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NKG GNSS Analysis Centre

ITRF densifications for the Nordic and Baltic countries

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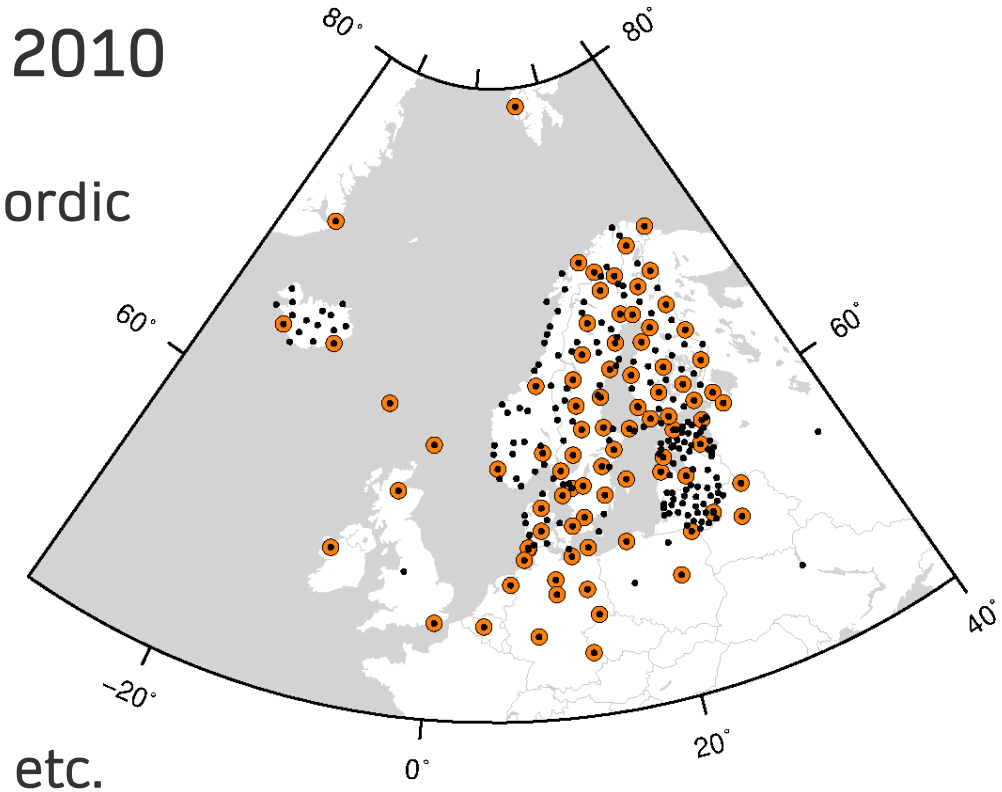
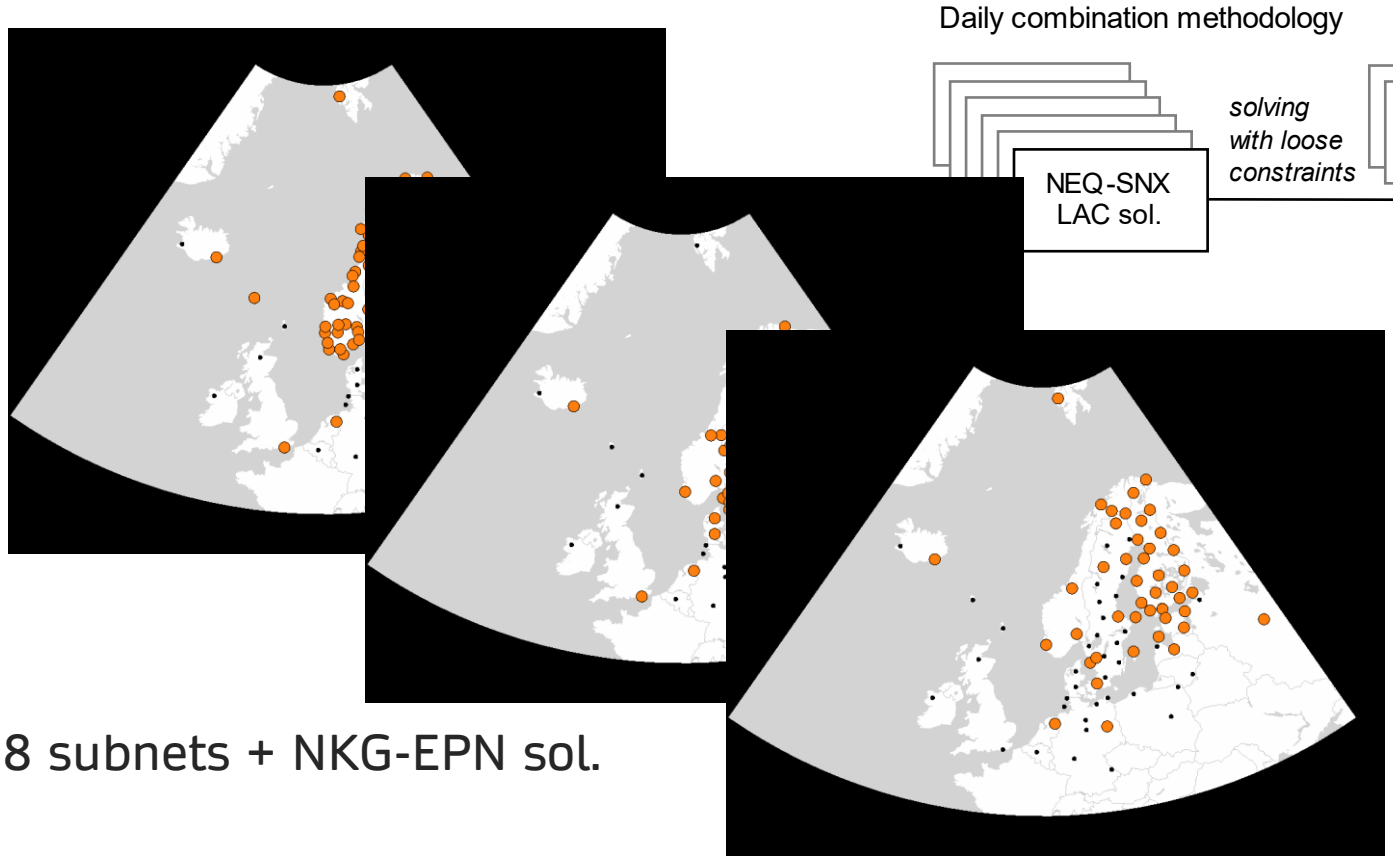
Background

- NKG GNSS Analysis Centre initiated in 2010
  - To produce common and consistent position/velocity solution in ITRF for the Nordic and Baltic countries

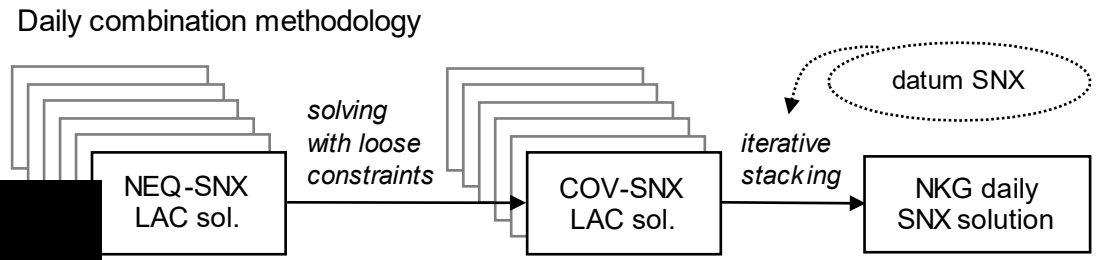


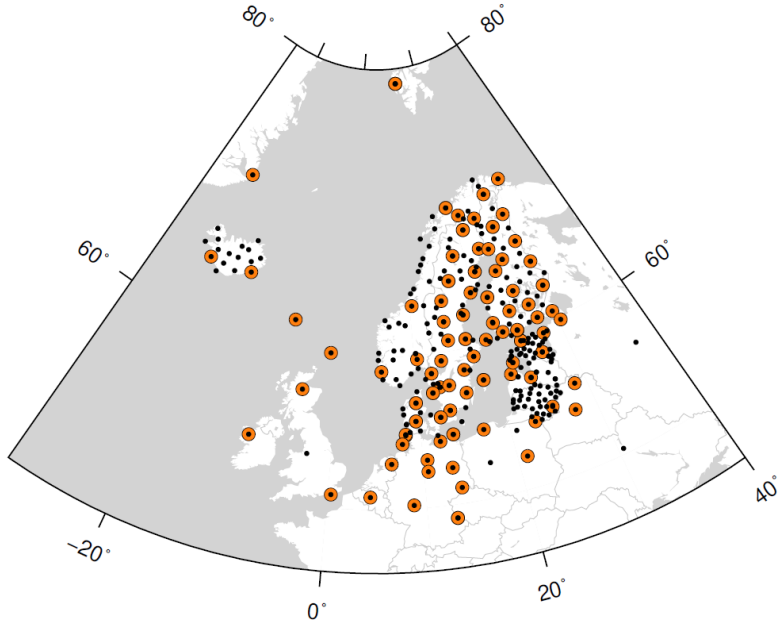
- This NKG period 2018-2022
  - 2019: NKG Repro1 – first long term position/velocity solution
  - 2021: NKG Cumulative solution
  - 2022: Dissertation: summary the methods etc.

Methods: daily combination with CATREF

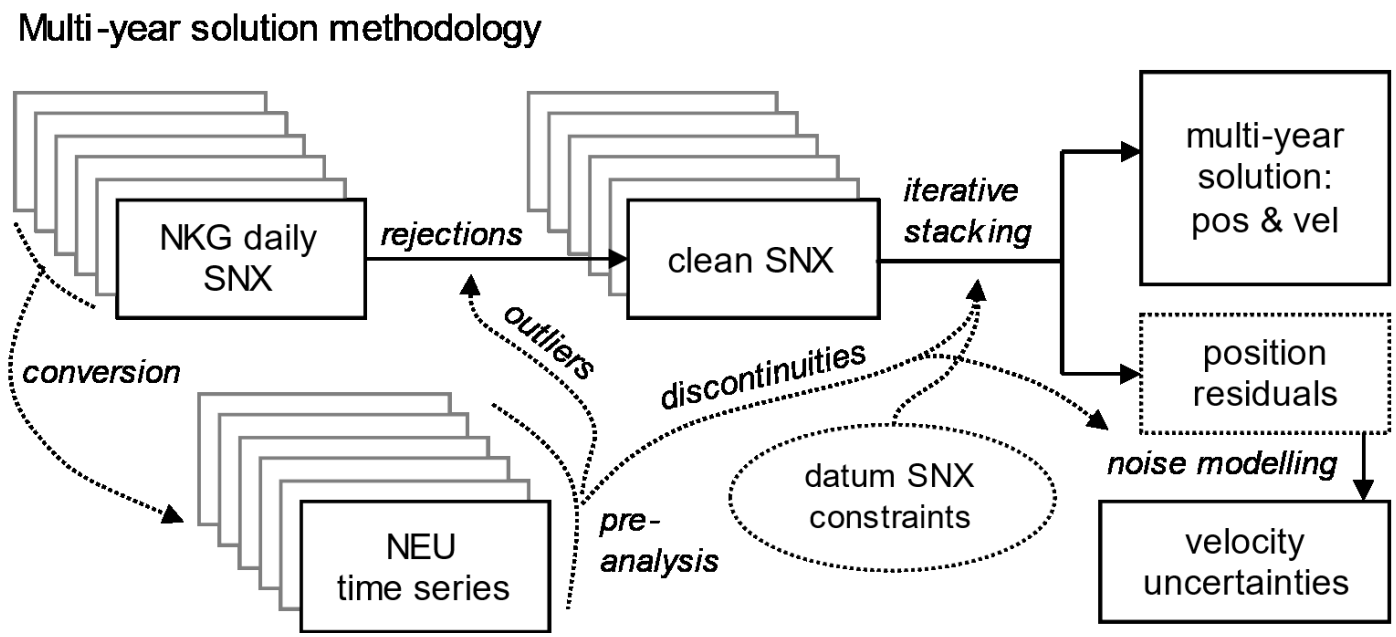


8 subnets + NKG-EPN sol.



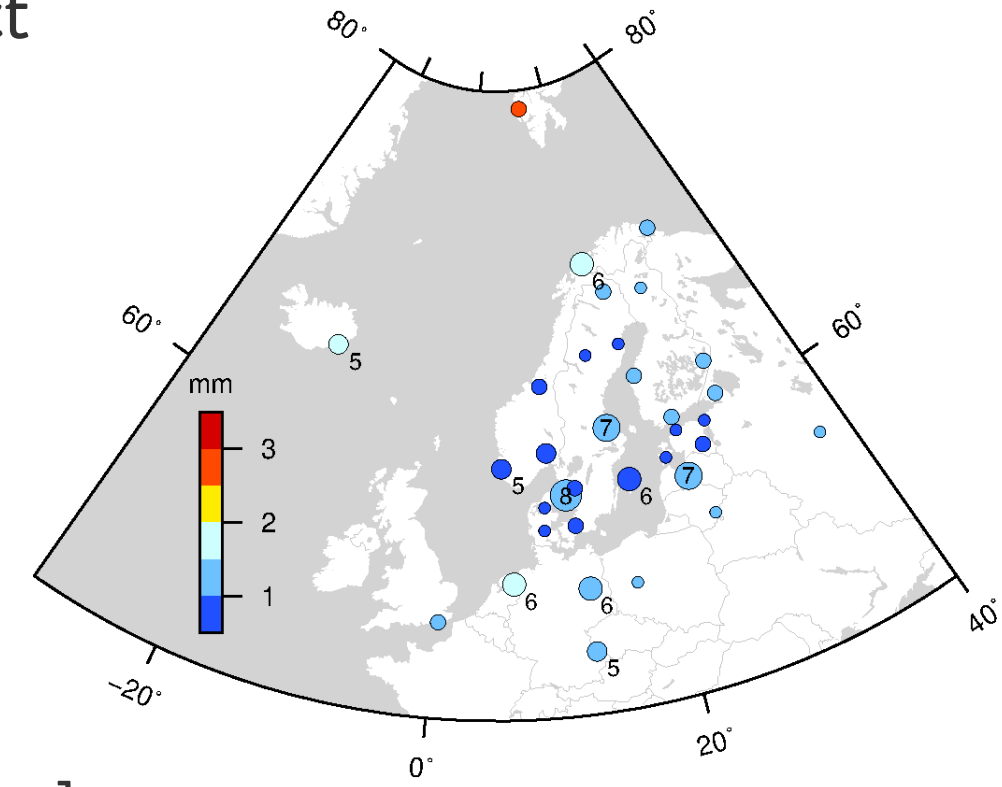


Methods: multi-year solution



About distributed analysis

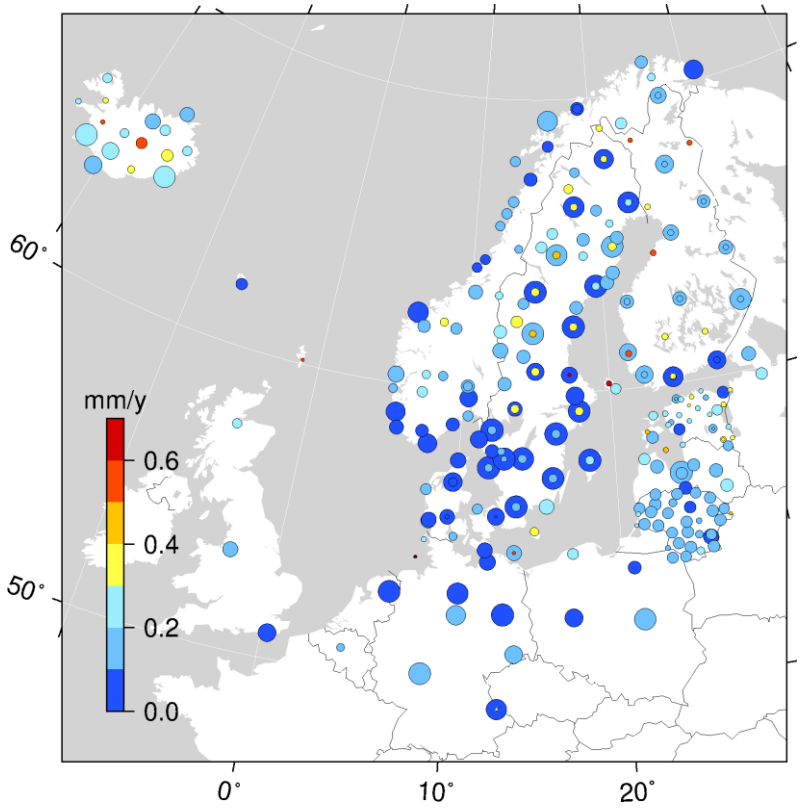
- How does the distributed analysis affect the resulting GNSS solution?
  - Our LAC solutions are consistent within 1-2 mm (rms)
    - We do not loose the accuracy of our subnets due to inconsistencies
  - Backbone gets stronger as several LACs processing those stations
  - Combination necessary, but the noticed differences are due to differences in the combination model
  - [sharing the knowhow on Bernese processing]



Pub1: Mean daily 3D rms of station positions

Quality of estimated velocities

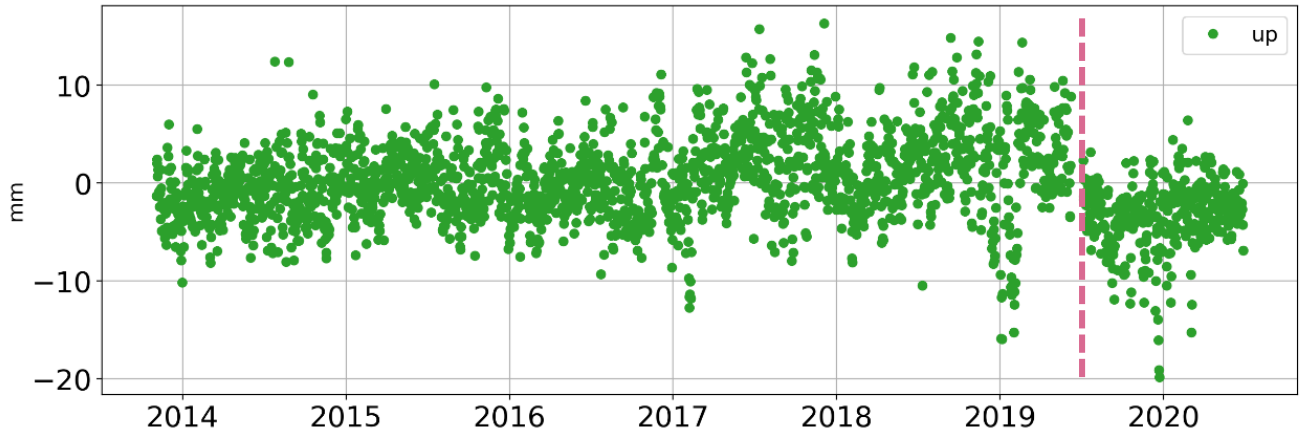
- Uncertainties from latest cumulative solution using powerlaw + white noise model by Hector
- 0.1, 0.1, 0.25 mm/y (NEU) was reached in 10 years for most of the stations (90%)
  - Longest time series, uncertainties even on 0.01, 0.01, 0.04 mm/y level
- Comparison of 3 and 10 degree solutions
  - No significant differences
- Uncertainties describes internal accuracy
  - Other error sources exists: frame etc.



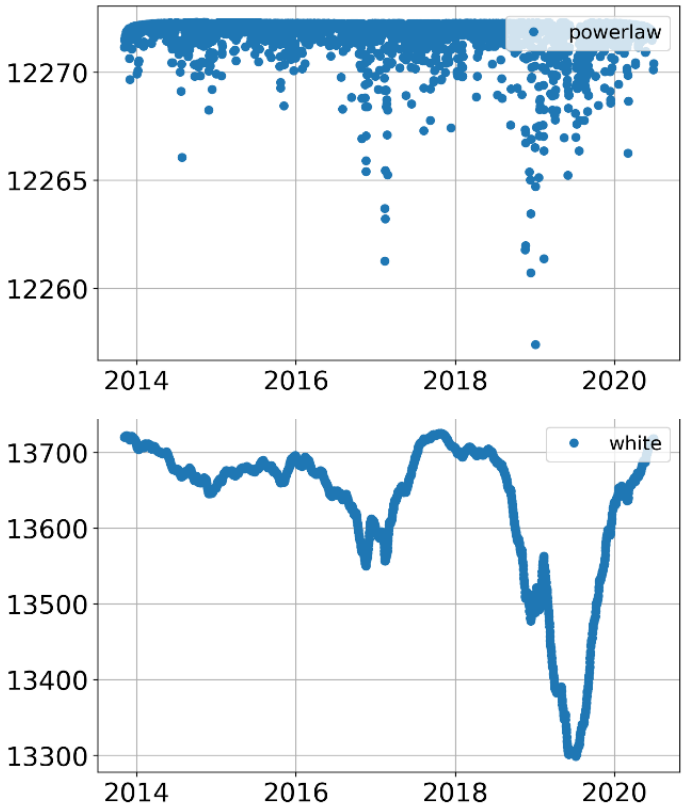
Latest velocity uncertainties in vertical

Automatic offset detection - is it possible?

- Yes, we could by using developed Bayesian based method, site log information and parameters from simulations
- Utilising Hector software to compute BIC

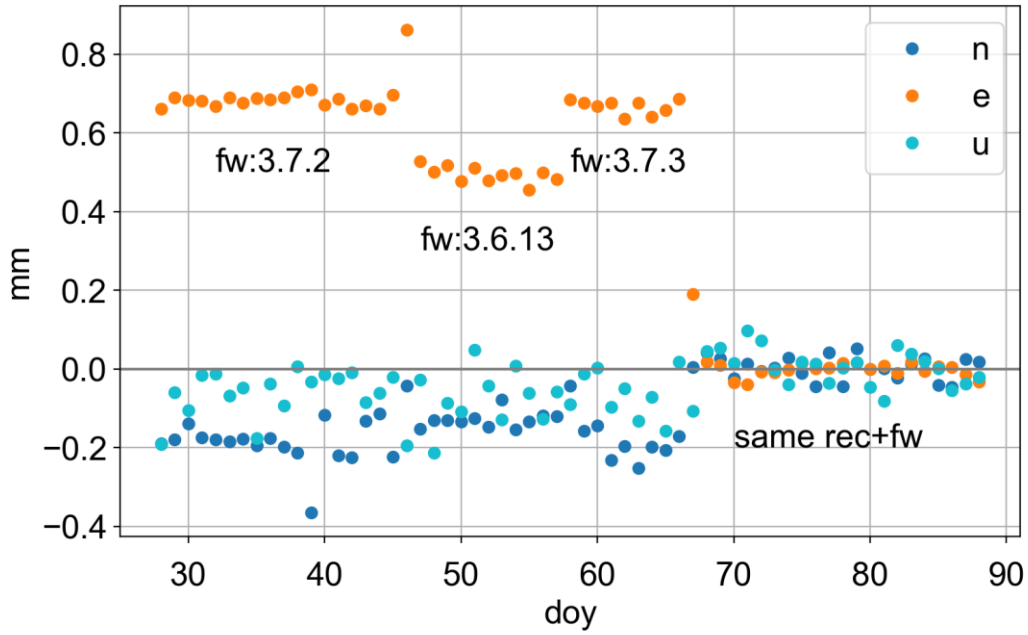


BIC time series



Automatic offset detection (cont.)

- Detected even offsets which were not found in manual analysis
- Also small offsets, linked e.g. to receiver changes at Finnish stations



2018: Zero-baseline solution at Metsähovi demonstrating the effect of a receiver change: two different Javad receivers

Accuracy of frame alignment

- On daily level, we see systematics
  - both outdating of datum solution
  - network effects
- On multi-year solutions (ITRF2014), achieved weighted rms of
  - 0.4, 0.7, 1.6 mm/y for positions
  - 0.1, 0.1, 0.2 mm/y for velocities
- Challenges in alignment multi-year solution to multi-year datum
  - Differences in discontinuities, time series lengths etc.
- The extended network would be beneficial
  - Minimise systematic effects, like tilting
  - Case YEBE/Spain: a very good control station in our network

Implications

- Scientific
  - Knowledge of our GNSS stations / time series
    - Tree-growth, velo. differences at twin stations, small offsets
    - Will hopefully contribute to future reference frames
- Practical
  - We need these solutions to maintain our ETRS89 realisations
  - Contributes to NKG transformation and deformation modelling

Recommendations for future

- Next repro: a possibility to improve details, because the path is clear at the beginning
- Automatic pre-analysis: outliers and offsets
  - Development should be continued for regular cumulative update process
- Evaluation against other software

Results available

- Latest cumulative solution
  - Velocities in publication
  - Positions etc. at WG's ftp server
- Thesis
  - Online @aaltodoc: https://aaltodoc.aalto.fi/handle/123456789/114101
  - Some paper copies available