



Velocity Fields of the Latvian CORS Station Daily Coordinates for 2012-2017

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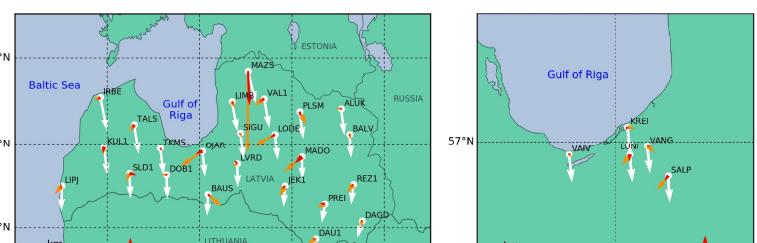
Introduction

The objective of this study is to obtain horizontal and vertical velocity fields of the continuously operating reference stations (CORS) in Latvia for 6 year time period: years 2012-2017. Latvian CORS velocities have been previously obtained by (Haritonova, 2016) for years 2012-2015. Here both solutions are displayed.

The raw observation data are collected from GNSS ground based continuously operating reference stations (CORS) observation sites in Latvia: LatPos (26 stations in 2018) and EUPOS®-Riga (5 stations). Bernese GNSS Software V5.2 is used for obtaining daily solutions. Global data corrections (GNSS orbit and clock corrections, Earth rotation, ionosphere, troposphere corrections, ocean loading parameters) are applied. 9 IGS/EPN reference station observations, coordinates and velocities are used to compute the coordinates of Latvian CORS.

Daily coordinates are computed in IGS and International Terrestrial Reference Frame (ITRF) realization IGS08 (up to end of year 2016) and IGS14 (since beginning of year 2017). Daily solutions are then transformed to ETRF2000, epoch 2000.0. Up coordinates are expressed also in ITRF2008. Time series were aligned from shifts occurred due to antenna change and introduction of GLONASS observations in 2015. Outliers were removed.

The horizontal and vertical velocity fields as well as monthly station velocities of the daily solutions have been computed for all LATPOS and EUPOS®-Riga CORS stations for years 2012-2017. Velocity fields were not computed for new stations: VALK introduced in 2015. VAIN introduced in 2016 and KUL2 introduced in 2017.



EUPOS-RIGA (right) and LATPOS (left) CORS station horizontal (top) and vertical (bottom)
movements obtained from the daily solutions (2012-2017: red; 2012-2015: yellow);
horizontal and vertical velocities from NKG_RF03vel and NKG2016LU_abs models (white)

Latvian CORS station velocities (mm/yr) in North, East and Up components (2012-2015 and 2012-2017) with RMS values (mm) (2012-2017) from daily solution;
velocities from the deformation models NKG_RF03vel and NKG2016LU_abs

Station	North ETRF2000			East ETRF2000			Up ETRF2000			Up ITRF2008			
	2012-2017	RMS	2012-2017	NKG_RF03vel	2012-2017	RMS	2012-2017	NKG_RF03vel	2012-2017	RMS	2012-2017	NKG2016LU_abs	
ALUK	0.02	0.05	-0.01	-0.57	-0.04	0.05	-0.11	0.07	-0.22	-0.22	0.76	0.17	0.76
BALV	-0.03	0.04	-0.11	-0.52	-0.03	0.07	0.03	0.03	-0.15	-0.11	0.81	0.14	0.85
BAUS	-0.07	0.04	-0.26	-0.46	0.07	0.05	0.29	-0.02	-0.04	-0.04	0.91	0.13	0.91
DAGD	-0.02	0.05	-0.15	-0.37	-0.04	0.04	-0.02	-0.10	-0.18	-0.22	0.77	0.15	0.73
DAU1	0.00	0.05	-0.11	-0.34	-0.07	0.05	-0.18	-0.12	-0.22	-0.22	0.73	0.15	0.73
DOB1	-0.01	0.05	0.00	-0.52	-0.04	0.05	-0.11	0.02	0.02	0.01	0.98	0.13	0.97
IRBE	-0.07	0.05	-0.07	-0.73	-0.07	0.05	-0.15	0.15	0.47	0.91	1.45	0.18	1.89
JEK1	-0.07	0.05	-0.22	-0.45	-0.07	0.04	-0.11	-0.03	-0.11	0.02	0.84	0.16	0.97
KRE1	-0.07	0.04	-0.04	-0.58	-0.04	0.07	0.15	0.06	0.04	-0.01	1.01	0.15	0.96
KUL1	-0.15	0.06	-0.18	-0.62	-0.03	0.05	-0.02	0.07	0.18	0.22	1.15	0.15	1.25
LIMB	-0.07	0.05	-0.15	-0.64	0.04	0.05	0.07	0.12	0.26	0.51	1.24	0.16	1.49
LIPJ	-0.07	0.05	-0.18	-0.54	-0.04	0.05	-0.15	-0.01	0.22	0.33	1.18	0.16	1.29
LODE	-0.07	0.05	-0.26	-0.56	-0.11	0.05	-0.44	0.06	-0.03	0.03	0.94	0.14	1.00
LUNI	-0.15	0.05	-0.22	-0.56	-0.01	0.06	-0.15	0.05	-0.04	0.07	0.92	0.13	1.03
LVRD	0.07	0.06	-0.07	-0.51	-0.07	0.05	-0.11	0.01	0.11	0.22	1.08	0.17	1.19
MADO	-0.15	0.05	-0.33	-0.50	-0.15	0.05	-0.37	0.01	0.01	0.04	0.97	0.15	1.00
MAZS	-0.73	0.21	-1.75	-0.69	0.03	0.14	-0.01	0.17	0.15	0.33	1.13	0.22	1.31
OJAR	-0.07	0.06	-0.33	-0.56	-0.15	0.08	-0.47	0.05	0.15	0.40	1.12	0.17	1.37
PLSM	-0.11	0.07	-0.29	-0.59	0.02	0.06	0.15	0.08	0.11	0.22	1.08	0.15	1.19
PREI	0.02	0.05	-0.07	-0.40	-0.11	0.09	-0.18	-0.07	-0.18	-0.15	0.77	0.15	0.80
REZ1	-0.04	0.07	-0.18	-0.43	-0.07	0.04	-0.15	-0.05	-0.26	-0.18	0.69	0.16	0.77
SALP	-0.11	0.11	-0.29	-0.54	-0.07	0.11	-0.22	0.03	-0.22	-0.88	0.75	0.19	0.09
SIGU	-0.03	0.06	-0.11	-0.58	-0.04	0.06	0.03	0.07	0.03	0.11	1.00	0.16	1.08
SLD1	-0.04	0.06	-0.18	-0.54	0.15	0.09	-0.07	0.02	0.07	0.00	1.04	0.13	0.97
TALS	-0.11	0.05	-0.15	-0.65	-0.03	0.06	-0.11	0.10	0.26	0.40	1.23	0.15	1.37
TKMS	-0.07	0.05	-0.07	-0.59	0.04	0.04	0.04	0.07	0.11	0.18	1.08	0.11	1.15
VAIV	0.01	0.05	-0.07	-0.57	-0.02	0.06	0.07	0.06	-0.22	-0.11	0.74	0.15	0.85
VAL1	-0.07	0.05	-0.15	-0.63	-0.11	0.05	-0.22	0.11	0.15	0.26	1.13	0.14	1.24
VANG	-0.03	0.05	-0.15	-0.56	0.07	0.08	0.15	0.06	0.02	0.18	0.99	0.15	1.15

Conclusions

- The resulting daily solution vertical velocity range for 2012-2017 is 0.76 mm/yr: from +0.69 to +1.45 mm/yr, vertical velocity field for 2012-2017 is more homogeneous than for 2012-2015.
- Daily solution vertical velocities for years 2012-2015 and for years 2012-2017 correlate well, average difference is 0.06 mm/yr, the minimum difference -0.44 mm/yr in IRBE and the maximum difference 0.66 mm/yr in SALP.
- The velocity range of NKG2016LU_abs model is 1.90 mm/yr, with the minimum +0.02 mm/yr and the maximum +1.91 mm/yr. According to the daily solution, the vertical velocities of western GNSS stations correlate well to the data of NKG2016LU_abs. However in south-eastern part of Latvia velocity differences in the vertical component reaches up to 0.75 mm/yr.
- The station horizontal displacements have similar orientation for both years 2012-2015 and years 2012-2017, but with smaller absolute values for years 2012-2017.
- NKG_RF03vel horizontal velocities are more oriented to south and have larger absolute values.
- Monthly velocities show larger values and standard deviations in winter months, the main reason could be seasonal deformations of constructions where antennas have been fixed.

Monthly velocities (mm/month) and Standard Deviations (mm) for Latvian CORS stations

