

UPDATE OF EUREF-FIN

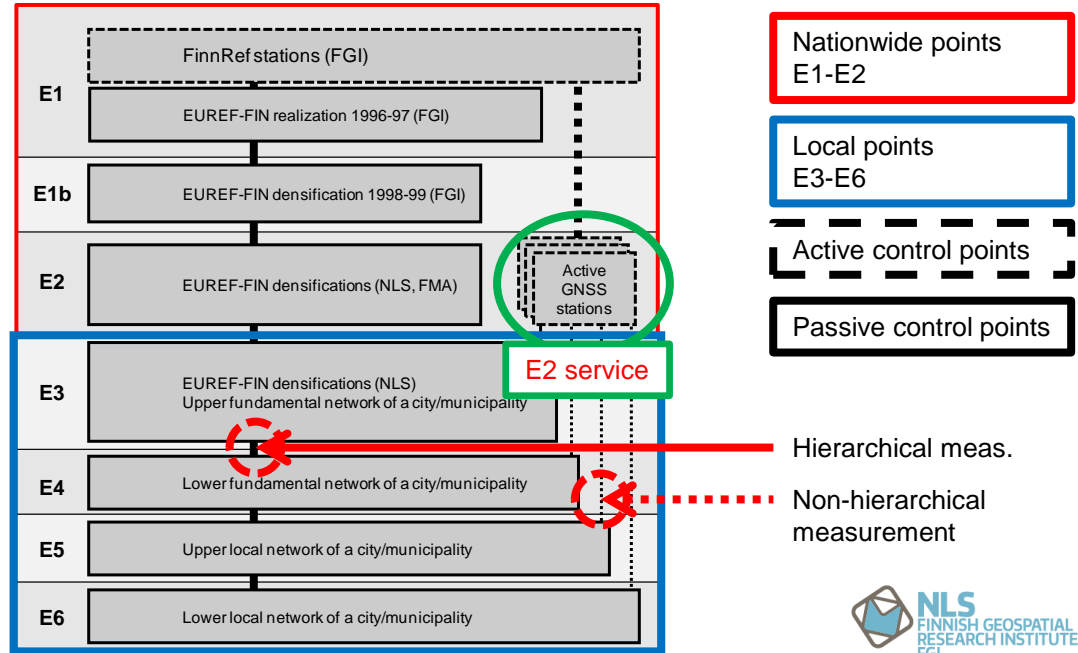
Pasi Häkli, Sonja Lahtinen, Ulla Kallio and Hannu Koivula



NKG WGRF meeting,
March 22-23, 2021

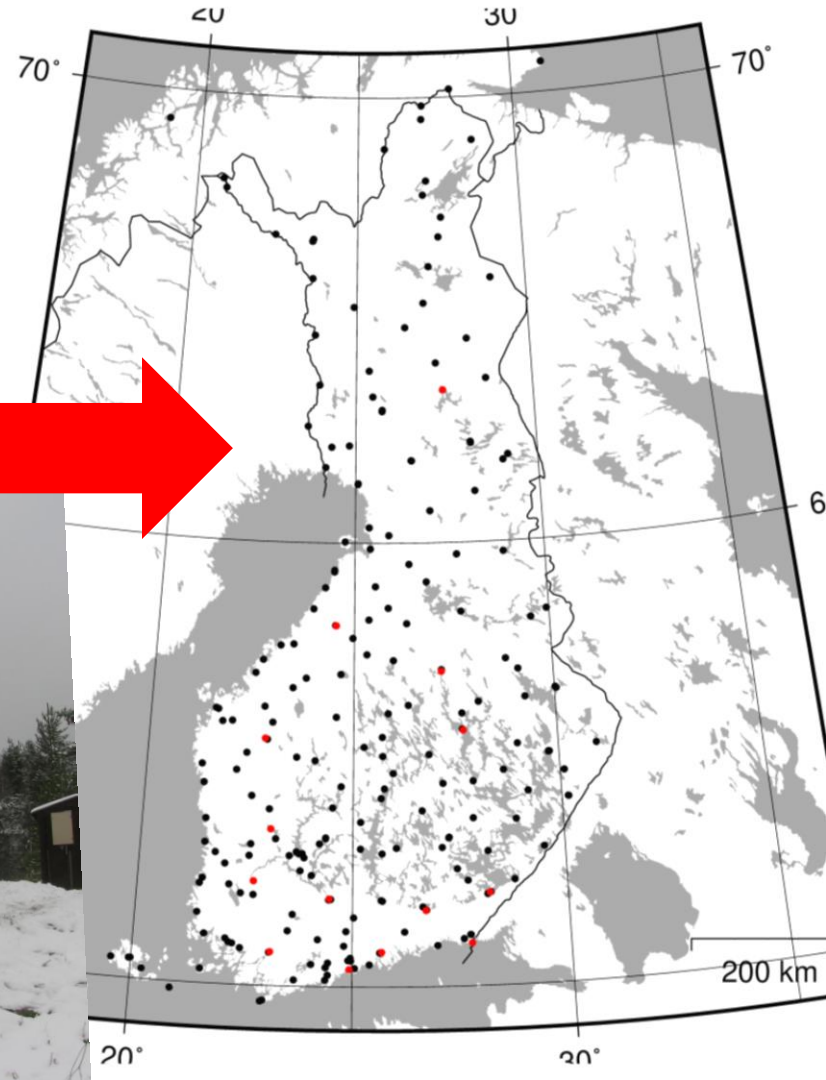
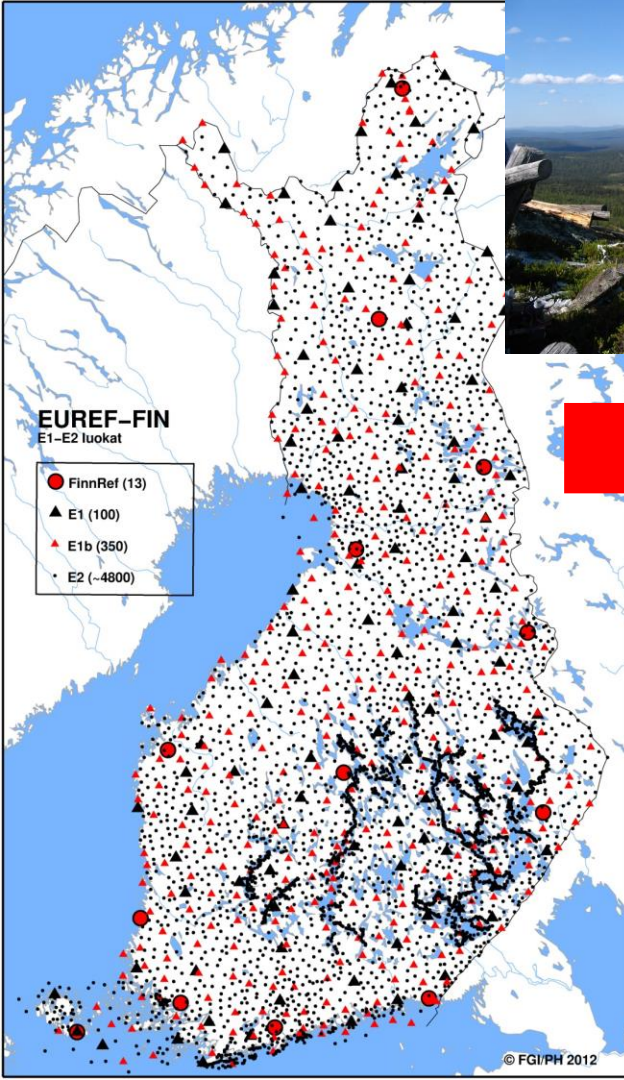
EUREF-FIN DEFINITION

- Highest order E1 coordinates define EUREF-FIN reference frame – EUREF-FIN GPS campaign in 1996-1997
 - 12 FinnRef stations ~23 weeks of data
 - 100 passive benchmarks
 - IGS01.pcv compatible (relative type antenna calibrations)
 - Static reference frame in ETRF96 at (land uplift) epoch 1997.0
- Lower order points
 - Mostly densified hierarchically
 - Since 2012 also non-hierarchical measurements allowed according to rules in Recommendations for the public administration, [JHS184](#)



EUREF-FIN TODAY

- **FinnRef network renewed** in 2012-2013 and **densified** in 2016-2018
 - Now 47 stations
 - "Rapid" 3rd order (E3) EUREF-FIN coordinates determined as soon as station is up and running
 - **2nd order (E2) EUREF-FIN coordinates** determined according to [E2 service](#) for active stations
 - 5 weeks of data
 - IGSy/IGby coordinates transformed to EUREF-FIN with NKG2008 transformation
 - E2 coordinates from a couple of different processings (first 20 stns in 2014, rest 27 in 2019)
- Today ~200 active stations (network RTK services) nationwide give the main access to the EUREF-FIN
 - Use of passive benchmarks reduced
- Most of the original **FinnRef stations decommissioned** already (only METS, VAAS, JOEN and SODA still alive)
- All E1 coordinates except METS remained the same throughout years



GEODESY STRATEGY – GOALS BY 2026

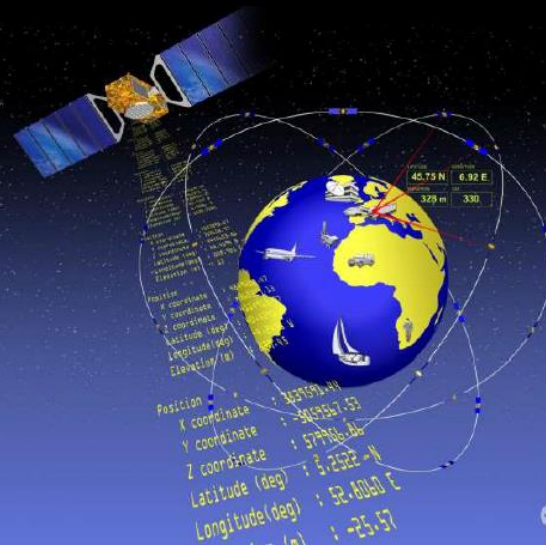
- preparations carried out for the **adoption of a semi-dynamic reference frame** to be used in all spatial data production, and investigated **possibilities for switching to a fully dynamic reference frame**
- investigated the requirements for switching to an **active network of control points** with regard to different reference systems, and the **FinnRef network** points have been incorporated into the semi-dynamic reference frame
- the Metsähovi geodetic research station is part of the global network of geodetic stations under the UN resolution, and producing high-quality research
- **new land uplift and geoid models** provide accurate 3D models for the transformations needed in dynamic and semi-dynamic reference frames and for the maintenance of the height system
- developed methodology for maintaining the national height system
- metrologically reliable and accurate coordinate (3D), height and gravity reference systems enable easily accessible geospatial information for all applications

Geodesia Suomessa

Visio ja strategia 2017 – 2026

Geodesy in Finland

Vision and Strategy 2017 – 2026



GEODESY STRATEGY: SEMI-DYNAMIC REFERENCE FRAME

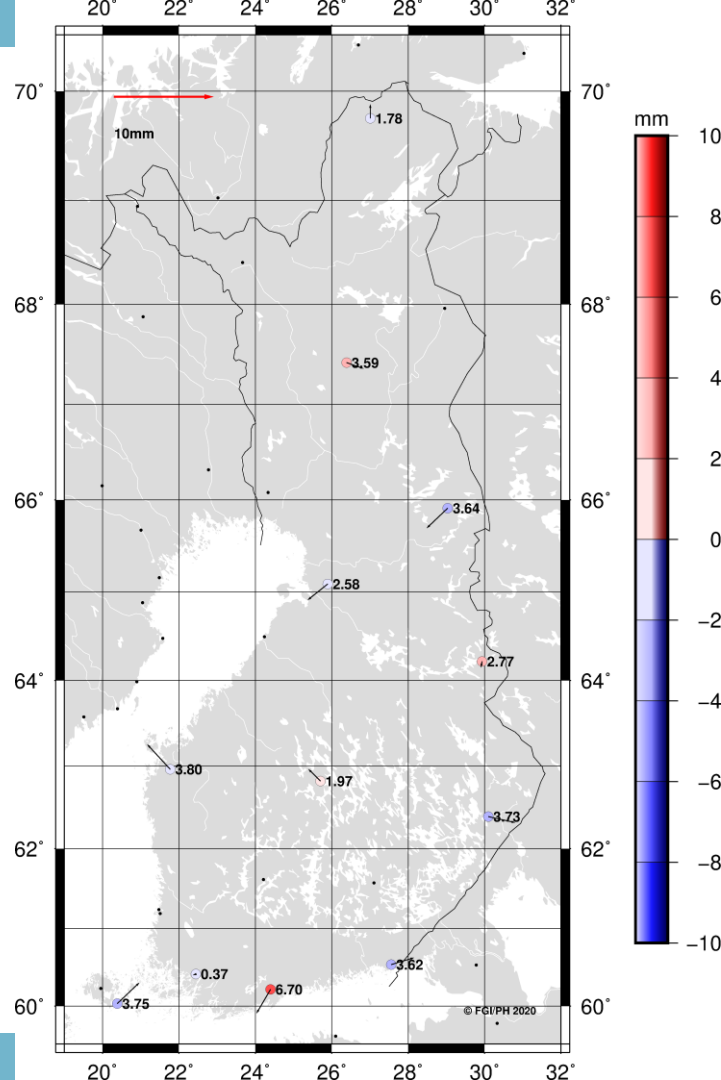
1. preparations carried out for the **adoption of a semi-dynamic reference frame** to be used in all spatial data production, and investigated possibilities for switching to a fully dynamic reference frame

Projects:

- 2020: Updated NKG transformation (NKG project)
- **2020: New “semi-dynamic” coordinates for FinnRef stations** (related to NKG transformation)

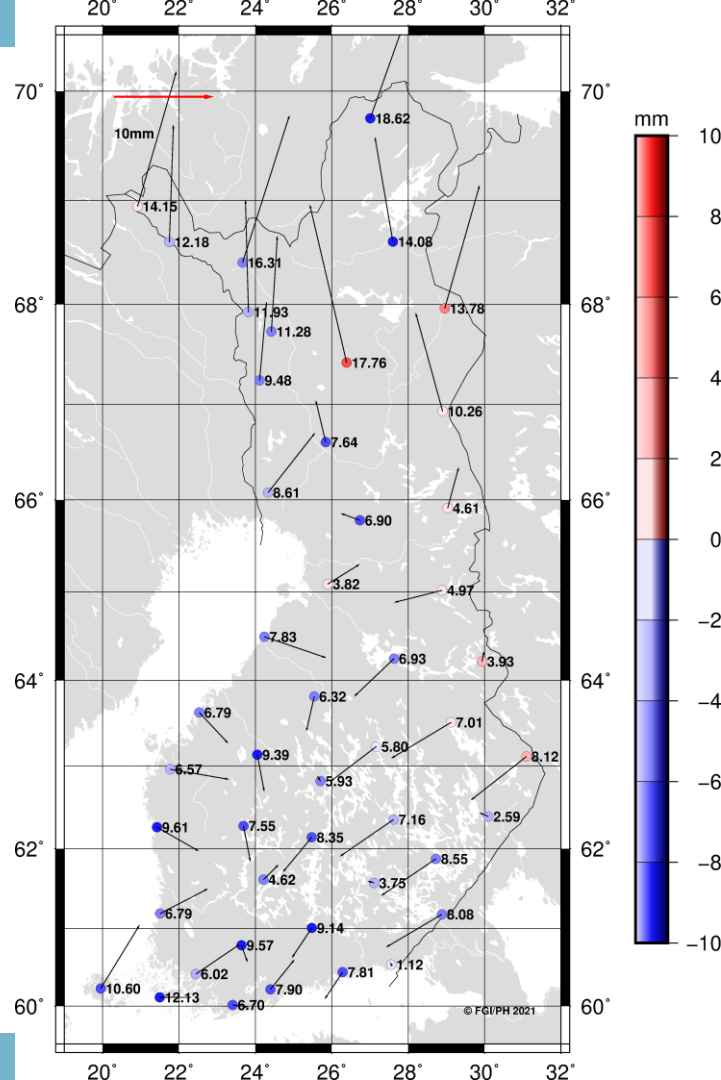
NEW/UPDATED FINNREF E1 COORDINATES

- **Old** (decommissioned) **FinnRef stations** (12+1)
 - Updated coordinates mostly for transformation purposes where old stations may be still needed
 - Original coordinates corrected for antenna models and METS offsets
 - **For NKG2020 transformation:** original coordinates corrected with IGN correction igs05.atx→igs08.atx (to agree with NKG Repro1)
 - In the figure NKG2020 transformation residuals (rms, NEU): 1.53/1.77/2.63 mm
 - Similarly, when needed, corrections to the antenna models in the corresponding GNSS processing, e.g. to igs14.atx
- **Renewed/new FinnRef stations** (47)
 - Previously E2 (E3) coordinates, now updated to E1
 - Tests with short vectors at twin stations, tachymeter measurements but in the end decided to determine coordinates from NKG AC
 - Data: 2-4 years (period 2017.1-2020.9)
 - Stacked from the NKG AC operational solutions (GPS+GLONASS)
 - IGS14(2019.004) transformed **with NKG2020 transformation** (including intraplate corrections from the NKG_RF17vel models) to EUREF-FIN → **E1 coordinates**
- Came into operation in February 1, 2021



WHAT CHANGES?

- **New FinnRef E1 coordinates are also defining the EUREF-FIN frame**
 - Minor changes to the EUREF-FIN at the reference frame level/domain (cf. NKG2020 transformation residuals in the previous slide)
- Slightly bigger changes to the FinnRef coordinates (from E2 to E1): mostly 5-10mm, in Northern Finland 10-15mm (figure)
 - Biggest differences in Northern Finland caused by the change of the NKG transformation:
 - previously E2 coordinates with the NKG2008 transformation
 - New E1 coordinates with the NKG2020 transformation
 - Most of the difference explained by the different models NKG_RF03vel and NKG_RF17vel models
 - Some differences at individual stations caused by change in data span (from weeks to years)
- Due to selected methodology (NKG transformation), EUREF-FIN can now be considered as a **semi-dynamic reference frame** (cf. goal in the Geodesy strategy)
 - Not really a giant leap but a step forward (in practice recommended already before in JHS184 for larger regions where intraplate deformations need to be considered, e.g. E2 service. But now used also for the highest order coordinates. Also use of static coordinates allowed.)
 - NKG2020 transformation (as the official transformation) available in PROJ



WHAT NEXT?



GEODESY STRATEGY: ACTIVE TRF/VRF DEFINITION

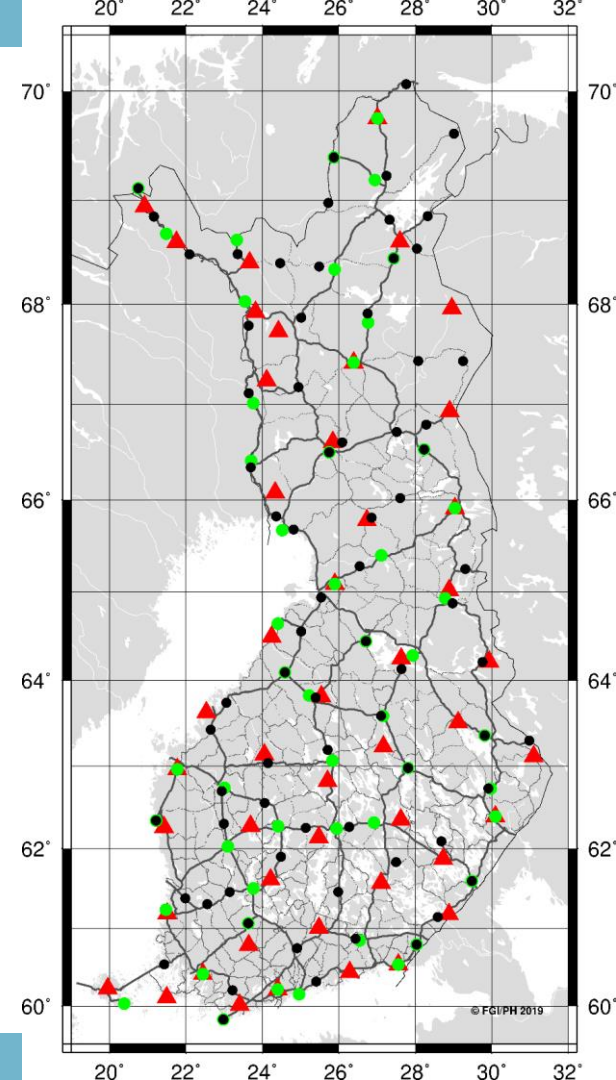
2. investigated the requirements for switching to an **active network of control points** with regard to different reference systems, and the FinnRef network points have been incorporated into the semi-dynamic reference frame

Projects:

- 2021: Study on active definition for EUREF-FIN (KaRef WP2: e.g. passive vs. active points,...)
- 202x: Changing to active definition in EUREF-FIN?

ACTIVE DEFINITION

- [KaRef project](#) (Preparing for the Renewal of the Finnish National Reference Systems) 2020-2021
- WP2: Active definition:
 - What is coordinate agreement between active and passive networks?
 - What are the requirements if we change into active definition of coordinate reference system?
 - Reducing a number of maintained passive benchmarks, e.g. GNSS/levelling points (figure)?
 - No official decision yet but in practice maintenance of old and/or measurements of new passive EUREF-FIN points decreased drastically
 - Instead, regular re-measurements? (partly already started...)
 - Requirements/changes on accurate positioning services? (access to active reference frame...)
 - Currently private network RTK services for public use
 - FINPOS of the NLS currently for internal use but discussions ongoing on governmental open positioning service (mentioned e.g. in [Report on spatial data policy](#) by the Ministry of Forestry and Agriculture)



THANKS!

