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ESTPos – new Estonian GNSS-RTK network and its relations to scientific applications

Karin Kollo
Department of Geodesy
Estonian Land Board

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Outline

- GNSS reference station network in Estonia
  - History
  - Equipment
- New GNSS-RTK reference station network
  - Equipment
  - Software
- Scientific applications

ESTREF: History

- 9 stations established from 1996-2008
  - Suurupi – established in 1996
  - Mustamäe – established in 2006
  - Kuressaare, Toila, Tõravere, Audru – established in 2007
  - Võru, Kärdla, Mustvee – established in 2008

ESTREF: Equipment

- Ashtech Z-12 receiver and Dorne Margolin choke ring antenna
- Ashtech Z-12 receiver and GPS L1/L2 antenna
- Leica GPS 500 receiver and GPS choke ring antenna
- Leica GRX1200GG receiver and 2D GNSS choke ring antenna with radome

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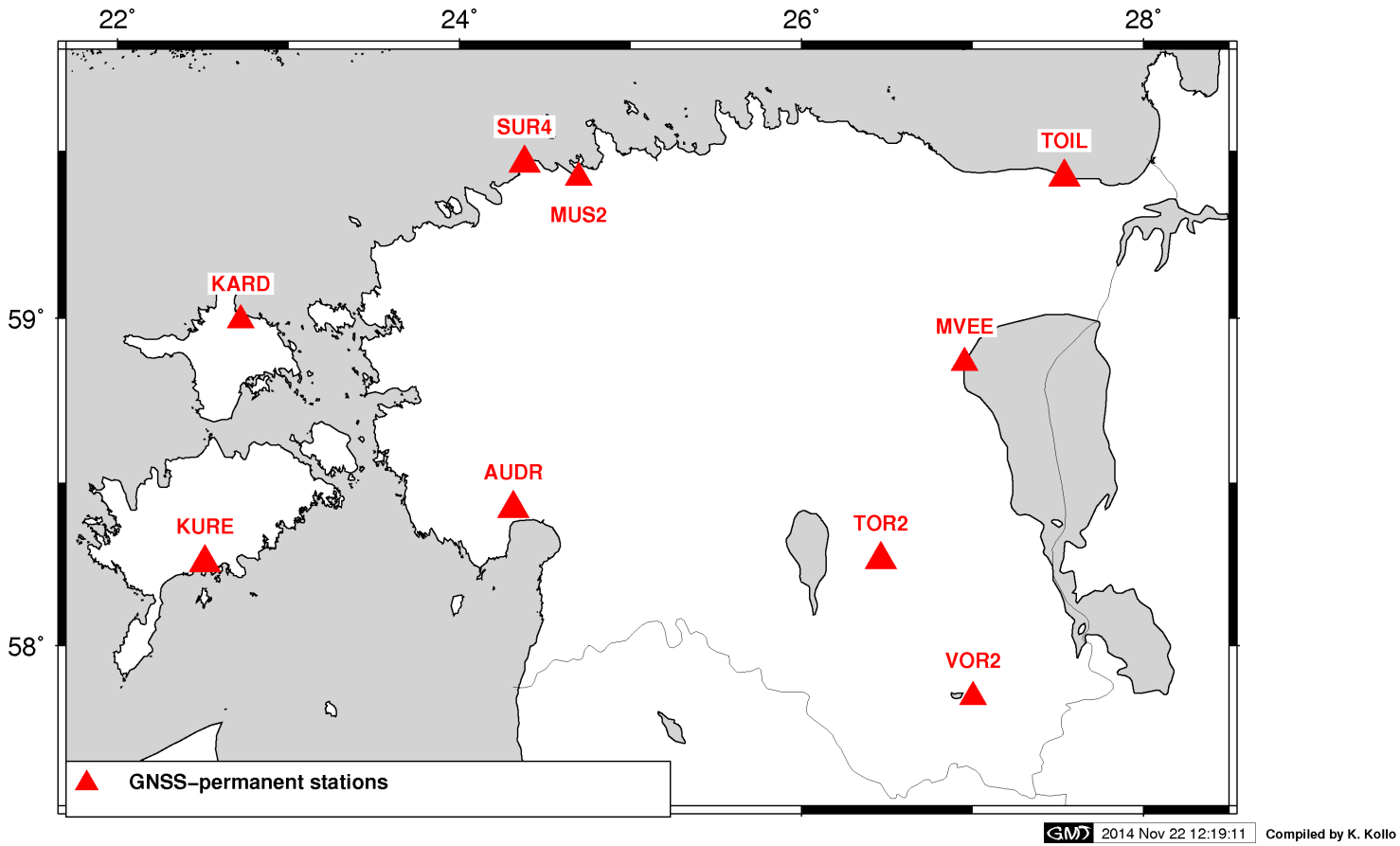
ESTREF network



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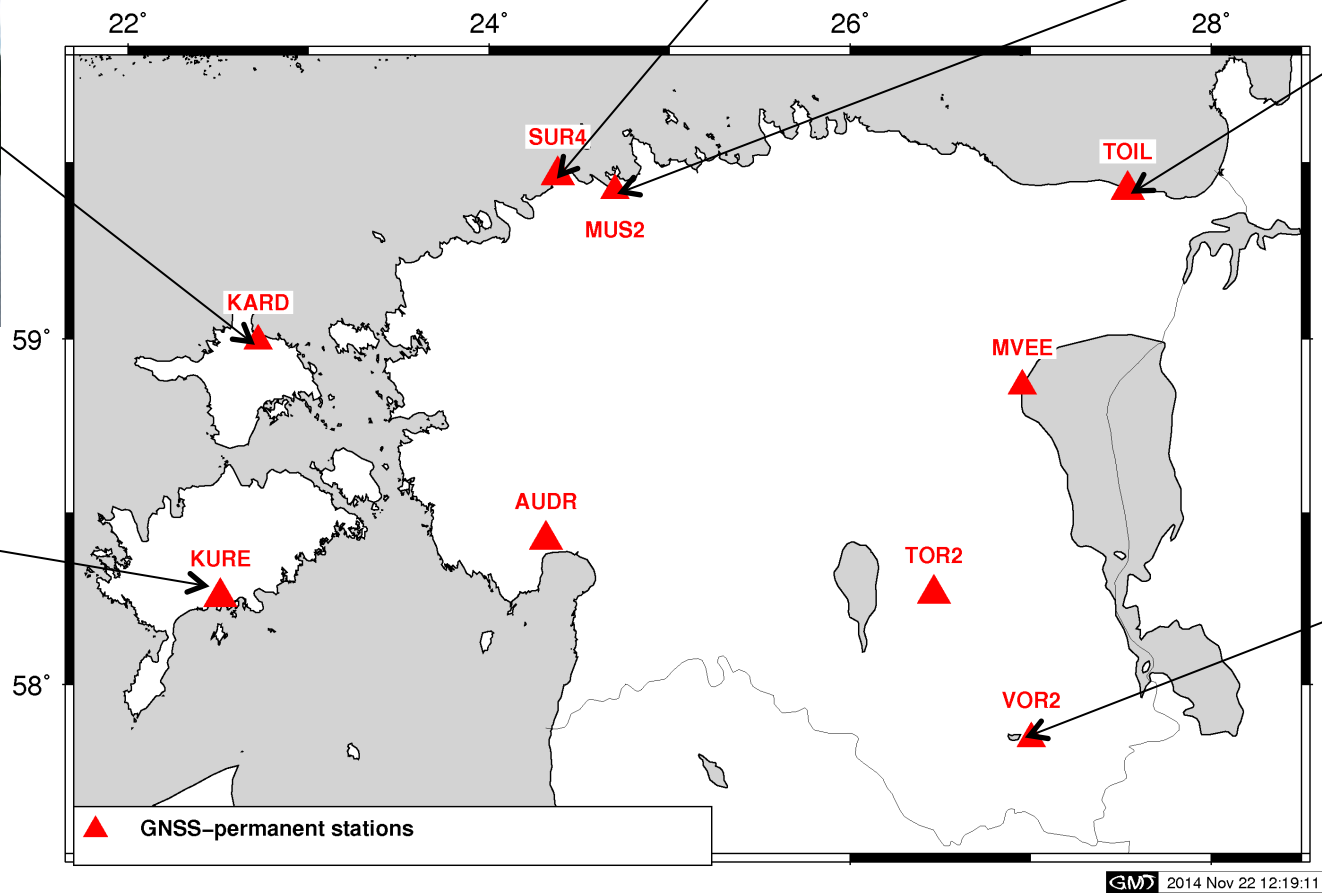
ESTREF network



ESTPOS

- Estonian-Swiss cooperation programme
- For establishing GNSS-RTK permanent station network
  - Hardware (11+4 receivers, 6 meteosensors)
  - Software for GNSS-RTK network
- Stations established in 2014 May-October

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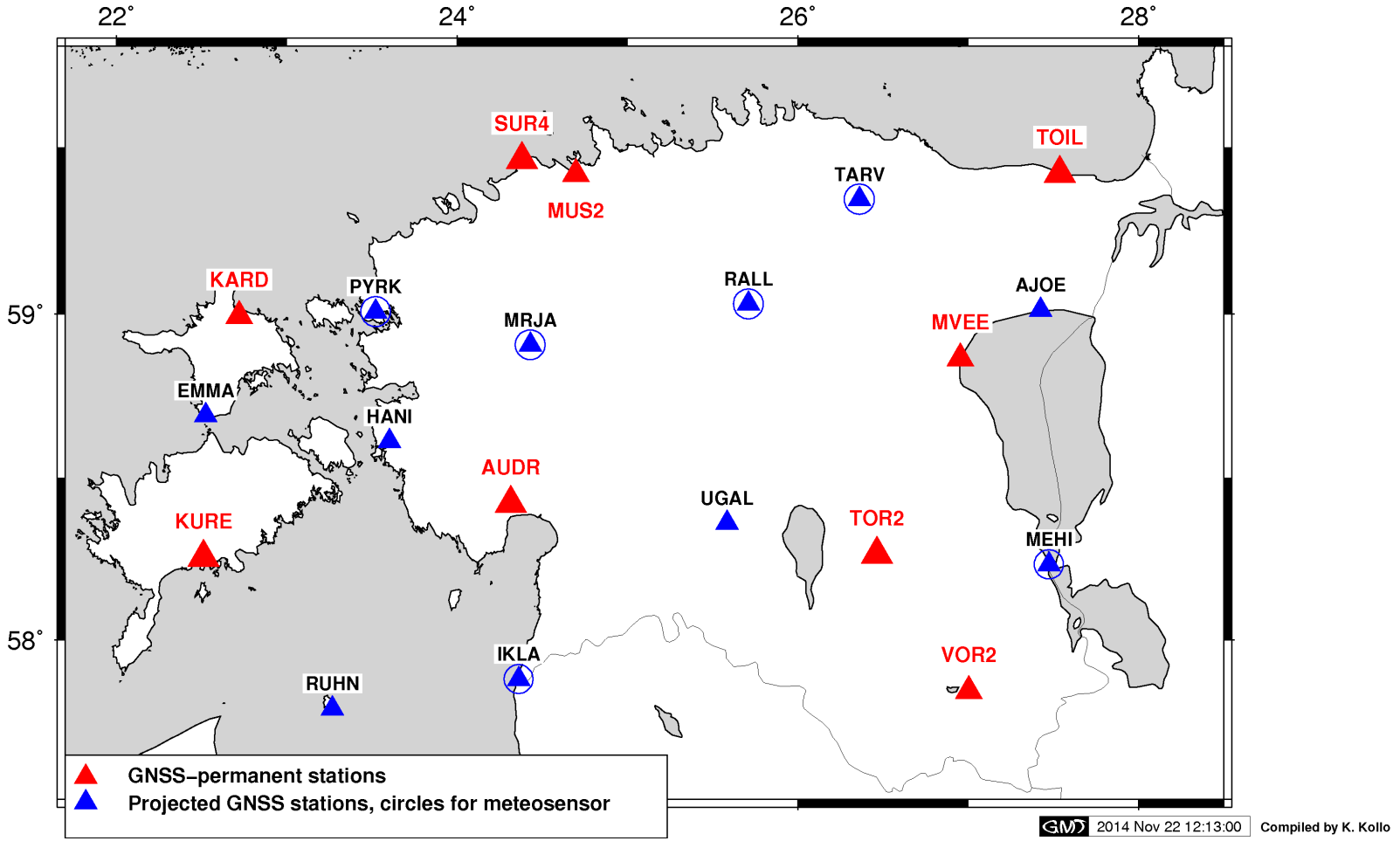
EESTI-ŠVEITSI KOOSTÖÖPROGRAMM
ESTONIAN-SWISS COOPERATION PROGRAMME

ESTPOS network



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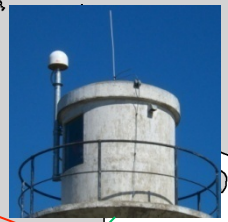
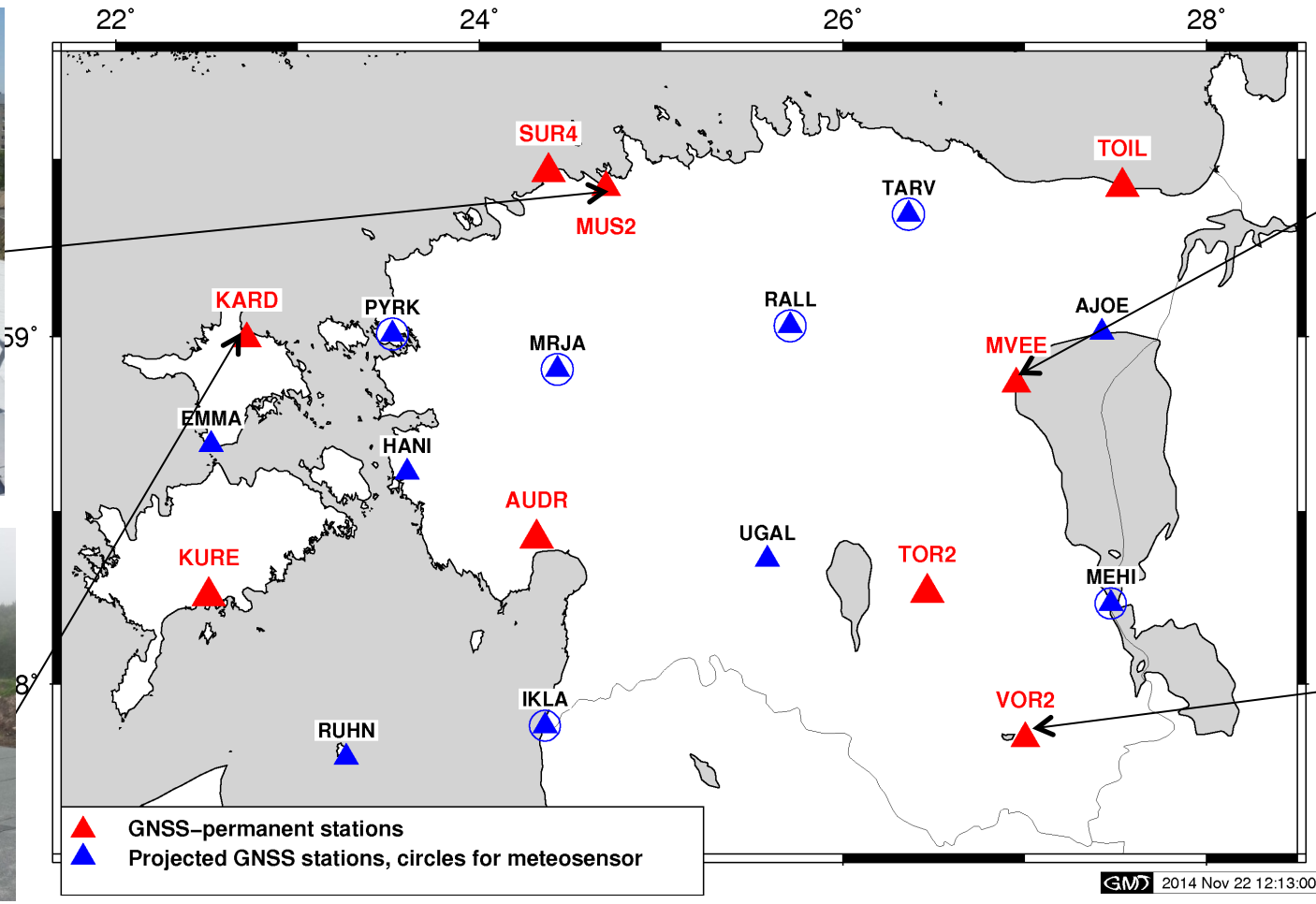
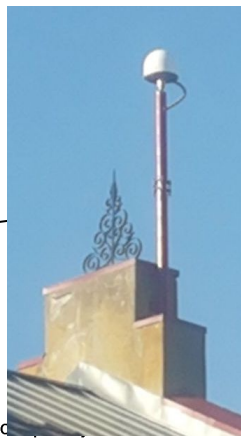
EESTI-ŠVEITSI KOOSTÖÖPROGRAMM
ESTONIAN-SWISS COOPERATION PROGRAMME

ESTPOS network



ESTPOS network





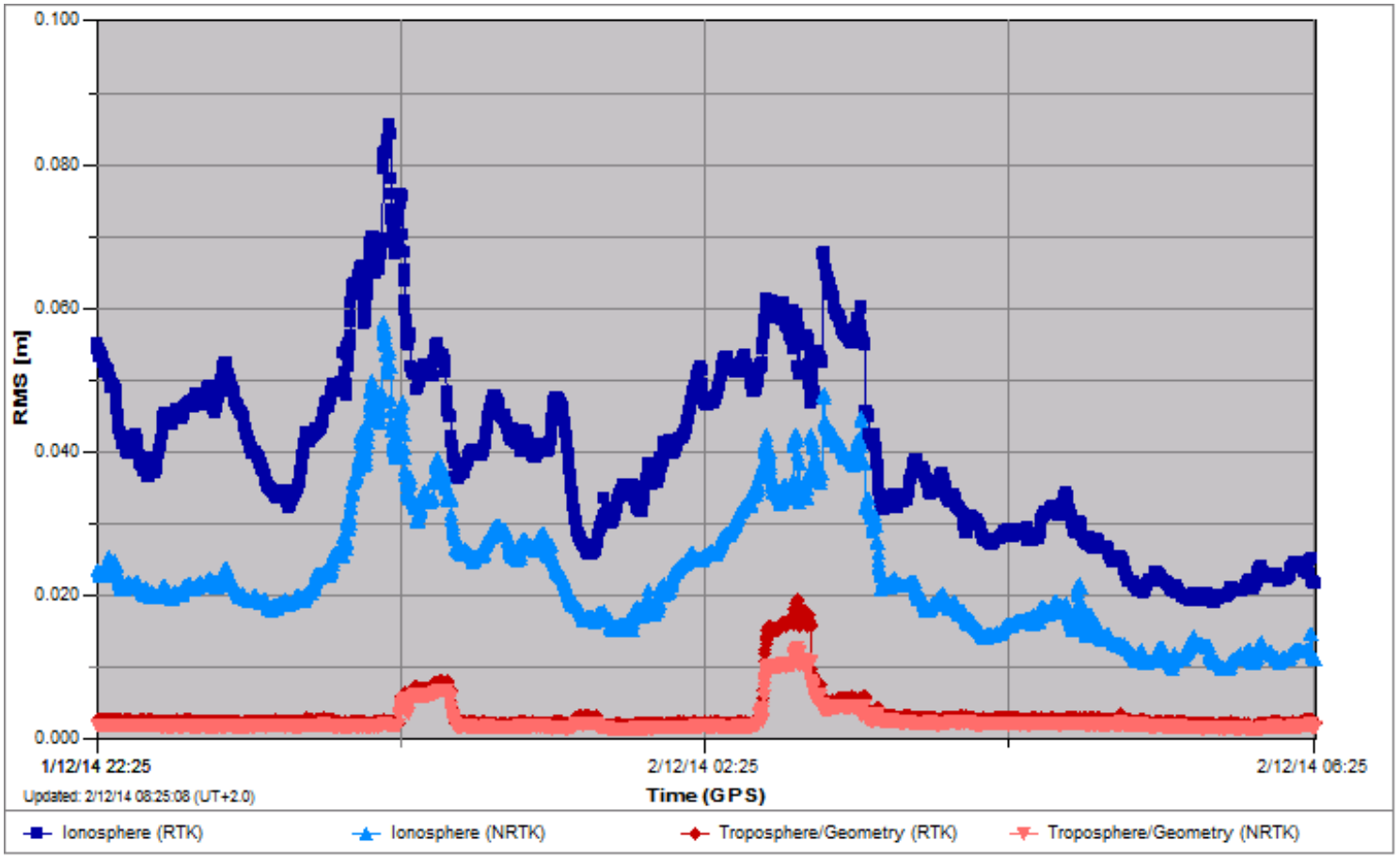
ESTPOS: Equipment

- 11 new stations
  - receiver Leica GR25
  - antenna LEIAR25 + radome LEIT
  - meteosensors (Väisala WTX520) in 6 stations
- Equipment change in 4 stations
  - system GPS500 → receiver GR25 and antenna LEIAR25 + radome LEIT

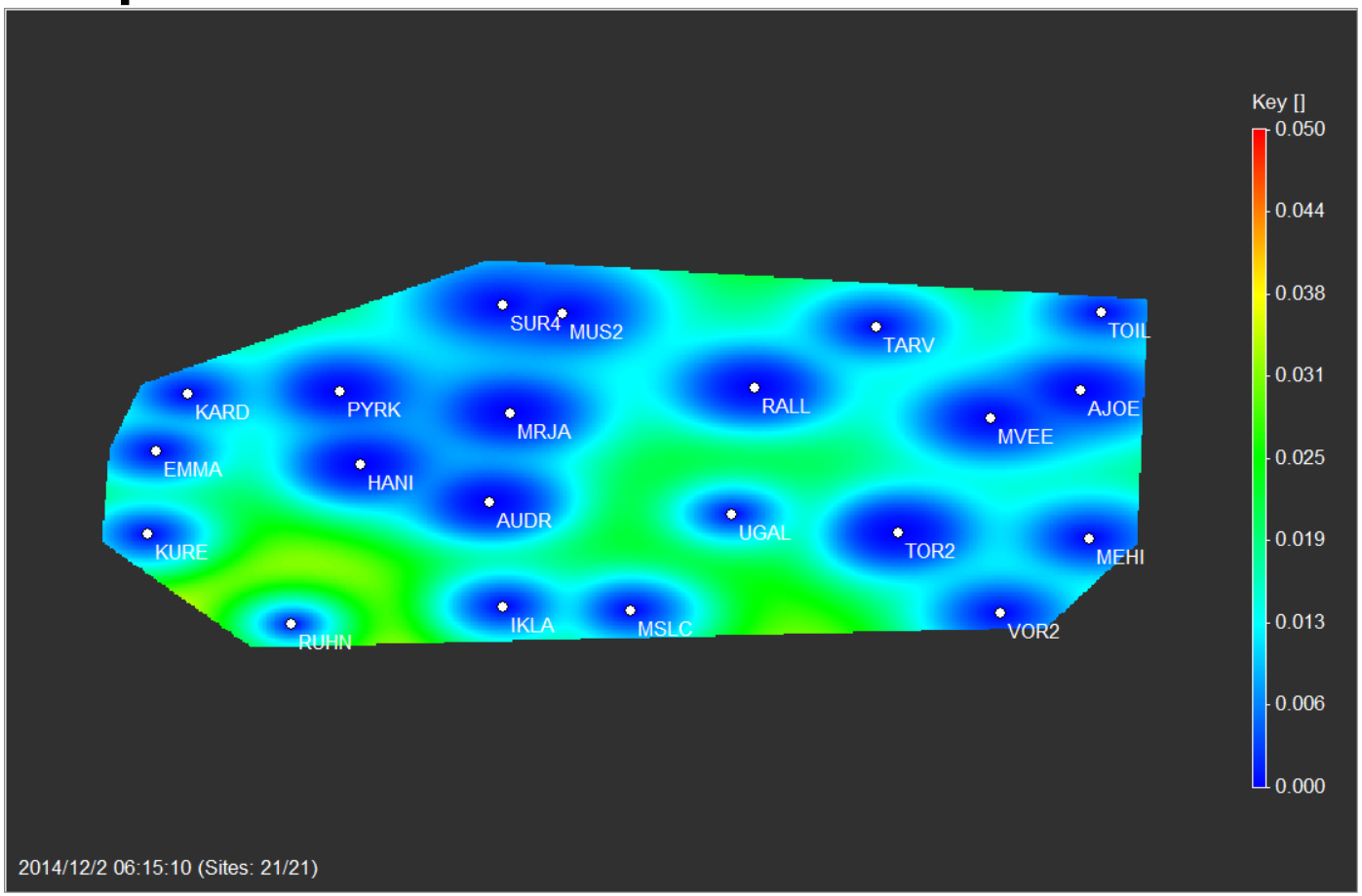
ESTPOS: Software

- Leica Spider software for monitoring and RTK-network
  - Site server
  - Network server
- Leica Business Center
  - Online RINEX/Virtual RINEX download
  - Online coordinate computation service
  - RTK-products management

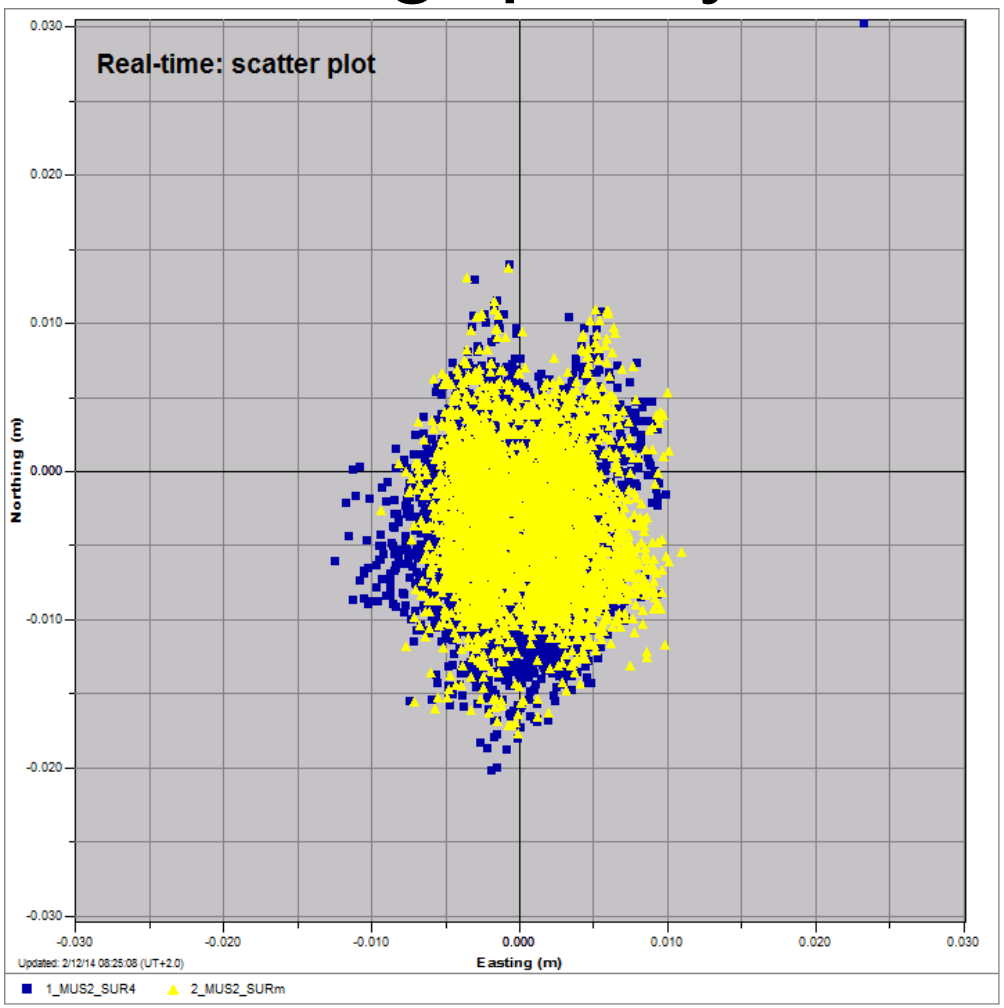
ESTPOS: Monitoring quality: Global RMS



ESTPOS: Monitoring quality: Ionosphere



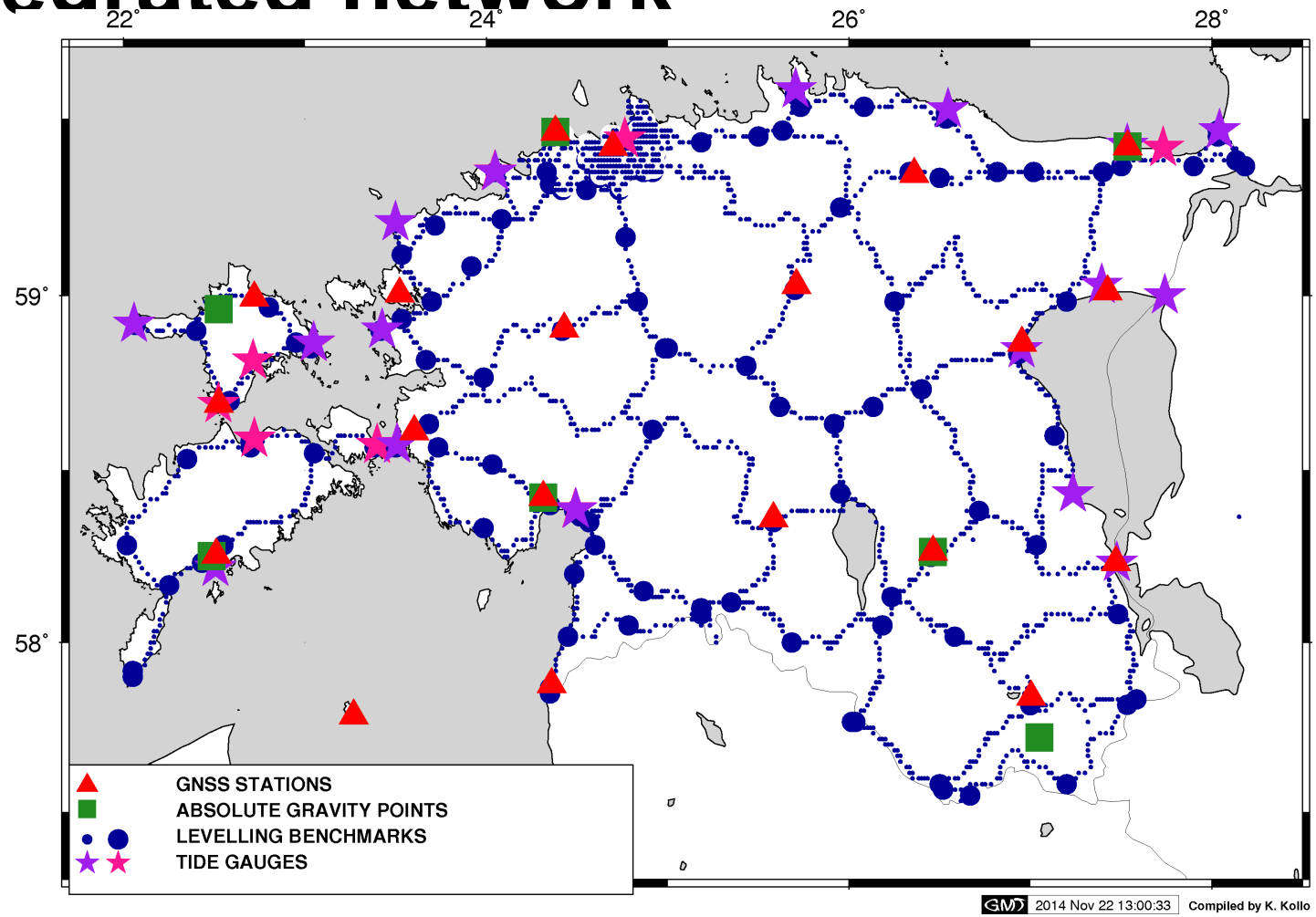
ESTPOS: monitoring quality: Real-time



Scientific applications

- Integrated network
- Analysis centres
- Time-series analysis
- Land uplift investigations

Integrated network



Analysis centres

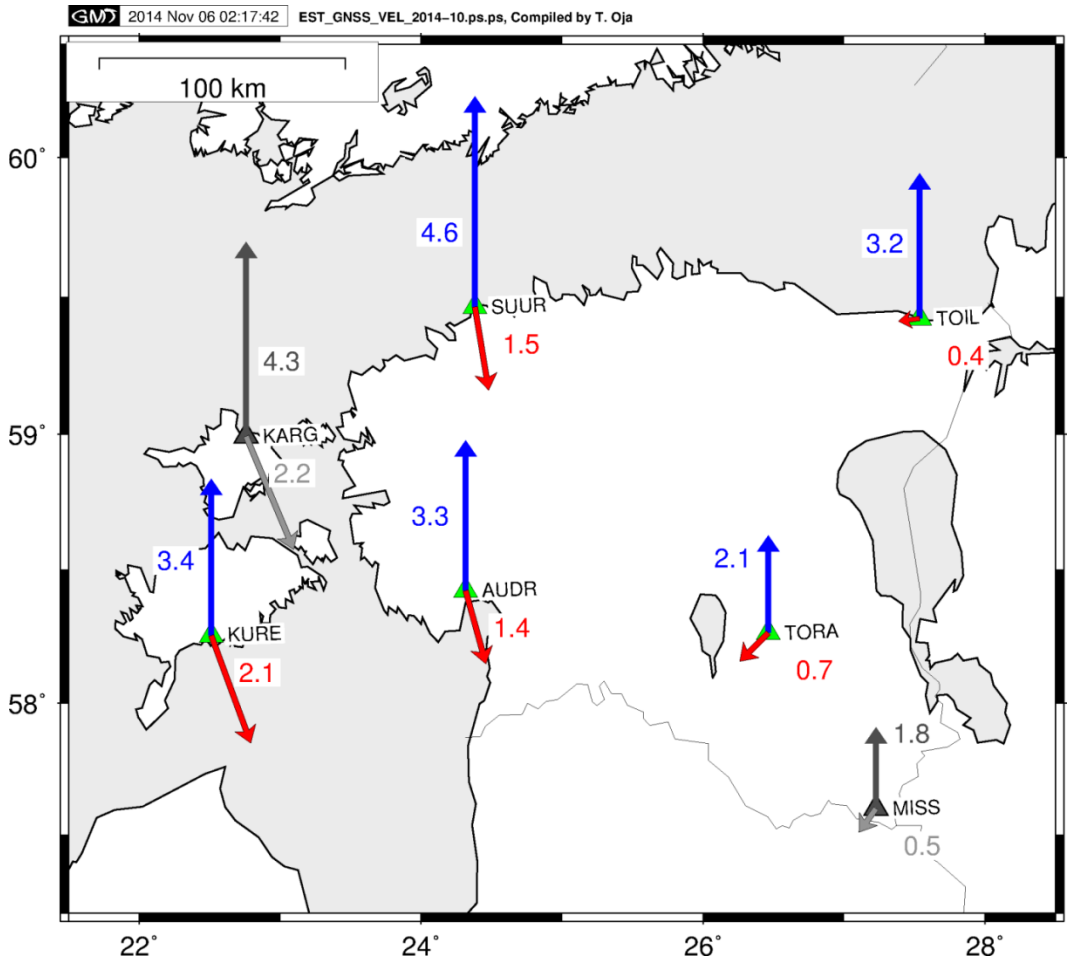
- EPN stations (KURE, TOIL, TOR2, SUR4)
  - 1h and 24h data submitted
- Weekly computations with Bernese 5.2
- Weekly combinations submitted to
  - EUPOS analysis centre
  - NKG analysis centre

Time-series analysis

- Fom GPS week 1448 (7.10.2007)
- Reference frames:
  - IGS05 (GPS weeks 1448...1631)
  - IGS08 (GPS weeks 1632...1708)
  - IGb08 (from GPS week 1709)
- Used programs:
  - CATS, CATREF

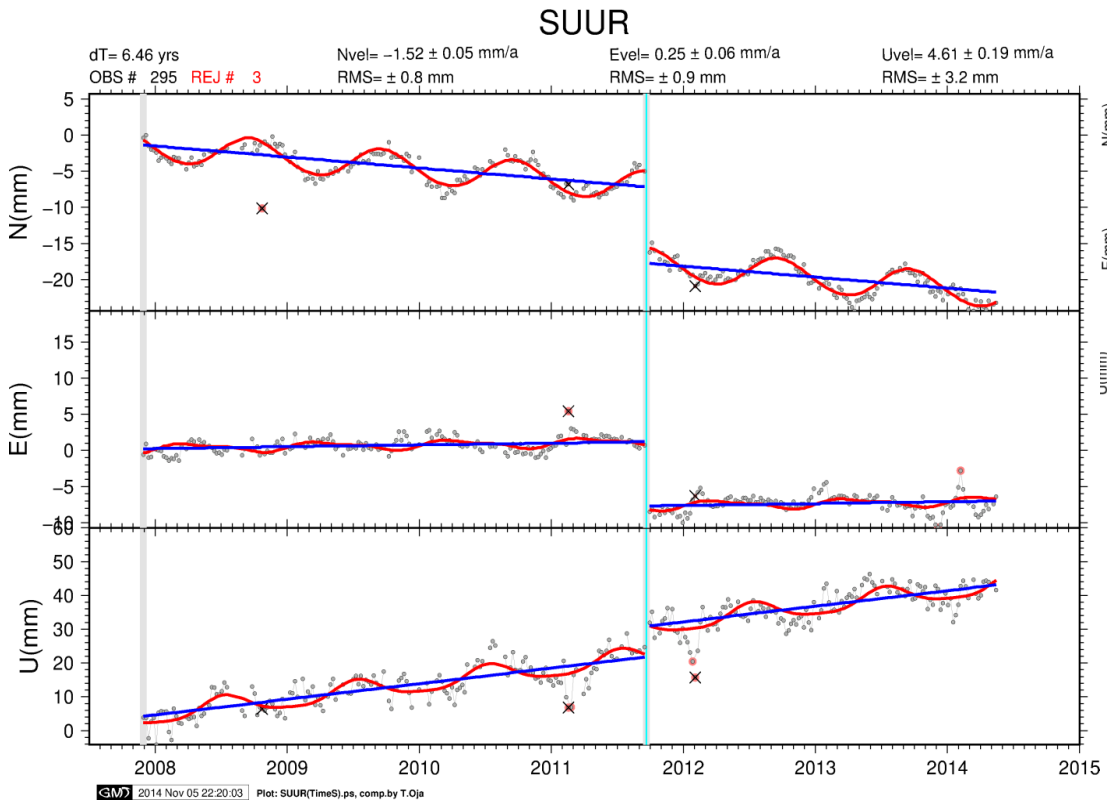
Time-series analysis

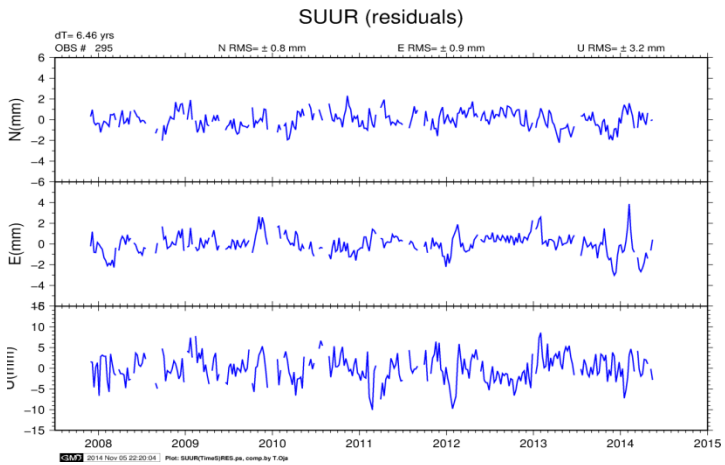
- 2008-2014 IGS05/08
- horisontal movements (red)
- vertical movements (blue)

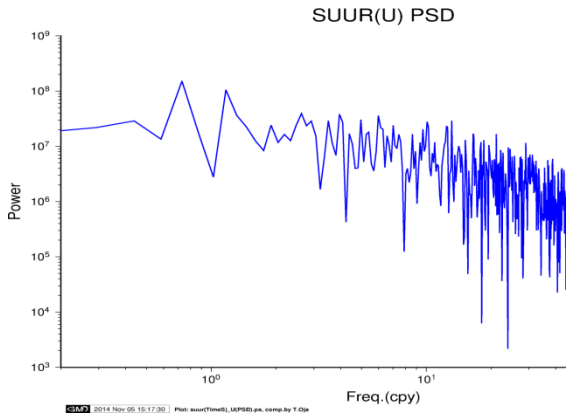


- Kollo, K., Oja, T., Pihlak, P. (2014). The verification of GIA in Estonia using GNSS data. EGU General Assembly 2014, 28 April - 02 May 2014, Vienna, Austria

Time-series analysis







- Kollo et al., 2014

Land uplift investigations

- Open source software SELEN (Spada and Stocchi 2007)
- Ice model ANU-ICE (KL05)
- For the physical Earth's model:
  - the nominal parameters (with KL05)
  - the optimum parameters from χ^2-fitting based on the GNSS velocities (Lidberg et al., 2010)

Land uplift investigations

- GIA_ANU-ICE (*LT* ~ 65 km, *UM* ~ $0.3 \cdot 10^{21}$ Pa·s, *LM* ~ $10 \cdot 10^{21}$ Pa·s; χ^2-9.54 from GNSS velocities)
- GIA_BIFROST (*LT* ~ 76.5 km, *UM* ~ $0.55 \cdot 10^{21}$ Pa·s, *LM* ~ $6.5 \cdot 10^{21}$ Pa·s; χ^2 5.00 from GNSS velocities)

- (from Kollo, et al., 2014)

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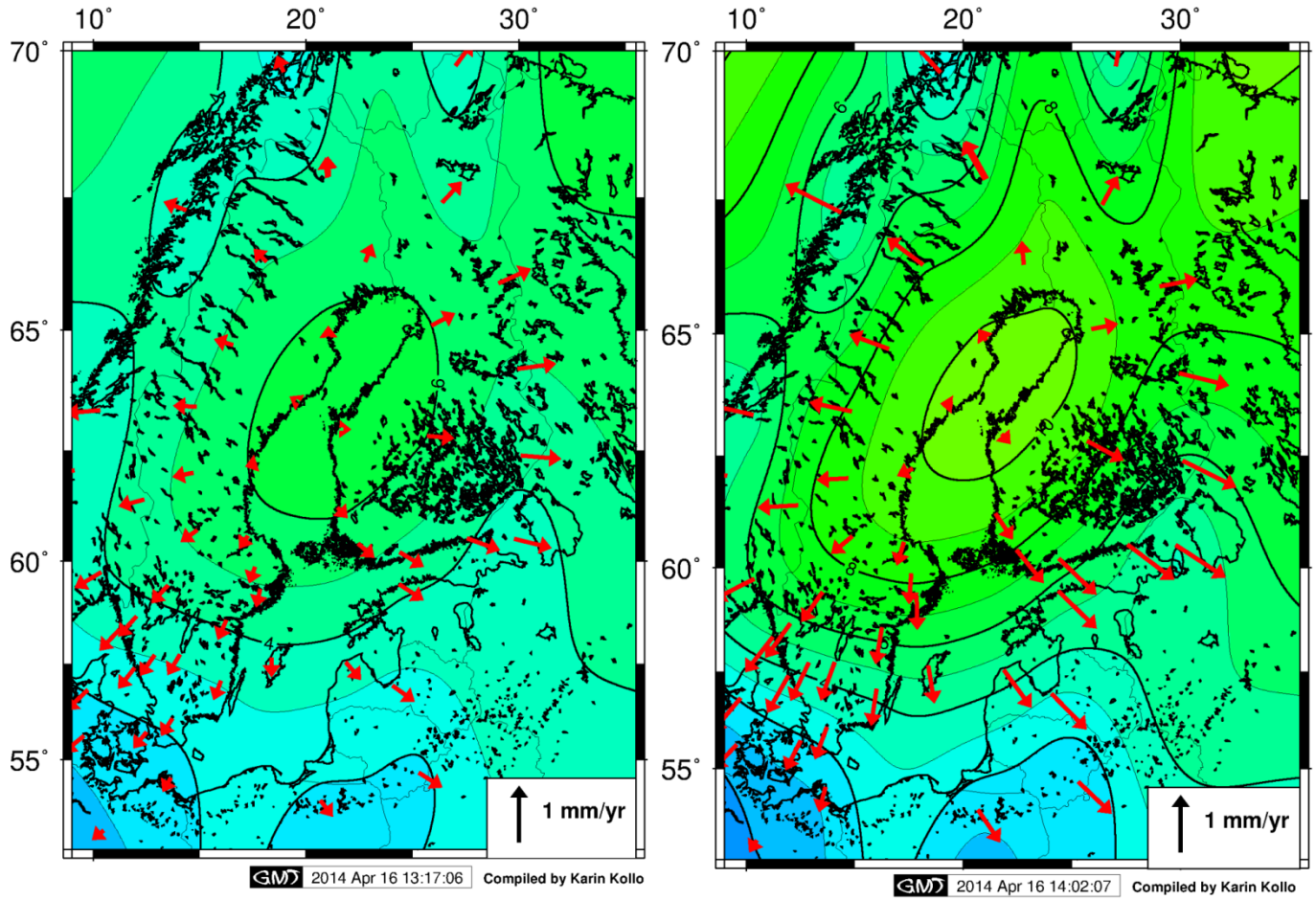
Land uplift investigations

- Left GIA_ANU-ICE
- Right GIA_BIFROST



- Kollo et al., 2014

- AUDR 10603S001 | A A | -0.81 -0.21 4.18 | |
- GEOS 10637M001 | A A | -1.26 -0.04 21.95 | |
- HAAD 10640M001 | A A | 5.48 -6.53 -54.15 | * |
- IKLA 10656M001 | A A | 1.95 -0.62 -9.74 | |
- KURE 10604S001 | A A | -0.96 -0.89 6.29 | |
- KURG 10604M001 | A A | -0.90 0.05 23.43 | |
- KURS 10604M002 | A A | 0.20 -1.04 18.54 | |
- MAR6 10405M002 | W W | -0.91 -0.76 -4.58 | |
- RIGA 12302M002 | W W | 0.41 0.30 6.85 | |
- RUHN 10660M001 | A A | 0.07 0.32 -8.14 | |
- TOIL 10605S001 | A A | 0.20 -1.52 -3.23 | |
- TOR2 10602M001 | A A | 0.63 -0.57 -6.01 | |
- VALG 10642M001 | A A | -3.22 0.83 -25.82 | |
- VOR2 10633M002 | A A | -0.24 -0.31 -8.77 | |

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Thank you for your attention!

Karin Kollo
Karin.Kollo@maaamet.ee