SLR simulations for improved geodetic parameters in light of the Genesis mission

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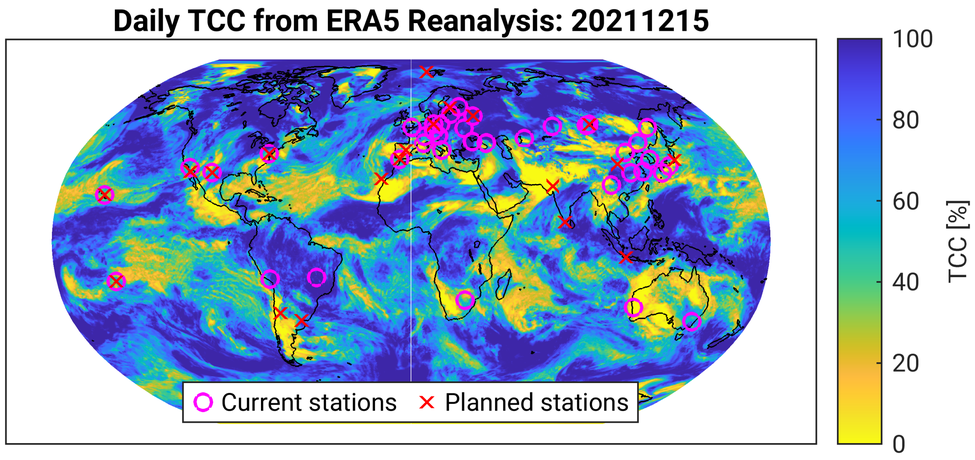
Introduction

This study looks ahead to a **future SLR network with 20 new stations** planned to be in operation by the Genesis launch date to determine the impact of the expanded network on SLR-derived geodetic parameters. The **simulated new station performance considers total cloud cover (TCC)**[4] to reflect a realistic number of observations to LAGEOS-1/-2. This simulation will be continued in the future to assess the capabilities of the expanded SLR network in light of the Genesis mission.

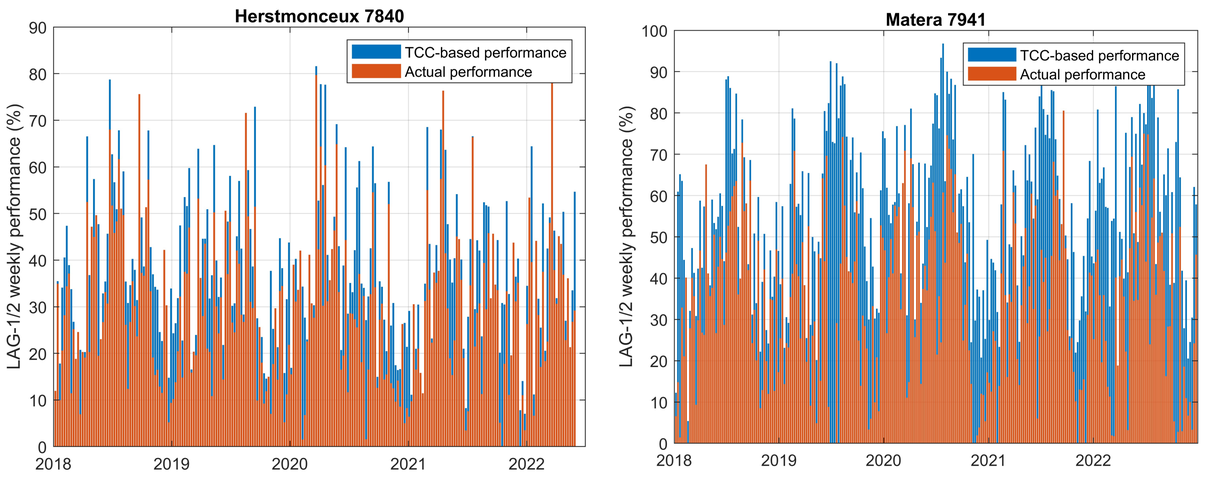


Planned new ILRS stations [1]

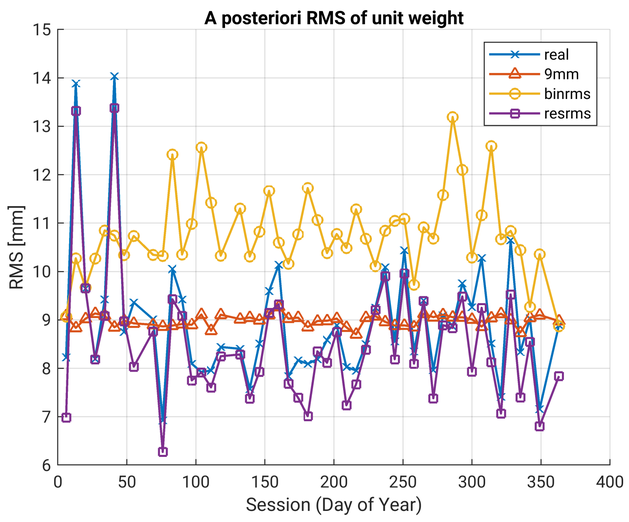
Site name	Time frame
La Plata, San Juan (ARG)	2024-2025
Metsähovi (FIN)	2024-2025
Greenbelt, Haleakala, McDonald (USA)	2026-2029
Ny-Alesund (NOR)	2024-2025
Ensenada (MEX)	2024-2026
Java (IDN)	2024-2026
Gran Canaria, Yebes, San Fernando (ESP)	2024-2026
Tahiti (PYF)	2024-2026
Mt Abu, Ponmundi (IND)	2025-2026
Ishioka (JPN)	2024
Irkutsk, Mendelevo (RUS)	2025-2026
Xi-an (CHN)	2025
Potsdam (DEU)	2027

Why use TCC-based visibility?

Current SLR station performance shows significant variability, largely depending on TCC. Thus, restricting the simulated performance by cloud cover can achieve a more realistic observation scenario [3]. This accounts for both station-specific visibility, as well as seasonal variations.



Simulated noise



To simulate noise, white noise was scaled by the following options:

- Normal point bin RMS
- Post-fit residual RMS
- Constant 9mm noise

Comparing these options, post-fit residual RMS appears to provide the most realistic noise for simulated SLR observations.

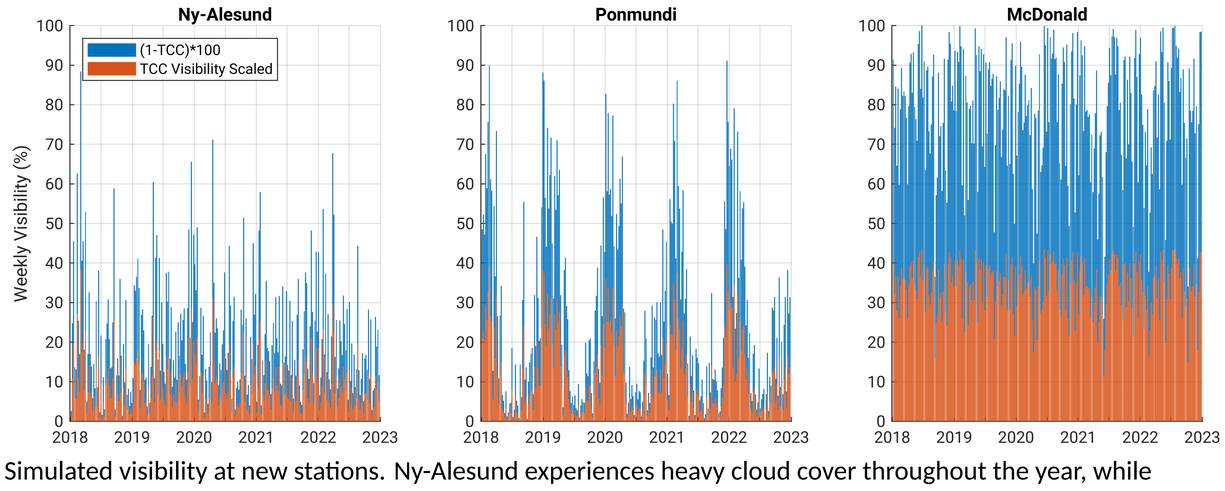
Simulation set-up

Current stations

- Reduce number of simulated observations to match actual observations
- Noise from daily post-fit residual RMS for each station-satellite pair

New stations

- Reduce number of all possible simulated observations using scaling factor calculated from daily TCC visibility at each station divided by the real performance (ratio of actual/possible observations) of the current network
- Noise from satellite-specific daily post-fit residual RMS over all stations

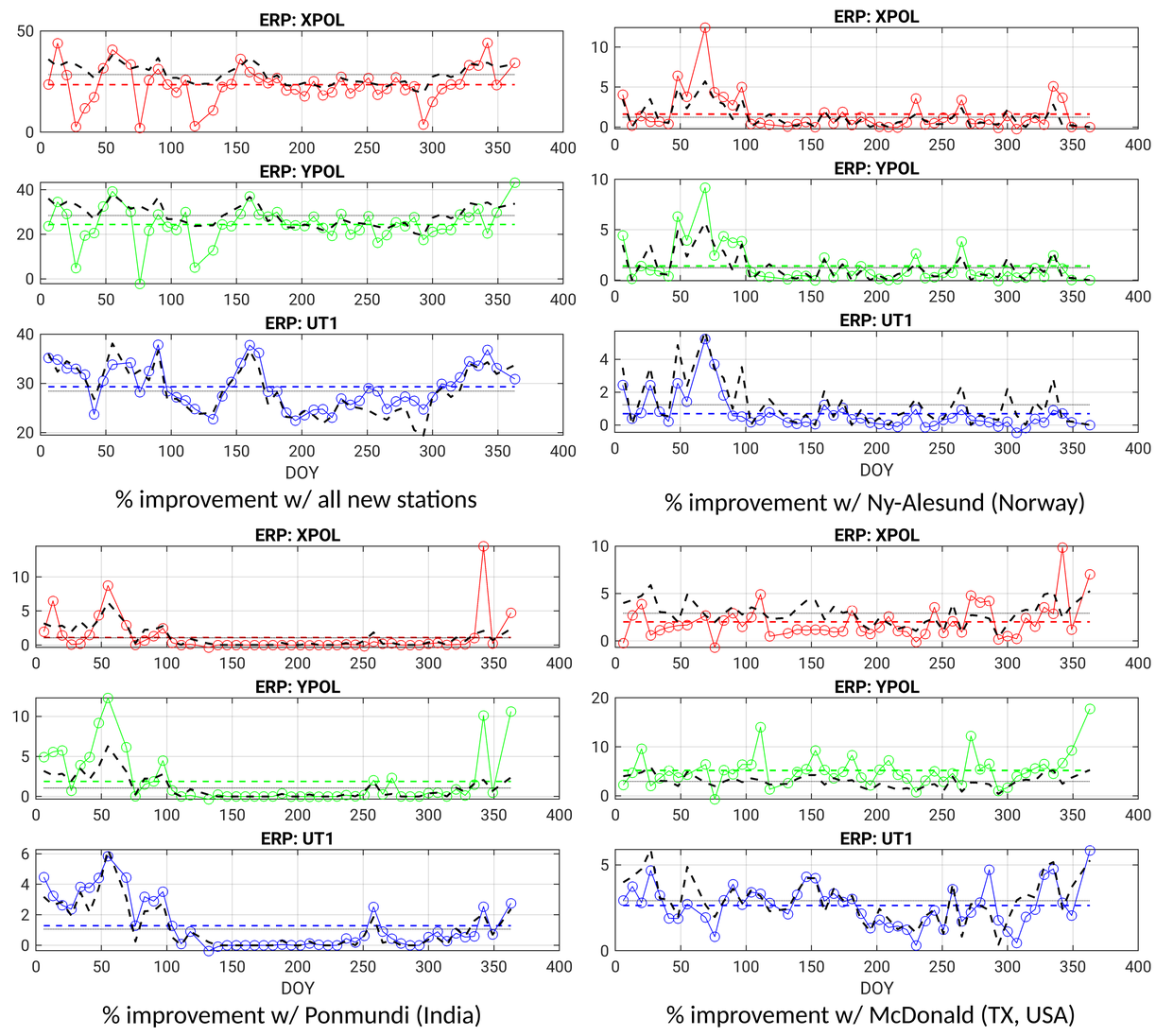


Simulated visibility at new stations. Ny-Alesund experiences heavy cloud cover throughout the year, while McDonald remains clear. Ponmundi shows strong seasonal variations in cloud cover.

The simulation and parameter estimation were performed using a modified version of Bernese GNSS Software Version 5.4 [2].

Results: Formal errors of ERP

Decrease in formal error of the estimated parameters is compared with the expected degree-of-freedom (DOF)-based improvement from an increased number of observations. Different stations are compared to see the impact of number of observations and geographic location, with DOF-based improvement plotted in black, actual improvement plotted in color.



Station	*Add'lObs*	x_{pol}	y_{pol}	ΔUT	*Expected*
All new	120725	23.4%	24.4%	**29.3%**	**28.4%**
Ny-Alesund	3260	**1.6%**	**1.4%**	0.7%	**1.2%**
Ponmundi	2618	**1.1%**	**1.9%**	**1.3%**	**1.1%**
McDonald	7461	2.0%	**5.2%**	2.6%	**2.9%**

% formal error improvement of ERP, compared with % expected DOF-based improvement

Conclusion and outlook

- New station performance is simulated in accordance with local weather conditions to achieve a more realistic observing scenario.
- Simulated noise from post-fit residuals resembles noise of real SLR obs.
- Expanded SLR station network leads to reduction in formal error of ERPs. The improvement depends on station location and number of observations.
- Next steps: Investigate how the addition of a Genesis-like satellite impacts estimated parameters of the expanded SLR network.

References

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