

# National Report, Denmark



### EUREF Symposium Tallinn, May 22-24 2019



<u>Casper Jepsen,</u> Aslak Meister, Thomas Knudsen, Joanna Balasis-Levinsen, Kristian Evers, Kristian Keller, Erik Lysdal and Mette Weber

### **Motorised levelling continues in Denmark**

Trigonometric levelling system coming of age Prime operational season now october-march

	2010	2011	2012	2013	2014	2015	2016	2017	2018
MGL	880 km	687 km	1374 km	2050 km	1314 km	1250 km	1000 km	154 km	7 km
MTL	1427 km	931 km	31 km	1 km	0 km	9 km	126 km	807 km	1200 km







### GNET

- 16 SDFE/DTU GNSS stations
- 43 stations funded by NSF 2007-2018

### As of 2019-01-01:

- Ownership and responsibility for the 43 stations transferred from NSF to SDFE
- Future funding on the Finance Act
- Development of GNET in cooperation with DTU Space, NSF and primary stakeholders



## Modernisation GNSS infrastructure

- Modernisation has been going on for years, mostly onsite (Galileo etc.)
- As of 2019-01-01 all GNSS data is free
- More use of real time data
- Unified architecture for GNSS data management in progress
- Rinex3 and Rinex2

Agency for Data Supply and Efficiency - ESA Living Planet Symposium

Page 5

## Towards a 5 mm geoid model - with DTU Space

- Verifying existing data:
- Gravimetry: Verify old data for biases etc.
- New levelling lines along the west coast and GNSS surveying to eliminate less accurate data
- Test geoid based on 120 high accuracy levelled GNSS points (the 5D-network)
- New data:
- Focus on coastal areas, both gravimetry, GNSS and levelling
- Marine gravity survey along the coasts
- Airborne gravity survey of Kattegat between Denmark and Sweden
- Precise test geoid in Aarhus for the TAPAS project



11 June, 2019

#### **TAPAS** - Testbed in Aarhus for Precision positioning and Autonomous Systems





- TAPAS is a research and development platform situated in a challenging real life environment of both dense urbanization as well as coastal zones.
- TAPAS is designed flexible for adjustments to user needs. It can be remodeled and undergo developments in firmware and software.
- 11 State of the art GNSS stations
- Fully deployed and operational
- 15 users (so far!)
- Tests show sub cm accuracy

## **Geodetic IT**

### PROJ

- 3 new releases (5.1, 5.2, 6.0)
- ISO 19111, 2018 WKT specifications now fully supported

### Data management

- New database *FIRE*, new data model for observations and coordinates

## InSAR & geodesy

#### SDFE goal

 Use InSAR to support governmental responsibility for maintaining national geodetic height network

#### Motivation

- No more nationwide leveling campaigns
- S1: Unprecedented high spatio-temporal resolution

#### **Expected** applications

- Datum connection by collocating permanent GNSS stations with reflector (active/ passive)
- · Optimised planning of leveling campaigns: Location and frequency
- Elevation benchmarks: Validation of stability, location for new ones
- GNSS: Location for new stations
- Improved modelling of postglacial uplift

<text>

Agency for Data Supply and Efficiency - ESA Living Planet Symposium

14 May, 2019

## InSAR & geodesy

### **Current actions**

- Answer the "how"
- Establish nationwide network of Compact Active Transponders by permanent GNSS stations and tide gauges
- Evaluate CAT performance
- Plan establishment of additional corner reflectors



Agency for Data Supply and Efficiency - ESA Living Planet Symposium

14 May, 2019

## Transpondors installed in may 2019



Agency for Data Supply and Efficiency - ESA Living Planet Symposium



14 May, 2019

Page 11

## First nationwide deformation map

#### Spring 2018

• Entered into contract with TRE Altamira (2018 – 2021)

#### Summer 2018

• First nationwide deformation map, based on all orbits

#### Selected deliverables

- · LOS observations for each relative orbit
- Decomposed vertical and horizontal deformation rates
- Hotspots
- Access to TREMaps<sup>™</sup> for data visualization and download



Ref: TRE Altamira (2018)

Agency for Data Supply and Efficiency - ESA Living Planet Symposium

14 May, 2019