Simulation of Multi-Technique Terrestrial Reference Frames with Focus on Enhanced SLR Networks

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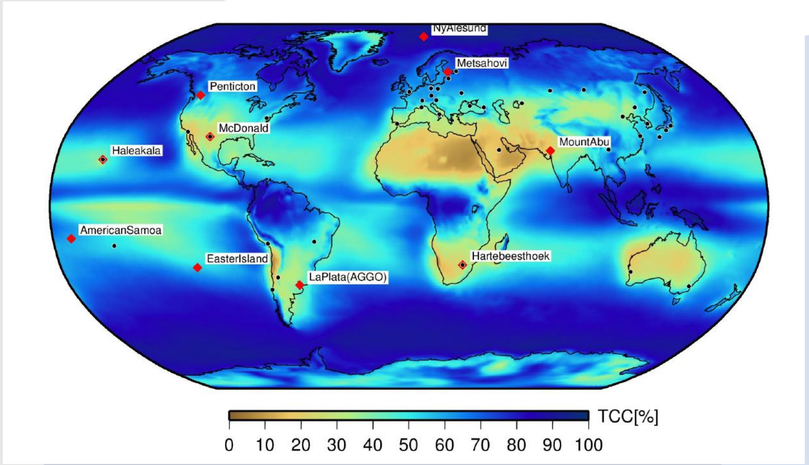
Abstract

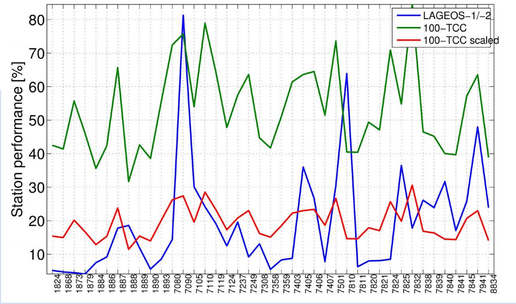
The requirements of the Global Geodetic Observing System (GGOS) on the quality of global terrestrial reference frames (TRFs), i.e. 1 mm accuracy and 0.1mm/yr stability, have not been met by the available state-of-the-art TRFs. In order to address this issue we simulate the observations of all four space geodetic techniques contributing to the TRF in the time span 2008-2014. The simulations are carried out as realistically as possible following the tracking record of the stations and the accuracies achieved in that time span. At the time being we have succeeded in combining the simulated GPS, SLR, and VLBI networks and assessing the requirements on local ties and the potential of the planned VLBI network enhancements to reach the GGOS goals. Here we investigate the benefits of enhancing the SLR network by foreseeable upgrades and re-locations of current sites and by probable new sites. For the network enhancements we selected 14 sites, the simulations of their observations are based on a global cloud atlas that allows to better predict possible tracking records. We then assess the benefits of each new site with respect to the old situation in terms of improvement of mean coordinate and Earth Orientation Parameter (EOP) precision.

Cloud Atlas

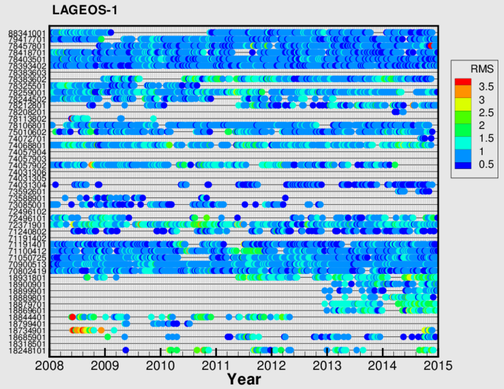
Total cloud coverage (TCC) from 6-hourly ECMWF half degree grids averaged over 2008-2014



Total Cloud Coverage Versus Real Performance



SLR Simulation Close to Reality



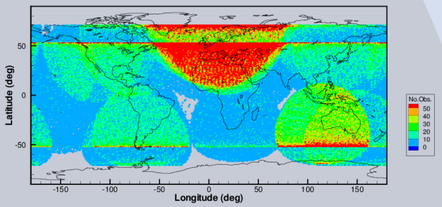
Additional Sites

“Planned” (ILRS, 2017):
- LaPlata, Argentina, TIGO re-location
- McDonald, Texas, new installation
- Ny Alesund, Norway, new installation
- Haleakala, Hawaii, new installation
- Mount Abu, India
- Ponmundi, India
- Hartebeesthoek, South Africa, new installation
- Metsahovi, Finland, station replacement

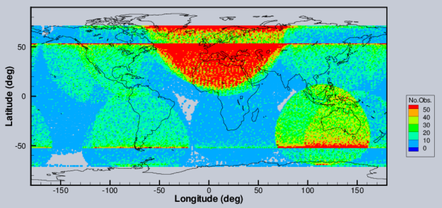
“Very important” (Pavlis, 2016):
- American Samoa, Pacific
- Easter Island, Pacific

“Beneficial”:
- McMurdo, Antarctica
- Whitehorse
- Penticton
- Syowa, Antarctica

Geographical Distribution of Observations by Original Network



Geographical Distribution of Observations by Original Network plus Syowa



Performance of Additional Sites due to TCC. Improvement of Estimated Station Positions and Velocities, and EOPs in Terms of Mean Standard Deviation if This Additional Site is Added

Station	TCC-Perf scaled [%]	Pos. [%]	Vel. [%]	EOP [%]
LaPlata, 9911	21.5	3	2	4
McDonald, 7080	26.2	3	4	4
Ny Alesund, 7331	6.3	1	0	-1
Haleakala, 7119	23.3	2	21	23
Mount Abu, 9919	27.9	3	2	2
Ponmundi, 9920	11.0			
Hartebeesthoek, 7501	26.7	2	23	23
Metsahovi, 7806	12.4	1	4	1
American Samoa, 7096	14.6	0	17	18
Easter Island, 7097	16.6	2	27	28
McMurdo, 9923	16.7	2	0	0
Whitehorse, 7284	9.4			
Penticton, 7283	14.1	1	10	7
Syowa, 9991	9.4			

Preliminary results