Optimization of the current SLR tracking network: potential for SLR-derived reference frames

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with contribution of Peter König

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Introduction and outline

Yesterday's presentation (Session 1): Impact of additional future SLR stations

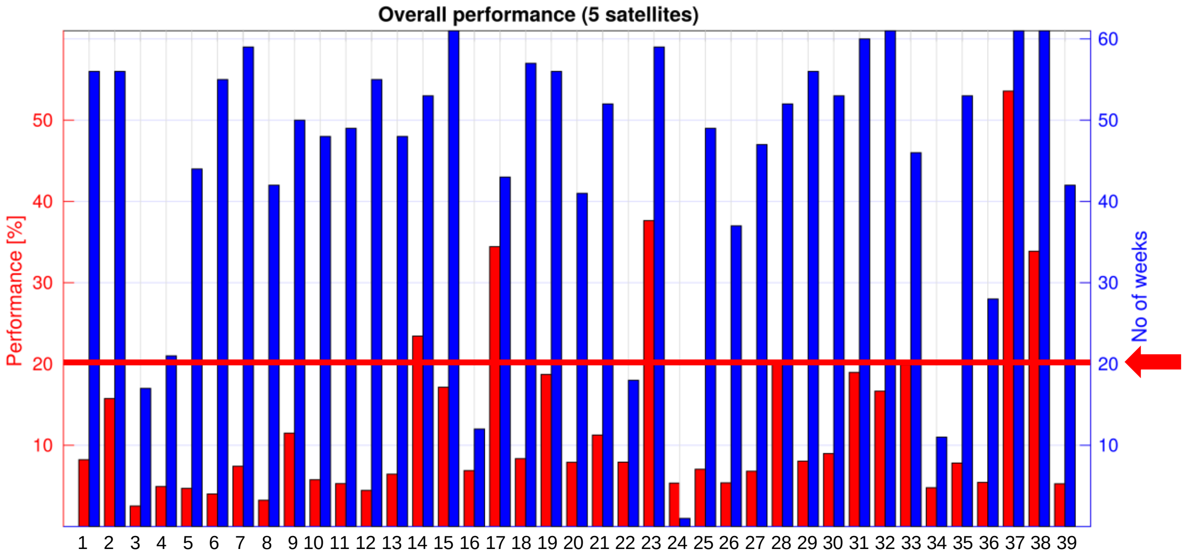
⇨ *improved geometry*

Today: Impact of **site upgrades**: potential of the existing network

⇨ *improved performance*

- Current state of the global SLR network: performances of the existing stations
- Simulation studies:
  - Impact of one upgraded station on TRF and EOP
  - Test case of a fully upgraded SLR station network
- *Improved performance* vs. *improved geometry*?

Current state of the global SLR network



GPS weeks 1773–1833 (12/2013–02/2015)

Current station performances within the network: 4 … 54 % (average: 13 %)

Performance goal of this study: 20 %

red: performance = $\frac{\text{no. of passes observed}}{\text{no. of possible passes}}$ (omitting longer periods of inactivity > 1 GPS week)

blue: number of weeks with observations (a station has only been simulated within weeks it has actually observed)

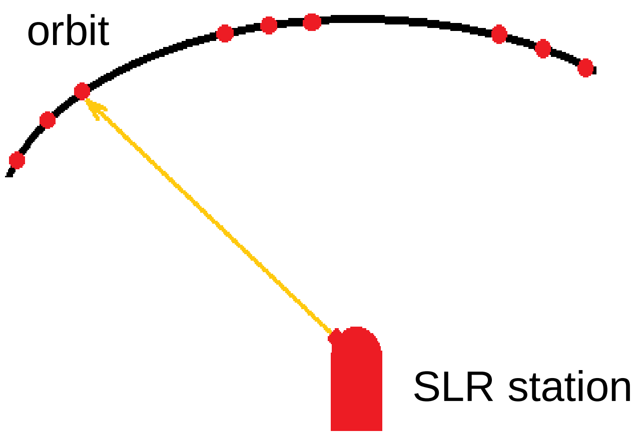
Simulation of SLR observations

Observation scheduling:

- Three normal points at the beginning, mid and end of each pass
- Normal point „bin size“ according to mission

satellite	NP bin size
Etalon-1	300 s
Etalon-2	300 s
LAGEOS-1	120 s
LAGEOS-2	120 s
LARES	30 s

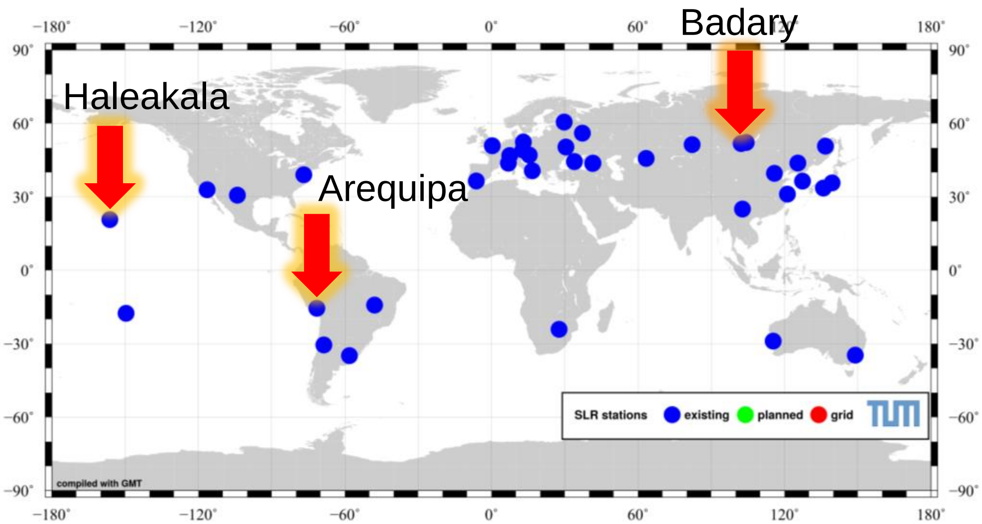
- The results are based on a 5-satellite setup including LARES (future ILRS setup)

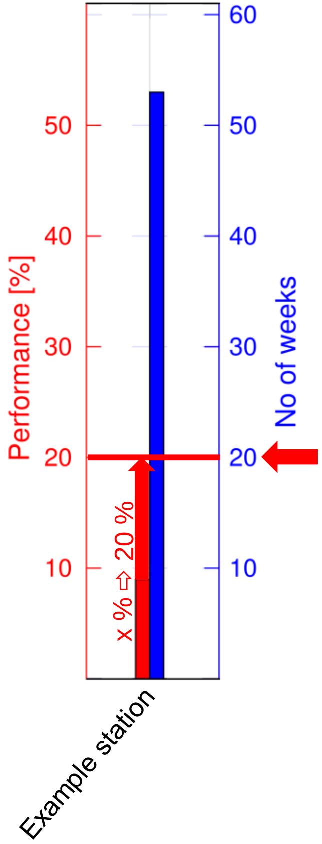


Performance enhancement of existing stations

Scenario 1

- Simulation of the existing network
- Pass performance **of one single station** increased to 20 %

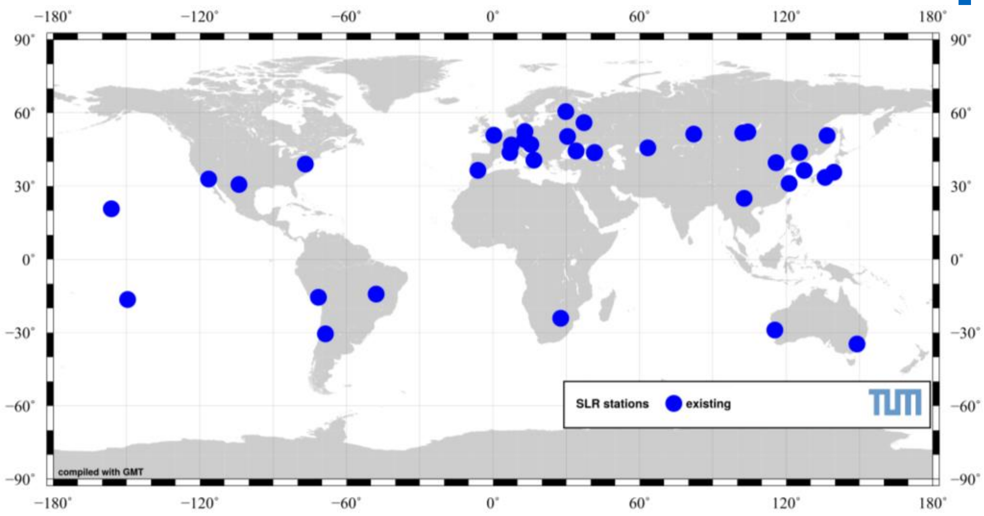


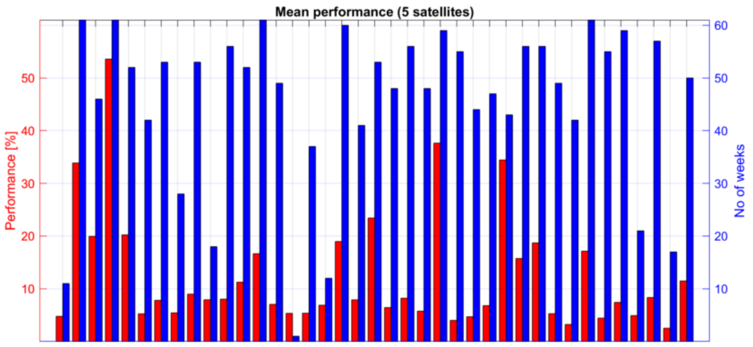


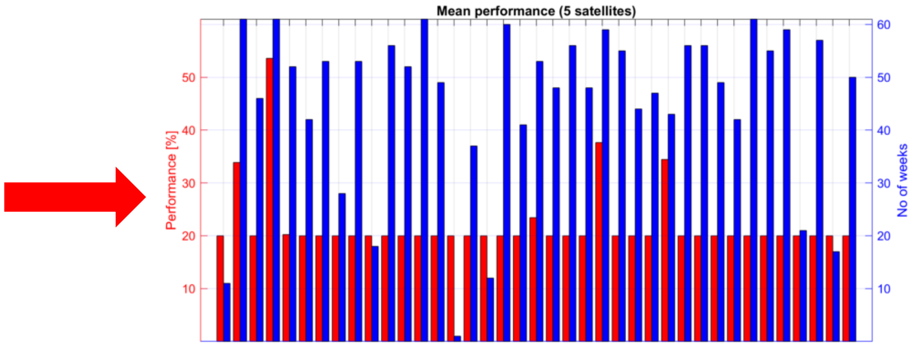
Complete network

Scenario 2

- Simulation of the existing network
- Pass performance **of all stations increased** to 20%

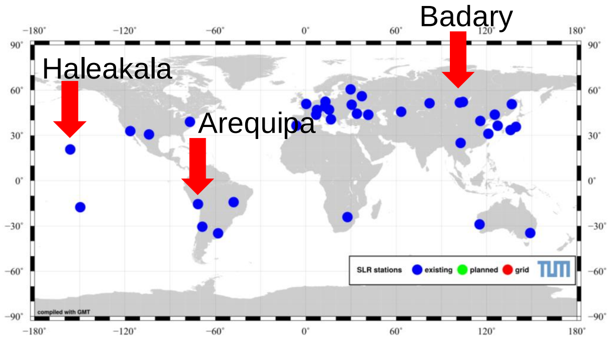






Performance enhancement of existing stations

Results



- Improvement of WRMS of the time series w.r.t. reference
- Helmert transformation; Earth Orientation Parameters

	$-\Delta$*WRMS* [%]	t_x	t_y	t_z	*scale*	x_{pole}	y_{pole}	*LoD*
Scenario 1	Arequipa 20 %	**3**	**4**	**6**	**3**	0	**3**	0
	Haleakala 20 %	**3**	1	**5**	**4**	**2**	**2**	1
	Badary 20 %	**3**	**3**	– 1	**3**	**2**	**2**	0
Scenario 2	all 20 % (Kehm et al., 2017)	**10**	**27**	**14**	**49**	**10**	**10**	**4**

Improved geometry vs. improved performances?

Improvement w.r.t. reference solution (simulated real network with real station performances)

Effect of	Helmert parameters (reference: SLRF2008)					EOP (ref.: IERS 08 C04)		
	WRMS				RMS of residuals	WRMS		
	t_x	t_y	t_z	M		x_{Pol}	y_{Pol}	LoD
Performance (real Network)	10 %	27 %	14 %	49 %	44 %	10 %	10 %	4 %
Geometry (+ 8 Stations)	18 %	20 %	24 %	20 %	6 %	4 %	5 %	2 %
combined	**26 %**	**41 %**	**35 %**	**59 %**	**48 %**	**13 %**	**15 %**	**6 %**

⇨ Increasing the **performance** of the existing network should go hand in hand with improving the **network geometry**!

Results published in:

*Kehm et al. (2017): **Future global SLR network evolution and its impact on the terrestrial reference frame.***
Journal of Geodesy 92:625–635, DOI: 10.1007/s00190-017-1083-1

Conclusion

- It is strongly recommended to invest into the **improvement of existing stations** alongside **establishing new stations** (Kehm et al., 2017; also refer to talk by Kehm et al. from yesterday, Session 1)
- Even the improvement of a single existing station can have a significant impact on the quality of the estimated geodetic parameters

- However, the assigned performance assumptions could still be made more realistic

➢ We are currently working on a **week-based cloud extraction** in order to assign a more realistic weekly “maximum performance” to each station

PLATO

GGOS Standing Committee

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Performance SimuLations and **A**rchitectural **T**rade-**O**ffs

Chairs: D. Thaller (BKG), B. Männel (GFZ)

- Simulations for an efficient implementation of GGOS (enhancement of existing station networks)
- SLR simulation studies on improved station performances or network extensions

➢ **Coordination and consolidation** of the ongoing simulation activities in order to let them culminate in **one common recommendation** for GGOS and the ILRS!

Publication on the topic, e.g.:

Männel et al. (2018): ***Recent Activities of the GGOS Standing Committee on Performance Simulations and Architectural Trade-Offs (PLATO).*** *In: International Association of Geodesy Symposia. Springer. DOI: 10.1007/1345_2018_30*

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