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Recent activities of the GGOS Standing Committee on Performance Simulations and Architectural Trade-Offs (PLATO)

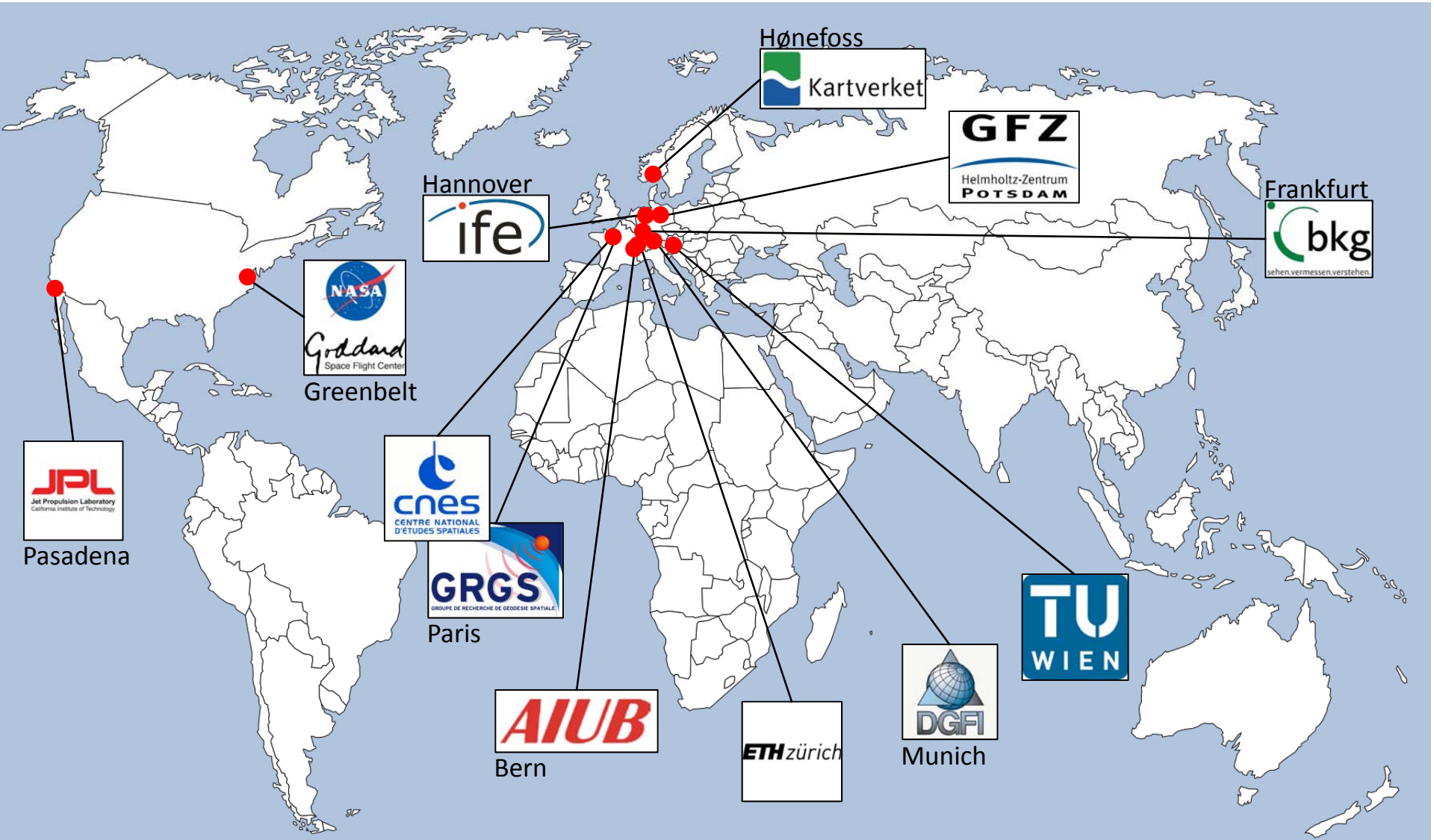
BKG, Frankfurt: **Daniela Thaller**

GFZ, Potsdam: **Benjamin Männel, Susanne Glaser**

DGFI-TUM, Munich: **Alexander Kehm, Mathis Bloßfeld**

Workshop on the Implementation of the GGRF in Latin America, September 19, 2019, Buenos Aires

PLATO has been established in 2014



Topics to be studied and methods used

Overall goal: Fulfill the GGOS requirement for accuracy and stability of the reference frame (1 mm in position, and 0.1 mm/y in velocity)

Questions to be answered:

How can the gobal reference frame benefit from:

- Improved system performance?
- Denser ground network?
- More co-location sites?
- Inclusion of other available observation data?
- Inclusion of space-based co-locations?
- New observation concepts?

Simulation studies

Improved analysis strategies

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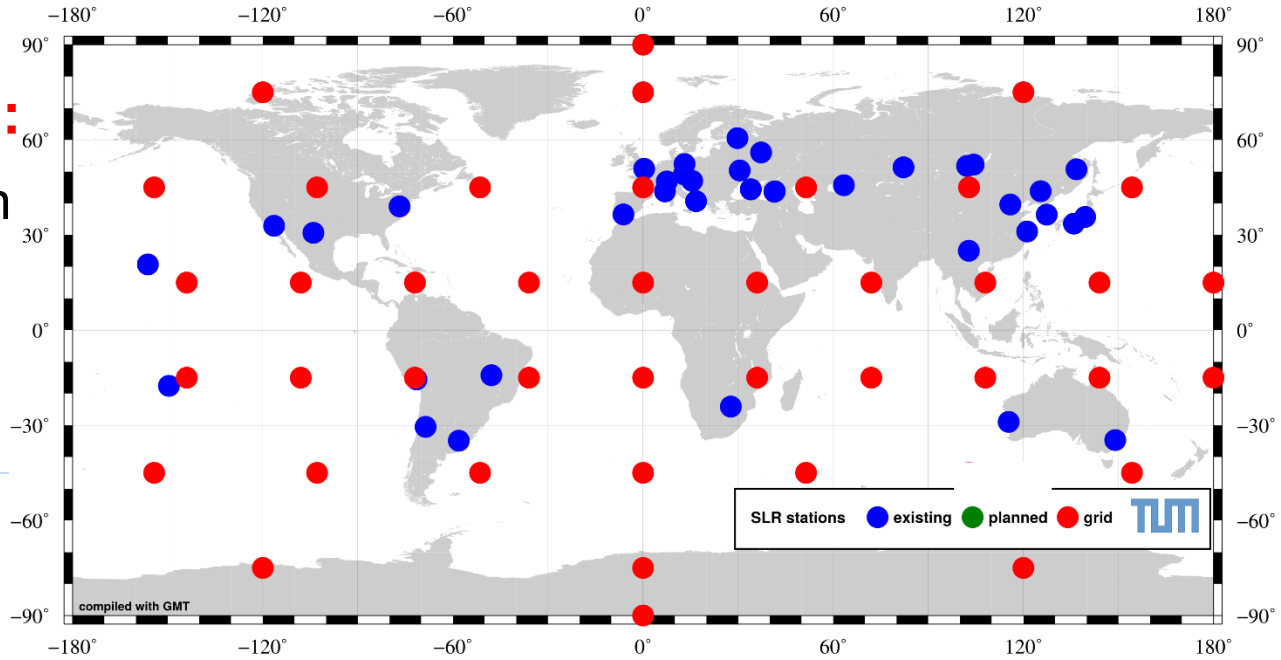
Simulations: Improving the SLR network

- Investigate impact of a **single additional SLR station** on geodetic parameters:
  - real network + one of 42 grid points (equally distributed)
- Station performance:
  - real network: as is (station-wise average)
  - „new“ stations: 20% of possible passes

Overall Conclusion:

The preferable location depends on the parameter of interest



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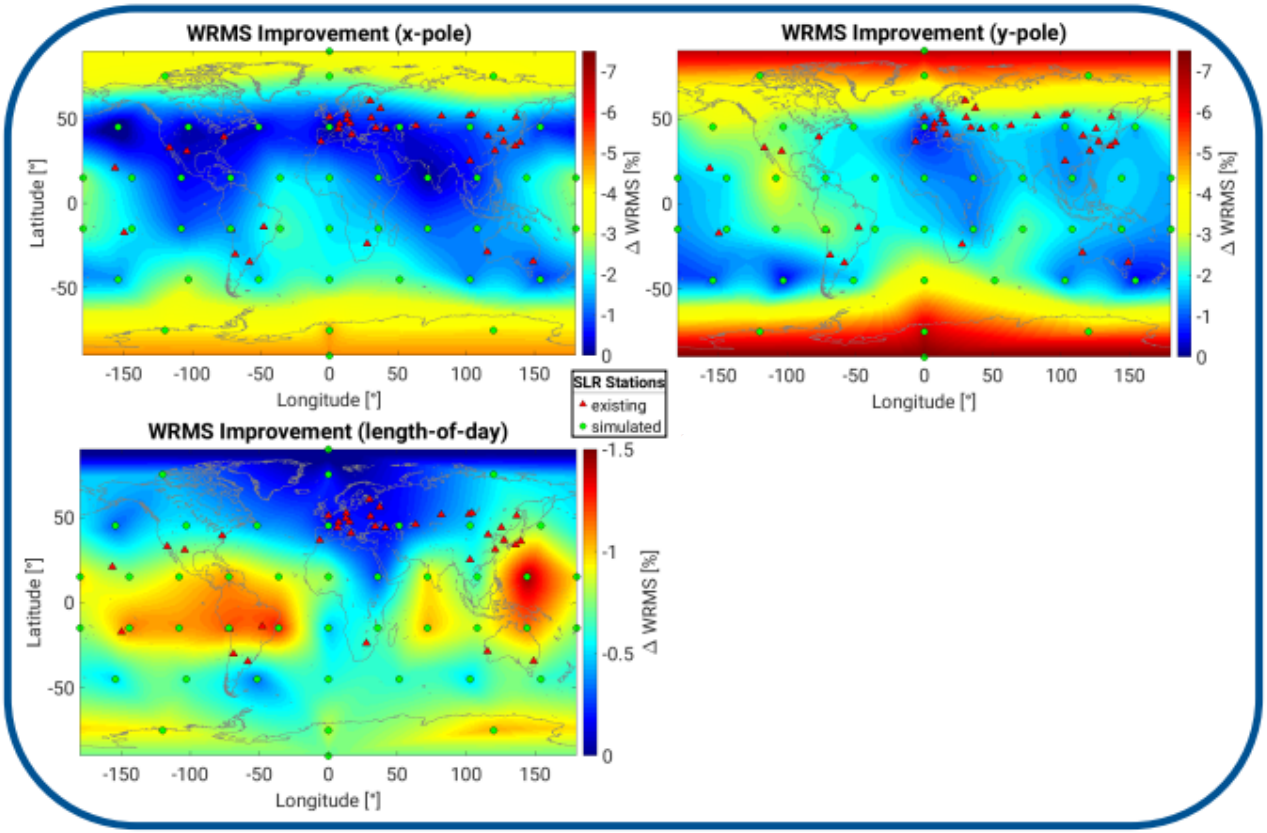
Simulations: Improving the SLR network

- Stations in polar regions: **Pole coordinates** improve most
- Stations in equatorial regions: **LOD** improves most
- Stations on Southern hemisphere: **all ERPs** benefit



Kehm A, König P, Bloßfeld M, Seitz F: ***Future TRFs and GGOS – Where to put the next SLR station?*** *Advances in Geosciences (submitted)*

Focus on SLR stations in South America

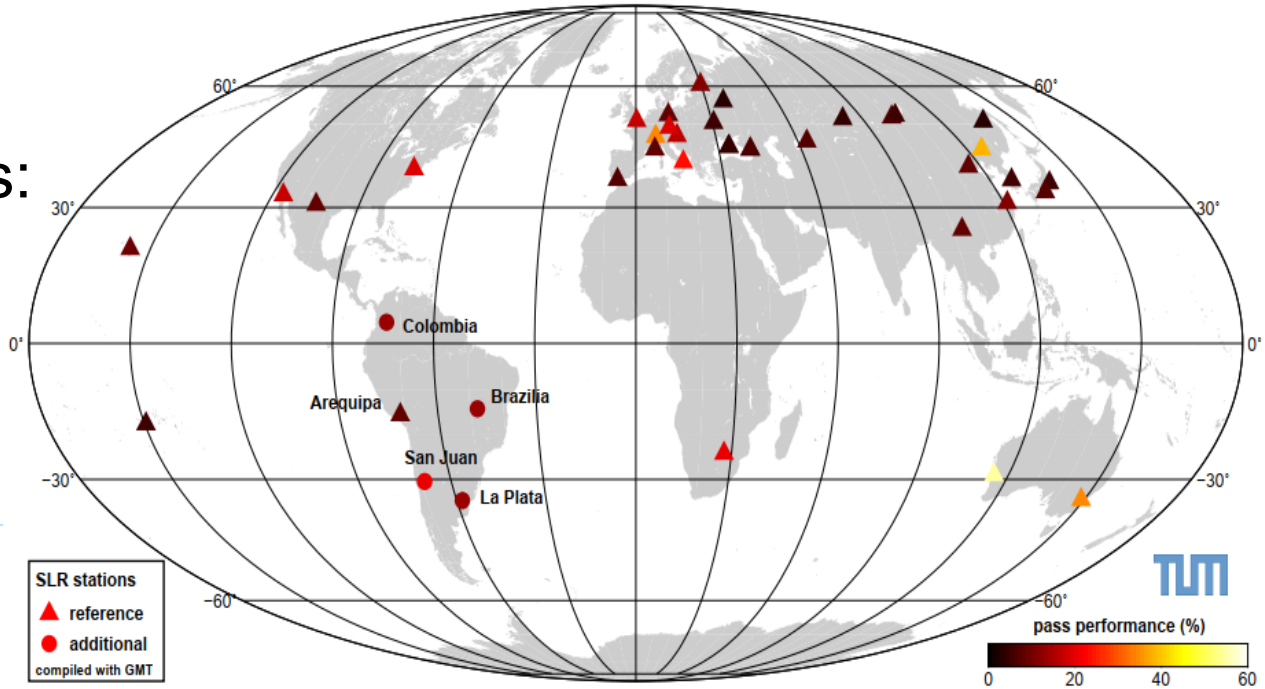
Deutsches Geodätisches Forschungsinstitut (DGFI-TUM)

2 Simulated networks:

- **Reference network**: Global SLR network excluding all Latin American stations (except of Arequipa)
- Calculation of different solutions containing additional stations in Latin America

61 weekly solutions:

(GPS weeks 1852-1792)



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Focus on SLR stations in South America: Impact on Geocenter + Scale

- **Adding San Juan only:**
  - 16-17 % improvement in translations
  - 14 % improvement in scale
- **Adding San Juan, La Plata and Brazilia:**
  - 25-26 % improvement in tx and ty, 29 % in tz
  - 21 % in scale
- **Adding all (San Juan, La Plata, Brazilia, Colombia):**
  - Similar result, the improvement in tz increases to 31 %

At least a permanently operational **4-station SLR network** is required for TRF determination, a 5th station in Colombia would help to improve the z-translation.

Focus on SLR stations in South America: Impact on Earth Rotation Parameters

Deutsches Geodätisches Forschungsinstitut (DGFI-TUM)

- **Adding San Juan only:**
  - 2.3 % improvement in x-pole, 4.0 % in y-pole
  - 1.4 % improvement in LOD
- **Adding San Juan, La Plata and Brazilia:**
  - 6.0 % improvement in x-pole, 8.3 % in y-pole
  - 3.7 % improvement in LOD
- **Adding all (San Juan, La Plata, Brazilia, Colombia):**
  - Similar result

An operational **4-station SLR network** improves the ERP estimation;
A 5th station in Colombia would further support this goal.

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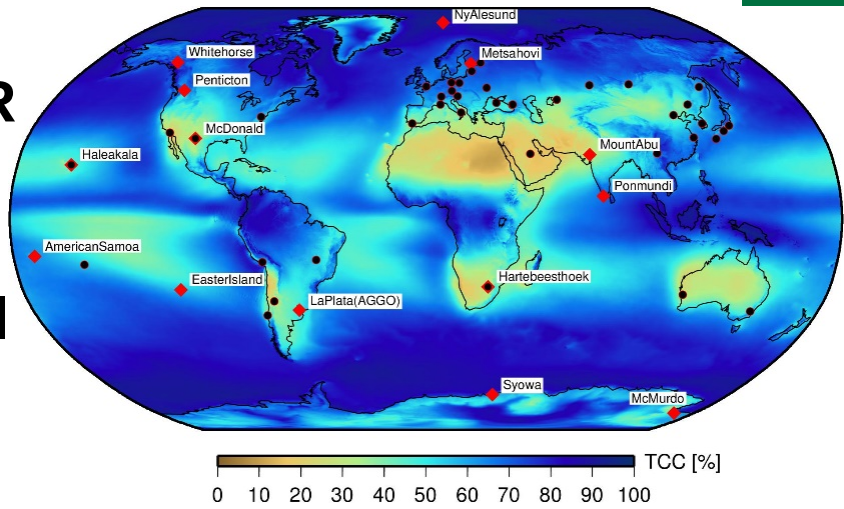
SLR stations in South America

- Study impact of **14 additional SLR stations** on reference frame
- Station performance: based on **Total Cloud Cover** from numerical weather model ERA5



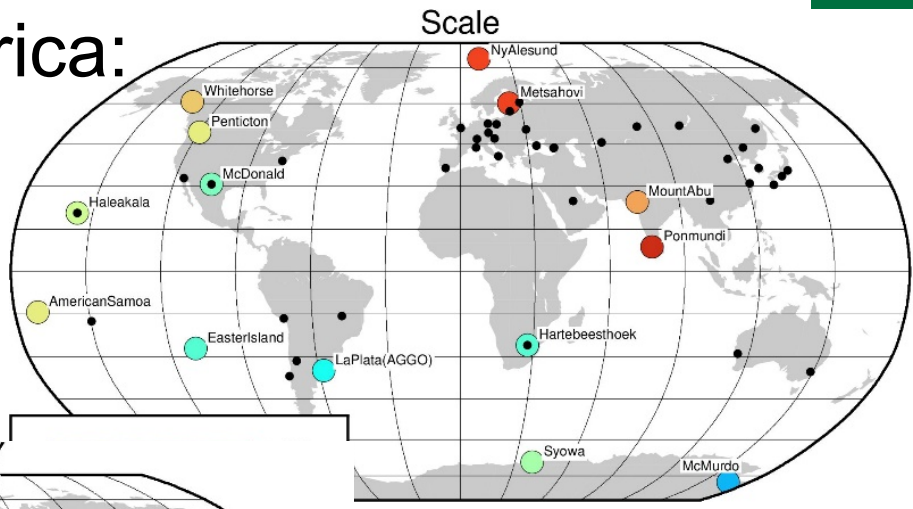
Precision of estimated parameters w.r.t. current SLR network:

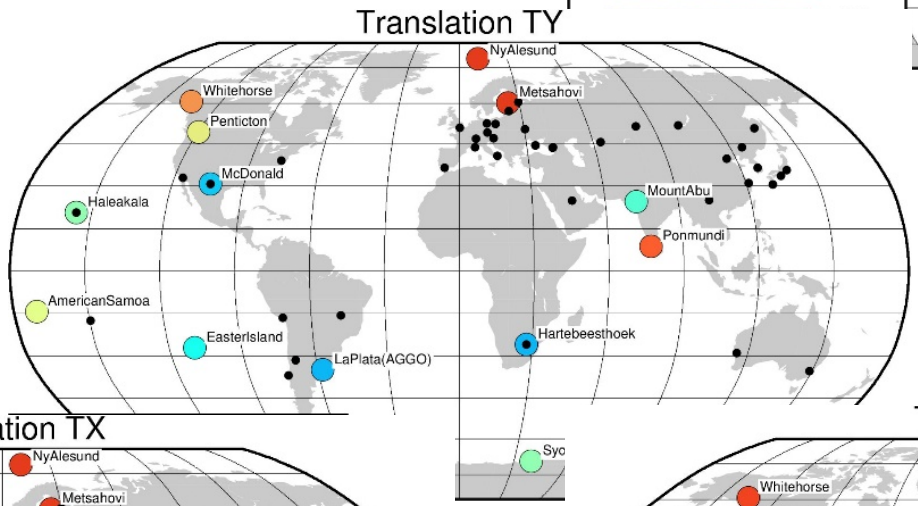
- Station coordinates $\vec{X}$, velocities $\dot{\vec{X}}$ (average over all stations)
- ERPs: pole coordinates (xp,yp), UT1-UTC

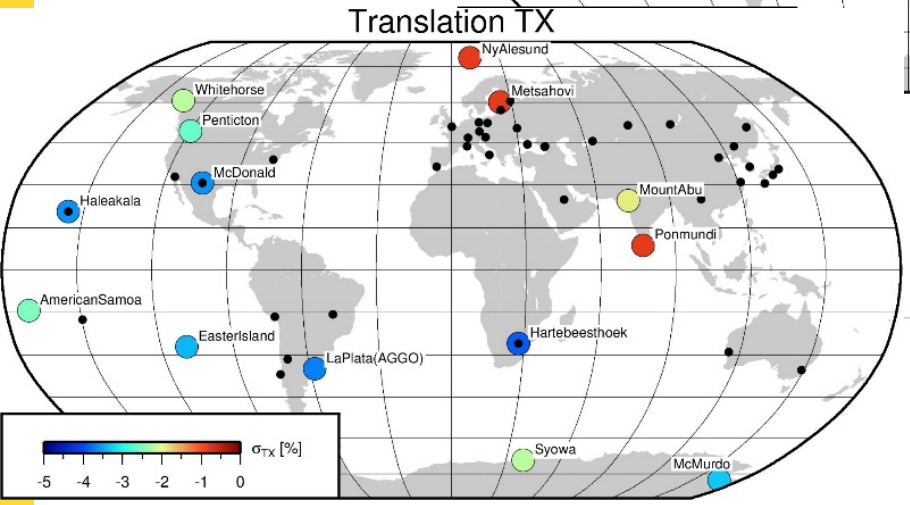
	$\bar{s}_{\vec{X}}$ [mm]	$\bar{s}_{\dot{\vec{X}}}$ [mm/yr]	$\bar{s}_{xp}$ [mas]	$\bar{s}_{yp}$ [mas]	$\bar{s}_{UT1}$ [ms]
w/ AGGO	−2%	−2%	−1%	−3%	−3%
w/o South American stations	+2%	+3%	+1%	+6%	+6%

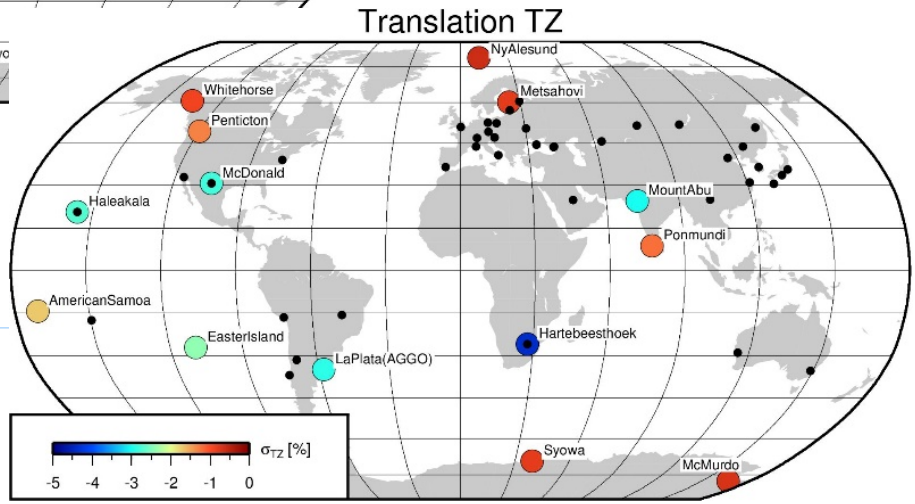
SLR stations in South America: Impact on combined TRF

Improvement of **Origin** and **Scale** by adding a single additional SLR station to the current network (black dots)





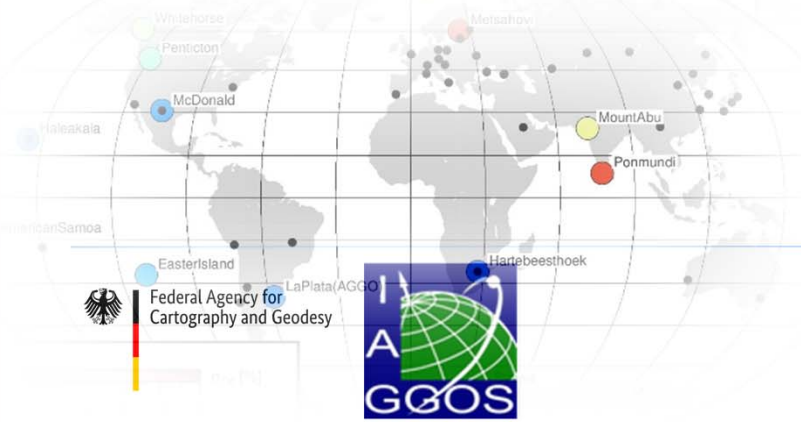




SLR stations in South America: Impact on combined TRF

Improvement of **Origin** and **Scale** by adding a single additional SLR station to the current network (black dots)

	Origin X	Origin Y	Origin Z	Scale
w/ AGGO	-4%	-3%	-3%	-3%
w/o South America	+15%	+13%	+11%	+12%



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VLBI stations in South America: Impact on combined TRF

GFZ Helmholtz Centre Potsdam

Different network designs in South America:

Study the impact on mean coordinate precision, standard deviations of pole coordinates xp, yp and UT1-UTC w. r. t. the legacy network, and degree of freedom (DOF)

AGGO (La Plata) is very important for good estimation of Earth rotation parameters

	legacy	TIGO→AGGO		w/o AGGO	
DOF	182,911	189,507		181,273	
$\bar{s}_x$ [mm]	1.56	1.51	(-3%)	1.56	(-0%)
s_{xp} [mas]	0.051	0.051	(-1%)	0.054	(+5%)
s_{yp} [mas]	0.060	0.060	(-1%)	0.067	(+12%)
s_{UT1} [ms]	0.004	0.003	(-1%)	0.004	(+10%)

Thank you for your attention!

Contact:

Bundesamt für Kartographie und Geodäsie
Section G1
Richard-Strauss-Allee 11
DE-60598 Frankfurt

Contact person:
Dr. Daniela Thaller
daniela.thaller@bkg.bund.de
www.bkg.bund.de
Tel. +49 (0) 69 6333-273

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