VELOCITIES VALIDATION IN THE NEW RUSSIAN REFERENCE FRAME GSC-2011

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REFERENCE FRAME GSC-2011

- Introduced alongside with PZ-90.11
- Centimeter-level agreement with ITRF2008 at epoch 2011.0
- Based on GNSS observation campaign 2010-2011
- Kinematic: typical velocities of ground points 2-7 cm/year
- NUVEL-1A tectonic plate motion model was used in adjustment
- Physically represented by the State Geodetic Network (SGN)
46 Continuously Operating Reference Stations (CORS)
Only 33 GNSS stations to be available for civil users

Nearly 288 000 “passive” reference points
(landmarks, pillars)
1st LEVEL OF THE STATE GEODETTIC NETWORK
CORS of the State Geodetic Network

Regional CORS which belong to private organizations or local authorities
HORIZONTAL VELOCITIES: GSC-2011 vs. ITRF2008

- Eurasian Plate
- Amur Plate (not in NUVEL-1A)

- ↔ 13 mm/y
- ↔ 10 mm/y
- ↔ 56 mm/y

Figure shows the relative movements of the Eurasian and Amur plates with respect to each other.
HORIZONTAL VELOCITIES: GSC-2011 vs. ITRF2008

ULAB
KHAJ
YSSK
VLDV
STK2
DAEJ

1 cm/year
0 km
1000 km

(GSC-2011)
**VELOCITY VALIDATION:**
GSC-2011 vs. Velocity Estimate for the Closest Local Station

**VLDV – VLAD**
Distance 37 km

<table>
<thead>
<tr>
<th>Station</th>
<th>Data source</th>
<th>Velocity, mm/y</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VLDV</strong></td>
<td>GSC -2011</td>
<td>70  -38  10</td>
</tr>
<tr>
<td><strong>VLAD</strong></td>
<td>PPP time-series (6 months)</td>
<td>21 ± 7 (95%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 ± 6 (95%)</td>
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<tr>
<td></td>
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<td>-35 ± 12 (95%)</td>
</tr>
</tbody>
</table>
VERTICAL VELOCITY DEVIATION
GSC-2011 vs. ITRF2008

↑ 10 mm/y

↓ -40 mm/y

↓ -9 mm/y
VELOCITY VALIDATION:
GSC-2011 vs. Velocity Estimate for the Closest Local Station

**EKTR – EKAT**
Distance 4 km

<table>
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<th>Station</th>
<th>Source</th>
<th>Velocity, mm/y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$V_E$</td>
</tr>
<tr>
<td>EKTR ((\text{GSC-2011}))</td>
<td>GSC-2011</td>
<td>14</td>
</tr>
<tr>
<td>EKAT ((\text{SmartNet}))</td>
<td>PPP time-series ((6 \text{ months}))</td>
<td>16 ± 5 ((95%))</td>
</tr>
</tbody>
</table>
CONCLUSION

• Significant inconsistencies with ITRF in vertical and horizontal velocity components are detected.
• Cause is unknown: local geodynamic processes or data processing issues?
• GSC-2011 dataset needs to be thoroughly checked before its introduction.
• Vertical and horizontal deformation models are needed.
• Non-SGN CORS to be used also for deriving deformation models.
AKNOWLEDGEMENT

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THANK YOU FOR YOUR ATTENTION!

QUESTIONS?