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Introduction and motivation: The terrestrial reference frame is conventionally realized by the adoption of positions referred to a specific reference epoch and constant velocities for a set of global tracking sites. In reality, the assumption of constant site velocities is in conflict with non-linear effects caused by several geophysical phenomena (e.g. seismic or volcanic effects, deformations at plate boundary zones, local effects). In addition, mass redistributions within the Earth system, from various internal processes and from surface mass changes associated with the atmosphere, oceans, and the continental hydrological cycle, cause variations of the geocenter relative to a crust-fixed coordinate frame like the International Terrestrial Reference Frame (ITRF).

This poster focusses on the analysis of site position time series obtained from VLBI, SLR, GPS and DORIS solutions. We also present time series for the origin and scale derived from these solutions and discuss their contribution to the realization of the terrestrial reference frame. We analyzed the time series with respect to non-linear effects, periodic signals and systematic differences, and compared the results at colocation sites.

Data: The major characteristics of the various solutions used for these investigations are summarized in the table below. In order to realize the datum of the individual VLBI, SLR, GPS and DORIS solutions in a similar way, we applied 7 parameter Helmert transformations to transform them into a consistent reference frame, the ITRF2000.

Technique	Analysis Center	Software	Data Time Span	Number of Stations	Station Coordinates Solutions
DORIS	IGN/JPL	GIPSY / OASIS	1992.8-2002.4	80	weekly SINEX files, all DORIS satellites
GPS	CODE	Bernese	1996.0-2002.2	163	weekly SINEX files
GPS	JPL	GIPSY	1996.0-2002.2	180	weekly SINEX files
GPS	SIO	GAMIT	1995.0-2002.2	157	weekly SINEX files
SLR	DGFI	DOGS	1992.9-2002.2	75	weekly solutions, combined Lagesos-1 & 2
VLBI	DGFI	OCCAM	1984.0-2002.0	56	2227 daily session solutions

Results

Both SLR and VLBI determine the global scale with a high long-term stability and the results are in good agreement with ITRF2000 scale. GPS and DORIS show larger discrepancies and irregularities (fig. 1).

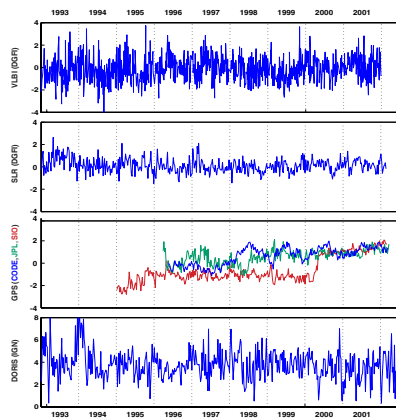


Figure 1: Time series of scale variations [ppb]

The VLBI scale variations of the daily session solutions have a higher noise level compared to the weekly solutions of the other techniques mainly due to the poor network geometry of single VLBI sessions and due to the fact that the solutions span only one day. These large scale variations of the daily VLBI session solutions are smoothed significantly due to a monthly accumulation (fig. 2).

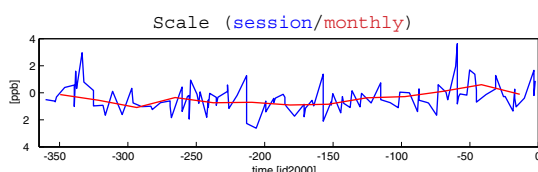


Figure 2: VLBI scale variations obtained from daily session and accumulated monthly solutions.

The most stable results for the origin of the terrestrial reference frame were obtained by SLR, whereas the GPS and DORIS results show some larger variations, especially for the z-component (fig. 3).

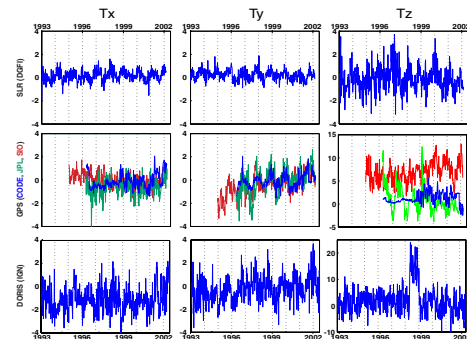


Figure 3: Time series of weekly translation variations [cm]

For many tracking stations, the instrumentation changed several times due to system upgrades, antenna and receiver changes, etc. The effects of these changes are shown for two co-location sites (fig. 4).

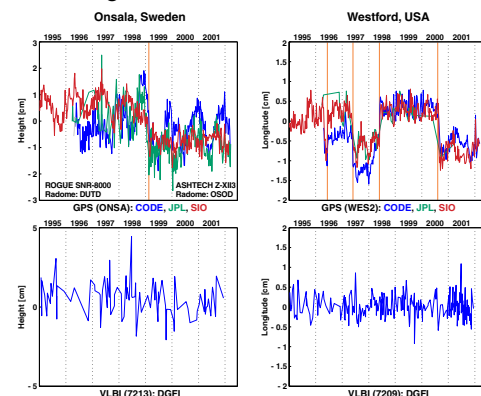


Figure 4: Effect of instrumental changes

A number of stations is located in deformation zones, which cover about 15% of the Earth's surface. In these geodynamically active regions large earthquakes occur quite often, which are accompanied by seismic deformation processes that may cause non-linear motions of surrounding stations (fig. 5).

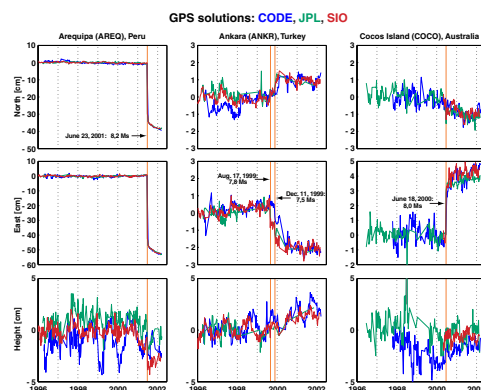


Figure 5: Effect of large earthquakes

Conclusions: The time series of the datum parameters have evidenced that SLR is the major technique to define the origin of the terrestrial reference frame. VLBI and SLR define the scale consistent with ITRF2000. Further improvements for GPS and DORIS seem to be necessary to use these techniques for the TRF datum definition.

The observed non-linear effects in the position time series are in conflict with the assumption of constant velocities. This may degrade the accuracy and consistency of the ITRF. A better monitoring of the terrestrial reference frame may require non-linear components in site positions and geocenter motion.