



ETRS89 implementation in the Netherlands

Status and ambition

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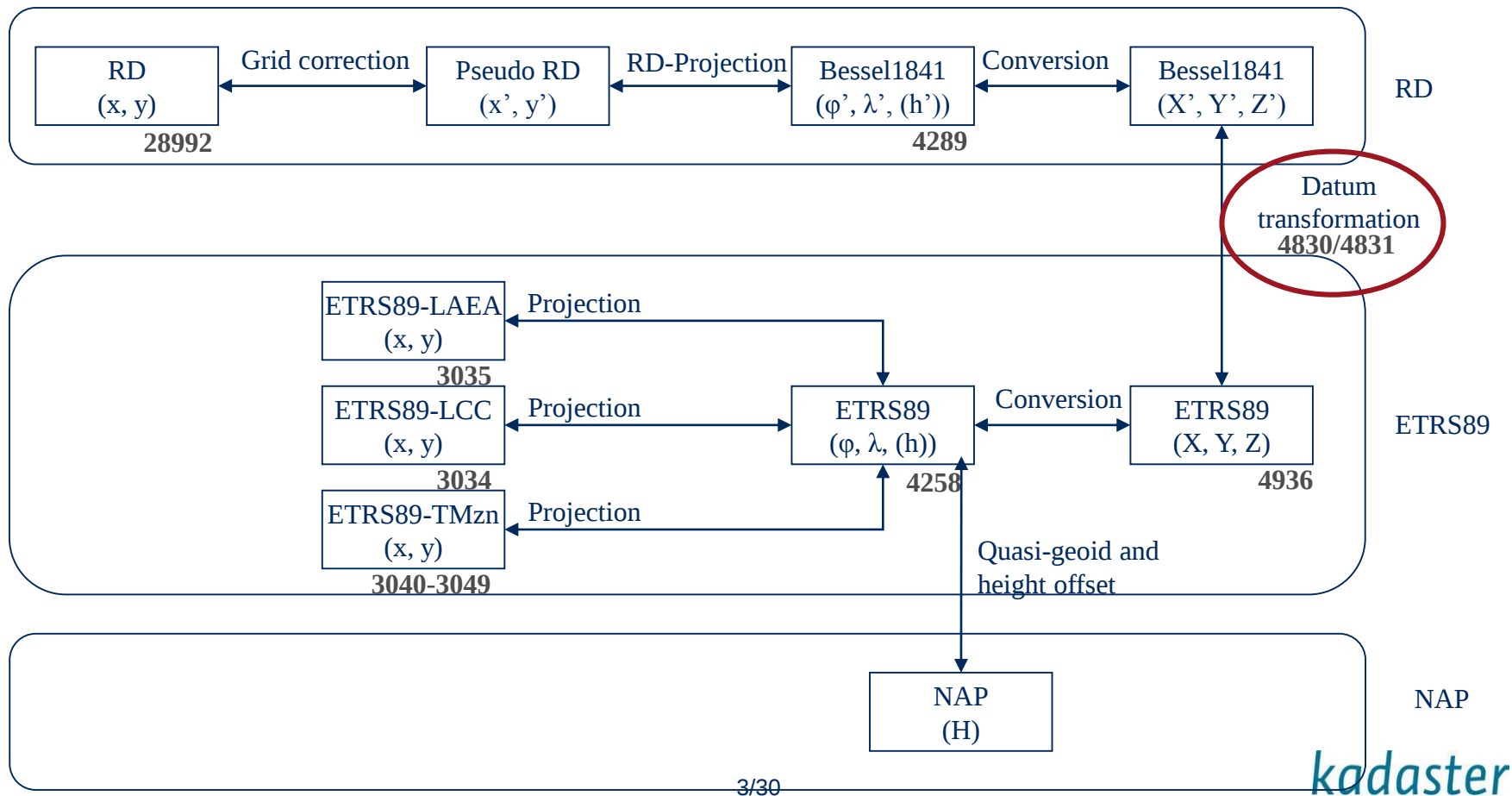
⁴ Rijkswaterstaat

Outline

- **Current access and applications of ETRS89**
- What is behind the realization of ETRS89
- New needs and applications of ETRS89
- What needs to be done (ambitions)

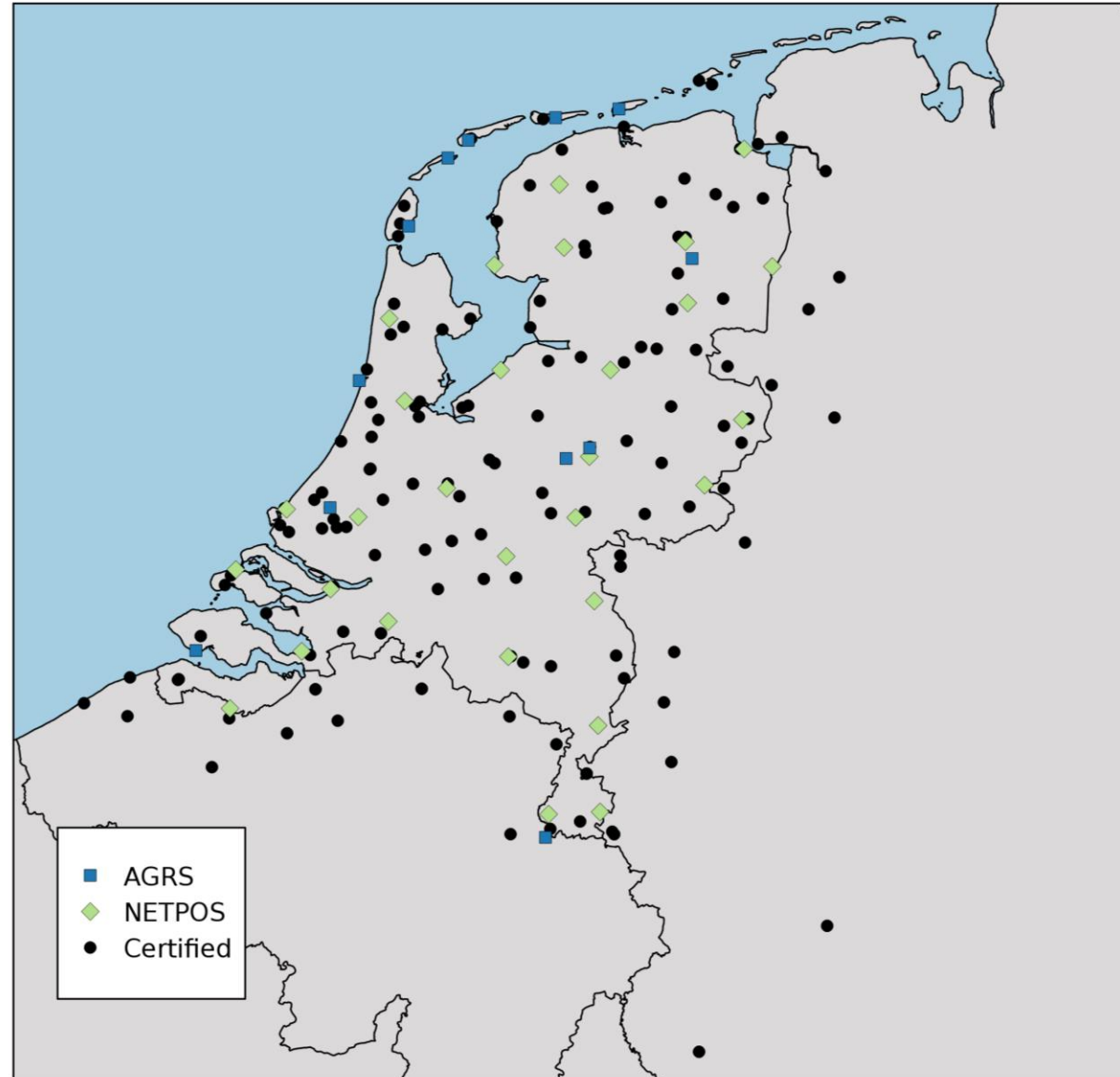
Applications of Dutch GNSS based reference frame realization

- Provides link between ETRS89 and RD/NAP



Applications of Dutch GNSS based reference frame realization

- Common reference frame for precise GNSS-positioning



Applications of Dutch GNSS based reference frame realization

- Exchange of data (INSPIRE)

The screenshot shows the INSPIRE Geoportal website in a Windows Internet Explorer browser window. The address bar displays <http://inspire-geoportal.ec.europa.eu/>. The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The page header features the European Commission logo and the text "INSPIRE GEOPORTAL Enhancing access to European spatial data". A navigation bar below the header shows "EUROPEAN COMMISSION > INSPIRE > INSPIRE GEOPORTAL". The main content area is titled "Welcome to the INSPIRE geoportal" and includes a paragraph about the INSPIRE Directive. A "Discovery / Viewer" section on the left describes the portal's search and discovery capabilities. A "Validator" section on the right explains the purpose of the INSPIRE Metadata Validator. The background of the page is a map of Europe with various cities and regions labeled. The browser's status bar at the bottom indicates "Contains commands for working with the selected items." and "100%".

INSPIRE Geoportal - Windows Internet Explorer

http://inspire-geoportal.ec.europa.eu/

File Edit View Favorites Tools Help

Contact | Search | Legal notice English (en)

European Commission

INSPIRE GEOPORTAL

Enhancing access to European spatial data

EUROPEAN COMMISSION > INSPIRE > INSPIRE GEOPORTAL

What's new

Welcome to the INSPIRE geoportal

The INSPIRE Directive requires the Commission to establish a community geo-portal and the Member States shall provide access to their infrastructures through the geo-portal as well as through any access points they themselves decide to operate.

[More...](#)

Discovery / Viewer

Search, discover and access geographic information provided by European governmental, commercial, and non-commercial organizations.

[More ...](#)

Validator

The purpose of the INSPIRE Metadata Validator is to test the compliance of INSPIRE metadata with the INSPIRE Metadata Regulation.

[More ...](#)

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100%

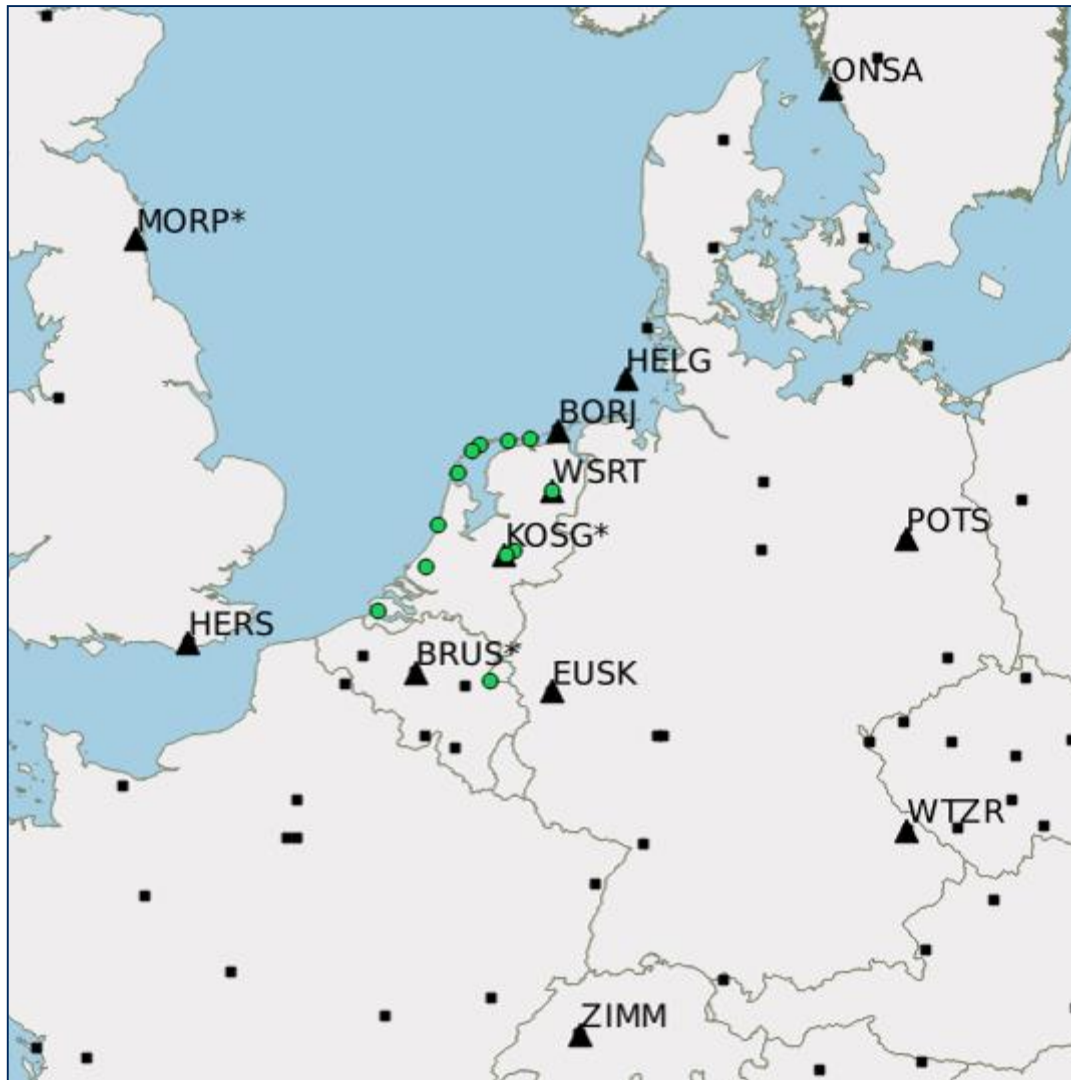
Applications of Dutch GNSS based reference frame realization

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- Common reference frame for precise GNSS-positioning
- Exchange of data (INSPIRE)

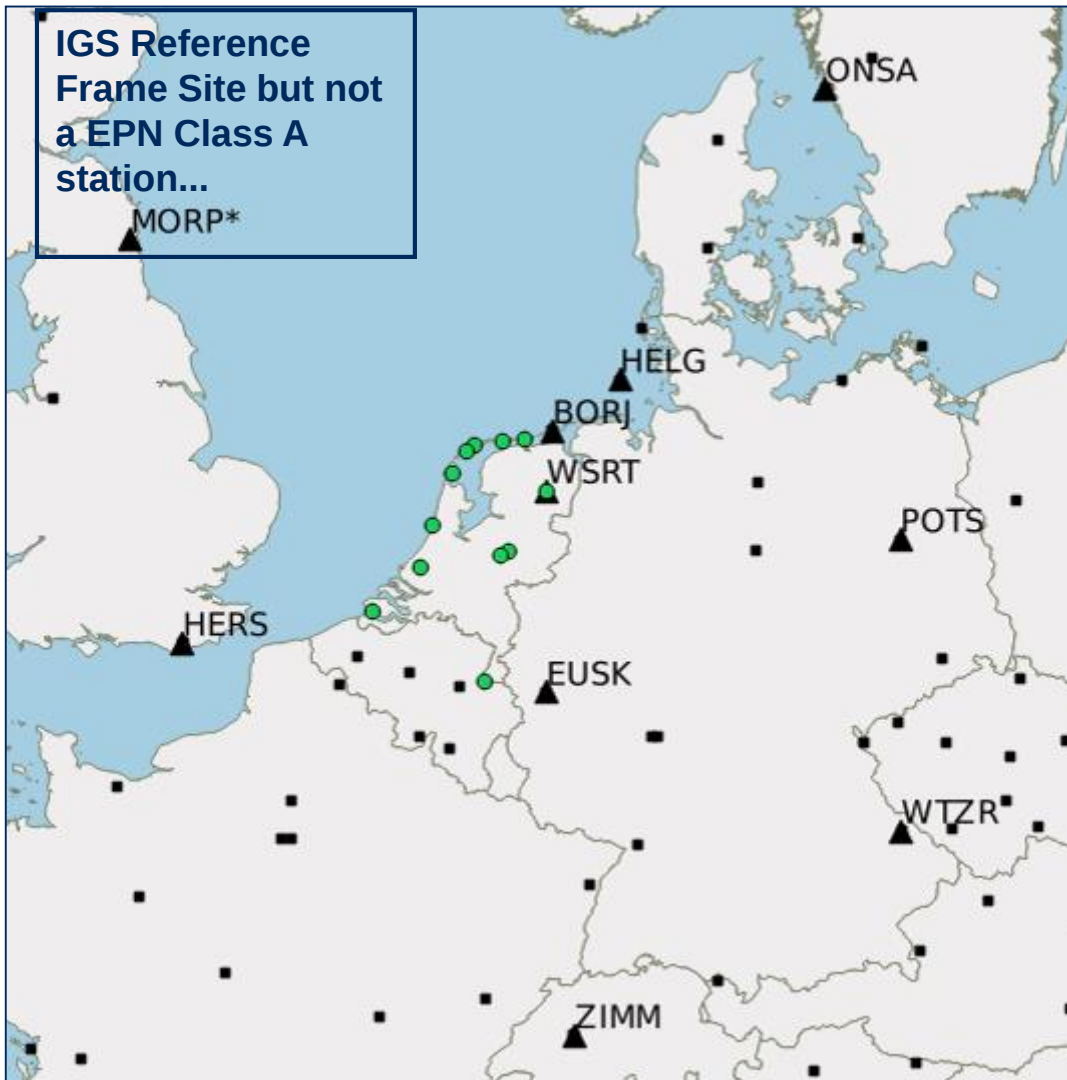
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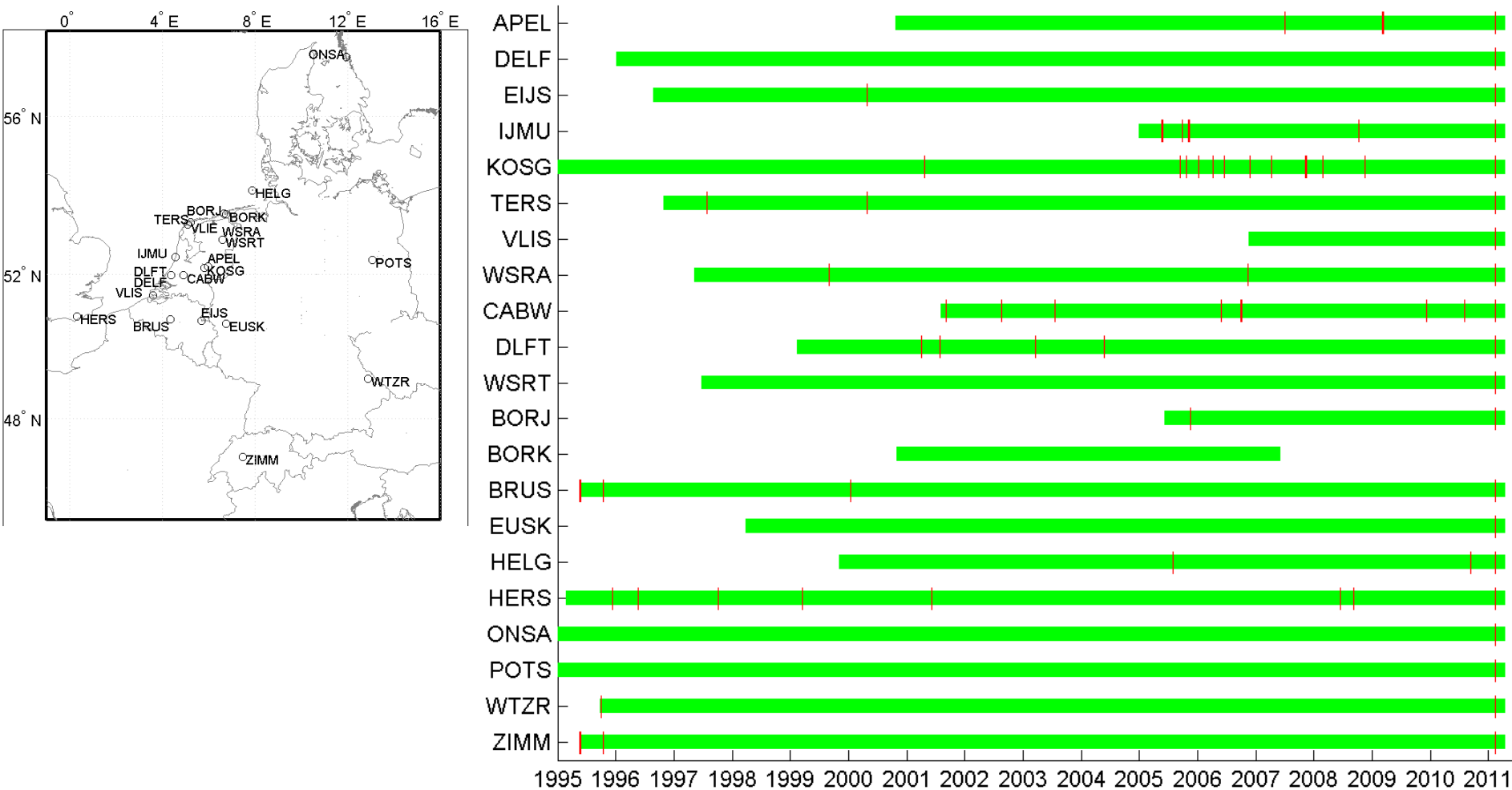
Active GNSS Network



Active GNSS Network

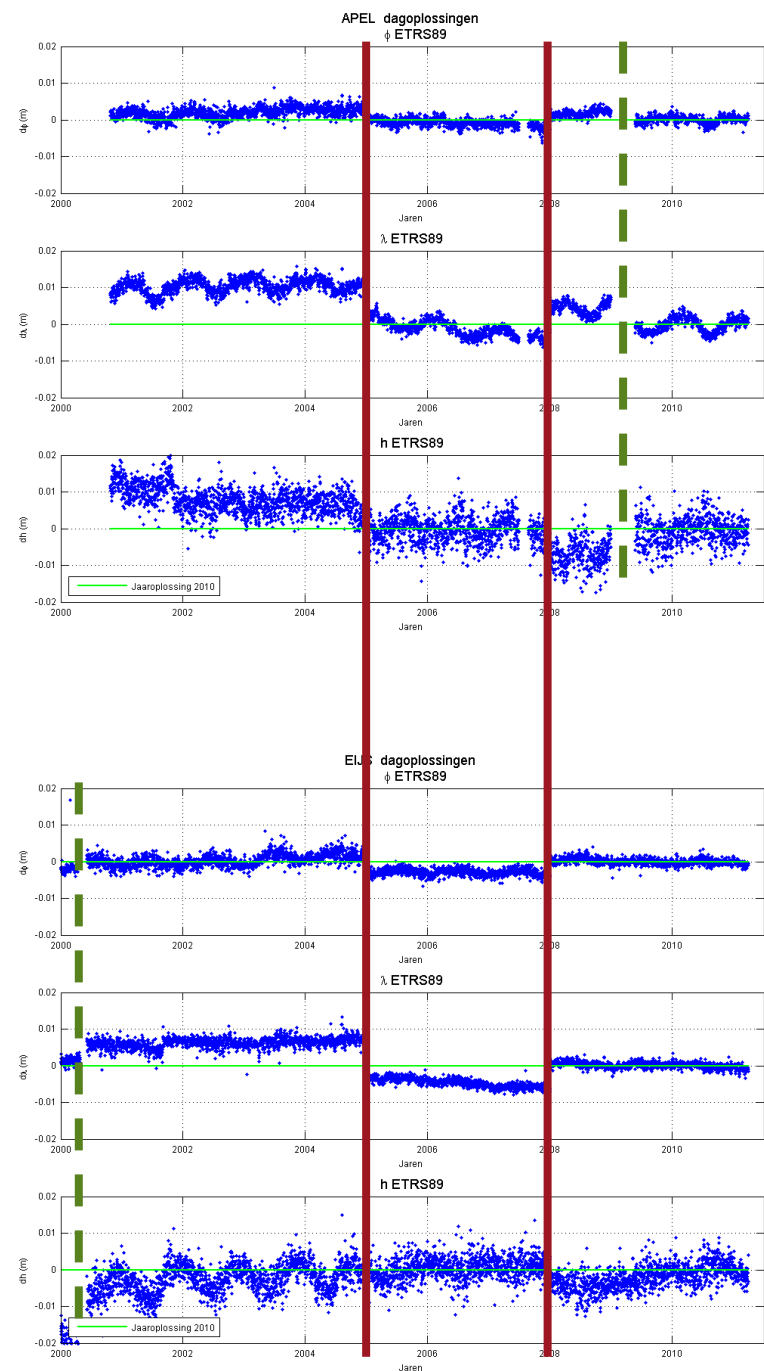


Continuous Observations



Historic time series

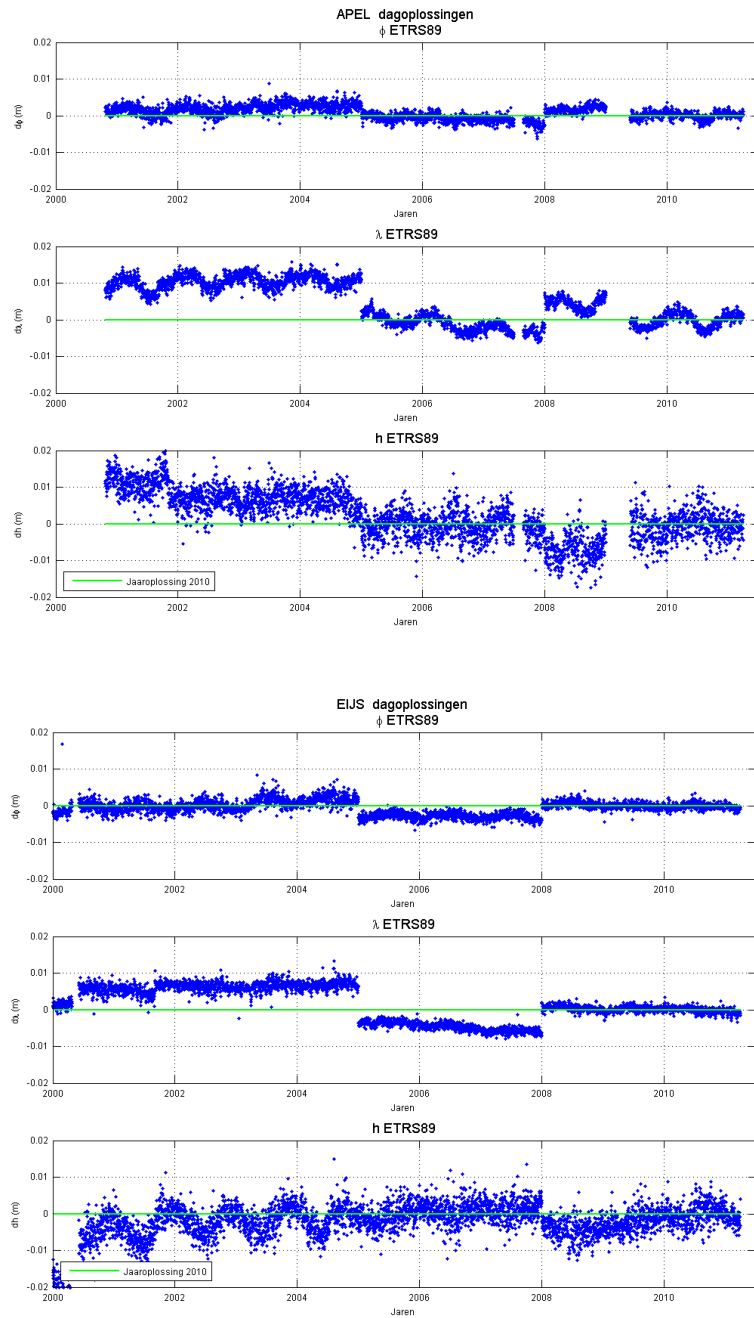
- Daily time-series
- Improved computation strategy
- — Antenna change
- Inconsistent trends
- Higher precision at end of series



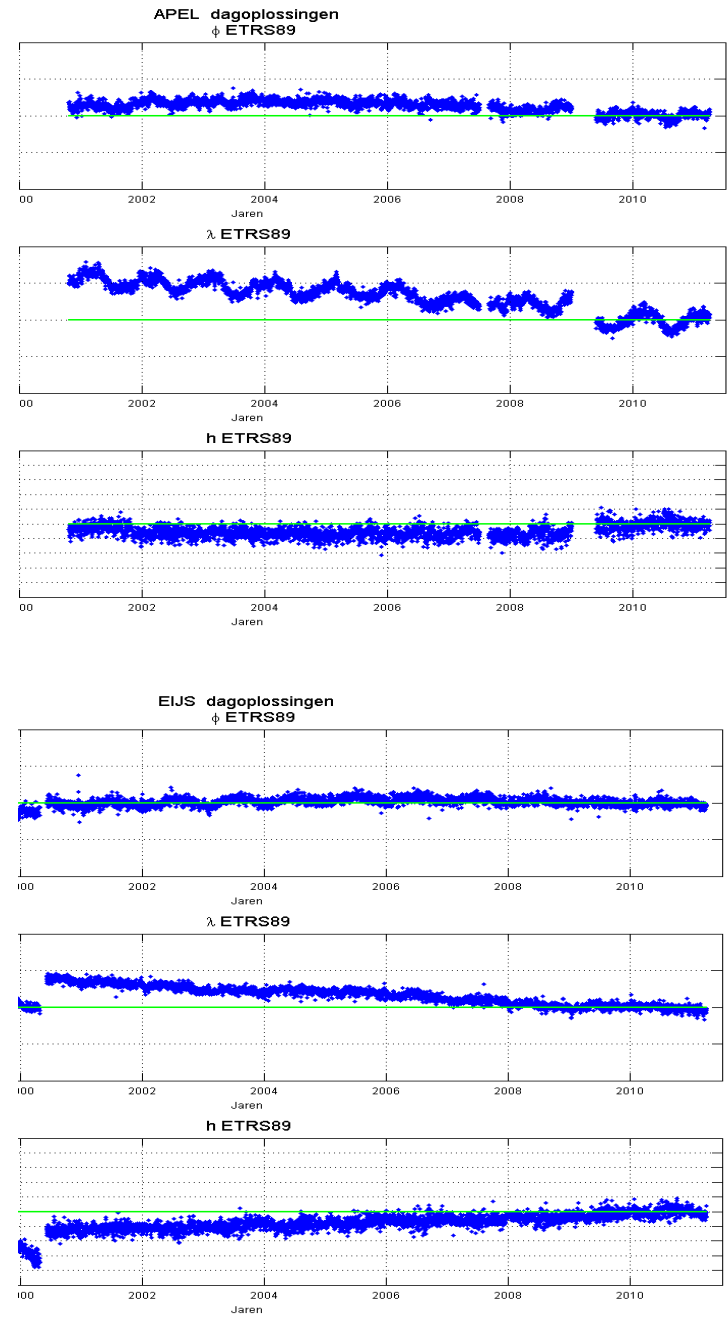
Consistent computation strategy

- Bernese GPS Software 5.0
- Processing strategy based on IGS and EPN guidelines and IERS conventions
- Input
 - Gps data
 - Reprocessed precise igs orbits, clocks and earth rotation parameters
 - Correction for ocean loading, solid earth tides
 - Troposphere modelling: Niel mapping function
- Estimation
 - Station coordinates
 - Hourly ZPD
 - Daily gradient

Before

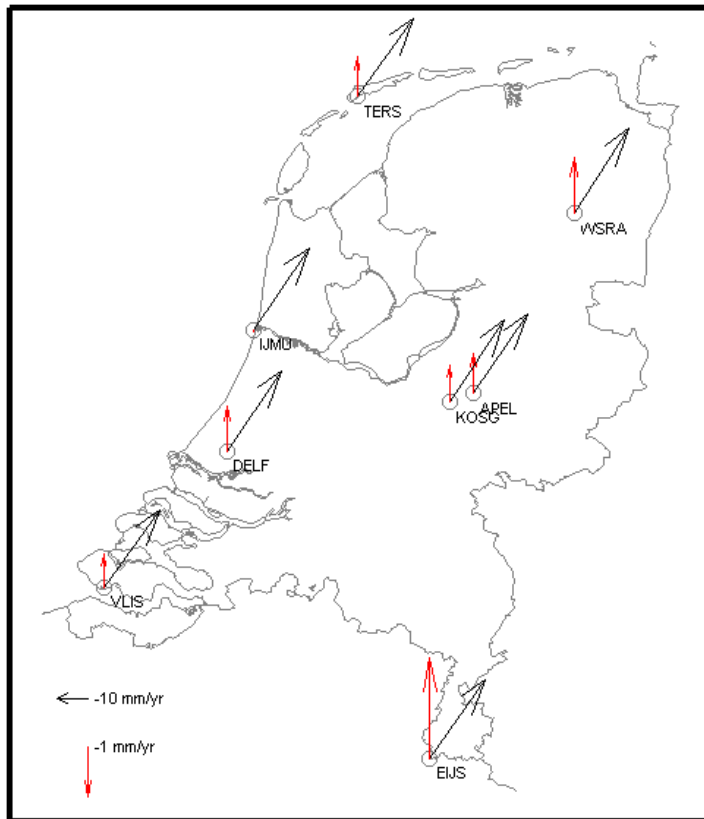


After

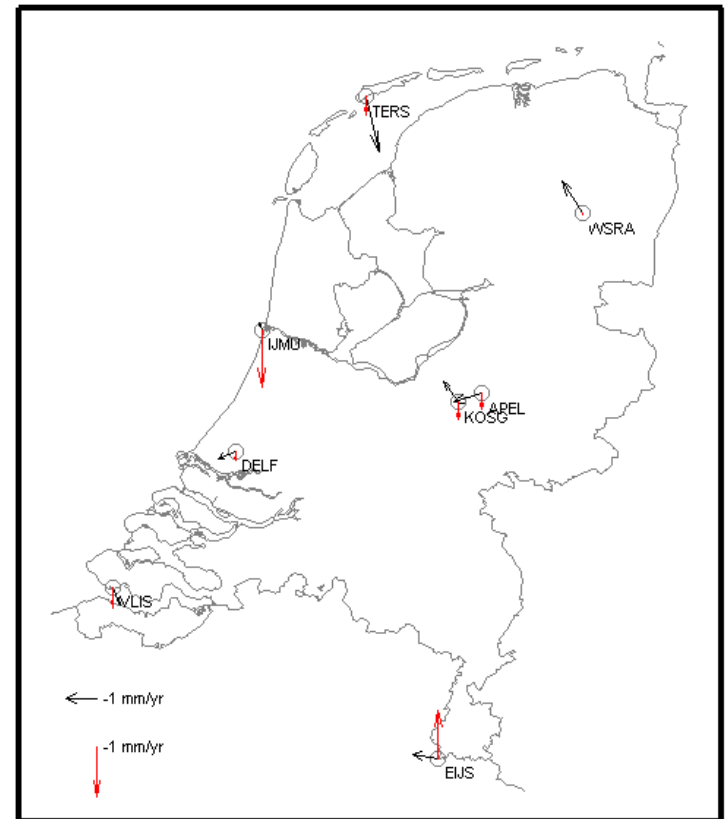


GNSS based velocities

■ ITRF



ETRF

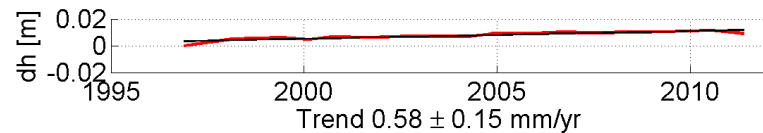
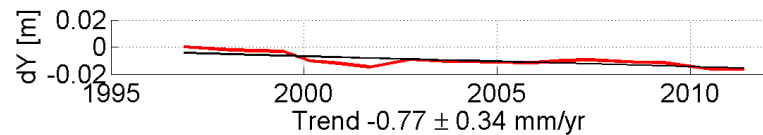
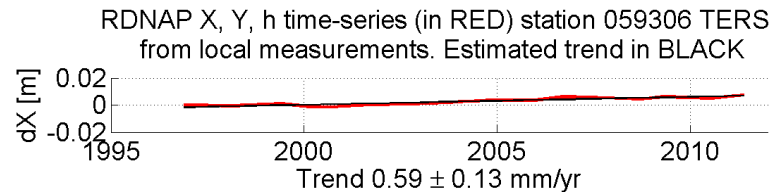


Local measurements

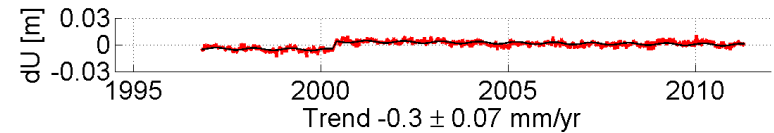
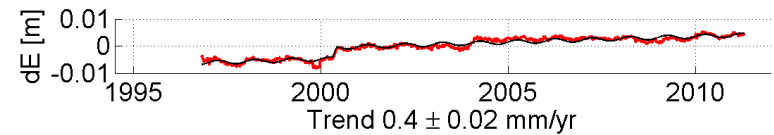
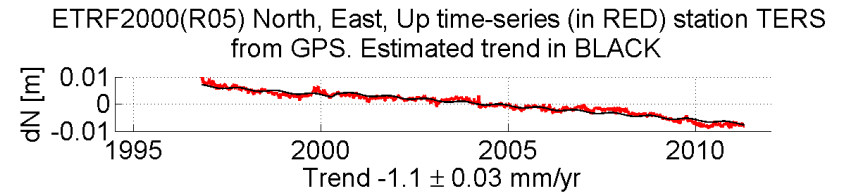


Local and GNSS time series

■ Local

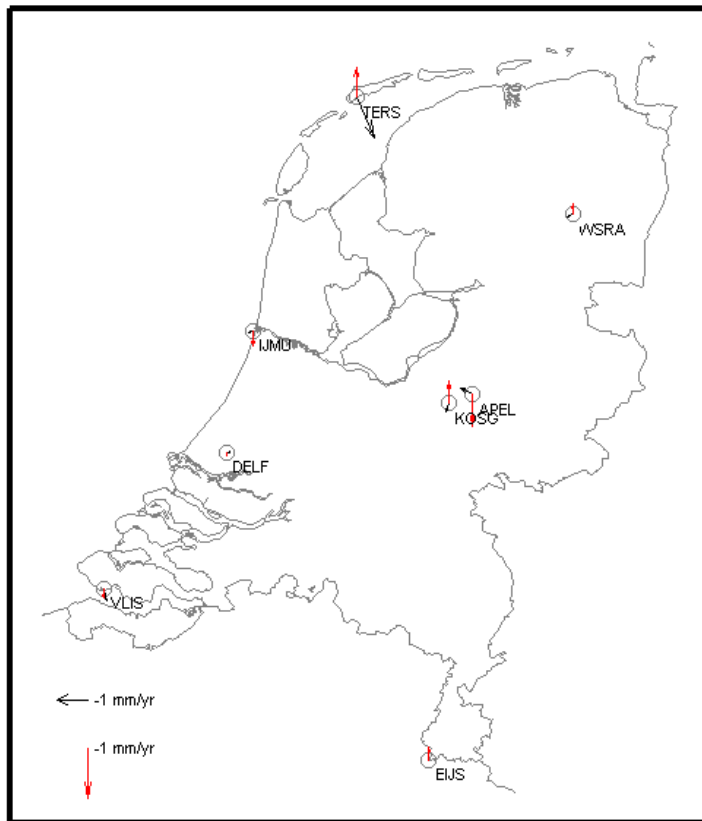


ETRF

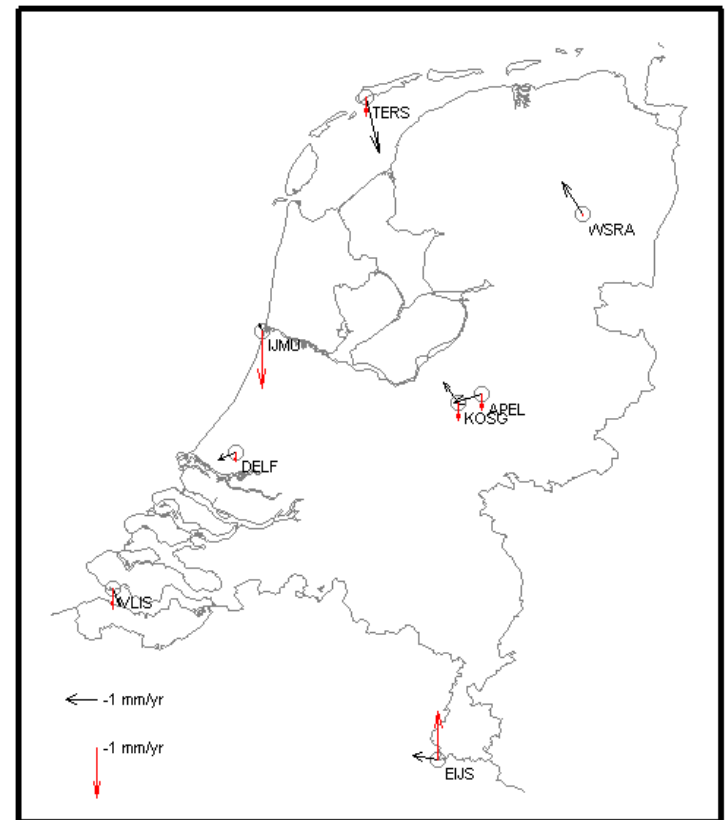


Local and GNSS time series

■ Local



ETRF



Tilting station: TERS

Local time series



GNSS time series (ETRF2000)

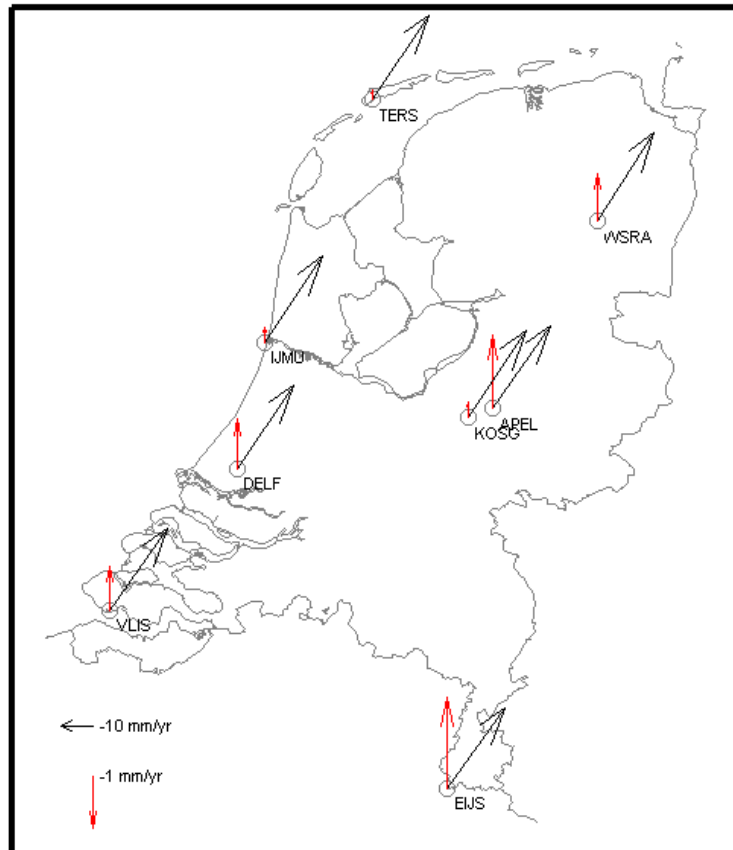


GNSS - Local

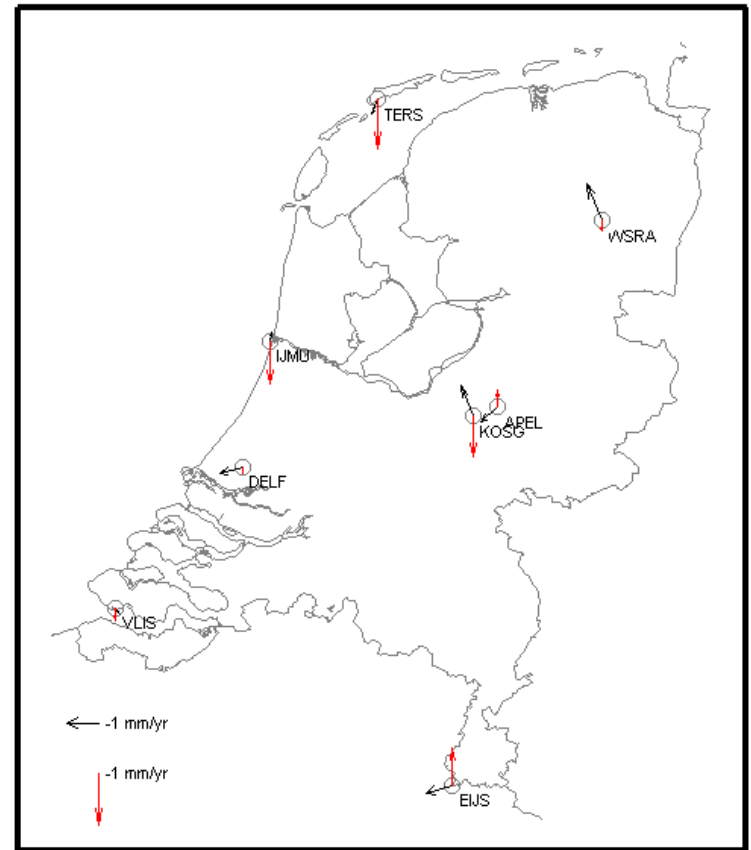


Local and GNSS time series

■ ITRF – Local

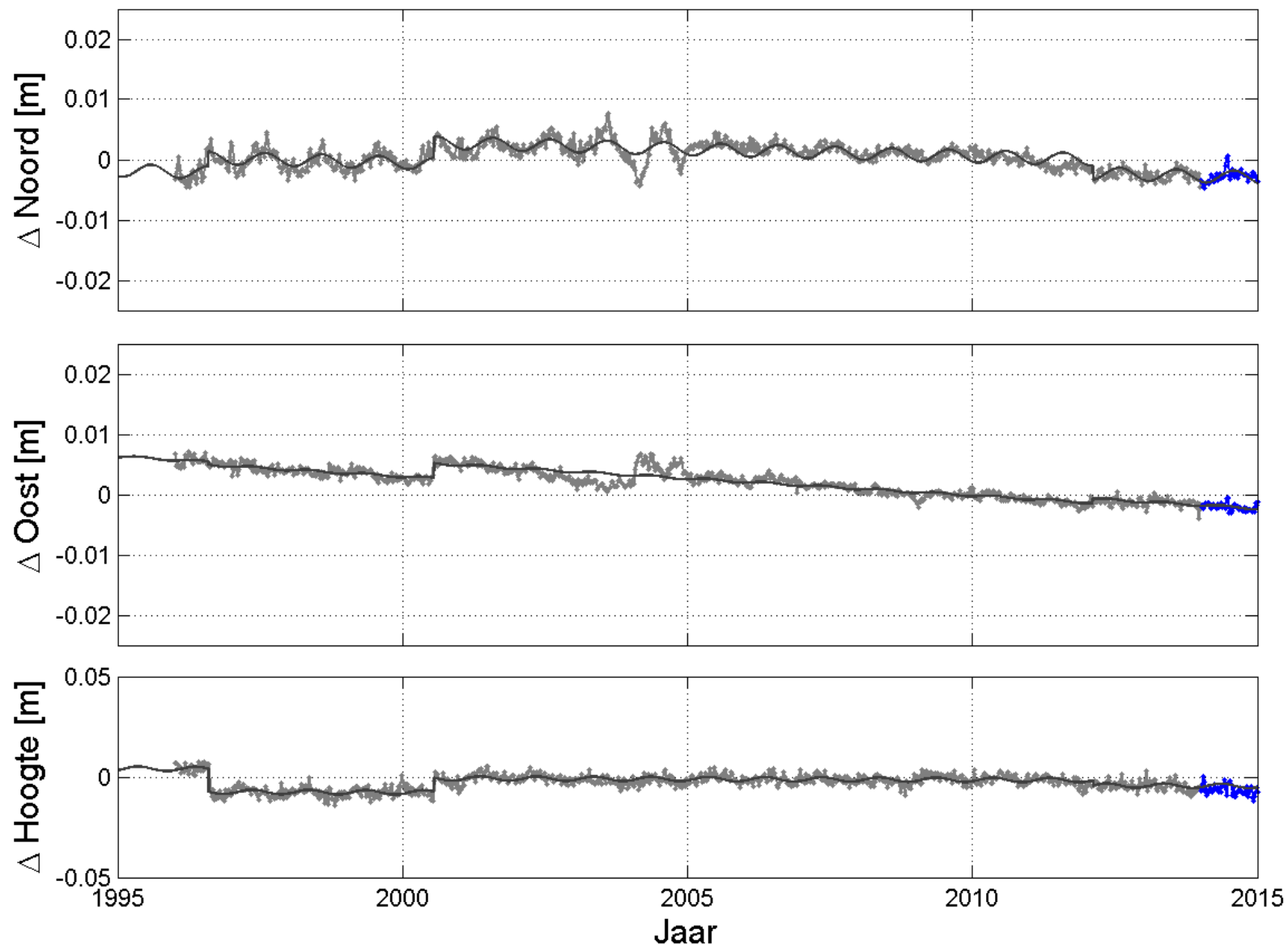


ETRF – Local



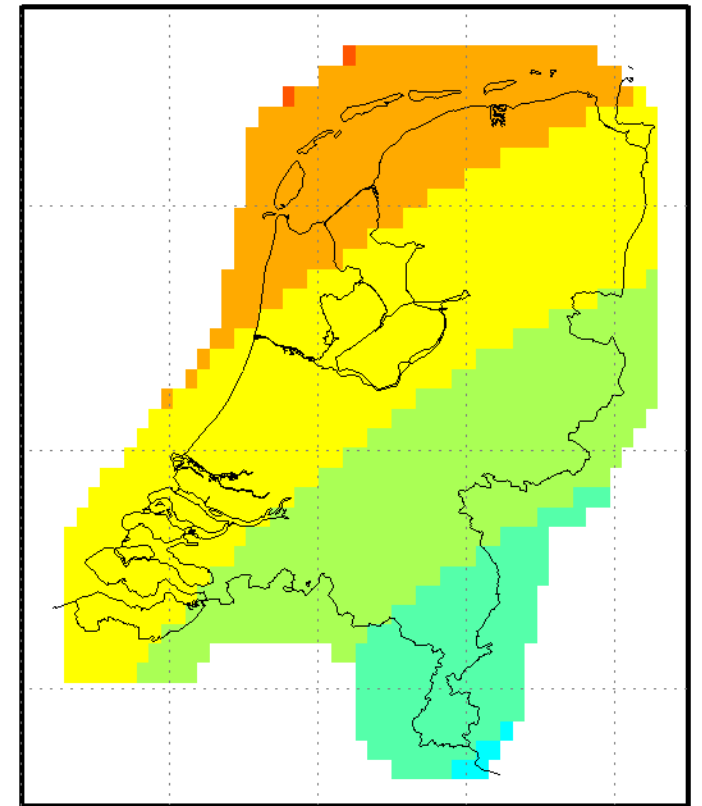
Time series usage

Lokale coördinaatverschillen tussen weekoplossingen en gepubliceerde AGRS-coördinaten voor station DELF



New coordinates and parameters

- New coordinates:
 - Difference with current coordinates more than $3 \cdot \sigma$
- New transformation parameters
 - Effect of new coordinates more than 1 cm within area of validity RD



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New applications where GNSS bases reference frame not fully utilized

- Vertical land movement (hot topic)
- Sea level changes
- Trends in atmosphere
- Quasi-geoid determination

Vertical deformation mm/yr in ETRF2000



Vertical deformation mm/yr in ITRF2008



insar_lat_lon_vetrf2000_vitr2008

- -10.00 - -5.00
- -5.00 - 0.00
- 0.00 - 5.00
- 5.00 - 10.00

Outline

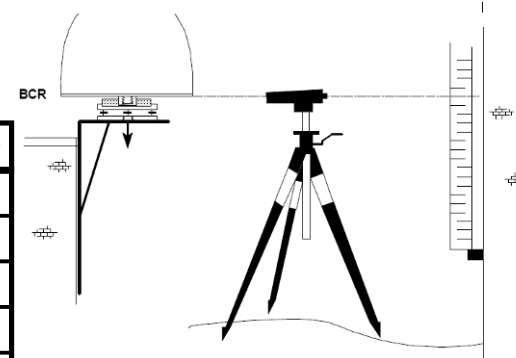
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- **What needs to be done (ambitions)**

What is needed/planned (ambition)

- More co-locations
 - Gravity
 - InSAR
 - Tide gauges
- Dense network

Co-locations

Station	GNSS	Gravity	InSAR	Meteo	NAP	Tide-Gauge
AMEL	√				√	
APEL	√					
CABW	√		√	√		
DELF	√				√	
EIJS	√		√		√	√
IJMU	√		√		√	
KOS1	√	√			√	
TERS	√	√			√	√
VLIE	√				√	
VLIS	√				√	√
WSRT	√	√	√		√	



Planned/Under investigation/Not fully operational yet

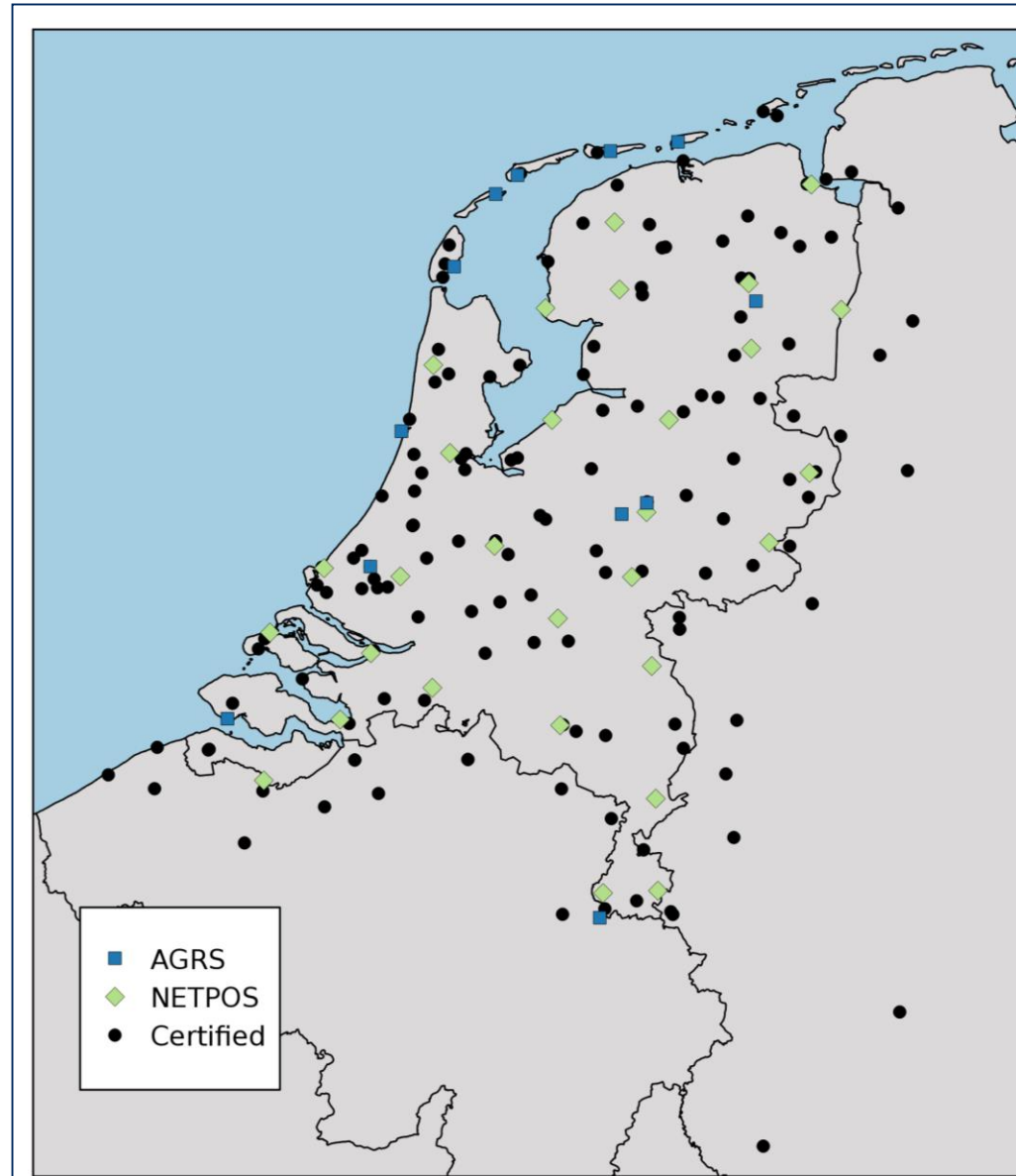


CAT IJmuiden



Ambition dense (re)processing

- Include data 100 km? outside NL
- Coordinate and troposphere products (sliding window)

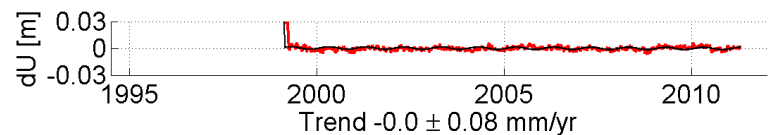
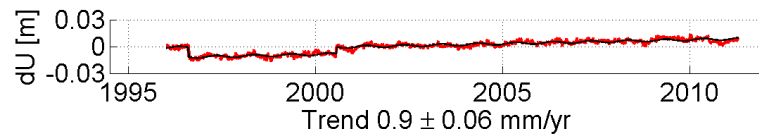
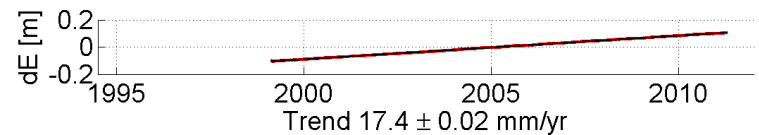
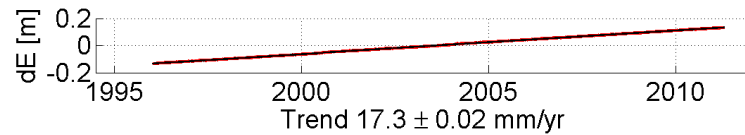
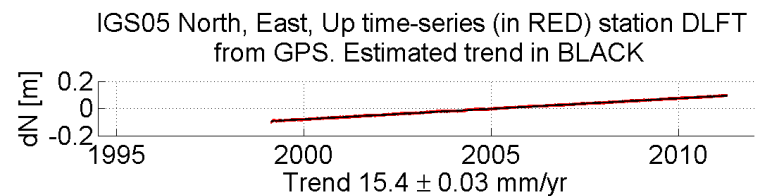
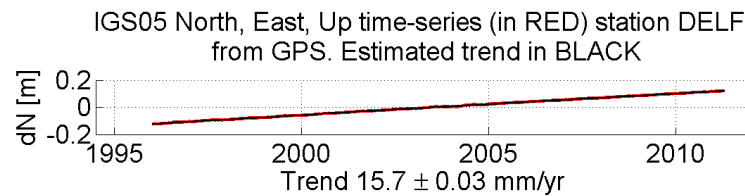


Summary

- Permanent GNSS based reference frame used for
 - Providing relation ETRS89 and RD/NAP
 - GNSS-Positioning
 - Data exchange (INPSIRE)
- Main infrastructure 11 stations, more than 100 permanent GNSS available
- Local measurements needed for independent control
- GNSS based reference frame to be used for
 - Vertical land movement
 - Combination of techniques (levelling, gravity, InSAR, tide gauges)
- Next steps
 - Denser network processing (and assess quality of stations)
 - More co-locations
 - Adapt strategy (sliding window) for better troposphere time series

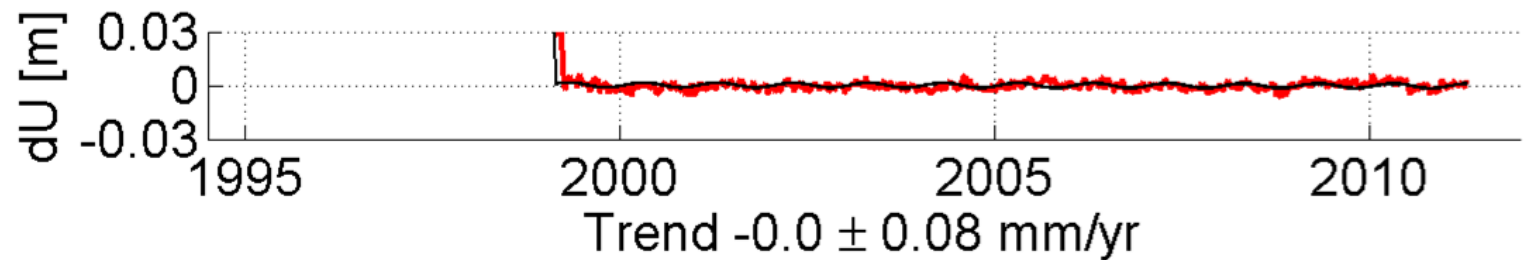
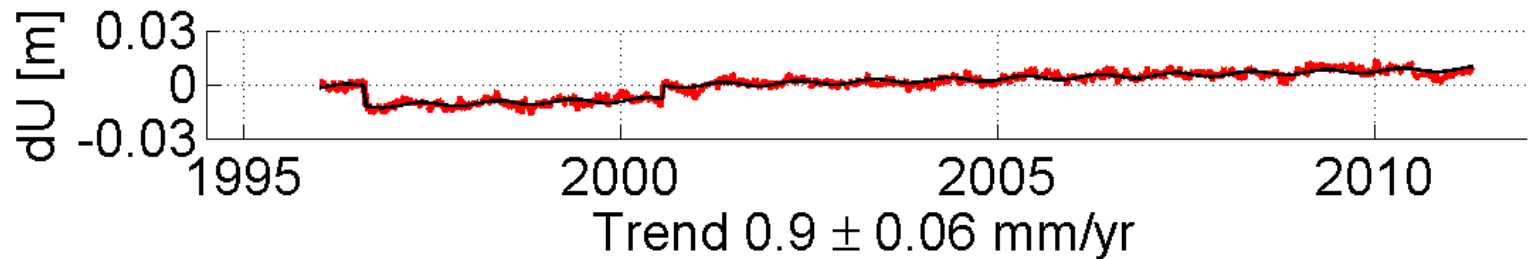
Discrepancies?

- Co-located stations: DELF-DLFT, WSRT-WSRA



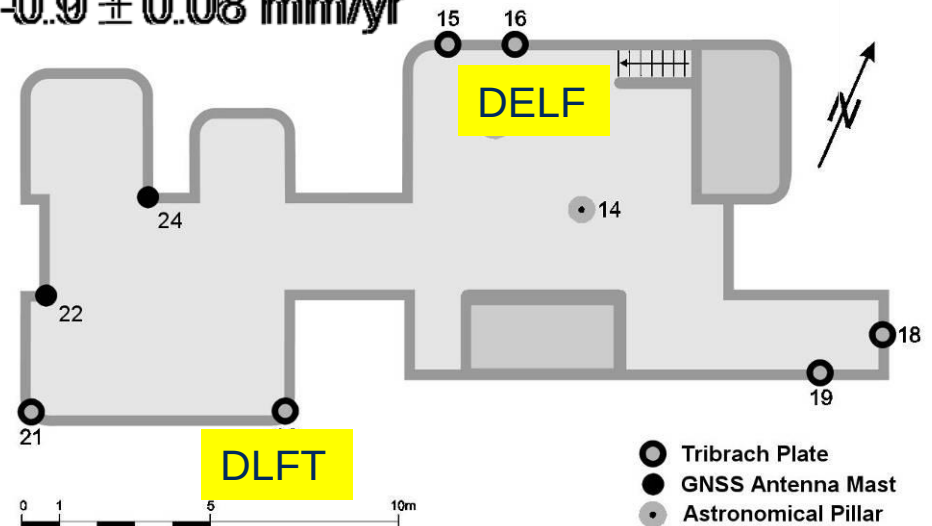
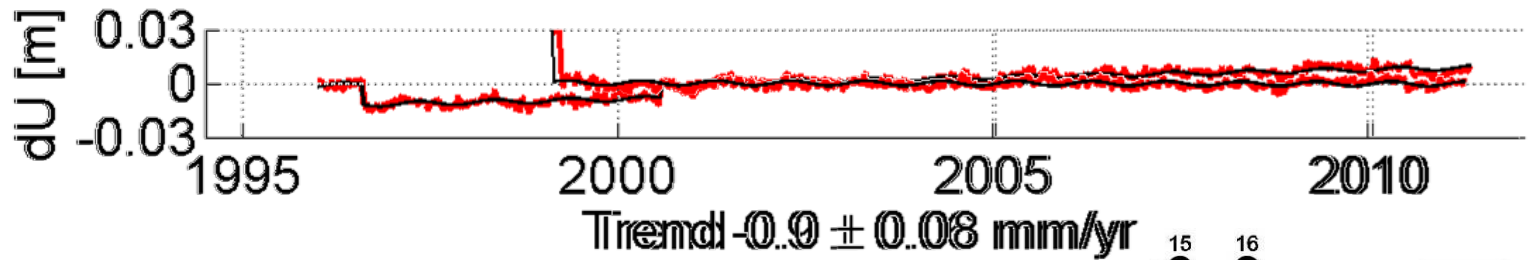
Discrepancies

- DELF and DLFT



Discrepancies

- DELF and DLFT



Antenna changes: Convergence of coordinates

- Convergence of cumulated weekly solutions for previous antenna changes

Station	Year of jump	Convergence (N,E < 1 mm, U < 2mm)	
		1 year combined solution	2 year combined solution
DELF	2000	9	6
TERS	2000	9	9
EIJS	2000	5	5
APEL	2009	1	1
KOSG	2003	1	1
TERS	2004	1	1
WSRT	2005	1	1

Figure: DELF comparison to two year combined solution

