Studying different tracking strategies to LAGEOS and Etalon with respect to the weekly ILRS solution

Florian Andritsch

Astronomical Institute, University of Bern, Switzerland

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Overview

- Introduction
  - ILRS solution for ITRF
  - Motivation: Simulation approach

- Replacing observations by simulation

- Changing the distribution of observations between LAGEOS and Etalon

- Conclusions

- Outlook and open questions

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Introduction – The ILRS targets

- 85 targets today.

- Upon completion of the galileo constellation and others:
  soon 100+ targets.
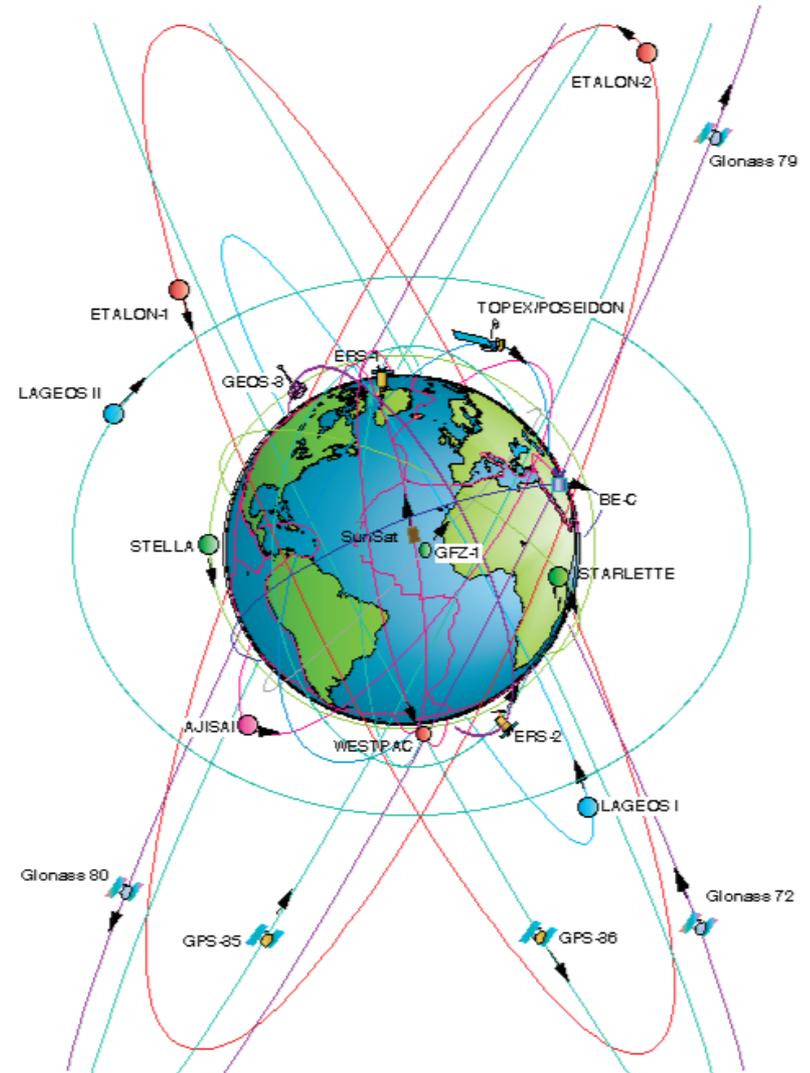
*https://ilrs.cddis.eosdis.nasa.gov/missions/satellite_missions/index.html*

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Introduction – number of NPs

In 2016:

- In average 130000 NPs/month in total.

- 13000 NPs of those to LAGEOS.

  - 10% of total NP to only 2 of 100 satellites.

- 1200 NPs to Etalon.

  - Only 10% of the ILRS solution for the ITRF comes from Etalon

Comparison of tracking volume

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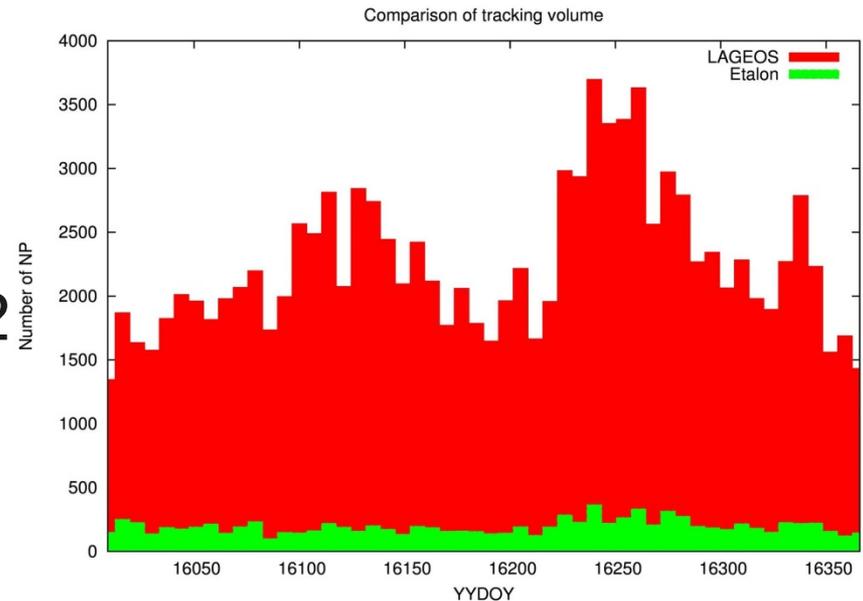
Introduction – ILRS contribution to the ITRF
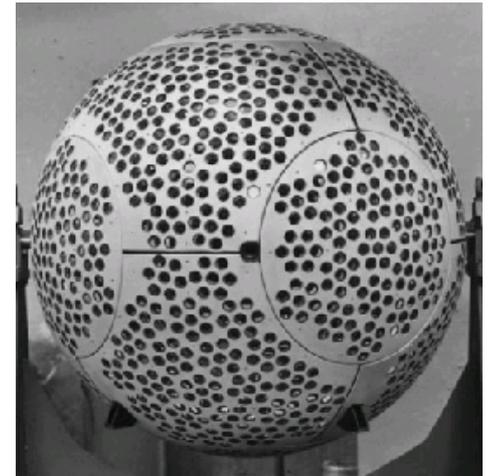
SLR observations to LAGEOS1, LAGEOS2, Etalon1 and Etalon2 are used to estimate

- the individual ERP,

- station coordinates,

- and orbits.

(7 day arcs)

→ then combined in weekly solution.

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Introduction – SLR productivity shortcomings

- **Highly inhomogenous station network.**

  - Station distribution, expanding the Network.

  - Increasing the productivity of stations with less observations.

- **Scheduling according to priority list.**

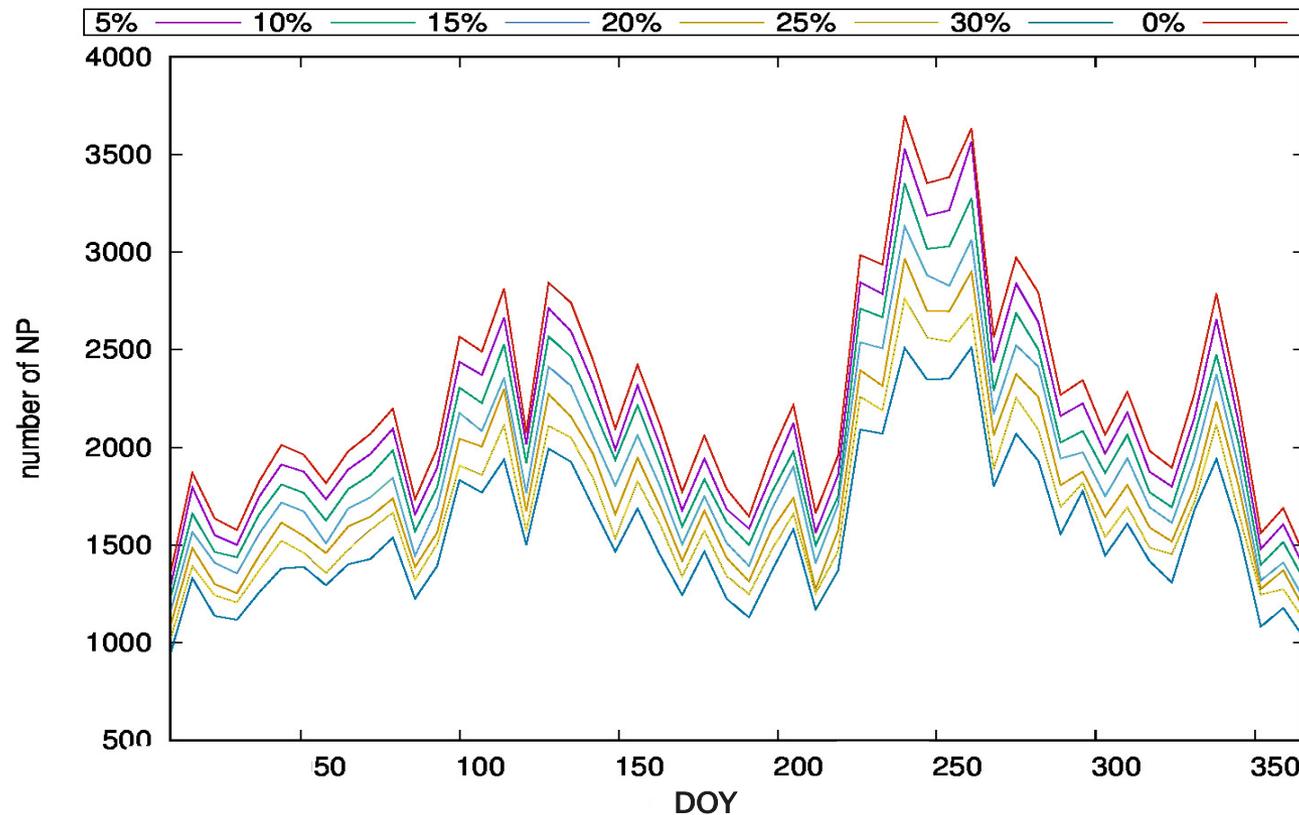 - Study the effect of specific tracking strategies on different products

LAGEOS 1 and 2 normal points
from April 1, 2016 through March 31, 2017

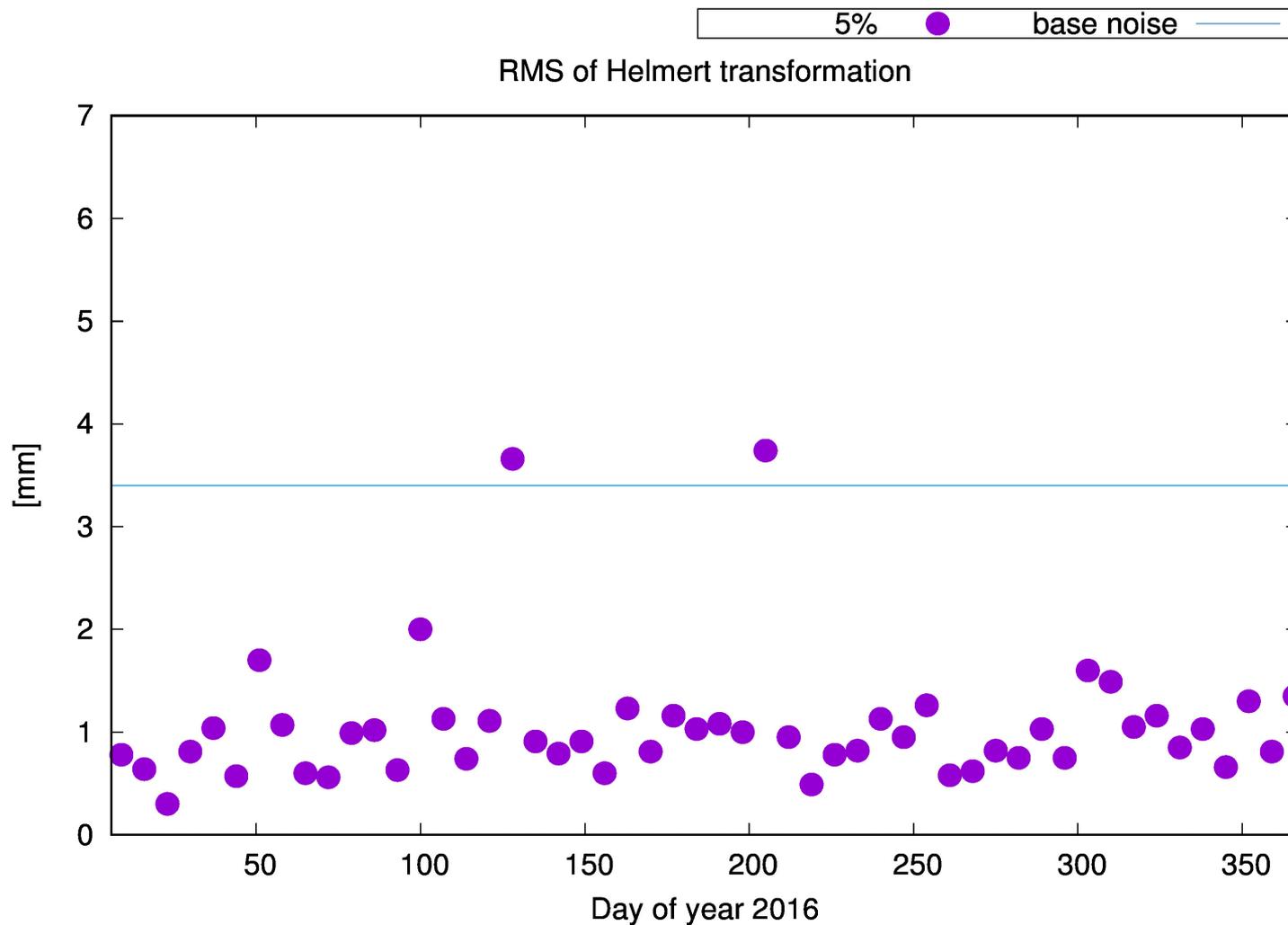
Simulation

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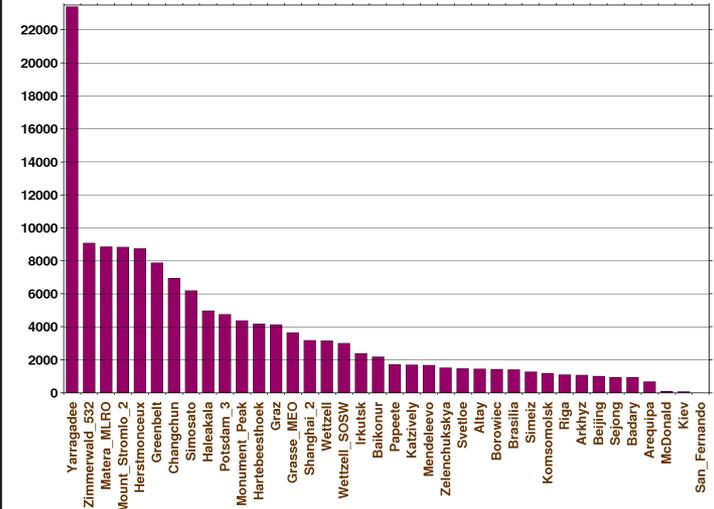
Experiment: Reducing LAGEOS NPs

- Impact of number and distribution of observations on the LAGEOS and Etalon satellites.
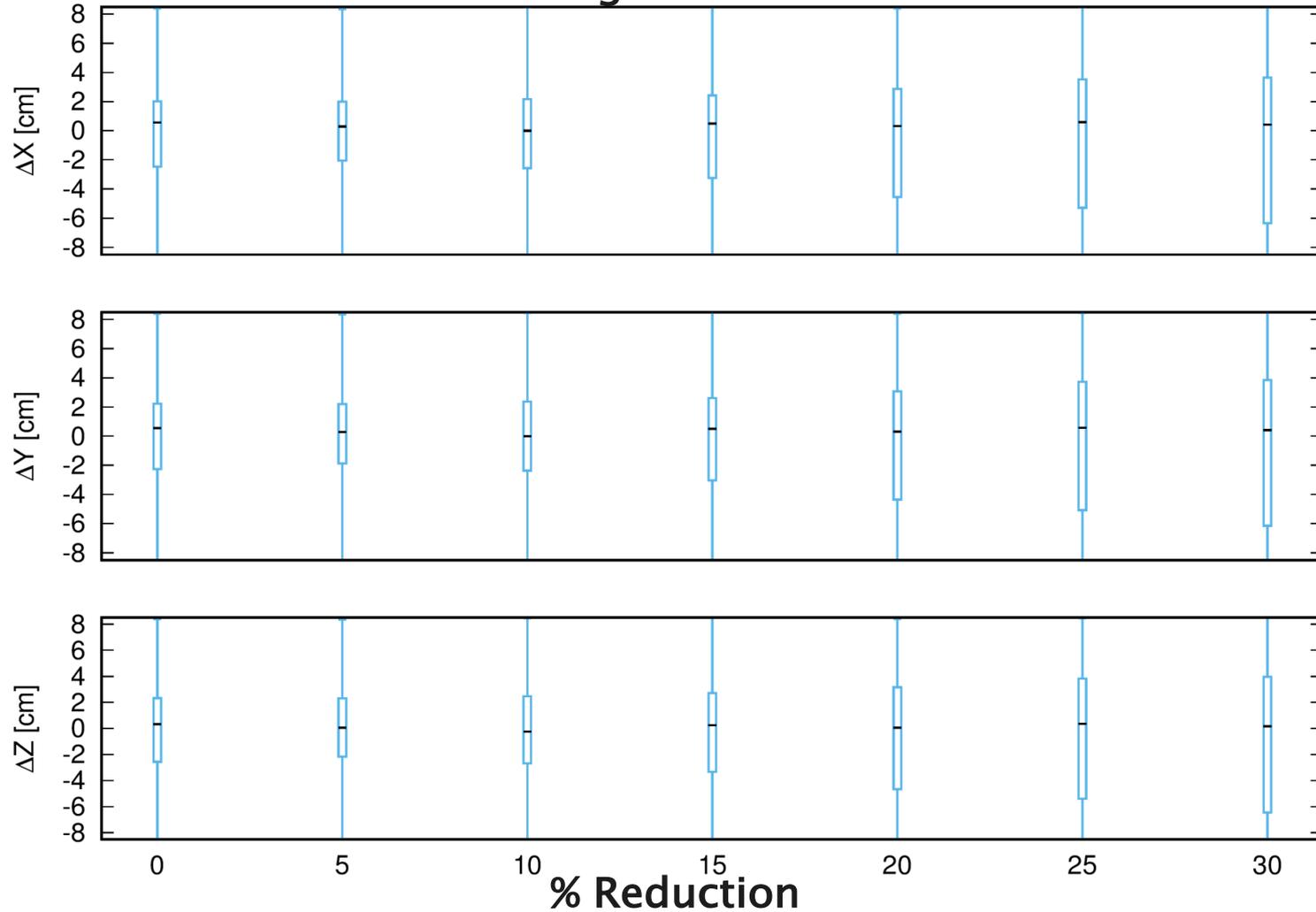 - Comparison of different scenarios:

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Comparing scenarios

RMS of Helmert transformation

Legend: 5% ● base noise ▬

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Differences of geocenter coordinates
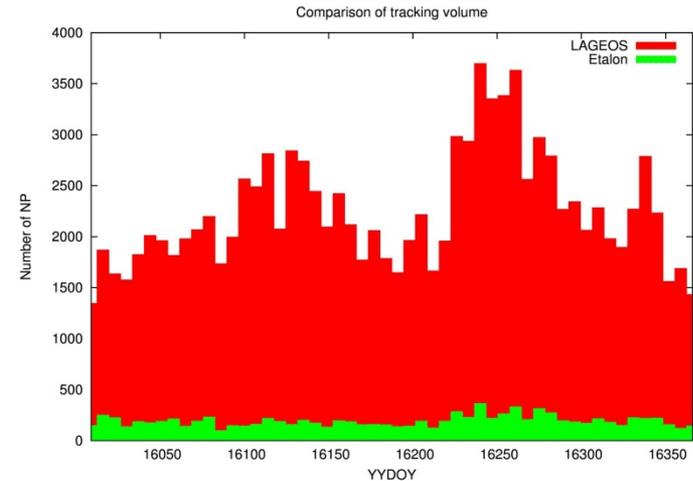
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Summary

- **RMS of Helmert:** increases when reducing LAGEOS observations. Up to 20% Reduction the RMS stays within the simulation noise RMS threshold.

- **ERP, translation/rotation:** insignificant difference.

- **Orbits:** Average residuals of LAGEOS orbits slightly increase but remain at the same maximum level of ~10cm.

- **Scale factor, geocenter**: Scenarios clearly show a decrease beyond 20% reduction.

   => 20% of LAGEOS NPs could go to other targets.

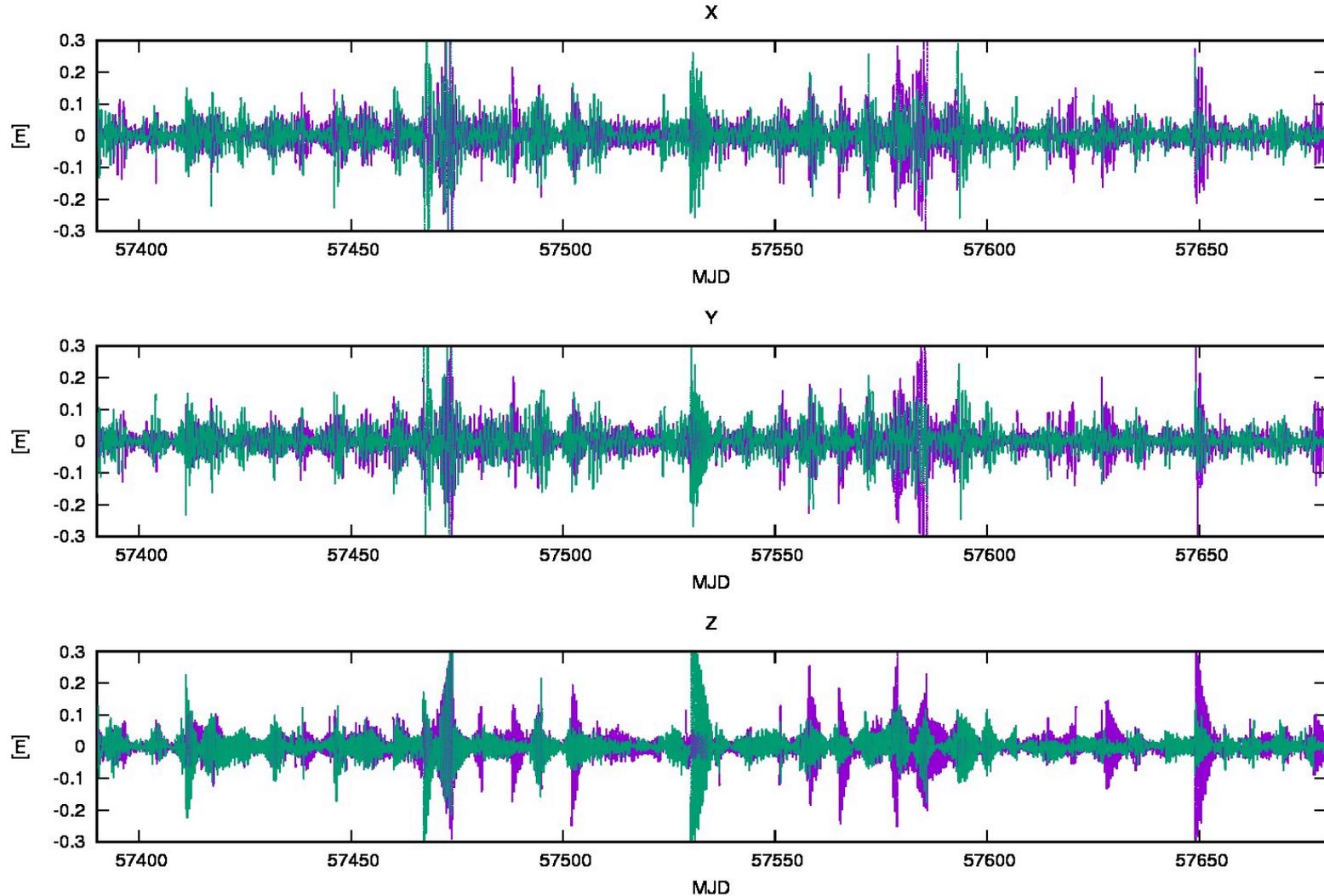Astronomical Institute University of Bern

Experiment: Increasing NPs to Etalon

- Taking **20%** of LAGEOS observations and replace them with Etalon.

- **Total number of NP in ILRS solution remains the same!**
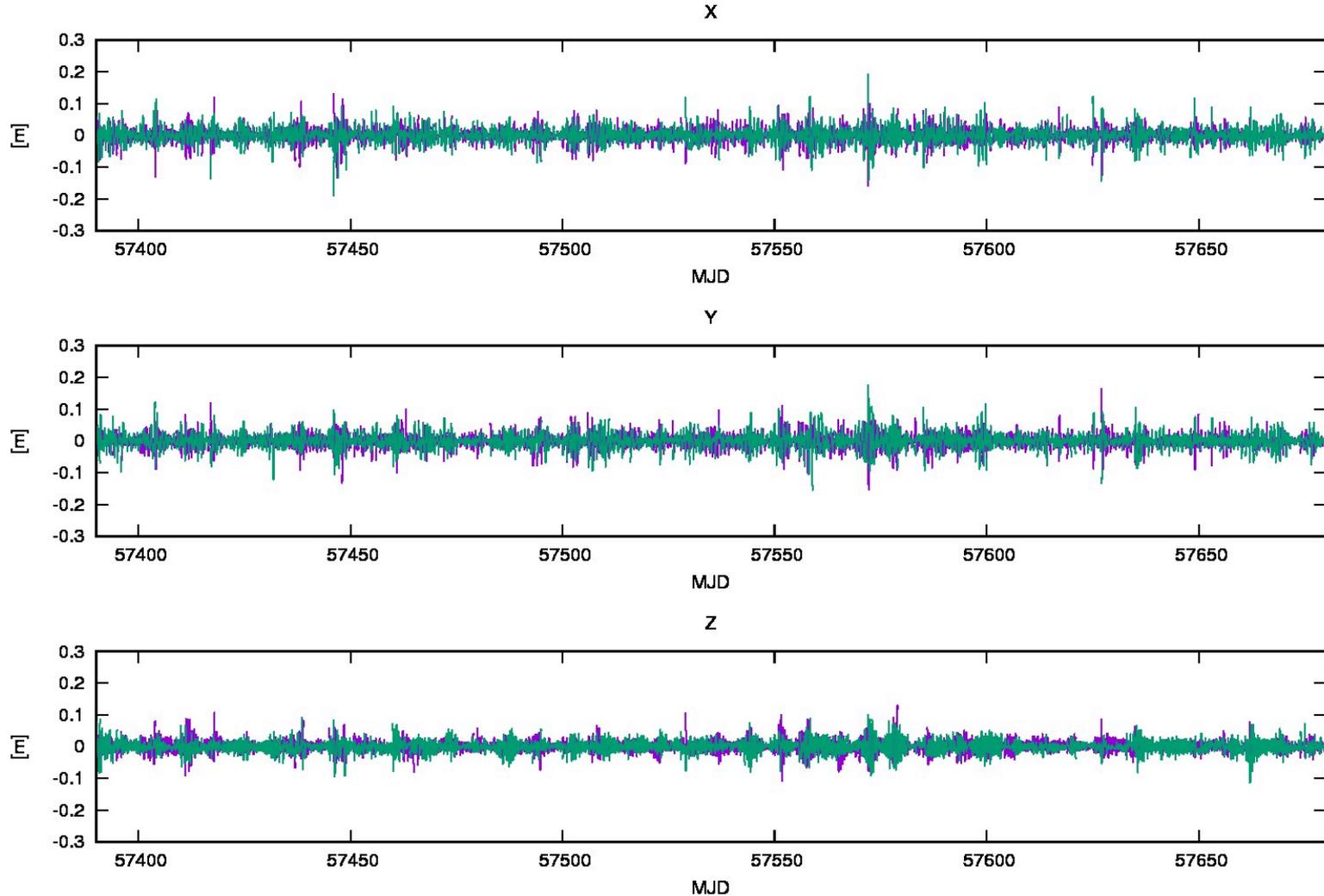
- Impact on the main parameters of the solution?

Comparison of tracking volume

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Etalon orbits

RESIDUALS IN EARTH-FIXED SYSTEM 953 and 954 2016

Etalon1
Etalon2

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Etalon orbits

RESIDUALS IN EARTH-FIXED SYSTEM 953 and 954 2016

Etalon1
Etalon2

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Increasing NPs to Etalon − ERPs

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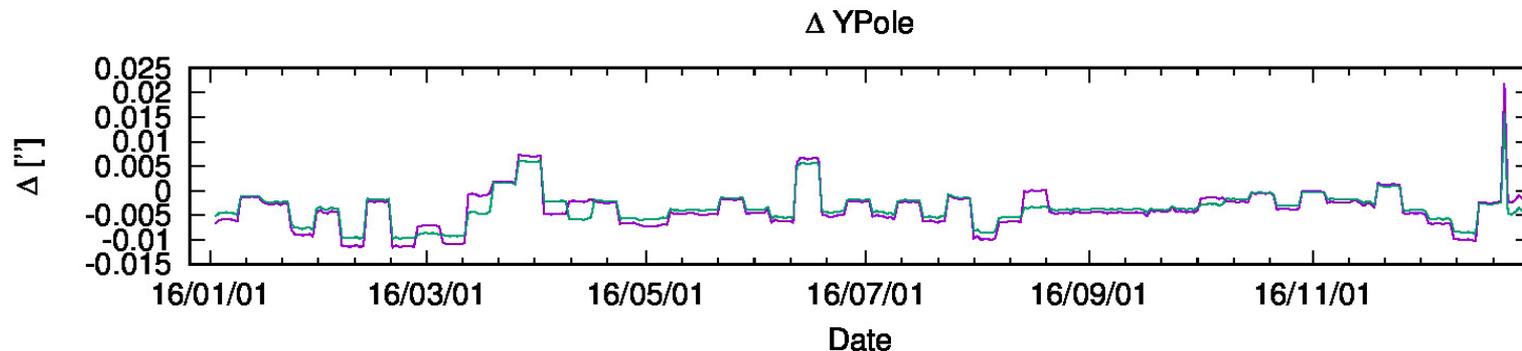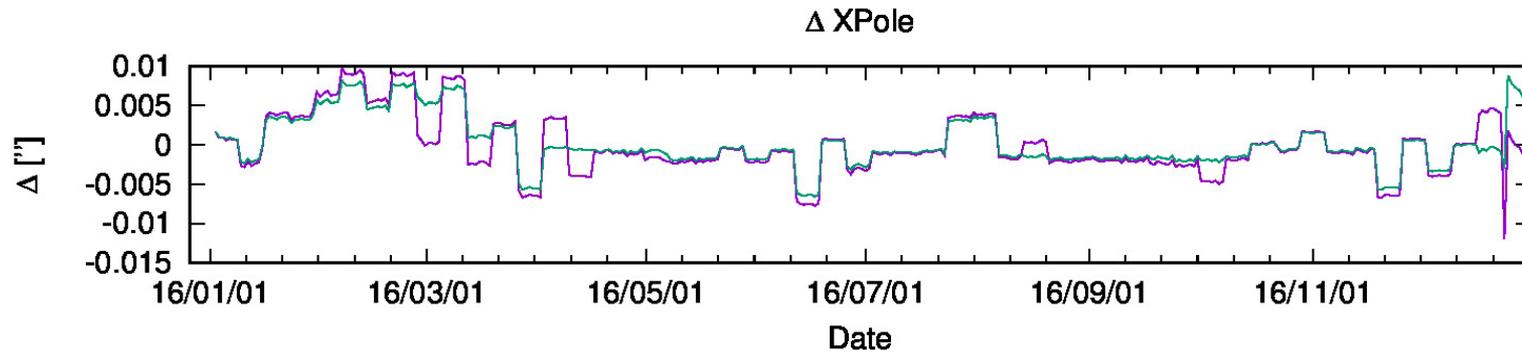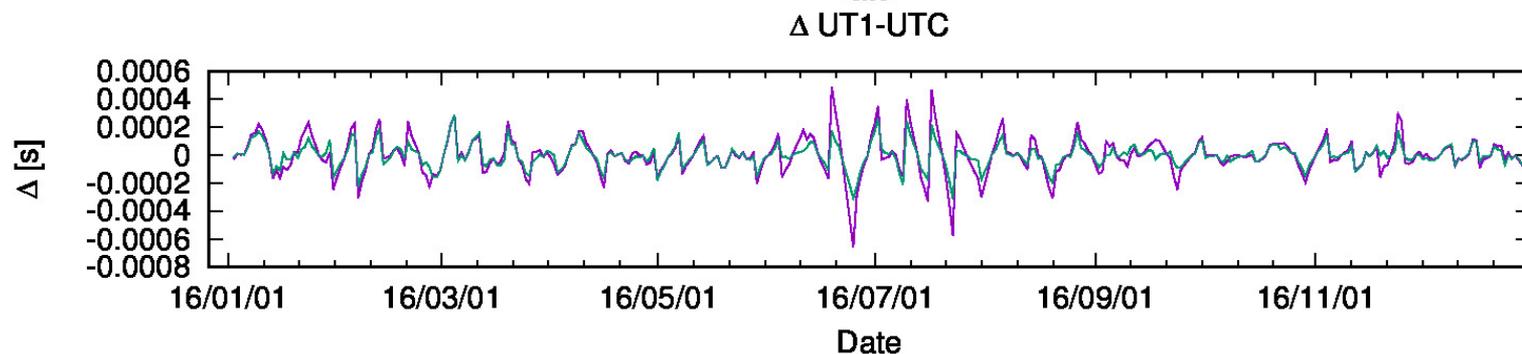
Summary

- **RMS of station coordinates**: on the same level as with LAGEOS.

- **Translation/Rotation**: not significant.

- Orbits:
  - LAGEOS: Slightly bigger average differences, but still on the same ~10cm level.
  - Etalon: Vastly improved orbits.

- **ERPs improved by 10%**

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Conclusions

- Meaningful comparison of similar tracking scenarios is possible.

- Simulation of tracking strategies to evaluate improvements and benefits.

- Reduction of observations to LAGEOS by **20%** without significant decrease of the quality of solution.

- Increasing the number of NPs to Etalon improves **Etalon orbits** and **ERP**s.

Each NP can make a difference!

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Outlook

- Including LARES in the solution and increasing NPs for it.

- More NPs for other low flying satellites.

- Synchronized regional tracking (e.g. in Europe)
  - Same or different targets at specific passes?

- **Comparison of tracking strategies to GNSS satellites in SLR+GNSS Combination**
  - **Less than100NP/week per GLONASS satellite**
  - **Less than 1000NP/week on all GLONASS**

- What else? – Looking forward to discussing ideas.

Thank you for your attention!

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