3.6.2.8 Institut Géographique National (IGN)

Intra-technique combination

The software package Combination and Analysis of Terrestrial Reference Frames (CATREF) has been updated to include internal constraints. Those can be used to define the output reference frame origin, scale and orientation when stacking mono-technique reference frames (intra-technique combination) (Altamimi et al., 2006). The frame time series provided by the IAG services mainly IVS, ILRS, IGS and IDS, have been analyzed using CATREF software to estimate long term mono-technique frames and Helmert parameter time series. The internal constraints were applied in order to preserve the intrinsic origin and scale of SLR and the scale of VLBI solutions. Monitoring of such defined Helmert parameters is shown to be advantageous and therefore their continuous analysis is essential to qualify solution internal quality and to study the behavior of the individual technique frame definition over time. In order to illustrate the internal constraint feature, Figure 1 shows the intrinsic translation and scale components of the ILRS time series (submitted to ITRF2005), using this approach, while Figure 2 shows the scale of VLBI time series.

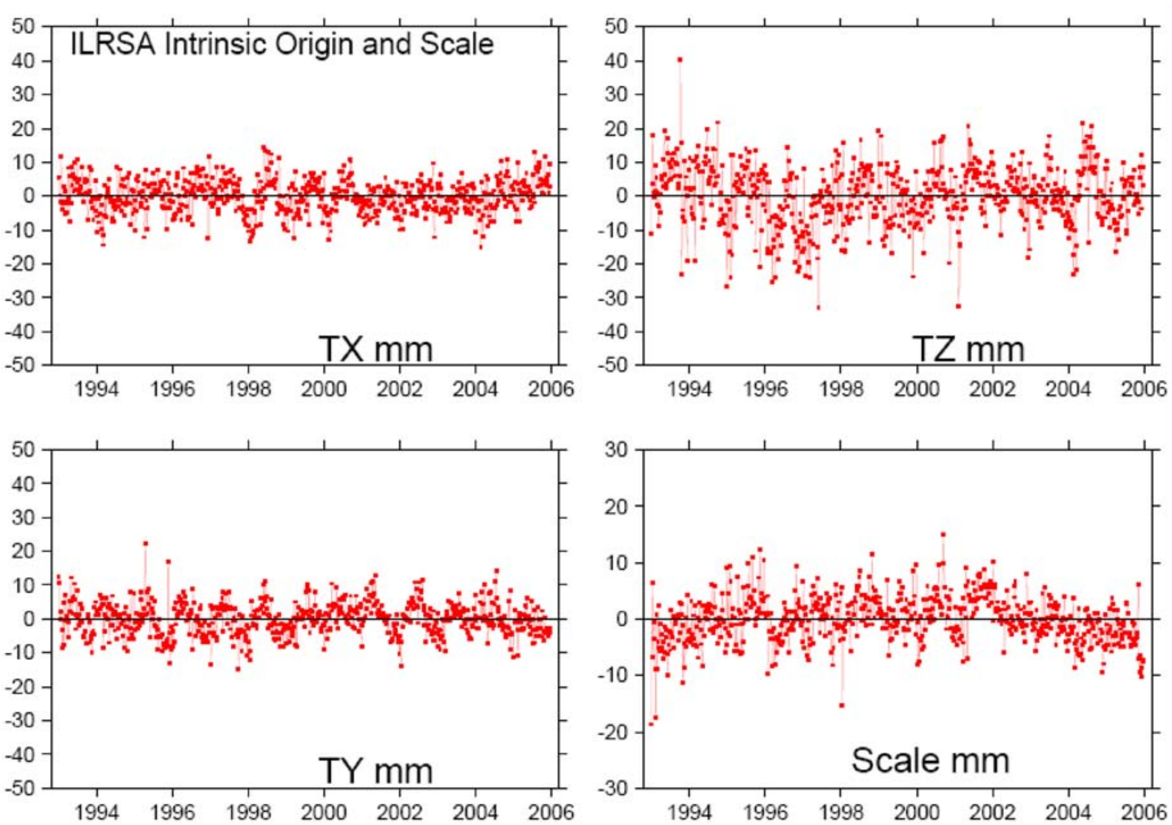

Fig. 1: Time series of the translation components and scale factor of the ILRS solution submitted to ITRF2005, as determined by CATREF software using the approach of internal constraints.

Time series analysis

Position residual time series from ILRS, IVS and IGS have been investigated to look for common signals and systematic errors. Firstly, spectral analyses have been performed to look for specific technique frequencies and systematic errors. Secondly, correlation computations have been carried out for residual position time series at co-location sites with sufficient common data. Due to sampling heterogeneities and time-varying position uncertainties, suitable methods and tools have been developed and applied to these data sets. Such analyses show some discrepancies between technique non linear motion estimations but also point out good agreement at some co-location sites and also in some area of the world at the annual frequency, especially in the height component (Collilieux et al., 2007). Figure 3 shows residual height time series for four co-location sites. Smoothed curves represent the correlated signals contained in the couple of time series. One can observe impressive agreement for some time series or some discrepancies well located in time. Such analyses are essential for future developments since they can lead to the definition of additional equality constraints when combining data at the observation level.

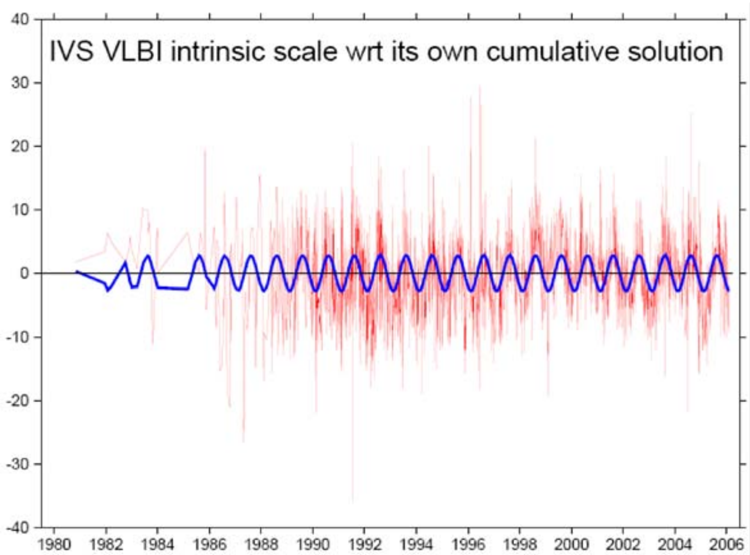

Fig. 2: Time series of the scale of VLBI solution submitted to ITRF2005, as determined by CATREF software using the approach of internal constraints.

No-Net-Rotation condition

The No-Net-Rotation condition (NNR condition) is used to define the orientation of the ITRF. Currently, this condition is ensured by minimizing three rotations between the ITRF velocity field and an external velocity field which verify the NNR condition. A method has been developed to generate an NNR velocity field from an ITRF solution: the ITRF velocity field is first interpolated over a grid by means of least-squares collocation. Then the rotation which allows the interpolated velocity field to satisfy a NNR condition is explicitly estimated and can be applied to the original ITRF velocity field (Legrand, 2007). Such an analysis has been used to evaluate the ITRF2005 NNR-condition implementation at about two millimeters per year, which is consistent with other published NNR velocity field estimated from space geodesy (Altamimi et al., 2007).

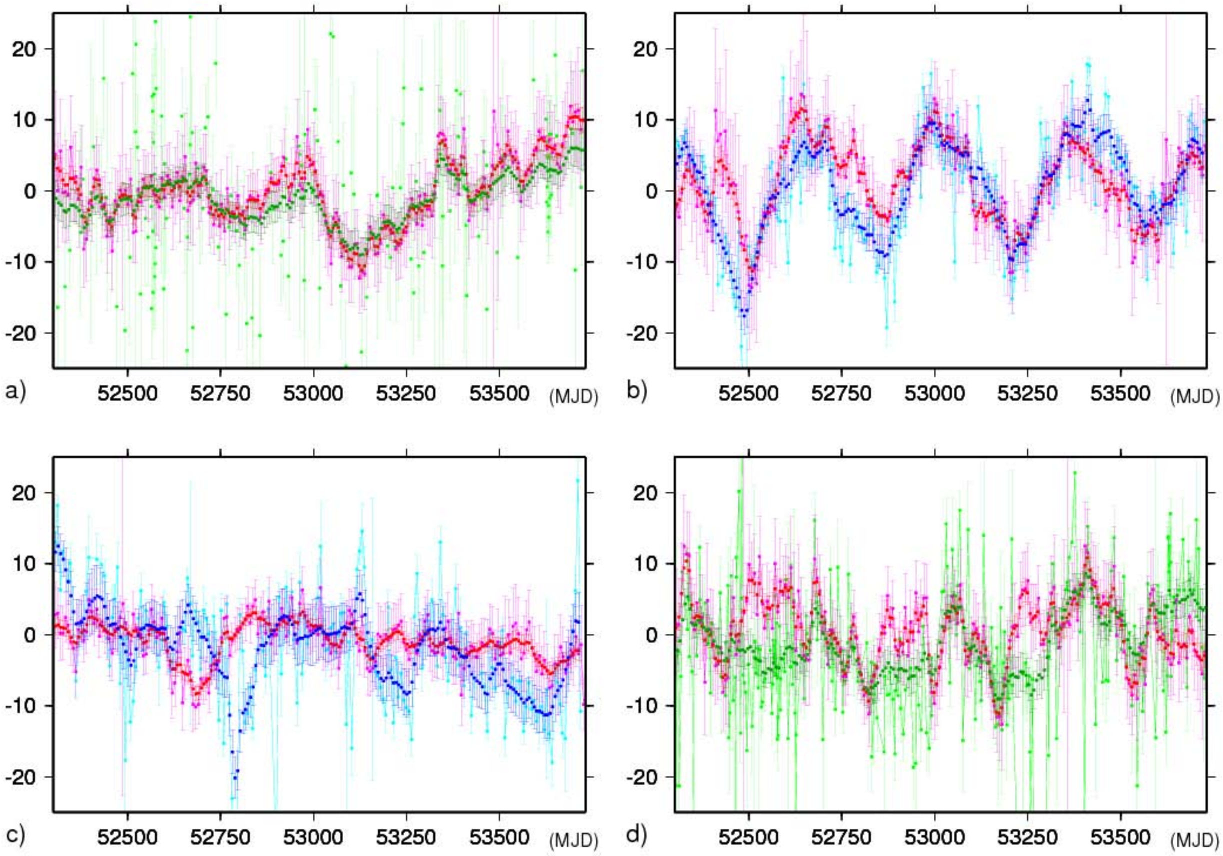

Fig. 3: Height residual time series at four co-located sites. a) Hartebeesthoek: 7232 (VLBI) and HRAO (GPS). b) Yarragadee: 7090 (SLR) and YAR2 (GPS). c) Wettzell: 8834 (SLR) and WTZR (GPS). d) Ny-Alesund: 7331 (VLBI) and NYA1 (GPS). IGS, IVS and ILRS height residual time series are respectively plotted in magenta, light green and cyan. Smoothed curves produced are plotted over in solid red for GPS, dark green for VLBI and solid blue for SLR.

Publications

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Altamimi, Z., X. Collilieux, J. Legrand, B. Garayt, and C. Boucher, ITRF2005: A new release of the International Terrestrial Reference Frame based on time series of station positions and Earth Orientation Parameters, *Journal of Geophysical Research,* 2007*, 112*, 9401, doi:10.1029/2007JB004949.

Altamimi, Z., X. Collilieux, and C. Boucher, Accuracy assessment of the ITRF datum definition, *"V Hotine-Marussi Symposium on Mathematical Geodesy", IAG Symposia, Wuhan,* 2007, in press.
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