Quasi-Zenith Satellite System
Service Performance Report
MADOCA-PPP
(1stH FY2025)

Dec 2025

Cabinet Office

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1. Service Performance Evaluation Conditions

1.1. Evaluation Period

From April 1, 2025 to September 30, 2025 (UTC)

1.2. Evaluation Item

- Convergence Time
- Positioning Accuracy after convergence
- Availability

1.3. Evaluation Points

IGS monitoring stations as shown in Table 1.3-1 and Figure 1.3-1

Table 1.3-1 IGS monitoring stations used as evaluation points (*)

#	Station Name	Latitude [deg]	Longitude [deg]	Notes
1	HKSL00HKG	22.372	113.928	
2	KAT100AUS	-14.376	132.153	
3	KIRI00KIR	1.355	172.923	
4	MIZU00JPN	39.135	141.133	
5	NNOR00AUS	-31.049	116.193	
6	OUS200NZL	-45.869	170.511	
7	SGOC00LKA	6.892	79.874	
8	URUM00CHN	43.808	87.601	

(*) Refer to IGS0OPSSNX_20251590000_07D_07D_CRD.SNX (8 June 2025)

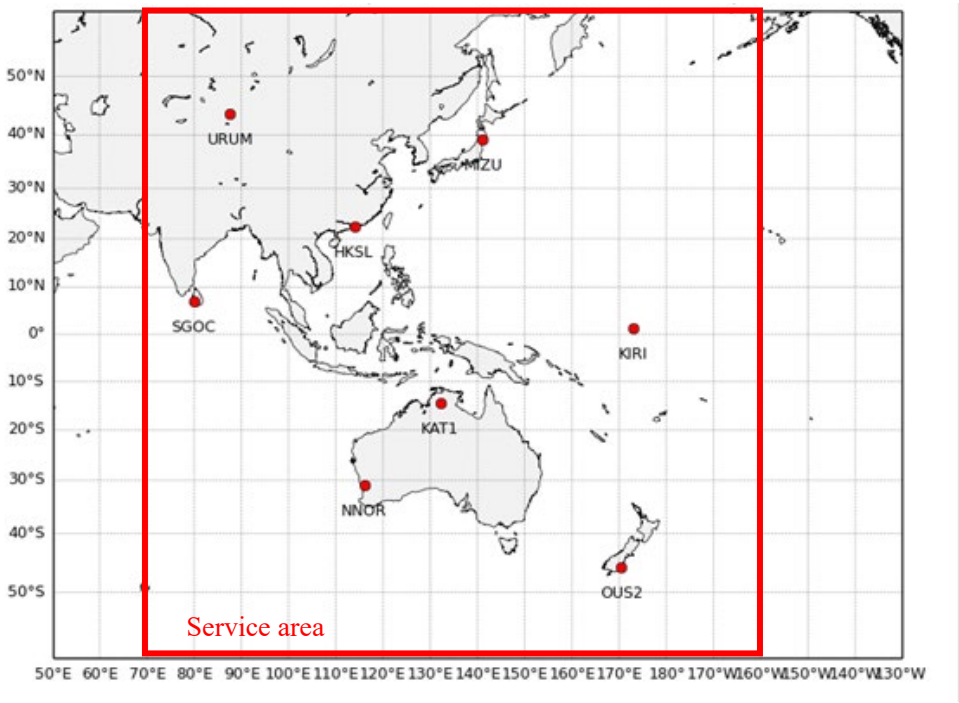

Figure 1.3-1 Evaluation points

1.4. Augmented GNSS

- GPS+QZSS+Galileo+GLONASS

1.5. Calculation Conditions

1.5.1. PPP Conditions

- Observation Data Frequency
  - GPS：L1+L2
  - QZSS：L1+L5
  - Galileo : E1+E5a
  - GLONASS : G1+G2
- Tool and Data

  The MADOCA-PPP test library (MADOCALIB; Multi-GNSS Advanced Orbit and Clock Augmentation - Precise Point Positioning Test Library), and the archived L6 messages are utilized (*1).
  - MADOCALIB: Ver. 1.4 (1 April 2025 -30 June 2025)

    Ver. 2.0 (1 July 2025 -)
  - Key parameter setting: See Table 1.5-1 and Table.1.5-2 (These and other parameters are same as the sample configuration files in the library.)

Table 1.5-1 Parameter setting for MADOCALIB Ver.1.4

Item	PPP (sample.conf)	PPP-AR (sample_pppar.conf)
pos1-posmode	ppp-kine	ppp-kine
pos1-frequency	l1+2	l1+2
pos1-soltype	forward	forward
pos1-elmask	10	10
pos1-tidecorr	on	on
pos1-ionoopt	dual-freq	est-stec
pos1-tropopt	est-ztd	est-ztd
pos1-sateph	brdc+ssrapc	brdc+ssrapc
pos1-navsys	29	29
pos2-ionocorr	off	off
pos2-armode	off	continuous
pos2-arsys	-	25
pos2-arthres	-	2.5
pos2-arelmask	-	15
pos2-slipthres	0.15	0.15
pos2-rejionno	100	100
pos2-rejgdop	30	30
pos2-siggpsIIR-M	0	0
pos2-siggpsIIF	0	0
pos2-siggpsIIIA	0	0
pos2-sigqzs1_2	0	0
stats-eratio1	300	300
stats-eratio2	300	300
stats-uraratio	0.1	0.1
stats-errphase	0.003	0.003
stats-errphaseel	0.003	0.003
file-satantfile	igs20.atx(*2)	igs20.atx(*2)
file-rcvantfile	igs20.atx(*2)	igs20.atx(*2)

Table 1.5-2 Parameter setting for MADOCALIB Ver.2.0

Item	PPP (sample.conf)	PPP-AR (sample_pppar.conf)
pos1-posmode	ppp-kine	ppp-kine
pos1-frequency	l1+2(*3)	l1+2(*3)
pos1-soltype	Forward	Forward
pos1-elmask	10	10
pos1-tidecorr	On	On
pos1-ionoopt	dual-freq	est-stec
pos1-tropopt	est-ztd	est-ztd
pos1-sateph	brdc+ssrapc	brdc+ssrapc
pos1-navsys	29(*4)	29(*4)
pos2-ionocorr	Off	Off
pos2-armode	Off	Continuous
pos2-arsys	-	57(*4)
pos2-arthres	-	2.5
pos2-arelmask	-	15
pos2-slipthres	0.15	0.15
pos2-rejionno	100	100
pos2-rejgdop	30	30
pos2- siggps	L1/L2/L5(*3)	L1/L2/L5(*3)
pos2- sigqzs	L1/L5/L2(*3)	L1/L5/L2(*3)
pos2- siggal	E1/E5a/E5b/E6(*3)	E1/E5a/E5b/E6(*3)
pos2- sigbds2	B1I/B3I/B2I(*3,*4)	B1I/B3I/B2I(*3,*4)
pos2- sigbds3	B1I/B3I/B2a(*3,*4)	B1I/B3I/B2a(*3,*4)
stats-eratio1	300	300
stats-eratio2	300	300
stats-uraratio	0.1	0.1
stats-errphase	0.003	0.003
stats-errphaseel	0.003	0.003
file-satantfile	igs20.atx(*2)	igs20.atx(*2)
file-rcvantfile	igs20.atx(*2)	igs20.atx(*2)

(*1) MADOCALIB is available at the following web address:
https://qzss.go.jp/en/technical/dod/madoca/madoca_test-library.html (English)
https://qzss.go.jp/technical/dod/madoca/madoca_test-library.html (Japanese)

Archives are available at the following web address:
https://sys.qzss.go.jp/dod/en/archives/agree_madoca.html

(*2) The antenna phase information file was obtained on the IGS Web site.
https://cddis.nasa.gov/Data_and_Derived_Products/GNSS/GNSS_product_holdings.html

(*3) Since pos1-frequency takes precedence over the settings for pos2-siggps, pos2-sigqzs, pos2-siggal, pos2-sigbds2, and pos2-sigbds3, this configuration is equivalent to dual-frequency.

(*4) pos1-navsys=29 specifies GPS, QZSS, Galileo, and GLONASS. Although pos2-arsys is set to 57, the pos1-navsys setting takes precedence. As a result of this configuration, the settings for pos2-sigbds2 and pos2-sigbds3 are ignored.

1.5.2. Initial Convergence Time

- The PPP calculation was performed every 15 minutes during the evaluation period.
- By using each calculation result, the positioning accuracy (95%) was statistically calculated every 30 seconds.
- Initial convergence time was calculated as the time for the positioning accuracy (95%) to reach below 30 cm horizontally and 50 cm vertically from the start of PPP calculation.

1.5.3. Positioning Accuracy after Convergence

- The PPP calculation started at 00:00:00 every day.
- By using each calculation result, the positioning accuracy (95%) was statistically calculated every 30 seconds.
- Positioning Accuracy after convergence was the horizontal and vertical positioning accuracy (95%) from 00:30:00 to 23:59:30 every day.

1.5.4. Availability (Reference)

The availability is the time ratio that the healthy (*) L6E signal utilized in MADOCA-PPP from a specific satellite is available. The availability is not defined in any specification and is for reference only.

(*) Unhealthy conditions are described in PS-QZSS.

2. Evaluation Results

2.1. Initial Convergence Time

See Table 2-1,2 and Figure 2-1,2.

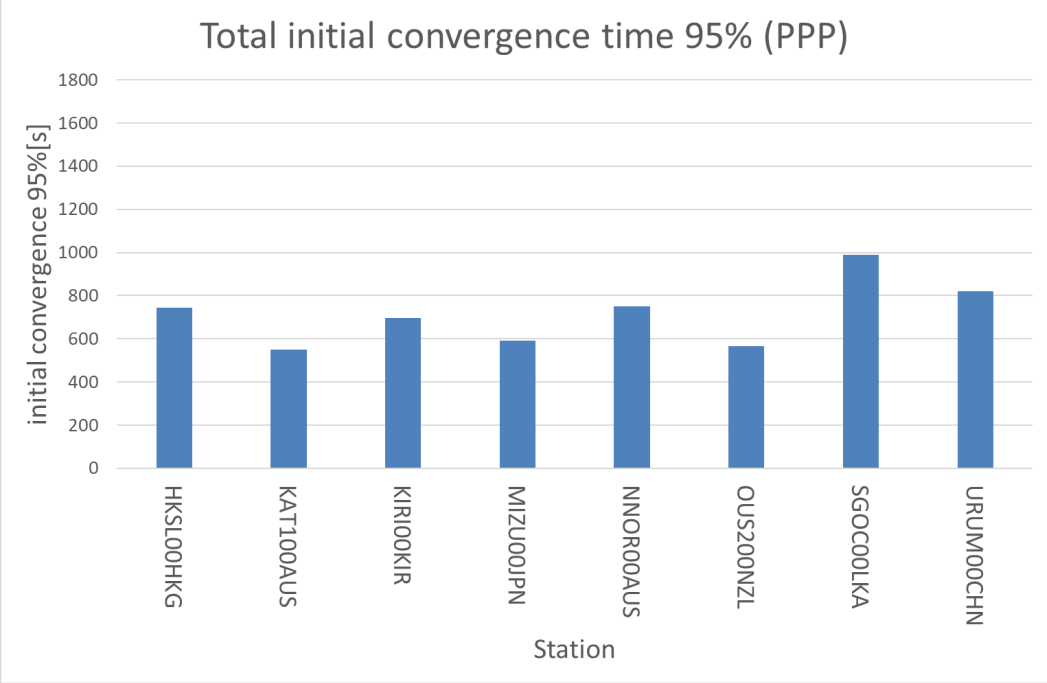

Figure 2-1 Initial Convergence Time (PPP)

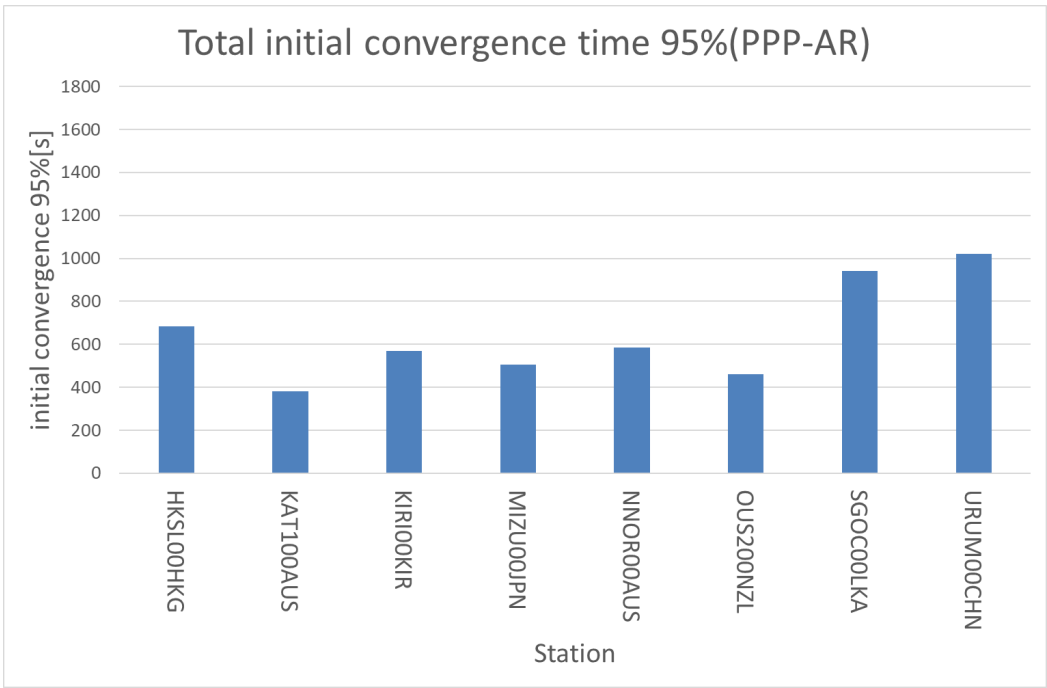

Figure 2-2 Initial Convergence Time (PPP-AR)

Table 2-1 Initial Convergence Time (PPP)

#	Station	Initial Convergence Time [s] (PPP)					
		Apr.	May	Jun.	Jul.	Aug.	Sep.
1	HKSL00HKG	660	690	870	750	750	750
2	KAT100AUS	600	570	540	540	510	540
3	KIRI00KIR	780	690	690	690	690	630
4	MIZU00JPN	570	570	630	540	630	600
5	NNOR00AUS	780	780	750	720	750	720
6	OUS200NZL	630	630	600	540	480	510
7	SGOC00LKA	1260	1290	990	720	780	900
8	URUM00CHN	720	810	1110	840	810	630

Table 2-2 Initial Convergence Time (PPP-AR)

#	Station	Initial Convergence Time [s] (PPP-AR)					
		Apr.	May	Jun.	Jul.	Aug.	Sep.
1	HKSL00HKG	690	630	810	660	630	690
2	KAT100AUS	390	420	420	360	360	330
3	KIRI00KIR	720	630	630	540	480	420
4	MIZU00JPN	510	480	570	510	510	450
5	NNOR00AUS	630	660	660	540	510	510
6	OUS200NZL	570	570	510	420	330	360
7	SGOC00LKA	1290	1320	930	660	660	780
8	URUM00CHN	870	900	1320	1110	1080	840

2.2. Positioning Accuracy after Convergence

See Table 2-3,4 and Figure 2-3,4.

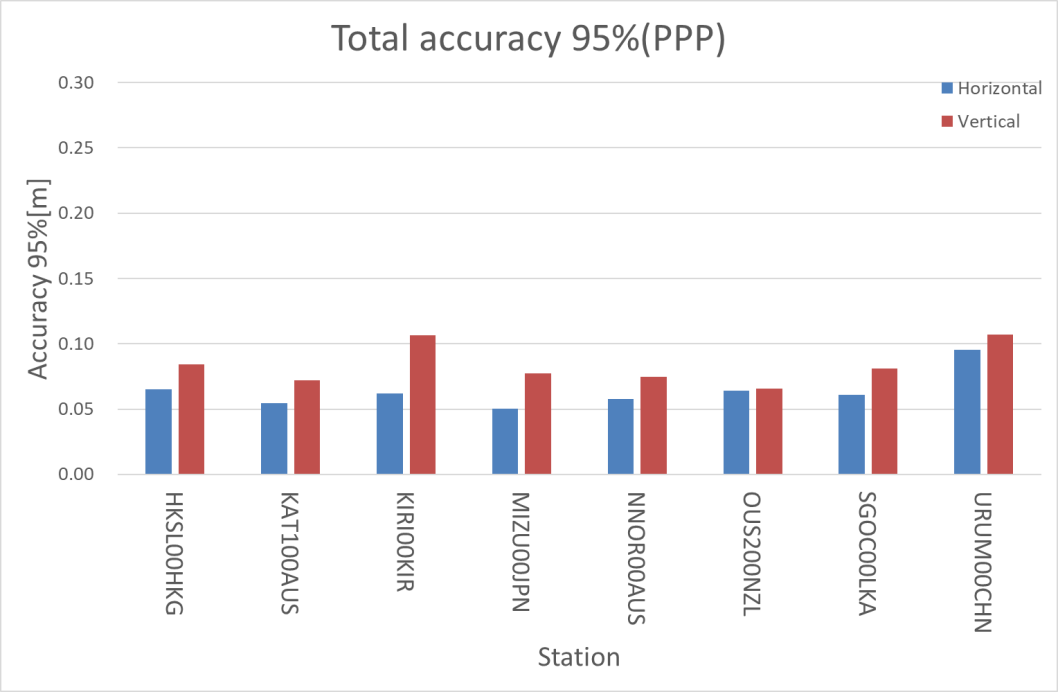

Figure 2-3 Positioning Accuracy after Convergence (PPP)

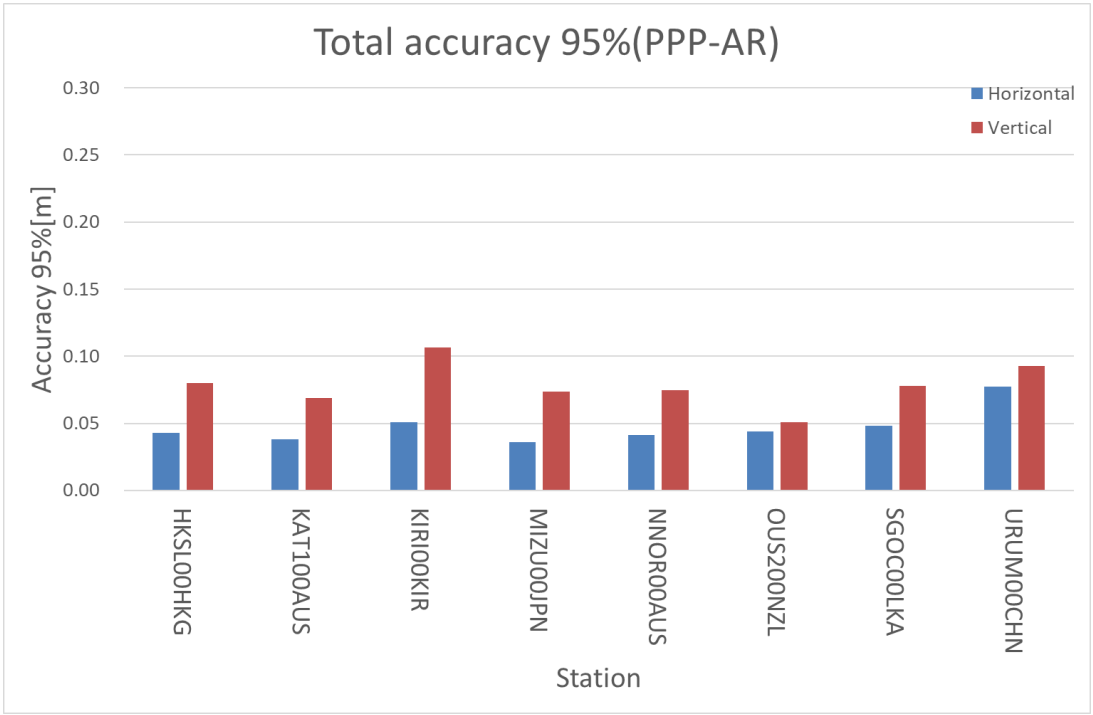

Figure 2-4 Positioning Accuracy after Convergence (PPP-AR)

Table 2-3 Positioning Accuracy after Convergence (PPP)

#	Station	Positioning Accuracy after Convergence [cm] (PPP)											
		Apr.		May		Jun.		Jul.		Aug.		Sep.	
		H	V	H	V	H	V	H	V	H	V	H	V
1	HKSL00HKG	5.9	7.2	7.0	7.4	7.8	9.0	8.0	9.6	5.1	8.5	5.3	8.9
2	KAT100AUS	5.5	7.8	5.0	7.6	6.6	7.6	8.7	6.7	3.1	6.4	3.7	7.0
3	KIRI00KIR	7.1	11.4	7.0	11.2	7.2	10.6	5.1	10.2	5.2	10.6	5.6	9.8
4	MIZU00JPN	4.4	6.6	4.5	6.7	5.0	7.0	5.7	8.1	5.5	9.4	5.1	8.8
5	NNOR00AUS	5.8	7.7	5.8	7.4	6.5	8.0	8.5	7.9	4.5	7.4	3.6	6.3
6	OUS200NZL	7.4	7.8	7.0	7.6	8.3	7.2	7.9	5.7	3.8	5.2	4.1	6.0
7	SGOC00LKA	7.5	10.9	6.6	9.6	6.6	8.1	7.3	6.5	3.8	6.7	4.6	6.9
8	URUM00CHN	5.9	7.9	5.6	8.1	18.0	18.2	8.4	9.1	14.8	14.4	4.3	6.7

Table 2-4 Positioning Accuracy after Convergence (PPP-AR)

#	Station	Positioning Accuracy after Convergence [cm] (PPP-AR)											
		Apr.		May		Jun.		Jul.		Aug.		Sep.	
		H	V	H	V	H	V	H	V	H	V	H	V
1	HKSL00HKG	3.6	7.2	4.6	7.5	5.4	8.6	4.7	8.8	3.6	7.8	4.0	8.2
2	KAT100AUS	3.1	7.5	3.3	7.2	5.6	7.8	5.0	6.0	2.5	6.3	3.3	6.5
3	KIRI00KIR	5.7	11.4	6.0	11.0	6.6	10.9	3.8	10.0	4.2	10.9	4.1	9.8
4	MIZU00JPN	3.0	5.9	3.3	6.6	4.2	7.4	3.7	7.2	3.7	8.4	3.7	8.6
5	NNOR00AUS	3.4	7.3	4.3	7.5	5.5	9.3	5.0	7.5	3.1	7.1	3.5	6.1
6	OUS200NZL	4.8	5.9	5.1	5.9	5.4	5.4	5.4	4.4	2.6	3.9	2.9	5.0
7	SGOC00LKA	7.3	11.1	5.9	9.7	4.8	7.3	4.3	6.1	3.0	6.1	3.6	6.3
8	URUM00CHN	4.6	6.7	4.9	7.4	15.6	15.1	7.0	8.2	11.1	12.1	3.3	6.3

2.3. Availability (Reference)

See Table 2-5.

Table 2-5 Availability (Reference)

Satellite	SVN	PRN code	Availability (Reference)
QZS-1R	005	206	0.999
QZS-2	002	204	0.999
QZS-3	003	209	0.999
QZS-4	004	205	0.999
QZS-6	007	210	0.995

Appendix　95% accuracy and fix-ratio over time

Figures A-1 and A-2 illustrate the trend of 95% accuracy over time following PPP initialization in September 2025. Figure A-1 presents the case without AR, while Figure A-2 shows the case with AR, including the AR fix rate.

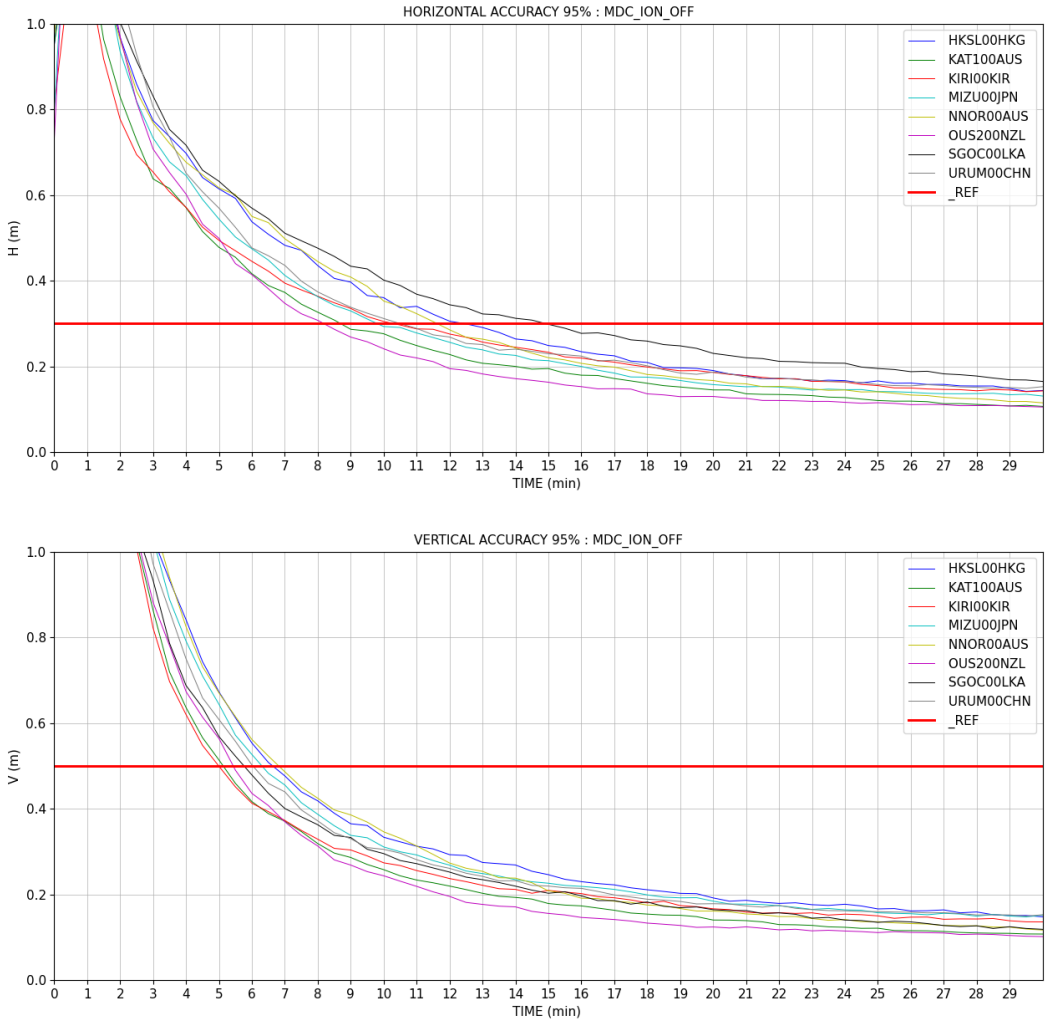

Figure A-1 Trend of 95% Percentile Accuracy Over Time (PPP)

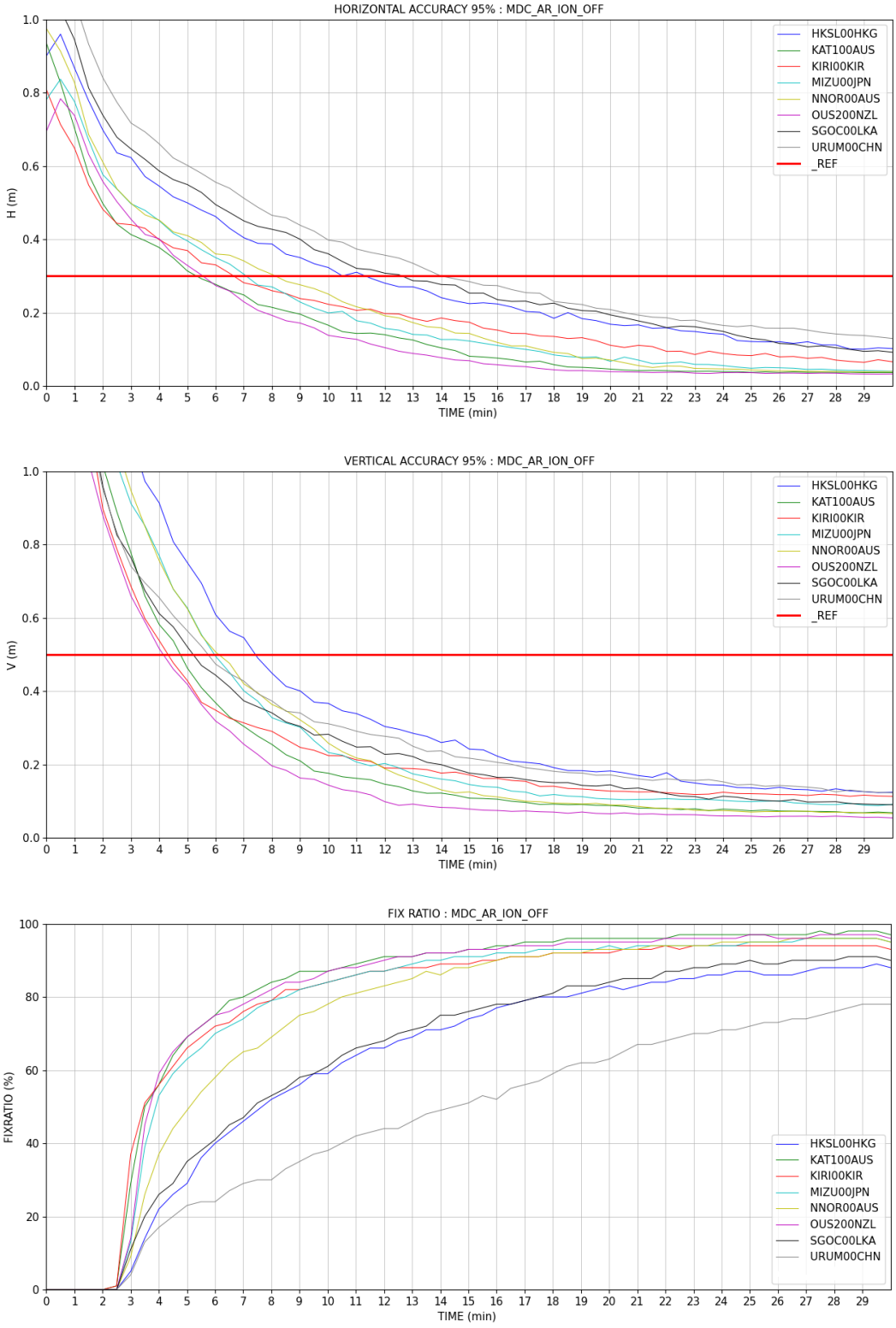

Figure A-2 Trend of 95% Accuracy and Fix Ratio Over Time (PPP-AR)