Approaching target: A service for nationwide deformation monitoring in Denmark using Sentinel-1

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Approaching target: A service for nationwide deformation monitoring in Denmark using Sentinel-1

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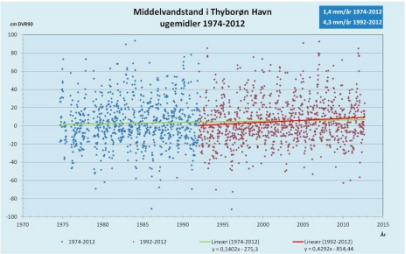
Why? Motivation

What? Activities

...and then what? Road map

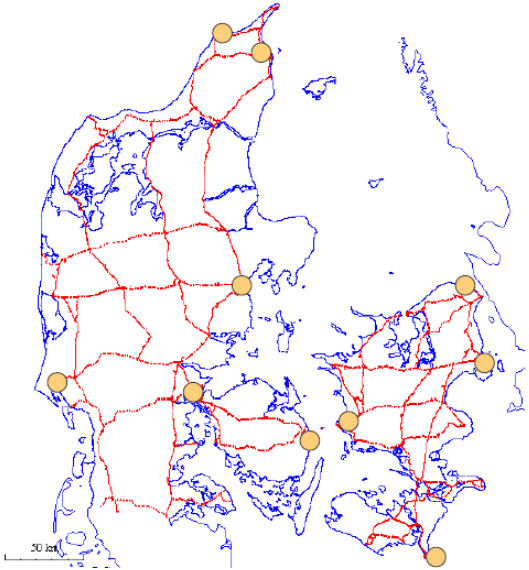
The ”why”: Motivation

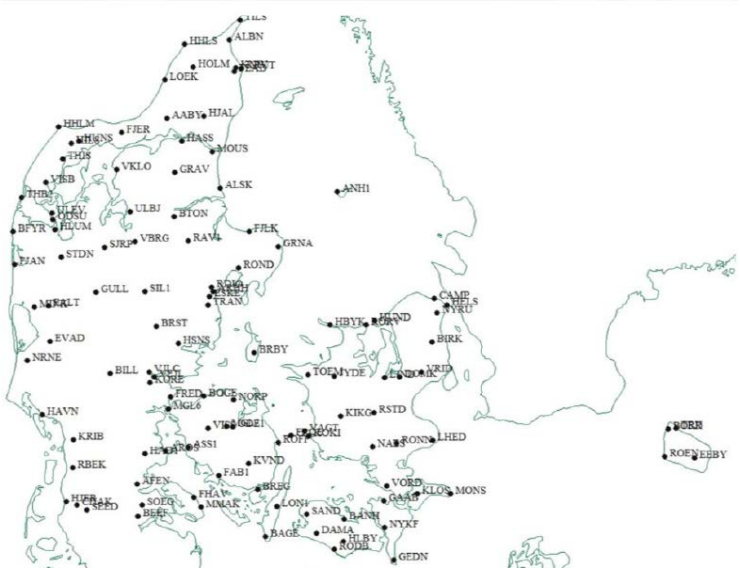
- Small country w/ lor
  little topography
- Issues:
  - Climate change
  - Management of
    levels
  - Soil managemer
  - Coastal urbanis
- Vertical ground moti
  - Imminent risk o
  - Broken pipes
  - Explosion of pip
  - …



The "why": Need for deformation monitoring

Long-term experience with: Precision leveling + GNSS



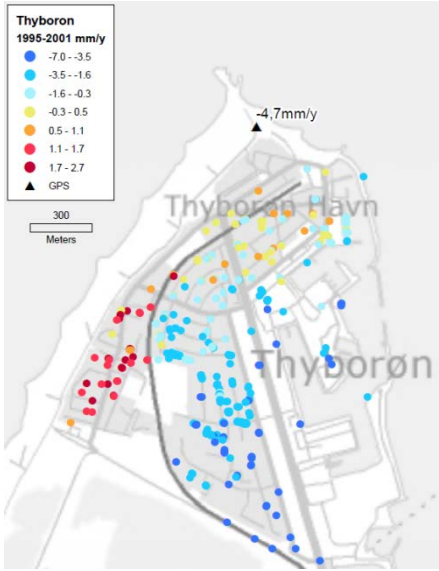


Precision leveling (1885→): Cycles of 1 yr, 3 yrs, 50 yrs

GNSS: Permanent (1998→) as well as semi-permanent (2007→) stations with cycles of 1 yr, 3 yrs

The "why": Need for deformation monitoring

Long-term experience with: InSAR



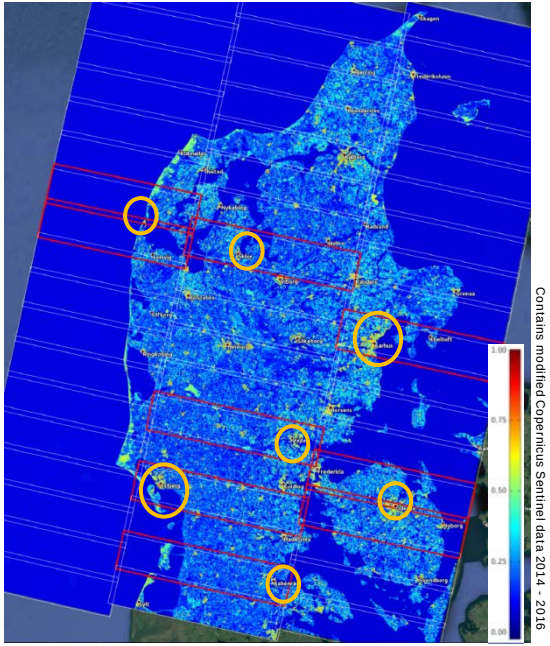
ERS-2 (1995-2001)

Various test studies with ERS, EV, S1 data.

Activities:

- QC over selected sites
- Build up experience
- Demonstrate potentials

Optimal climate change adaptation ↔ high spatial coverage + hotspot detection: possible with InSAR, particularly Sentinel-1!



Contains modified Copernicus Sentinel data 2014 - 2016

Ref: PPO.Labs, NORUT, NGU (2017)

The "why": Motivation

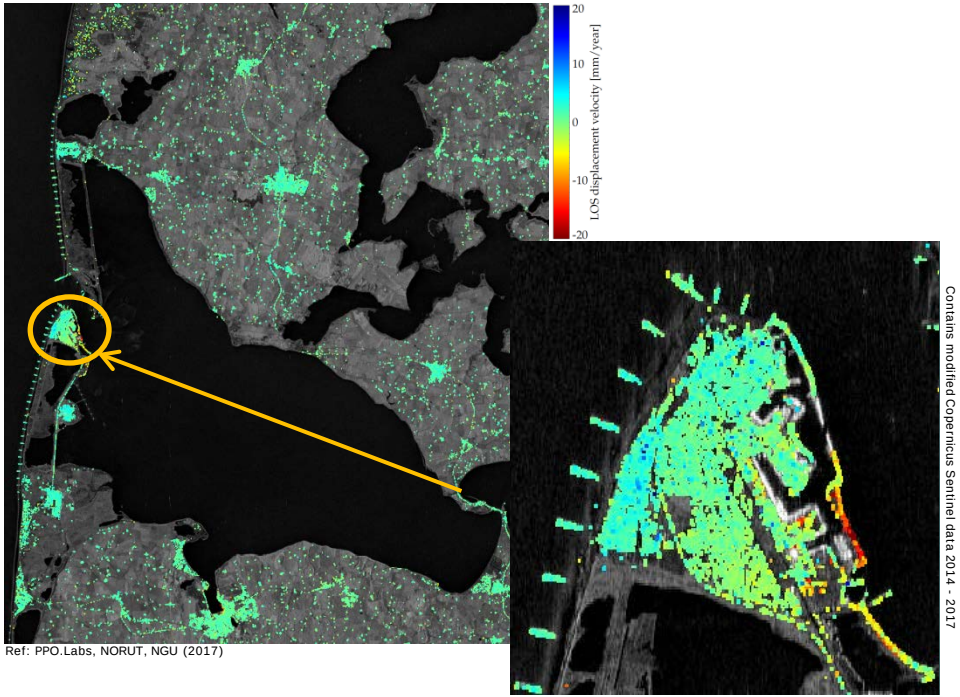
Summary:

- Imminent risk of flooding.
- InSAR ideal screening tool.

Copernicus program:

- Sentinel-1: High spatio-temporal resolution and spatial coverage.
- Data acquisition ensured until 2030.
- Free and open data policy.

→ Great potential for nationwide deformation monitoring!



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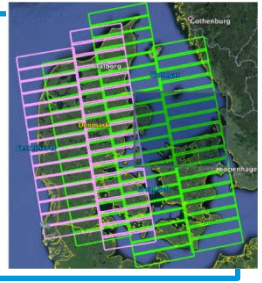
The "what": Activities

Requirements for establishing operational service for nationwide deformation monitoring in Denmark?

Process:

How? Identify technical approach (status: completed)

- Which technique is optimal for DK, and why?
- How to update, and why?
- How to include leveling, GNSS, corner reflectors?
- How to expand network of corner reflectors?
- Costs for service?
- Processing: Esbjerg, Aarhus, first large-scale deformation map.



Why? Identify end-user requirements (status: on-going)

- Point density? Error estimate? Data format? Type of visualisation? …?

How much? Cost-benefit analyses (status: on-going)

When? Basis of decision (status: November)

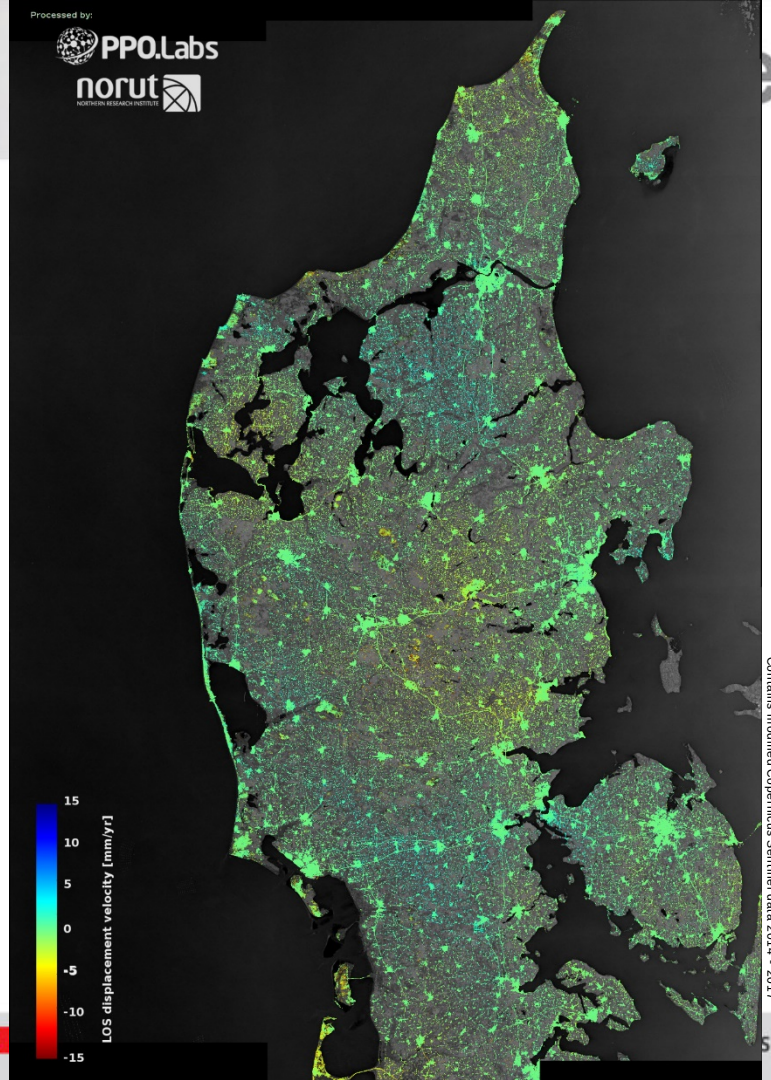
- If yes: EU tender (2018)

The "what": Results

- Integration of multitude of methods
- PSI and SBAS
- Utilisation of all relevant geometries
- On-going R&D to resolve long-wavelength components: GIA signal and seasonal signal

- Preliminary, large-scale result:
  - PSI: Oct. 2014 – Mar. 2017
  - Most infrastructure resolved
  - Islands and mainland well-connected
  - Expected errors: ± 3 mm/yr

→ En route to nationwide solution



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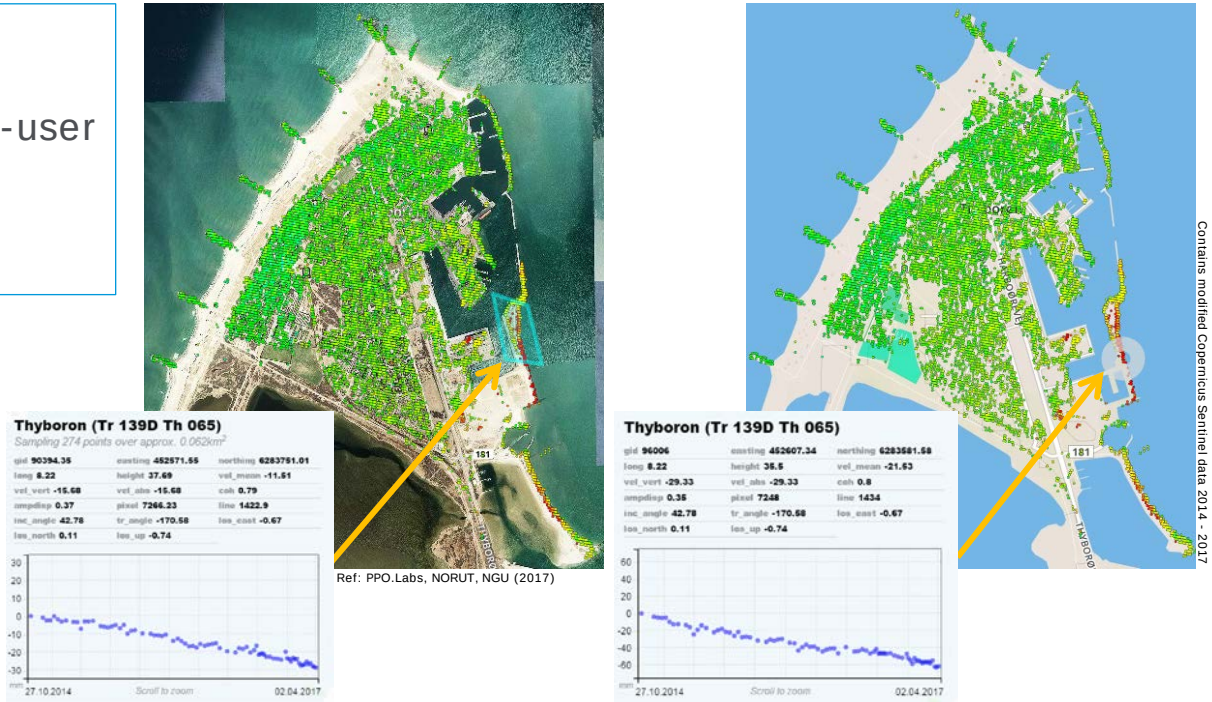
The "what": Results

Platform for dissemination

- Web-interface essential
- Must be profiled to end-user needs

Work-in-progress!



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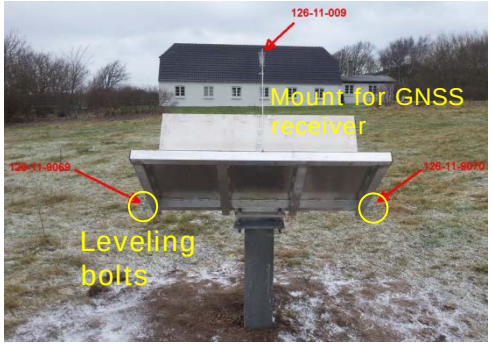
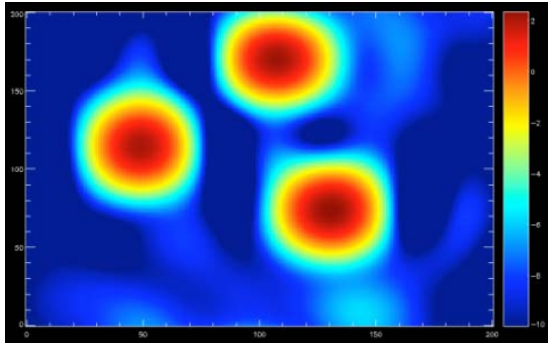
The "what": Results

Corner reflectors

- Test and permanent set-ups
- Quality control
- Demonstration
- Integration
- Geo-referencing





Road map: Potentials with Sentinel-1

Q: How did DK make it this far?

A: The possibility to establish operational services →

Cross-border collaborations

- Simple to confine AOI and avoids multiple, cross-border computations (ex: SNGMS).
- Exploitation of regions facing similar issues (ex: climate changes).
- Exploitation of other countries' expertise/ knowledge.

Maximising output

- Inclusion of potential end-users to specify technical requirements

Thank you!

The presentation contains modified Copernicus Sentinel data 2014-2017

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Agency for Data Supply and Efficiency

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