NATIONAL AGENCY FOR CADASTRE AND LAND REGISTRATION

National Center for Cartography

EUPOS 2026 · ROMPOS · GEODESY · GNSS INTERFERENCE

National Report of Romania to EUPOS 2026

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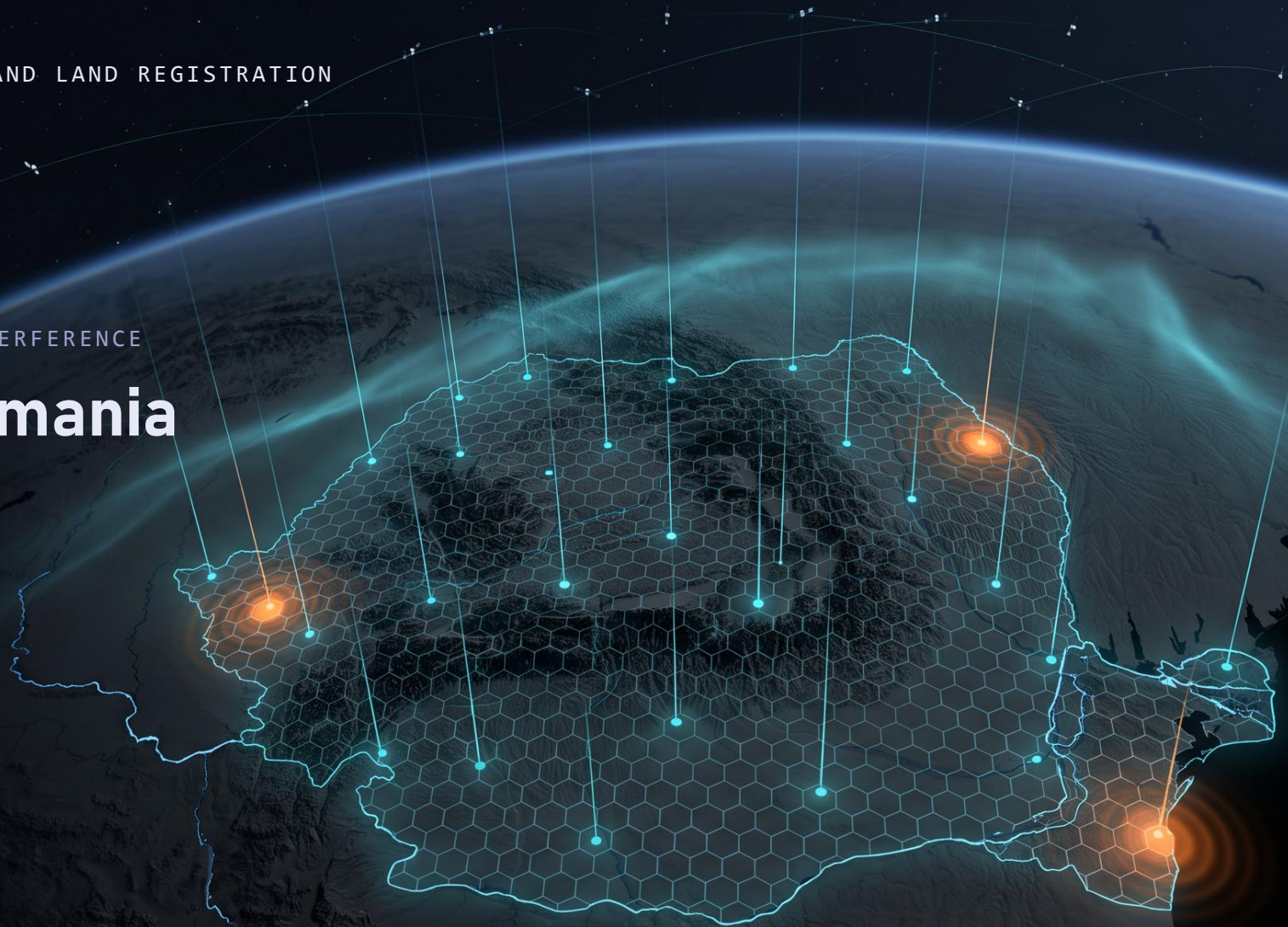


10.2026

ROMPOS CORS NETWORK · CURRENT STATUS · OCTOBER 2026

87 reference stations.
Audited epoch by epoch.

ROMPOS delivers real-time and post-processing corrections across Romania. In 2026 every station is also re-processed as a rover and read as an interference sensor.

01 **Usage statistics**
Sessions, users, products, density

02 **User retention**
Churn and return since 2019

03 **RTK-NMA**
Every station re-processed as a rover

04 **GeoReper**
Field inventory of geodetic points

05 **GeoVeil**
Interference: detection to evidence

06 **Open libraries**
geoveil-mp · geoveil-cn0

ROMPOS reference stations · illustrative rendering

87 stations
re-processed as rovers by RTK-NMA
83 resolving ambiguities

217 mountpoints
on the NTRIP caster
VRS · station · mobile

6,604 users
unique, Sep 2025 – Aug 2026
+2.2% vs previous period

2.75 M sessions
RTK sessions, Sep 2025 – Aug 2026
7,546 per day

Executive Overview

Sessions, users and products at a glance.

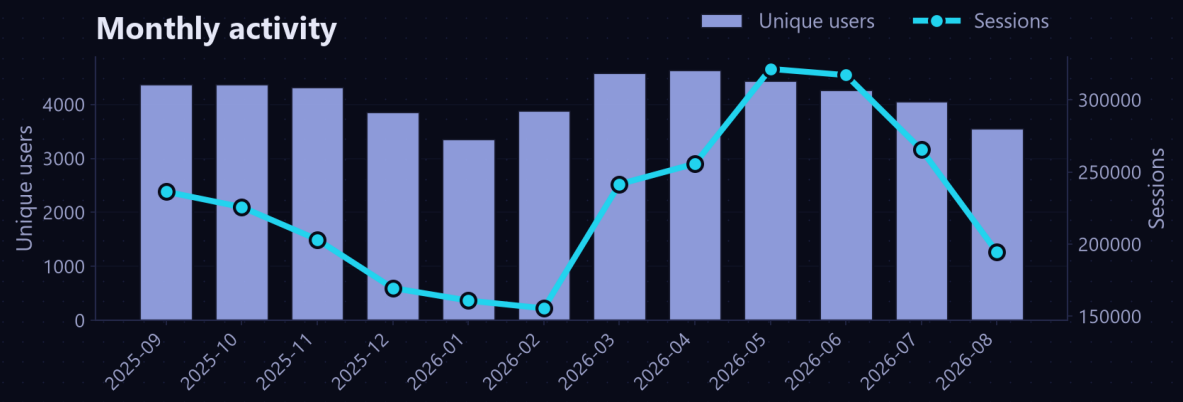
2,746,831
Total Sessions
-8.3% vs prev. period

6,604
Unique Users
+2.2% vs prev. period

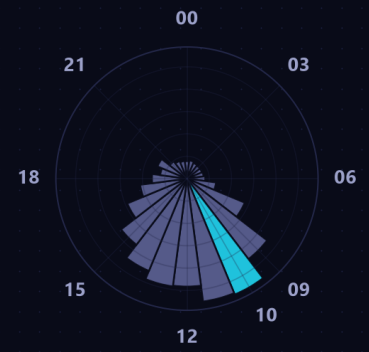
249
Distinct Products
-3.9% vs prev. period

7,546.2
Sessions / day
-8.3% vs prev. period

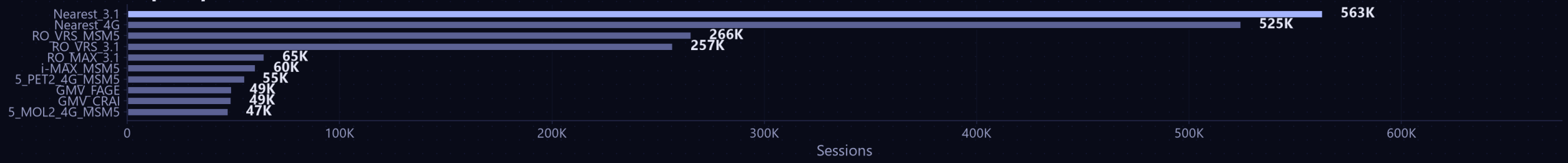
Monthly activity



24h activity (peak 10:00 = 280K sessions)



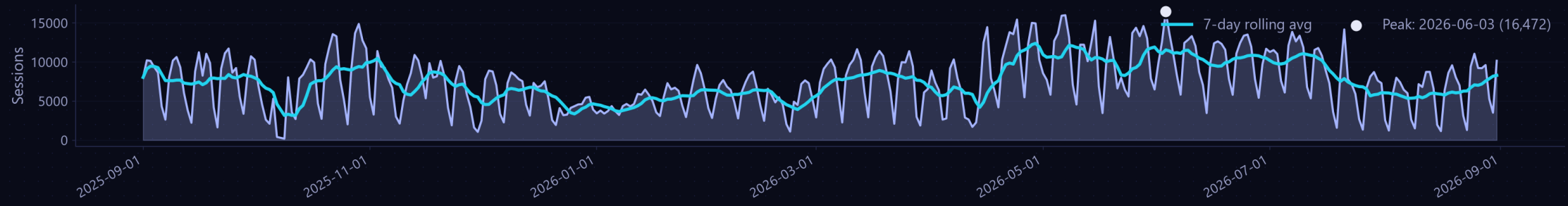
Top 10 products (leader: Nearest_3.1)



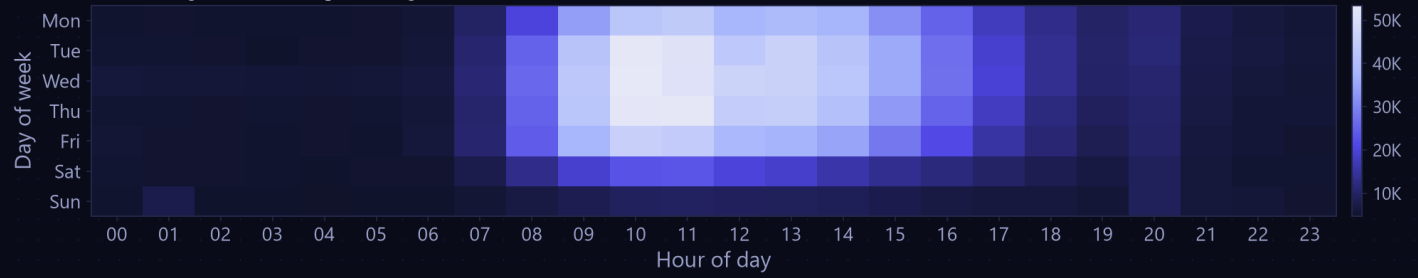
Temporal Patterns

When the network works hardest.

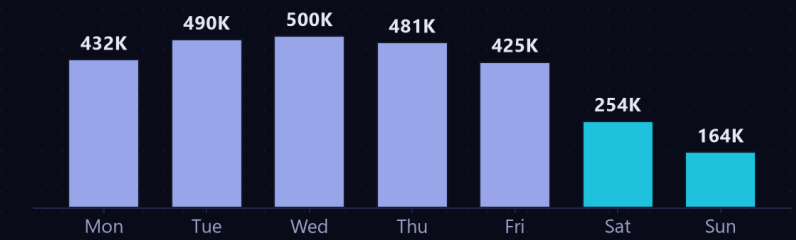
Daily session volume



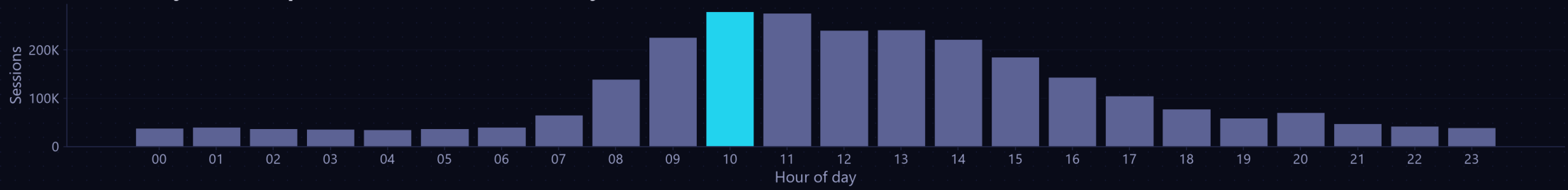
Activity heatmap (day x hour)



Day-of-week (weekday vs weekend)



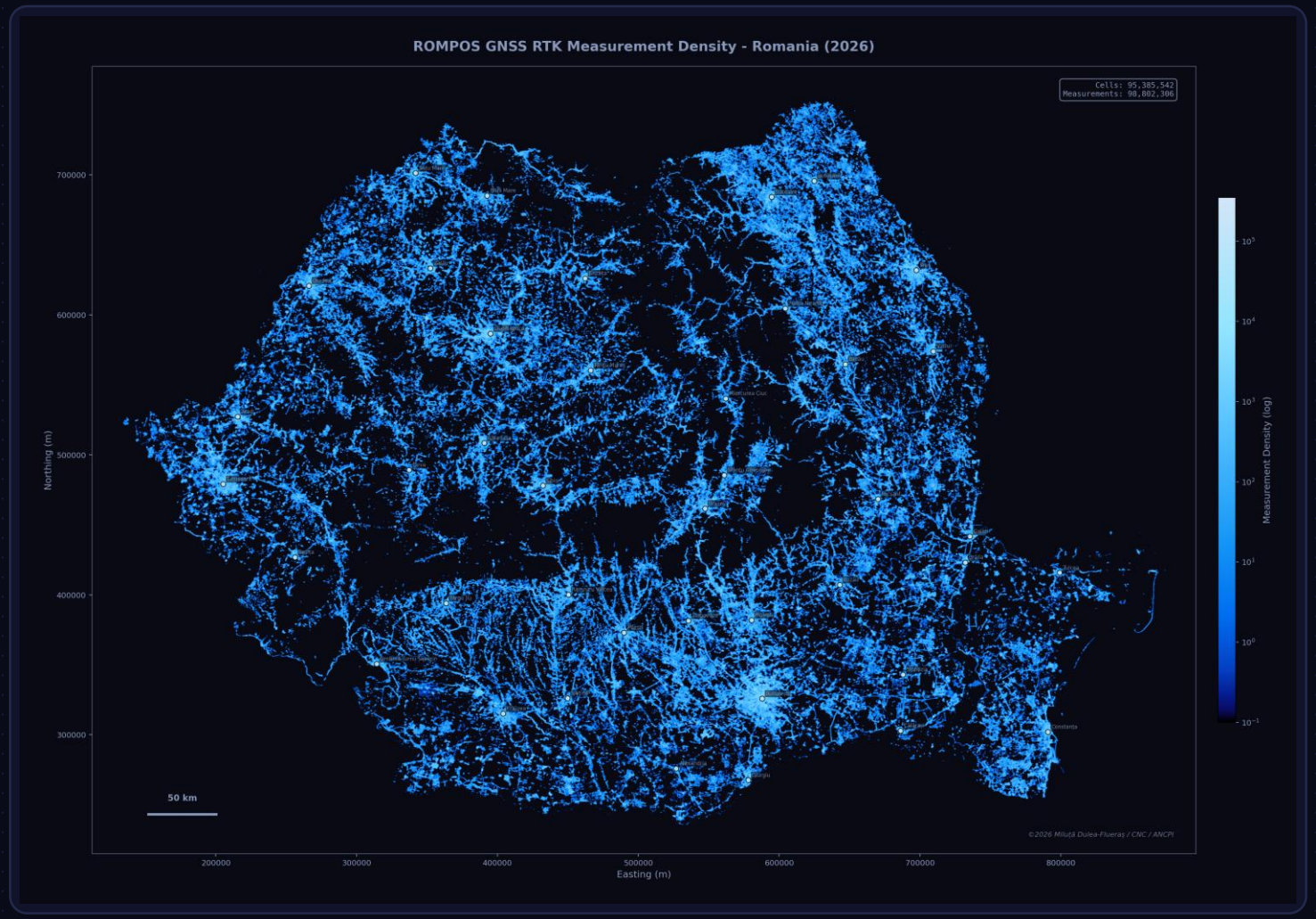
Sessions by hour — peak 10:00 (280K, 10% of day)



ROMPOS · USAGE STATISTICS · 2026

98.8 million fixes.
Where Romania measures.

Every ROMPOS RTK measurement, binned on the Stereo 70 grid and drawn on a log scale. Density follows towns, roads and river valleys. The high Carpathians stay dark.



98.8 M

RTK measurements on the map

98,802,306

95.4 M

grid cells with at least one fix

95,385,542

Real output · ROMPOS RTK measurement density · 2026 · log scale

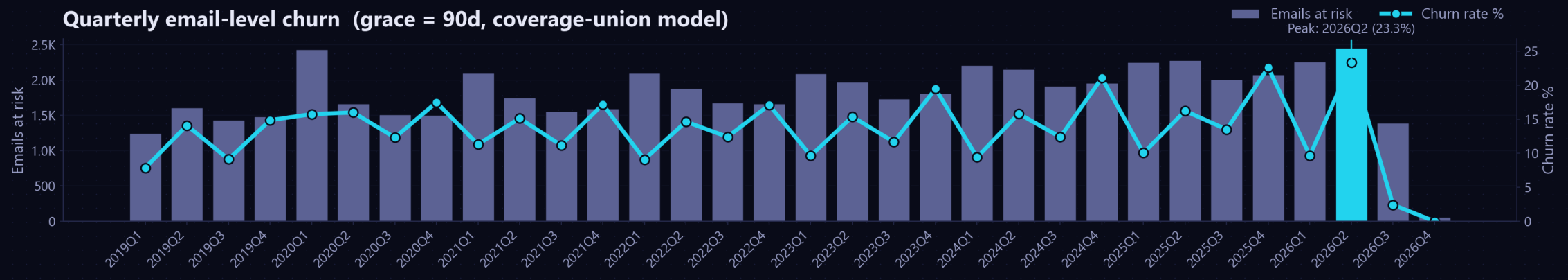
ROMPOS · 2019-02-04 TO 2026-10-04

Email-Level Churn

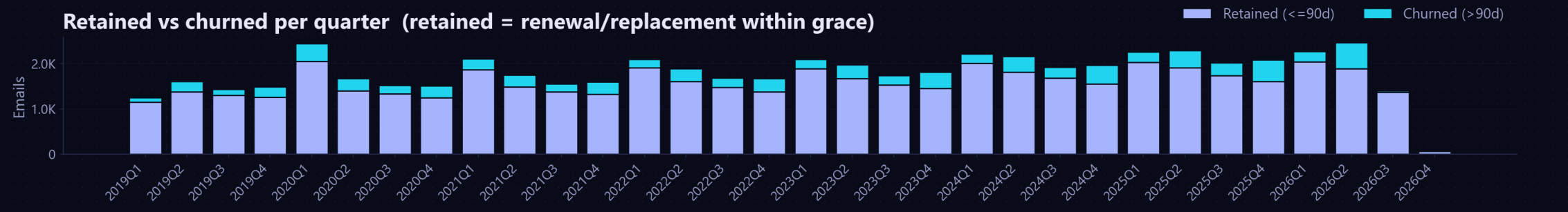
How many emails lapse each quarter.

6.7 K	13.4 %	44 %	57 %
Unique emails analysed	Avg quarterly email churn	Annualised churn rate	Lifetime return rate

Quarterly email-level churn (grace = 90d, coverage-union model)



Retained vs churned per quarter (retained = renewal/replacement within grace)



Source: rompos_beta DB · Generated: 2026-10-04 23:14

ROMPOS · 2019-02-04 TO 2026-10-04 · CHURN = GAP > 90 DAYS

Email Return Rate

How many come back, and how fast.

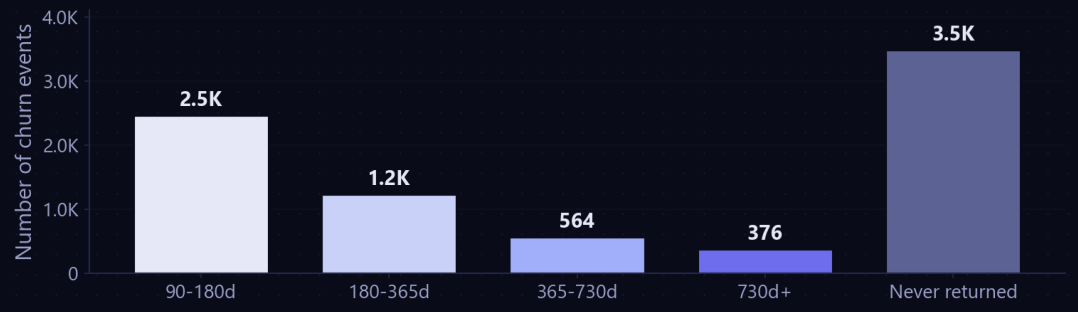
8.1 K
Churn events (gap > 90d)

4.6 K
Eventually returned

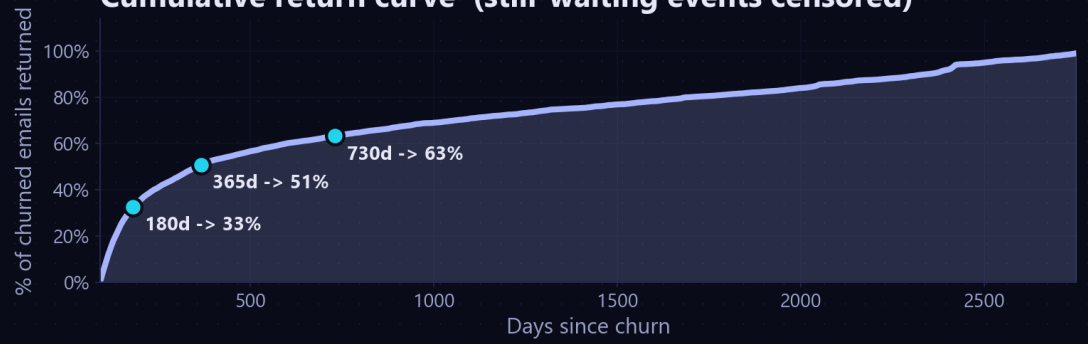
57 %
Lifetime return rate

169 d
Median time to return

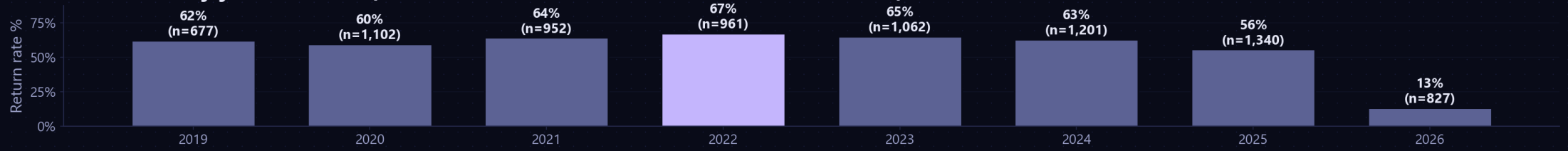
Time-to-return distribution



Cumulative return curve (still-waiting events censored)



Return rate by year of churn (older churn cohorts have had more time to return)



Source: rompos_beta DB · Generated: 2026-10-04 23:14

Eight releases in four weeks.
The network now audits itself.

Every reference station is re-processed as if it were a rover and compared with its surveyed coordinate. Twenty-seven capabilities shipped on top of that comparison, two of them auditing the monitor itself.

91.4 %
Fixed-solution rate, last 24 h
26.9% before the fix

271.7 M
Position epochs since 30 Jun
11 GB compressed

83 / 88
Stations resolving ambiguities
34 of 88 before the fix

4.3 %
Fixed solutions over 20 mm off
9.9% two weeks ago

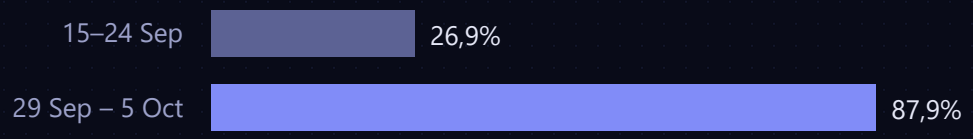
DELIVERED · 1.1.0 → 1.7.0

27 capabilities · release that shipped each one on the left

1.1	Daily RINEX 3.04 archive, shipped off-host	1.2	ROTI, GPS and Galileo, Jacobsen 2014	1.3	Real-solution flag on every stored row
1.1	Database backup with a verified restore	1.4	ROTI network map, any hour of the day	1.3	Field manual inside the dashboard
1.1	Fix-rate feed for the federation	1.4	Coherence gated at 40 stations	1.4	Per-solution sigmas and ambiguity ratio
1.2	Station QC: multipath, C/N0, cycle slips	1.2	Space weather context, 5-minute cadence	1.4	Network incident alarm
1.2	Signal statistics, per constellation signal	1.3	Live interference exposure per station	1.5	Cold-start guard for ambiguity resolution
1.2	Fix-rate history that outlives retention	1.3	Interference against RTK: a bounded null	1.5	Fix-capability alarm
1.2	Robust daily positions, fixed solutions only	1.3	Receiver flags with a stuck-bit guard	1.6	Alerts that clear themselves
1.2	Changepoint review queue	1.3	Daily baselines to a neighbouring station	1.6	Three-strike deviation debounce
1.2	Diagnostics console for every layer	1.3	Fix acquired and fix lost events	1.7	Pipeline-change windows, charted

RECOVERY

Network fixed-solution rate, epoch-weighted daily means



Before: the base window could cover the first rover epoch, so the filter opened converged.

WHAT THE INSTRUMENT FOUND

52%	of station-days are degenerate — no information about the monument
63 of 68	changepoint candidates were our own pipeline, not movement
null	no skill in the integrity ensemble against receiver flags

Miluta Dulea-Flueras · 5 October 2026

PolyForm Noncommercial 1.0.0 · free for research with credit · commercial licence on request

ARCHITECTURE · DATA STREAMS · AS BUILT · 300 S BATCH CYCLE · 176 LIVE SESSIONS

One pipeline, twice per station.
A zero-kilometre baseline, by design.

Each station is pulled twice: its own observations, and a virtual base generated at its own coordinates. That zero-kilometre baseline is what makes a millimetre comparison possible, and what makes ambiguity resolution fragile enough to need a guard.

176 NTRIP sessions
300 s batch cycle
11 GB TimescaleDB

INGEST

176
NTRIP sessions: 88 rover, 88 virtual base

~1 Hz
RTCM3 MSM5 per stream, GGA driven

0 km
base generated at the station itself

PROCESS

300 s
batch over a ~55 min observation window

0.8 ms
event-loop lag p50, parsing off-thread

240 s
watchdog restarts a silent station

STORE

271.7 M
position epochs, 11 GB compressed

10.2 M
signal-integrity checks

489.4 k
ROTI windows, 30-minute cadence

DERIVE

659.9 k
distance-monitor solutions, 10–30 km

330.0 k
fix acquired and lost events

1,937
station-days of QC and daily baselines

Miluta Dulea-Flueras · 5 October 2026

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GEOREPER 1.2.3 · ARCHITECTURE · EXPO · GRAPHQL · POSTGIS

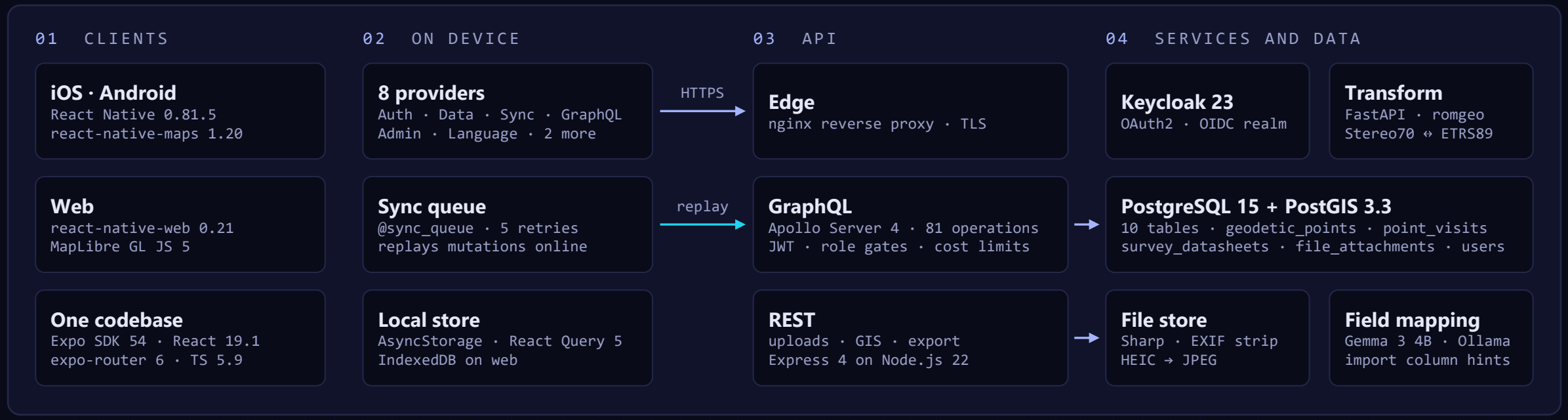
Map every geodetic point.
One codebase, three platforms.

GeoReper is a field inventory for geodetic points. Surveyors locate a point, record its state with photos, and the office approves the visit. The same TypeScript runs on iOS, Android and the web.

3 platforms
Apps for iOS, Android and the web
Expo 54 · RN 0.81.5

81 operations
GraphQL queries, mutations, subscriptions
28 Q · 50 M · 3 S

48k lines
TypeScript in the app and the API
41.6k app · 6.5k API



→ live request → queued replay from the device

Counted from schema.graphql, the SQL migrations and the source tree · 1.2.3

URL georeper.app

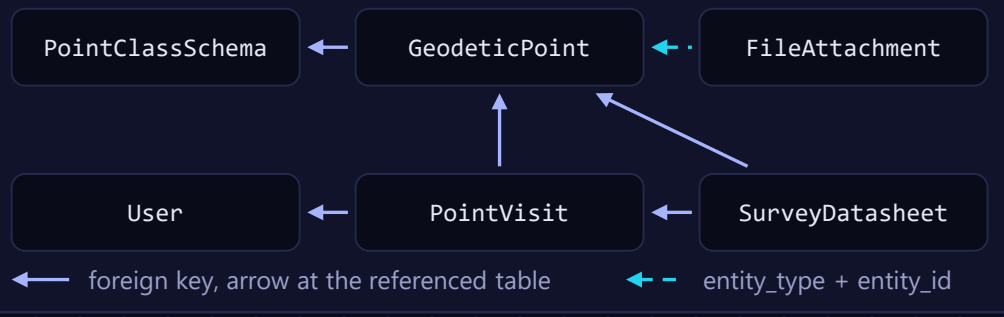
iOS · ANDROID · WEB · EN / RO

GEOREPER 1.2.3 · CLASSES AND FUNCTIONS · TYPESCRIPT

Typed end to end.
Classes hold, functions move.

The point model is declared three times and kept in step: TypeScript interfaces, GraphQL types and PostGIS tables. Mapping functions convert at each boundary.

RELATIONS foreign keys in init.sql



CLASSES TypeScript interfaces and their tables

GeodeticPoint geodetic_points

code · unique, the import key
type · PointType, 5 kinds
latitude, longitude · WGS84
orthometricHeight · H_MN75
projectedCoordinates · x, y, EPSG
state · PointState, 9 values

PointVisit point_visits

pointId · the visited point
state · PointState at the visit
photos · PointPhoto[], by direction
distanceFromPoint · user to point
correctedStereoX, correctedStereoY
approvalStatus · 3 values

SurveyDatasheet survey_datasheets

surveyType · PointType
measurements · SurveyMeasurements
antennaHeight, receiverType · GNSS
sessionDuration, observationMethod
userLatitude, userLongitude
notes · free text

PointClassSchema point_class_schemas

pointType · PointType
fields · FieldDefinition[]
.fieldType · FieldType, 6 kinds
.source · FieldSource, 3 kinds
.required · boolean
.validation · min, max, pattern

FUNCTIONS exported names, grouped by where they run

APP providers and utils

fetchPointsCluster(bounds, zoom)	Viewport pins, clustered on the server
enqueueSync() · processQueue()	Queue a change offline, replay it online
serverPointToLocal()	API shape to device shape
parseXlsx() · autoMapFields()	Read a spreadsheet, match its columns

API resolvers, guards, file service

bulkImportPoints	Insert rows, skip existing codes
pointsCluster · pointsInBounds	At most 500 clusters, 5,000 points
approveVisit · rejectVisit	Admin decision on a field visit
requireAtLeast(auth, role)	admin > gis > surveyor > observer
saveFile()	Validate an upload, file it by point code

TRANSFORM FastAPI routes, Pydantic classes

POST /transform/to-wgs84	Stereo70 to ETRS89 on the romgeo grid
ToWGS84Request · TransformResponse	Pydantic request and response models

URL georeper.app

iOS · ANDROID · WEB · EN / RO

GEOREPER 1.2.3 · FIELD WORKFLOW · OFFLINE FIRST

From import to approval.
Six steps. Two run offline.

A point enters as a spreadsheet row and leaves as an approved record. Steps 02 and 03 run on the device with no connection.

● works offline ● needs a connection

01 SURVEYOR+

Import ● ONLINE

Load an XLS or CSV, map columns to the schema, preview, import.

`parseXlsx · autoMapFields`
`bulkImportPoints`

02 SIGNED IN

Locate ● OFFLINE

Find the point on the map. Tiles and points are cached on the device.

`pointsCluster · pointsInBounds`
`downloadRegion`

03 SIGNED IN

Visit ● OFFLINE

Record one of nine states, photos by direction and corrected heights.

`createVisit`
`calculateDistance`

04 AUTOMATIC

Sync ● ONLINE

Queued changes replay when the connection returns, five tries each.

`enqueueSync · processQueue`
`@sync_queue`

05 ADMIN

Approve ● ONLINE

An admin approves or rejects pending visits and new points.

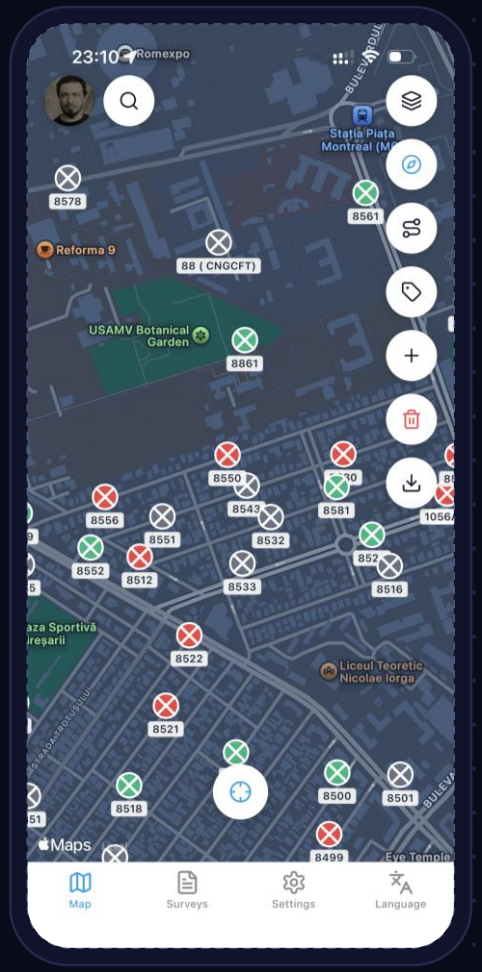
`approveVisit · rejectVisit`
`rollbackAction`

06 GIS+

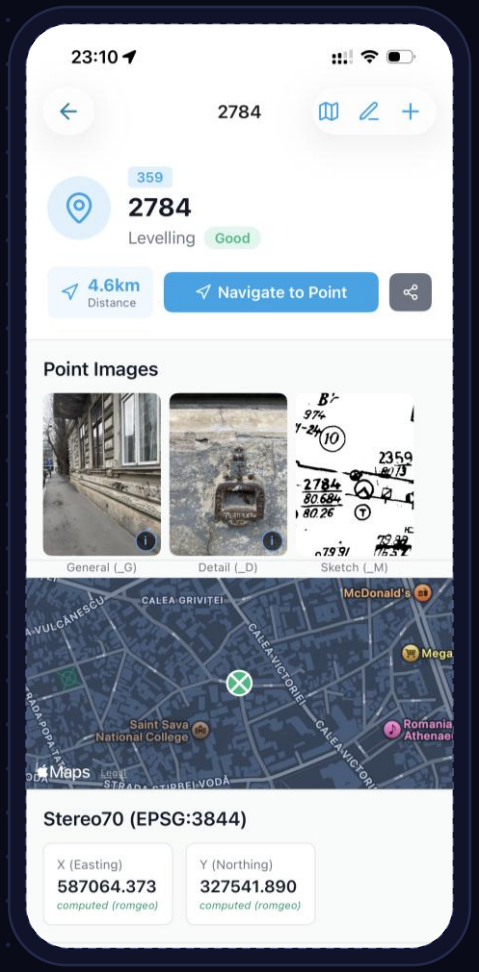
Export ● ONLINE

GIS users download the inventory as GeoJSON or a Shapefile.

`/api/gis/export/geojson`
`/api/gis/export/shapefile`



CAPTURE 01 · MAP



CAPTURE 02 · POINT VISIT

ROLES observer < surveyor < gis < admin

URL georeper.app

iOS · ANDROID · WEB · EN / RO

AUGUST — SEPTEMBER 2026

From detection to evidence

5
new detectors, F10–F14

18×
lower ingest lag, 273 → 15 s

2/2
PITR rehearsals passed

0
WAL failures in 23,335

Detect

- Position: a surveyed coordinate cannot move — alert at 150 m against 22 m of noise
- Clock: the offset inequality names synthesizer vs repeater
- Doppler: one antenna gives every satellite the same shift

Prove

- Aircraft cross-check and a one-call case file per station
- A staged spoof fired the whole chain unattended, inside 60 s
- All three detectors now feed the verdict, not just an alert

Keep running

- Whole epochs stored: 34 → 167 observations each
- Write volume 76 → 39 GB/day; cache hit 100%
- Three silent outages found, and a watchdog that now calls them

83 stations · ROMPOS CORS network · figures measured 2026-09-28

Architecture and data streams

Row counts and sizes measured on the live system, 2026-09-28

TELEGRAM · OCTOBER 2026

Two bots, one brain: every command

LIVE — what is happening now

expint /now · /sa · RANGEA · Kaplan

/now COST	last seconds: threat tier, bands, sweep detector
/sa COST	spoofing analysis, last hour
/va COST 5	VADASE displacement, last N minutes
/rangea SULI	per-satellite C/N₀ from RANGEA
/impact COST	Kaplan: C/N₀ loss and RTK verdict per band

HUNT — go and find it

expint /kraken · forecaster

/hunt COST	Kraken tasking: centre, gain, GO / NO-GO
/hunt COST 1	the same report every minute (feed)
/predicthunt	where & when: Constanța area, next 12 h
/predict ARAD	one station's 24 h plan · flags a dead station
tap a code	paged picker, hunt area first

ALERTS — pushed to the phone

engine · VADASE · RTK · watchdog

threat	HIGH / CRITICAL spoofing tier rises
VADASE	displacement ≥ 5 cm
RTK	degraded · lost · loss of lock
position	station moved ≥ 150 m (F10)
ingest	pipeline stopped ≥ 10 min

MANAGE — your subscription

per chat · RO and EN

/watch SULI COST	only these stations · /watch all
/mute 2h	silence for a while · /unmute
/start /stop	subscribe · unsubscribe
/status /list	your settings · subscriber count
/help	everything, one screen

RO @GeoveilBot · 16 commands · EN @GeoveilWGbot · 15 · one code base, one subscriber store

PREDICTION · OCTOBER 2026

Prediction models: what runs, on what data

73
events/h error, vs 105

0.792
AUC · busier-than-usual hour

+11.6%
Brier skill vs climatology

94
days of rolling backtest

LIVE

V2 Forecaster

- Live NovAtel data since 26 May
- LightGBM: last hours, yesterday, neighbours
- Events + P(busy), 1–24 h, hourly
- API, console, geoveil.ro, /predicthunt

FALLBACK

Calendar LightGBM

- 16 calendar + station features, no memory
- Honest test: 72 % · AUC 0.760
- Counts worse than every baseline
- Only fills hours the forecaster skips

NOT SERVED

LSTM

- 24 h sequences, 8 features
- Matched persistence on campaign days
- Still trains, not served
- Shown in V2 LAB and /compare

ARCHIVE

V1 Classic

- Spider Event archive since 2024
- Pre-filtered events, city keys
- LightGBM + lag features, ~82 %
- Different data: not comparable

Also in the trainer: Kaplan C/N₀ calibration and PSD baselines, physics models with learned coefficients, refitted nightly.

trainer container · daily retrain, hourly forecast · gated by ops/ml/backtest.py · measured 2026-10-04

GEOVEIL-MP 1.0.1 · GNSS CODE MULTIPATH · RUST CORE · PYTHON API

Measure multipath.
Map where it comes from.

Code multipath for every pseudorange signal in RINEX 2, 3 and 4, with cycle slips per carrier. Version 1.0 adds SNR wavelets and first Fresnel zones, so the numbers point back to the ground that caused them.

01 Code multipath
MP per code, RMS against elevation

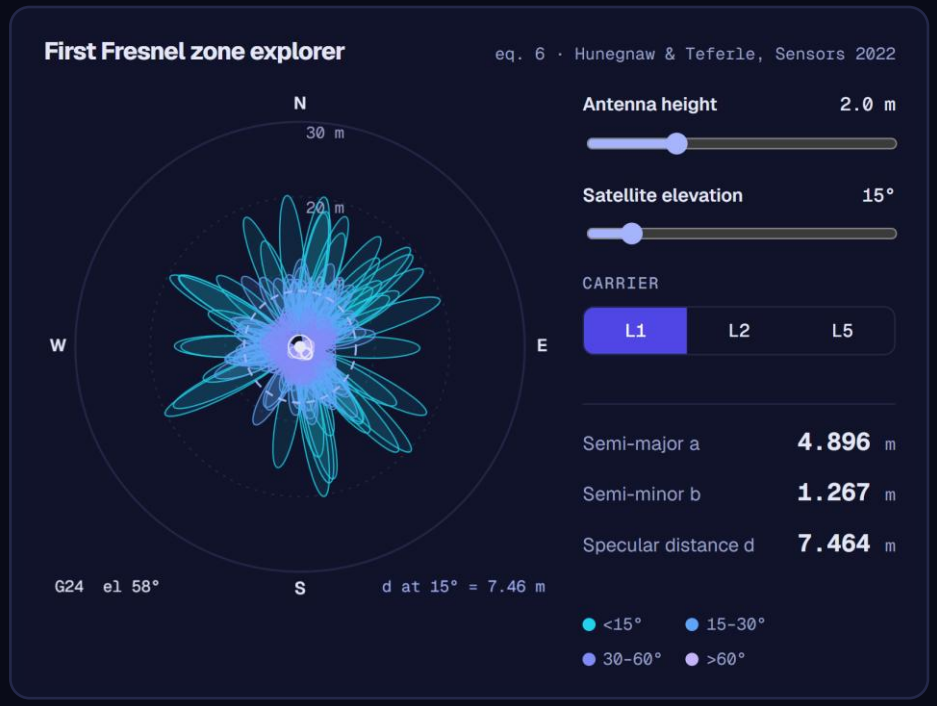
02 Cycle slips
Geometry-free, code-phase and LLI

03 SNR wavelets
Morlet CWT, red-noise significance

04 Fresnel zones
First-zone ellipses around the antenna

05 Six constellations
GPS · GLO · GAL · BDS · QZSS · NavIC

06 RINEX 2, 3 and 4
Plain or gzip, 30 s down to 1 Hz

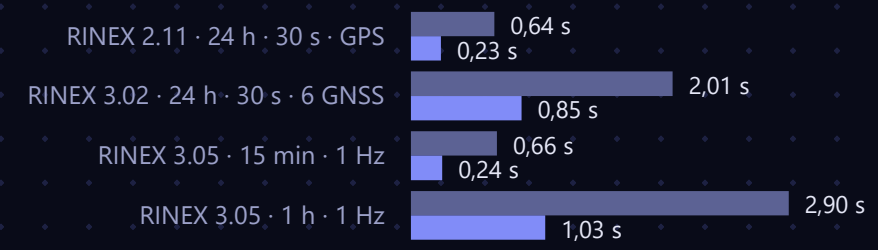


Interactive on the docs page · geometry from gm.fresnel_zone()

SPEED parse + multipath + cycle slips + wavelets, seconds per file

Xeon E5-2620 v3 · 2014 · 12 threads
EPYC 7313 · 2021 · 32 threads

Same wheel from PyPI, same container on both machines, median of three runs. Public IGS data, 31 December 2025.



25.3 s
24 h at 1 Hz, 948 MB of RINEX
Xeon: 66.1 s

51.7k /h
station-days per hour, all threads
Xeon: 6.9k /h

14–28×
SNR wavelets vs numpy
on the Xeon

```
$ pip install geoveil-mp
```

miluta7.github.io/geoveil-mp

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GEOVEIL-CN0 0.4.2 · GNSS SIGNAL QUALITY · RUST CORE · PYTHON API

Know how clean your signal is.
Every satellite, every epoch.

Turns CN0 from RINEX 2, 3 and 4 into a 0–100 quality score, constellation statistics, skyplots and jamming, spoofing and interference checks. A navigation file adds predicted satellite visibility.

01 Quality score
0–100 from five weighted components

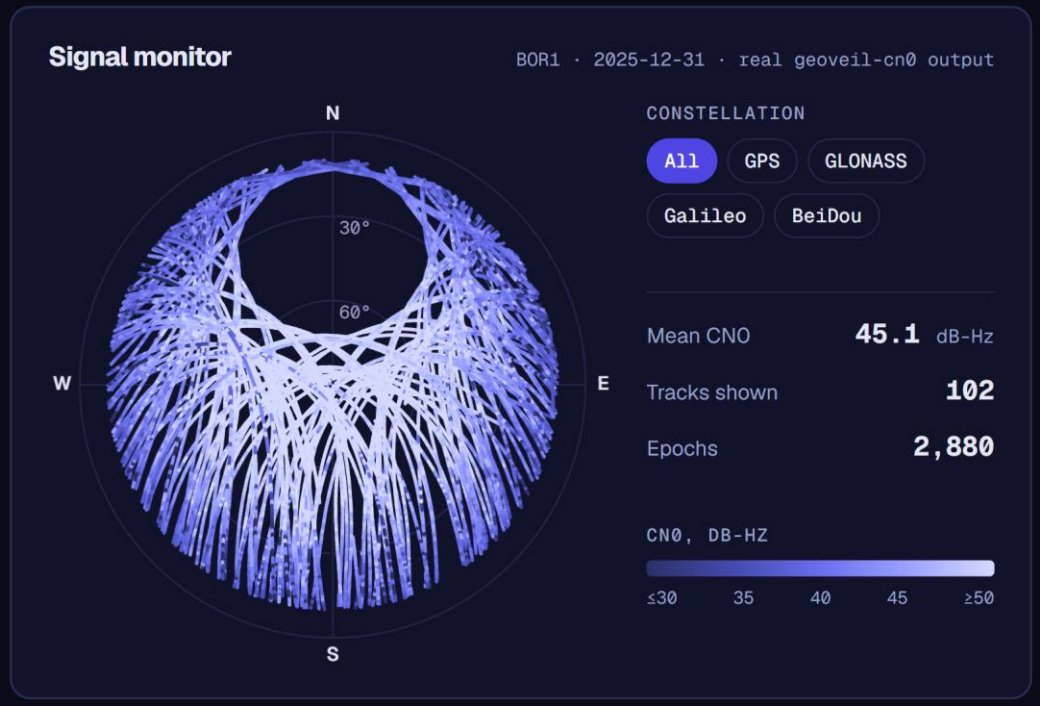
02 Threat checks
Jamming, spoofing, interference

03 Visibility
Predicted against observed satellites

04 CN0 skyplots
Azimuth, elevation and CN0 per track

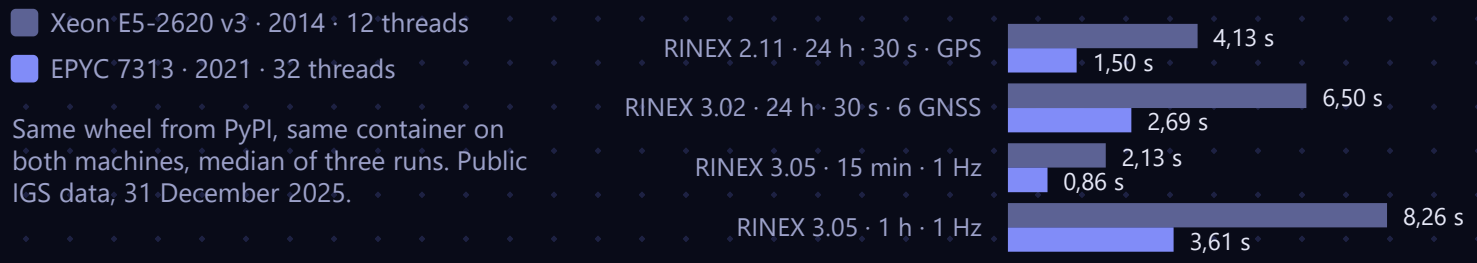
05 Six constellations
GPS · GLO · GAL · BDS · QZSS · NavIC

06 One call per file
JSON, timeseries and anomaly export



Real output · BOR1 (EPN) · 31 Dec 2025 · 24 h at 30 s

SPEED full analysis with broadcast navigation, seconds per file, one core



Same wheel from PyPI, same container on both machines, median of three runs. Public IGS data, 31 December 2025.

101.1 s
24 h at 1 Hz, with navigation
Xeon: 239.8 s

25.4k /h
station-days per hour, all threads
Xeon: 2.9k /h

0.05 s
RINEX 2 GPS day, CN0 only
Xeon: 0.14 s

```
$ pip install geoveil-cn0
```

miluta7.github.io/geoveil-cn0

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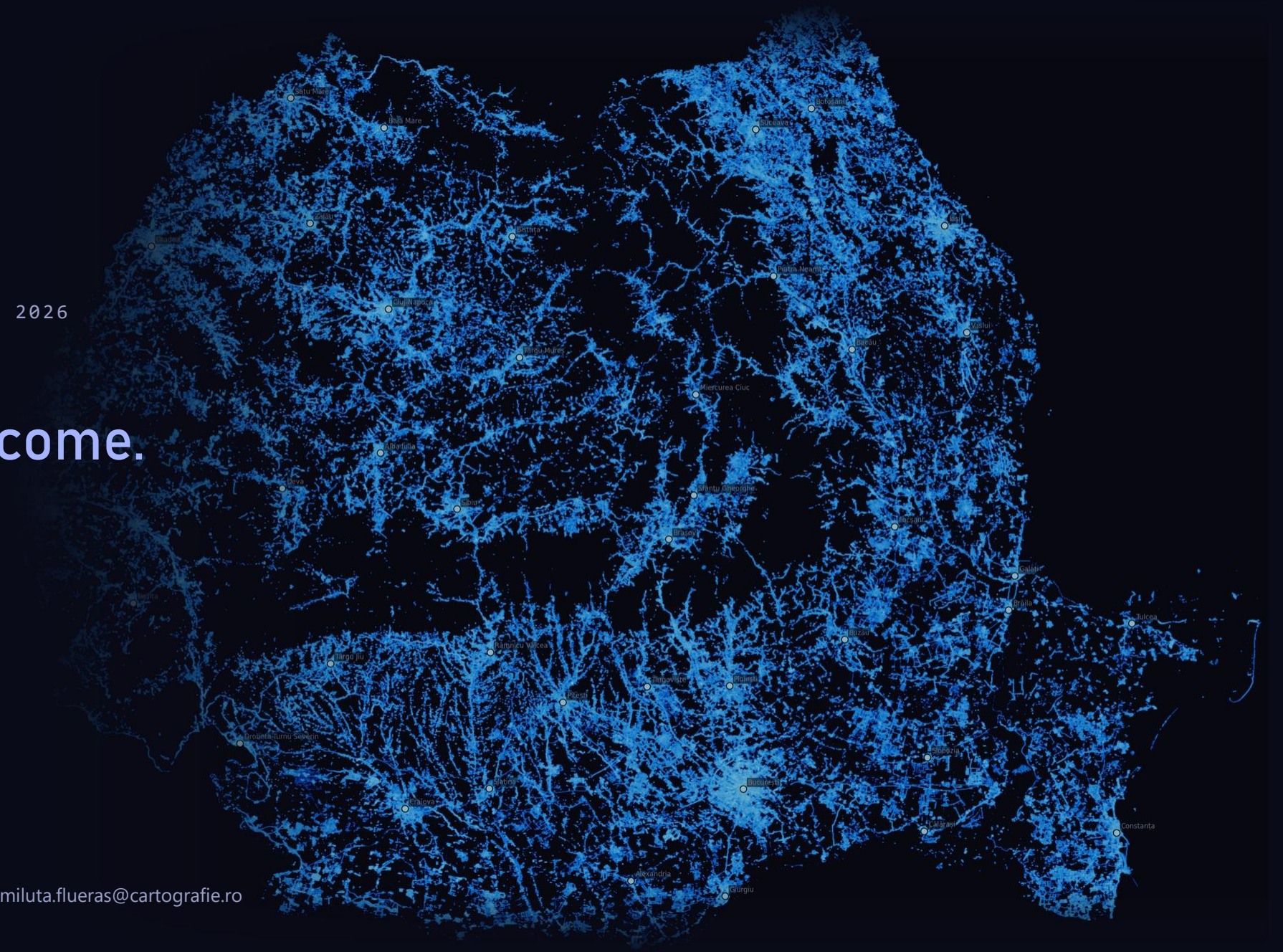
Thank you.
Questions are welcome.

rompos.ro

cartografie.ro

geoveil.ro

georeper.app



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