Experience with RTK using Galileo and BeiDou from SKPOS

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6th EUPOS® Council and Technical Meeting
October 30-31, 2019. Budapest, Hungary
Slovak real-time positioning service

SKPOS®

13 years of continuous operation
+1,800 active users
+50 reference stations

GPS, GLONASS, Galileo, BeiDou

NetR9
Alloy
Choke Ring

Zephyr Geodetic 2
Zephyr Geodetic 3
Trimble Pivot Platform
Ver. 4.3
RTXNet Processor
Since October 2018
Slovak real-time positioning service

SKPOS® +Galileo and +BeiDou

from Dec 2006
  • GPS+GLO

from Oct 2018
  • GPS+GLO+GAL+BDS

Galileo and BeiDou usage need to be checked!

⇒ Decision to perform +Galileo +BeiDou test within SKPOS®:
  • Long term RTK test (24 hours continuous RTK performance) done by GKU
Long term RTK test

- GNSS antenna on InSar reflector
- Only 10 meters from the nearest reference station
- 24 hours RTK test

<table>
<thead>
<tr>
<th></th>
<th>SKPOS_CM_31</th>
<th>SKPOS_CM_32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rover</td>
<td>Trimble NetR9</td>
<td>Trimble NetR9</td>
</tr>
<tr>
<td>Software</td>
<td>RTKNAVI</td>
<td>RTKNAVI</td>
</tr>
<tr>
<td>Format</td>
<td>RTCM 3.1</td>
<td>RTCM 3.2 MSM5</td>
</tr>
<tr>
<td>GNSS</td>
<td>GPS, GLO</td>
<td>GPS, GLO, GAL, BDS</td>
</tr>
</tbody>
</table>
Number of satellites
SKPOS_CM_31

Number of Satellites during 24 hours, 2019-08-24

- GLONASS (Mean = 6.6)
- GPS (Mean = 8.5)
Number of satellites
SKPOS_CM_32

Number of Satellites during 24 hours, 2019-08-24

- BeiDou (Mean = 2.5)
- Galileo (Mean = 6.1)
- GLONASS (Mean = 5.8)
- GPS (Mean = 8.2)
Number of satellites
SKPOS_CM_31 vs SKPOS_CM_32

Mean values during 24 hours

<table>
<thead>
<tr>
<th>GNSS</th>
<th>CM_31</th>
<th>CM_32</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS</td>
<td>8.5</td>
<td>8.2</td>
</tr>
<tr>
<td>GLONASS</td>
<td>6.6</td>
<td>5.8</td>
</tr>
<tr>
<td>Galileo</td>
<td>-</td>
<td>6.1</td>
</tr>
<tr>
<td>BeiDou</td>
<td>-</td>
<td>2.5</td>
</tr>
<tr>
<td>SUM</td>
<td><strong>15.1</strong></td>
<td><strong>22.6</strong></td>
</tr>
</tbody>
</table>
Horizontal position during 24 hours

STD_DEV = 2.0 mm

STD_DEV = 1.7 mm
Height component during 24 hours

SKPOS_CM_31 (STD_DEV = 5.9 mm)

SKPOS_CM_32  (STD_DEV = 4.9 mm)
SKPOS® Data Shop and Mountpoint usage statistics

- Reference Data Shop post-processing files download statistics
  - GAL+BDS fully available only in RINEX v3 format (too in T02-4)
  - 78% of users still use RINEX v2 files (no correct BDS)

- Mountpoint usage statistics
  - GAL+BDS provided only by SKPOS_CM_32 mountpoint (RTCM 3.2 MSM5)
  - only 9% of all SKPOS users use SKPOS_CM_32 mountpoint
Conclusions

- Performed test showed a positive impact of using Galileo and BeiDou satellites
  - an average of 7 more satellites
  - decrease PDOP
  - reduction of standard deviation
  - more fixed solutions

- The main benefits of using Galileo and BeiDou
  - better measurement availability in bad conditions (forest, urban area, ...)
  - more fixed solutions
  - greater measurement reliability - less outliers
Thank you for your attention