pntmoni

MONTHLY REPORT

pntmoni Monthly Report

QZSS CLAS performance evaluation — Rapid (R5)

Reporting period	**2026-04**
Published	**2026-09-26**
Methodology version	**v1.1.0**
Config hash	**cfg:8f6422e9b5b433ec**
Dataset	**sha256:a94784ba…4c85 (11 files)**

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1 Revision History

Version	Date	Notes
1.0	2026-09-26	Initial edition
1.1	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); satellite list now uses the snapshot nearest the month-end. No change to evaluation figures
1.2	2026-09-27	Rapid-edition notice revised (final editions planned as part of the paid Pro plan from Phase 1); stray spaces in the Japanese text removed. No change to evaluation figures
1.3	2026-10-21	GPS operational status in the appendix satellite table corrected (completed outage reports had been shown as unusable). Rapid-edition notice corrected (the final national-aggregate edition is free). Brand written as pntmoni; subtitle and table layout aligned with the website. 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. A **final edition** based on the Final series (F5/F5.1, published ~3 weeks after observation) is planned as a free national-aggregate report around the end of the following month, and will supersede these rapid values; a per-station detailed edition based on F5 is planned for the paid plan. Until then this rapid edition is the current evaluation.

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).

This edition was produced and first published about 5 month(s) after the end of the reporting period, as part of completing the monthly series. The methodology, inputs and processing are the same as for the editions published on schedule.

2 Introduction

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

As an independent evaluation service for GNSS augmentation, pntmoni 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 is planned.

Known structural differences from official QSS figures: pntmoni'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.

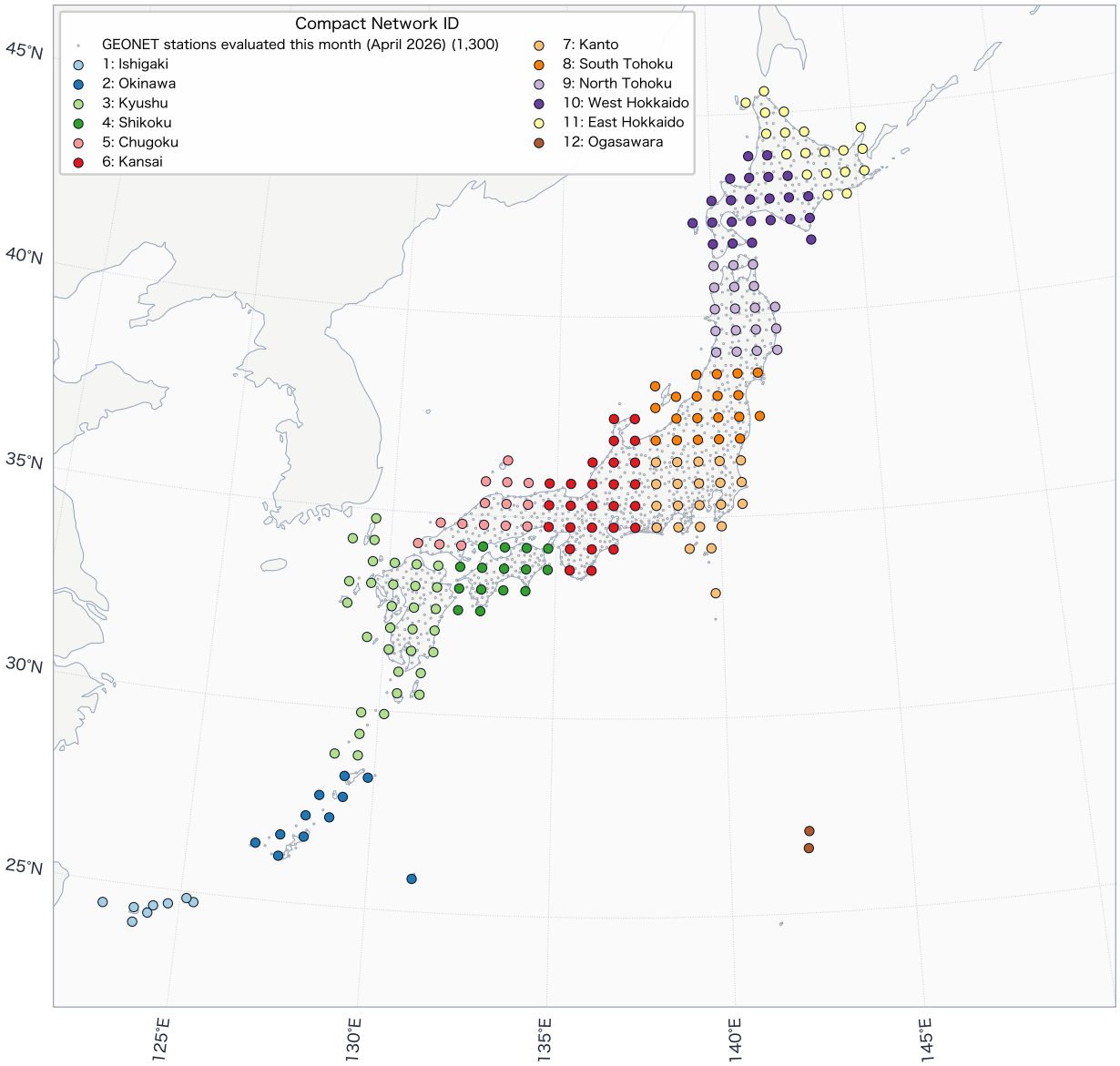

Figure 1: CLAS 12-network grid points and the GEONET stations evaluated this month.

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
Stations evaluated	1,031
Horizontal error 50% [cm]	2.19
Horizontal error 95% [cm]	10.48
Horizontal error 99% [cm]	17.71
Vertical error 95% [cm]	17.35

Metric	Value
TTFF 50% [s, 15-min reset]	180.0
TTFF 95% [s, 15-min reset]	300.0
National fix rate (Q=4)	97.7 %

Highlights for April 2026:

- National horizontal error, 95th percentile: **10.48 cm**
- National vertical error, 95th percentile: **17.35 cm**
- TTFF (15-min reset, 95th percentile): **300.0 s**
- National fix rate (Q=4): **97.67%**
- 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). pntmoni'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

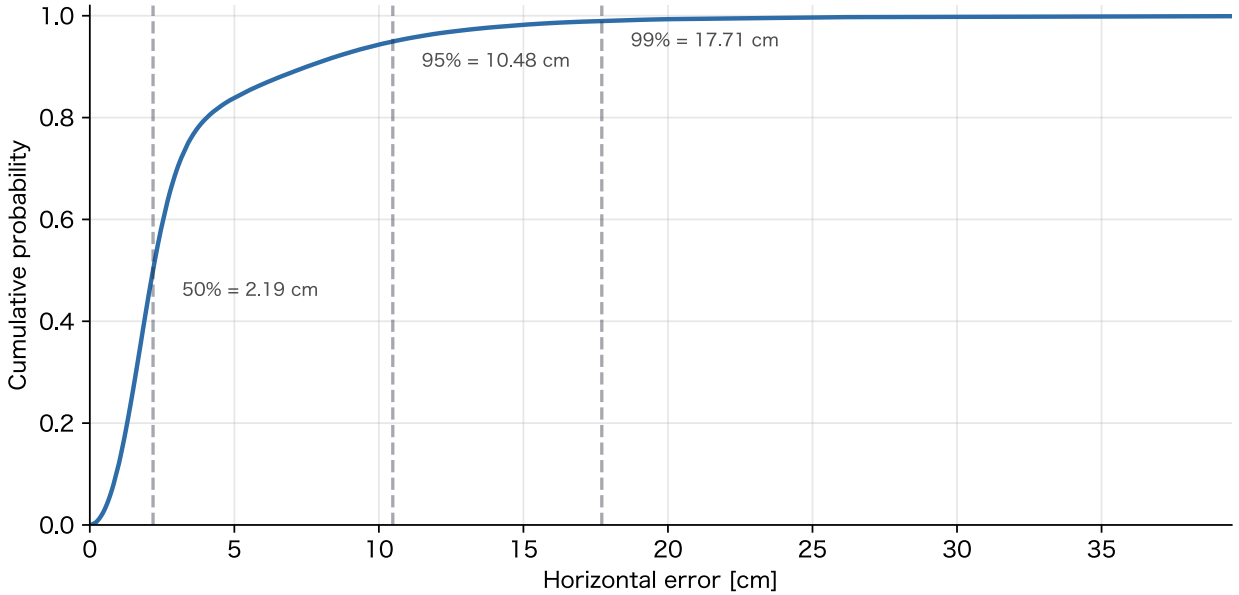

Figure 2: Cumulative distribution of horizontal error (epochs pooled over qualified stations).

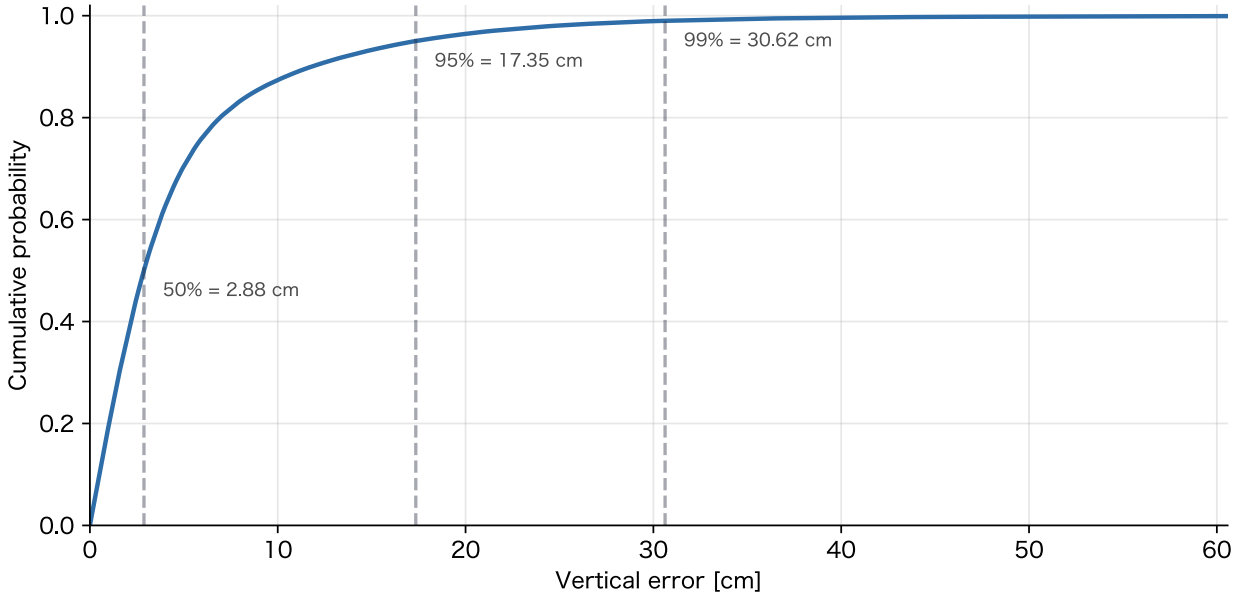

Figure 3: Cumulative distribution of vertical error (epochs pooled over qualified stations).

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

Percentile	TTFF [s]
50%	180.0
90%	240.0
95%	300.0
99%	480.0

April 2026: TTFF success rate **98.19 %** (97,180/98,976 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.

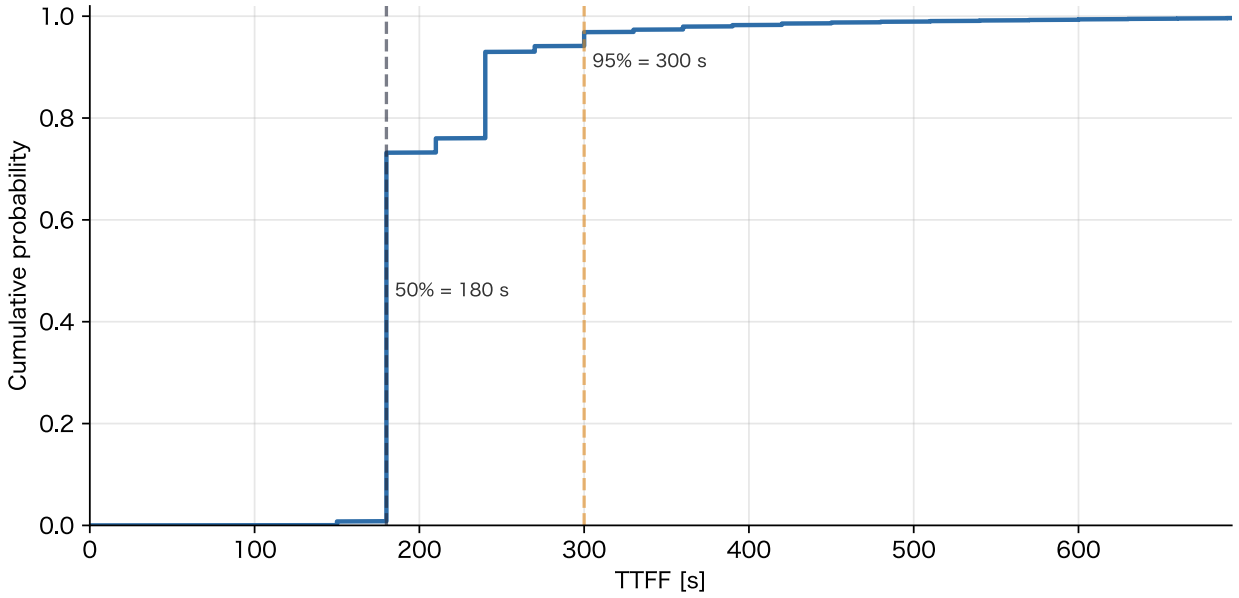

Figure 4: Cumulative distribution of TTFF (15-min reset, reset windows pooled nationwide over the period).

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 pntmoni'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).

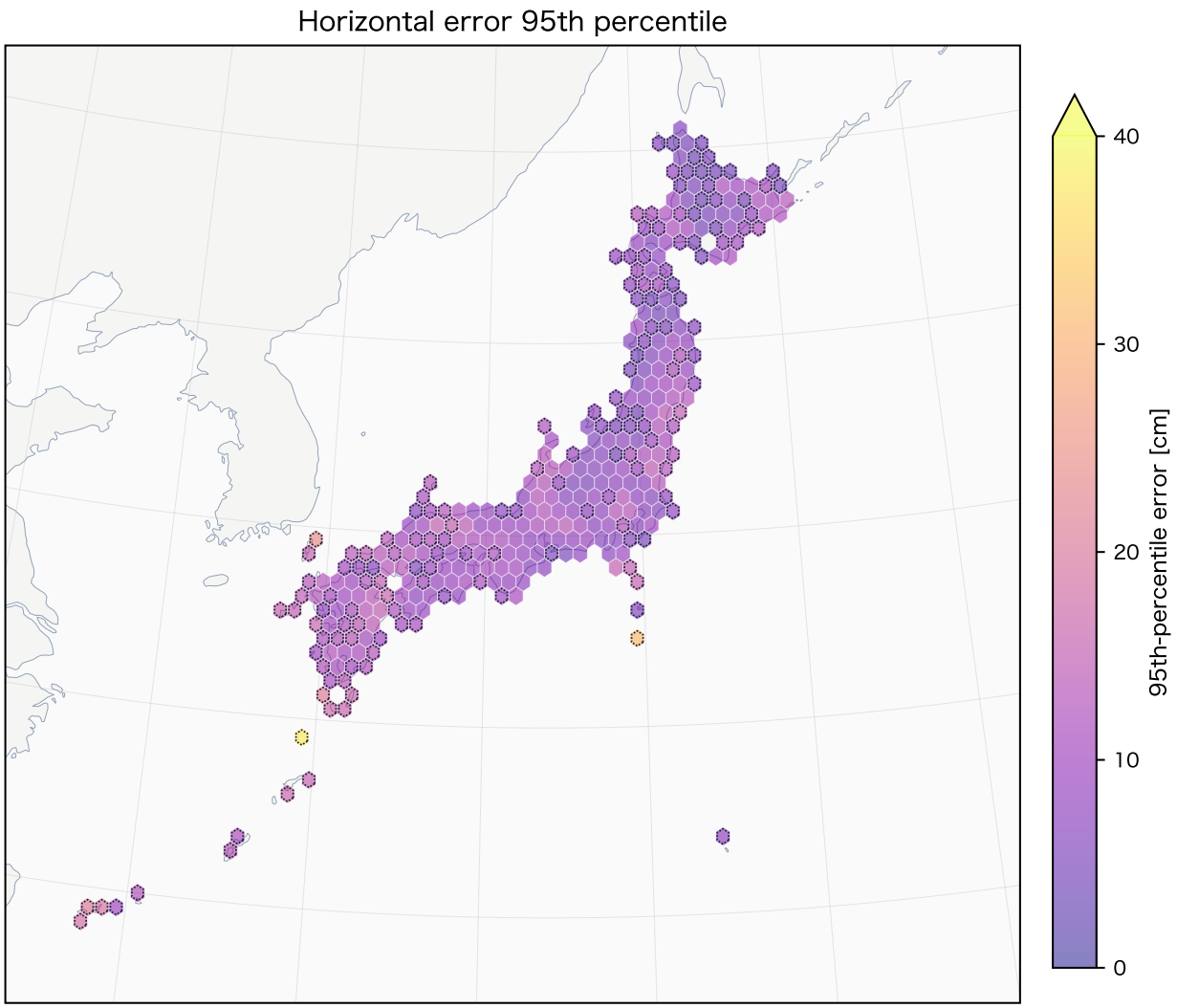

Figure 5: Spatial distribution of the horizontal-error 95th percentile (60 km hex cells, epochs pooled). Dotted ring = cell backed by fewer than 3 stations (indicative).

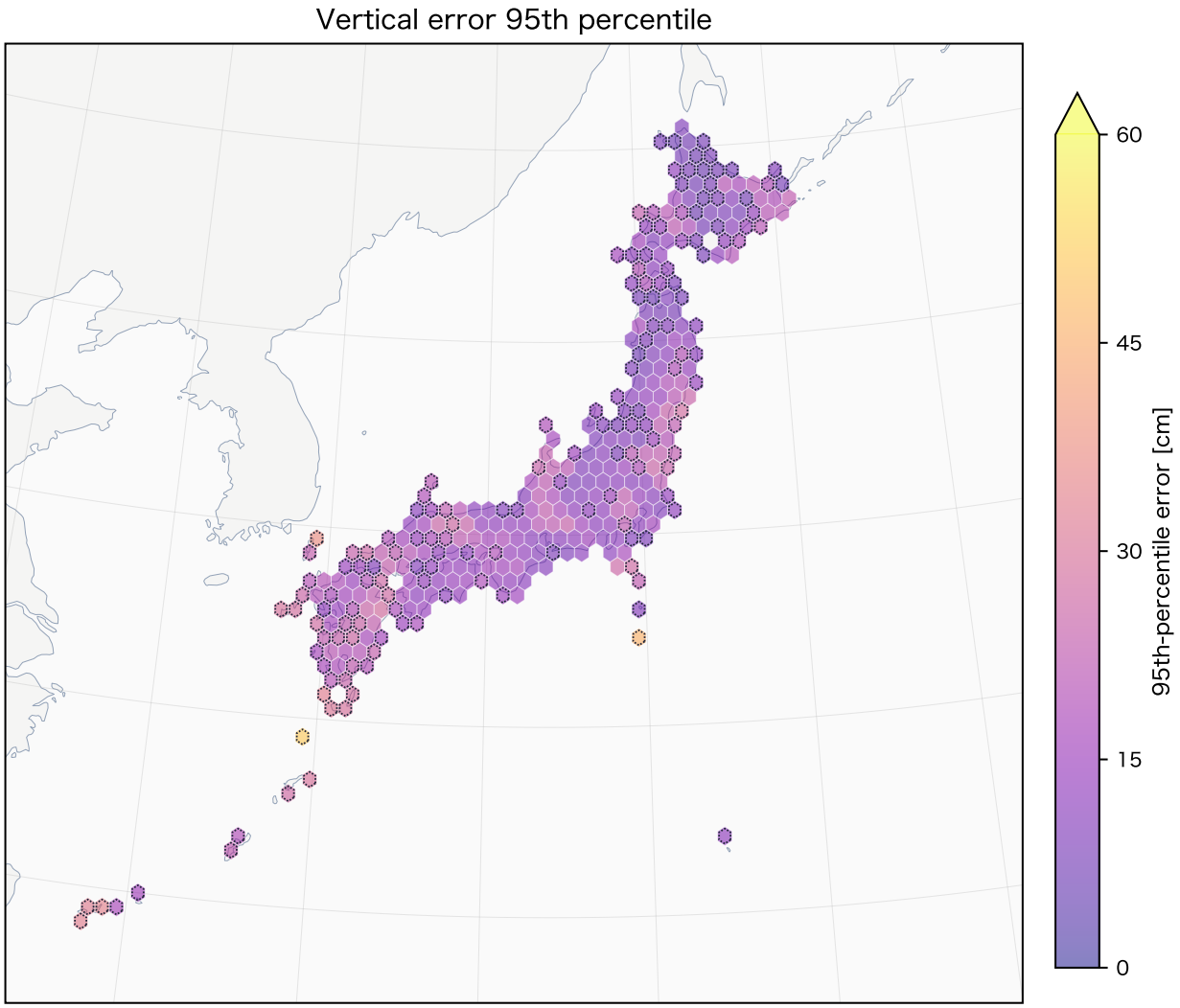

Figure 6: Spatial distribution of the vertical-error 95th percentile (60 km hex cells, epochs pooled). Dotted ring = cell backed by fewer than 3 stations (indicative).

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 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

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 pntmoni's evaluation agrees across independent OSS implementations, in preparation for making MRTKLIB primary in 2027/Q4.

Next: publish cross-validation on the parallel sample stations. Planned for 2027/Q4: role reversal — MRTKLIB primary, CLASLIB as historical reference.

6 Data Availability

6.1 Overview

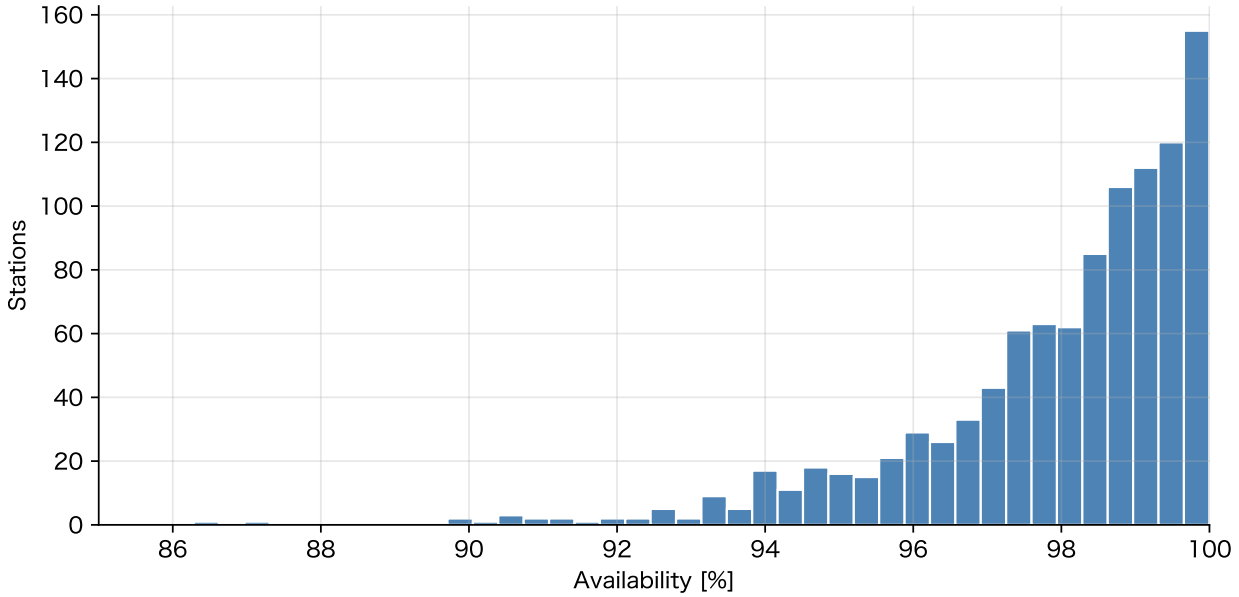

Figure 7: Distribution of data availability across stations.

National-statistics availability for April 2026: **97.7%**.

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

April 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.

April 2026: **3 co-seismic offset event(s)** catalogued (2 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).

- **2026-04-01** — 茨城県南部 M5.0 (茨城県南部, M5.0, max. intensity 5 弱): **1 station(s)** excluded for that day — candidate, to be reviewed for the Final edition (JMA)
- **2026-04-10** — Uncatalogued step (step detected on the daily solutions with no JMA trigger): **5 station(s)** excluded for that day — candidate, to be reviewed for the Final edition
- **2026-04-20** — 三陸沖 M7.7 (三陸沖, M7.7, max. intensity 5 強): **58 station(s)** excluded for that day — confirmed (JMA)

8 Appendix

8.1 GNSS System Notices: NAGU / NANU / NAQU

Notices issued against GNSS constellation operations during April 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
2026-04-02 02:10 UTC	GAL	NAGU 2026020, NAGU 2026023	scheduled_maintenance	informational
2026-04-07 11:35 UTC	GAL	NAGU 2026022, NAGU 2026024	scheduled_maintenance	informational
2026-04-09 22:45 UTC	GPS PRN2	NANU 2026030, NANU 2026031	scheduled_maintenance	total
2026-04-13 17:59 UTC	QZS PRN199	NAQU 2026120, NAQU 2026128	scheduled_maintenance	total
2026-04-15 01:55 UTC	GAL	NAGU 2026025, NAGU 2026026	scheduled_maintenance	informational
2026-04-17 02:15 UTC	GPS PRN20	NANU 2026032, NANU 2026033	scheduled_maintenance	total
2026-04-13 01:27 UTC	QZS PRN194	NAQU 2026121, NAQU 2026124	other	partial
2026-04-13 01:27 UTC	QZS PRN205	NAQU 2026122, NAQU 2026125	other	partial
2026-04-13 01:28 UTC	QZS PRN204	NAQU 2026123, NAQU 2026126	other	partial
2026-04-23 16:59 UTC	QZS PRN200	NAQU 2026127, NAQU 2026144	scheduled_maintenance	total

Date	Satellite	Notice	Type	Severity
2026-04-15 08:53 UTC	QZS PRN209	NAQU 2026130, NAQU 2026132	other	partial
2026-04-15 08:53 UTC	QZS PRN199	NAQU 2026129, NAQU 2026131	other	partial
2026-04-24 02:00 UTC	GPS PRN22	NANU 2026034, NANU 2026036	scheduled_maintenance	total
2026-04-26 18:59 UTC	QZS PRN194	NAQU 2026133, NAQU 2026147	scheduled_maintenance	total
2026-04-21 14:10 UTC	QZS PRN185	NAQU 2026135, NAQU 2026139	other	partial
2026-04-21 14:10 UTC	QZS PRN185	NAQU 2026136, NAQU 2026138	other	partial
2026-04-21 14:10 UTC	QZS PRN185	NAQU 2026134, NAQU 2026137	other	partial
2026-04-21 14:10 UTC	QZS PRN195	NAQU 2026140, NAQU 2026142	other	partial
2026-04-21 14:10 UTC	QZS PRN205	NAQU 2026141, NAQU 2026143	other	partial
2026-04-24 16:00 UTC	GPS PRN13	NANU 2026035, NANU 2026038	scheduled_maintenance	total
2026-04-28 10:54 UTC	GAL	NAGU 2026027, NAGU 2026028	scheduled_maintenance	informational
2026-04-30 15:45 UTC	GPS PRN21	NANU 2026037, NANU 2026040	scheduled_maintenance	total
2026-04-29 19:27 UTC	GPS PRN13	NANU 2026039	other	total

`April 2026`: **23 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: 2026-06-02 02:42 UTC

This snapshot was taken 33 days after the end of the reporting period; no snapshot closer to the period exists. Satellite status may have differed during the period — see the NAGU / NANU / NAQU notices above.

8.2.1 GPS

Table 4: GPS satellite constellation status.

PRN	SVN	Block	Slot	Clock	Status	Notice
G16	56	IIR	B1	RB	Operational	FCSTSUMM
G29	57	IIR-M	C1	RB	Operational	FCSTSUMM
G02	61	IIR	D1	RB	Operational	FCSTSUMM
G24	65	IIF	A1	RB	Operational	UNUSABLE
G03	69	IIF	E1	RB	Operational	FCSTSUMM
G32	70	IIF	F1	RB	Operational	UNUSABLE
G31	52	IIR-M	A2	RB	Operational	FCSTSUMM
G15	55	IIR-M	F2	RB	Operational	FCSTSUMM
G25	62	IIF	B2	RB	Operational	FCSTSUMM
G27	66	IIF	C2	RB	Operational	FCSTSUMM
G10	73	IIF	E2	RB	Operational	FCSTSUMM
G01	80	III	D2	RB	Operational	UNUSABLE
G22	44	IIR	B3	RB	Operational	FCSTSUMM
G05	50	IIR-M	E3	RB	Operational	FCSTSUMM
G30	64	IIF	A3	RB	Operational	FCSTSUMM
G09	68	IIF	F3	RB	Operational	FCSTSUMM
G08	72	IIF	C3	RB	Operational	FCSTSUMM
G07	48	IIR-M	A4	RB	Operational	FCSTSUMM
G17	53	IIR-M	C4	RB	Operational	FCSTMX
G12	58	IIR-M	B4	RB	Operational	FCSTSUMM
G06	67	IIF	D4	RB	Operational	FCSTDV
G04	74	III	F4	RB	Operational	FCSTDV
G13	43	IIR	A5	RB	Decommissioned	DECOM
G20	82	III	F5	RB	Operational	FCSTSUMM
G19	59	IIR	C5	RB	Operational	FCSTSUMM
G26	71	IIF	B5	RB	Operational	FCSTSUMM
G23	76	III	E5	RB	Operational	FCSTSUMM
G11	78	III	D5	RB	Operational	FCSTSUMM
G21	81	III	E6	RB	Operational	FCSTSUMM
G18	75	III	D6	RB	Operational	FCSTSUMM
G14	77	III	B6	RB	Operational	FCSTSUMM
G28	79	III	A6	RB	Operational	UNUSABLE

8.2.2 QZSS (Michibiki)

Table 5: QZSS satellite constellation status.

PRN	SVN	Block	Signals	Status	Notice
J194	002	II-Q	L1C/A, L1C, L2C, L5, L1S, L5S, L6D, L6E	Operational	
J199	003	II-G	L1C/A, L1C, L2C, L5, L1S, L5S, L1Sb, L6D, L6E, Sr/Sf	Operational	
J195	004	II-Q	L1C/A, L1C, L2C, L5, L1S, L5S, L6D, L6E	Operational	
J196	005	II A-Q	L1C, L2C, L5, L1C/B, L1S, L5S, L6D, L6E	Operational	
J200	007	III-G	L1C, L5, L1C/B, L5S, L1Sb, L6D, L6E	Operational	

8.2.3 Galileo

Table 6: Galileo satellite constellation status.

E#	GSAT	Clock	Status	Notice
E11	GSAT0101	RAFS	Operational	
E12	GSAT0102	RAFS	Operational	
E19	GSAT0103	RAFS	Operational	
E18	GSAT0201	PHM	Unusable	GENERAL 2021008
E14	GSAT0202	RAFS	Unusable	GENERAL 2021008
E26	GSAT0203	PHM	Operational	
E22	GSAT0204	RAFS	Unusable	GENERAL 2017045
E30	GSAT0206	PHM	Operational	
E07	GSAT0207	PHM	Operational	
E08	GSAT0208	PHM	Operational	
E09	GSAT0209	RAFS	Operational	
E01	GSAT0210	RAFS	Unusable	GENERAL 2023048
E02	GSAT0211	PHM	Operational	
E03	GSAT0212	PHM	Operational	
E04	GSAT0213	PHM	Operational	
E05	GSAT0214	PHM	Operational	
E21	GSAT0215	PHM	Operational	
E25	GSAT0216	PHM	Operational	
E27	GSAT0217	PHM	Operational	
E31	GSAT0218	PHM	Operational	
E36	GSAT0219	PHM	Operational	
E13	GSAT0220	PHM	Operational	
E15	GSAT0221	PHM	Operational	
E33	GSAT0222	PHM	Operational	
E34	GSAT0223	PHM	Operational	
E10	GSAT0224	PHM	Operational	

E#	GSAT	Clock	Status	Notice
E29	GSAT0225	PHM	Operational	
E23	GSAT0226	PHM	Operational	
E06	GSAT0227	PHM	Operational	
E16	GSAT0232	PHM	Operational	
E28	GSAT0233	PHM	Operational	USABINIT 2026033
E32	GSAT0234		Commissioning	LAUNCH 2025061

pntmoni'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	April 2026
Data mode	live

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

Note

Sources & terms of use: GEONET data is distributed by GSI under PDL 1.0 (source: GSI GEONET data service). The official QSS Service Performance Report is governed by the Government Standard Terms of Use v2.0.

About pntmoni: pntmoni (from "PNT Monitor") 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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