3.6.2.8 Institut Géographique National (IGN)

Impact of loading effects

Station positions estimated from space geodesy observations have been shown to exhibit significant non-linear variations, especially at the annual signal. Altamimi and Collilieux (2008) have shown that repeatability of GPS positions time series can be fully explained by a combination of noise models and loading displacements. As a consequence, the impact of the inclusion of loading models in the combination process has been studied in an ITRF-like combination involving Satellite Laser Ranging (SLR), Very Long Baseline Interferometry (VLBI) and Global Positioning System (GPS) data. Collilieux et al. (2010) have shown that such a method clearly reduce spurious annual signals observed in translation and scale factors. The combination residuals also slightly reduce although this conclusion can not be generalized to all sites.

ITRF and EOPs consistency

The availability of frame time series is fundamental to insure the mutual consistency between a secular Terrestrial Reference Frame (TRF) and a set of Earth Orientation Parameters (EOPs) (Altamimi et al., 2007, Altamimi et al., 2008). Indeed, EOPs are dependent on the underlying terrestrial reference frame and thus EOPs can be compared to previous values only if they refer to the same TRF. EOP alignment is efficiently achieved if a set of core stations is used to define the orientation of the station position set. Coulot et al. (2010) have developed an original and rigorous method that allows choosing the reference set of stations to be used thanks to a multi objective genetic algorithm. This method has been applied to SLR data and evidenced an improvement of 10% of the SLR EOP time series accuracy (about 25 µas) compared to the method currently used (Coulot et al., 2010).

Multi-technique combination at the observation level

IGN, being part of the Groupe de Recherche en Géodésie Spatiale (GRGS), has been involved in the IERS Combination Pilot Project (CPP). Research on the combination of station positions and Earth Orientation Parameters (EOPs) at the observation level has been carried out (Coulot et al., 2007) and is still underway. A new modeling of the station position parameters, which involves Helmert parameters directly in the observation equations, is being implemented to ensure that the combined reference frame is well defined and self-consistent. Eight months of data from SLR (LAGEOS1 and 2), VLBI, DORIS (SPOT2, SPOT4, SPOT5, ENVISAT, JASON), and GPS have been stacked using this model. First results demonstrate its benefit for estimating time series of multi-technique reference frames. Currently, the impact of the introduction of local ties on the combined frame is studied as well as their proper weight to be used. To ensure a better consisten-

cy of this combined reference frame, the use of other common parameters like zenithal biases or multi-technique satellite orbital parameters will be investigated.

SLR geocenter motion

SLR network translations with respect to ITRFs are often chosen as references for geocenter motion studies. But due to the SLR network sparseness, this estimation is biased, notably at the annual frequency. Collilieux et al. (2009) have evaluated this bias at the level of 1.5 mm scatter with annual error up to 1 mm on X and Z component. An adequate combination of GPS and SLR results allows producing more reliable estimations of the geocenter motion by mitigating this bias.

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Xavier Collilieux, Zuheir Altamimi, David Coulot, Arnaud Pollet, Laurent Métivier