pntmoni

MONTHLY REPORT

PNT Moni Monthly Report

QZSS CLAS Performance Evaluation — Free Tier

Reporting period	**2026-07**
Published	**2026-09-11**
Methodology version	**v1.1.0**
Config hash	**cfg:8f6422e9b5b433ec**
Dataset	**sha256:8155063d…5010 (11 files)**

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1 Revision History

Version	Date	Notes
1.0	2026-09-11	Initial edition
1.1	2026-09-26	Figures (error distribution, spatial distribution, TTFF) now drawn from the July month-end station qualification; v1.0 had used a later month's qualified set. No change to tables or national statistics
1.2	2026-09-27	Appendix GNSS system notices (NAGU/NANU/NAQU) completed: previously missed notices added (Galileo from the full-year notice archive; follow-up GPS/QZSS notices reflected). No change to evaluation figures

⚠ Warning

Rapid edition: this report uses the **GSI Rapid series** (R5.1 from 2026-04 onward, R5 before that) as the reference coordinates. The Rapid series is a quick-look solution published 2–3 days after observation; once the Final series (F5/F5.1, published ~3 weeks after observation) is complete a **separate finalised edition will be issued**.

Rapid-vs-Final differences are usually at the mm level, but can widen briefly right after events such as earthquakes or equipment changes (methodology §3.2 / §8.5).

2 Introduction

This report summarises PNT Moni's evaluation of QZSS CLAS (Centimeter Level Augmentation Service) performance for **July 2026**, using publicly available data and open-source tooling.

As an independent evaluation service for GNSS augmentation, PNT Moni continuously monitors CLAS performance at higher spatial and temporal resolution than the official Service Performance Report published by the Cabinet Office / Quasi-Zenith Satellite System Services Inc. (QSS). This monthly report complements the official semi-annual report, offering monthly cadence, an independent third-party assessment, and practically

useful analytical depth. This Free-tier monthly report covers **national statistics only**; per-station analysis is provided in the **Pro tier**.

The "Methodology Version Tag" at the end of this report uniquely identifies the processing configuration that produced it. For the full methodology document see https://pntmoni.com/methodology/clas/v1.1.0.

3 Methodology

This section summarises the methodology; see the link above for the full document.

Data sources: 30-second RINEX observations from ~1,300 GEONET stations distributed by the Geospatial Information Authority of Japan (GSI) under PDL 1.0 (source: GSI GEONET data service), the CLAS L6 augmentation archive published on the web by QSS, and IGS broadcast ephemerides / Earth-rotation parameters from CDDIS.

Processing engine: pntmoni-claslib v0.8.3-pntmoni-1, PPP-RTK mode (`kinematic`, `l1+l2+l5`).

Reference coordinates: GSI daily coordinate solutions (the series matching the period — F5 era = ITRF2014, F5.1 era = ITRF2020; R5 / R5.1 when the Rapid series is used) are relativised to station 92110 (Tsukuba 1) and smoothed with a **±7-day (15 calendar-day) median filter** centred on the target day d (common-mode removal, Method B). Method version: gsi-daily-median15d-1.1.

Quality control (QC): teqc 2019Feb25 for 2026–2027, with migration to MRTKLIB's `mrtk qc` planned around 2027/Q4.

Statistical aggregation: 95% / 99% percentile errors are computed by **pooling the epoch errors of all stations and all days** in each aggregation cell (methodology §5.1, same rule as NAVIGATION 2026). TTFF uses a **15-minute reset** (continuity with NAVIGATION 2026, methodology §5.2); a 60-minute reset will be added in Phase 1.

Known structural differences from official QSS figures: PNT Moni's methodology differs structurally from the official QSS Service Performance Report in four respects — sampling rate (30 s vs 1 s), a parameter set retuned for 30 s, CLASLIB version differences, and the resulting Kalman-filter behaviour. See Shiono & Kubo (2025, 2026). These are treated as **structural characteristics**, not bugs; comparing absolute values or equating the numbers is not meaningful (methodology §8.3). In direction, the lower epoch density at 30 s gives filter convergence and re-convergence intervals a relatively larger weight in the pooled statistics, pushing the tail percentiles (95% / 99%) **above** the official evaluation. PS-QZSS standard values are accordingly used in this report as reference values only, never for compliance judgement (see the note in the Executive Summary).

3.1 Evaluation Network

CLAS divides the country into 12 networks; each station's network is determined by the Compact Network ID assigned by CLASLIB. Stations are further classified as **Inside Network** or **Outside Network** by a point-in-polygon test against the per-network polygons defined in the ION GNSS+ 2025 / NAVIGATION 2026 papers (Shiono & Kubo) — i.e. regions where augmentation is interpolated vs extrapolated. The network polygons

below are updated only when the CLAS service area changes (rarely); the polygon version is recorded in the Methodology Version Tag at the end of this report.

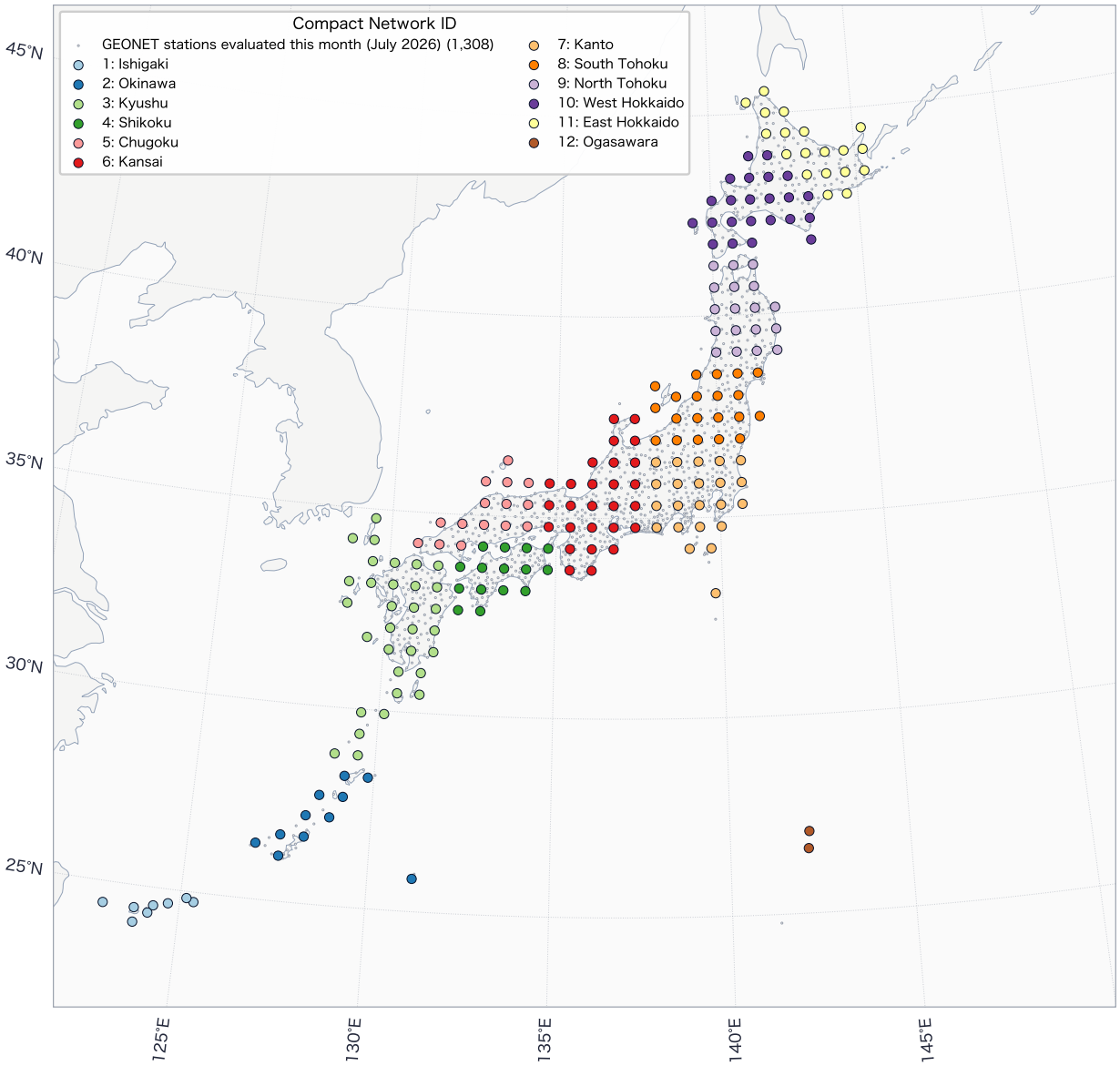

Figure 1: CLAS 12-network grid points and the GEONET stations evaluated this month.

The CLAS network polygons define the regions where the augmentation is intended to meet spec. Outside-Network stations receive corrections derived by extrapolation and may therefore have different error characteristics (Inside/Outside aggregate analysis is provided in the **Pro tier**).

4 Executive Summary

Table 1: Headline performance metrics.

	Metric	Value
0	Stations evaluated	1,133
1	Horizontal error 50% [cm]	2.77
2	Horizontal error 95% [cm]	13.42

	Metric	Value
3	Horizontal error 99% [cm]	22.48
4	Vertical error 95% [cm]	21.91
5	TTFF 50% [s, 15-min reset]	180.0
6	TTFF 95% [s, 15-min reset]	420.0
7	National fix rate (Q=4)	96.2 %

Highlights for July 2026:

- National horizontal error, 95th percentile: **13.42 cm**
- National vertical error, 95th percentile: **21.91 cm**
- TTFF (15-min reset, 95th percentile): **420.0 s**
- National fix rate (Q=4): **96.19%**
- L6 broadcast alerts: **0**

ℹ Reading these values against the Performance Standard (PS-QZSS)

The QZSS Performance Standard (PS-QZSS) sets the CLAS kinematic positioning-accuracy standard at horizontal 95% 12 cm / vertical 95% 24 cm. Compliance with the standard is verified by QSS's official Service Performance Reports, whose evaluation is run under conditions that differ from this report's (1-s sampling, a fixed evaluation station set). PNT Moni's 30-s, ~1,100-station methodology (see Methodology) is known to produce structurally higher tail percentiles than the official evaluation (Shiono & Kubo 2026, §4.1.2). Whether a value in this report sits above or below a PS-QZSS standard value is therefore **not a compliance judgement**; the standard values appear in this report only as a reference scale (e.g. in the spatial distribution maps). Quantitative reconciliation against official figures is performed in the half-yearly Comparison Archive.

5 Performance

5.1 National Overview

5.1.1 Error Distribution

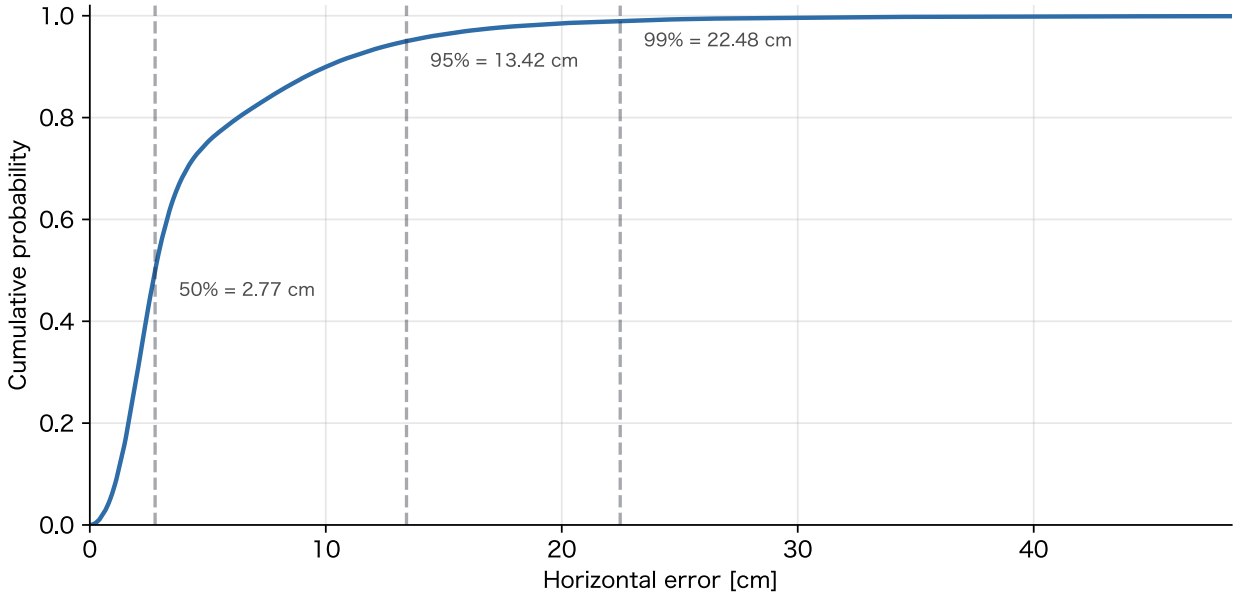

Figure 2: Cumulative distribution of horizontal error (epochs pooled over qualified stations).

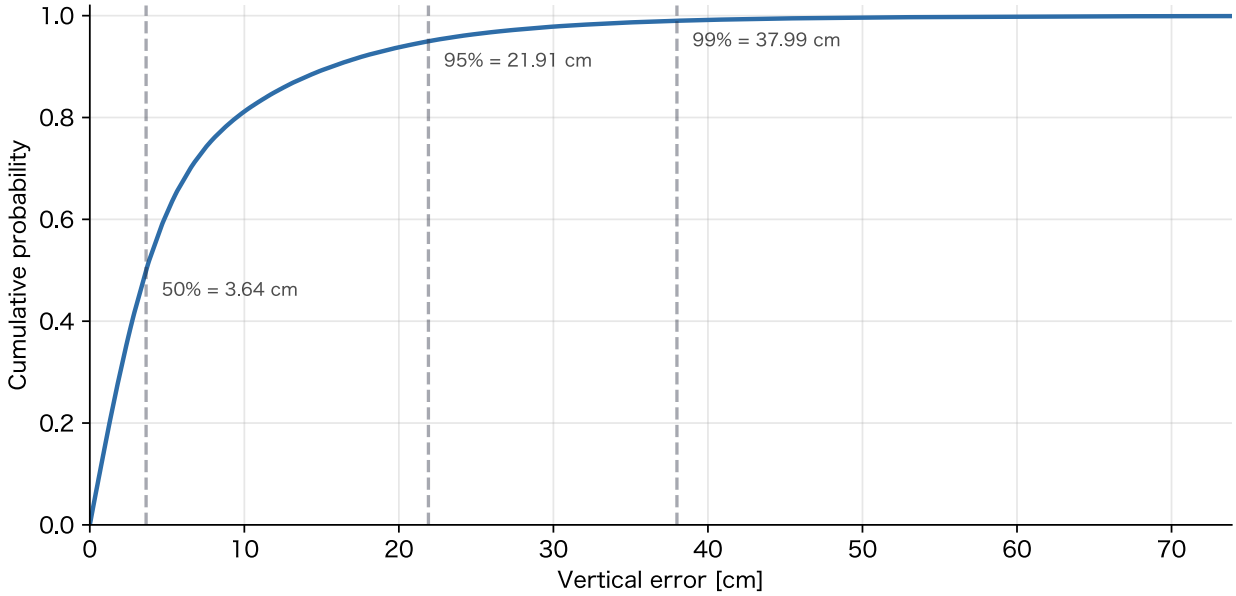

Figure 3: Cumulative distribution of vertical error (epochs pooled over qualified stations).

Table 2: TTFF percentiles (15-min reset, qualified stations, all days).

	Percentile	TTFF [s]
0	50%	180.0
1	90%	300.0
2	95%	420.0
3	99%	750.0

July 2026: TTFF success rate **85.12 %** (92,418/108,576 reset windows obtained a valid fix). At each reset the filter state is fully cleared and the solution re-initialized to standalone; TTFF is the time from that reset to the first fixed solution, recorded on the 30-second observation grid. A fix at the first epoch after reset is therefore recorded as 0 s (true TTFF ≤ 30 s), which is why P50/P95 are often 0 s; P99 reflects the convergence tail.

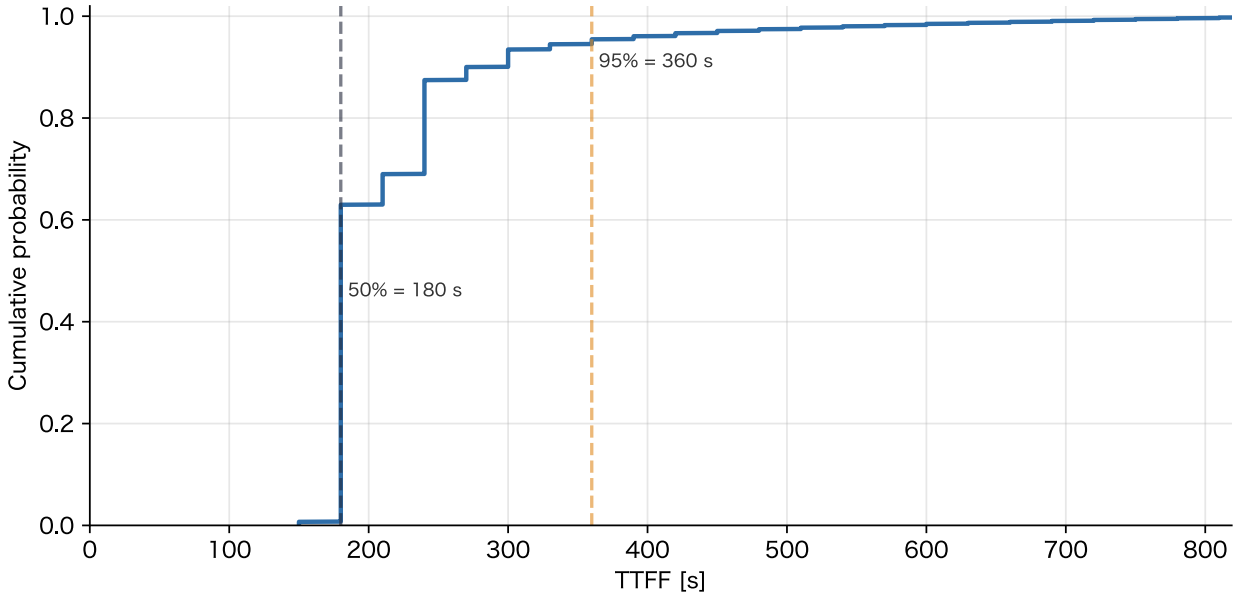

Figure 4: Cumulative distribution of TTFF (15-min reset, reset windows pooled nationwide over the period).

5.1.2 Spatial Distribution

Performance is visualised on hexagonal cells sized to the CLAS augmentation grid spacing (~60 km). Each cell's value is the **95th percentile computed over all stations and all epochs pooled within that cell** (same rule as methodology §5.1). Cells with no stations remain blank. **Cells backed by fewer than 3 distinct stations are drawn with a dotted inner ring** — a reliability marking: with so few stations the cell's percentile is statistically thin and station-local effects (multipath environment, antenna snow accretion) can colour the whole cell, so read those cells as indicative rather than representative (methodology §5.1, 2026-07-18 revision). Southern-island stations outside the CLAS service area (`out_of_service`) are excluded from cell evaluation.

Colour encodes error magnitude on a **perceptually-uniform continuous colormap** (purple = smaller error → yellow = larger error), with **no discrete boundaries** — the map shows the spatial gradient of performance, not a pass/fail classification. The scale spans a fixed range (0–40 cm horizontal, 0–60 cm vertical) set from PNT Moni's own historical error range, so maps stay comparable month to month; this range is **not** a Performance-Standard threshold and the colouring is **not** a compliance judgement (see Methodology and the Executive Summary note). Cells exceeding the range render at the top colour (colorbar top arrow).

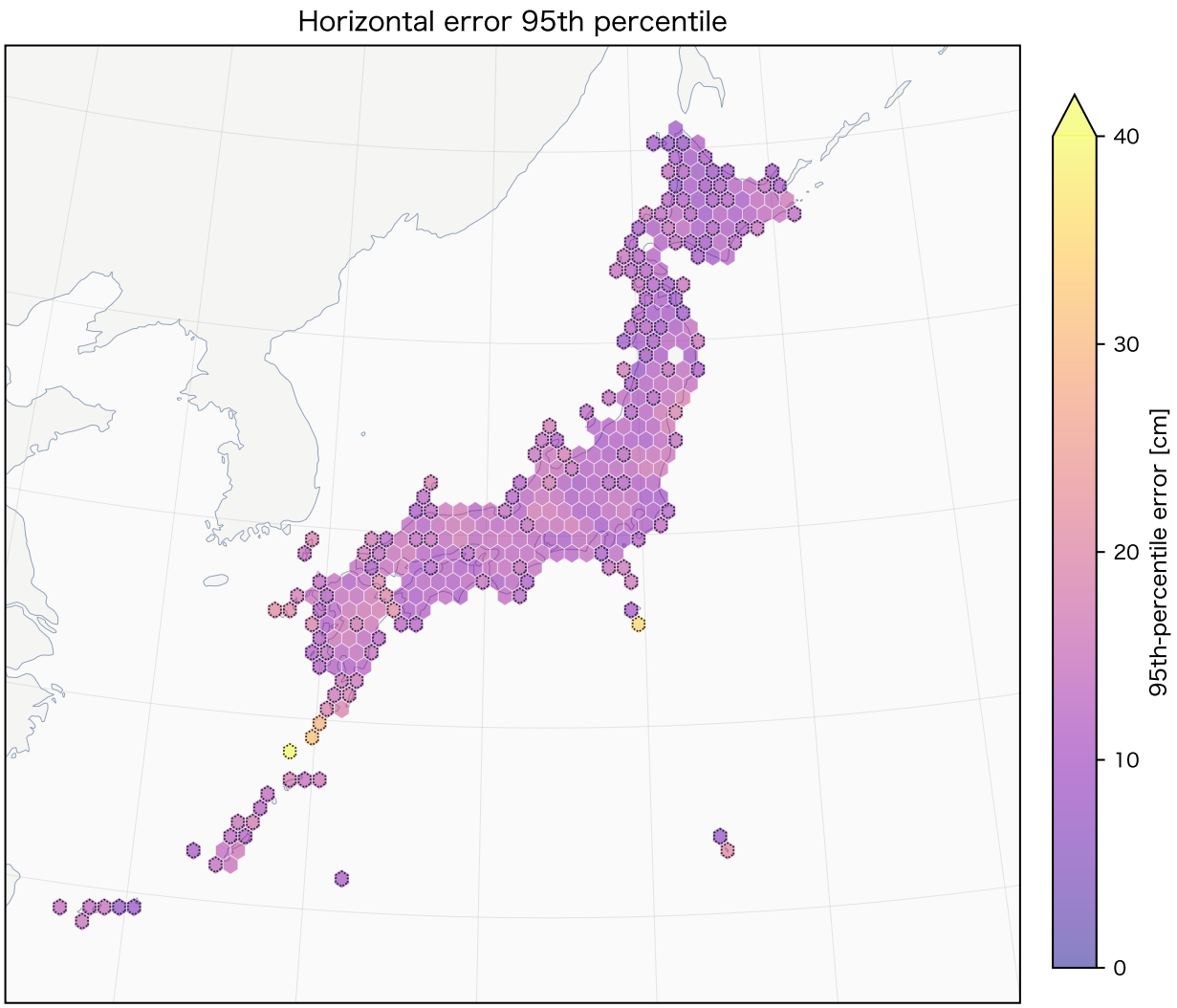

Figure 5: Spatial distribution of the horizontal-error 95th percentile (60 km hex cells, epochs pooled). Dotted ring = cell backed by fewer than 3 stations (indicative).

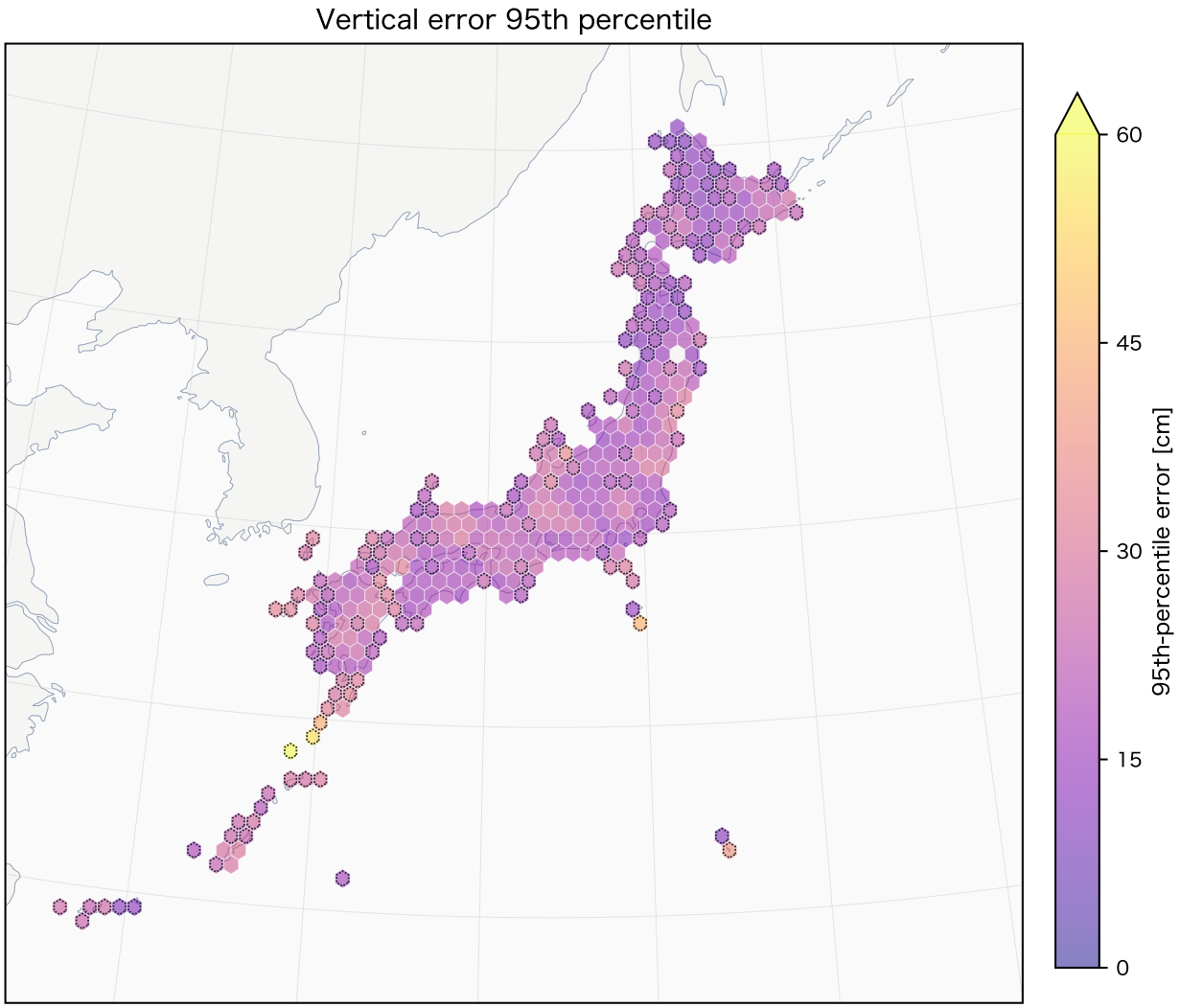

Figure 6: Spatial distribution of the vertical-error 95th percentile (60 km hex cells, epochs pooled). Dotted ring = cell backed by fewer than 3 stations (indicative).

5.1.3 Recent-Month Trend

Coming Soon. This section will show the past 13 months of national 95th-percentile horizontal/vertical error, with the current month highlighted and a comparison marker for the same month last year. The trend view becomes meaningful once the Phase 0 / Phase 1 backfill has filled in everything from April 2025 onward; until then the table above shows the current month's values only.

5.2 Cross-Validation

ℹ Note

Coming Soon (Phase 1+)

Cross-validation will report agreement statistics between the primary CLASLIB-based processing and the parallel evaluation engine MRTKLIB on a sample of ~100 stations. It demonstrates that PNT Moni's evaluation agrees across independent OSS implementations, in preparation for making MRTKLIB primary in 2027/Q4.

Phase 1 goal: publish cross-validation on the parallel sample stations. Phase 2 goal (2027/Q4): role reversal — MRTKLIB primary, CLASLIB as historical reference.

6 Data Availability

6.1 Overview

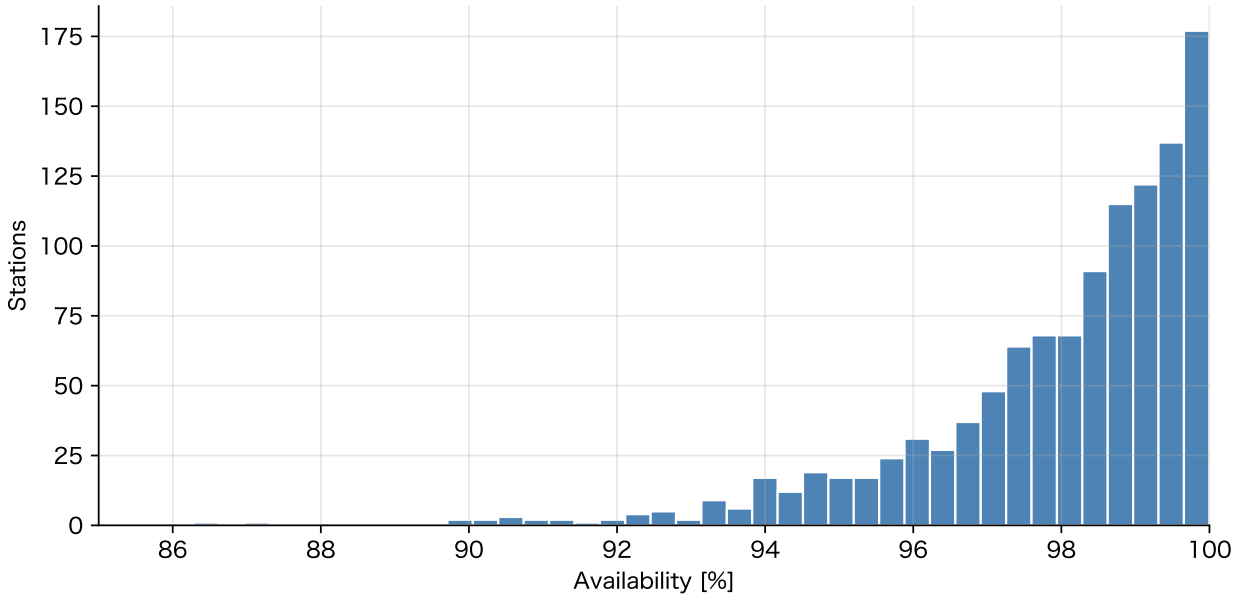

Figure 7: Distribution of data availability across stations.

National-statistics availability for July 2026: **96.2%**.

GEONET maintenance events affecting availability: no major maintenance events are recorded for July 2026.

For the latest GEONET maintenance notices see GSI's official notices page (https://terras.gsi.go.jp/).

7 Anomaly Detection

7.1 L6 Broadcast Alerts

The L6 broadcast Alert flag, carried in the CLAS augmentation stream (CSSR data part), signals a known issue detected on the generation side. This section aggregates it monthly to surface the broadcaster's self-reported health.

July 2026: **0 alerts** across all L6 broadcasts (no message had the Alert flag set).

7.2 Crustal Deformation Events

An earthquake large enough to displace a GEONET station breaks the continuity of that station's GSI daily-solution series. Because the reference coordinate is the denominator of every error metric in this report, the affected station-days are withheld rather than reported against a reference that straddles the discontinuity. Events are identified from JMA earthquake information and confirmed on the daily solutions themselves; a candidate is an event with only a few displaced stations, or an aftershock whose step estimate carries postseismic motion — it is excluded all the same and re-examined when the Final edition is produced.

July 2026: **2 co-seismic offset event(s)** catalogued (1 candidate). Events are identified from JMA earthquake information (M ≥ 6.0 or seismic intensity ≥ 5-lower) and confirmed

on the GSI daily solutions (station step > 1 cm horizontal or > 2 cm vertical near the epicentre). Per the methodology, a displaced station has an undefined reference coordinate on the event day and is excluded from that day's error metrics; the reference on neighbouring days is computed without spanning the event. Source: Japan Meteorological Agency website (edited).

- **2026-07-28** — 令和８年熊本地震 (熊本県熊本地方, M7.1, max. intensity 7): **55 station(s)** excluded for that day — confirmed (JMA)
- **2026-07-29** — 令和８年熊本地震 (熊本県天草・芦北地方, M5.8, max. intensity 5 弱): **21 station(s)** excluded for that day — candidate, to be reviewed for the Final edition (JMA)

8 Appendix

8.1 GNSS System Notices: NAGU / NANU / NAQU

Notices issued against GNSS constellation operations during July 2026, recorded for cross-referencing against anomaly events and signal availability.

Table 3: GNSS system notices within the reporting period.

	Date	Satellite	Notice	Type	Severity
0	2026-07-01 21:30 UTC	GPS PRN32	NANU 2026047, NANU 2026051	scheduled_maintenance	total
1	2026-07-05 11:59 UTC	QZS PRN199	NAQU 2026203, NAQU 2026205	scheduled_maintenance	total
2	2026-07-07 18:00 UTC	GPS PRN3	NANU 2026050, NANU 2026052, NANU 2026053, NANU…	scheduled_maintenance	total
3	2026-07-15 09:59 UTC	QZS PRN200	NAQU 2026204, NAQU 2026207	scheduled_maintenance	total
4	2026-07-17 00:35 UTC	GPS PRN26	NANU 2026055, NANU 2026056	scheduled_maintenance	total
5	2026-07-24 01:15 UTC	GPS PRN7	NANU 2026057, NANU 2026058	scheduled_maintenance	total
6	2026-07-29 22:59 UTC	QZS PRN196	NAQU 2026208, NAQU 2026220	scheduled_maintenance	total
7	2026-07-28 01:59 UTC	QZS PRN199	NAQU 2026209, NAQU 2026215	scheduled_maintenance	total
8	2026-07-23 14:25 UTC	GAL	NAGU 2026041	other	total
9	2026-07-28 10:00 UTC	QZS	NAQU 2026210, NAQU 2026216	scheduled_maintenance	partial
10	2026-07-30 10:00 UTC	QZS	NAQU 2026211, NAQU 2026217	scheduled_maintenance	partial

July 2026: **11 notice(s)** detected. Collected from the official NAGU (Galileo), NANU (GPS) and NAQU (QZSS) notices.

8.2 List of Satellites

A **snapshot of the constellation operators' official pages** (state at fetch time). Sources: GPS = USCG NAVCEN, QZSS = QSS DoD, Galileo = GSC Europa.

Fetched at: 2026-08-05 03:14 UTC

8.2.1 GPS

Table 4: GPS satellite constellation status.

	PRN	SVN	Block	Slot	Clock	Status	Notice
0	G16	56	IIR	B1	RB	Operational	FCSTSUMM
1	G29	57	IIR-M	C1	RB	Operational	FCSTSUMM
2	G02	61	IIR	D1	RB	Operational	FCSTSUMM
3	G24	65	IIF	A1	RB	Unusable	UNUSABLE
4	G03	69	IIF	E1	RB	Operational	FCSTSUMM
5	G32	70	IIF	F1	RB	Operational	FCSTDV
6	G31	52	IIR-M	A2	RB	Operational	FCSTSUMM
7	G15	55	IIR-M	F2	RB	Operational	FCSTSUMM
8	G25	62	IIF	B2	RB	Operational	FCSTSUMM
9	G27	66	IIF	C2	RB	Operational	FCSTSUMM
10	G10	73	IIF	E2	RB	Operational	FCSTSUMM
11	G01	80	III	D2	RB	Unusable	UNUSABLE
12	G22	44	IIR	B3	RB	Operational	FCSTSUMM
13	G05	50	IIR-M	E3	RB	Operational	FCSTDV
14	G30	64	IIF	A3	RB	Operational	FCSTSUMM
15	G09	68	IIF	F3	RB	Operational	FCSTSUMM
16	G08	72	IIF	C3	RB	Operational	FCSTSUMM
17	G07	48	IIR-M	A4	RB	Operational	FCSTSUMM
18	G17	53	IIR-M	C4	RB	Operational	FCSTSUMM
19	G12	58	IIR-M	B4	RB	Operational	FCSTSUMM
20	G06	67	IIF	D4	RB	Operational	FCSTDV
21	G04	74	III	F4	RB	Operational	FCSTDV
22	G13	43	IIR	A5	RB	Decommissioned	DECOM
23	G20	82	III	F5	RB	Operational	FCSTSUMM
24	G19	59	IIR	C5	RB	Operational	FCSTSUMM
25	G26	71	IIF	B5	RB	Operational	FCSTSUMM
26	G23	76	III	E5	RB	Operational	FCSTSUMM

	PRN	SVN	Block	Slot	Clock	Status	Notice
27	G11	78	III	D5	RB	Unusable	UNUSABLE
28	G21	81	III	E6	RB	Operational	FCSTSUMM
29	G18	75	III	D6	RB	Operational	FCSTSUMM
30	G14	77	III	B6	RB	Operational	FCSTSUMM
31	G28	79	III	A6	RB	Unusable	UNUSABLE

8.2.2 QZSS (Michibiki)

Table 5: QZSS satellite constellation status.

	PRN	SVN	Block	Signals	Status	Notice
0	J194	002	II-Q	L1C/A, L1C, L2C, L5, L1S, L5S, L6D, L6E	Operational	
1	J199	003	II-G	L1C/A, L1C, L2C, L5, L1S, L5S, L1Sb, L6D, L6E,⋯	Operational	
2	J195	004	II-Q	L1C/A, L1C, L2C, L5, L1S, L5S, L6D, L6E	Operational	
3	J196	005	II A-Q	L1C, L2C, L5, L1C/B, L1S, L5S, L6D, L6E	Operational	
4	J200	007	III-G	L1C, L5, L1C/B, L5S, L1Sb, L6D, L6E	Outage	NAQU 2026214, 2026214

8.2.3 Galileo

Table 6: Galileo satellite constellation status.

	E#	GSAT	Clock	Status	Notice
0	E11	GSAT0101	RAFS	Operational	
1	E12	GSAT0102	RAFS	Operational	
2	E19	GSAT0103	RAFS	Operational	
3	E18	GSAT0201	PHM	Unusable	GENERAL 2021008
4	E14	GSAT0202	RAFS	Unusable	GENERAL 2021008
5	E26	GSAT0203	PHM	Operational	
6	E22	GSAT0204	RAFS	Unusable	GENERAL 2017045
7	E30	GSAT0206	PHM	Operational	
8	E07	GSAT0207	PHM	Operational	
9	E08	GSAT0208	PHM	Operational	
10	E09	GSAT0209	RAFS	Operational	
11	E01	GSAT0210	RAFS	Unusable	GENERAL 2023048
12	E02	GSAT0211	PHM	Operational	

	E#	GSAT	Clock	Status	Notice
13	E03	GSAT0212	PHM	Operational	
14	E04	GSAT0213	RAFS	Operational	
15	E05	GSAT0214	PHM	Operational	
16	E21	GSAT0215	PHM	Operational	
17	E25	GSAT0216	PHM	Operational	
18	E27	GSAT0217	PHM	Operational	
19	E31	GSAT0218	PHM	Operational	
20	E36	GSAT0219	PHM	Operational	
21	E13	GSAT0220	PHM	Operational	
22	E15	GSAT0221	PHM	Operational	
23	E33	GSAT0222	PHM	Operational	
24	E34	GSAT0223	PHM	Operational	
25	E10	GSAT0224	PHM	Operational	
26	E29	GSAT0225	PHM	Operational	
27	E23	GSAT0226	PHM	Operational	
28	E06	GSAT0227	PHM	Operational	
29	E16	GSAT0232	PHM	Operational	
30	E28	GSAT0233	PHM	Operational	
31	E32	GSAT0234	PHM	Operational	USABINIT 2026041

PNT Moni's evaluation also covers the Galileo signals received at GEONET stations.

8.3 Methodology Version Tag

Item	Value
Methodology version	1.1.0
Pipeline config hash	8f6422e9b5b433ec
Engine	pntmoni-claslib v0.8.3-pntmoni-1
QC tool	teqc 2019Feb25
Reference-coordinate method version	gsi-daily-median15d-1.1
Evaluation stream	rapid
Reporting period	July 2026
Data mode	live

For the full methodology document see https://pntmoni.com/methodology/clas/v1.1.0.

Note

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About PNT Moni: PNT Moni is an independent service providing continuous evaluation of GNSS augmentation, starting from QZSS CLAS. The monthly report complements the official semi-annual report in cadence, independence and analytical depth; a semi-annual Comparison Archive synced to the official cycle is provided separately.

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