National Report of Finland

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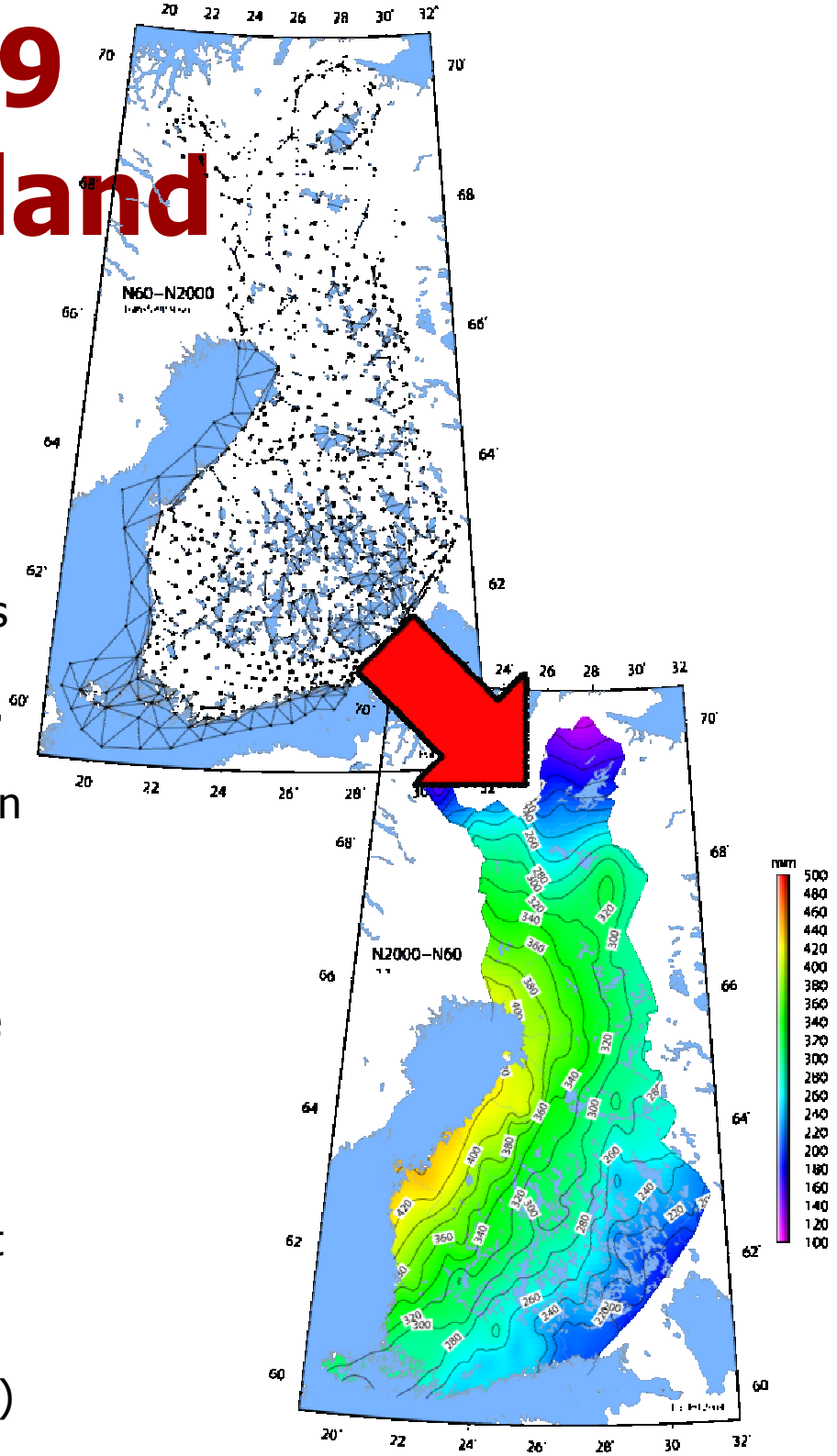
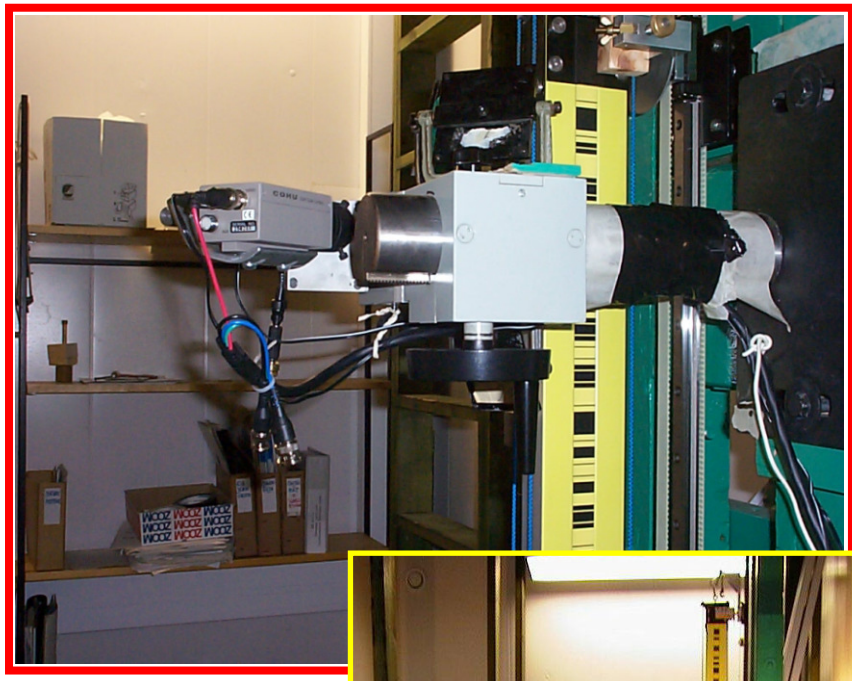
Status of ETRS89 and EVRS in Finland

- ETRS89: EUREF-FIN introduced already a decade ago
  - Several governmental authorities already changed to EUREF-FIN
  - But only recently municipalities started to change to EUREF-FIN, this work is still underway
- EVRS: N2000 introduced in 2007
  - Implementation at local level is still in the beginning (only some municipalities changed so far)
  - However, seems like several authorities will change to N2000 due to the fact that the old systems are deformed because of postglacial rebound
  - Transformation from previous height systems to N2000 implemented as triangle-wise transformation by the NLS of Finland (Figure: N60→N2000)



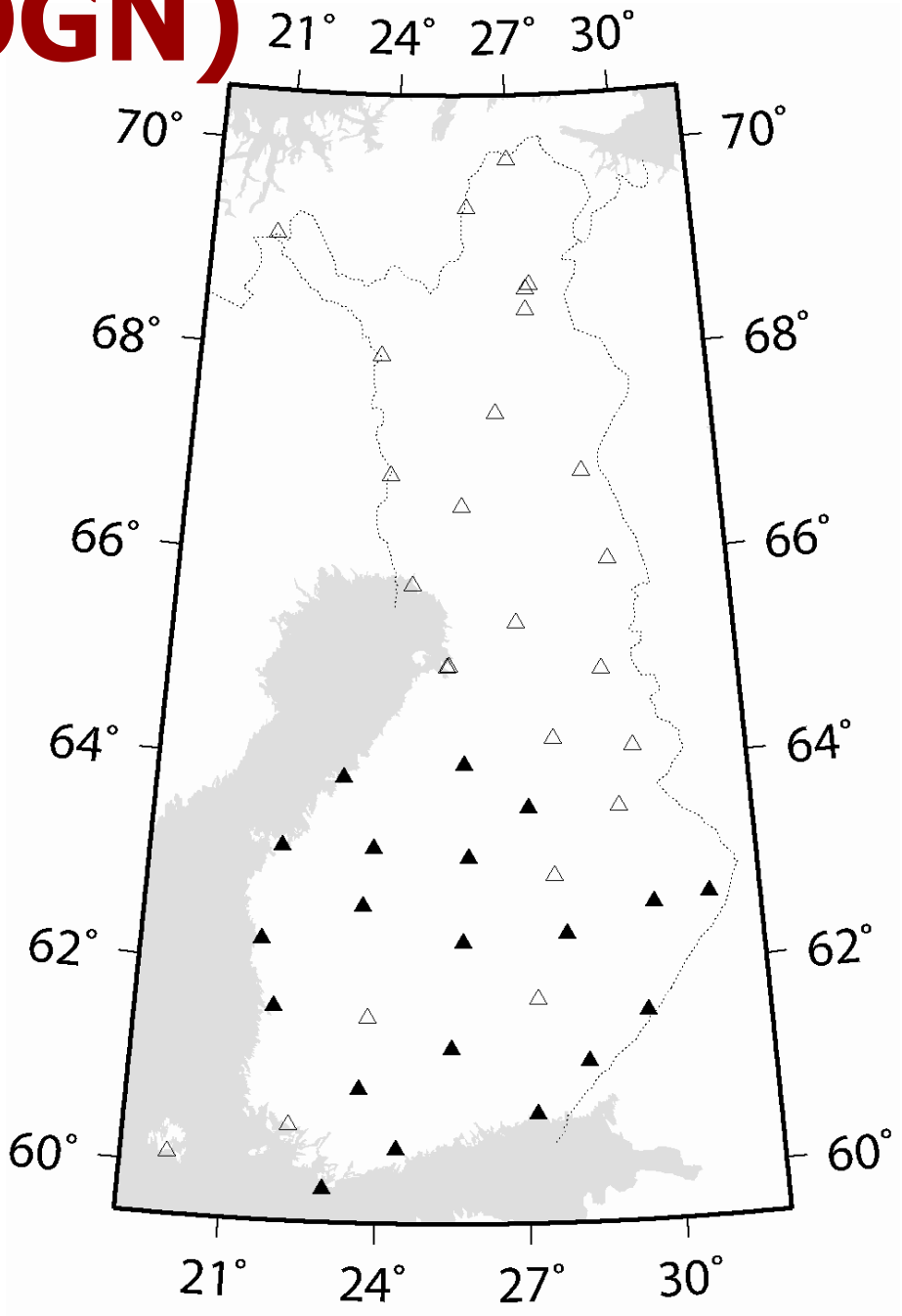
Some activities in 2009

- FinnRef, permanent GPS network of the FGI operating as usual
  - Monitoring of the stations independently from GNSS (tacheometry and levelling) continued with centring measurements at five stations (3 EPN stations)
- VLBI: 6 campaigns in 2009
- SLR: under construction
- National standards laboratory:
  - Acceleration of free fall:
    - Key comparison of absolute gravimeters (ICAG-2009) at the BIPM
  - Length:
    - European Metrology Research Programme (EMRP) continued
    - EDM instruments: several calibrations and scale transfers
    - Levelling instruments: 27 rod and 17 system calibrations



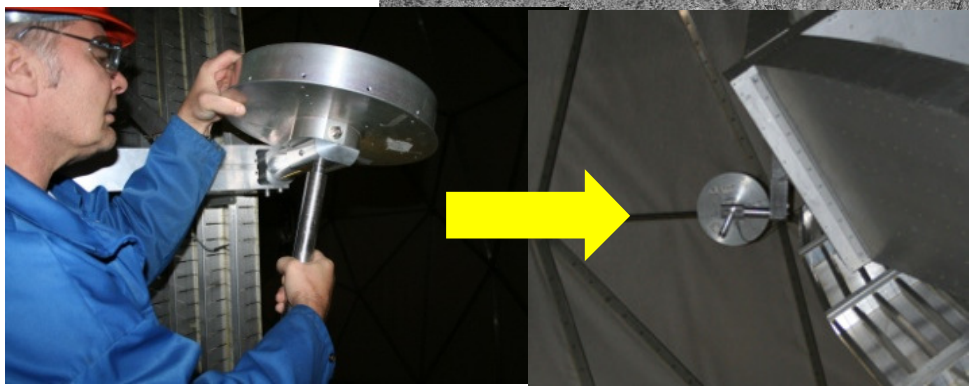
Renovation of the First Order Gravity Net (FOGN)

- 50 stations
- First measured in 1962-63 and checked in 1988
- Revision of the FOGN was started in 2009
- Measurements in cooperation with the Institute of Geodesy and Cartography (IGiK, Warsaw, Poland) using the A10-020 of the IGiK
  - In 2009 altogether 20 sites were occupied (Figure)
  - In addition 10 comparisons at 5 sites measured with the FG5-221 of the FGI were performed
- The work continues in 2010



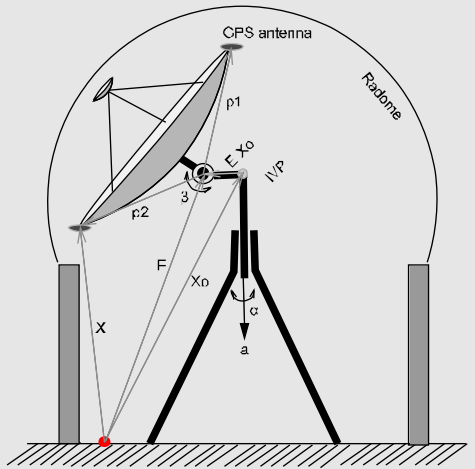
Metsähovi local ties - VLBI

- Measurements with:
  - Precision tacheometry
  - GPS measurements (antennas attached to the VLBI telescope)
  - Precise levelling
- New mathematical model
- In 2009 focus on GPS measurements
- Simutaneous (kinematic) GNSS measurements during four geodetic VLBI campaigns
- millimeter precision achieved with kinematic GPS



$$X_0 + R_{\alpha,a}(E - X_0) + R_{\alpha,a}R_{\beta,e} - X = 0$$

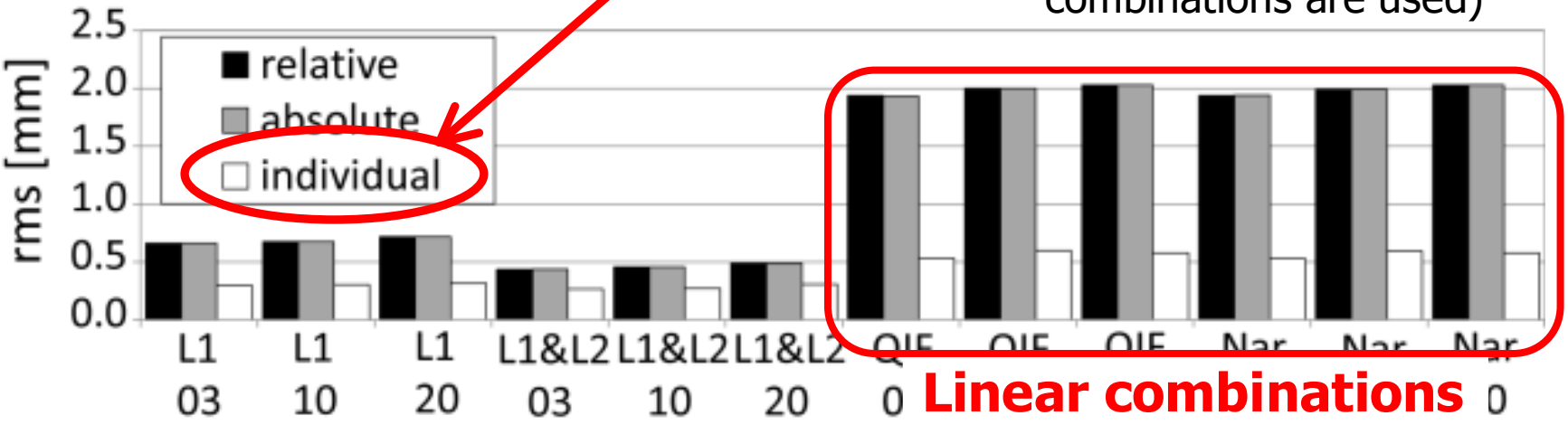
$$R(\alpha, a) = \cos\alpha \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} + (1-\cos\alpha) \begin{pmatrix} xx & xy & xz \\ xy & yy & yz \\ xz & yz & zz \end{pmatrix} + \sin\alpha \begin{pmatrix} 0 & -z & y \\ z & 0 & -x \\ -y & x & 0 \end{pmatrix}$$



GPS metrology

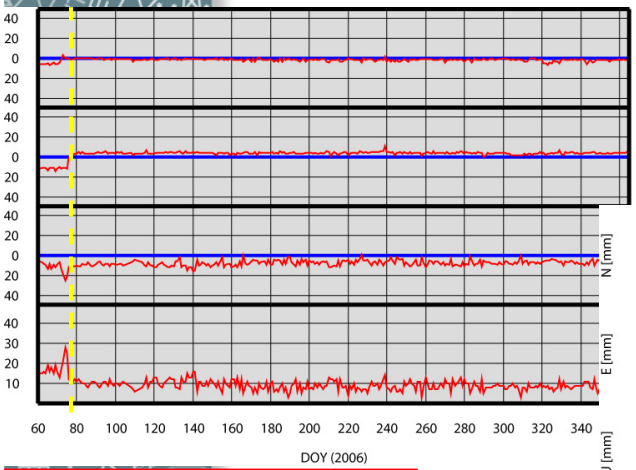
- Goal: to bring traceable scale (w.r.t. the definition of the metre) to GPS solutions at short distances (e.g. local ties)
- How:
  - GPS + mekometer measurements
  - Mekometer (calibrated under the National standards laboratory) results considered as true values (with well-defined and small uncertainties)
  - Testing of different GPS processing strategies, antenna tables, elevation angles, etc.

- Results and remarks:
  - Individual antenna calibration is required for the best accuracy by means of the best agreement with traceable EDM results.
  - L1 only gives the best agreement on short baselines (since small biases in the PCO/PCV values are multiplied when linear combinations are used)

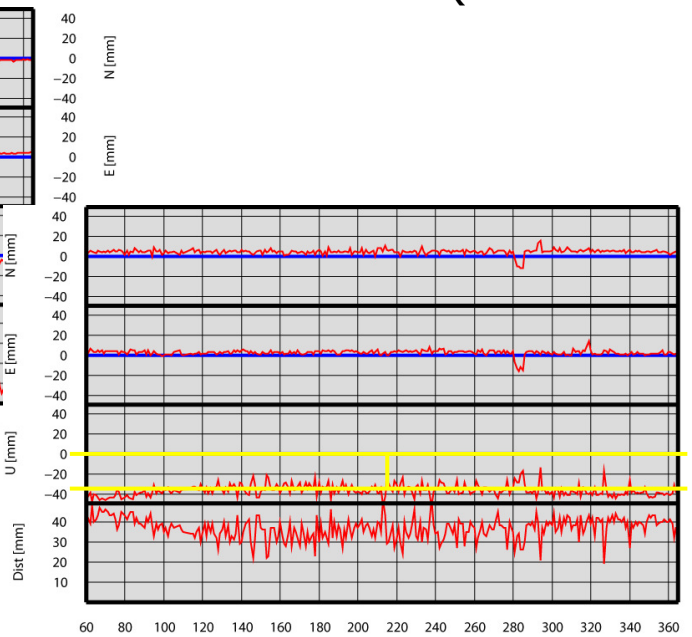


Other studies

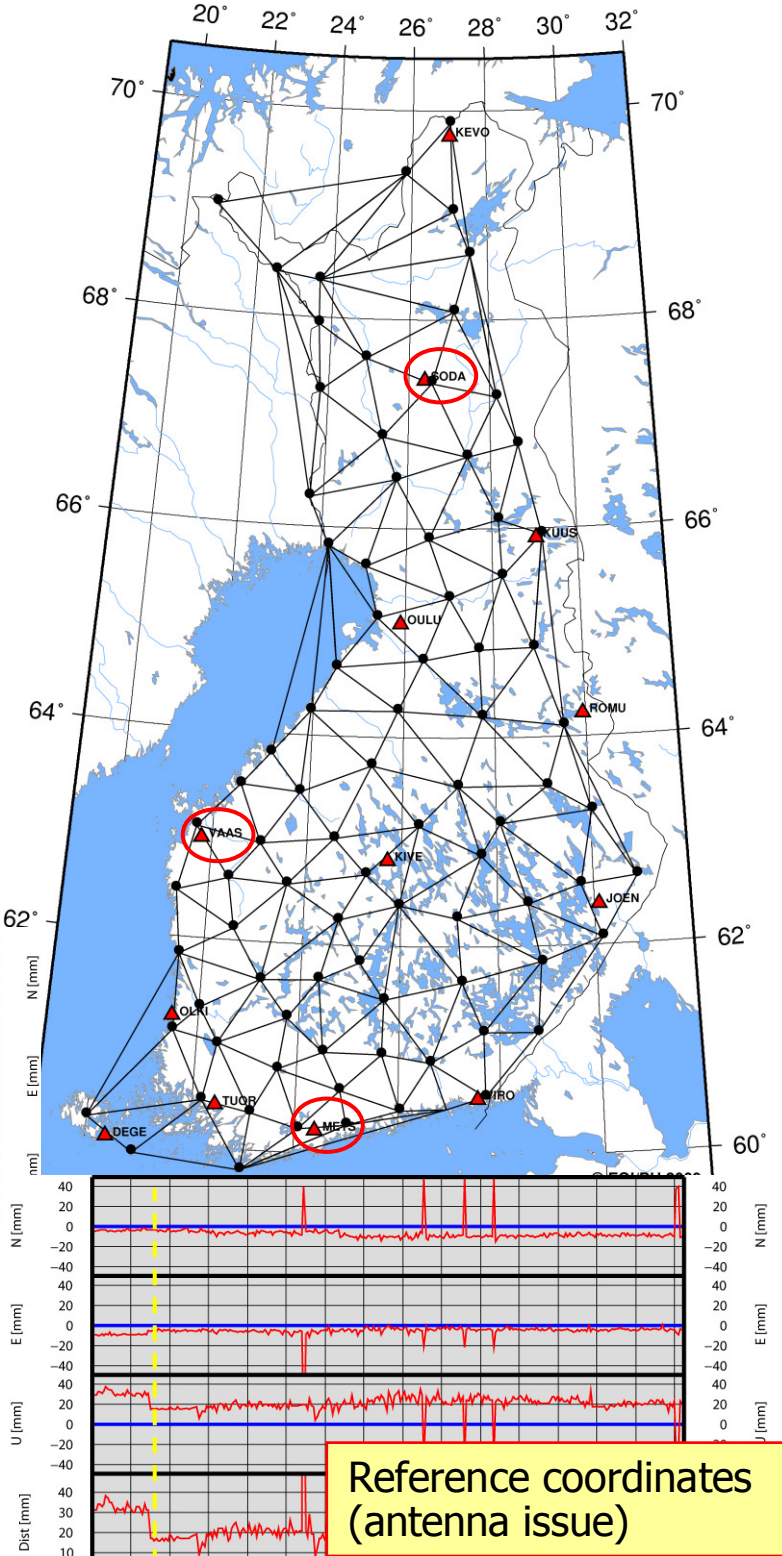
- Accuracy / quality of network RTK (VRS)
  - Network RTK one of the main ways to ”realise” ETRS89 in practise
  - 10-month time series of daily solutions of virtual data (zero-baseline) → long-term quality and systematic errors
  - Results in national ETRS89 (EUREF-FIN)



Environment (snow)



Reference frame fixing



Reference coordinates (antenna issue)

Other studies

- Accuracy / quality of network RTK (VRS)
  - Network RTK one of the main ways to ”realise” ETRS89 in practise
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  - Results in national ETRS89 (EUREF-FIN)
  - Accuracy: up component -35…+20mm
  - Mainly caused by deformed RF due to postglacial rebound (time span ~10 years)
- Transformation evaluations from ITRFyy to national ETRS89 realization
  - Tests with velocity models