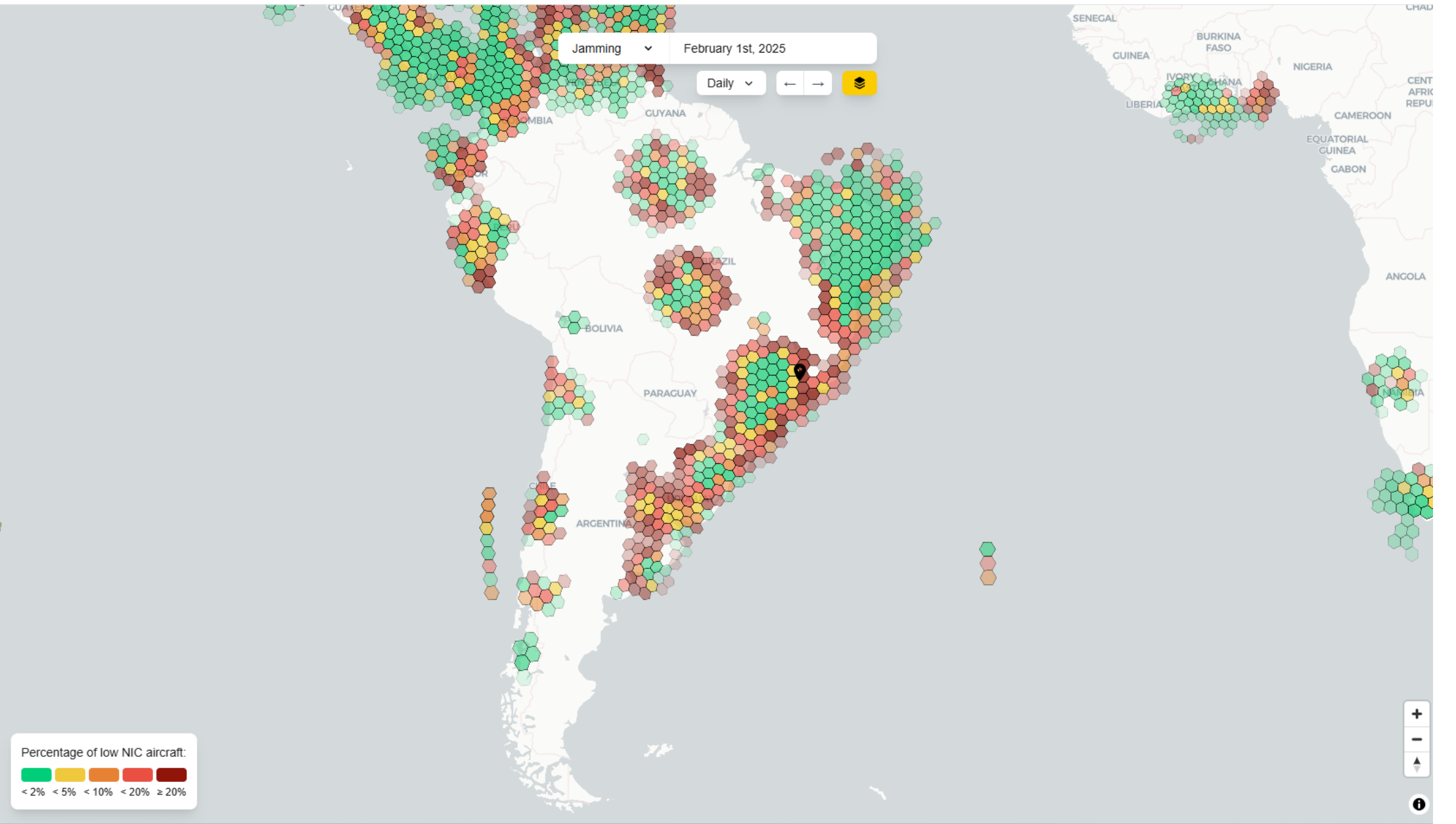


GNSS Interference Detection using ADS-B

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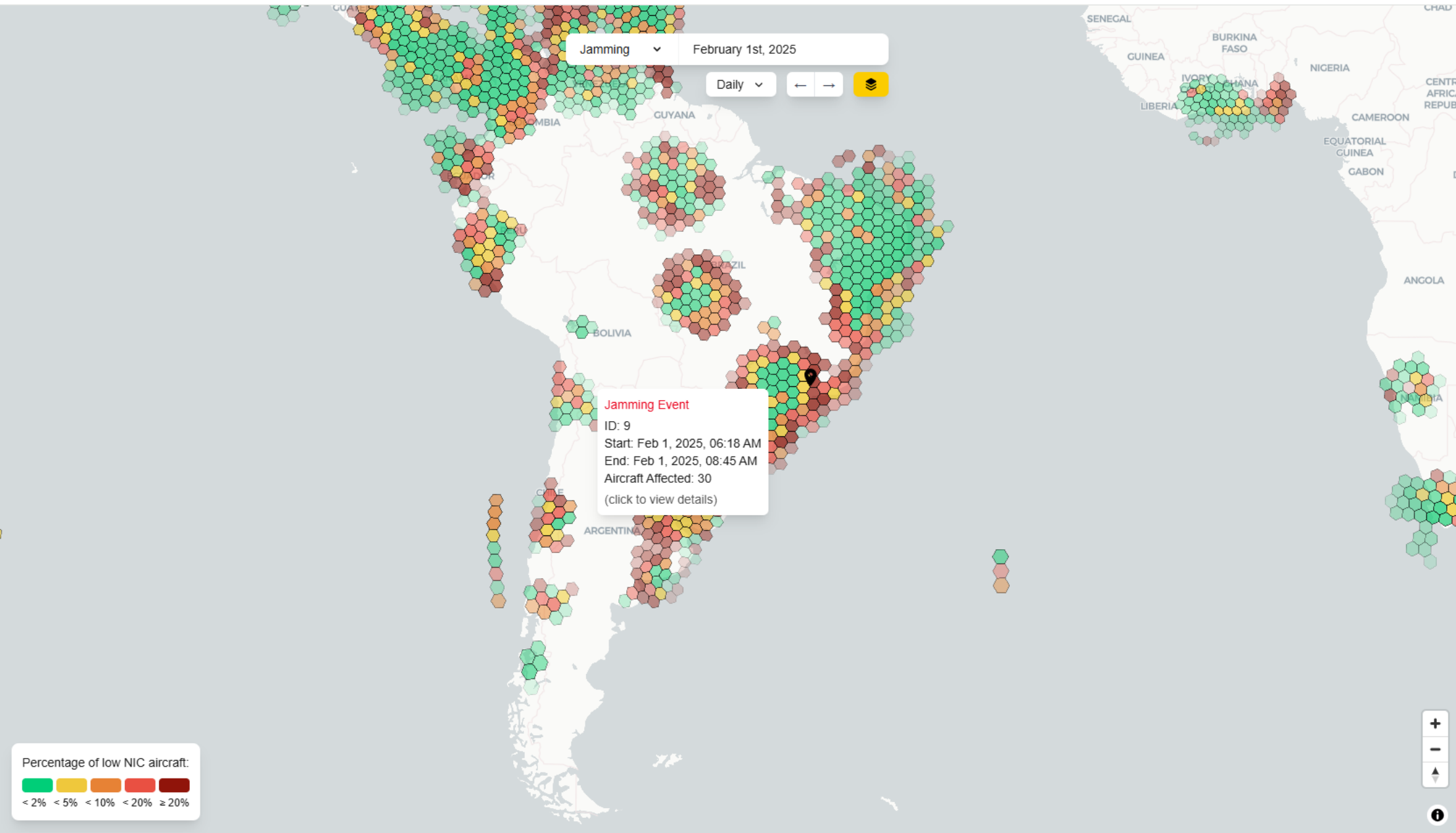


GNSS Interference Detection using ADS-B

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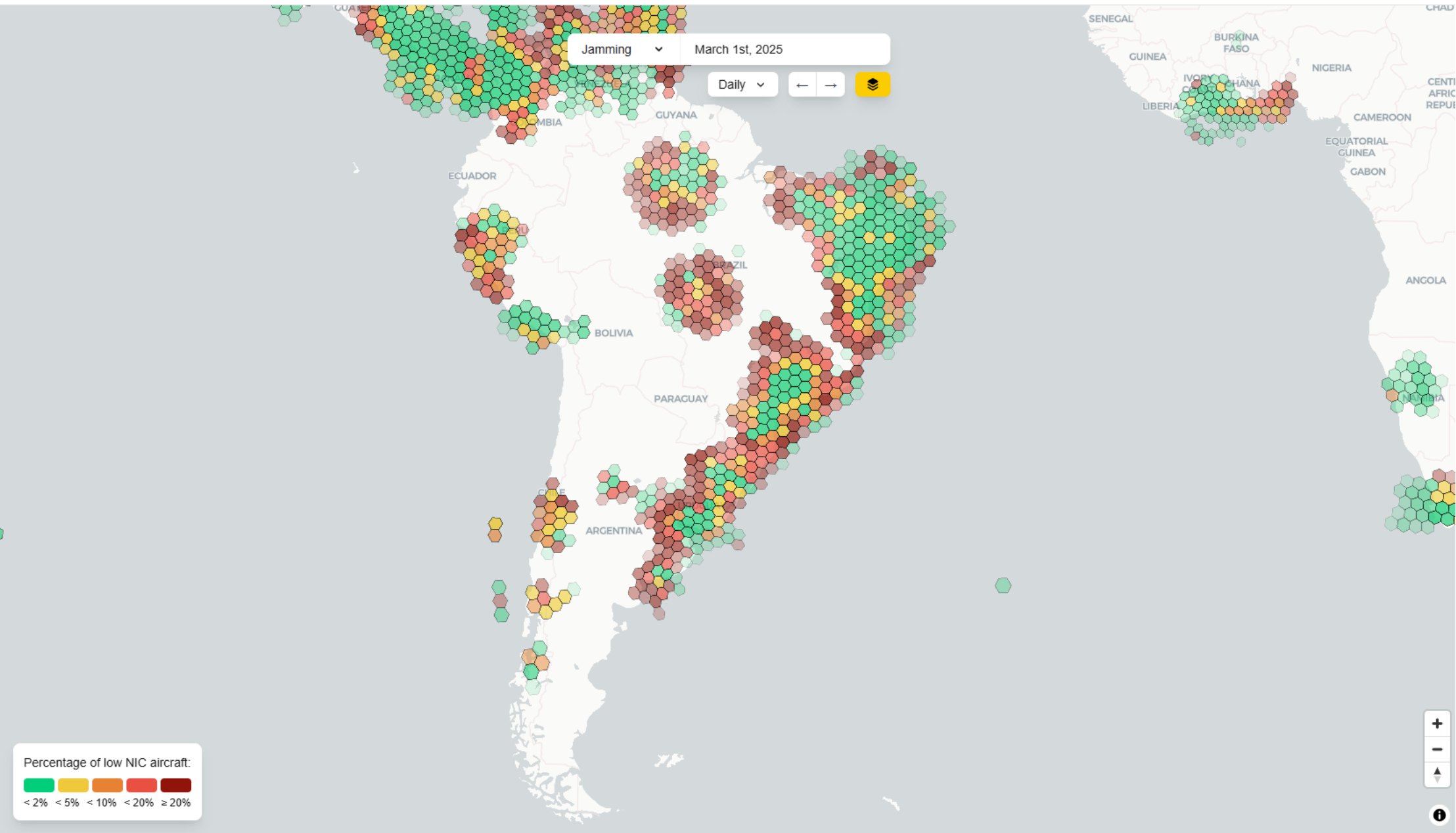


GNSS Interference Detection using ADS-B

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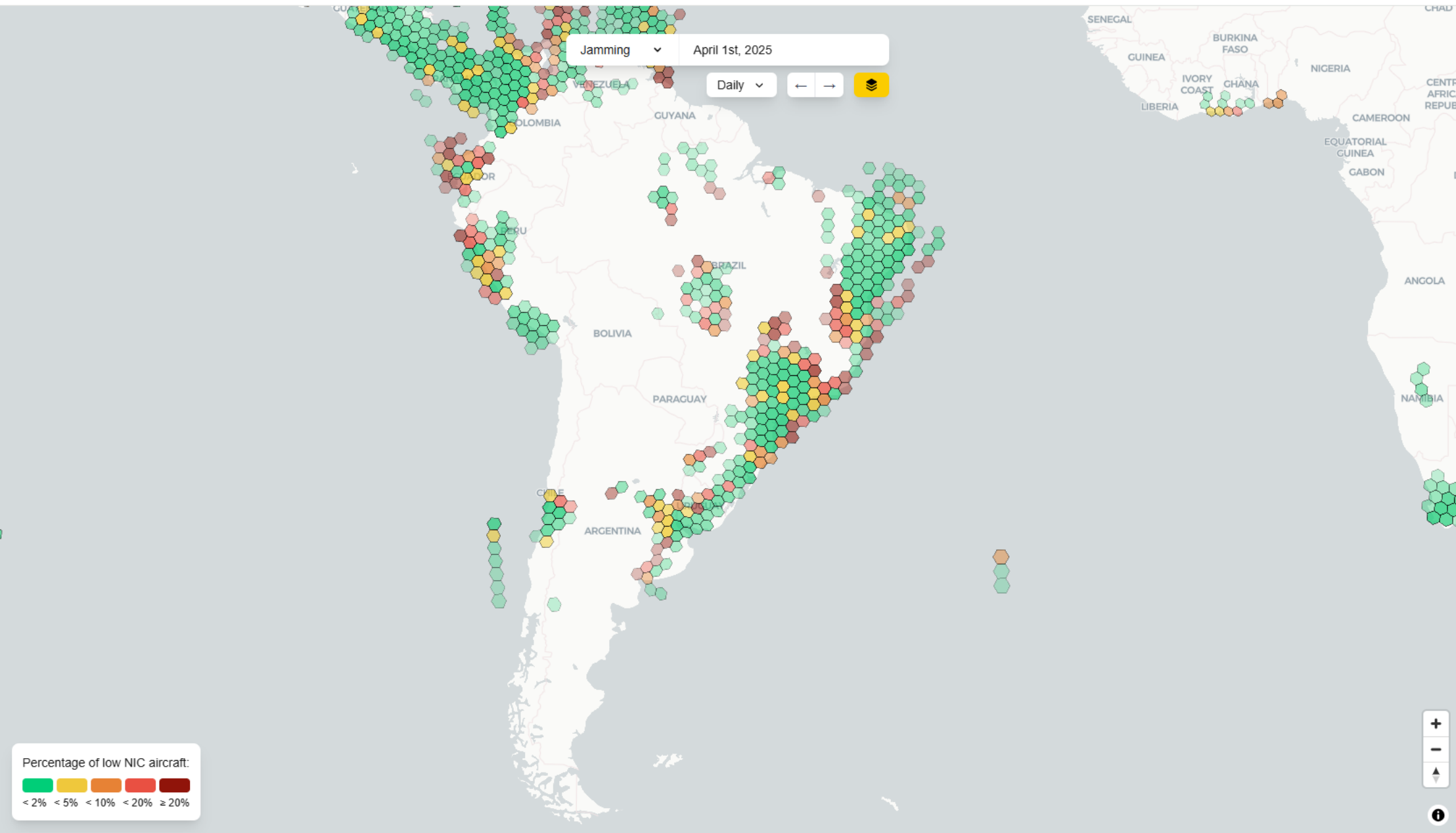


GNSS Interference Detection using ADS-B

- Map
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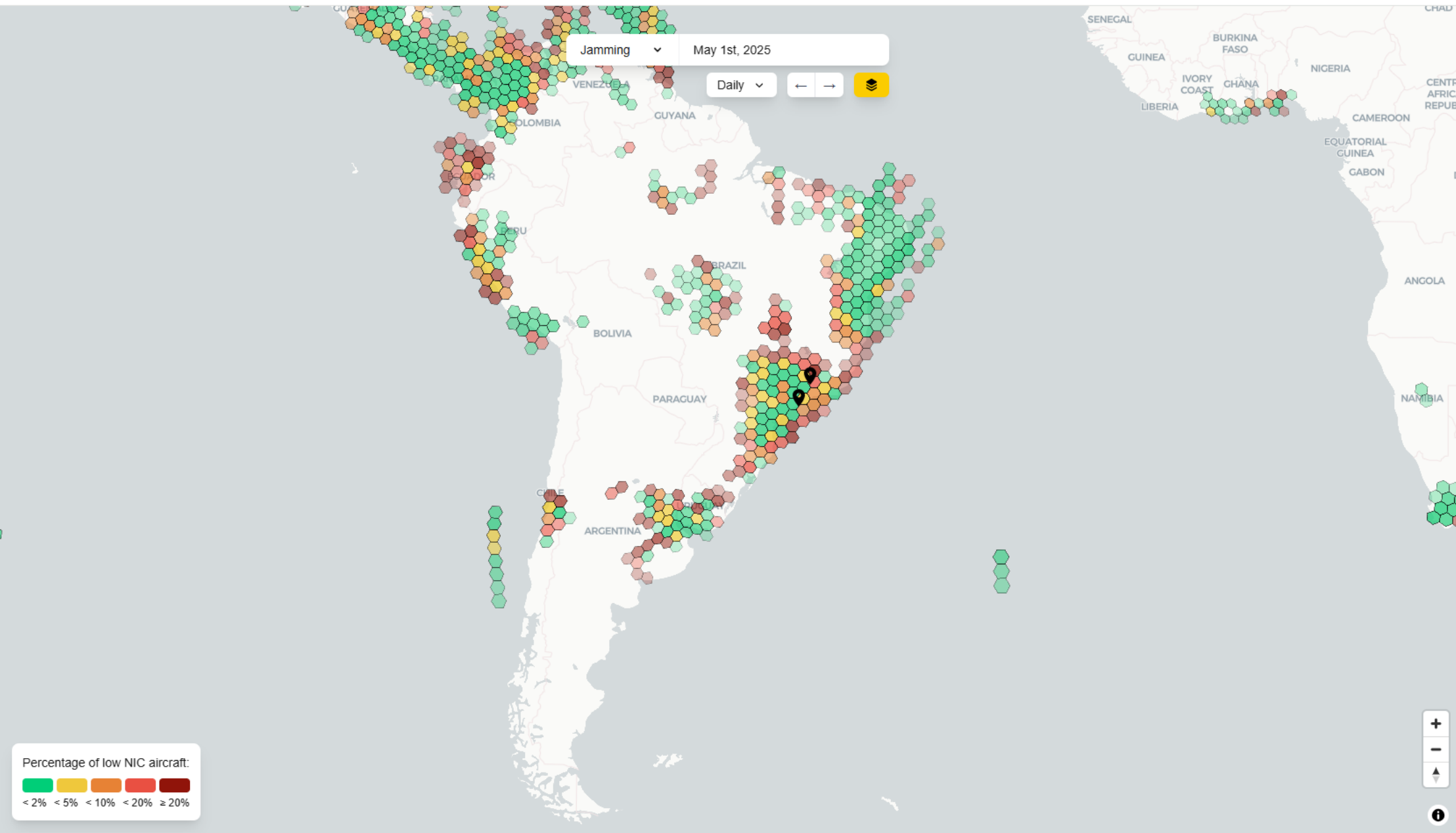


GNSS Interference Detection using ADS-B

- Map
- Statistics
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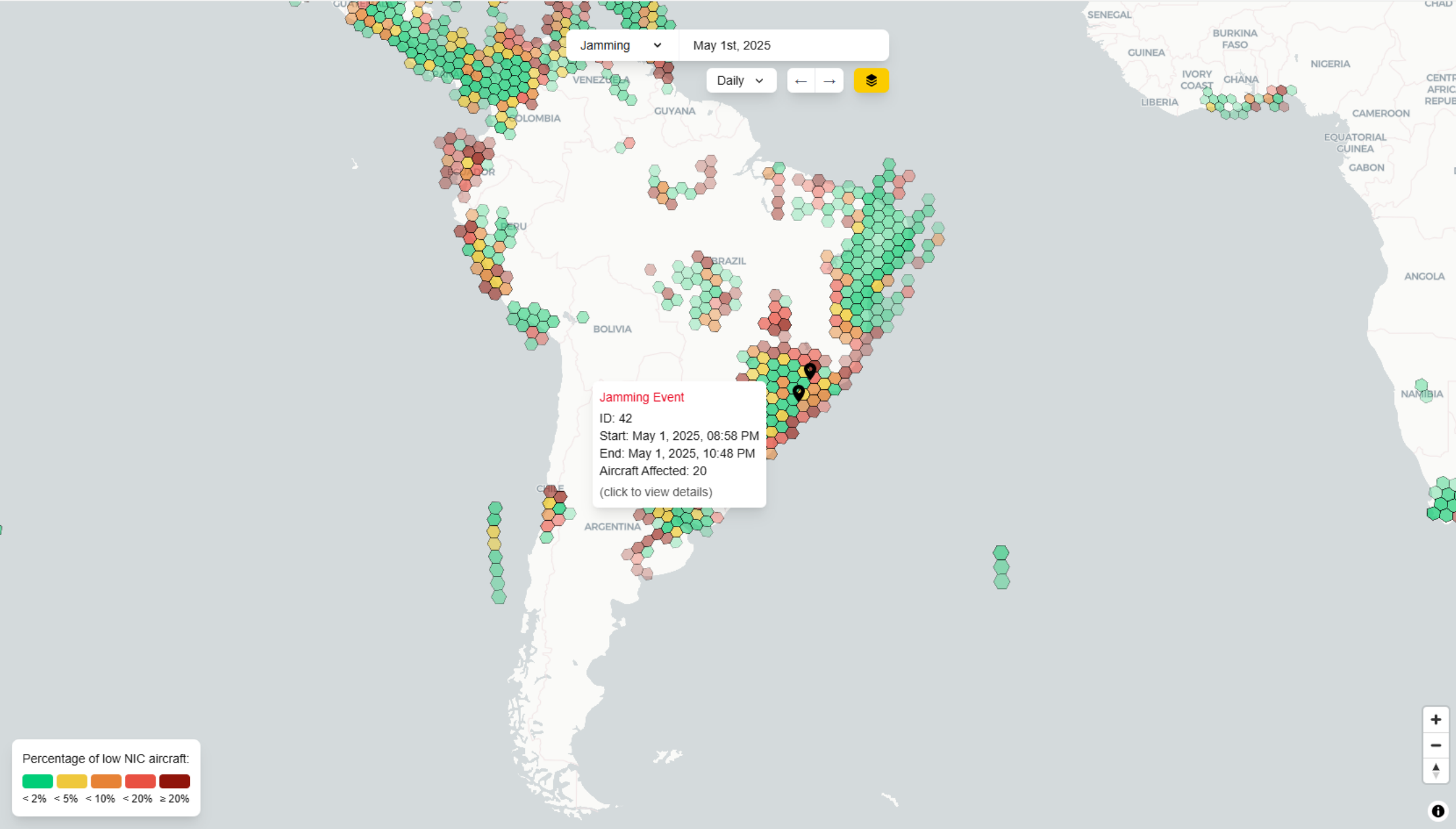


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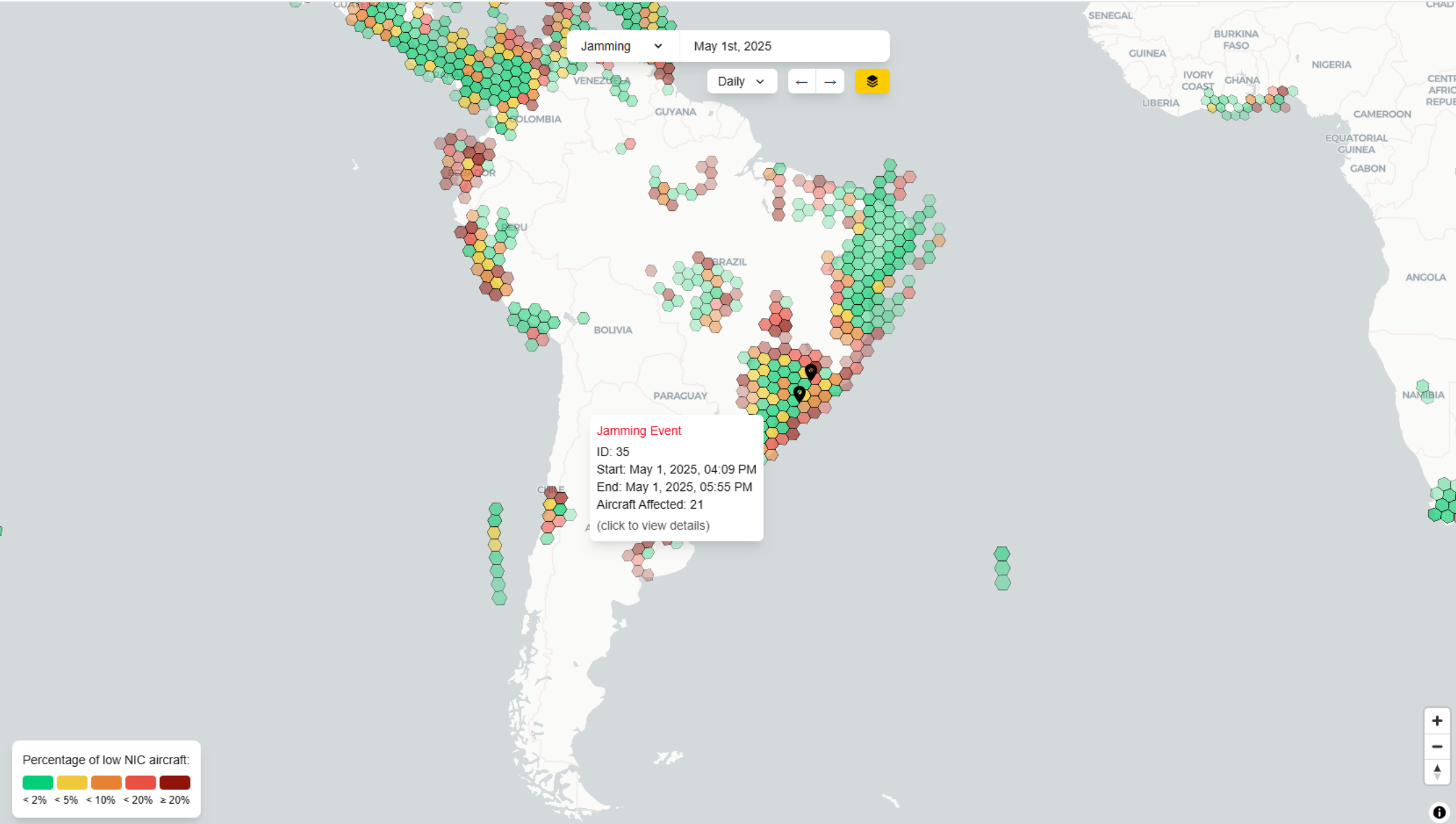
GNSS Interference Detection using ADS-B

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GNSS Interference Detection using ADS-B


- Map
- Statistics
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GNSS Interference Detection using ADS-B

- Map
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GNSS Interference Detection using ADS-B

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- Resources



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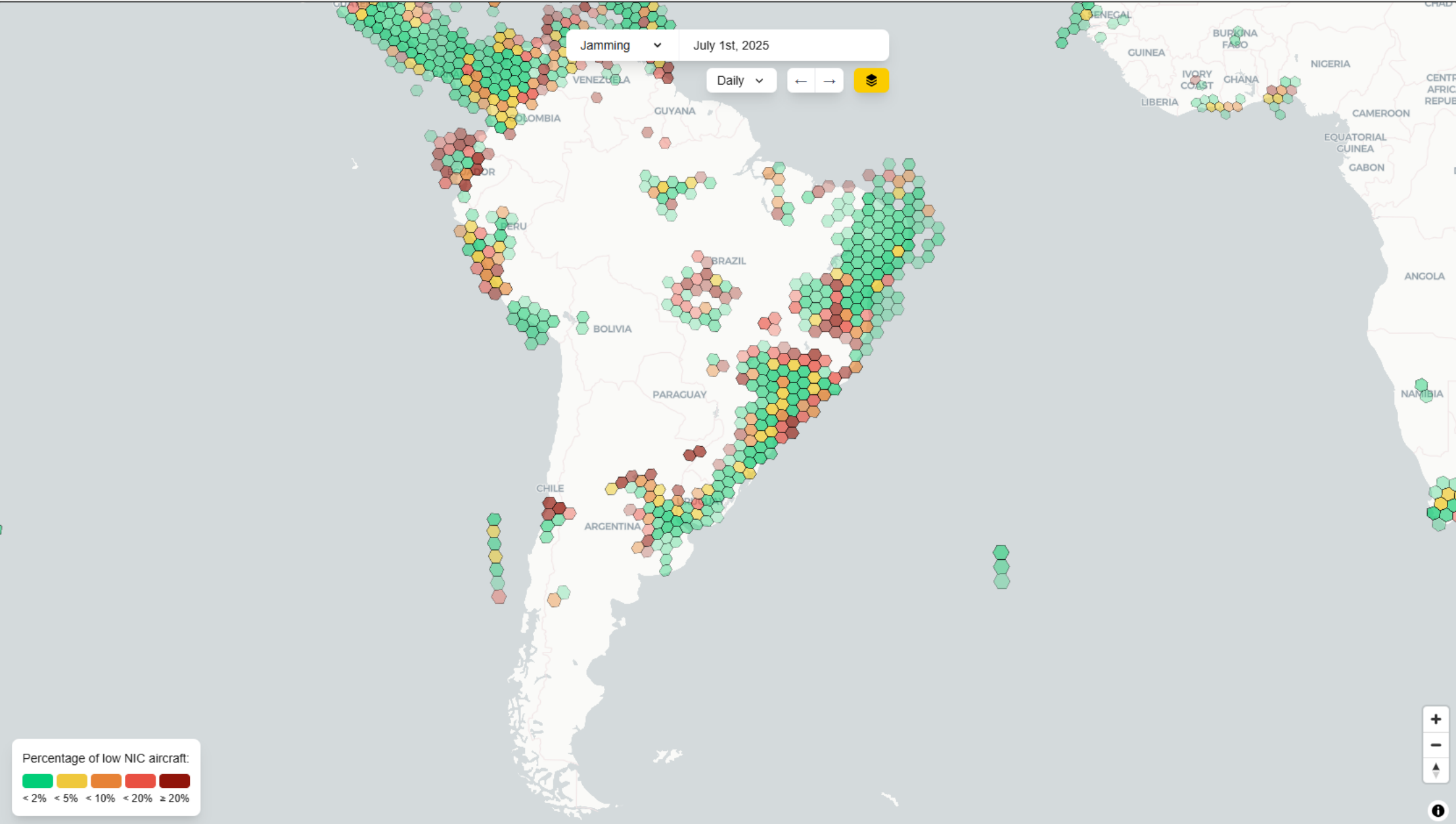
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Evolución de eventos GNSS en la Región SAM



CONCLUSIONES:

- **Identificación de los puntos mas recurrentes con eventos de GNSS**
 - **Extensión del patrón de eventos en Sudamérica en el ultimo año**
 - **Pocos casos de spoofing/jamming a nivel regional**
 - **Necesidad de mantener como contingencia la red de radioayudas convencionales**
- **Este patrón de eventos se puede considerar como insumo para los estudios de racionalización de radioayudas para soporte de la red de rutas basadas en navegación por satélites.**



Comparativo ARG Cobertura y performance DME-DME con eventos GNSS

Periodo: MARZO 2025

Taller sobre Sistemas de Navegación aérea para las regiones
NAM/CAR/SAM

Ciudad de México, México, del 2 al 4 de septiembre de 2025

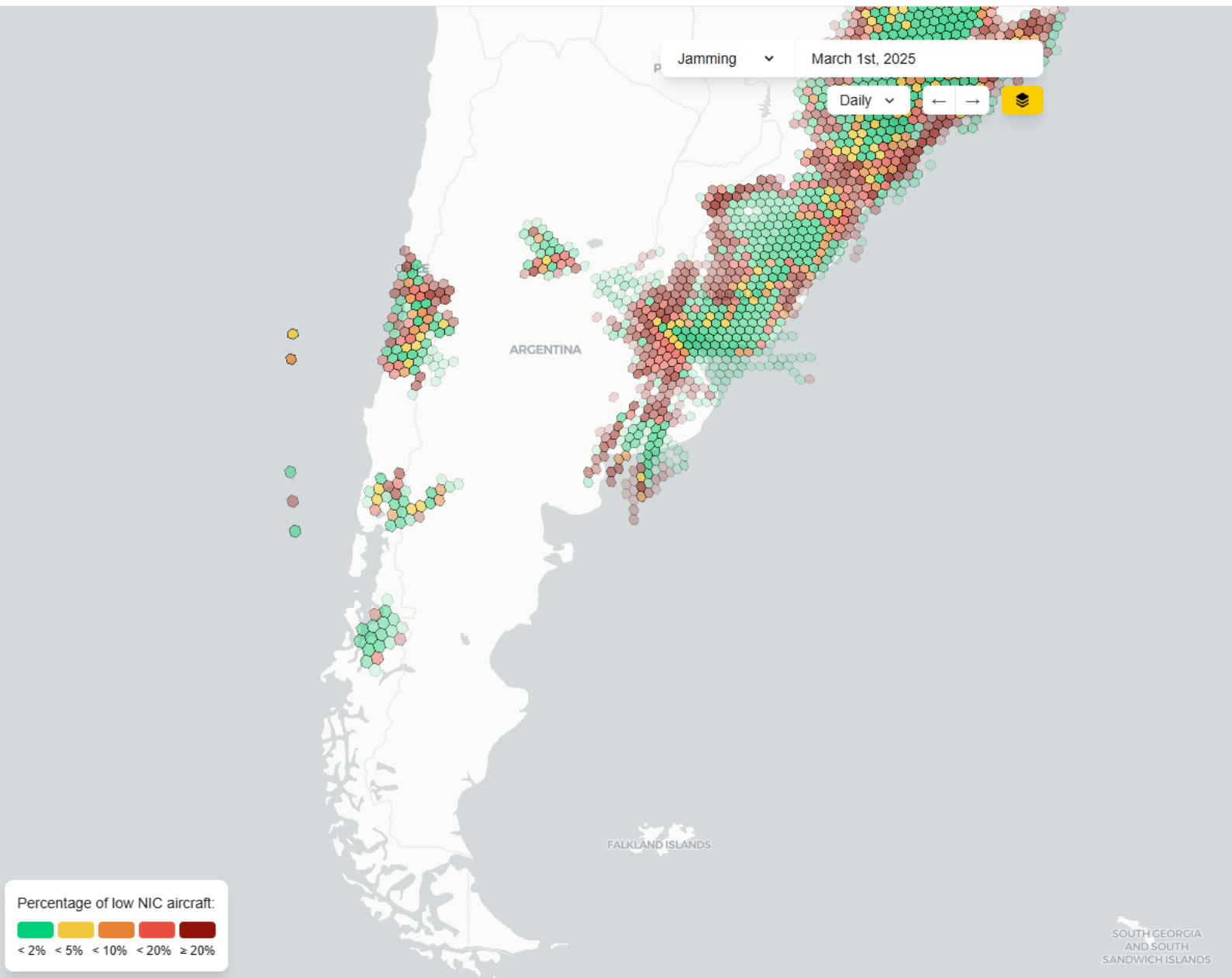
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GNSS Interference Detection using ADS-B

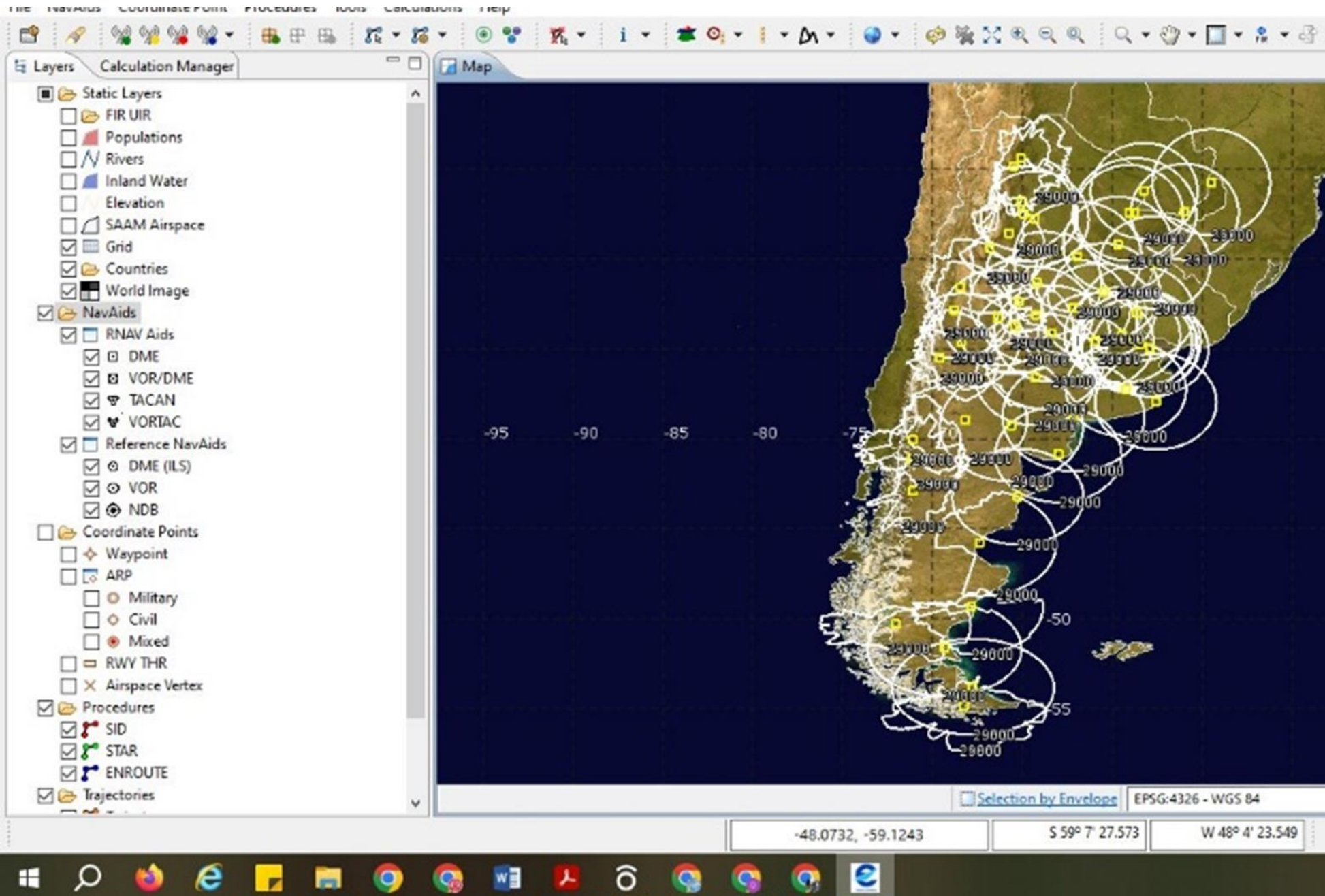
- Map
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Eventos GNSS Argentina

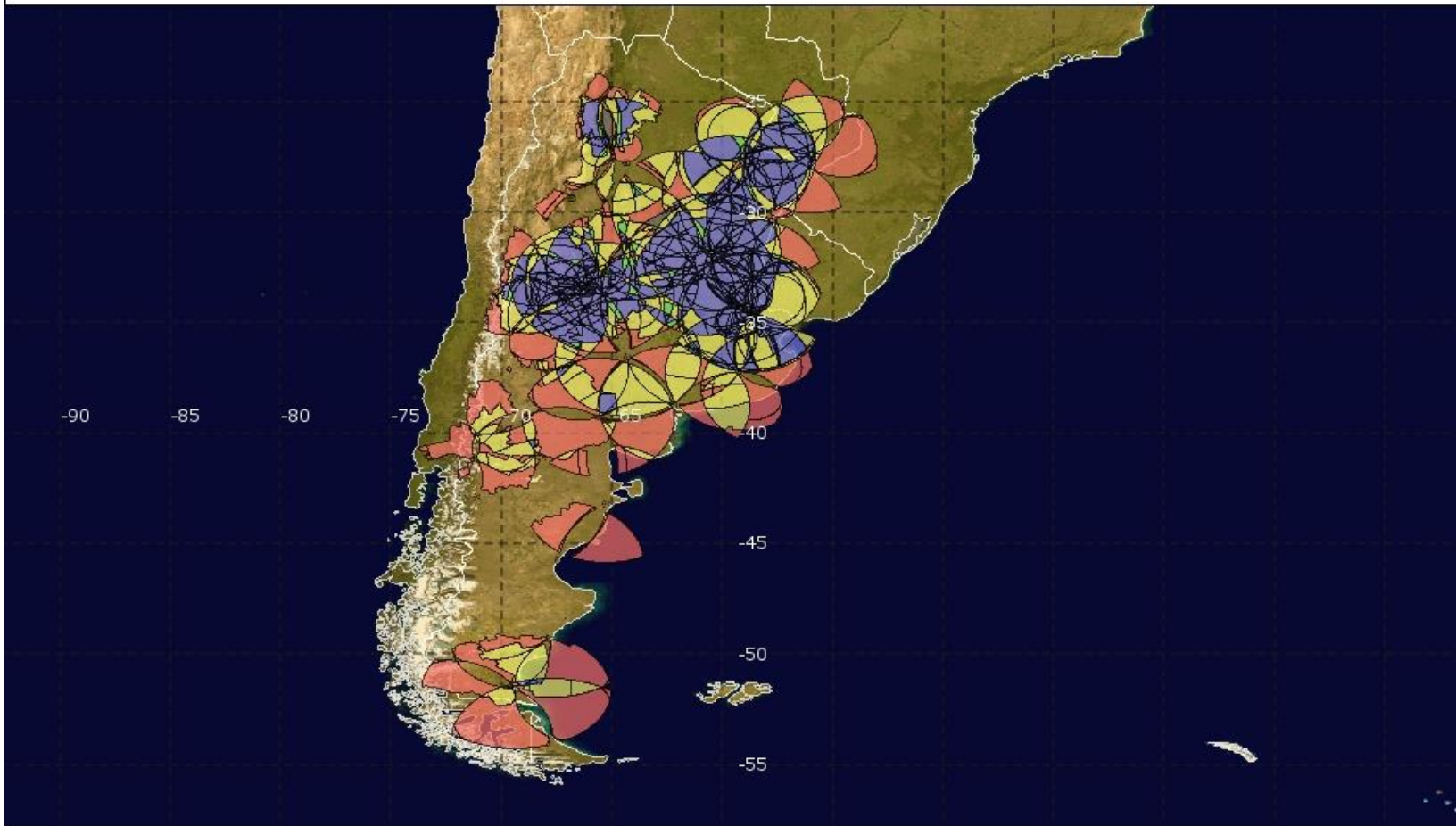
MAR 2025





Cálculo Coberturas DME Argentina (software DEMETER)

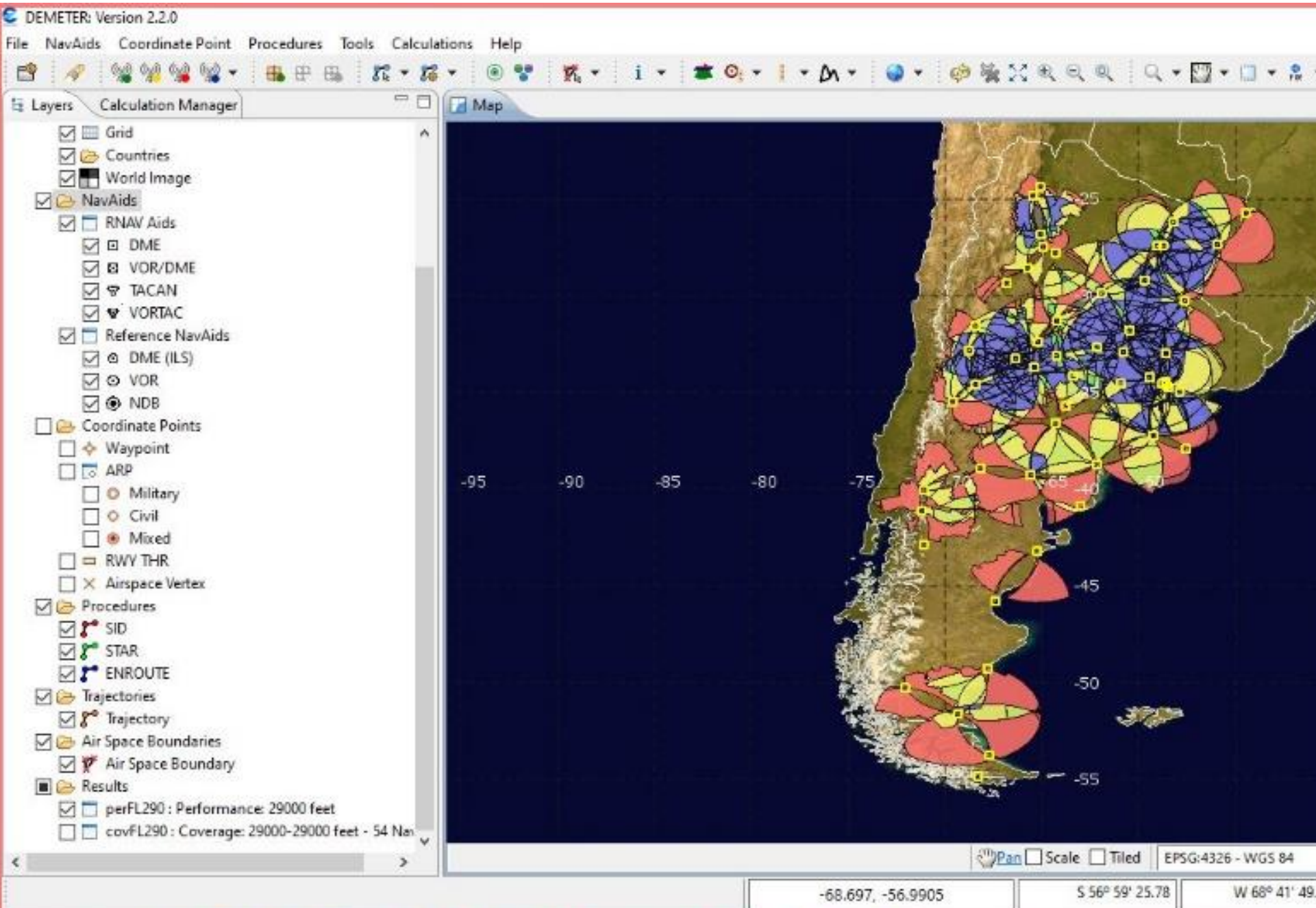
ARG FL290 Performance



Legend:

- Results/Performance: 29000 feet/Available Pairs - EUROCONTROL/DEMETER[2025_07_31 18:41:18, 236]
- No Coverage
- No Redundancy
- Limited Redundancy
- Full Redundancy
- Excessive Redundancy
- NavAids/RNAV Aids/VOR/DME/User defined
- NavAids/Reference NavAids/VOR/User defined

Cálculo
Performance
DME-DME
Argentina
(software
DEMETER)

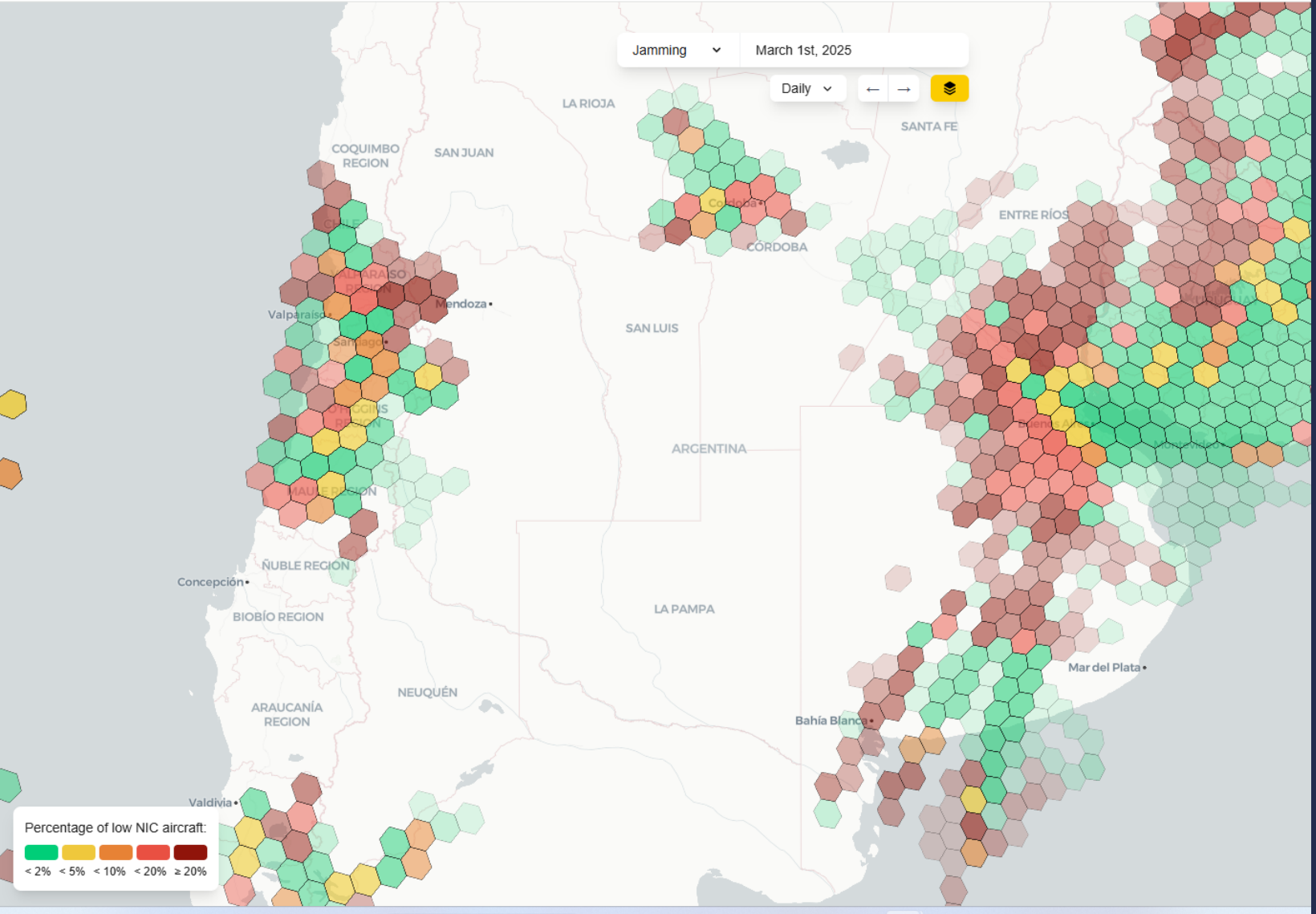


**Cálculo
Performance
DME-DME
Argentina
(software
DEMETER)**

GNSX Interference Detection using ADS-B

- Map
- Statistics
- Resources

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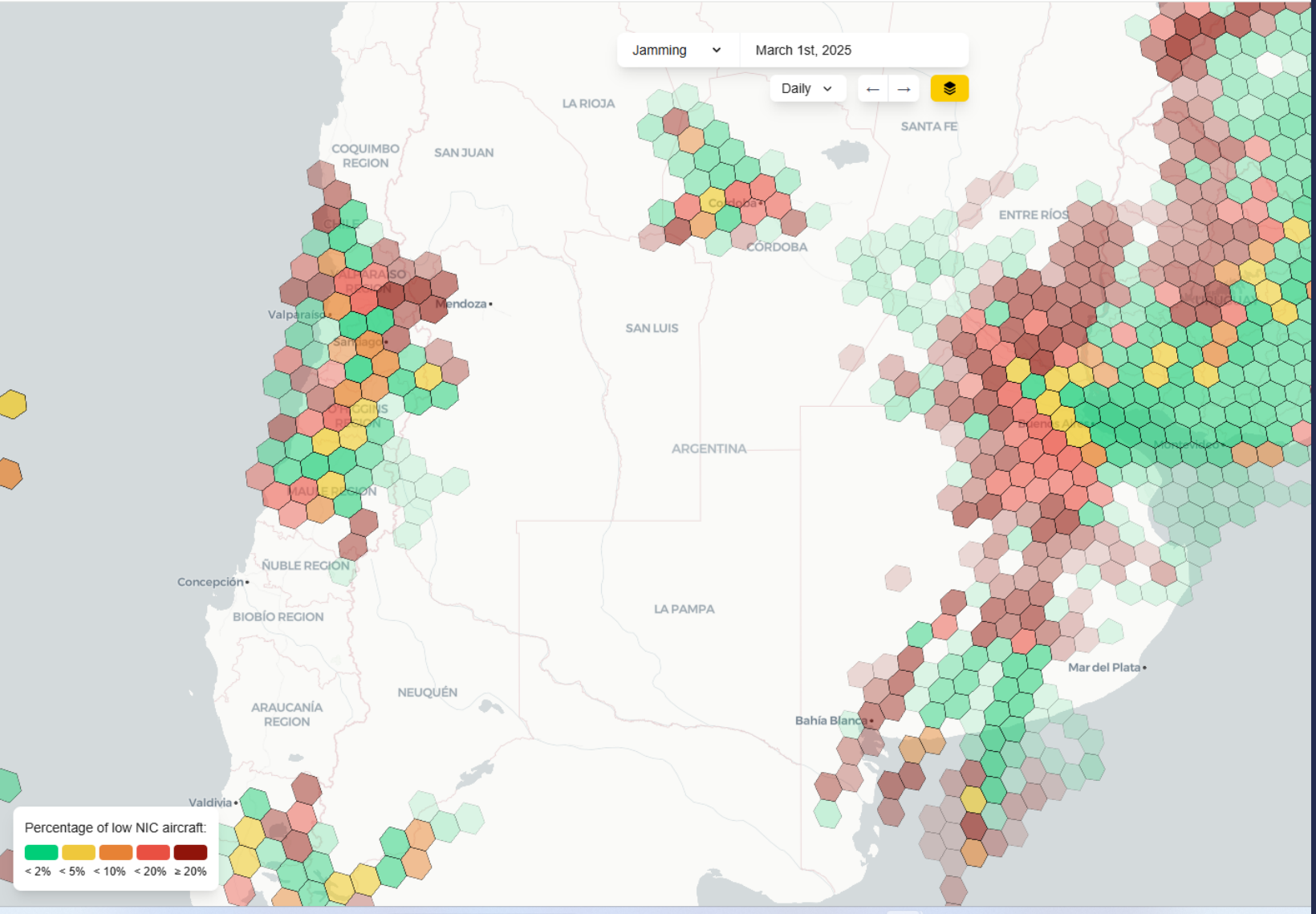
Eventos GNSX Región central Argentina

MAR 2025

GNSX Interference Detection using ADS-B

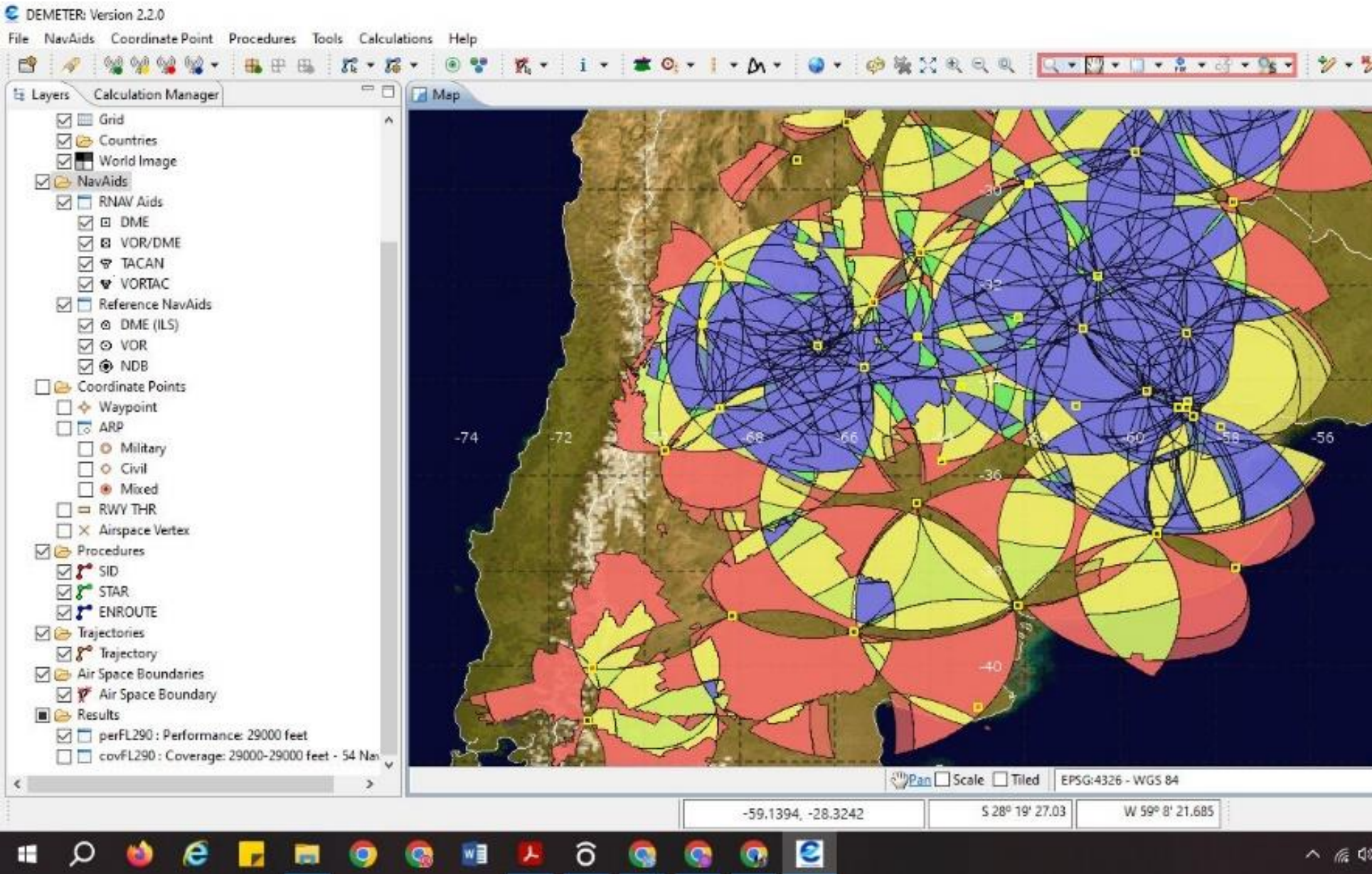
- Map
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- Resources

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Eventos GNSX Región central Argentina

MAR 2025



Calculo
performance
DME-DME
Región central
Argentina

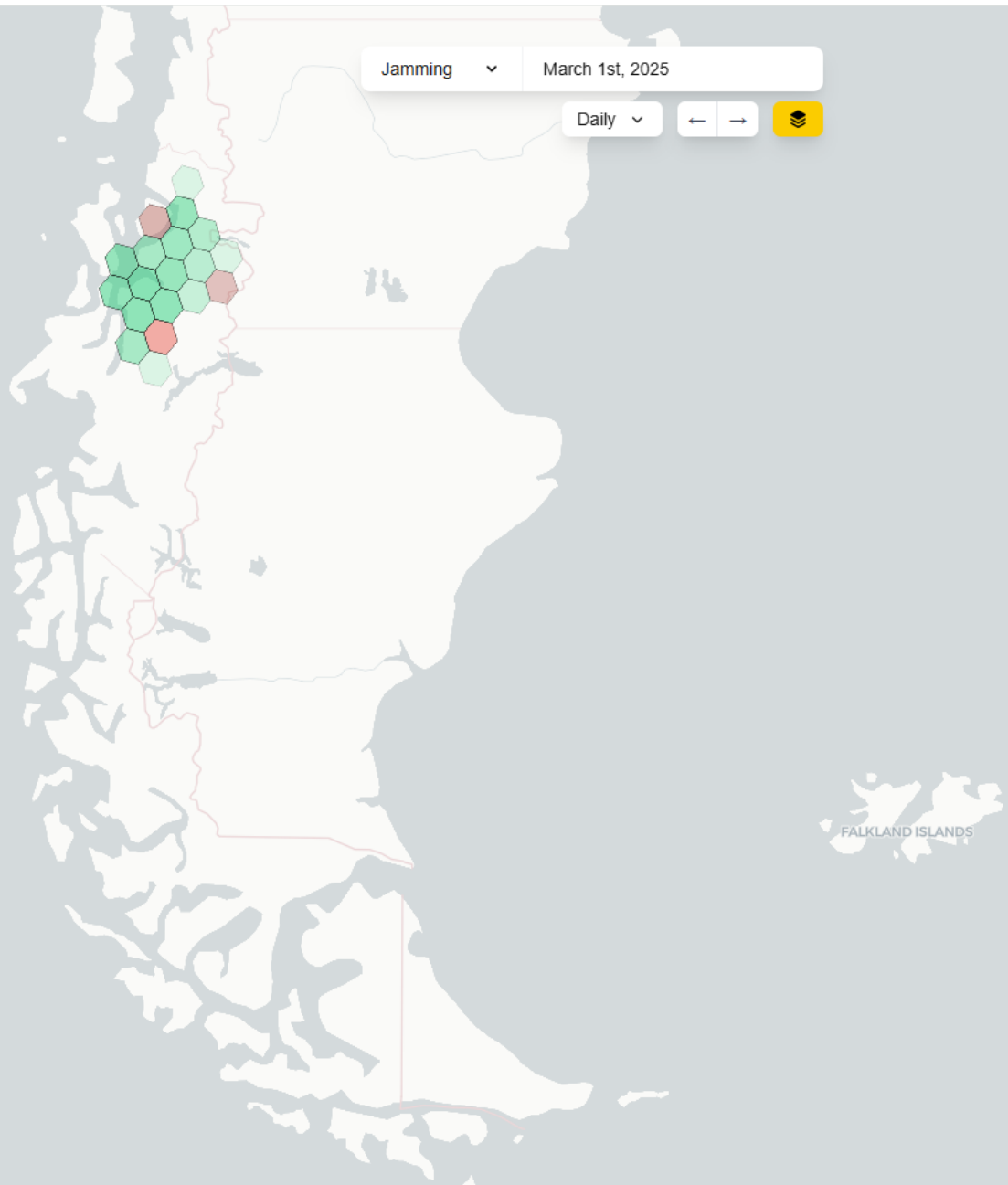
(software
DEMETER)

GNSS Interference Detection using ADS-B

Map

Statistics

Resources



Eventos GNSS Región Sur Argentina

MAR 2025

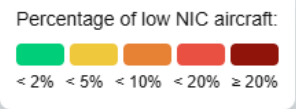


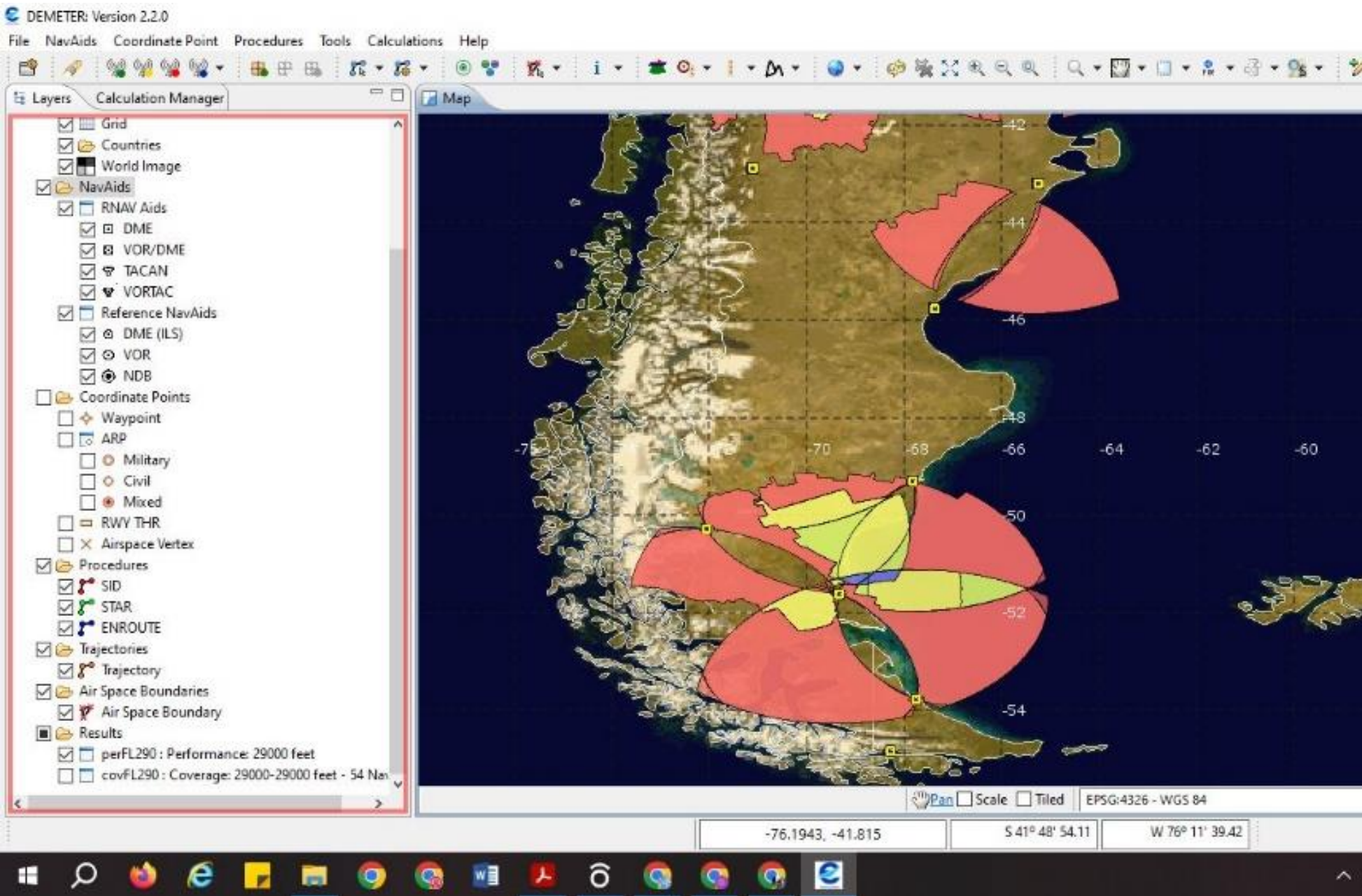
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Federal Aviation
Administration

Stanford
University





Calculo performance DME-DME Región Sur Argentina

(software
DEMETER)

EUROCONTROL Airspace Risk Assessment



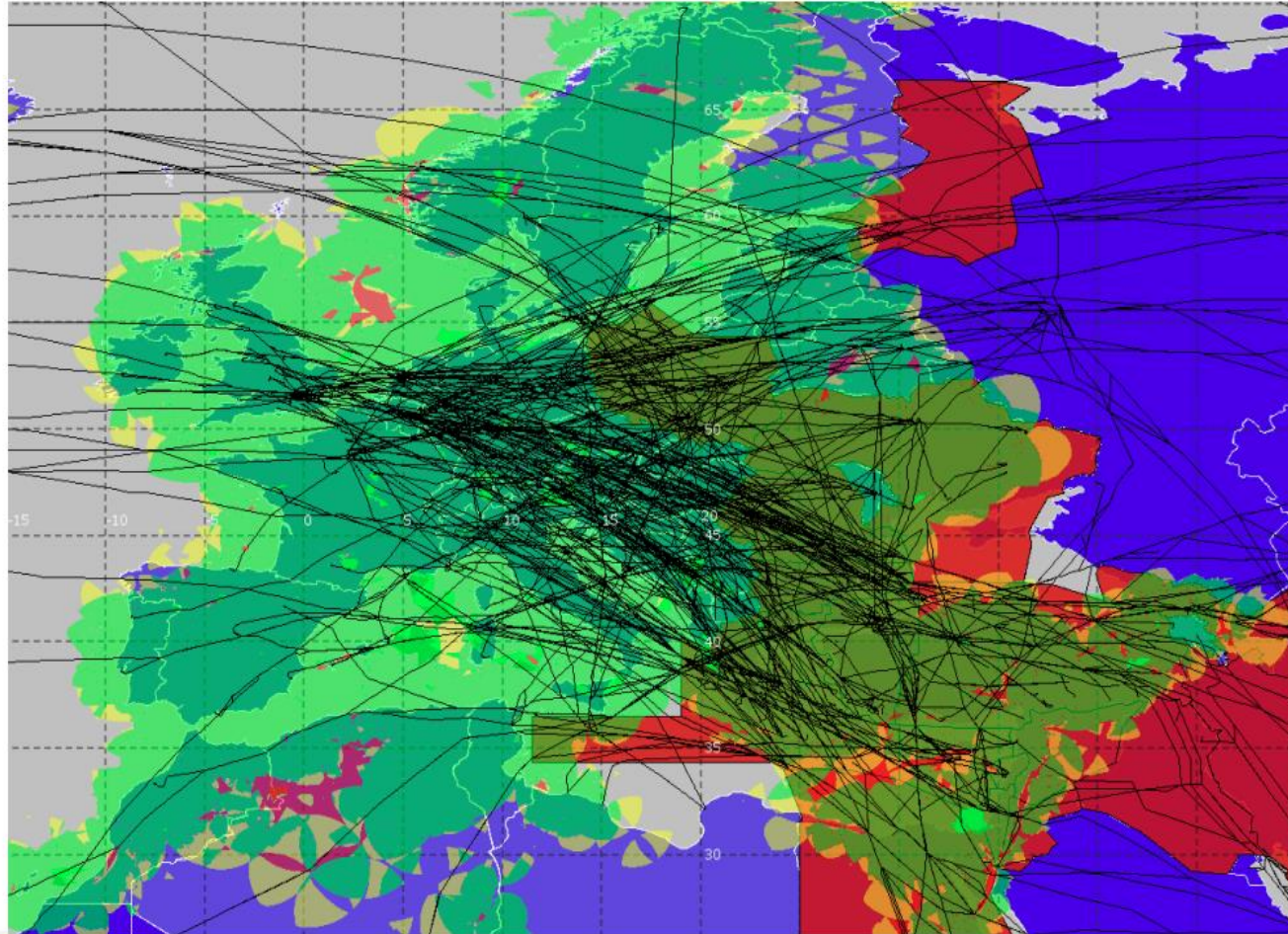
Dark RED: FIR affected by GNSS RFI

Black: Flights crossing affected FIRs

Green: Alternative DME/DME RNAV Coverage Available

Yellow/orange: DME/DME RNAV Coverage Available but no redundancy

Light red: No DME/DME RNAV Coverage



Cálculo Performance Europa

EUROCONTROL STAKEHOLDER FORUM

Comparativo ARG ADS-B con Eventos GNSS

Periodo: MARZO 2025

Taller sobre Sistemas de Navegación aérea para las regiones
NAM/CAR/SAM

Ciudad de México, México, del 2 al 4 de septiembre de 2025

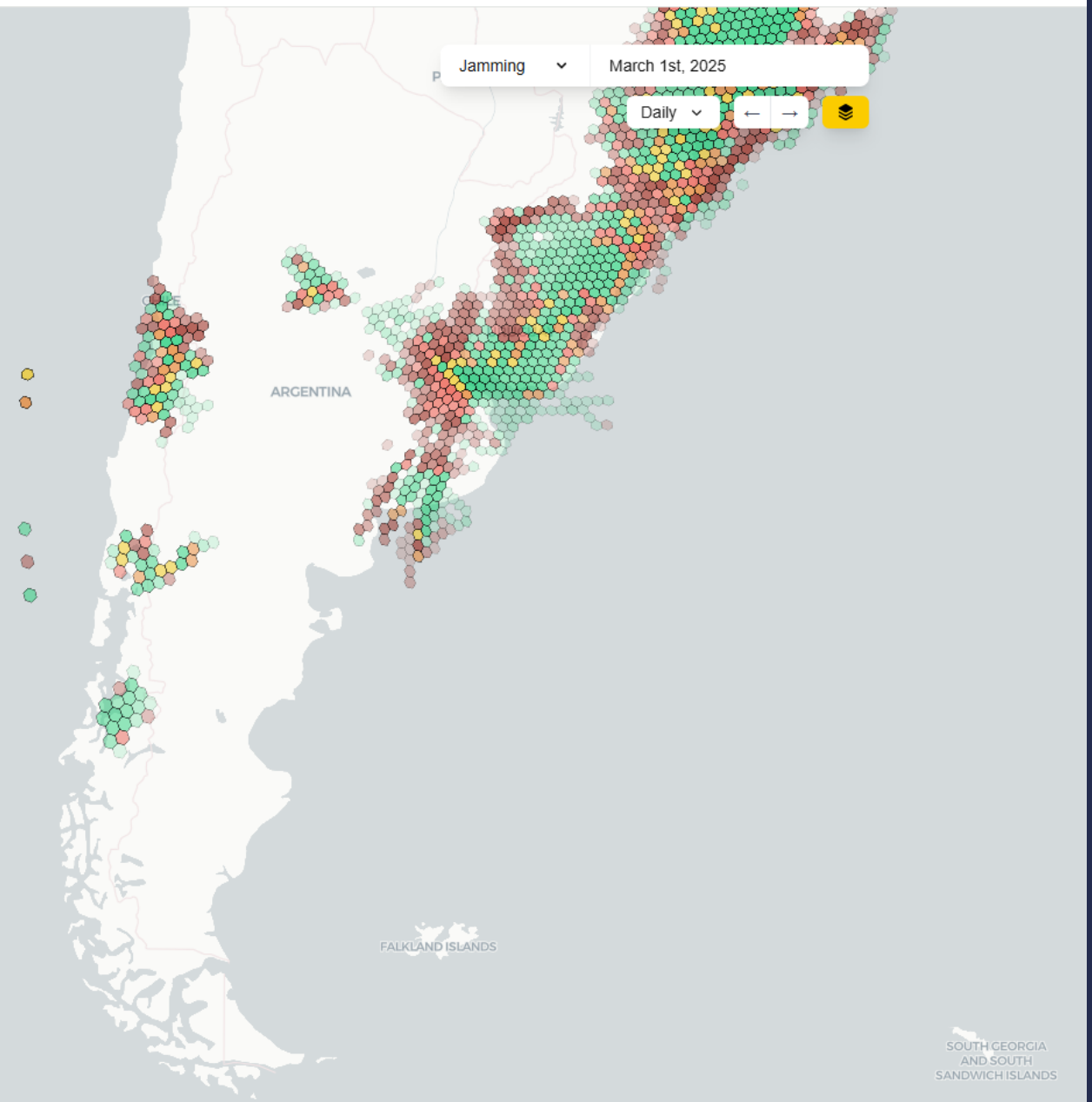
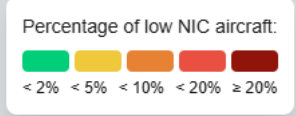
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Ministerio de Economía

GNSS Interference Detection using ADS-B

- Map
- Statistics
- Resources



Eventos GNSS Argentina


MAR 2025

GNSS Interference Detection using ADS-B

Map

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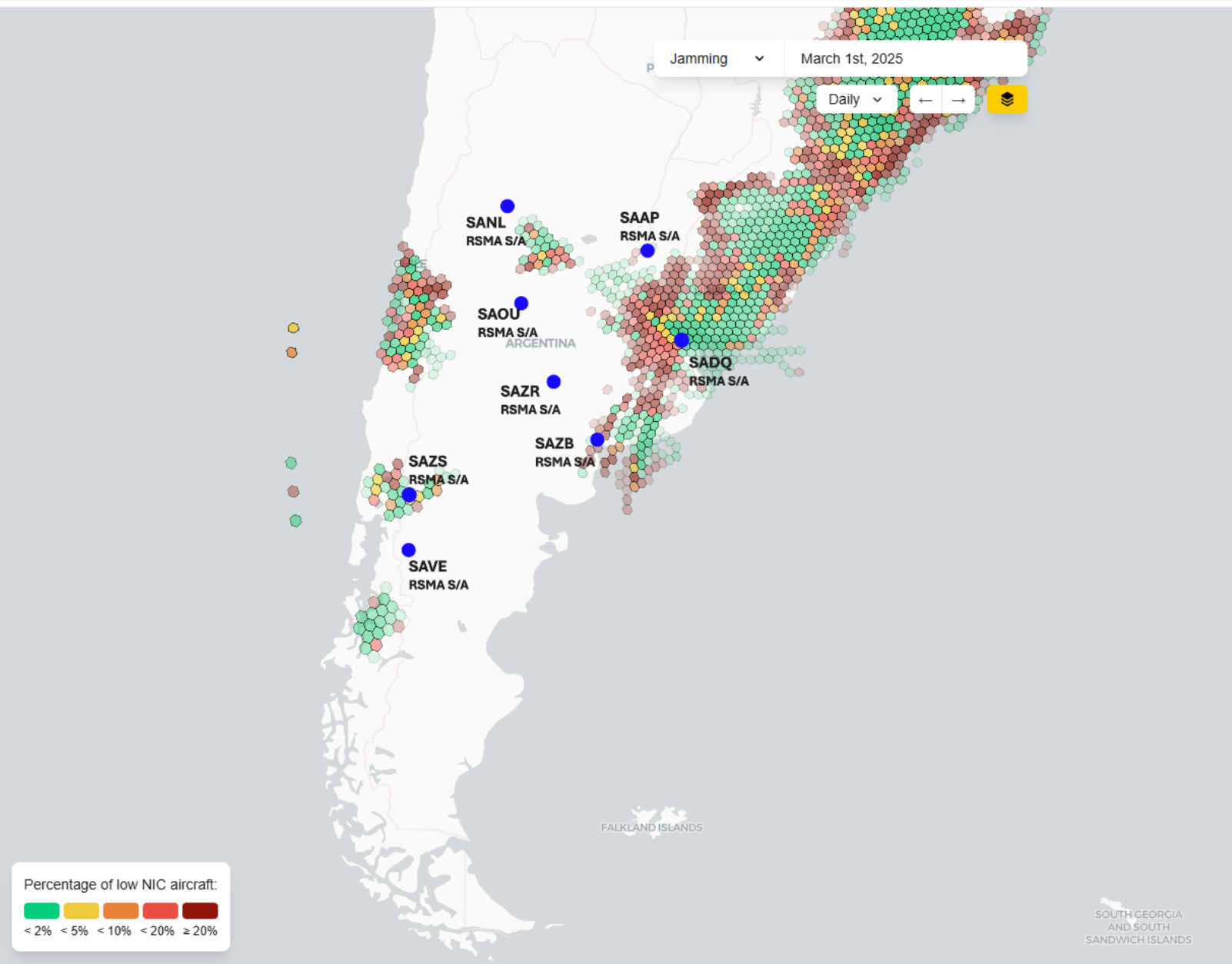


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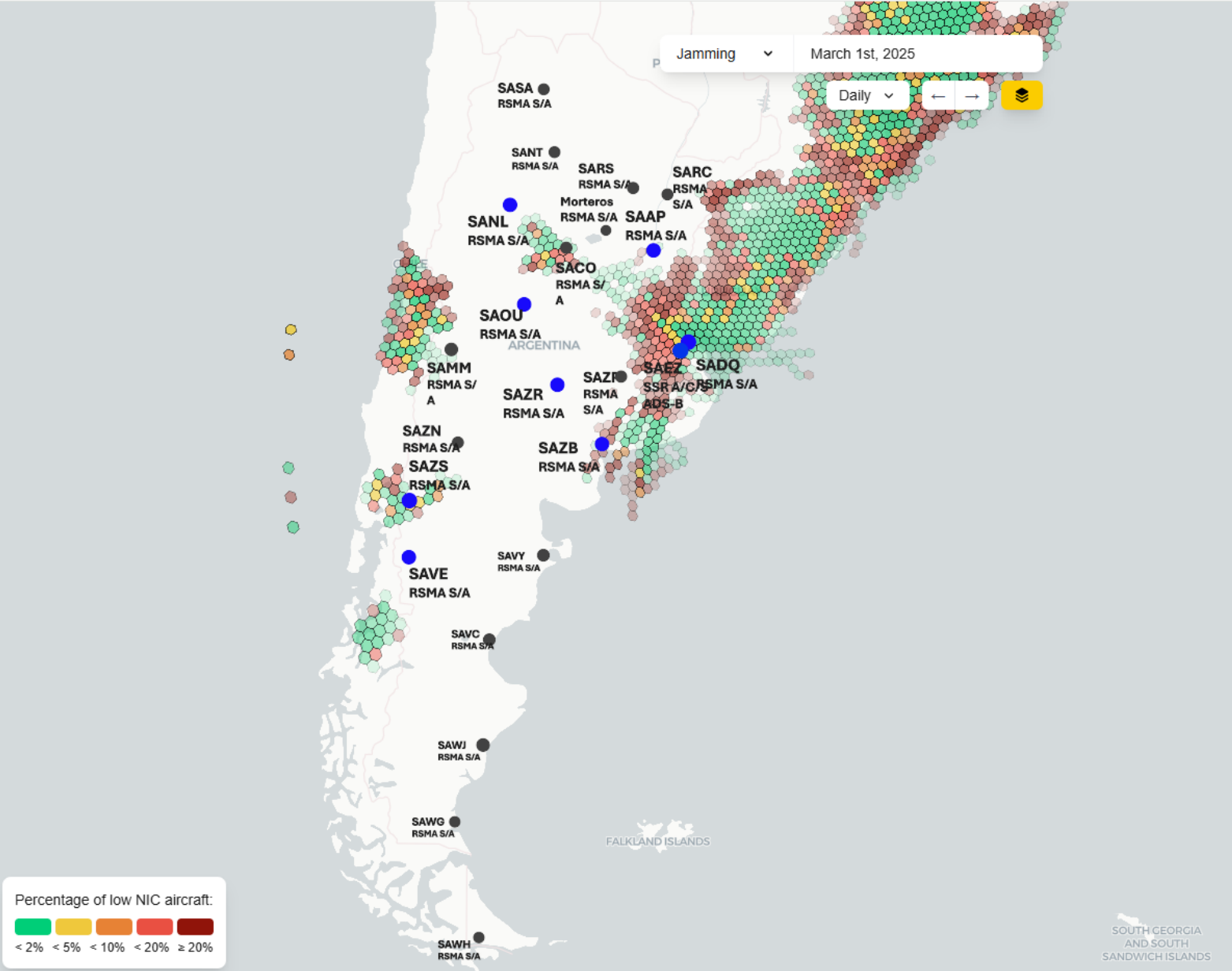
Sistemas RSMA S/A Modo S y capacidad ADS-B Argentina

JUL 2025

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Comparativo ARG sistemas radionavegación con eventos GNSS



CONCLUSIONES:

- Continuar con los estudios de los casos de interferencias GNSS, para detectar y corregir las situaciones de interferencias causadas por fuentes externas en las distintas fases del vuelo, y determinar acciones preventivas para evitar futuras situaciones de interferencias que pudieran causar diversas fuentes externas.
- Consolidar una guía de orientación que compile las medidas preventivas recomendadas y las acciones correctivas aplicadas, para proveer material de referencia con las particularidades propias de la Región.



Muchas gracias por su atención.
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