Geophysical Research Abstracts
Vol. 19, EGU2017-9547, 2017
EGU General Assembly 2017

Investigation of scale effects in the TRF determined by VLBI

Daniel Wahl (1), Robert Heinkelmann (2), Harald Schuh (1,2)

(1) Technische Universität Berlin, Institute of Geodesy and Geoinformation Science (daniel.wahl@tu-berlin.de), (2) GFZ Potsdam, Geodesy, Potsdam, Germany (heinkelmann@gfz-potsdam.de)

The improvement of the International Terrestrial Reference Frame (ITRF) is of great significance for Earth sciences and one of the major tasks in geodesy. The translation, rotation and the scale-factor, as well as their linear rates, are solved in a 14-parameter transformation between individual frames of each space geodetic technique and the combined frame. In ITRF2008, as well as in the current release ITRF2014, the scale-factor is provided by Very Long Baseline Interferometry (VLBI) and Satellite Laser Ranging (SLR) in equal shares. Since VLBI measures extremely precise group delays that are transformed to baseline lengths by the velocity of light, a natural constant, VLBI is the most suitable method for providing the scale. The aim of the current work is to identify possible shortcomings in the VLBI scale contribution to ITRF2008. For developing recommendations for an enhanced estimation, scale effects in the Terrestrial Reference Frame (TRF) determined with VLBI are considered in detail and compared to ITRF2008.

In contrast to station coordinates, where the scale is defined by a geocentric position vector, pointing from the origin of the reference frame to the station, baselines are not related to the origin. They are describing the absolute scale independently from the datum. The more accurate a baseline length, and consequently the scale, is estimated by VLBI, the better the scale contribution to the ITRF. Considering time series of baseline length between different stations, a non-linear periodic signal can clearly be recognized, caused by seasonal effects at observation sites. Modeling these seasonal effects and subtracting them from the original data enhances the repeatability of single baselines significantly. Other effects influencing the scale strongly, are jumps in the time series of baseline length, mainly evoked by major earthquakes. Co- and post-seismic effects can be identified in the data, having a non-linear character likewise. Modeling the non-linear motion or completely excluding affected stations is another important step for an improved scale determination. In addition to the investigation of single baseline repeatabilities also the spatial transformation, which is performed for determining parameters of the ITRF2008, are considered. Since the reliability of the resulting transformation parameters is higher the more identical points are used in the transformation, an approach where all possible stations are used as control points is comprehensible. Experiments that examine the scale-factor and its spatial behavior between control points in ITRF2008 and coordinates determined by VLBI only showed that the network geometry has a large influence on the outcome as well. Introducing an unequally distributed network for the datum configuration, the correlations between translation parameters and the scale-factor can become remarkably high. Only a homogeneous spatial distribution of participating stations yields a maximally uncorrelated scale-factor that can be interpreted independent from other parameters.

In the current release of the ITRF, the ITRF2014, for the first time, non-linear effects in the time series of station coordinates are taken into account. The present work shows the importance and the right direction of the modification of the ITRF calculation. But also further improvements were found which lead to an enhanced scale determination.