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Optimal VGOS telescope location for the estimation of Earth orientation parameters

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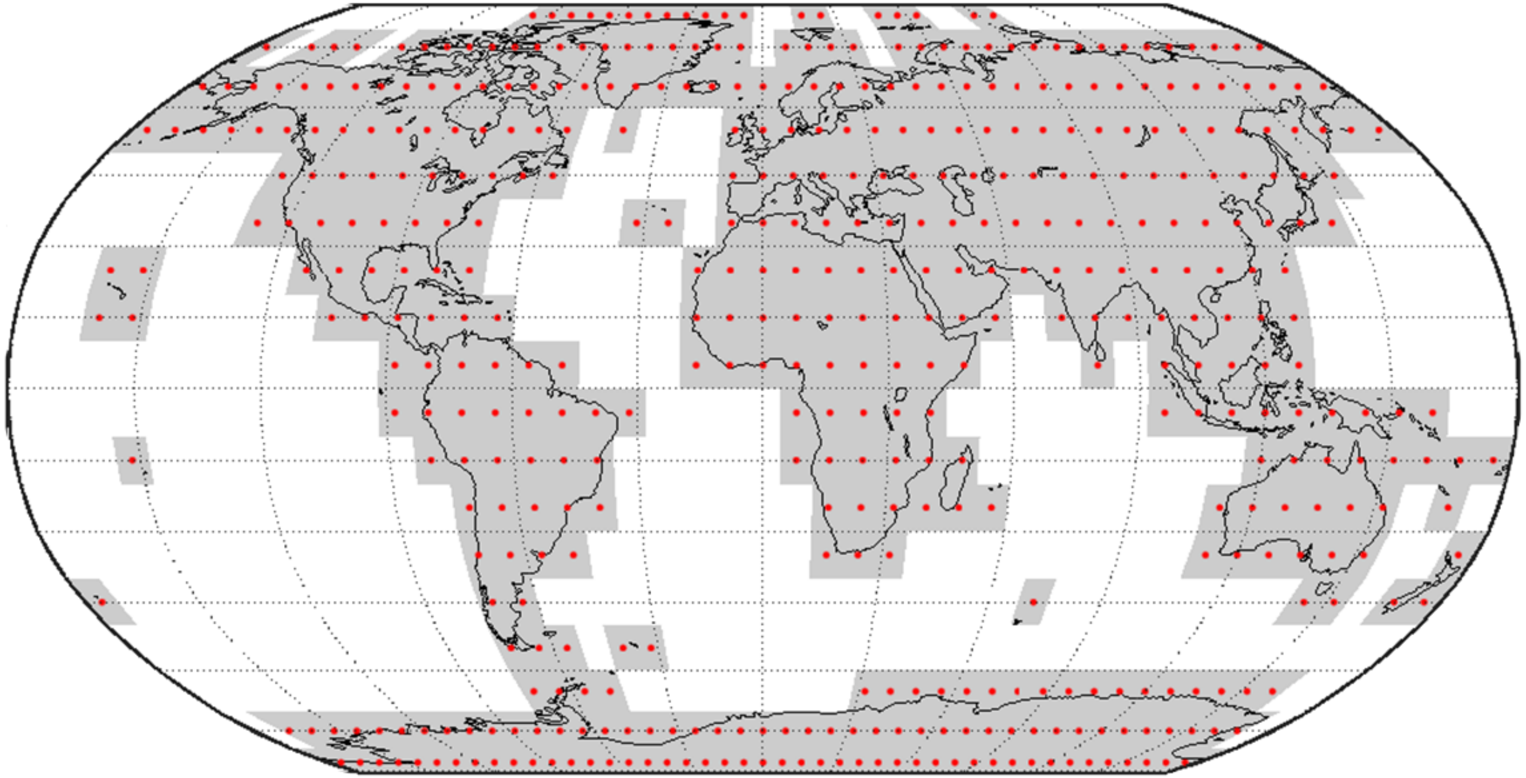
tested VGOS antenna locations

- tested 477 new locations (red dots)
- defined 6/12/18 station fixed VGOS networks
- added one new telescope to the fixed network
- generated 35/96/64 schedules per location*
  → 93.015 schedules
- 1000 simulations per schedule



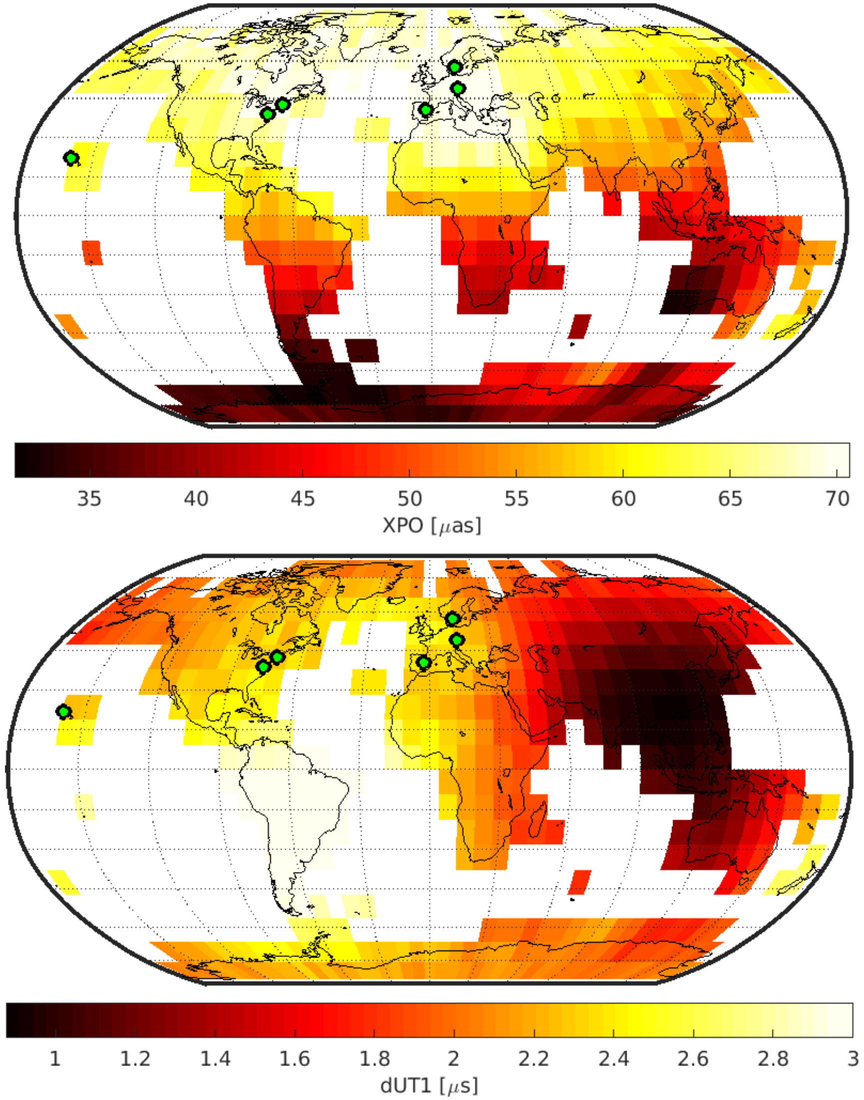
* optimized based on previous study, see final publication (last slide) for more details

Results

Following slides show simulation results

- green dots mark location of the 6, 12, 18 fixed VGOS antennas
- EOP repeatability based on the best schedule for this new antenna location is color-coded
- result form NUTX and NUTY is almost identical → averaged to one figure

6 fixed + 1 additional antenna

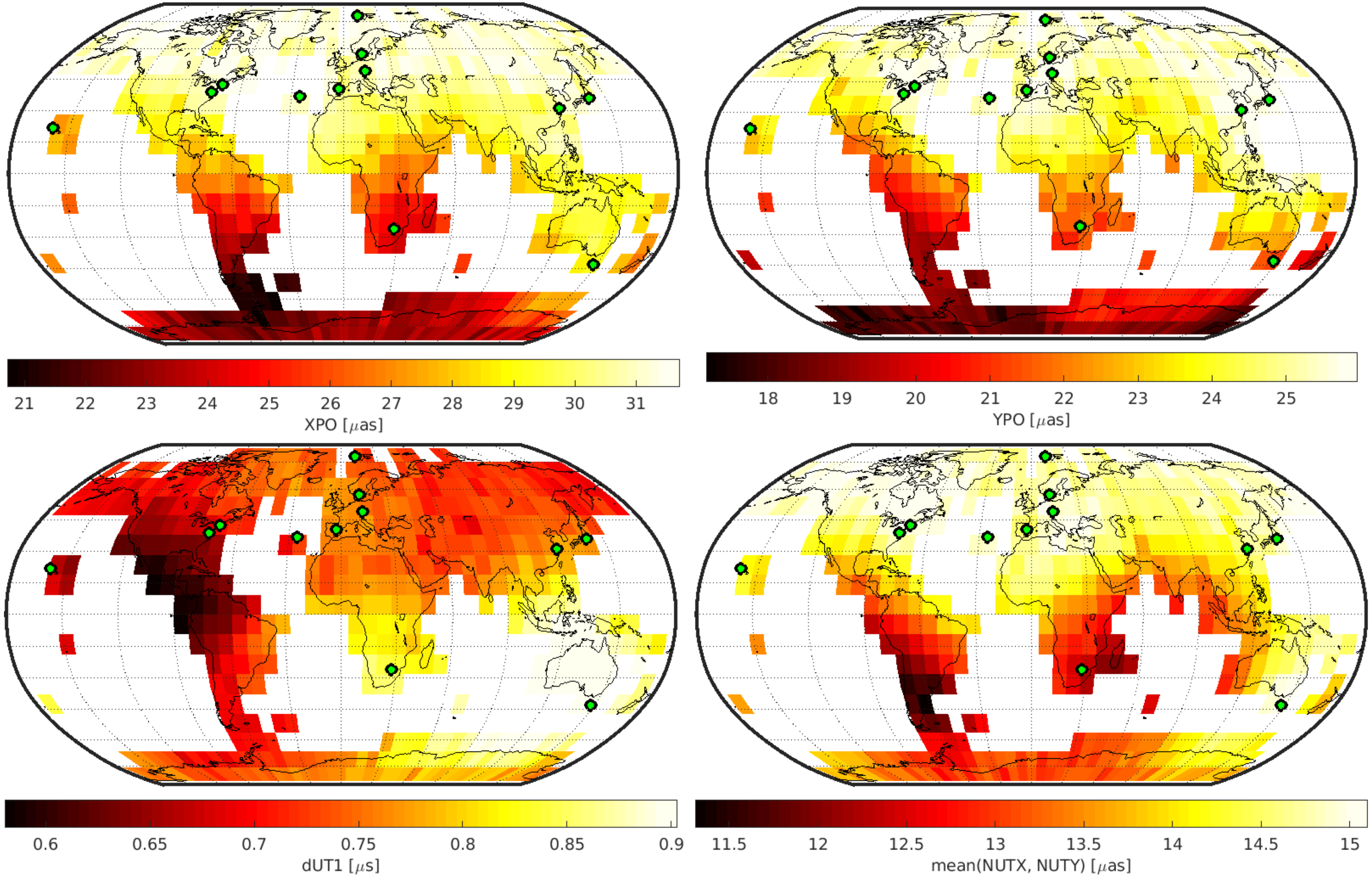


simple, regional fixed network → validate method

- results behave as expected (darker areas = better precision)
- E-W baselines for dUT1
- N-S baselines for polar motion and nutation

Schartner et al. (2020)

12 fixed + 1 additional antenna

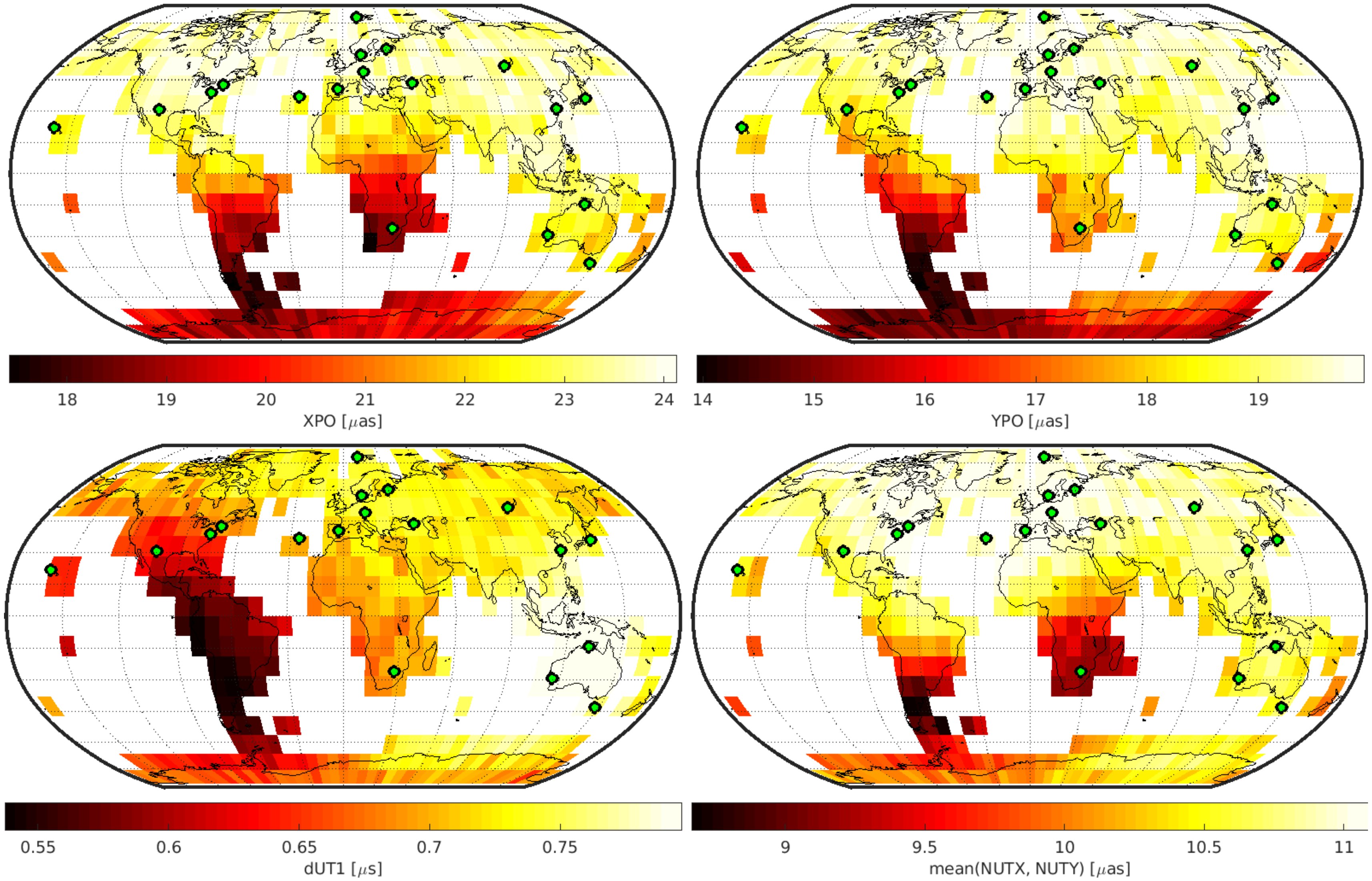


near-future VGOS network

- polar motion: best location South America and Antarctica (N-S baselines)
- dUT1: best location Central America
- nutation: best location South America

Schartner et al. (2020)

18 fixed + 1 additional antenna



future VGOS network

- best location for all EOP is South America (even for dUT1)
- highlights importance of VGOS antenna in South America

Schartner et al. (2020)

Conclusion

General:

- high number of simulations is necessary to gain trustworthy repeatabilites (see appendix)
- antenna network geometry highly influences location of new “best” antenna location
- different EOP have different requirements

VGOS:

- for easy network geometries (e.g.: our 6 station network) result follows expectations
- Southern Hemisphere is almost always advantageous
- for future VGOS network geometries (e.g.: our 12 and 18 station network) South America seems to be best target for additional telescope

Reference

A publication about the best VGOS antenna location is currently submitted to EPSP and is under review. This publication will include further information about the method and simulation approach and will provide more results.

M. Schartner, J. Böhm, A. Nothnagel, "Optimal antenna locations of the VLBI Global Observing System for the estimation of Earth orientation parameters". EPSP (under review), 2020

VieVS: https://github.com/TUW-VieVS/VLBI

VieSched++: https://github.com/TUW-VieVS/VieSchedpp

Appendix

Method

Requirements:

- global investigation
- different network geometries need different scheduling approaches
- different EOP need different scheduling approaches (N-S vs. E-W baselines)
- repeatabilities need high number of simulations

Challenges:

- proper scheduling for all network geometries
- performance issues due to high number of simulations

How many simulations do we need

- investigated 1.000.000 simulation runs of one VGOS session
- result is grouped by different number of simulation runs
  - red line: median repeatability
  - blue box: 0.25 and 0.75 percentile
  - whiskers: total repeatability scatter

Conclusion:

- repeatabilites need high number of simulations to provide trustworthy results → we used 1000 simulation runs per session

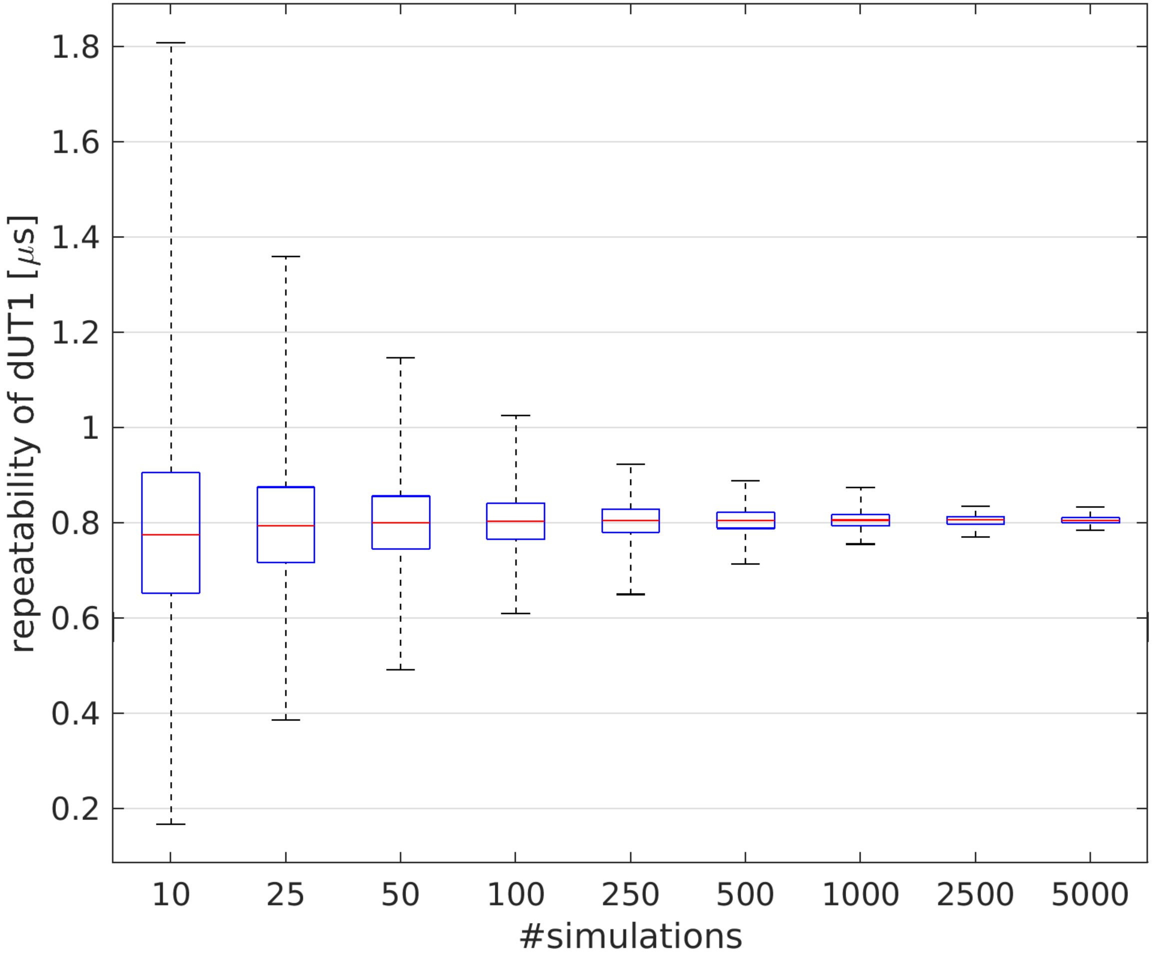


Figure: simulated repeatability scatter as a function of simulation runs for dUT1

How many simulations do we need

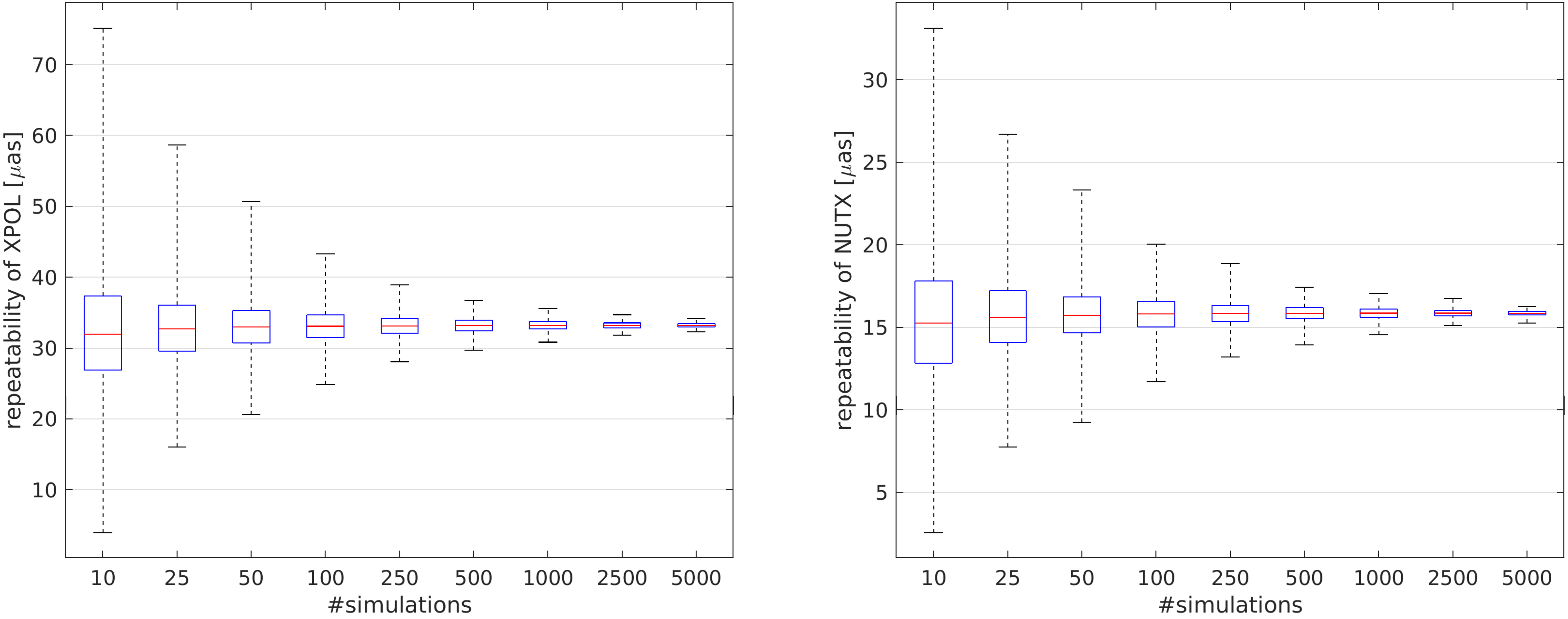


Figure: simulated repeatability scatter as a function of simulation runs for XPOL and NUTX

Performance issues

Scheduling

- generated sessions: 380.744 → 93.015 final schedules
- investigated scans: 334.000.000.000
- investigated observations: 2.210.000.000.000

Simulations

- simulated sessions: 93.015.000
- simulated scans: 181.000.000.000
- simulated observations: 4.960.000.000.000

→ we need highly sophisticated software: VieVS and VieSched++