



## **Can space ties on board GNSS satellites replace terrestrial ties in the implementation of Terrestrial Reference Frames?**

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The realization of Terrestrial Reference Frames (TRFs) must be periodically updated in order to account for newly acquired observations and for upgrades in data analysis procedures and/or combination techniques. Any innovative computation strategy should ameliorate the definition of the frame physical parameters, upon which a number of scientific applications critically rely. On the basis of the requirements of scientific cutting edge studies, the geodetic community has estimated that the present day challenge in the determination of TRFs is to provide a frame that is accurate and long-term stable at the level of 1 mm and 0.1 mm/y respectively.

This work aims at characterizing the frame realized by a combination of Satellite Laser Ranging (SLR) and Global Navigation Satellite Systems (GNSS) observations via their co-location on board GNSS spacecrafts. In particular, it is established how such a frame compares to the traditional ITRF computation and what is the impact on the realization of the frame origin and scale. Four years of data from a global network encompassing about one hundred GNSS stations and all SLR sites have been analyzed. In order to ensure the highest possible consistency, the raw data of both techniques are treated with the same analysis Software (Bernese GNSS Software 5.2) following IERS2010 Conventions. Both weekly and long term solutions are carried out exploiting either the Bernese or the Combination and Analysis of Terrestrial Reference Frames (CATREF) Software packages.

We present the results of a combination study involving GNSS data and SLR observations to the two LA-GEOS and to the GNSS satellites equipped with retroreflector arrays. The latter type of measurements is currently not included in the computation of the official ITRF solutions. The assessment of the benefit that they could provide to the definition of the origin and scale of the ITRF is however worth investigating, as such data provide the potential for linking the GNSS and SLR techniques via the so-called space ties, instead of relying on the terrestrial ties evaluated with ground measurement campaigns at co-located ITRF sites.