



Experience with using GAL and BDS from Slovakia

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Slovak real-time positioning service

SKPOS[®] +Galileo and +BeiDou

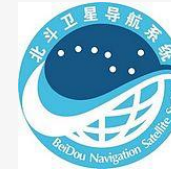
● december 2006

GPS+GLO



● október 2018

GPS+GLO+GAL+BDS



SKPOS[®]

SKPOS_dm

differential corrections
for code measurements

Galileo

BeiDou

SKPOS_cm

differential corrections
for phase measurements

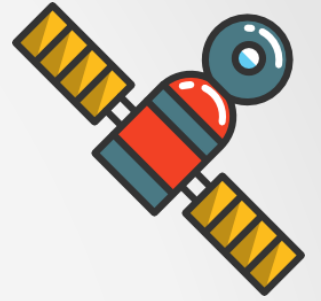
SKPOS_mm

postprocessing of code
and phase measurements

Galileo

BeiDou

Number of satellites



	GPS 	GLONASS 	Galileo 	BeiDou 	<u>SUM</u>
Current status	31	24	22	44	121
Full status	31	26	30	49	136

RTK Test (GPS+GLO vs. GPS+GLO+GAL+BDS)

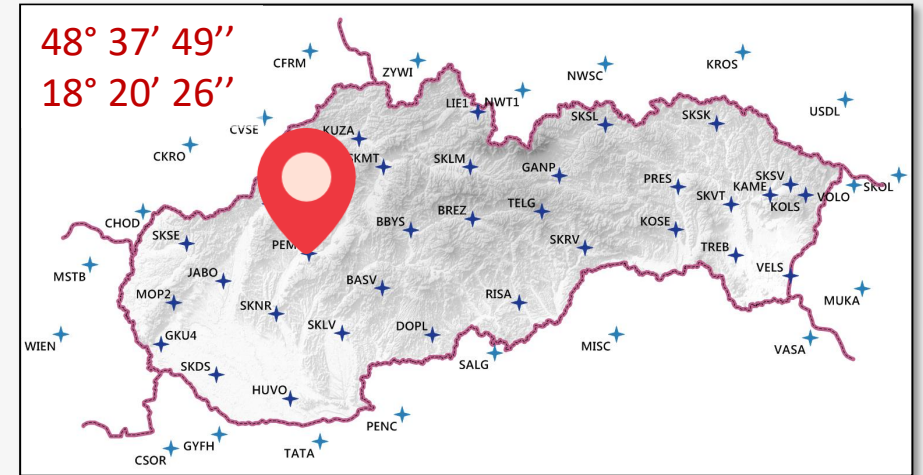
- 24-hours RTK test
- Comparison of results from 2 mountpoints :
 - RTCM 3.1 (SKPOS_CM_31)
 - RTCM 3.2 MSM5 (SKPOS_CM_32)
- 3 type of test:
 - at different times
 - in different locations
 - under different conditions



Test 1 (in Partizánske)

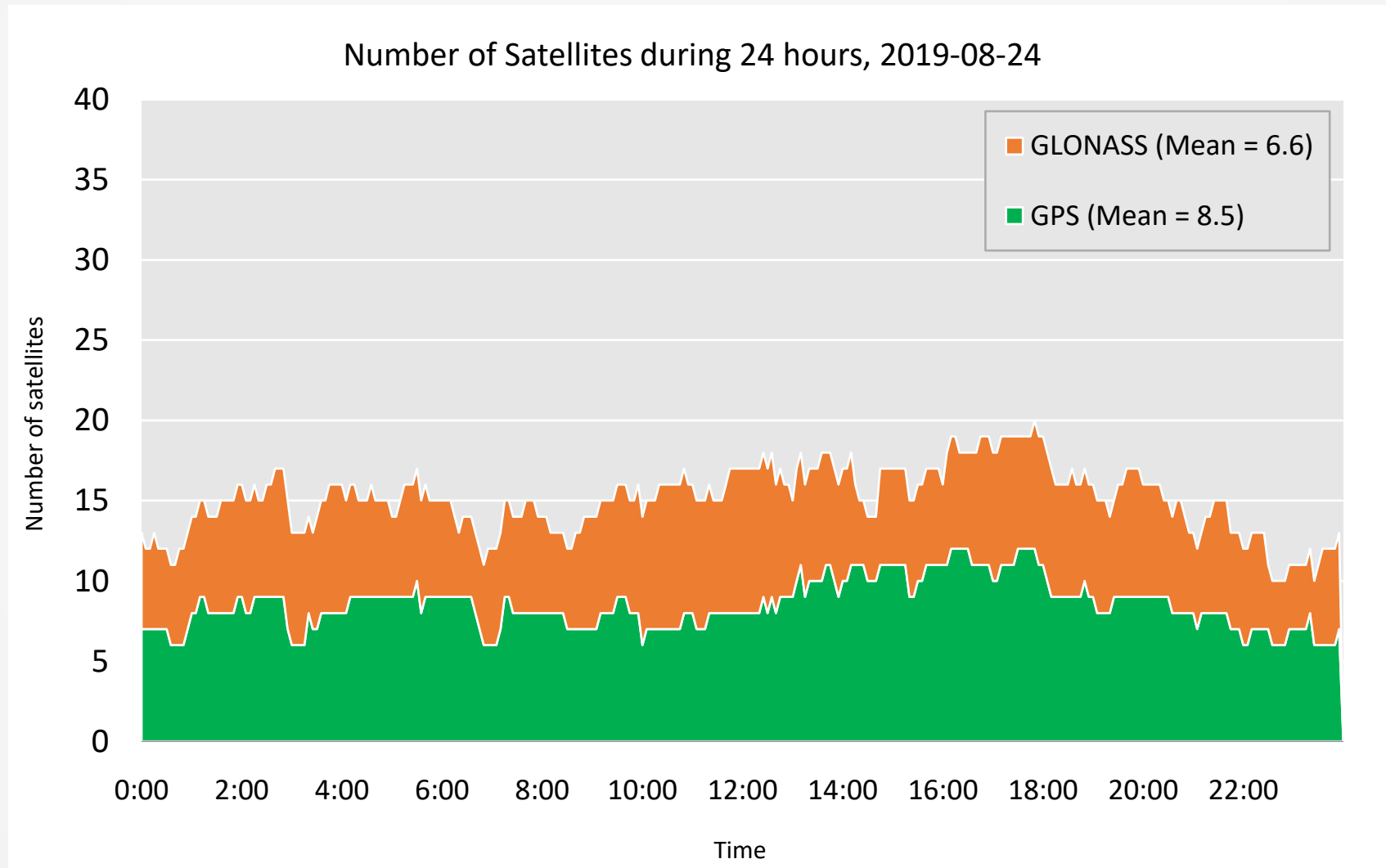
- GNSS antenna on InSAR reflector
 - 24-hours (RTCM 3.1)
 - 24-hours (RTCM 3.2)
- 1 receiver, 1 antenna and 2 results
- Ideal conditions, without obstacles

	SKPOS_CM_31	SKPOS_CM_32
Rover	Trimble NetR9	Trimble NetR9
Software	RTKNAVI	RTKNAVI
Format	RTCM 3.1	RTCM 3.2
GNSS	GPS, GLO	GPS, GLO, GAL, BDS



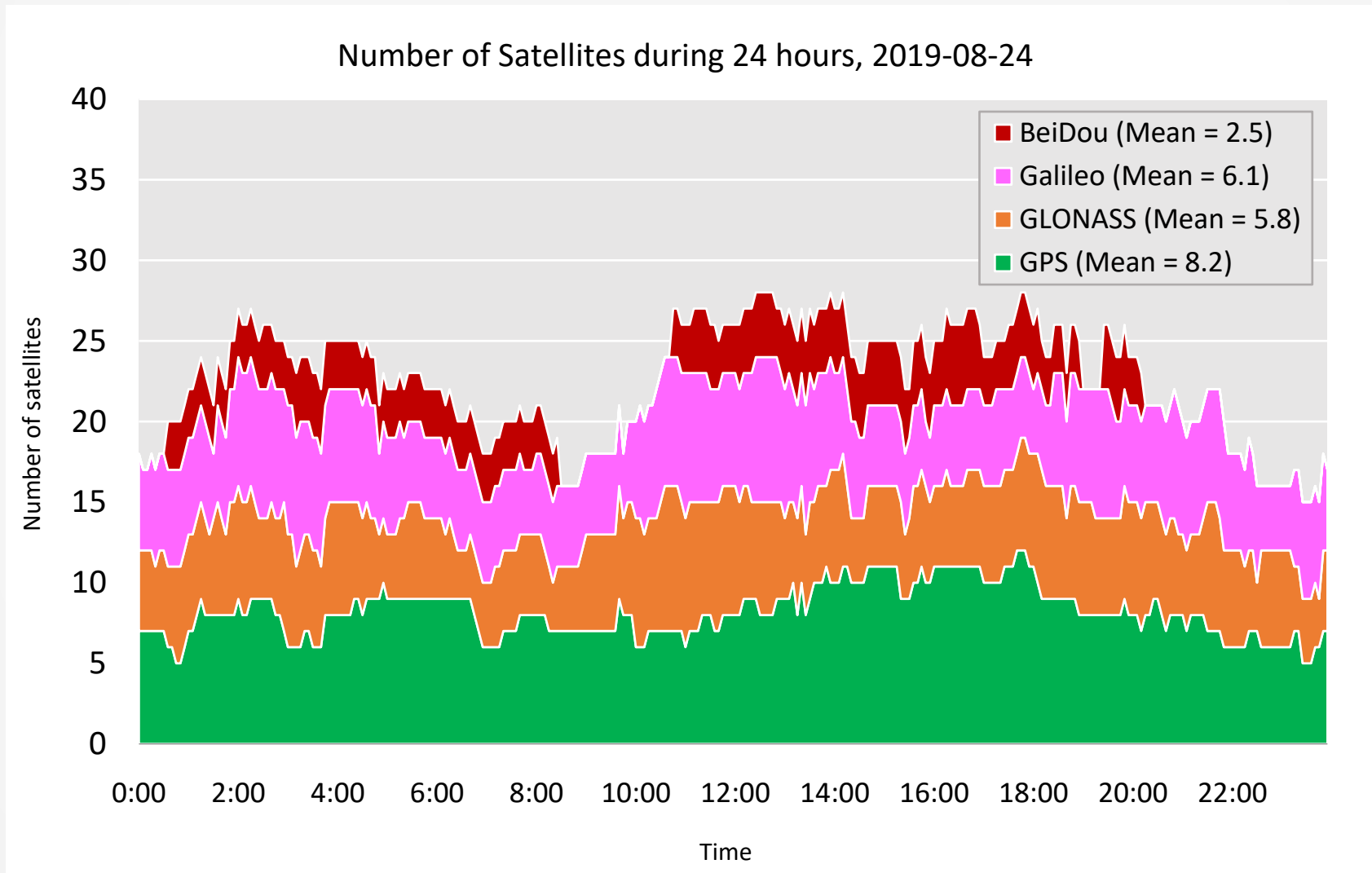
Test 1 – Number of satellites

SKPOS_CM_31



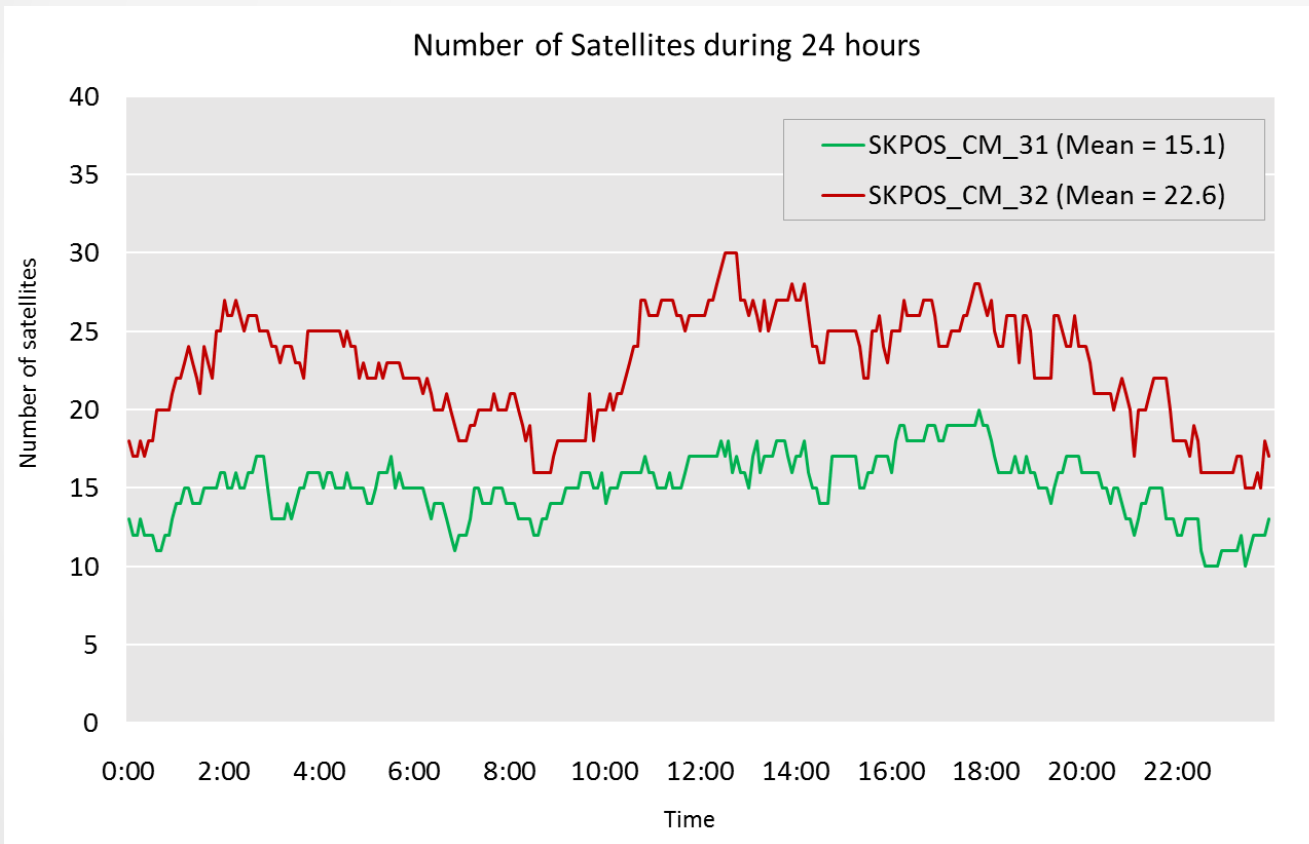
Test 1 – Number of satellites

SKPOS_CM_32



Test 1 – Number of satellites

SKPOS_CM_31 vs SKPOS_CM_32



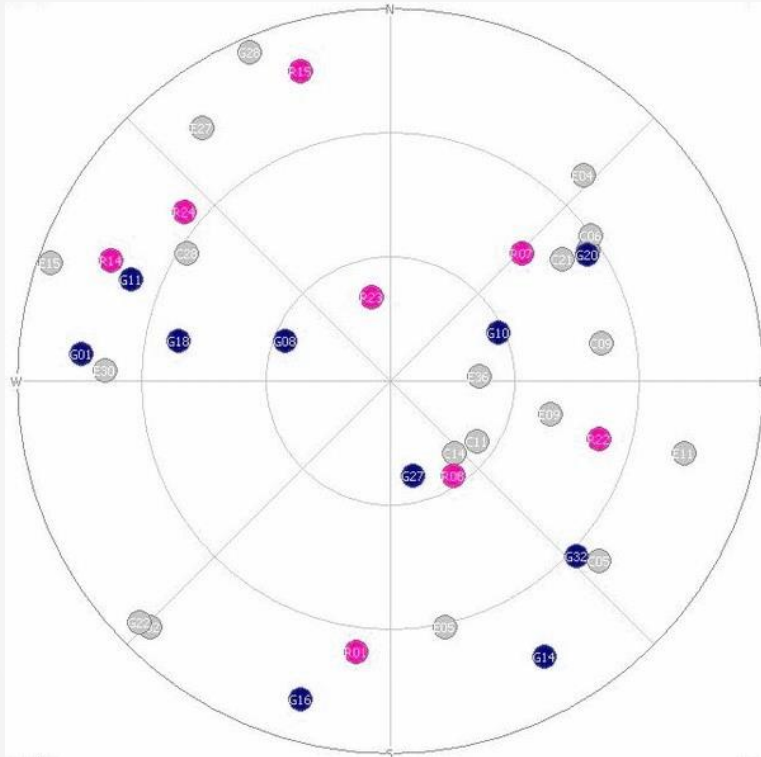
Mean values during 24 hours

GNSS	CM_31	CM_32
GPS	8.5	8.2
GLONASS	6.6	5.8
Galileo	-	6.1
BeiDou	-	2.5
Mean	15.1	22.6

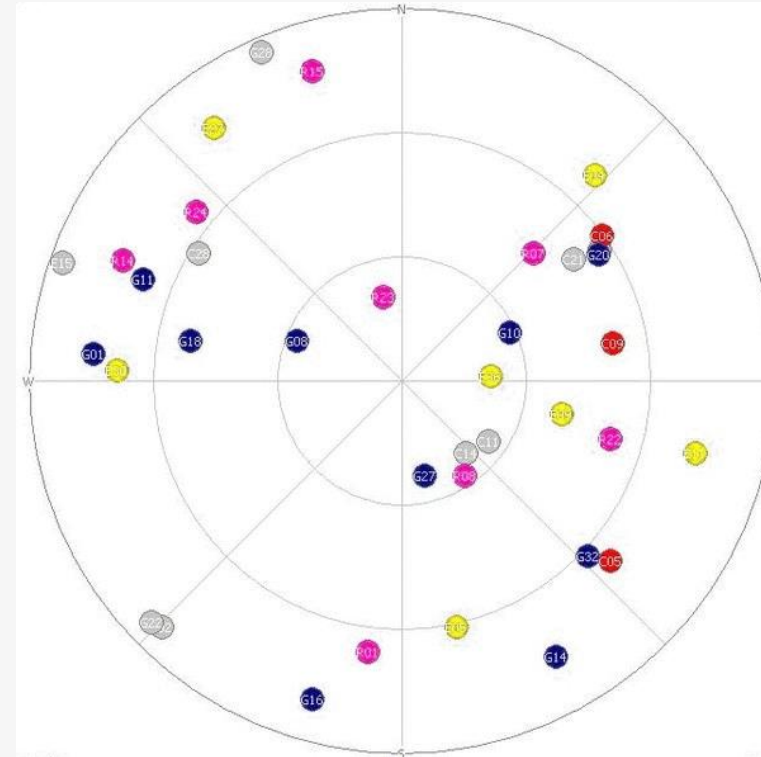
Test 1 - Skyplot

12 hours animation

SKPOS_CM_31

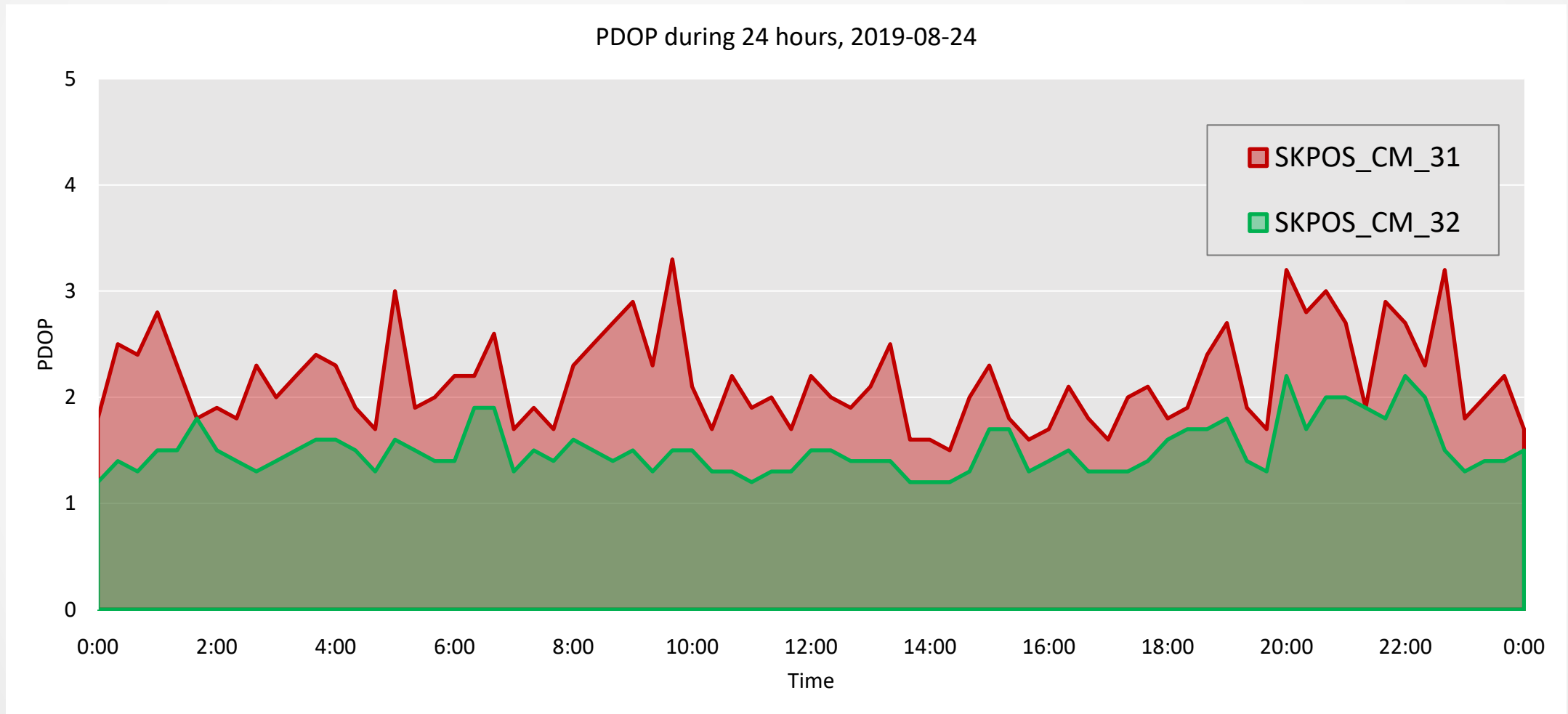


SKPOS_CM_32



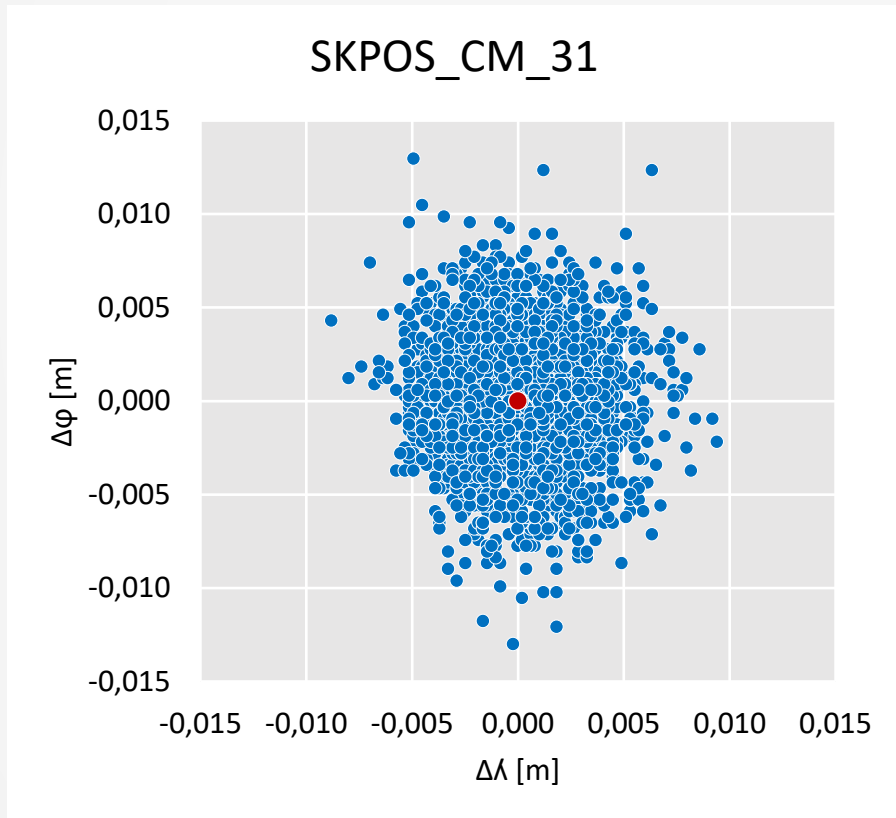
- GPS
- GLONASS
- Not broadcasted in VRS solution
- Galileo
- BeiDou

Test 1 - PDOP

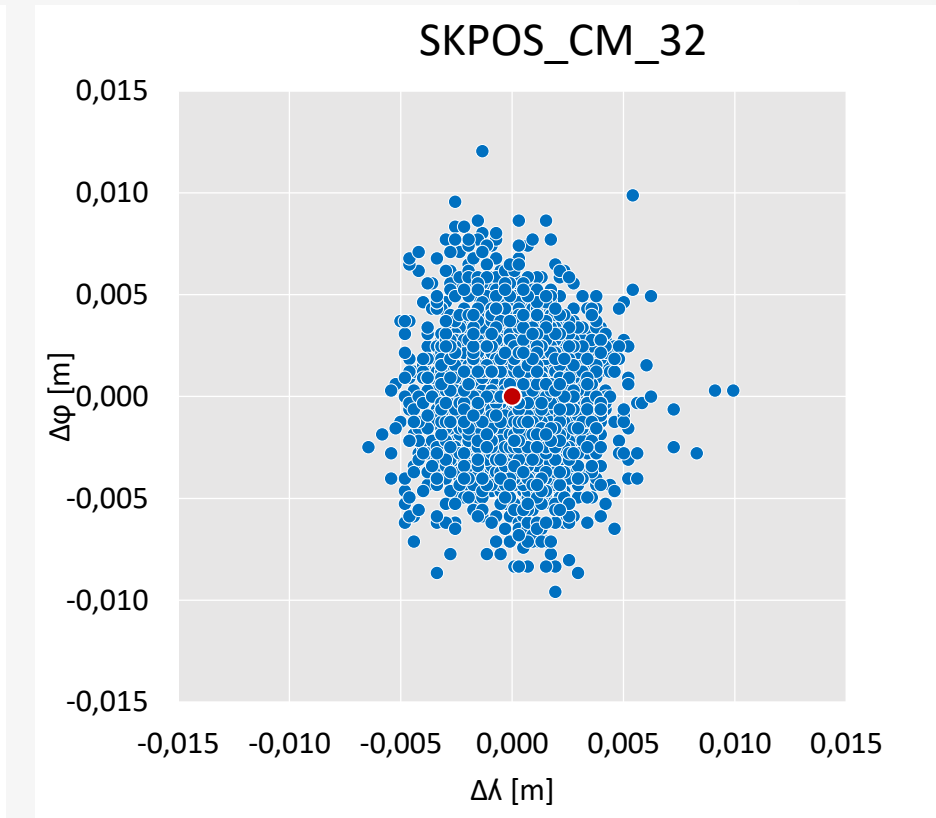


Test 1 – Horizontal position during 24 hours

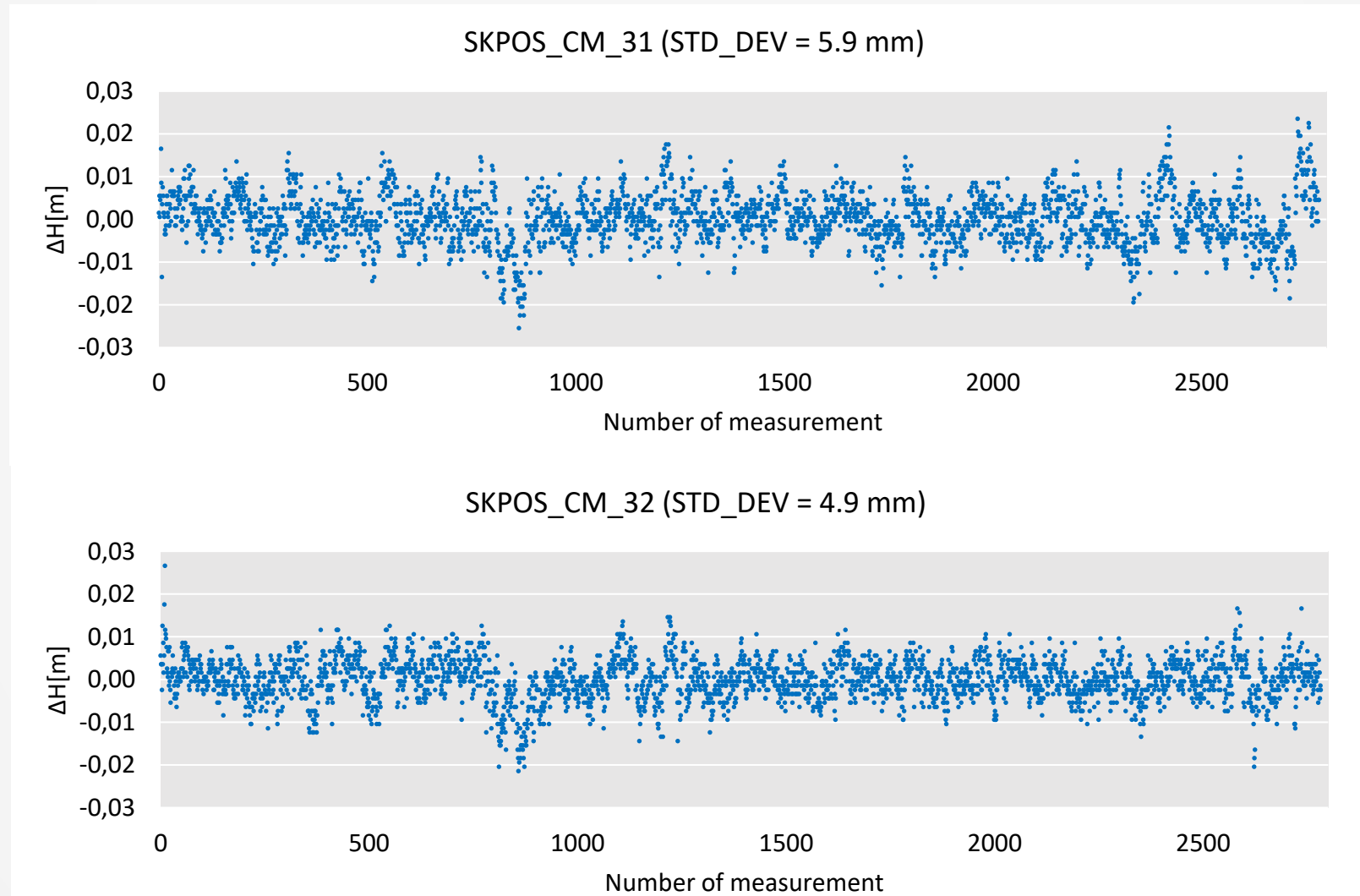
STD_DEV = 2.0 mm



STD_DEV = 1.7 mm

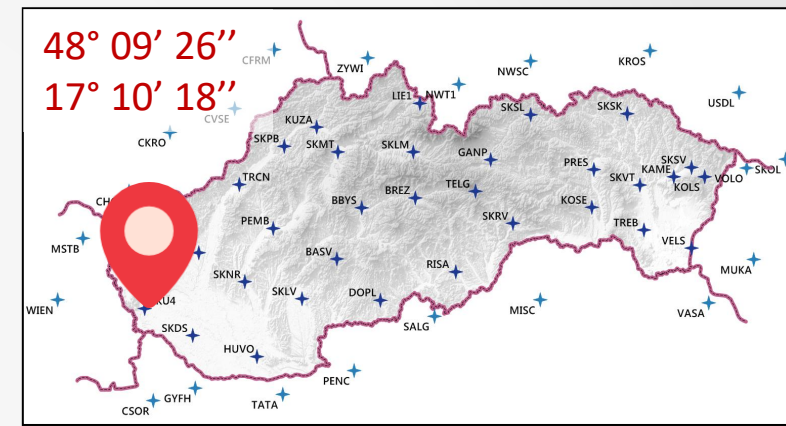


Test 1 – Height component during 24 hours



Test 2 – GKÚ Bratislava

- Location: Atrium of GKÚ Bratislava building
- 24-hours RTK test
- 2 identical rovers side by side
- Obstacles from all sides

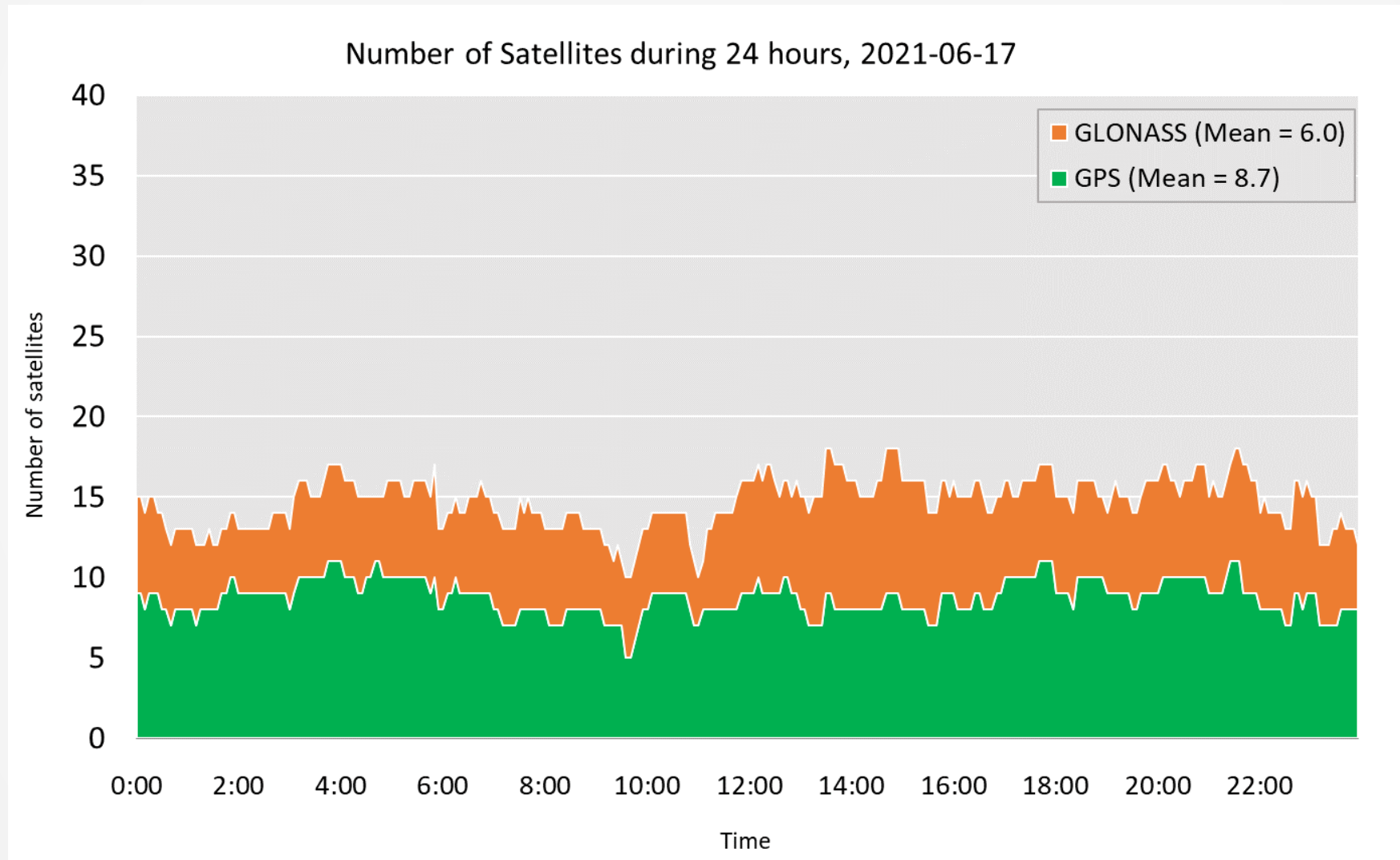


	SKPOS_CM_31	SKPOS_CM_32
Rover	Trimble R10	Trimble R10
Format	RTCM 3.1	RTCM 3.2
GNSS	GPS, GLO	GPS, GLO, GAL, BDS



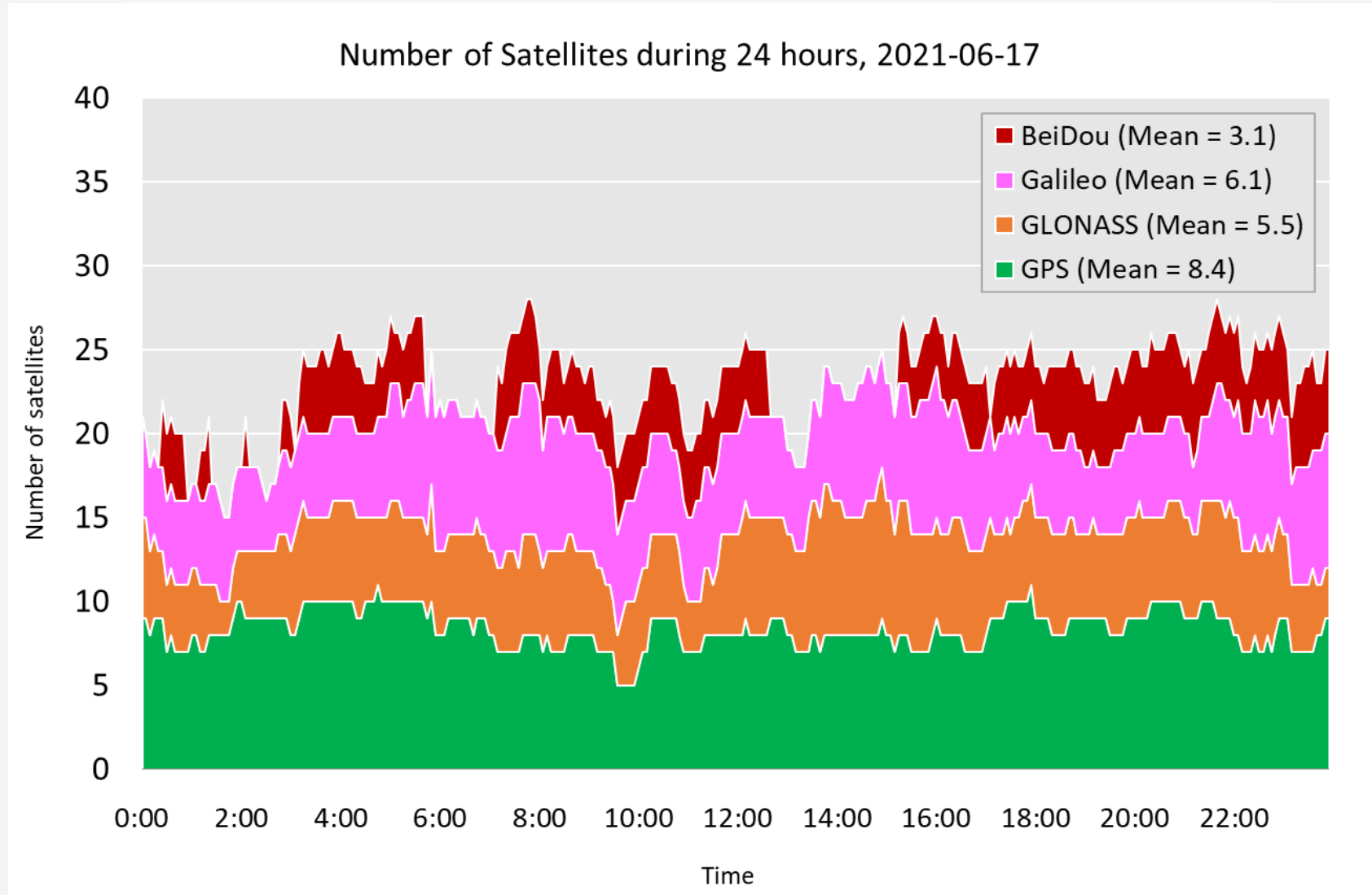
Test 2 – Number of satellites

SKPOS_CM_31



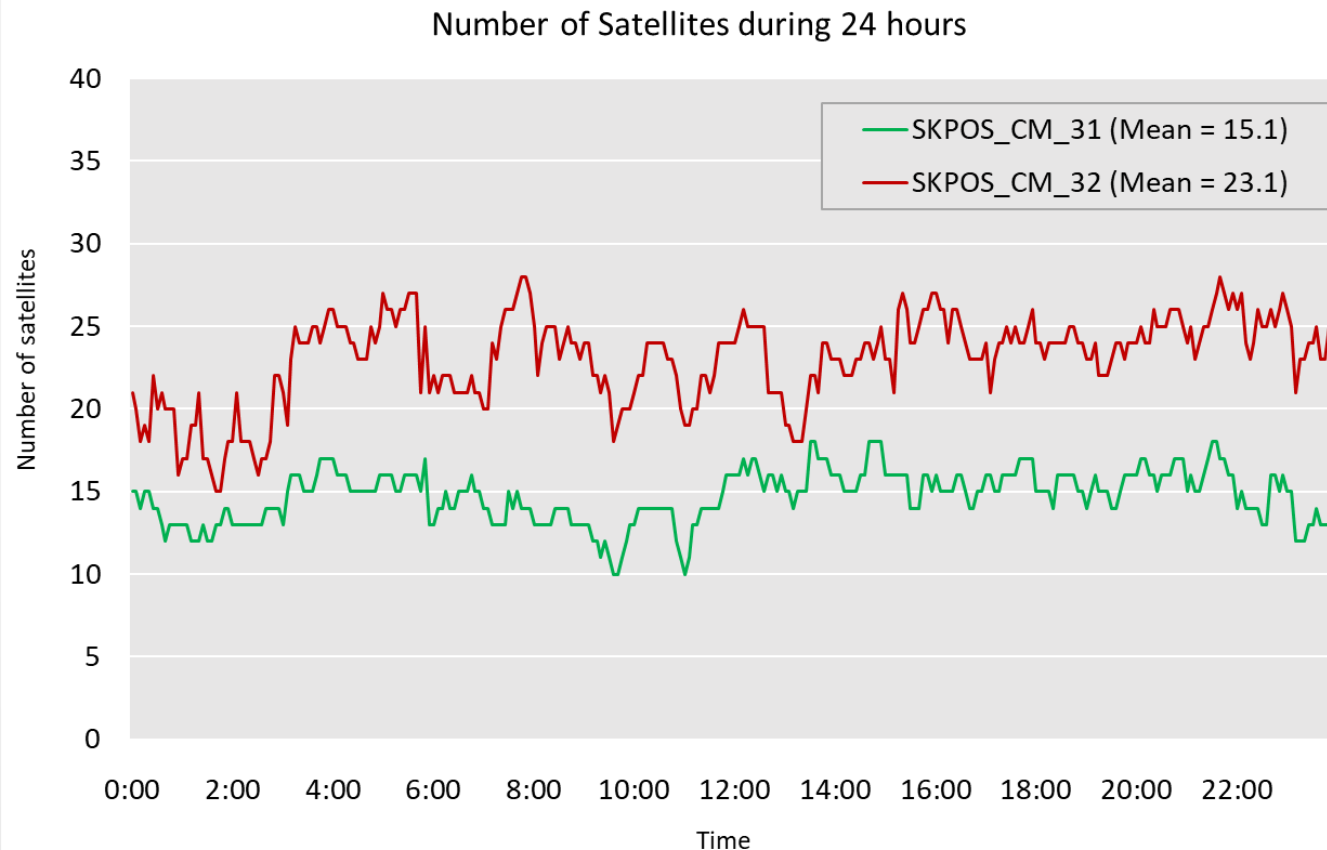
Test 2 – Number of satellites

SKPOS_CM_32



Test 2 – Number of satellites

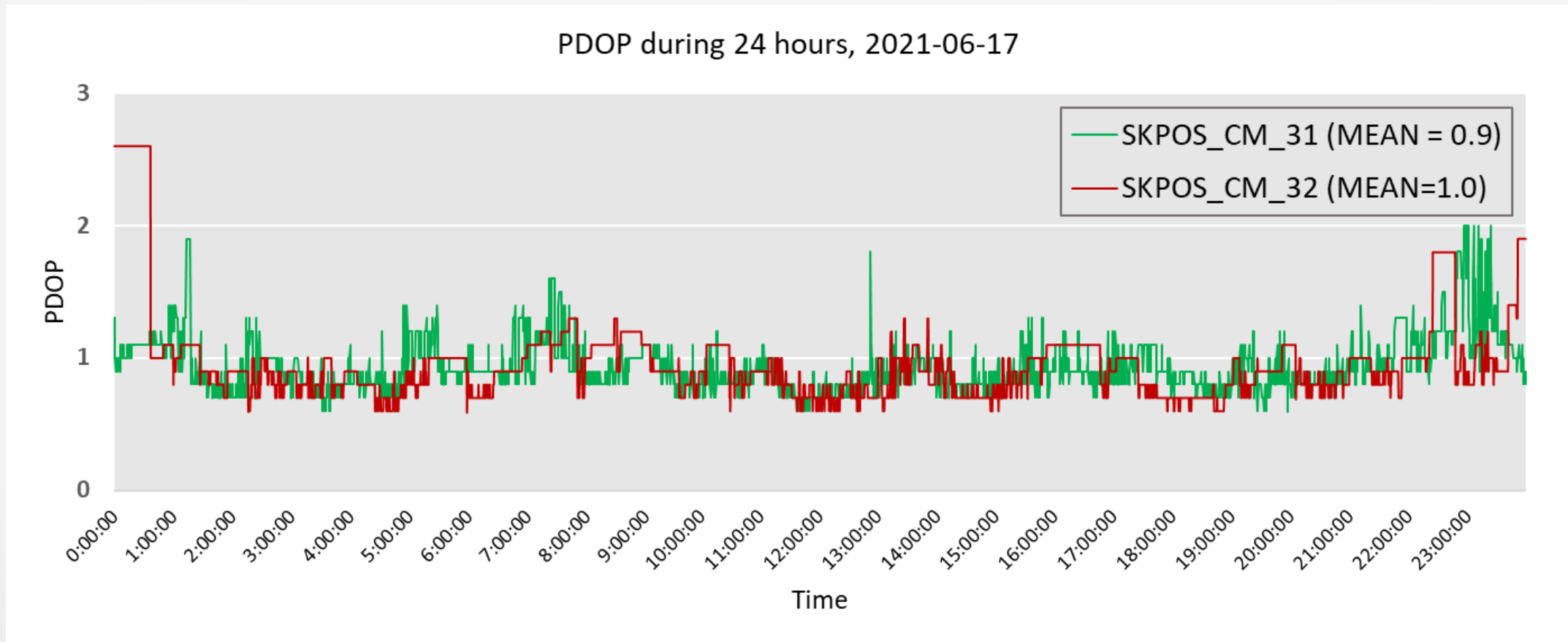
SKPOS_CM_31 vs SKPOS_CM_32



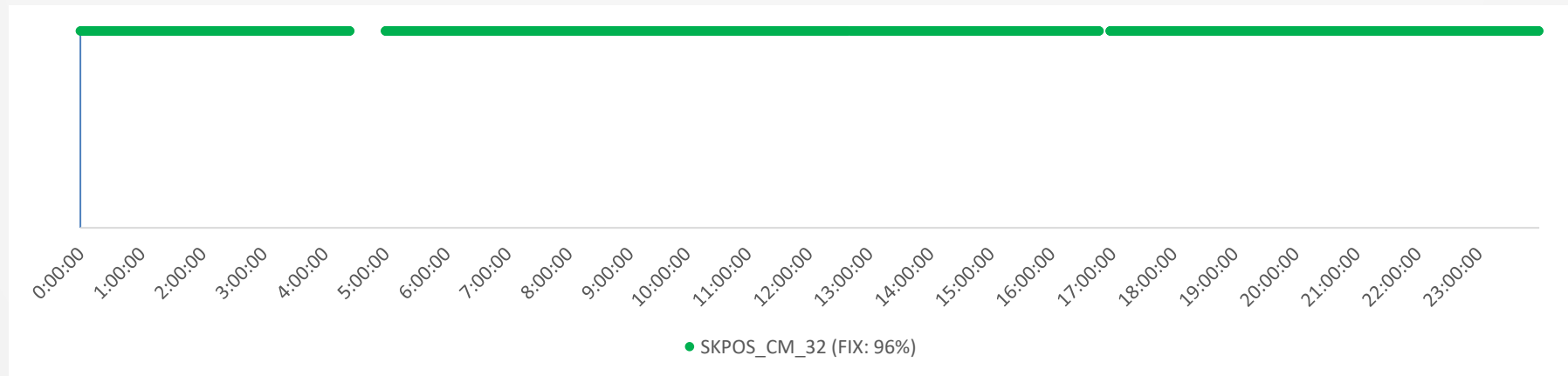
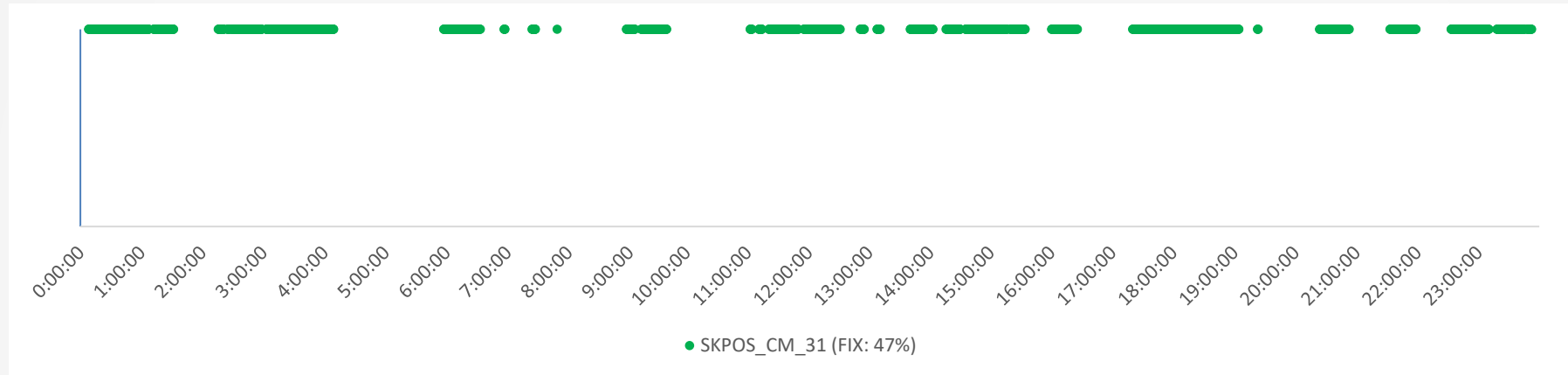
Mean values during 24 hours

GNSS	CM_31	CM_32
GPS	8.7	8.4
GLONASS	6.0	5.5
Galileo	-	6.1
BeiDou	-	3.1
Mean	14.7	23.1

Test 2 - PDOP

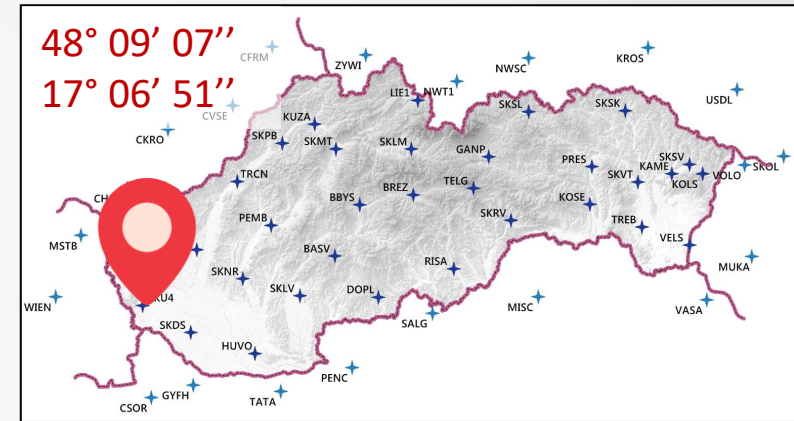


Test 2 – Number of RTK FIX solutions



Test 3 – STU Bratislava

- Location: Atrium at SUT Bratislava building
- 24-hours RTK test
- 2 identical rovers side by side
- Obstacles from all sides

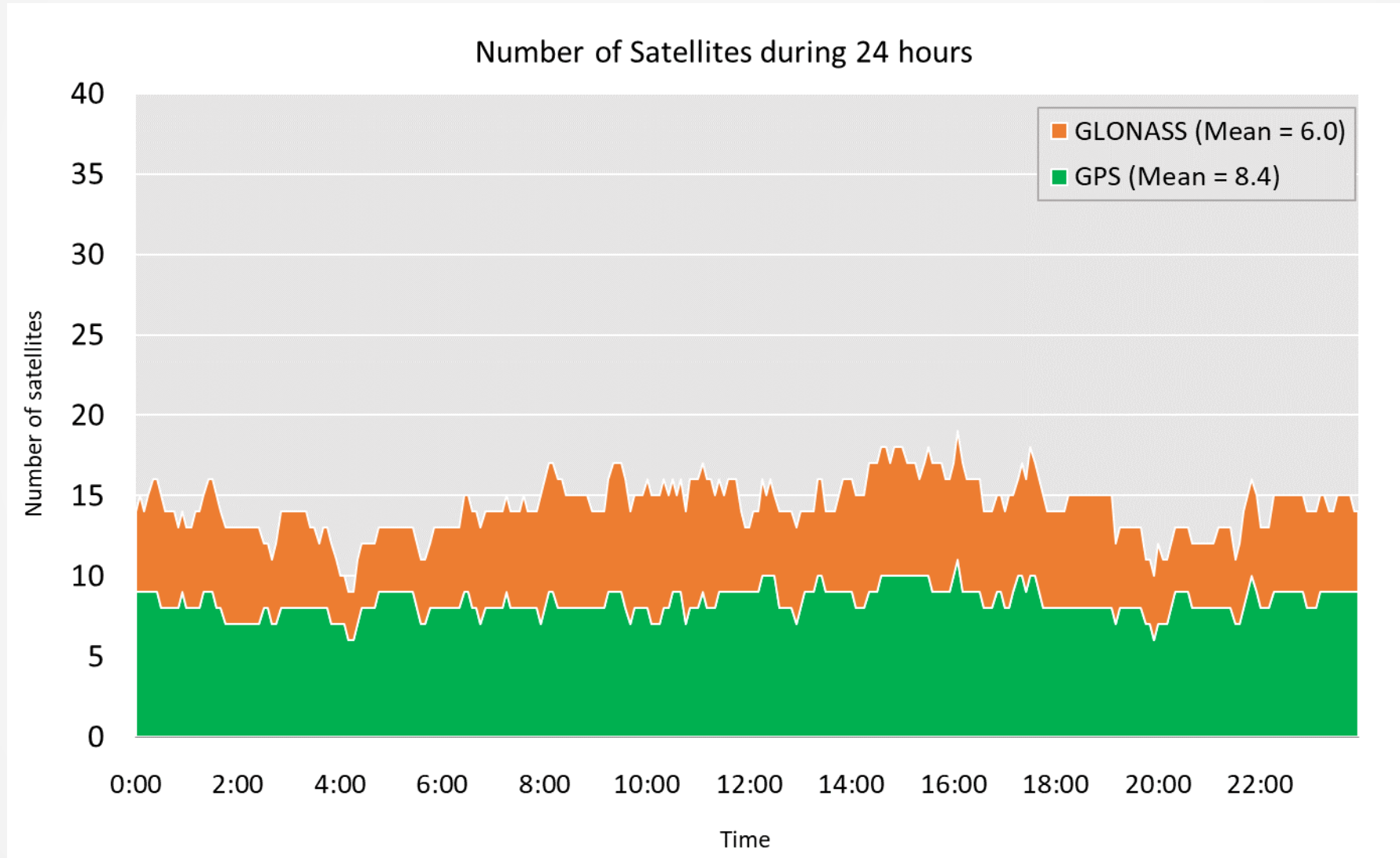


	SKPOS_CM_31	SKPOS_CM_32
Rover	Trimble R10	Trimble R10
Format	RTCM 3.1	RTCM 3.2
GNSS	GPS, GLO	GPS, GLO, GAL, BDS



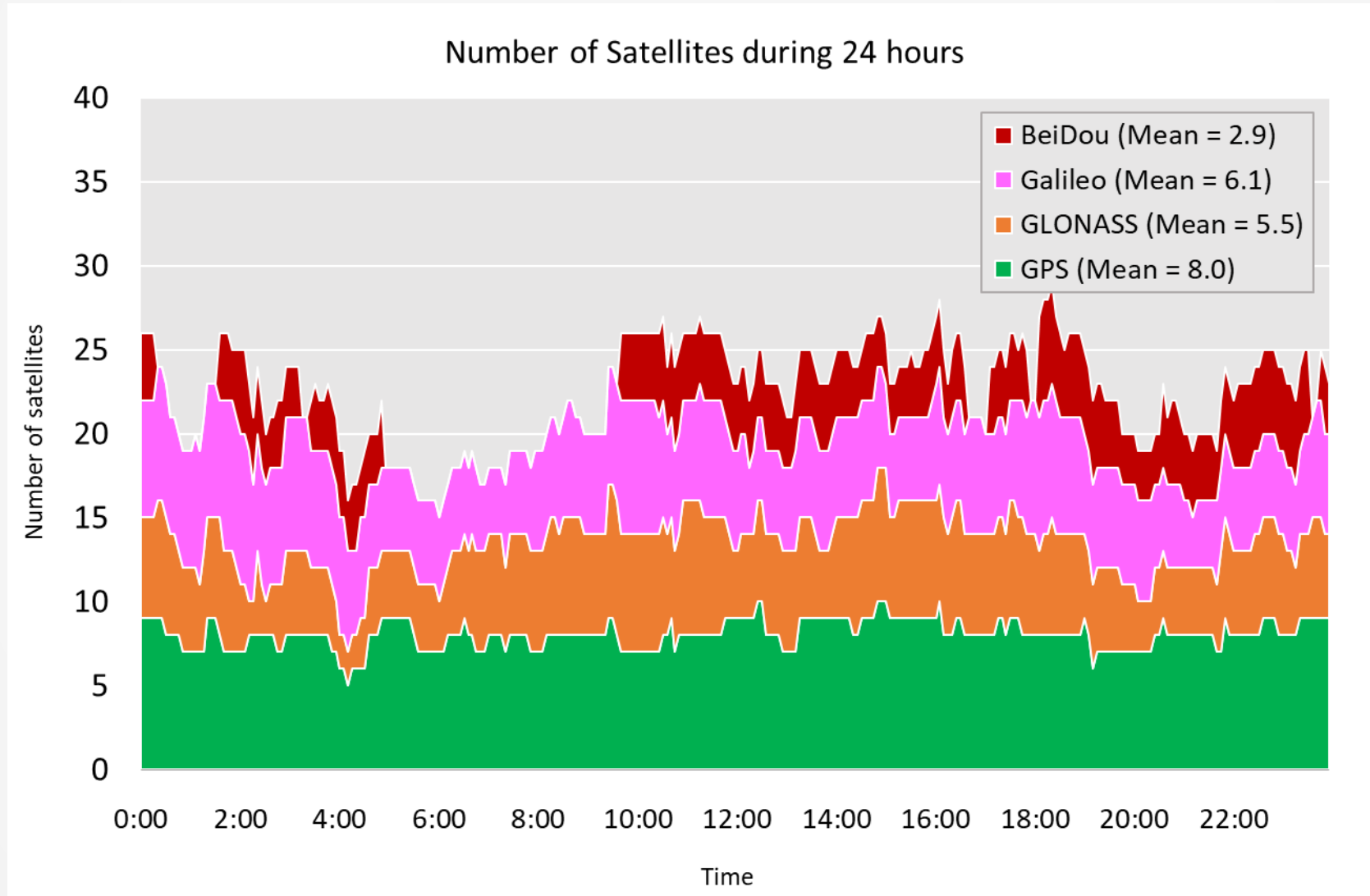
Test 3 – Number of satellites

SKPOS_CM_31



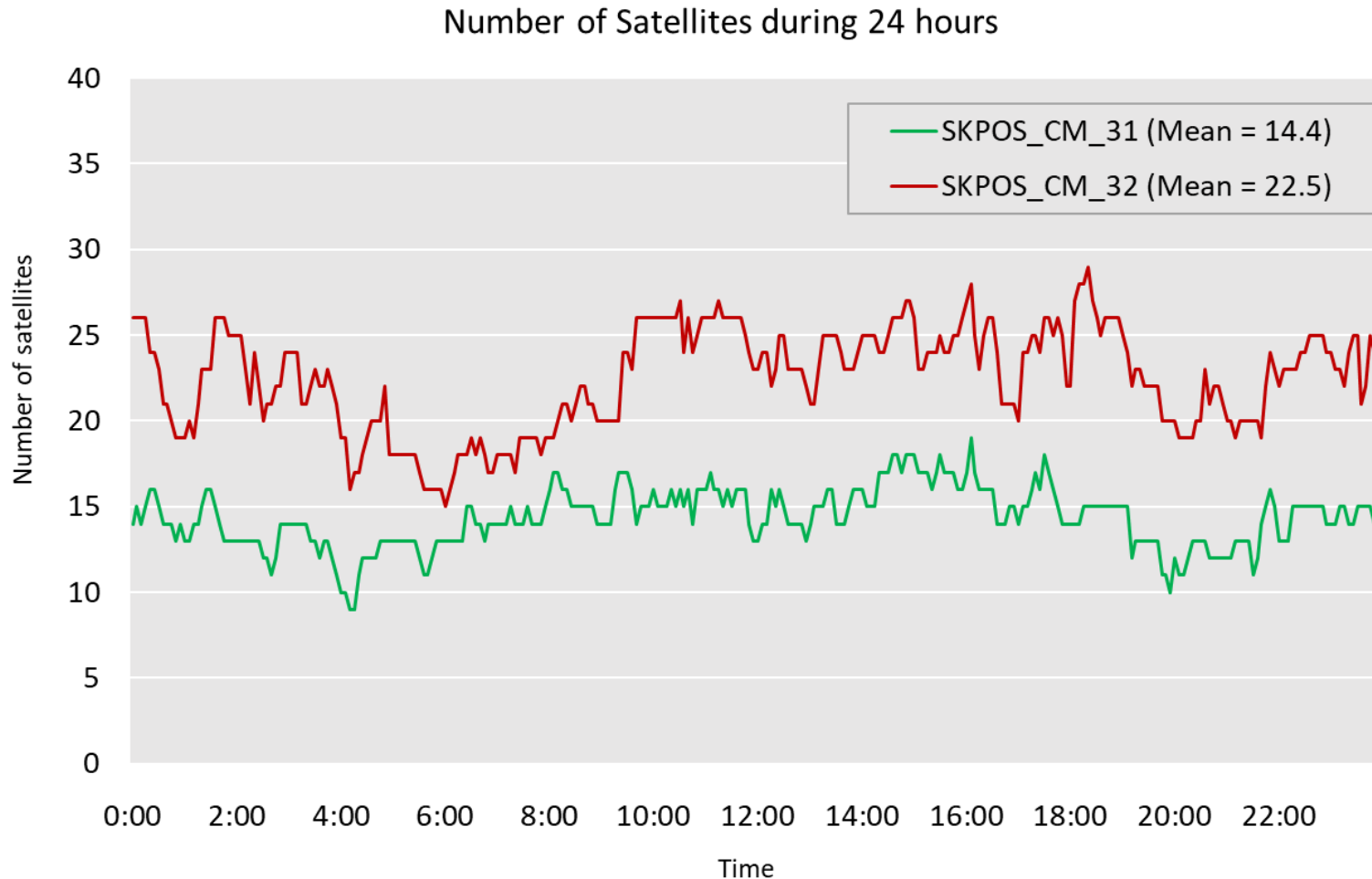
Test 3 – Number of satellites

SKPOS_CM_32



Test 3 – Number of satellites

SKPOS_CM_31 vs SKPOS_CM_32

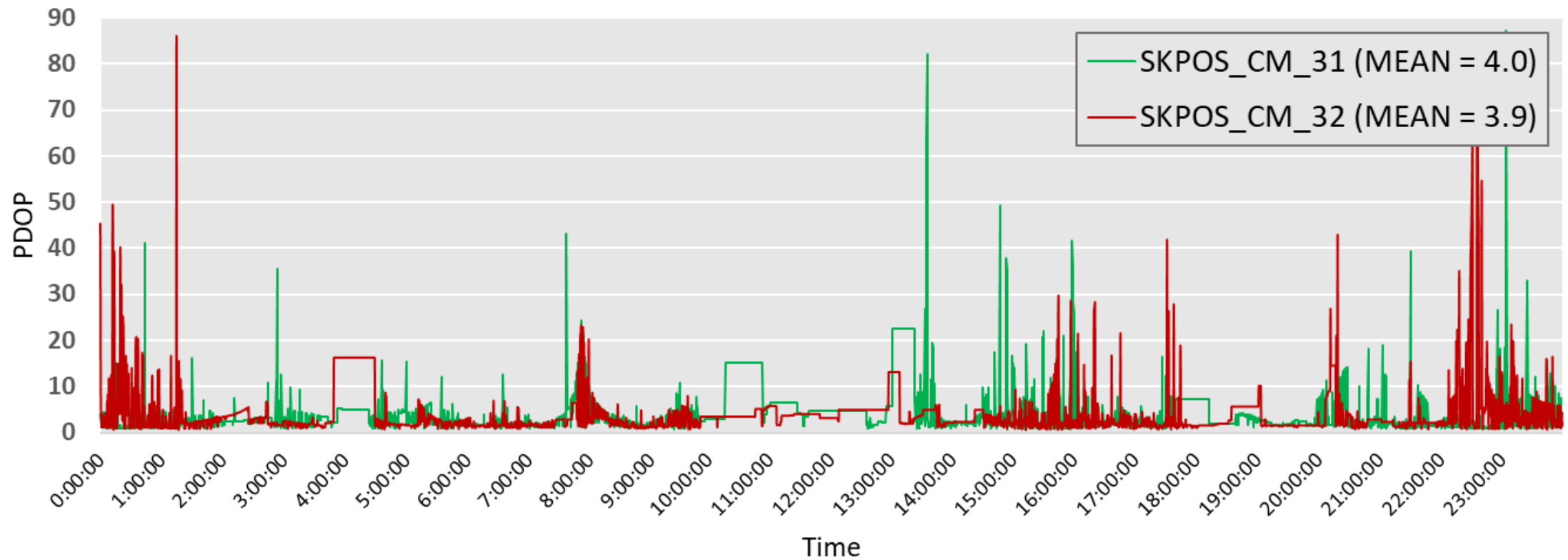


Mean values during 24 hours

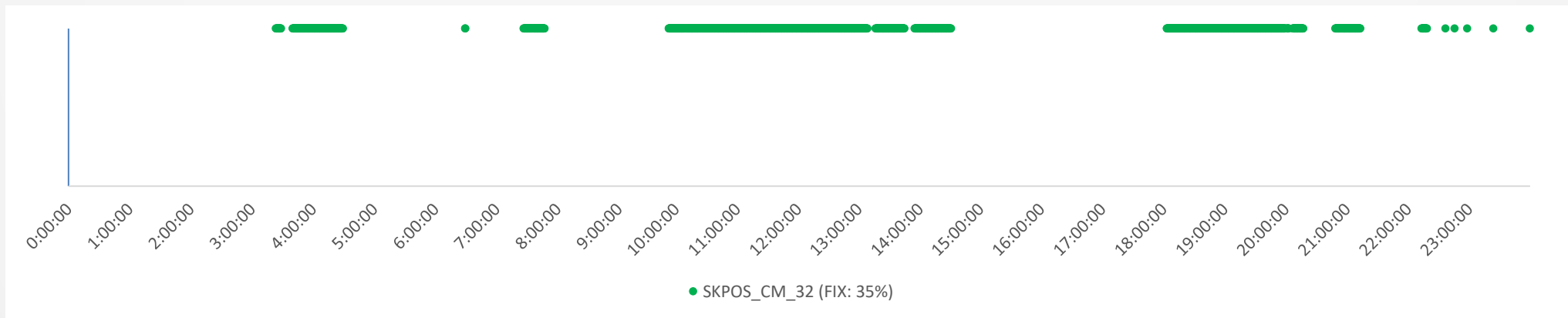
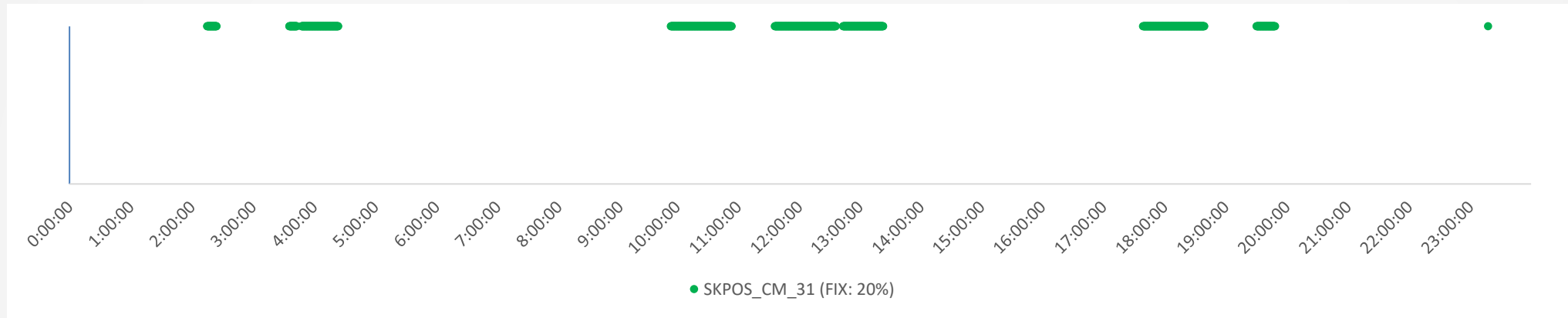
GNSS	CM_31	CM_32
GPS	8.4	8.0
GLONASS	6.0	5.5
Galileo	-	6.1
BeiDou	-	2.9
Mean	14.4	22.5

Test 3 - PDOP

PDOP during 24 hours



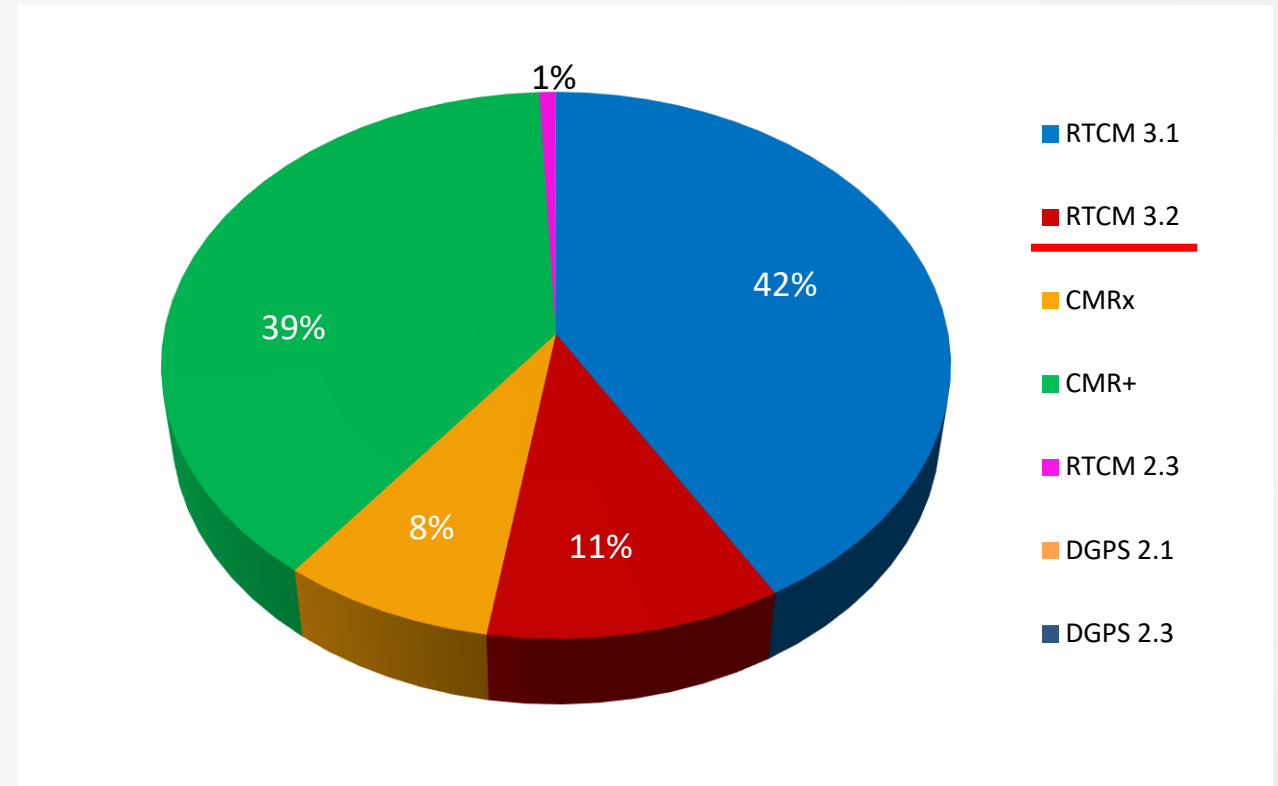
Test 3 – Number of RTK FIX solutions



Slovak real-time positioning service **SKPOS**[®]

Mountpoint usage

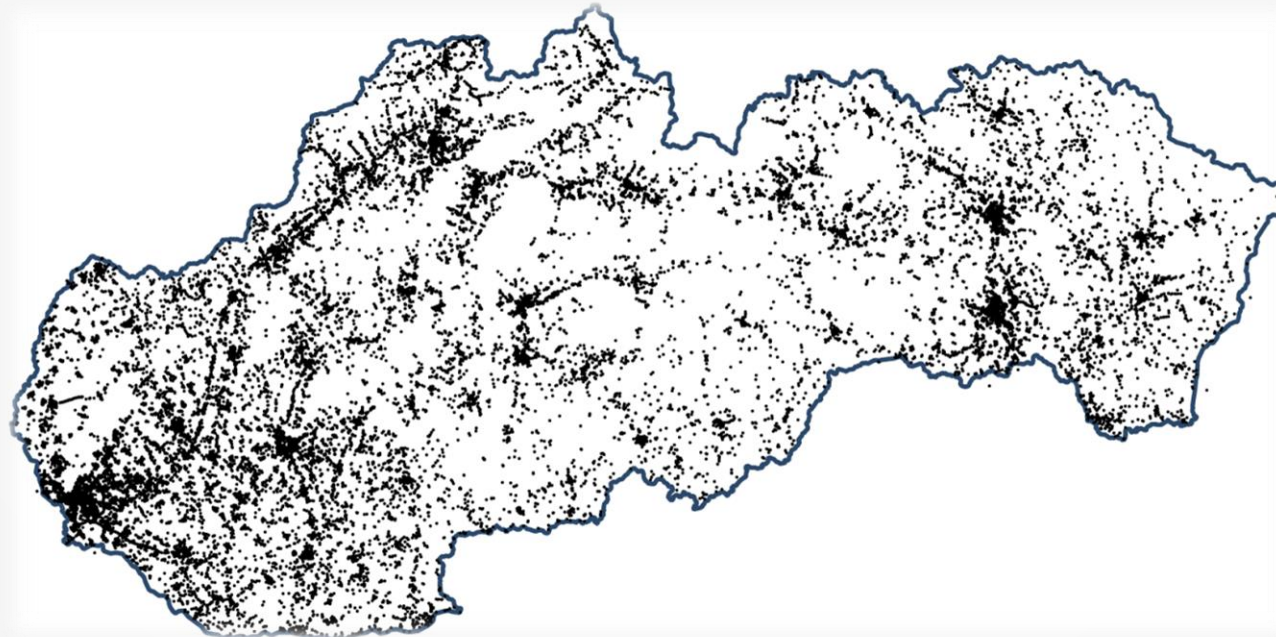
- 11% of SKPOS users use SKPOS_CM_32 mountpoint
- we assume that they use GPS+GLO+Gal+BDS



Slovak real-time positioning service **SKPOS**[®]

Initialization time (time to get FIX solution) comparison

Mountpoint	SKPOS_CM_32	Other mountpoints
Initialization time	26,8 s	29,2 s



Conclusions

- Performed test showed a positive impact of Galileo and BeiDou in SKPOS_CM_32 mountpoint
 - in average +8 satellites
 - decrease of PDOP
 - reduction of standard deviation
 - more fixed solutions
- The main benefits of adding Galileo and BeiDou
 - more satellites
 - more reliable results in bad conditions (forest, urban canyons, ...)
 - more fixed solutions
 - less outliers
 - lower initialization time



Thank you for your attention

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