



MAA-AMET

Verification of GNSS data in Estonia

Dr Karin Kollo

Department of Geodesy

Estonian Land Board



MAA-AMET

Outline

- Introduction
- Data used
- GNSS networks and time series
- Models (LU, GIA) and comparisons
- Results



Introduction

- Estonia is situated at the South-East corner of the Fennoscandian post-glacial rebound area
- The impact of ongoing Glacial Isostatic Adjustment (GIA) can be noticed on accurate geodetic measurements, such is GNSS



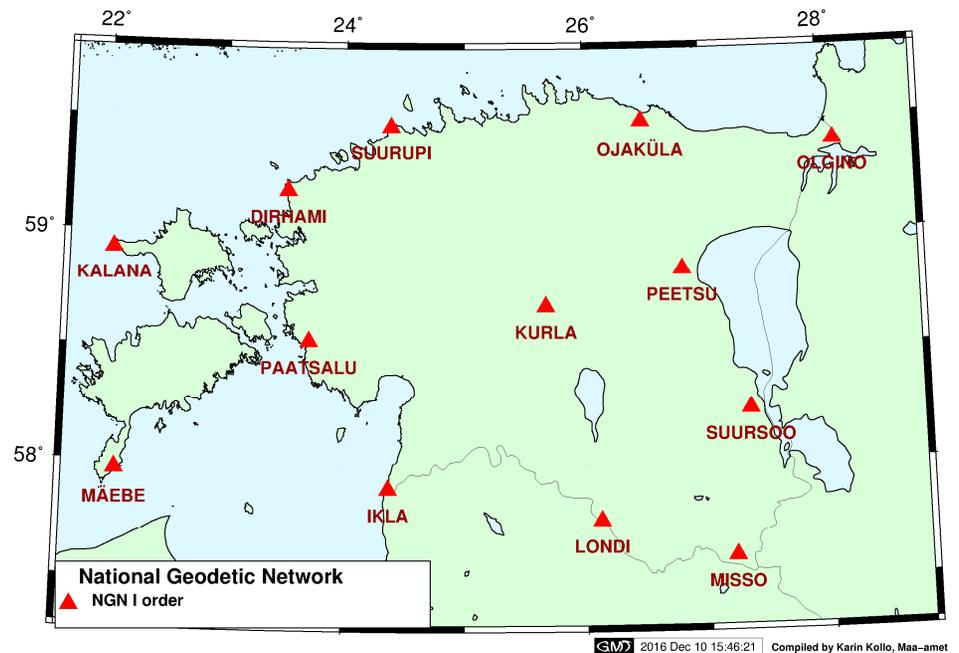
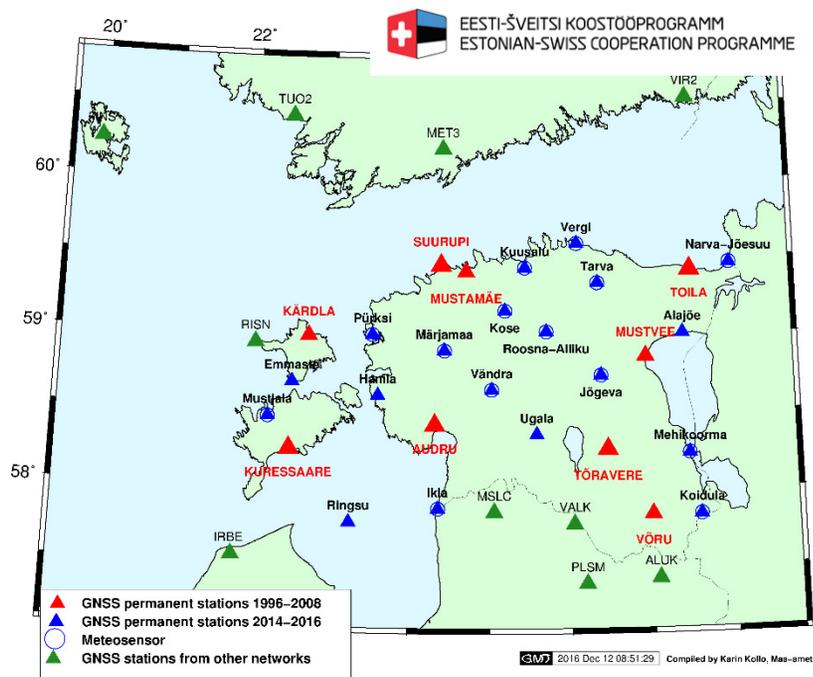
Data used

- From GNSS network
 - Estonian GNSS permanent reference stations
 - GPS campaigns held in 1997 and 2008
- From modelling
 - land uplift models (NKG2005LU and EST2013LU)
 - GIA model



MAA-AMET

ESTPOS and NGN I order network





Campaign-wise GPS measurements

- 1997 and 2008 for I-order geodetic network
- The computations with Bernese, versions 4.2 and 5.0



ESTREF computations

- Since 2007 (week 1448) cumulative daily and weekly solutions
- Bernese software (versions 5.0 and 5.2)
- Guidelines for EPN and NKG
- Altogether ca 80 stations computed

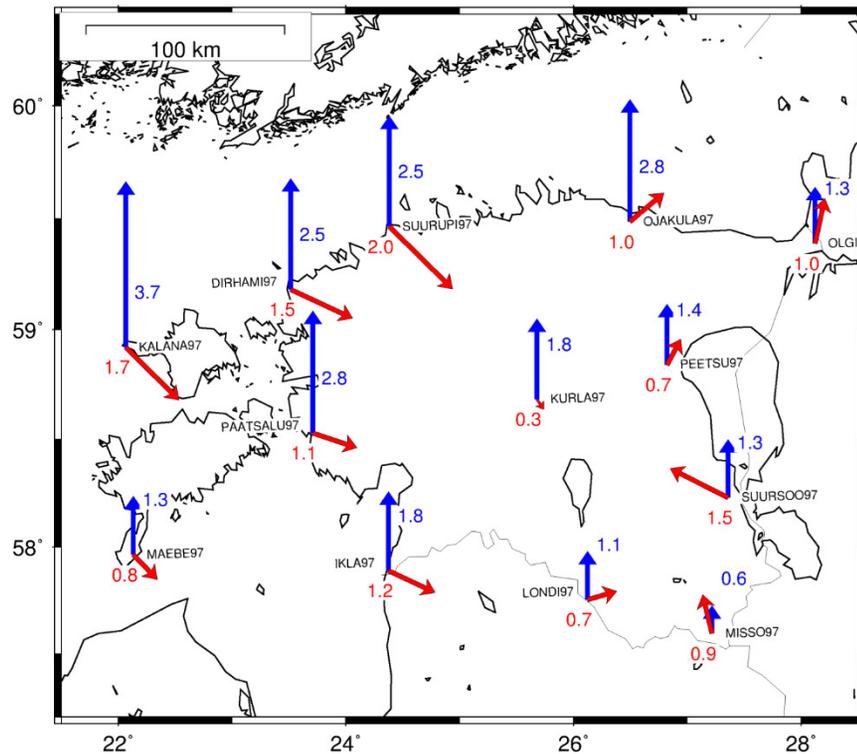


Time series analysis

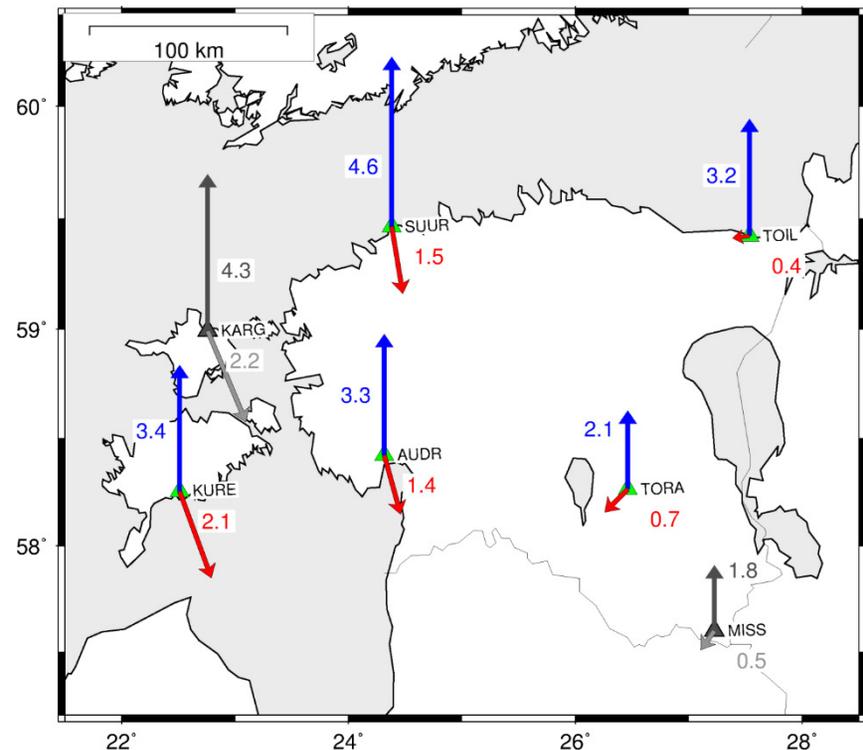
- TS from 7 CORS were analysed and horizontal and vertical uplift rates were derived
- The time-series were compiled using programs CATREF and CATS



Velocity from GNSS

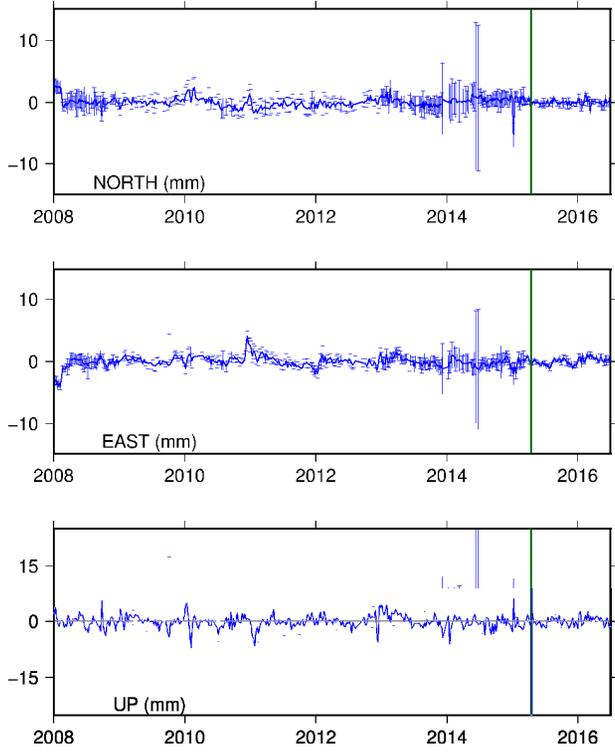


National geodetic network, I order

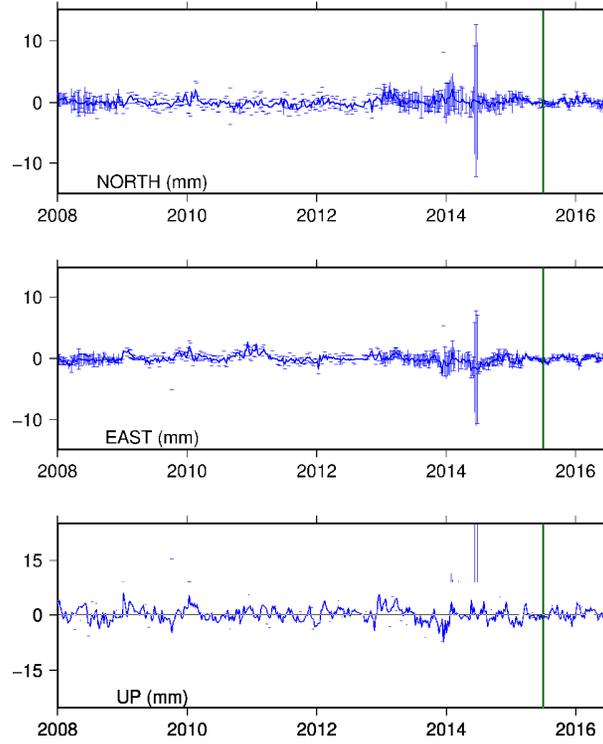


CORS stations

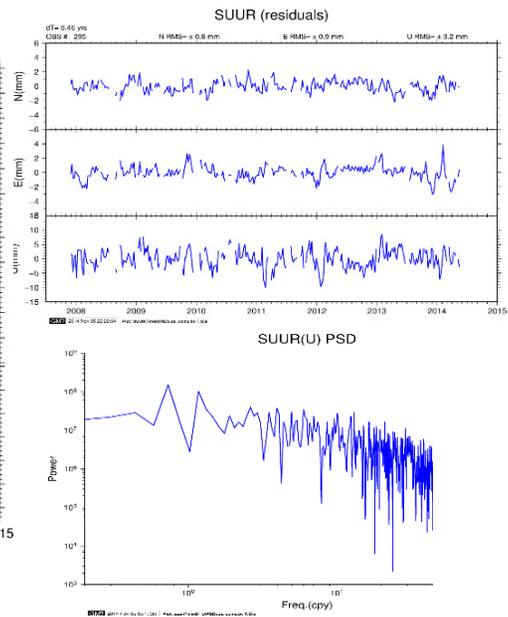
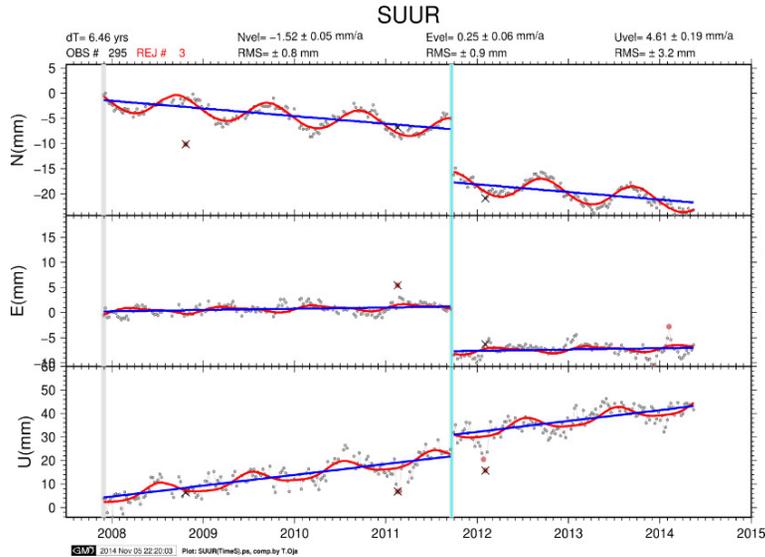
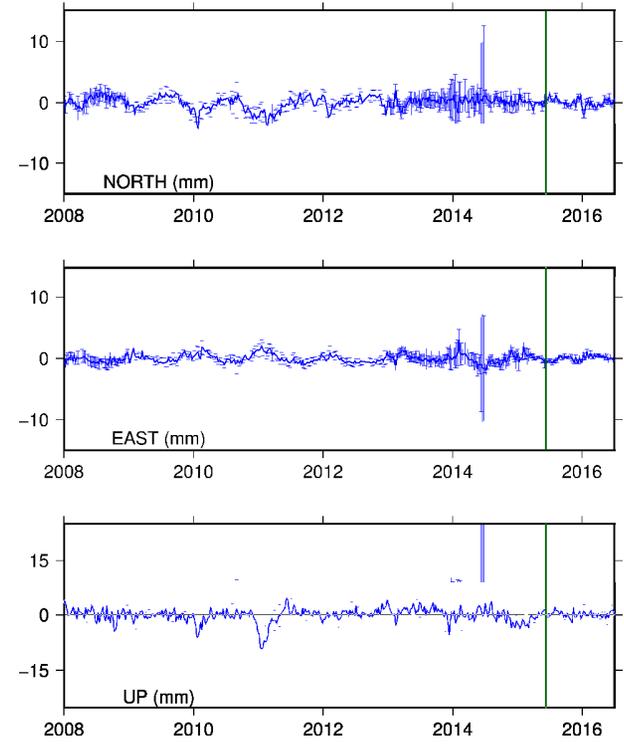
AUDR_ts Residual time series



KURE_ts Residual time series

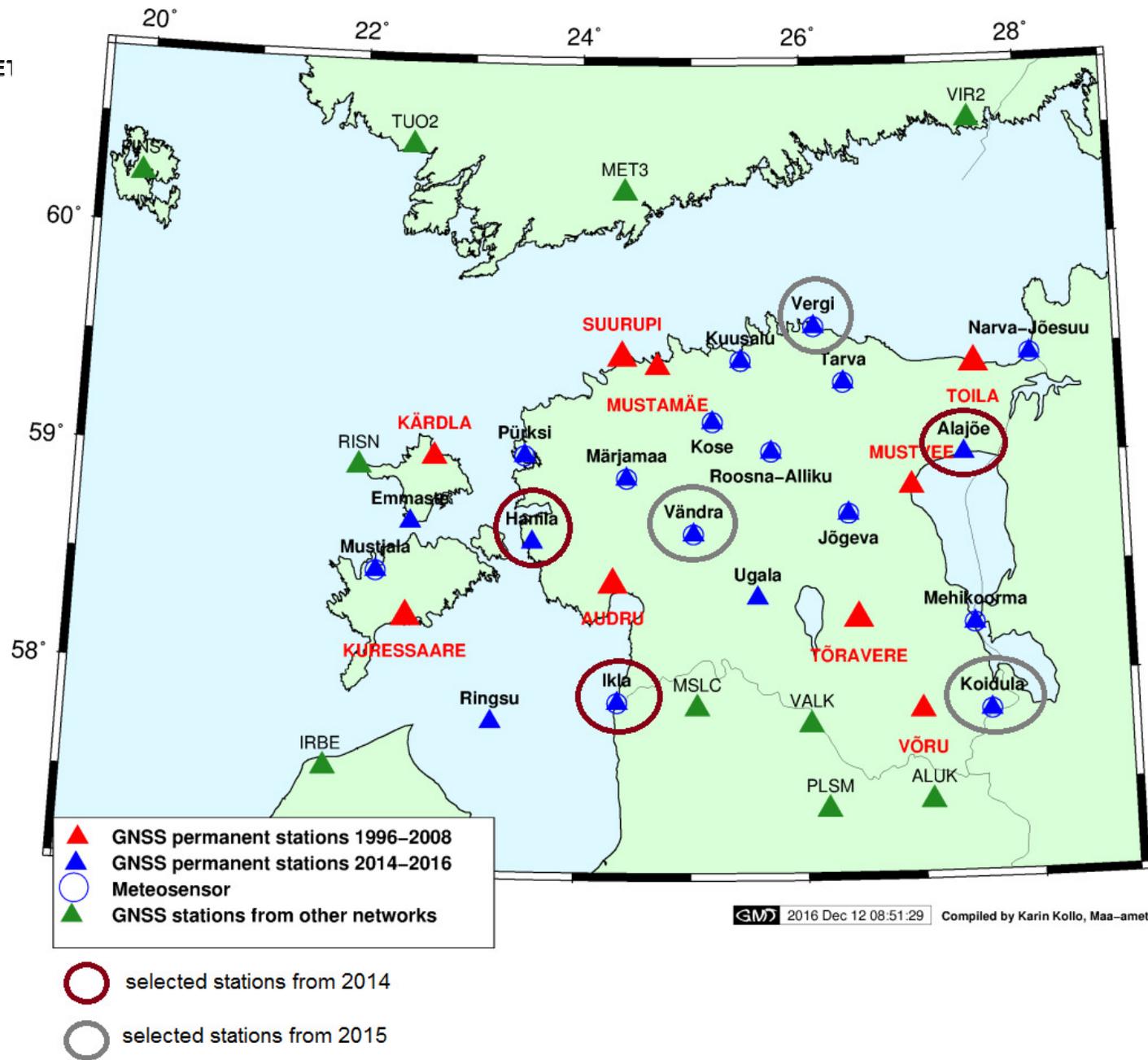


TOIL_ts Residual time series

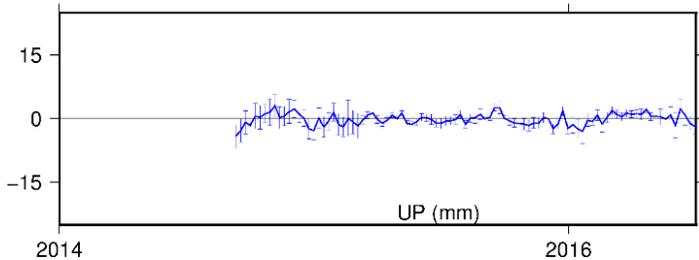
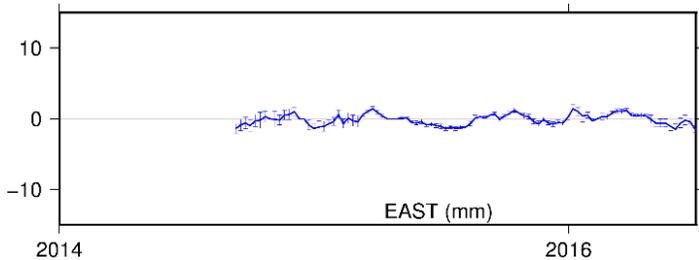
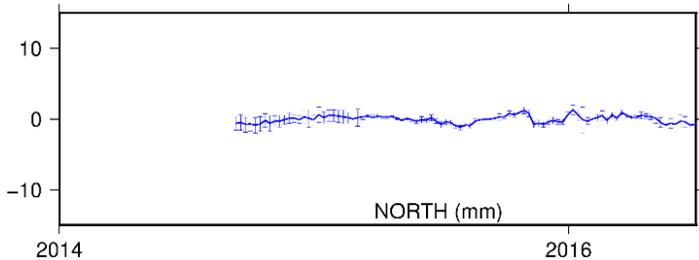




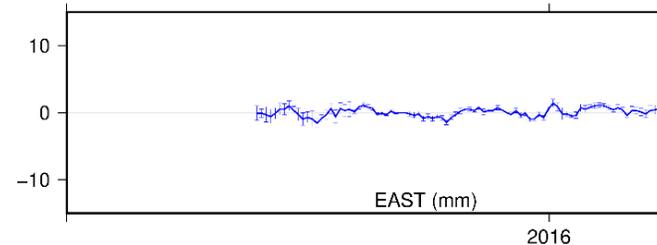
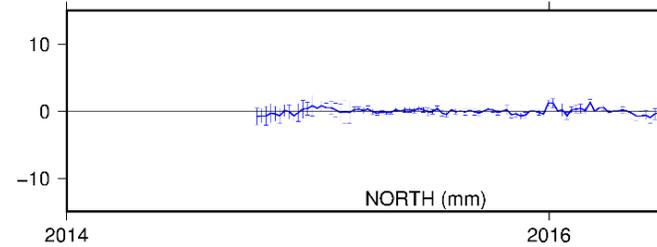
MAA-AMET



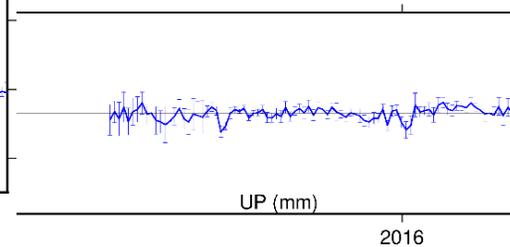
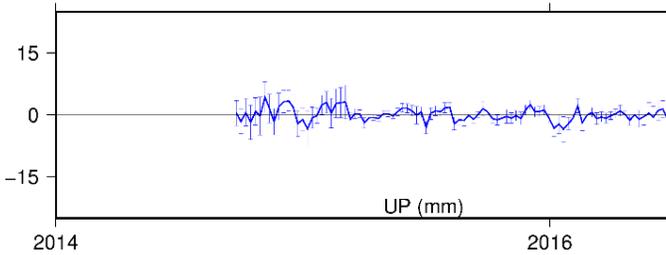
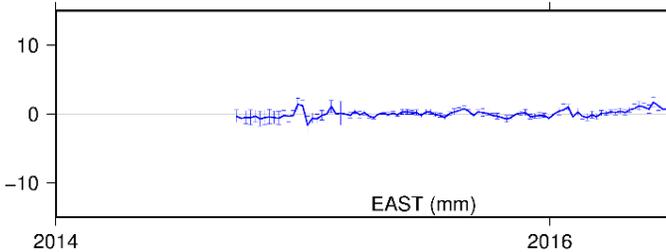
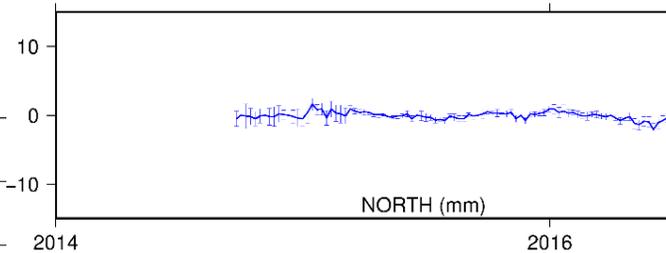
HANI_ts Residual time series



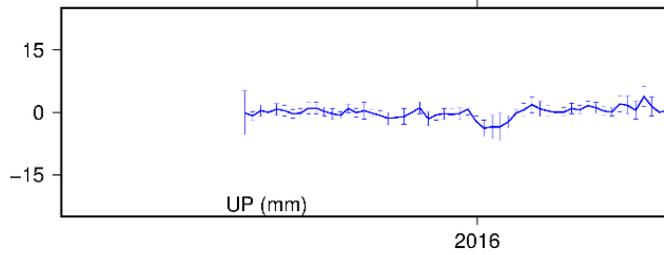
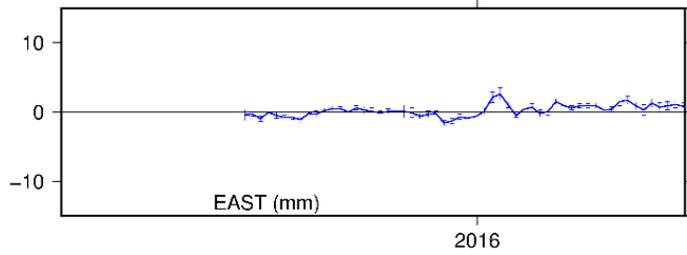
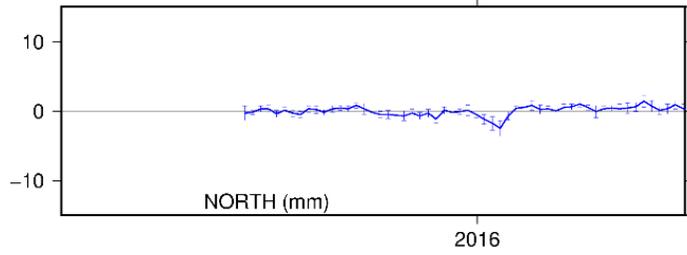
IKLA_ts Residual time series



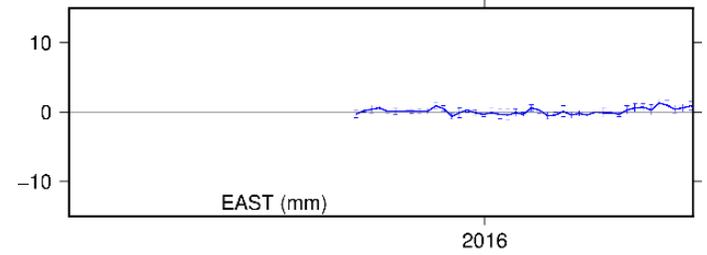
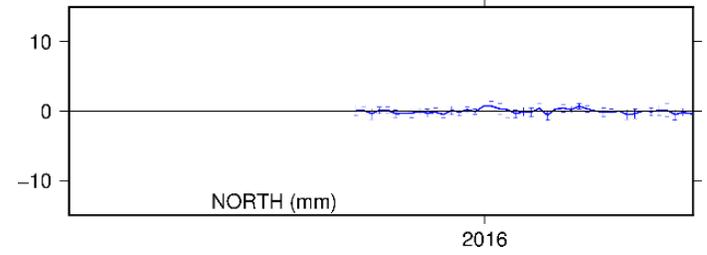
AJOE_ts Residual time series



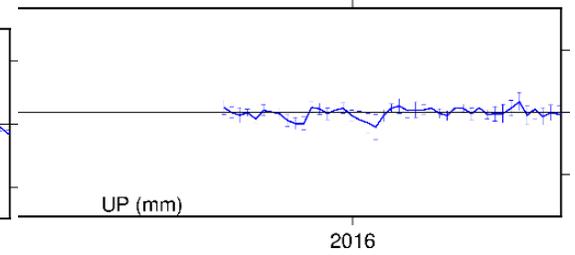
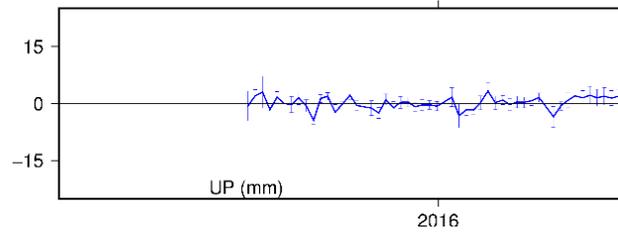
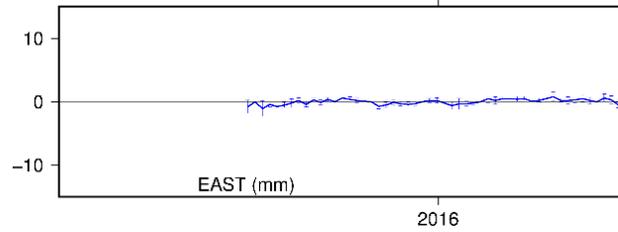
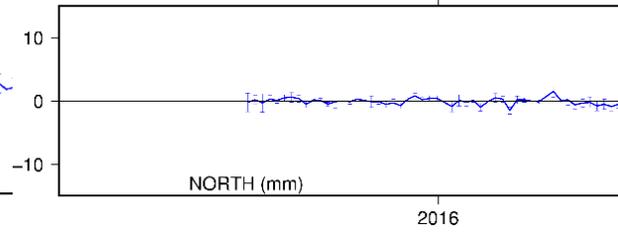
VAND_ts Residual time series

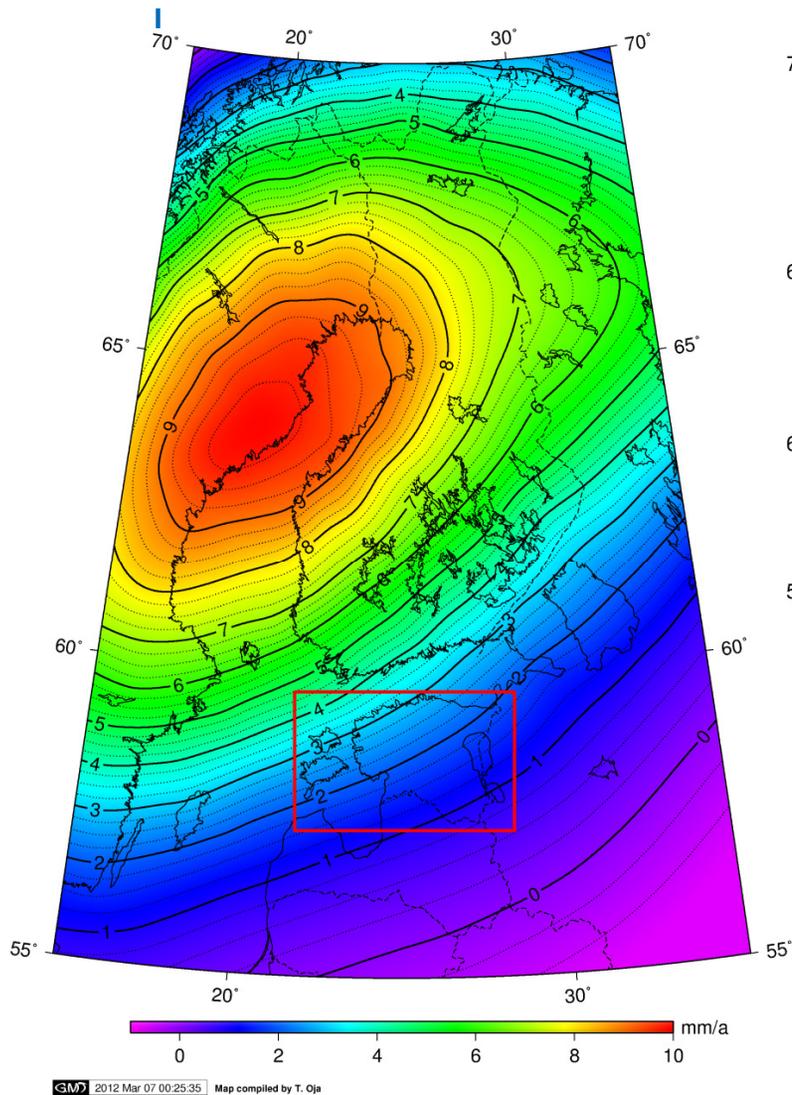


KOID_ts Residual time series

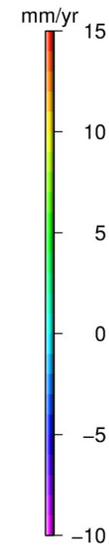
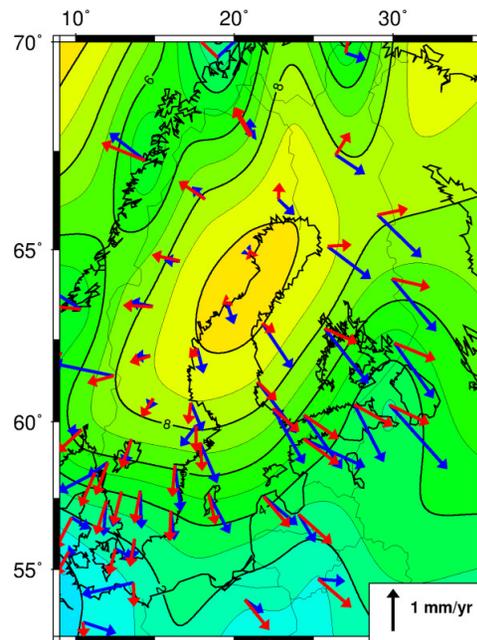


VERG_ts Residual time series



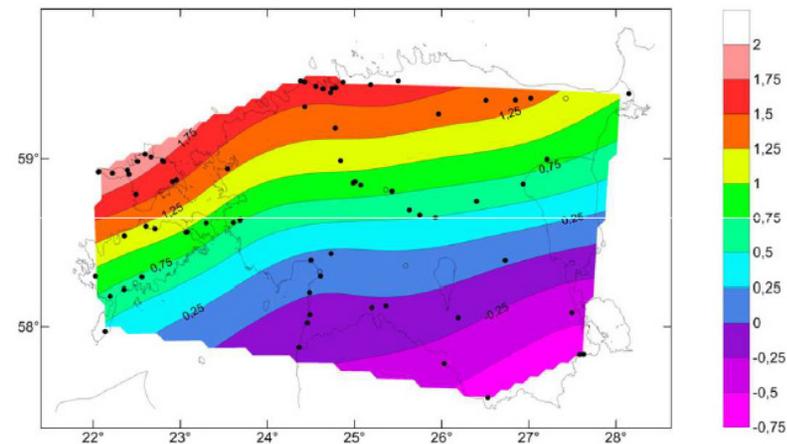


NKG2005LU model
(Ågren and Svensson, 2007)



$\mu = 0,6 \cdot 10^6 \text{ Pa s}$;
 $\text{Im} = 6,5 \cdot 10^6 \text{ Pa s}$;
 $LT = 75 \text{ km}$

GIA model for
 Fennoscandia,
 based on KL05
 ice model
 (Kollo et al., 2016)



EST2013LU model (Kall et al., 2016)

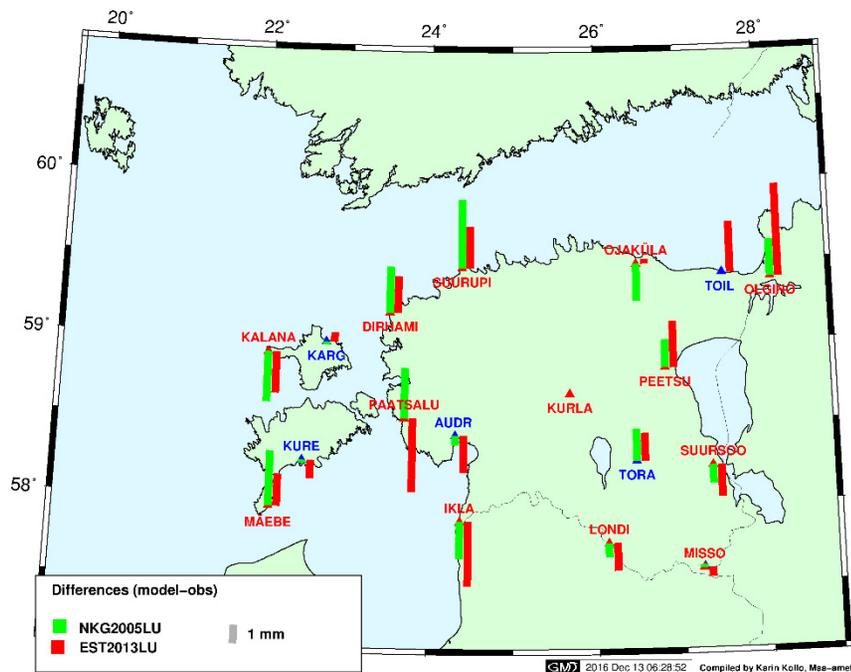


Comparisons with models

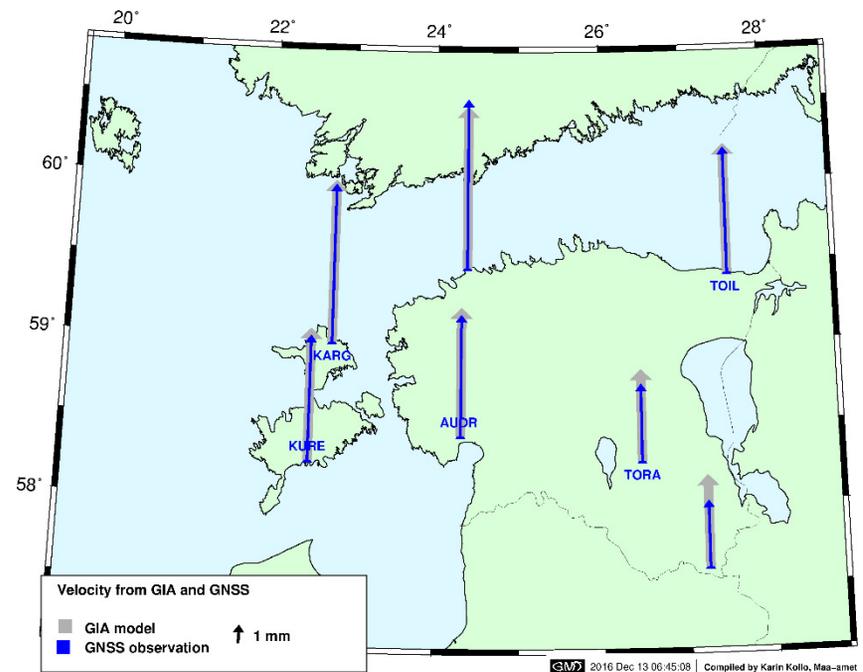
- The observed displacements of geodetic points as well as velocity estimates of CORS were compared with the predictions
 - latest PGR empirical models (e.g. NKG2005LU and EST2013 LU)
 - GIA model



Velocity from models (LU, GIA)



Comparison with LU models



Comparison with GIA model



Results

- In most cases good fit between the observations and models was found
- The higher discrepancies appeared in the East and South-East Estonia
 - Noise in measurements (GNSS, levelling, TG, gravity)
 - no observation data from study area have been used in compilation of widespread ice and GIA models



References

- Ågren, J., Svensson, R. (2007). Postglacial Land Uplift Model and System Definition for the New Swedish Height System RH 2000. LMV-Rapport 2007:4, Lantmäteriet, Sweden.
- Kall, T., Liibusk, A., Wan, J., Raamat, R. (2016). Vertical crustal movements in Estonia determined from precise levellings and observations of the level of Lake Peipsi. *Estonian Journal of Earth Sciences*, 65 (1), 27–47.
- Kollo, K., Spada, G., Vermeer, M. (2016). (Studying Earth rheology using GNSS permanent stations and GIA modelling tools. *Geophysica*, 51, 2016.
- Liibusk, A., Ellmann, A., Kall, T., Kollo, K., Jürgenson, H. (2012). Verifying hydrodynamic levelling results through improved land uplift rates in West-Estonian Archipelago. COST ACTION ES0701 Improved Constrains on Models of Glacial Isostatic Adjustment. National & Kapodistrian University of Athens, March 19-22, 2012.
- Oja, T., Kollo, K., Pihlak, P. (2014). GIAs ja maapinna liikumistest Eestis GNSS-täppismõõtmiste valguses. *Geodeet* 44, Tartu.
- **Acknowledgements: Priit Pihlk, Tõnis Oja**



MAA-AMET

Thank you!

Contact information:

karin.kollo@maaamet.ee

www.maaamet.ee

geoportaal.maaamet.ee

