National Report Finland 2020-2021

Pasi Häkli

& GEOGEO department

NLS
FINNISH GEOSPATIAL
RESEARCH INSTITUTE
FGI

NKG WGRF meeting, 22-23 March 2021

NKG RELATED TASKS

- NKG GNSS AC
  - Operational solutions FGI_LAC
  - Combined solutions NKF
  - Development of NKG cumulative solution
- NKG_RF17vel model
  - Uncertainty grid in progress
- Update of NKG transformations (NKG WGRF project)
  - Updated NKG transformations (NKG2020) between ITRFyy and national ETRS89 realizations were finalized in Dec 2020 – Feb 2021.
  - Utilizes new 2D+1D NKG_RF17vel model (2D: WGG/WGRF, 1D: WGG/WGGHS: NKG2016LU_abs) to account for intraplate deformations
  - New national parameters (Norway: correction grid), ITRF2014 coordinates from time series, national ETRS89 coordinates revised
  - Implemented in PROJ (starting version 7.2.1, except Norway that will be available soon) → CC-BY 4.0 license for the NKG_RF17vel model and transformation

NLS FINNISH GEOSPATIAL RESEARCH INSTITUTE FGI

PRECISE LEVELLING

2020: Precise levelling of FinnRef GNSS stations:
6 permanent GNSS stations levelled (red)

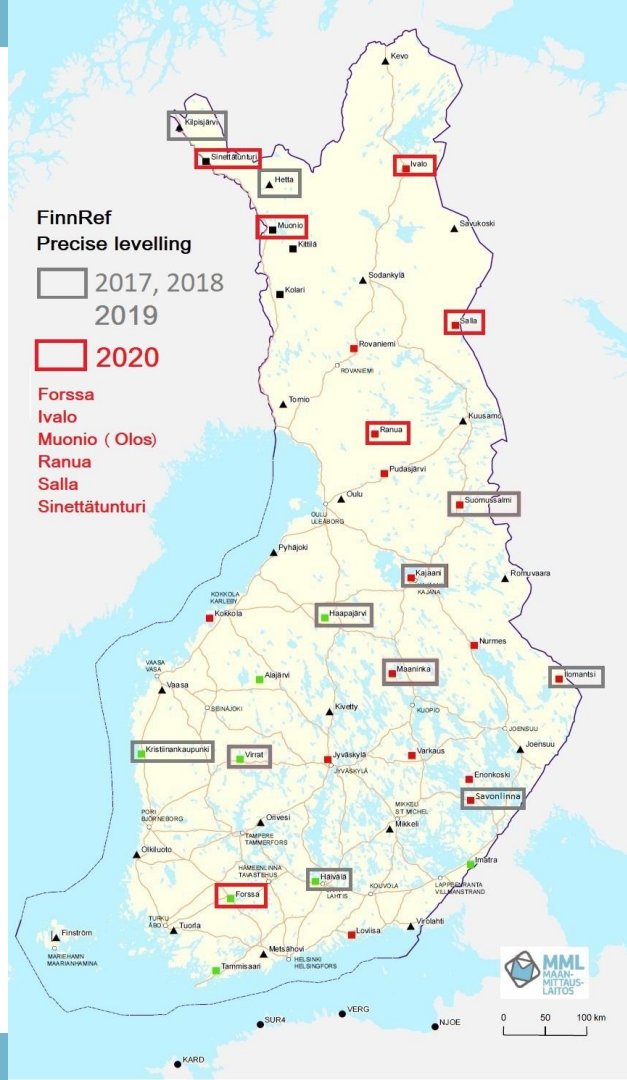
2021:

- Levelling of permanent GNSS stations
  All or most FinnRef stations connected to precise levelling network by the end of 2025.

- 3rd order precise levelling, mostly in central Finland

- Levelling of water level stations of Finnish Environment Institute (SYKE).
  Still 10 water level stations in the plan

- Rod calibrations



KAREF-PROJECT (2020-2021)

Preparations for the renewal of the Finnish national reference systems

Funded by Ministry of agriculture and forestry

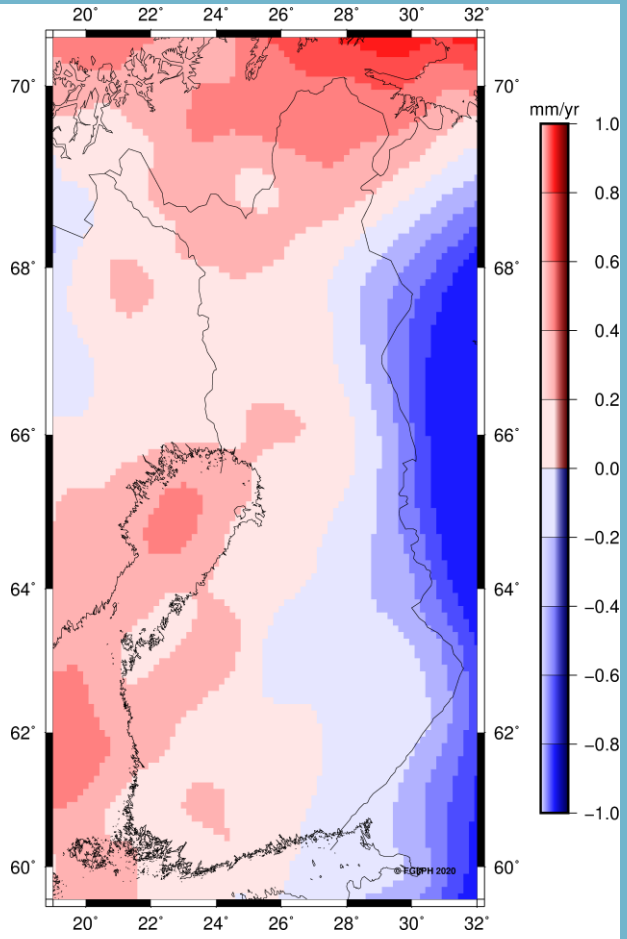
<u>2020:</u>

WP1 The use of land uplift models and EVRF in the maintenance of the height system

<u>2021:</u>

WP2 Coordinates determined in an active system versus coordinates in a passive system, what to take into account when moving to an active coordinate system?

WP3 The relative accuracy of the geoid model & Is it time to calculate a new national geoid model?



NKG2016LU-NKG2005LU

KAREF - RESULTS

Most relevant results so far:

1. *Observations* of the Third precise levelling re-adjusted with NKG2016LU_lev at epoch 2000.0 (VS2000). Comparison to ***EVRF2019 heights***. Note: different data (e.g. Russian data not used in Finnish adjustment). Differences very small (<5mm)

2. *Observations* of the Third precise levelling re-adjusted with NKG2016LU_lev at epoch 2000.0 (VS2000). Comparison to ***N2000 heights***. Differences very small, a couple of millimeters

3. *Observations* of the Third precise levelling re-adjusted with NKG2016LU_lev at ***epoch 2020.0*** (VS2020). This describes present-day state of the nationwide height system in absloute sense. Differences to N2000 heights between 4-18 cm.

4. *Observations* of the Third precise levelling re-adjusted with NKG2016LU_lev at ***epoch 2040.0*** (VS2040). This describes present-day state of the nationwide height system in absloute sense. Differences to N2000 heights between 10-32 cm.

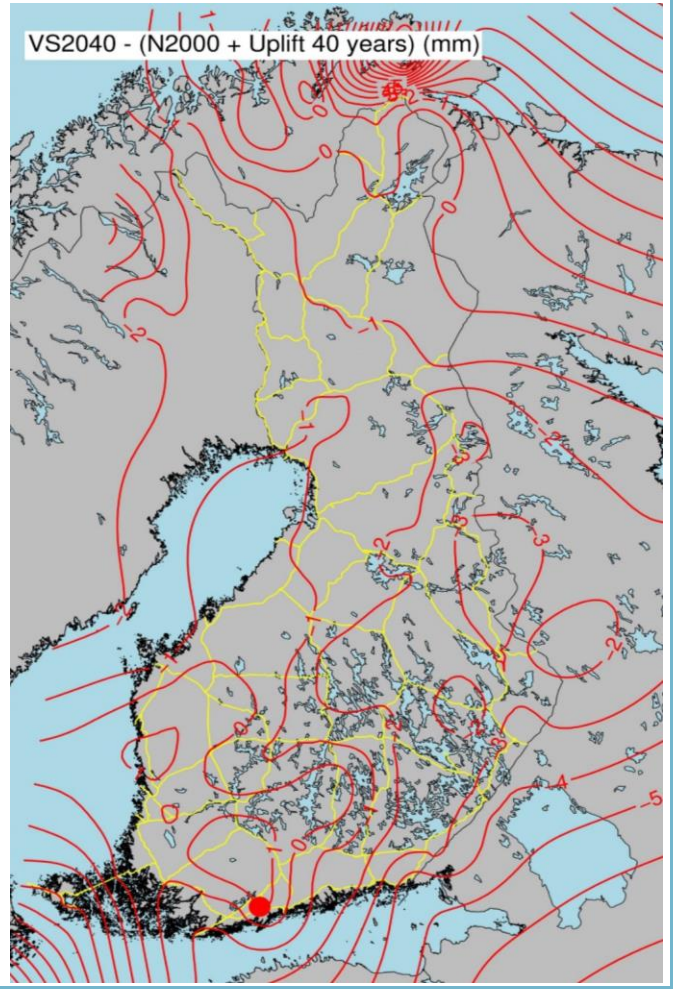
5. NKG2016_lev ***corrections directly to N2000 heights*** (semi-dynamic height system). Comparison to VS2040 (case 4). Minor differences, **see picture**.

Preliminary conclusions:

→ ***land uplift models can be used to prolong the lifetime of the height system. Up-to-date heights can be obtained reliably by applying corrections directly to N2000 heights*** **(semi-dynamic height system).**

→ However, land uplift ***models cannot replace geodetic observations*** in the long-term. Observations are needed also for improving and maintaining the models (in addition to establishment of new reference frames).

→ There are several alternative techniques to establish a new height system that will be studied later as a part of the Geodesy strategy.



DYNPOS PROJECT

Purpose of the project is to study if the positioning service of the NLS, FINPOS, can be set up to operate in a dynamic reference frame and to provide user positions in a dynamic and semi-dynamic RF

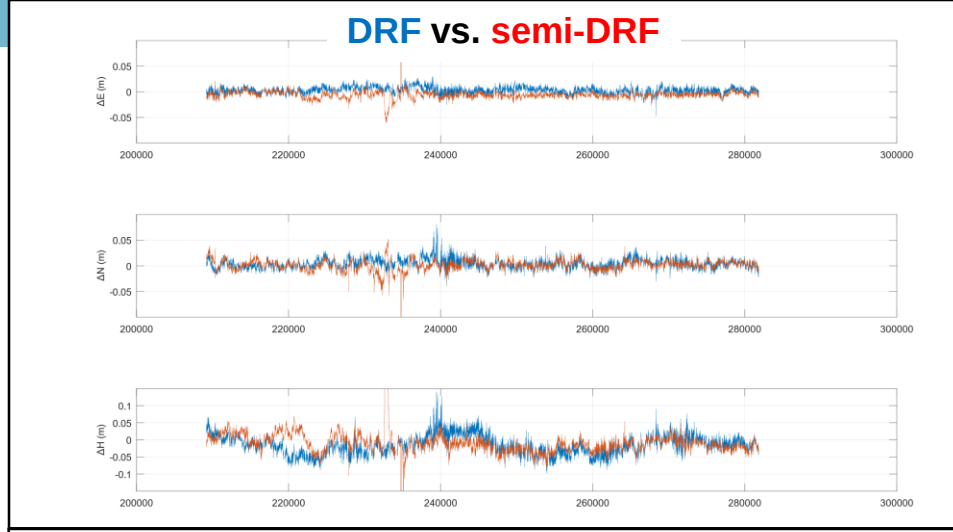
Tested three options in VRS mode:

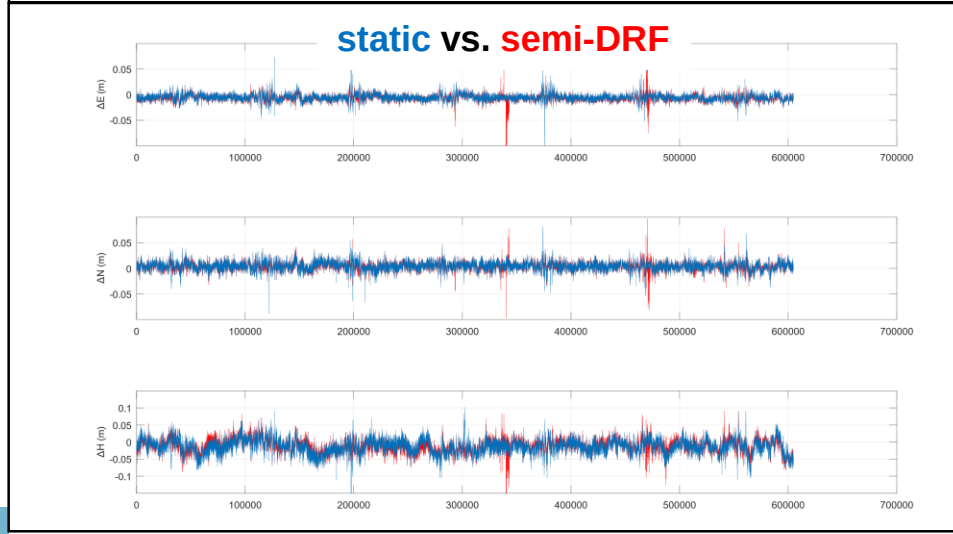
1. Dynamic ITRF2014@2020.75
2. Semi-dynamic EUREF-FIN (ITRF2014@2020.75 + NKG transformation → EUREF-FIN)
3. Static EUREF-FIN, (without transformation; from ”production” service)

- User coordinates compared to the reference coordinates (1: ITRF2014@2020.75 and 2-3: official E2 coordinates)

Conclusions:

- It is possible to set up FINPOS service to provide dynamic and semi-dynamic coordinates to users with approx. same accuracy as the current production service
- Results preliminary, further tests needed before taken into use





PROJ DEVELOPMENT

- Finnish national transformations are mainly implemented as triangulated transformations (TIN), e.g. KKJ→EUREF-FIN and N60→N2000
  - Support for TIN-based transformations was lacking from PROJ
  - **NLS had a project to implement national TIN-based transformations to PROJ.**
- A new method ***tinshift*** developed to PROJ
  - Using barycentric coordinates
  - Example:

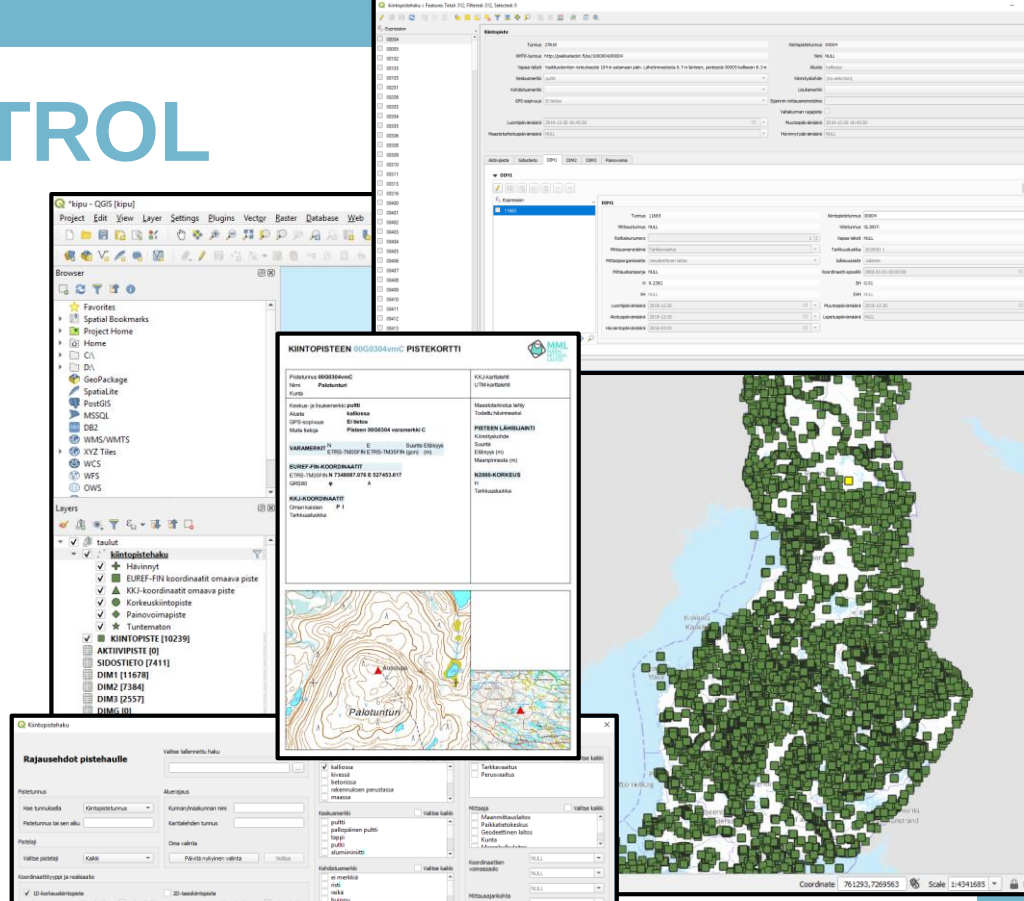
    $ echo 3210000.0000 6700000.0000 0 2020 | cct **+proj=tinshift +file=**fi_nls_ykj_etrs35fin.**json**

    209948.3217 6697187.0009 0.0000 2020
  - **Available starting from PROJ 7.2.0**
- **As a result, PROJ is capable to perform all Finnish but also international transformations** (using EPSG registry)
- Introducing Finnish TIN-based transformations (YKJ<->ETRS-TM35FIN, N60<->N2000, N43<->N60) to EPSG registry in progress

NLS FINNISH GEOSPATIAL RESEARCH INSTITUTE FGI

RENEWAL OF CONTROL POINT REGISTRY

- Includes/handles:
  - Traditional passive benchmarks
  - Active benchmarks (permanent GNSS stations)
  - Gravity benchmarks
  - Supports velocity, uncertainty and time information and validity of coordinates (time windows) and global reference frames
- GUI built on QGIS
  - Uses mostly native QGIS tools
  - Search tool (form), import, export, printing of point information ”card”
  - Currently uses NLS transformation interface (internal) for transforming and converting coordinates but maybe PROJ in the future



NLS FINNISH GEOSPATIAL RESEARCH INSTITUTE FGI

METSÄHOVI

Superconducting gravimeters iOSGS-022 & iGrav-013

- Work on automatization of prosesses
- 2021: Improve SG-AG synergy

Metsähovi renewal (now NLS funded)

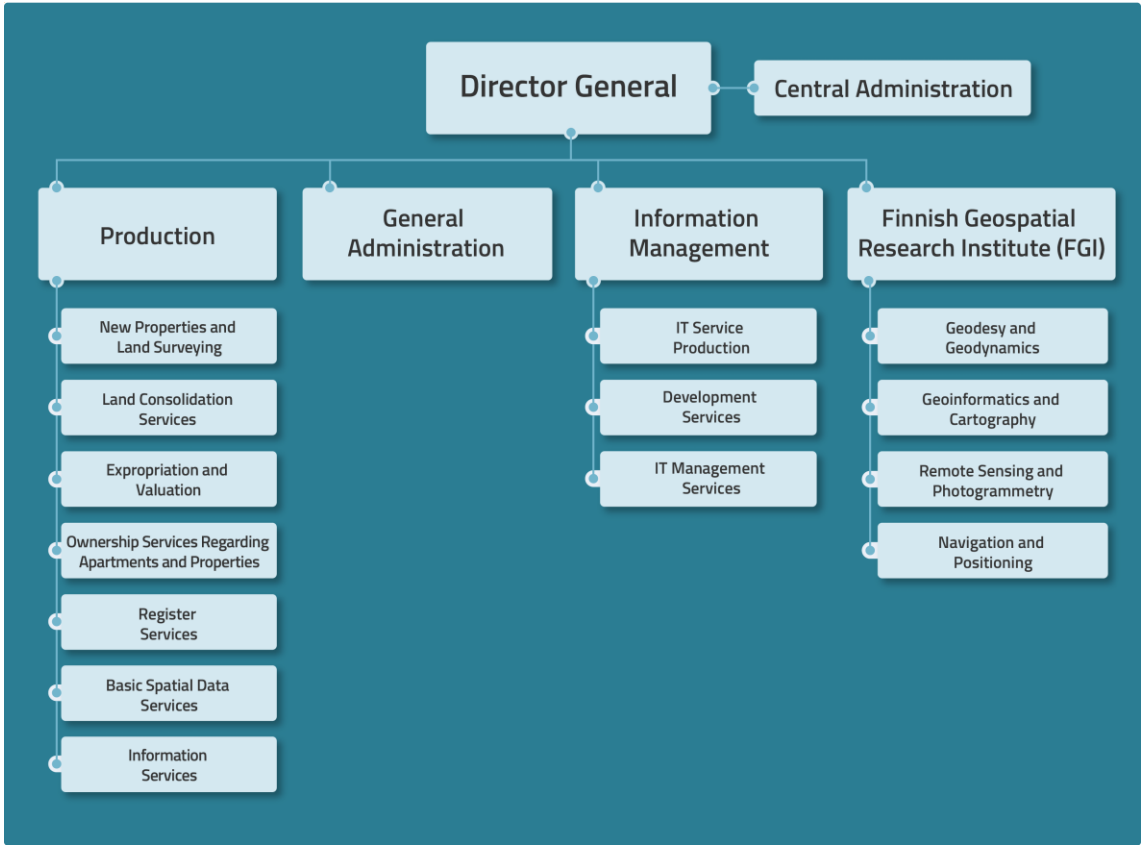
- SLR – finalizing still ongoing (at this moment)
- VLBI – Proceeding as planned
- 2022 testing phase, operational by end 2022
- Construction of new main building starts this autumn, ready mid-2022

FLEX-EPOS project (4 years, start 2020, Finnish Acadamy funded)

- Create a national pool of geophysical instruments and multi-disciplinary geophysical superstations & Strengthen role of Finland in European Plate Observing System (EPOS)
- NLS/FGI:
  - Time frequency link to Metsähovi (2020)
  - New relative gravimeter (2021)
  - 10 InSAR targets (2021)

NLS
FINNISH GEOSPATIAL RESEARCH INSTITUTE
FGI

1.3.2021 - NLS NEW ORGANIZATION



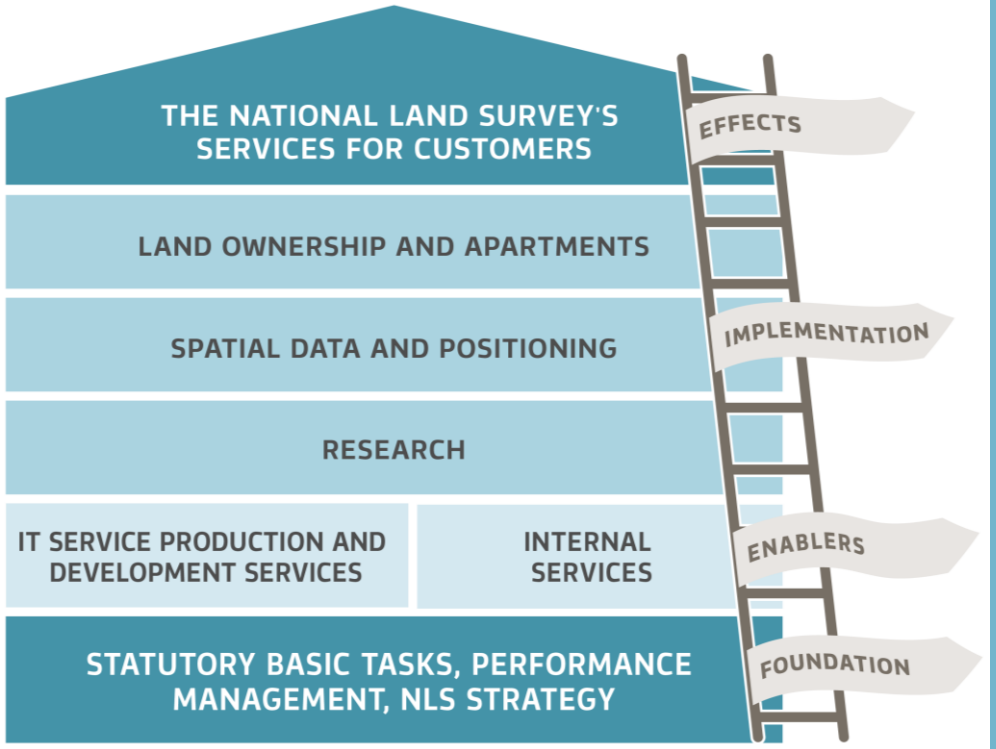
NLS
FINNISH GEOSPATIAL RESEARCH INSTITUTE
FGI

NLS NEW ORGANIZATION

Strengthen customer oriented approach

Changes from GEOGEO perspective:

- Production unit
  - Operates FINPOS
    - 400 RTK users of the NLS
  - Is responsible for reference frames
- FGI GeoGeo
  - Scientific basis of reference frames
  - Metrology
  - Research



THANKS!

NLS
FINNISH GEOSPATIAL
RESEARCH INSTITUTE
FGI