pntmoni

MONTHLY REPORT

# pntmoni Monthly Report

QZSS CLAS performance evaluation — Final (F5)

| | |
|---|---|
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# 1 Revision History

| Version | Date | Notes |
|---|---|---|
| 1.0 | 2026-10-30 | Initial edition |

> ℹ Note
>
> **Final edition**: this report uses the **GSI Final series** (F5.1 from 2026-04 onward, F5 before that; published ~3 weeks after observation) as the reference coordinates. It supersedes the rapid edition of the same month, which used the Rapid series (R5.1/R5).

Change from the rapid edition (national, qualified stations, epochs pooled):

| Metric | Rapid | Final | Change |
|---|---|---|---|
| Horizontal error 50% [cm] | 2.77 | 2.76 | –0.01 |
| Horizontal error 95% [cm] | 13.42 | 13.43 | +0.01 |
| Horizontal error 99% [cm] | 22.48 | 22.48 | +0.01 |
| Vertical error 95% [cm] | 21.91 | 21.91 | +0.00 |

This edition was produced and first published about 3 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 **July 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](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.

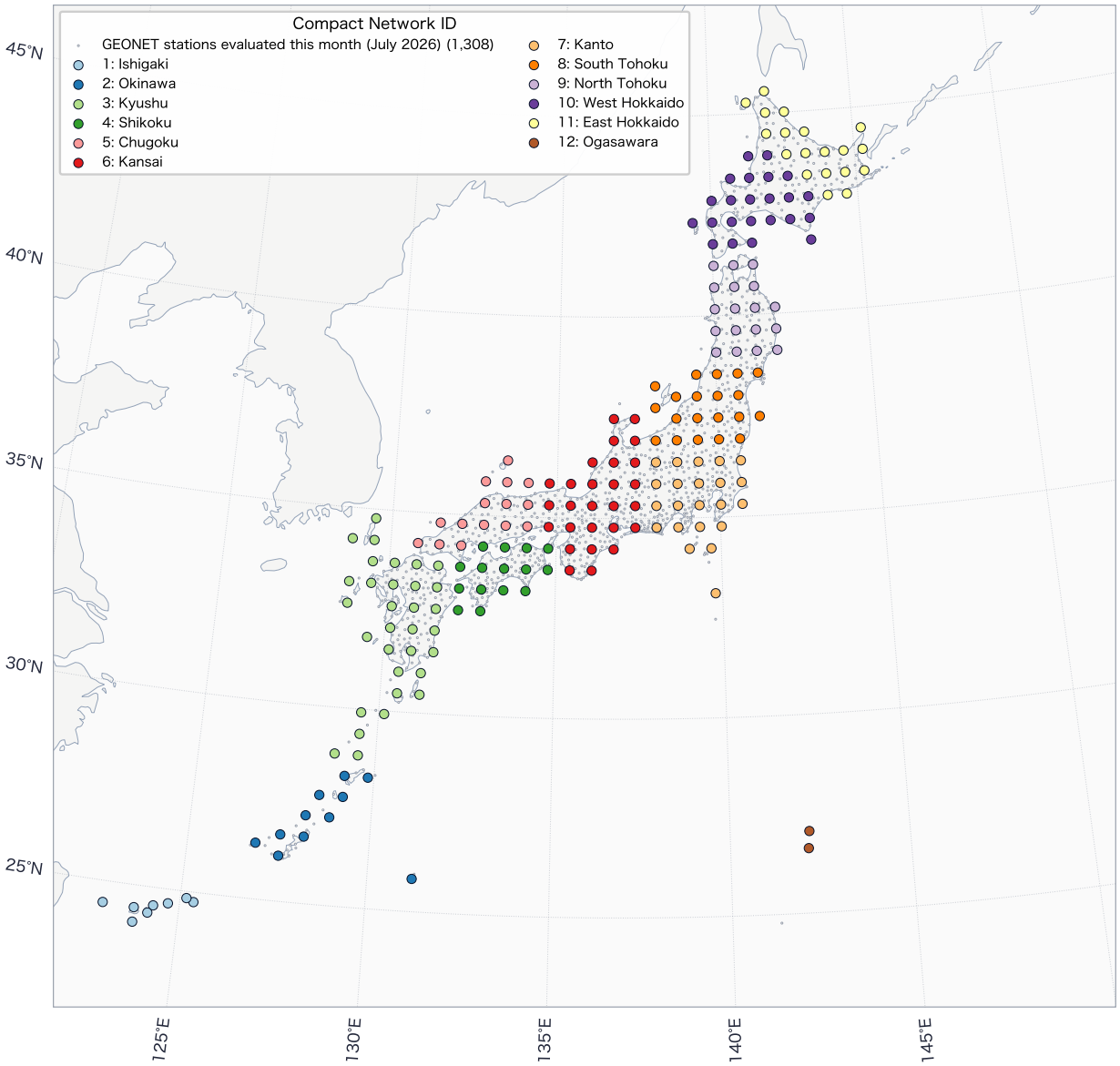



Figure 1: CLAS 12-network grid points and the GEONET stations evaluated this month.

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 | 1,133 |
| Horizontal error 50% [cm] | 2.76 |
| Horizontal error 95% [cm] | 13.43 |
| Horizontal error 99% [cm] | 22.48 |
| Vertical error 95% [cm] | 21.91 |

| Metric | Value |
|---|---|
| TTFF 50% [s, 15-min reset] | 180.0 |
| TTFF 95% [s, 15-min reset] | 420.0 |
| National fix rate (Q=4) | 96.2 % |

**Highlights for July 2026**:

- National horizontal error, 95th percentile: **13.43 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). 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

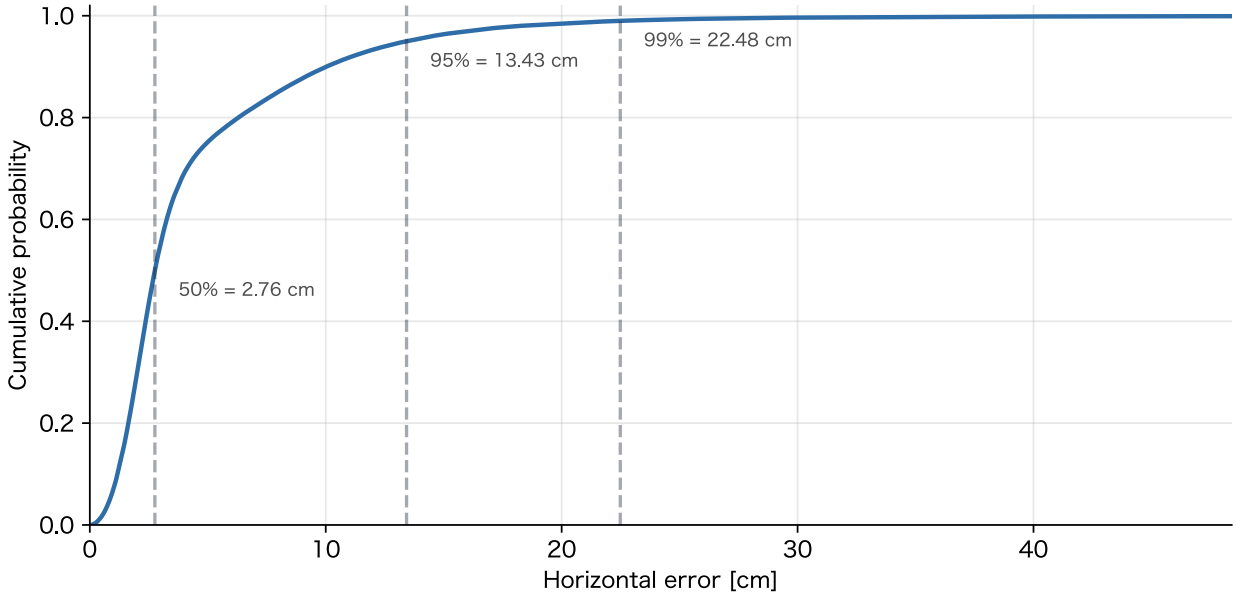



Figure 2: Cumulative distribution of horizontal error (epochs pooled over qualified stations).

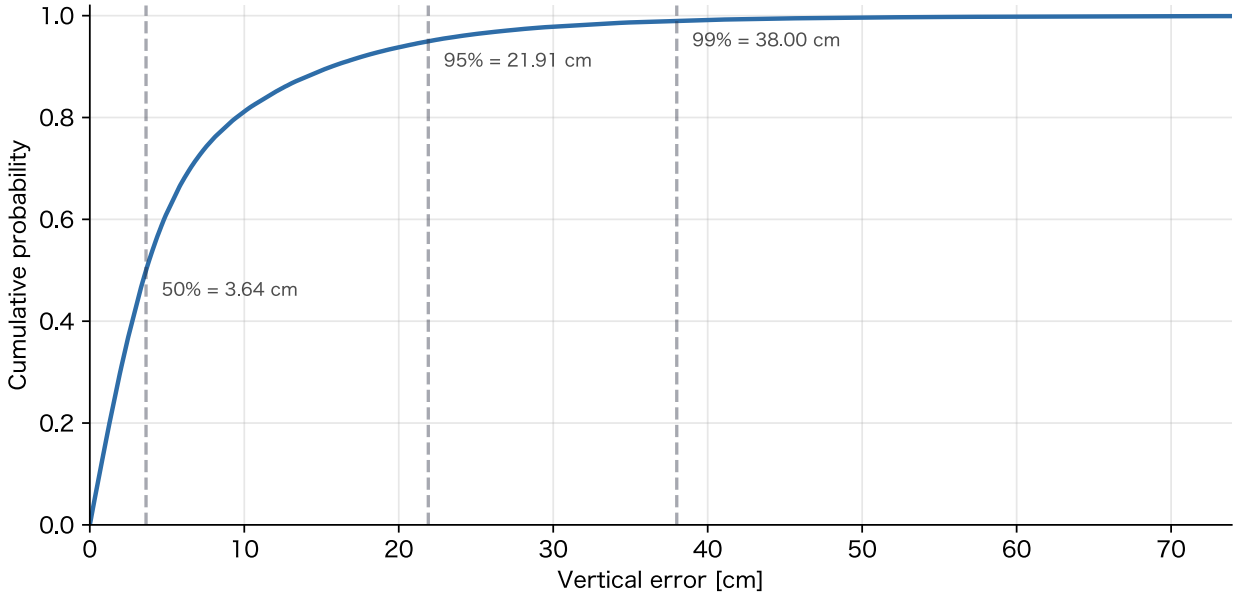



Figure 3: Cumulative distribution of vertical error (epochs pooled over qualified stations).

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

| Percentile | TTFF [s] |
|---|---|
| 50% | 180.0 |
| 90% | 300.0 |
| 95% | 420.0 |
| 99% | 750.0 |

**July 2026**: TTFF success rate **85.11 %** (92,408/108,576 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.

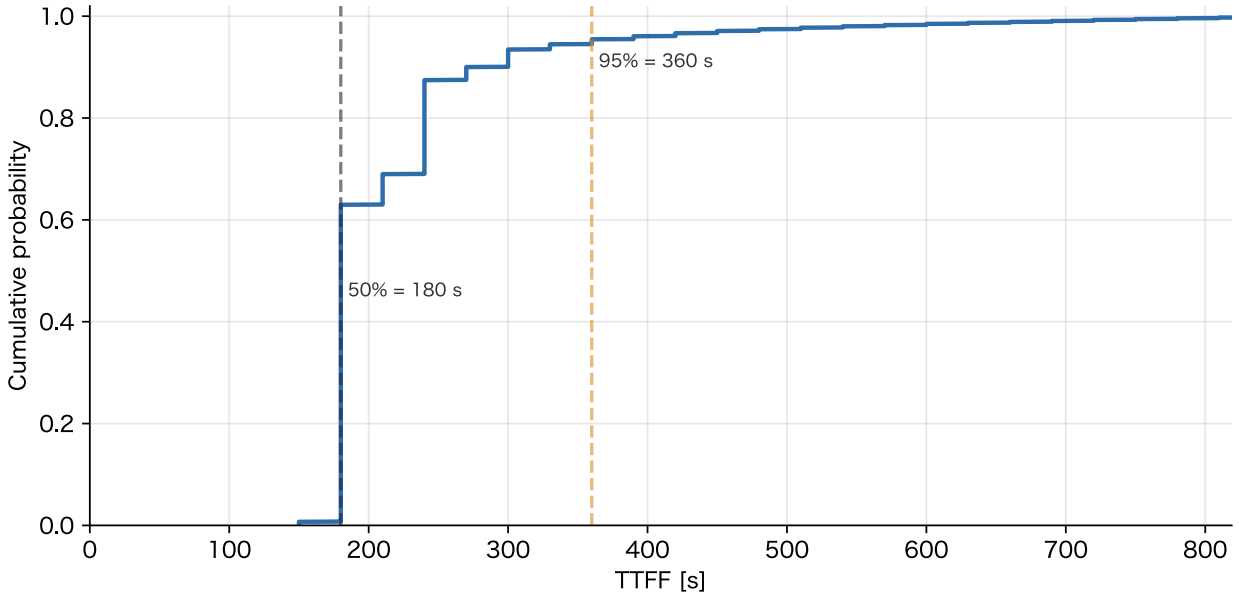



Figure 4: Cumulative distribution of TTFF (15-min reset, reset windows pooled nationwide over the period).

### 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 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).

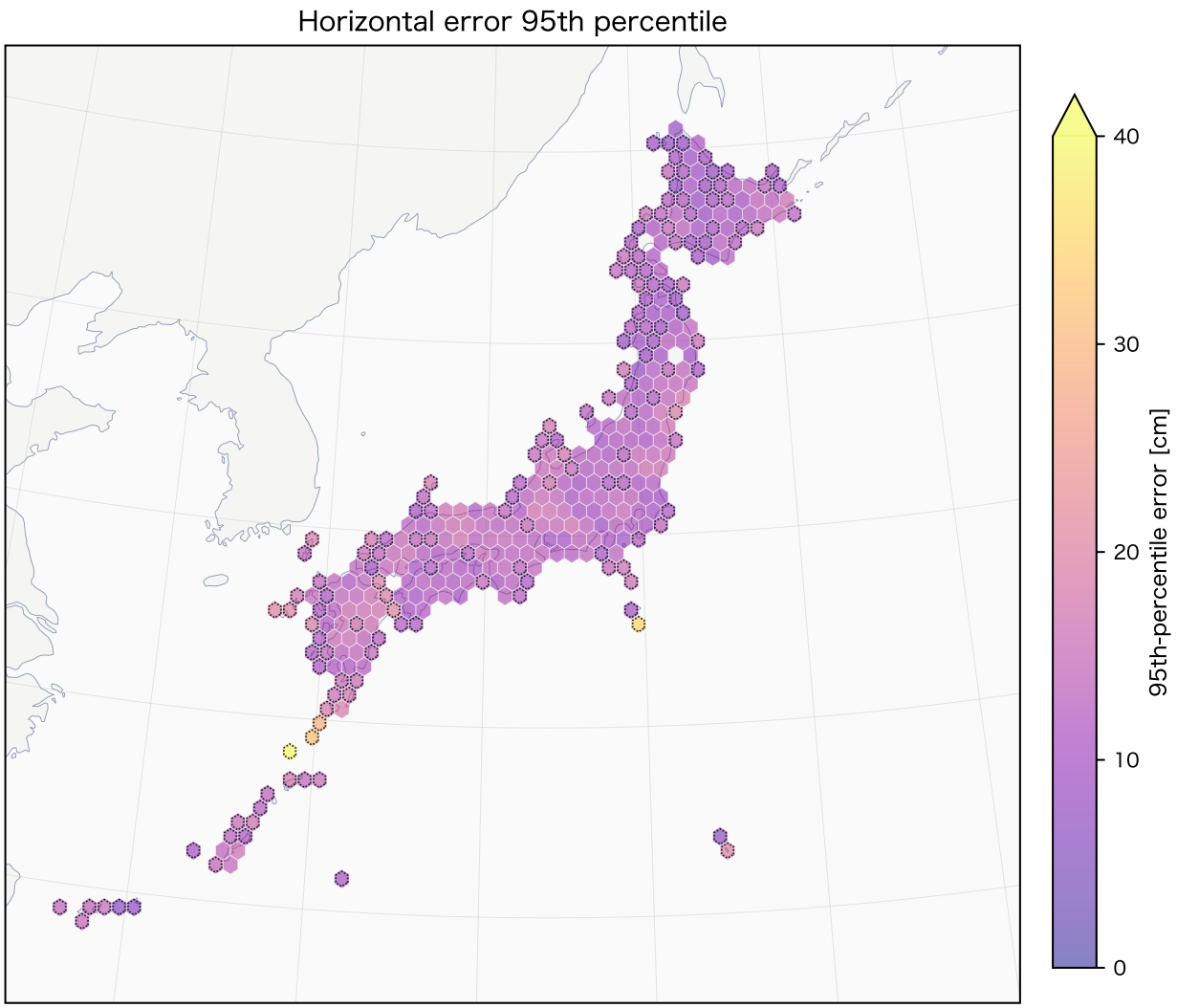



Figure 5: Spatial distribution of the horizontal-error 95th percentile (60 km hex cells, epochs pooled). Dotted ring = cell backed by fewer than 3 stations (indicative).

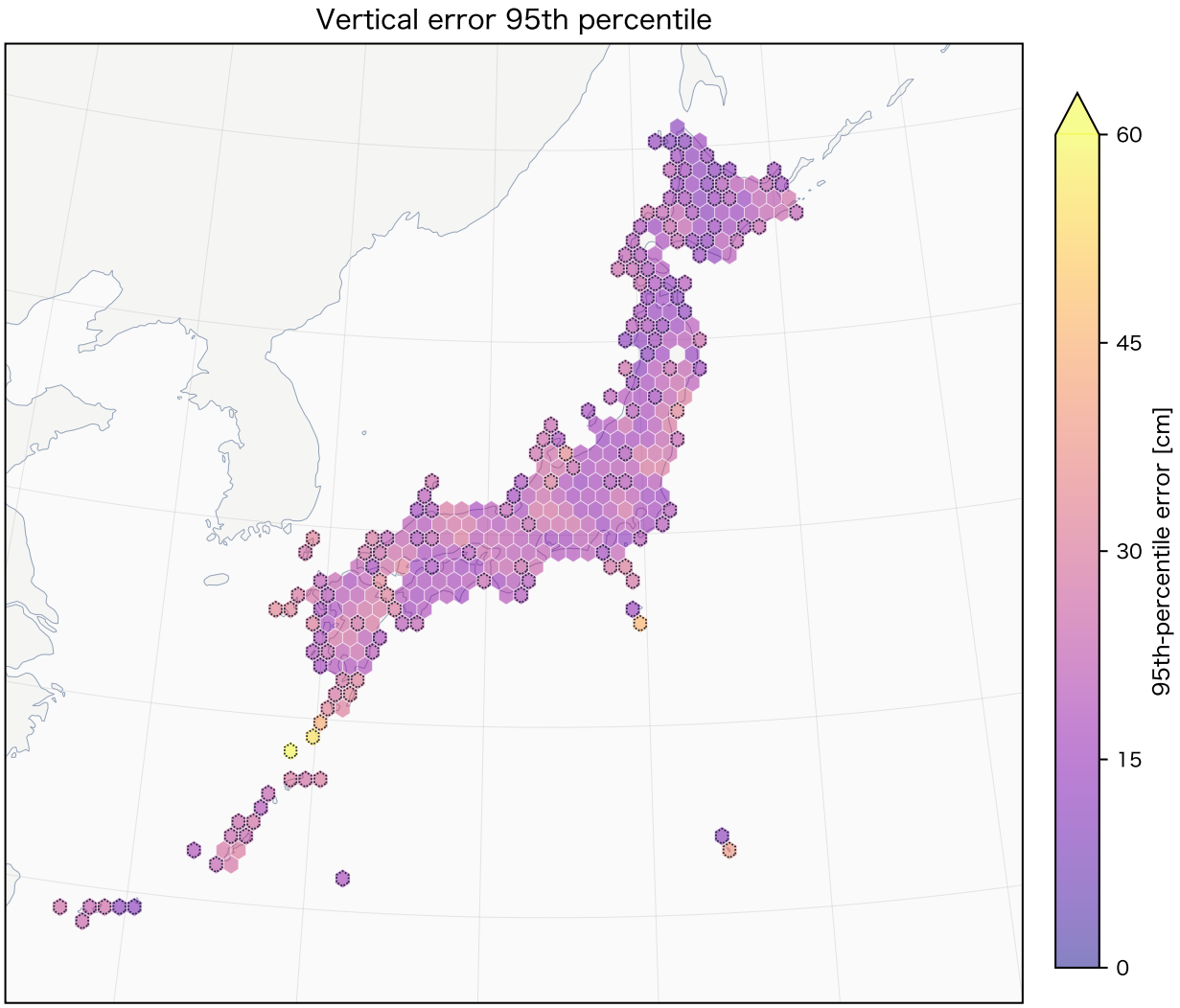



Figure 6: Spatial distribution of the vertical-error 95th percentile (60 km hex cells, epochs pooled). Dotted ring = cell backed by fewer than 3 stations (indicative).

### 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

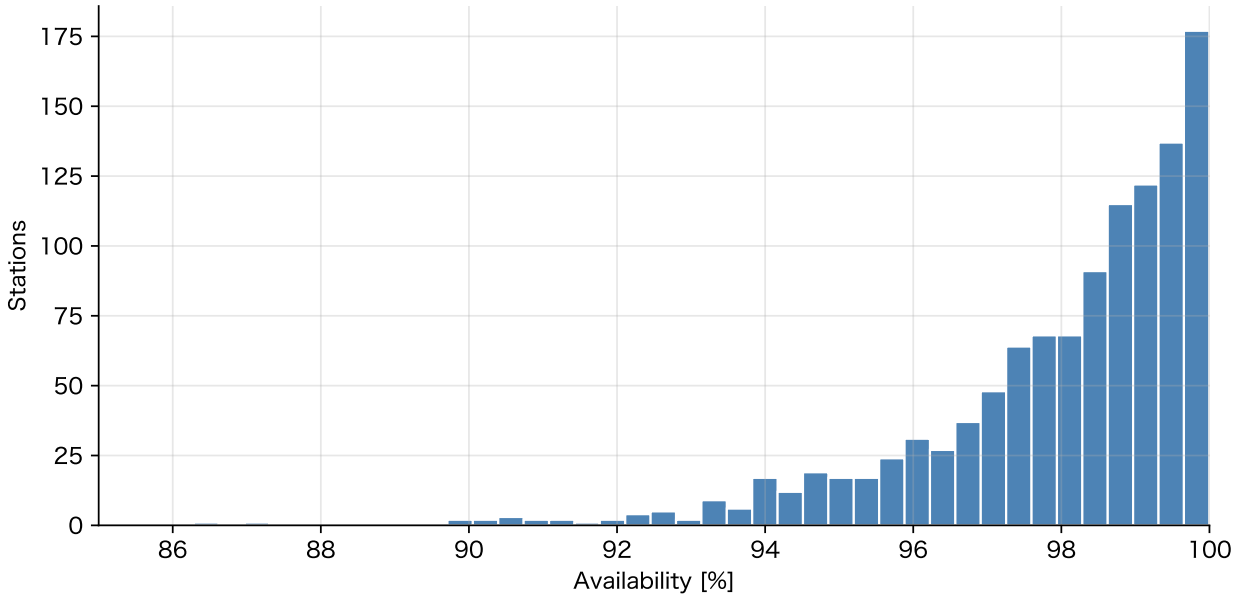



Figure 7: Distribution of data availability across stations.

National-statistics availability for 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 this Final edition keeps that exclusion as in the rapid edition rather than confirming or releasing the event.

**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, exclusion kept (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 |
|---|---|---|---|---|
| 2026-07-01 21:30 UTC | GPS PRN32 | NANU 2026047, NANU 2026051 | scheduled_maintenance | total |
| 2026-07-05 11:59 UTC | QZS PRN199 | NAQU 2026203, NAQU 2026205 | scheduled_maintenance | total |
| 2026-07-07 18:00 UTC | GPS PRN3 | NANU 2026050, NANU 2026052, NANU 2026053, NANU 2026054 | scheduled_maintenance | total |
| 2026-07-15 09:59 UTC | QZS PRN200 | NAQU 2026204, NAQU 2026207 | scheduled_maintenance | total |
| 2026-07-17 00:35 UTC | GPS PRN26 | NANU 2026055, NANU 2026056 | scheduled_maintenance | total |
| 2026-07-24 01:15 UTC | GPS PRN7 | NANU 2026057, NANU 2026058 | scheduled_maintenance | total |
| 2026-07-29 22:59 UTC | QZS PRN196 | NAQU 2026208, NAQU 2026220 | scheduled_maintenance | total |
| 2026-07-28 01:59 UTC | QZS PRN199 | NAQU 2026209, NAQU 2026215 | scheduled_maintenance | total |
| 2026-07-23 14:25 UTC | GAL | NAGU 2026041 | other | total |
| 2026-07-28 10:00 UTC | QZS | NAQU 2026210, NAQU 2026216 | scheduled_maintenance | partial |
| 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 |
|---|---|---|---|---|---|---|
| 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 | FCSTDV |
| 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 | FCSTDV |
| 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 | FCSTSUMM |
| 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 |

| PRN | SVN | Block | Slot | Clock | Status | Notice |
|---|---|---|---|---|---|---|
| G11 | 78 | III | D5 | RB | Operational | UNUSABLE |
| 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 | Outage | NAQU 2026214, 2026214 |

### 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 | |

| E# | GSAT | Clock | Status | Notice |
|---|---|---|---|---|
| E03 | GSAT0212 | PHM | Operational | |
| E04 | GSAT0213 | RAFS | 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 | |
| E29 | GSAT0225 | PHM | Operational | |
| E23 | GSAT0226 | PHM | Operational | |
| E06 | GSAT0227 | PHM | Operational | |
| E16 | GSAT0232 | PHM | Operational | |
| E28 | GSAT0233 | PHM | Operational | |
| E32 | GSAT0234 | PHM | Operational | USABINIT 2026041 |

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

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## 8.3 Methodology Version Tag

| Item | Value |
|---|---|
| Methodology version | 1.1.0 |
| Pipeline config hash | c519679781f1b186 |
| Engine | pntmoni-claslib v0.8.3-pntmoni-1 |
| QC tool | teqc 2019Feb25 |
| Reference-coordinate method version | gsi-daily-median15d-1.1 |
| Evaluation stream | final |
| Reporting period | July 2026 |
| Data mode | live |

For the full methodology document see [https://pntmoni.com/methodology/clas/v1.1.0](https://pntmoni.com/methodology/clas/v1.1.0).

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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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