

9th EUPOS Meeting

NATIONAL REPORT OF SLOVENIA

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Riga, November 22–23, 2023

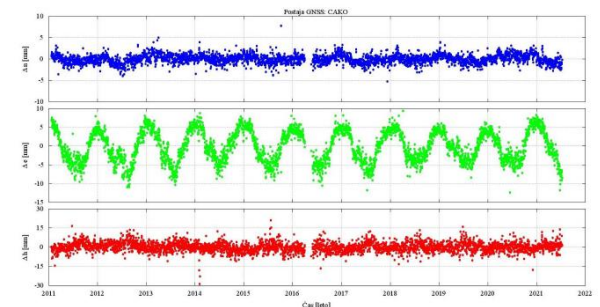
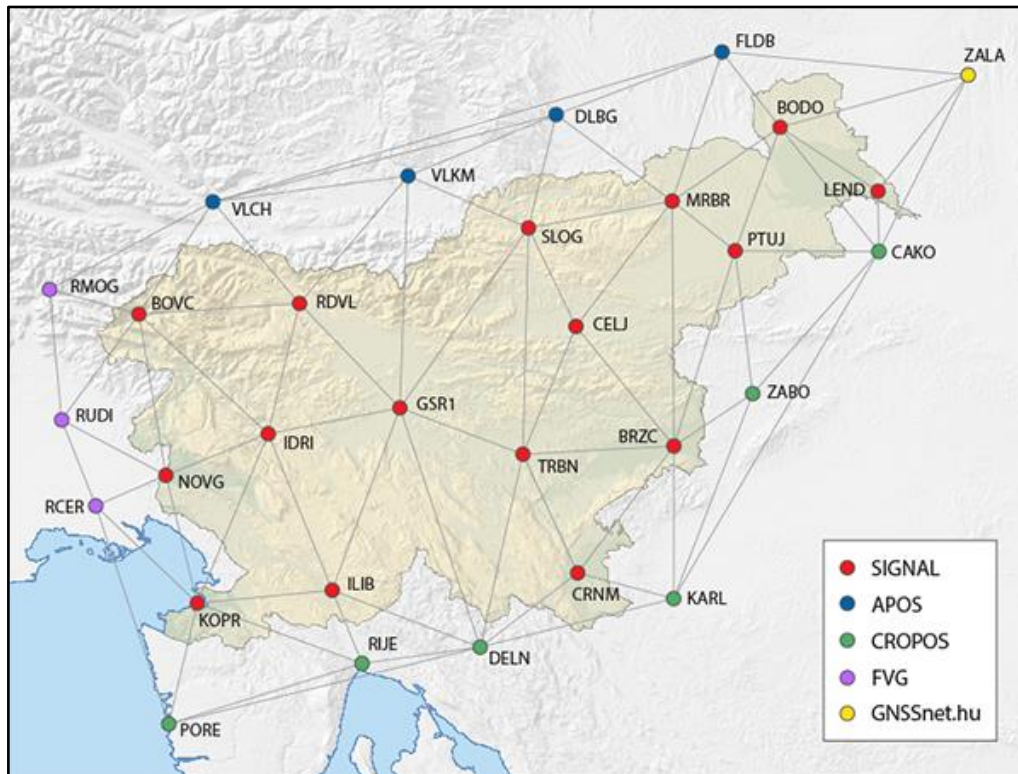
Presentation topics

- **CORS Networks: SIGNAL & Zero-Order Networks**
- **Passive GNSS Control Network**
- **Height Reference Frame:
Towards a New Height Transformation Model**
- **Terrestrial Reference Frame:
From Static to Kinematic**
- **Coordinate Reference Systems Support:
EPSG, Software & Equipment Settings**

SIGNAL Network (GBAS)

- 16 continuously operating GNSS stations in Slovenia (9 **Trimble** + 7 **Leica**)
- +14 continuously operating GNSS stations in Austria, Croatia, Hungary & Italy
- 1 EPN station (GSR1 – Ljubljana, EUREF Class A)
- **Trimble Pivot Platform** + **Alberding Quality Control**

- RTK services
- RINEX & Virtual RINEX data

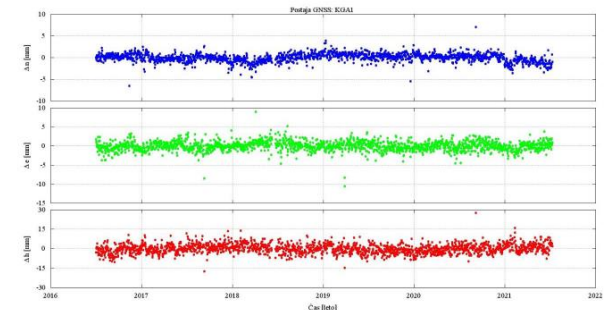
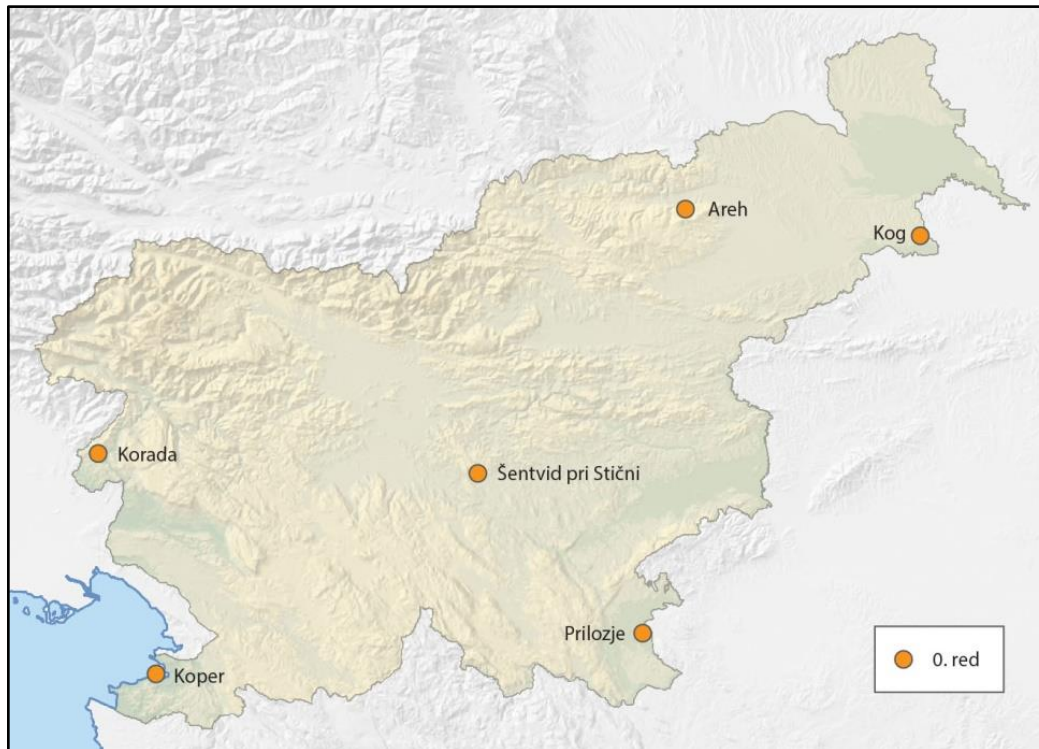


SIGNAL Network – News

- Trimble Pivot Platform (TPP) v5.1 in test phase on the backup system (as of april 2023)
 - VRS RINEX antenna name issue in TPP v4.7.2 (not present in v4.7.1) has been fixed
- Automated scripts to archive RINEX data directly from receivers (not TPP) and check data completeness has been implemented
- Upgrade of telekomunications in the SIGNAL Network operating center
- New Trimble Alloy receiver and antenna on stations BRZC, TRBN, and RDVL
- Several firmware upgrades of receivers in 2023

Zero Order GNSS Network

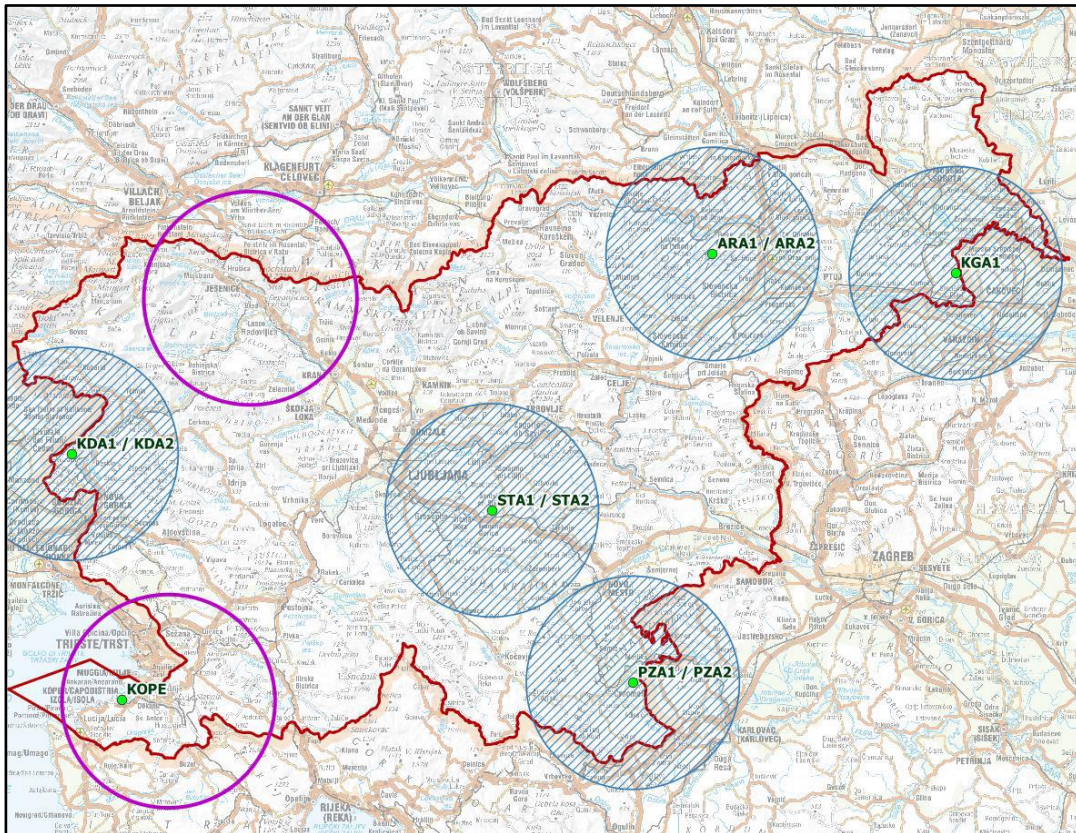
- 6 continuously operating GNSS stations in Slovenia (*Leica* equipment)
- 4 of them are **twin stations**, 1 combined with a **tide gauge station**, 1 with a **seismic station**, 1 near an old **triangulation point**, 1 near an **absolute gravimetric point**; all stations connected to the first order levelling network
- Operating for more than 6 years, *Alberding GNSS Status Software*



Zero Order GNSS Network – News

Building up **two new zero-order stations** is in progress.

The station in north-western part of the country is a densification of the network. The station in south-western part will replace the existing Koper station, which is identified as locally unstable.

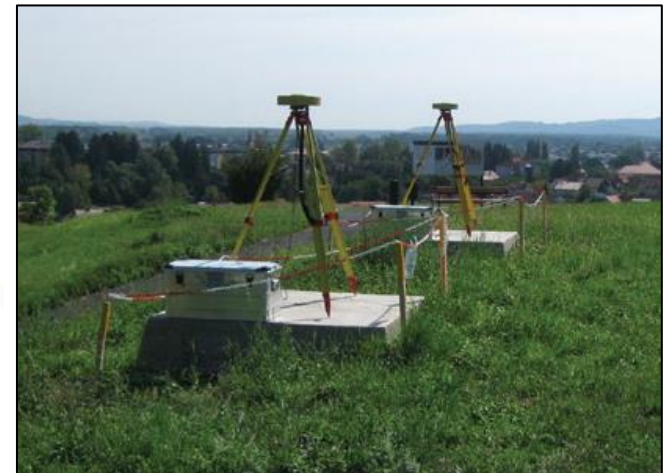
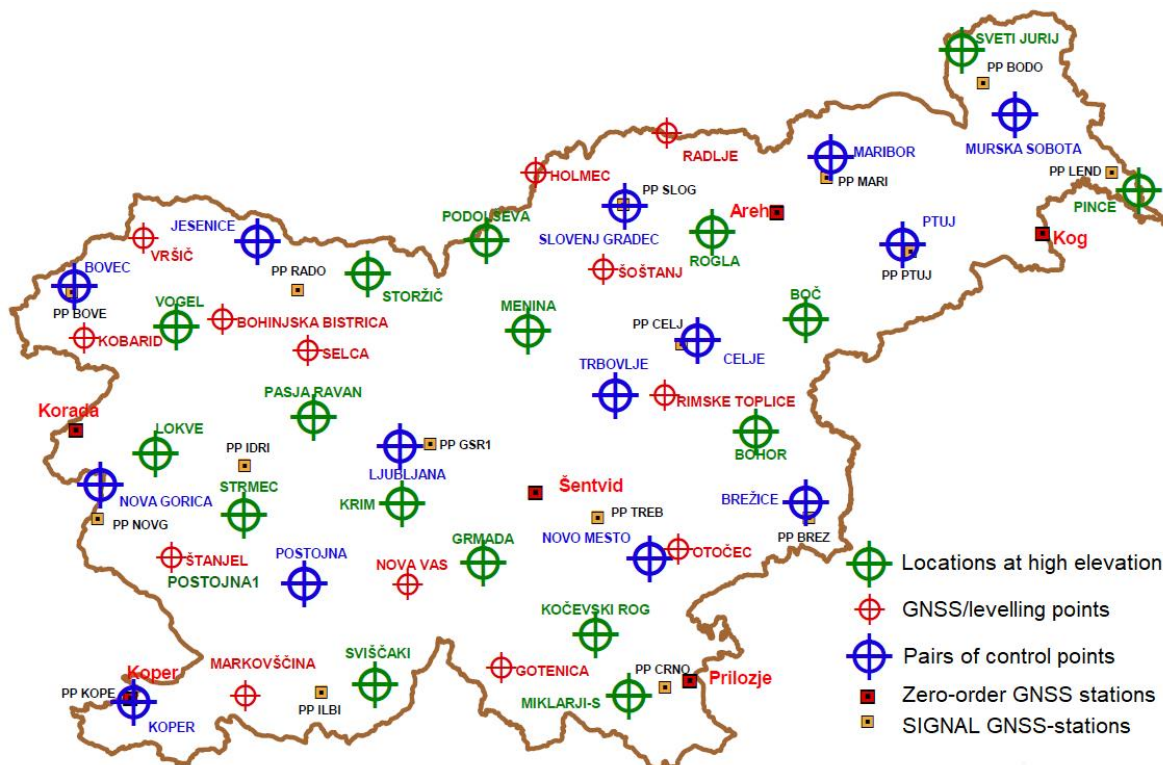


- All documentation is obtained
- Contracts are signed
- Building is in progress
- Works shall be finished in Q1 of 2024
- Equipment shall be installed in Q2 of 2024

Passive GNSS Control Network

- 14 locations with calibration baselines (pairs of points) for testing according to ISO 17123-8
- 17 control points at high elevations
- 13 GNSS/levelling points

- Monitoring the quality of the SIGNAL network products and services
- Verifying GNSS measurement equipment and methods
- Available for SMA and private surveyors

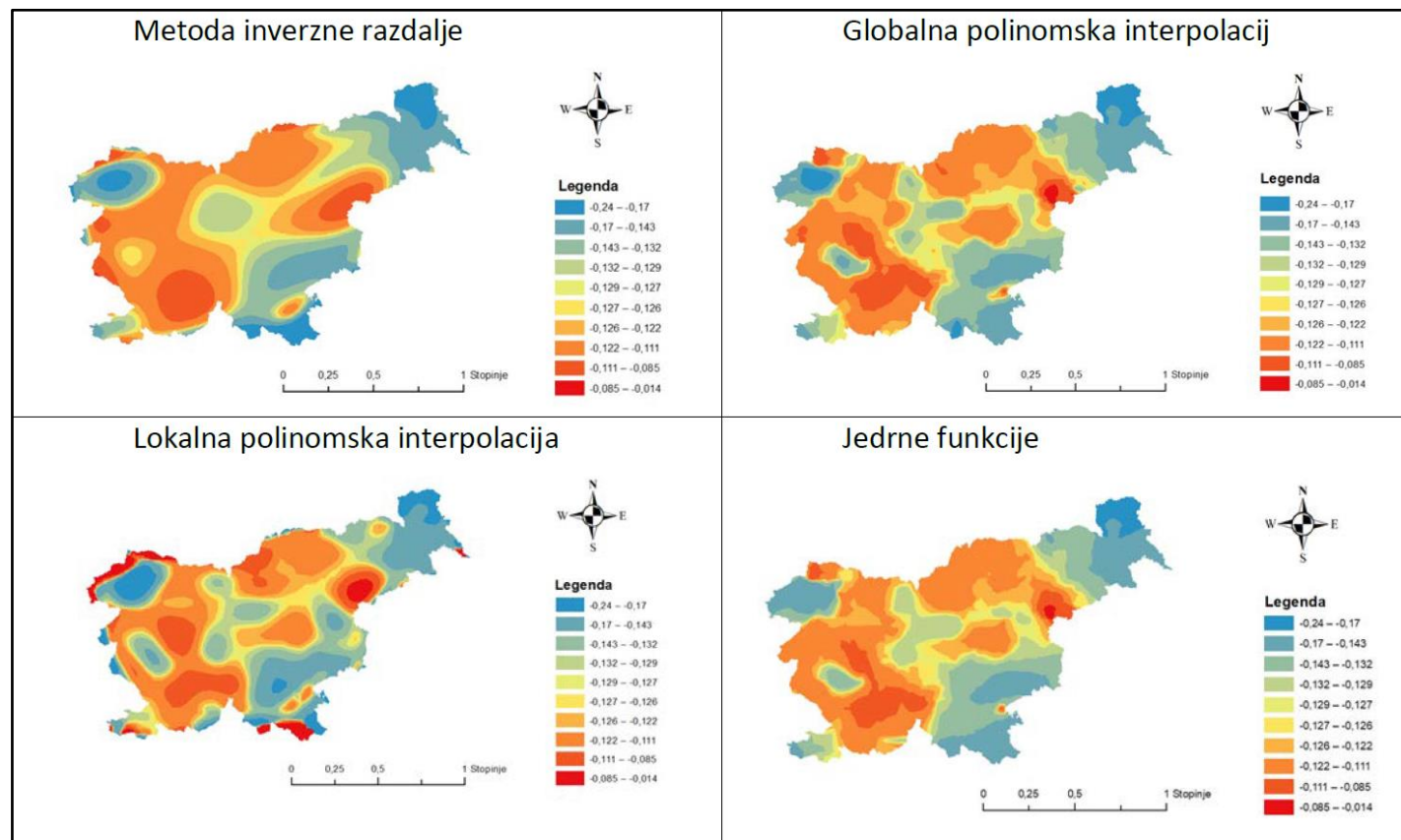


Height Reference Frame – Transformation to SVS2010

- **SVS2010** – a new Slovenian height reference system, adopted in 2018
- Creation of a national height transformation model is in progress

Height differences between SVS2000 (Trieste) and SVS2010 (Koper):

- **15.5 cm** in Koper (tide gauge station)
- **1.4 cm to 30.8 cm** – min/max differences
- **13.2 cm** – average difference

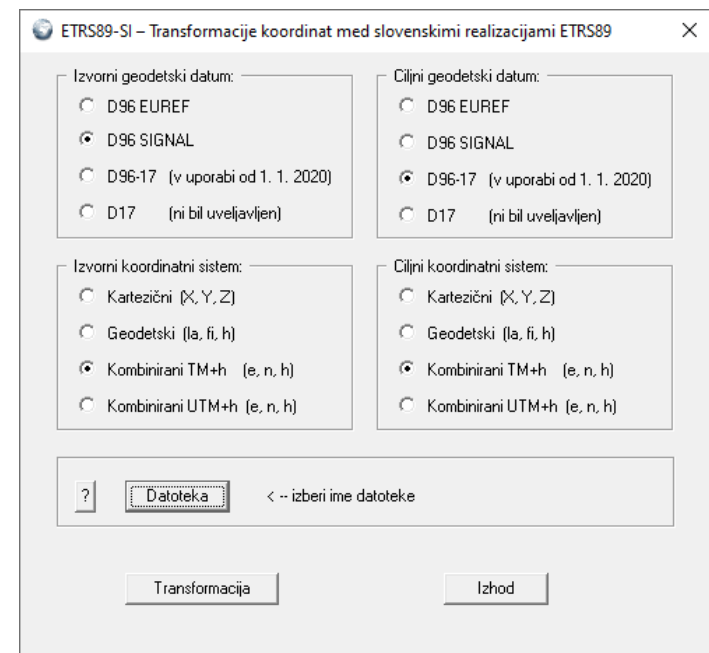
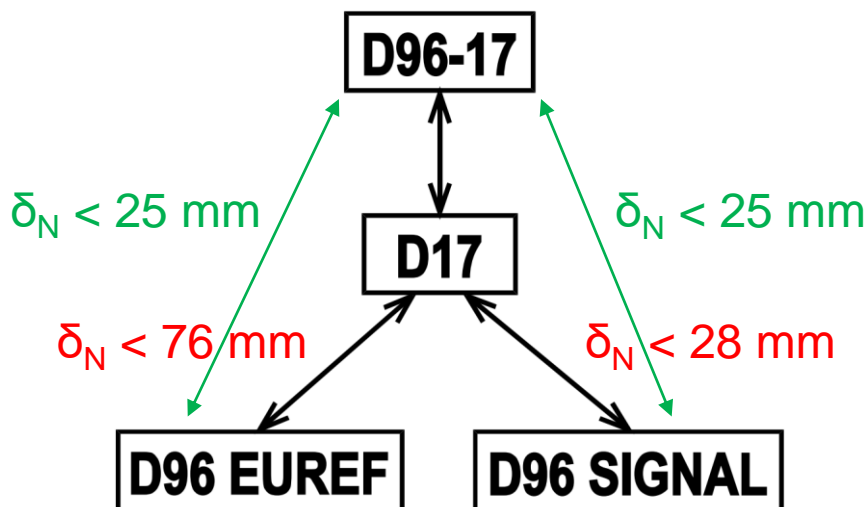


Terrestrial Reference Frame – Realization of ETRS89

- **D96-17** – a new realization of **ETRS89** (in use since January 1, **2020**)
- Three GNSS-campaign-based realizations:
 - **D17** (EUREF 2018 Symposium, Amsterdam, resolution no. 3)
 - **D96 SIGNAL** (de facto since **2007**)
 - **D96 EUREF** (EUREF **2003** Symposium, Toledo, resolution no. 1)

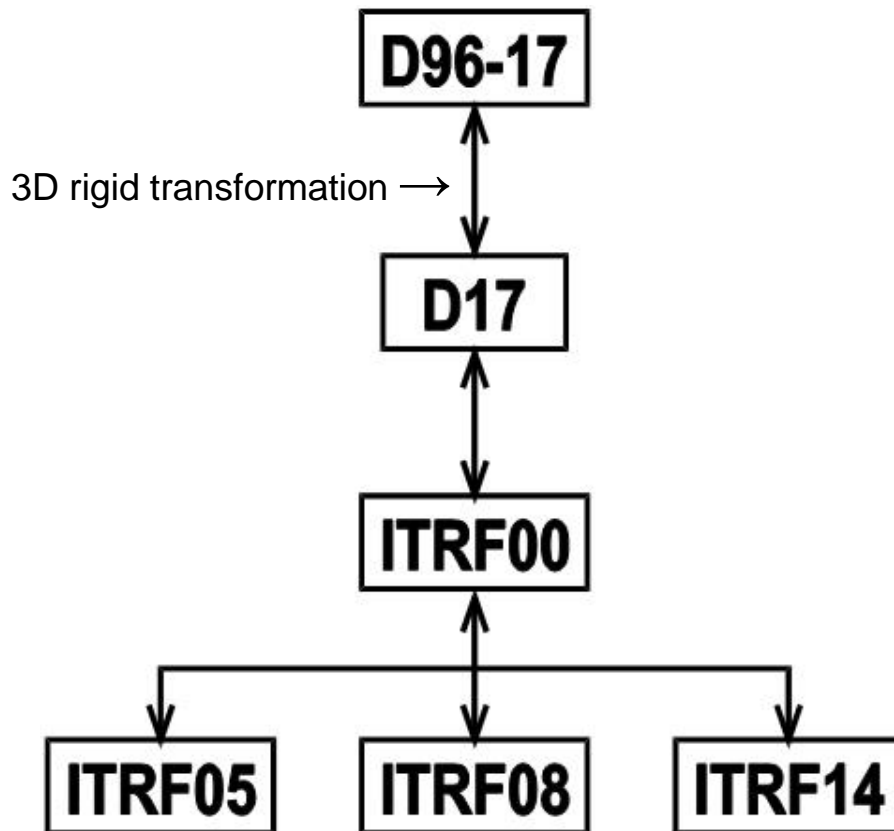
← A pragmatic approach is applied keeping the coordinate differences between the former and new realizations of ETRS89 as much as possible small.

A freeware tool (standalone desktop application) enables transformations between any pair of CRSes (16 CRSes, 240 combinations).



Terrestrial Reference Frame – Connection to ITRS

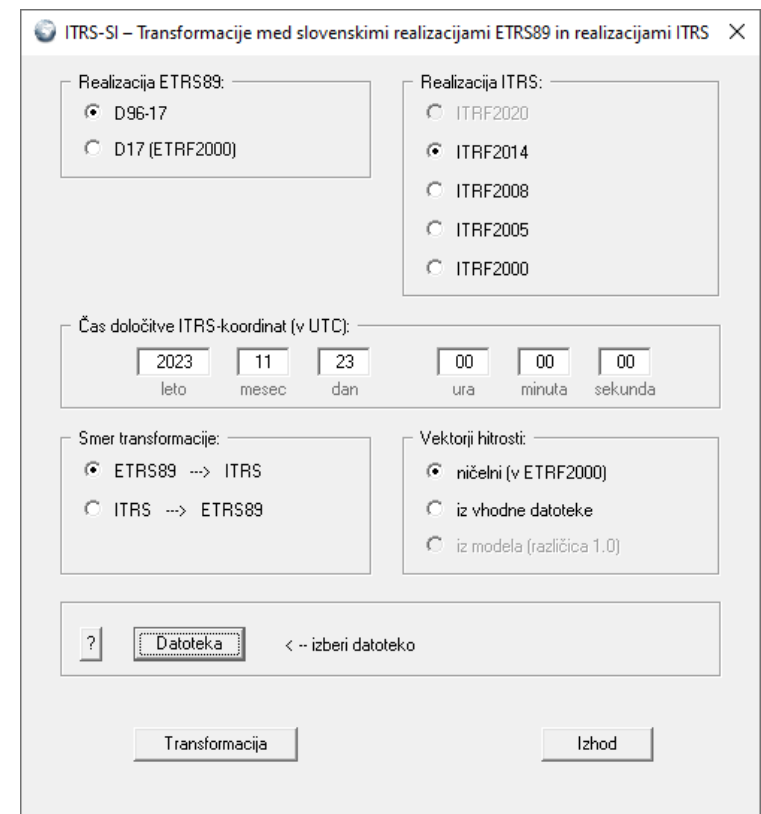
- **D96-17** – a new realization of **ETRS89** is connected to the latest ITRF releases via **D17** and **ITRF00**:



EUREF Technical Note No. 1 (Altamimi 2018)

A freeware tool (standalone desktop application) enables transformations by applying:

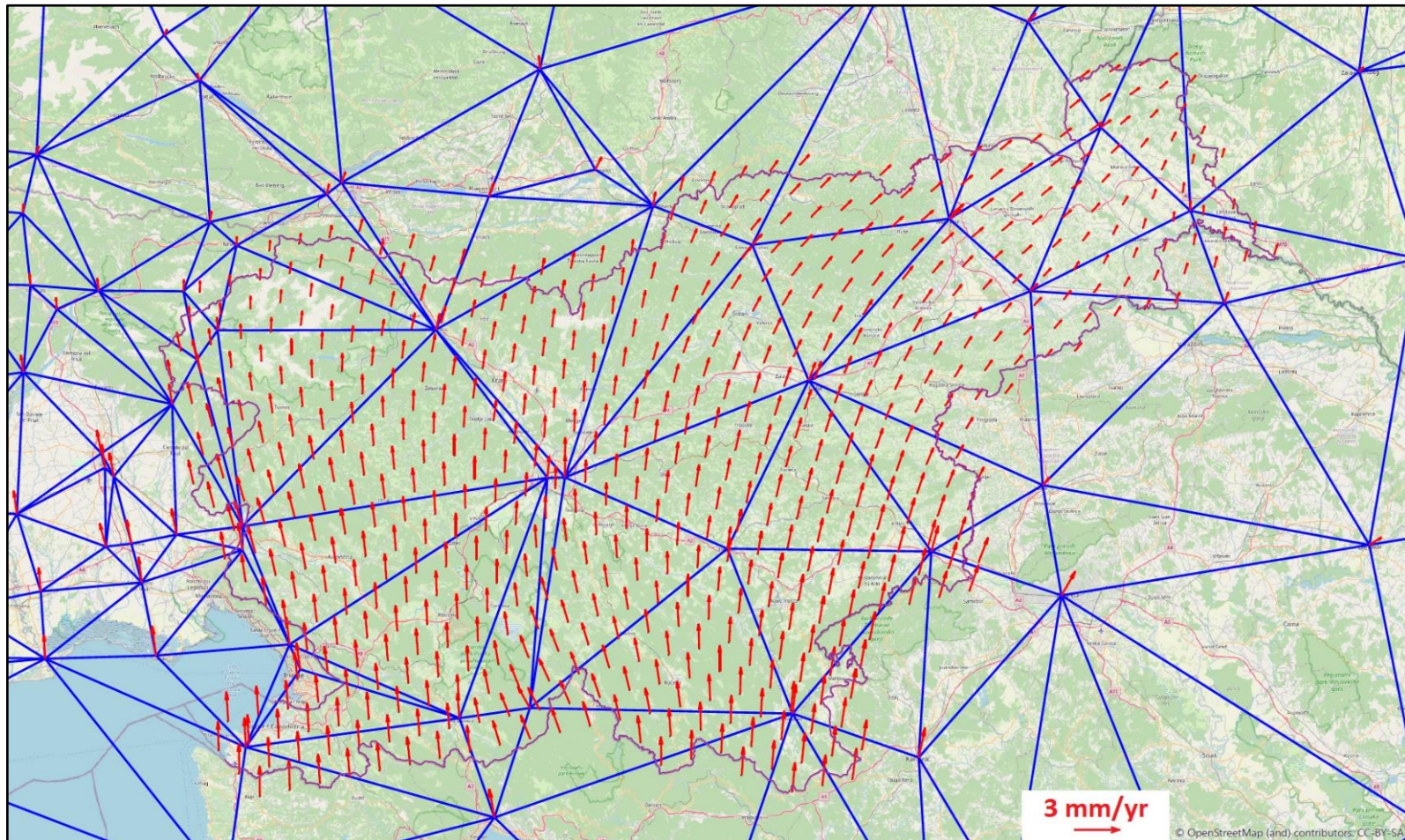
- zero velocities in the ETRF00,
- modelled velocities, or
- velocities from input file (*.VEL).



Terrestrial Reference Frame – Geokinematic model

- **SLOKIN project** by the University of Ljubljana and Geodetic Institute of Slovenia shall provide a geokinematic model for Slovenia

Velocity components in the ETRF2000 may reach up to **few mm/yr**.



(Piña-Valdés et al. 2022)

Terrestrial Reference Frame – 4D Reference System

- **SLO 4D project** at the Surveying and Mapping Authority of the Republic of Slovenia shall provide a solution for implementing the fourth (time) dimension in the national spatial reference system by:



- defining an optimal way to benefit from the new national geokinematic model (kinematic, semi-kinematic, pseudo-kinematic? ... reference system)
- defining transformation protokol and providing software solutions to support GNSS surveys, GBAS data and services, spatial dataset maintenance, location-based services, and precise (sub-metre) navigation procedures
- providing mechanisms (criteria and action plan) to maintain the national terrestrial reference frame (eg. when and how to update coordinates in CORS networks)
- providing support for the users (symposia, workshops, guidelines, software solutions, web services etc.)

Coordinate Reference Systems – News

combined Hz + V systems

New compound coordinate reference systems (CRS):

EPSG 10245 ... ETRS89-D96/ $\varphi\lambda$ + SVS2010/H

EPSG 10246 ... ETRS89-D96/TM + SVS2010/H

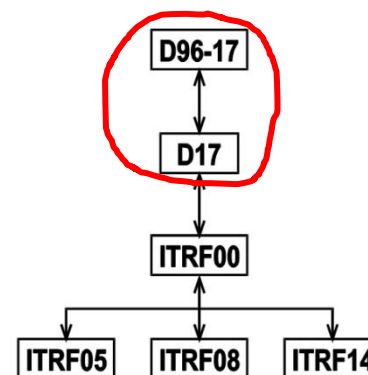


New CRS transformations:

EPSG 10247 ... ETRS89-D96/ $\varphi\lambda h$ \rightarrow SVS2010/H

EPSG 10248 ... ETRS89-D96/ $\varphi\lambda h$ \rightarrow ETRS89-D96/ $\varphi\lambda$ + SVS2010/H

ETRS89/D96-17 added in the **Trimble** coordinate system database in 2022 ... but not yet available in the latest version of the Trimble Pivot Software (a problem in Trimble Online Processing)



Thank you for your attention