Cabinet Office
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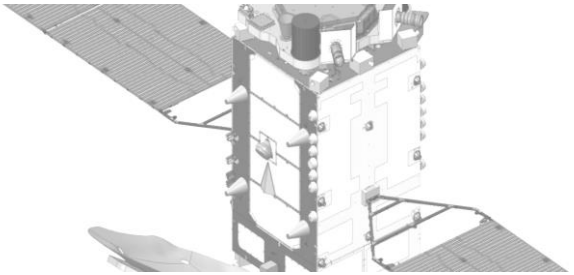

MADOCA-PPP introduction and toward the interoperability for 3PITF

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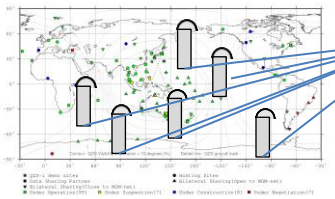
National Space Policy Secretariat
Cabinet Office, Government of Japan
Yoko SAKAI

Trial service of MADOCA-PPP has now started

- MADOCA-PPP: Multi-GNSS Advanced Orbit and Clock Augmentation - Precise Point Positioning
- The trial service has just started on 30 Sep. 2022.
- The operational service will start no later than JFY2024.
  - ✓ GNSS Monitoring Station Network, MIRAI (Multi-GNSS Integrated Real time and Archived Information system) has been released since April 2022.
  - ✓ To reduce initial convergence time of MADOCA-PPP, the ionospheric correction data for Asia Pacific region will be broadcasted from JFY2024 as an experiment.
- Demonstration will be coordinated with Asia-Oceanian partners for user expansion.

International GNSS Monitoring Station Network

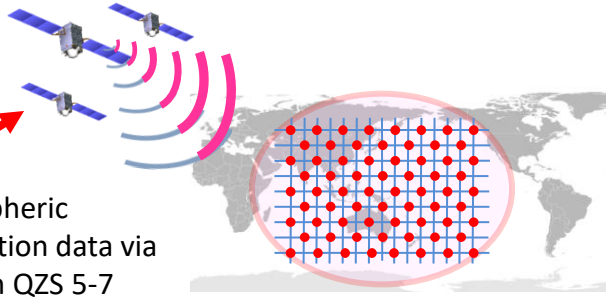


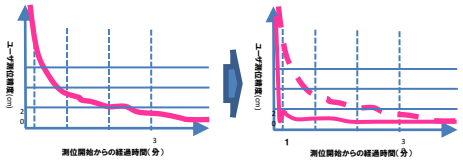
MIRAI

Correction Data Server

MADOCA-PPP augmentation signals via L6E on QZS 1R,2-7

Ionospheric correction data via L6D on QZS 5-7





Fast PPP convergence time would be able to reduce with QZSS wide area ionospheric correction.

Overview of MADOCA-PPP Performance specification

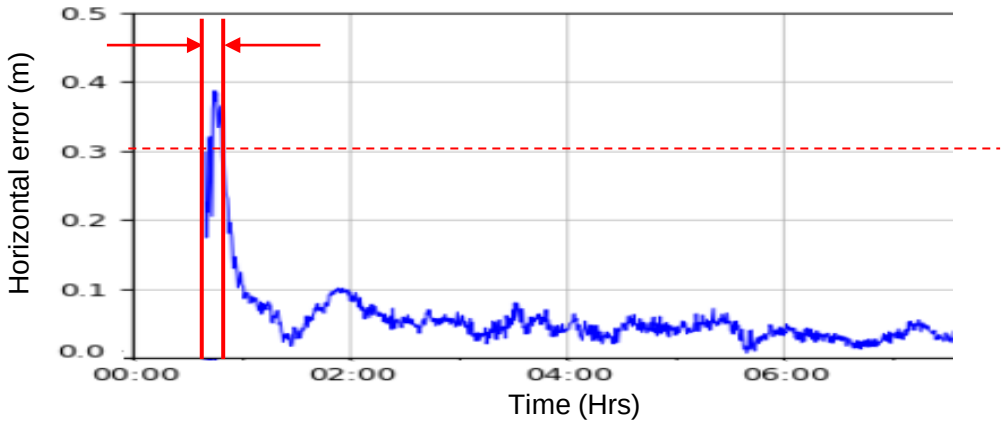
- PS-QZSS 003 and IS-QZSS-MDC 001 are shown in QZSS Web site.
- IS-QZSS-MDC will be updated to describe ionospheric corrections in the beginning of the next April.

	~2024	2024~ (after Q5-7 launch)	Remarks
Signal	L6E signal on QZS 1R,2-7	L6D signal on QZS 5-7	RF specifications are same as CLAS(L6D)
Service Area	Asia – Oceania area (± 60 latitude and 70E to 200E longitude)		
Format	RTCM3 Compact SSR	+ partially unique format	
Target GNSS	QZSS, GPS, GLONASS, Galileo		
Number of augmented GNSS	～80		
Correction data	Ephemeris, Clock, Code bias and phase bias	+ ionosphere	
Convergence Time	< 1800 sec	< 600 sec (Target)	Open-sky condition, dual-frequency receiver for surveying
Accuracy（95%）	< 30 cm(horizontal), < 50 cm (vertical)		

Test Transmission Results

The live test transmission of newly defined MADOCA-PPP error corrections through QZSS was conducted from August 18 to 31, 2022

[The example of convergence profile (Aug. 18, 2022 at MIZU00JPN)]



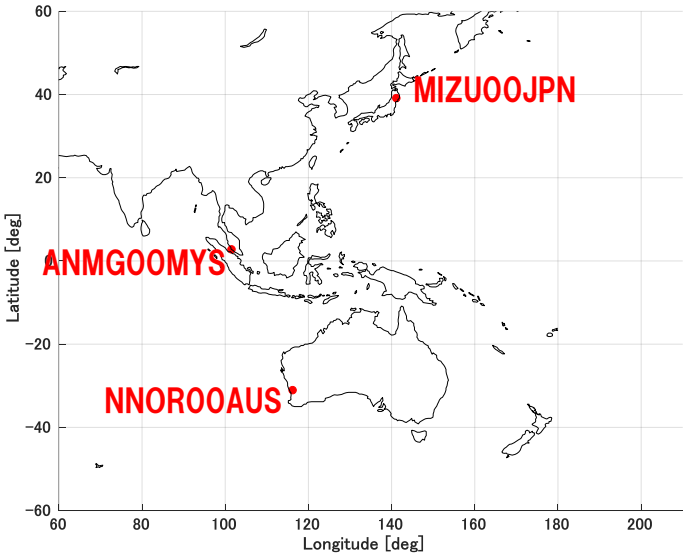
Convergence time at MIZU00JPN on Aug. 18 was 810 sec.

Note: Rebooting PPP computation was carried out every 15 minutes. 810 sec of convergence time is 95% statistics for 96 trials over one day

[Errors after reaching a steady state (Aug. 27, 2022)]

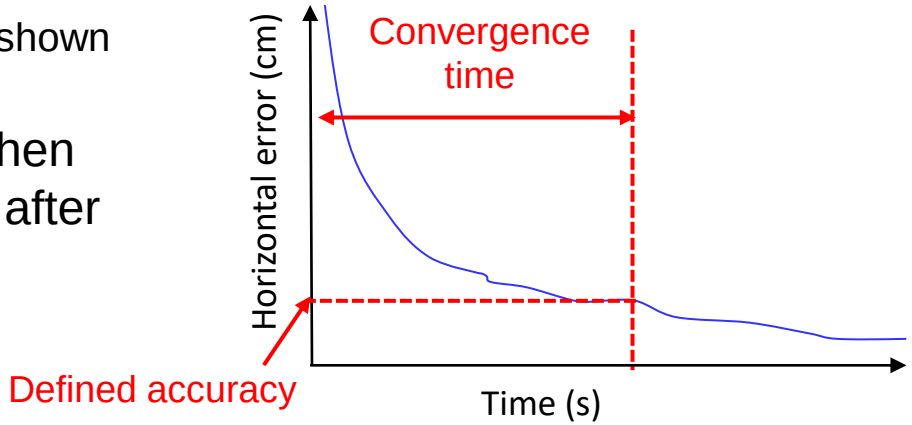
Station	Horizontal error [cm](95%)*	Vertical error [cm](95%)*
MIZU00JPN	4.8	8.2
ANMG00MYS	3.4	7.2
NNOR00AUS	4.3	7.7

*Statistics: from 00:30 to 24:00 (after convergence)



Comments on PPP interoperability

- Message format of MADOCA-PPP is based on Compact SSR as same as CLAS considering a certain degree of interoperability.
- It is considered difficult to unify message format, etc. for PPP service in each country as they are already being developed. However, CAO would like to positively engage in discussions on interoperability with PPP services in other countries because some users are interested in it.
- As the next step of the 3PITF report, the assumptions and definitions of the index like positioning accuracy and convergence time should be clarified for users.
  - In case of MADOCA-PPP, convergence time indicates the time from receiving augmentation data until reaching certain errors that is defined as accuracy. That is, the errors at 1800s are less than 30 cm (horizontal, 95%) and 50 cm (vertical, 95%), or the time when errors reach 30 cm (horizontal) and 50 cm (vertical) is less than 1800s. The assumptions are open-sky condition, dual-frequency receiver for surveying.
  - In case of CLAS, the assumptions are as shown in the next page.
- Further clarification may be needed when actual data evaluation. (e.g. accuracy after reaching a steady state)



6.3. Accuracy

CLAS Positioning accuracy is shown in Table. 6.3-1.

Table. 6.3-1 Positioning Accuracy

Positioning Type	Positioning Error		Remark
	Horizontal	Vertical	
Static	≤ 6cm(95%) (3.47cm(RMS))	≤ 12cm(95%) (6.13cm(RMS))	(*)(**)
Kinematic	≤ 12cm(95%) (6.94cm(RMS))	≤ 24cm(95%) (12.25cm(RMS))	(*)(**)

(*) The augmentation information shall satisfy the following condition.

- SIR-URE ≤ 0.08 m (95%)

(**) Usage assumptions to achieve the accuracy are as follows :

- All the augmented satellites (GNSSs) are used in the PPP-RTK positioning.
- A minimum number of satellites with no cycle slips : ≥ 5
- Elevation mask angle : 15 degrees
- Average Dilution of Precision (DOP) by augmented satellites :

  ≤ 1.1 for Horizontal

  ≤ 1.8 for Vertical
- Multipath :

  ≤ 0.34 m (RMS) for pseudorange per augmented satellite

  ≤ 0.75 cm (RMS) for carrier phase per augmented satellite
- Receiver noise :

  ≤ 0.30 cm (RMS) for carrier phase per augmented satellite
- Antenna phase center variation (PCV) error :

  ≤ 0.30 cm (RMS) for each frequency

6.7. Time to First Fix (TTFF)

The TTFF is the time from the reception of L6(CLAS) signals at a receiver until the first positioning computation result is obtained with the resolved carrier phase integer ambiguities. It shall satisfy the following condition:

- ≤ 60 sec (95%)

10.3. Convergence Time

The convergence time is the time from the reception of the augmentation messages via the L6(MADOCA-PPP) signal at a receiver until the PPP computation result which satisfies the following accuracy is obtained :

- Horizontal Accuracy ≤ 30 cm (95%)
- Vertical Accuracy ≤ 50 cm (95%)

The convergence time shall satisfy the following condition(*):

- Convergence Time ≤ 1800 sec (Performance Report: See reference document(9))

  (*) Assumptions:

  - Environment: Open-sky
  - Antenna and Receiver: Dual-frequency, for surveying