3.6.1.2 Institut Géographique National

This report summarizes the activities of the IERS ITRS Combination Centre at the Institut Géographique National (IGN) during the year 2001.

The main activities are:

- Data analysis and Software enhancement
- ITRF2000 project

Data analysis and Software enhancement

With interaction of IERS Analysis Centers (AC), individual solutions from the different techniques are frequently evaluated and tested, in order to improve the individual analyses as well as the ITRF combination. Thus both the individual ACs as well as the ITRF Section regularly test new analysis strategies. This cooperation between the IERS ACs and the ITRF Section is vital for quality control and improvement of IERS products. To achieve this goal, the software package Combination and Analysis of Terrestrial Reference Frames (CATREF), developed by the ITRF Section, is regularly updated and enhanced in order to perform proper analysis of the different solutions performed by the IERS ACs. In particular modeling of the Earth Orientation Parameters (EOP) is now included in the CATREF software, to be able to combine concisely and coherently station positions/velocities and EOPs.

ITRF2000 Project

A great part of the activity was devoted to the preparation and publication of the ITRF2000 solution. The ITRF2000 is intended to be a Standard and densified solution for a wide application community (geodesy, cartography, navigation, etc.).

The ITRF2000 was published in March 2001 and all results and related files are available at <http://lareg.ensg.ign.fr/ITRF/ITRF2000>. Moreover, a detailed article on the ITRF2000 technical description as well as geodetic and geophysical results is submitted to the Journal of Geophysical Research.

The ITRF2000 solution is the most dense and accurate frame ever developed, containing about 800 stations located on about 500 sites. It has been achieved by simultaneous combination of positions and velocities using full variance/covariance matrices of the individual solutions provided by the IERS Analysis Centers. It includes core stations observed by VLBI, LLR, SLR, GPS and DORIS (usually used in previous ITRF versions) as well as regional GPS networks for its densification (Alaska, Antarctica, Asia, Europe, North and South Americas and Pacific). Figure 1 shows the distribution of the primary sites of ITRF2000 highlighting the collocated techniques.

The ITRF2000 is intended to have an accurate datum definition, achieved as follows:

- the origin and its rate are defined by a weighted average of most consistent SLR solutions;

- the scale and its rate are defined by a weighted average of VLBI and most consistent SLR solutions. Unlike the ITRF97 scale, expressed in the Geocentric Coordinate Time-frame, that of the ITRF2000 is expressed in Terrestrial Time-frame. The effect of this change on the scale factor is 0.70 ppb (10^{-9}).

- the orientation is aligned to that of ITRF97 at 1997.0 epoch and its rate to be such that there is no-net-rotation rate with respect to NNR-NUVEL-1A. Note that the orientation as well as its rate are defined upon a selection of ITRF sites with high geodetic quality.

The ITRF2000 long-term stability, evaluated over 10 years, is estimated to be better than 4 mm in origin and better than 0.5 ppb in scale, equivalent to a shift in station heights of approximately 3 mm over the Earth's surface. Moreover, one of the important ITRF2000 results is that there is a statically significant disagreement between ITRF2000 and NUVEL-1A model in terms of relative tectonic plate motions. Although the ITRF2000 orientation rate is aligned to that of NNR-NUVEL-1A, per-plate residuals between the two corresponding velocity fields appear to be significant as shown in Figure 2. This per-plate residual behavior indicates the inadequacy of NUVEL-1A relative model to describe the current plate motions as seen by ITRF2000 results. Meanwhile it should be emphasized that these differences do not at all disrupt the internal consistency of the ITRF2000, simply because the alignment to NNR-NUVEL-1A defines the ITRF2000 orientation rate and nothing more. On the other hand, it is important to emphasize that the goal of aligning ITRF2000 to the NNR-NUVEL-1A model is to apply, implicitly, the No-Net-Rotation Condition or, equivalently, to realize a Tisserand Frame. The ITRF choice of the No-Net-Rotation Condition is dictated by the fact that the Tisserand axes frame is used in the theory of Earth rotation, having the property to minimize the Earth's crust motion and deformation that would affect the Earth Orientation Parameters. Analysis of the ITRF2000 velocity field demonstrated that the ITRF2000 satisfies the NNR condition at the 1 mm/y level.

Figure 1: ITRF2000 Primary Network

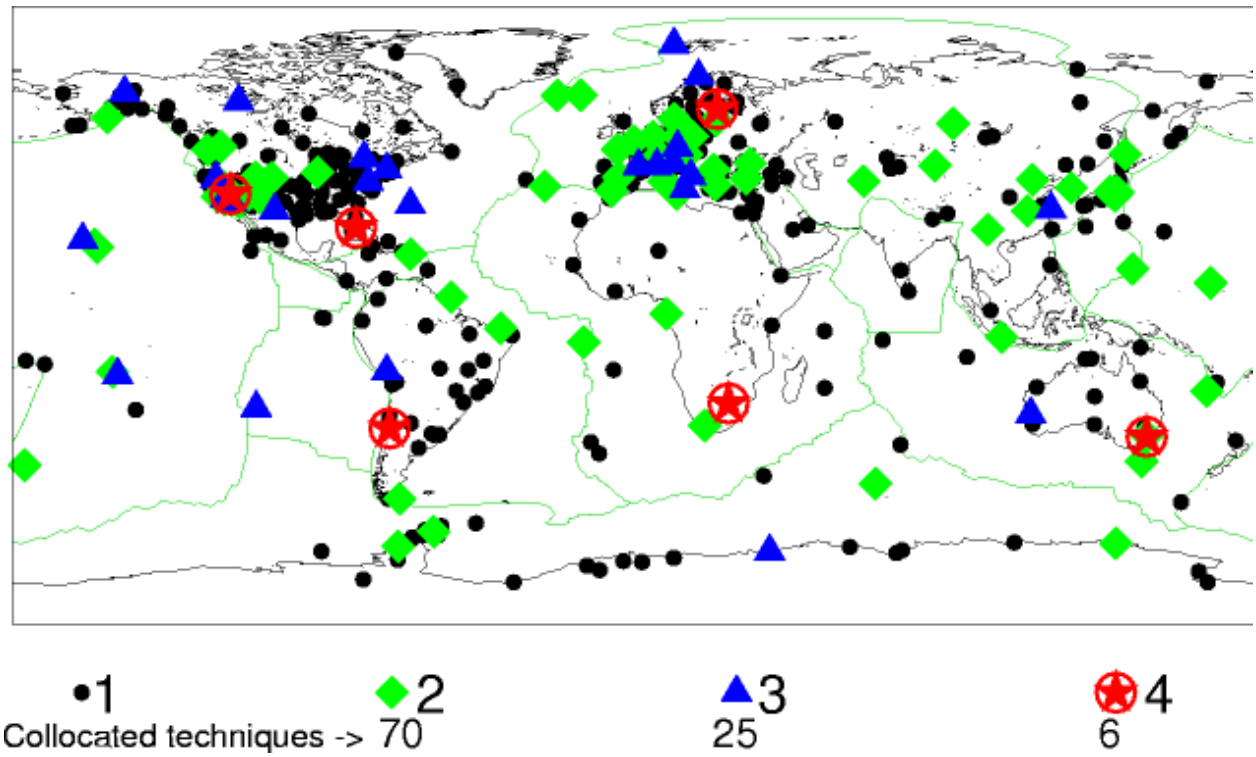
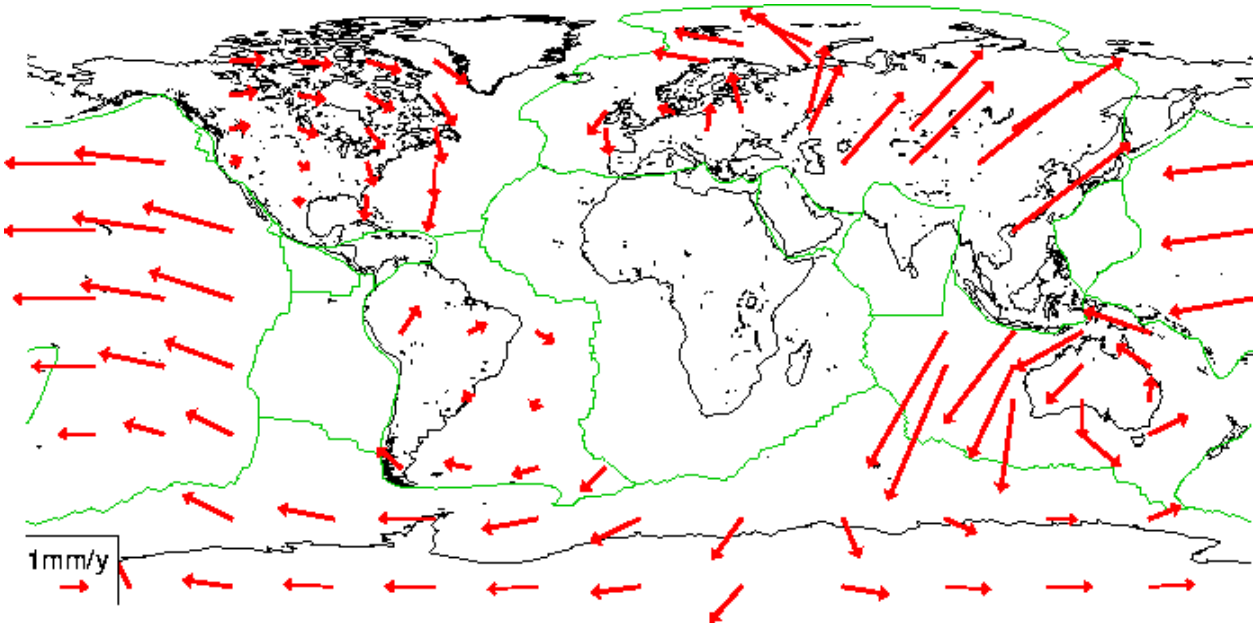


Figure 2. ITRF2000 and NNR-NUVEL-1A velocity differences



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