3.3 Analysis Coordinator

Improving the IERS Products

One duty of the IERS Analysis Coordination is the steady improvement of the IERS products and the initiation of new types of products if required.

Concerning the steady improvement of the IERS products the following aspects were important during the year 2006:

- Availability of official daily / weekly products for each of the technique services
- Availability of long time series of these official products as an input to the ITRF computations
- Finalization of the ITRF2005
- Workshop on Global Geophysical Fluids

The first three topics are all strongly linked. The idea of having weekly (or daily in the case of VLBI) SINEX files as official products from each of the technique services available was already the basis for the IERS Combination Pilot Project (CPP) that started in 2004 (see previous IERS Annual Reports for more details). Only shortly later, the call for long time series was issued so that all these activities were bundled with the major goal to generate a new ITRF. As it is the first time that the ITRF is generated from time series of weekly or daily SINEX files including station positions and EOPs, the analyses and computations lasted until 2006, but by the end of the year, the new realization called ITRF2005 could be finalized (see Sections 3.6.1.1 and 3.6.1.2 of this volume). The results were presented by IGN and DGFI at the IAG Symposium on Geodetic Reference Frames (GRF2006), held at Munich, October 9–13, 2006.

The Workshop on Global Geophysical Fluids held at San Francisco aimed at a review of the products of the Special Bureaus dedicated to each type of geophysical fluids. The actual needs of the geodetic community and how these requests can be fulfilled have been discussed.

Concerning new types of IERS products, the routine generation of weekly inter-technique combination products has already been mentioned as one goal of the IERS CPP. Although technique-specific intra-technique solutions are produced on a routine basis, no institution is yet routinely generating corresponding inter-technique solutions, the final goal of the IERS CPP. We can imagine the following sequence of events:

- Once a year or every two years a new IERS200x is computed based on a consensus of new standards (models, parameterization, processing strategies, etc.) and based on completely reprocessed and recombined solutions of all techniques.

- Routine weekly intra-technique combined solutions should be produced with exactly the standards used for the most recent ITRF200x realization.
- Latency envisaged: ca. 2–3 weeks (after the combination of the intra-technique solutions); i.e. a reduction of the latency is necessary.
- Each new weekly solution has to be validated carefully concerning station problems.
- Open questions: will several Combination Centers produce these inter-technique solutions? Will there be a combination of the combination?

For the combination of the inter-technique solutions different approaches can be envisaged and should be tested with the SINEX files of the IERS CPP or the long time series generated as contributions for the ITRF2005. Let us mention three different strategies here as examples, ranging from rigorous to minimal:

- Strategy 1: "Complete and Rigorous"
- Strategy 2: "Minimal and Weekly"
- Strategy 3: "Semi-Rigorous"

Let us shortly describe the major characteristics of these solutions:

Strategy 1 (complete and rigorous)

Every week a full "ITRF/EOP" solution is produced including all old and the new weekly intra-technique combined SINEX files (comparable to the cumulative solution of the IGS). This solution is then a fully correct and rigorous combination using all available information. As parameters, site coordinates and velocities, geocenter, annual signals, jumps, EOPs should be estimated as done for the corresponding ITRF200x generation. The detection and monitoring of site problems is very important and necessary. Variance component estimation is possible or weights could be taken from the corresponding ITRF200x solution. Local ties may be introduced with their variance-covariance information. This complete solution is demanding in computer resources (memory, CPU time), but it can one-to-one be realized with the strategy developed for ITRF200x. The weights of the local ties may have to be adjusted when the number of weekly solutions increases significantly. As IERS products we then have fully updated time series of EOPs and an up-to-date set of site coordinates and velocities (new sites …), etc. on a weekly basis.
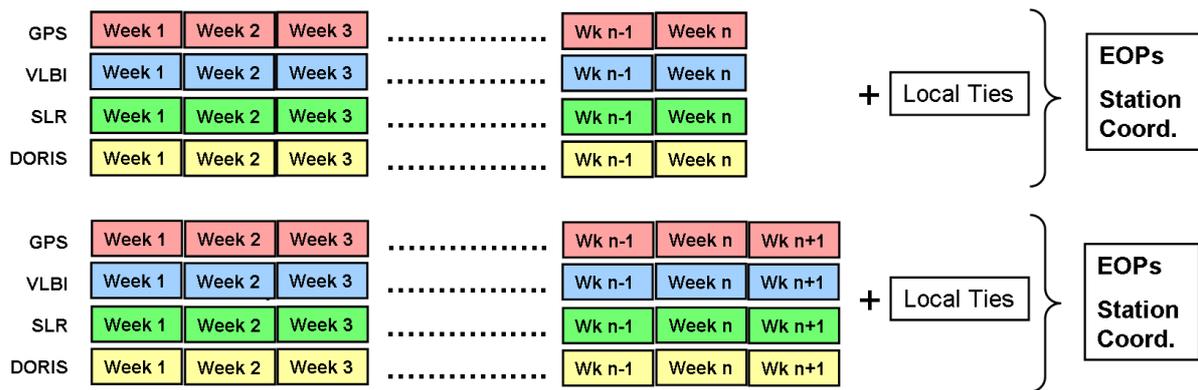
Fig. 1: Complete and rigorous inter-technique combination covering each week the full amount of data.

Strategy 2 (minimal and weekly)

Using this strategy, every week only the new weekly intra-technique combined SINEX files are processed to obtain the results for this new week. All information necessary for the combination (relative weights, local ties, datum, annual signals, etc.) are taken from the ITRF200x solution and are fixed to be compatible with ITRF200x. This solution type is certainly not a rigorous combination, but it is fast and efficient using almost no computer resources. The estimation of site velocities (and annual signals) is not possible and, therefore, coordinates of more recent sites will start to deviate after one year (quality of the velocities). It can be realized as soon as all the ITRF200x products are available. Due to the fact that the combination strategy is rather simple, other Combination Centers might join this effort. As IERS products we will obtain the most recent week of EOPs and site coordinates (resulting SINEX files are not to be used for further combinations). This strategy might be a way to go for rapid daily inter-technique combinations, but is probably suboptimal for the weekly update cycle.
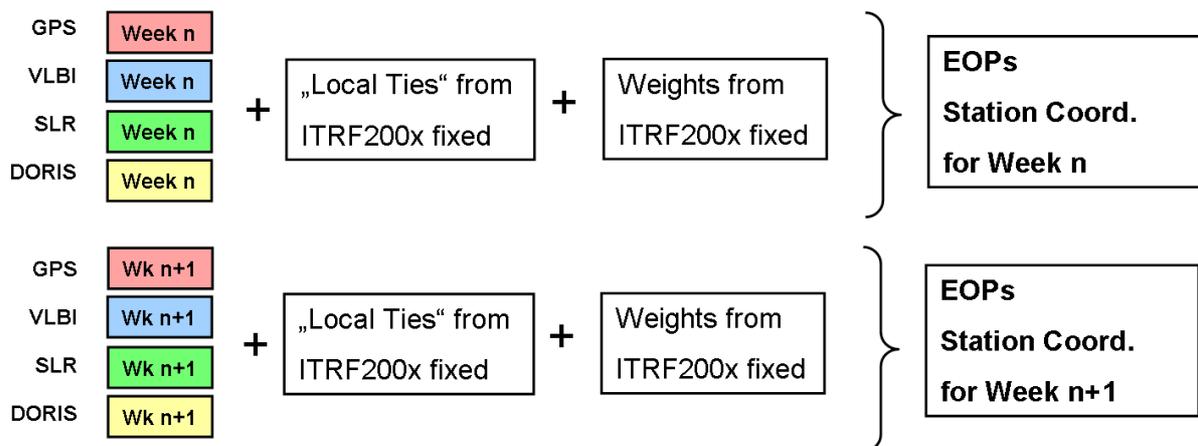

Fig. 2: Weekly inter-technique combination with a minimal effort.

Strategy 3 (semi-rigorous) Technique services produce weekly solutions (SINEX) fully aligned to a technique-specific, ITRF200x-aligned multi-year solution (e.g., IGS: IGS05). The combination is done here as a pure stacking (no local ties, no additional datum) including weights. The consistency of the individual technique combined solutions is kept. It might take some time to realize such a strategy by the technique combination centers. Alternatively, the alignment could be done by the IERS CCs. As IERS products we will get the most recent week of EOPs and site coordinates and it is clear, that the resulting SINEX files are not to be used for further combinations.
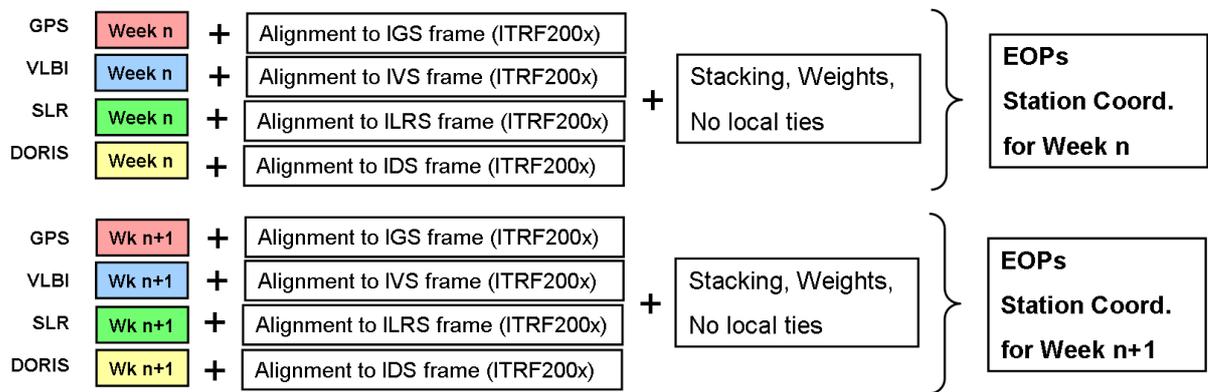

Fig. 3: Semi-rigorous combination, where the datum definition is taken from the reference frames of the individual techniques (as, e.g., IGS05 for the IGS realization of ITRF2005).

It is to be hoped that soon some of the institutions involved in combination work will start research on the best strategy to be used for weekly routine inter-technique solutions.

In addition to this weekly combined product that will have a latency of a few days, it is planned to provide a rapid daily product with very short latency. The main intention of this product is to have EOPs of high quality updated as soon as possible after the observations. Therefore, a combination of the VLBI intensive sessions and the rapid GPS solutions would be suitable for this product. A case study for such a combination procedure was done by Tesmer et al. (2006).

SINEX Version 2.02 The SINEX format description has been extended in some aspects (see IERS Messages No. 96 and 103):

1) New parameter types were added: nutation angles according to the new paradigm (IAU2000) and normalized spherical harmonic coefficients of the Earth's gravity field.

2) The inclusion of Galileo was defined regarding the station and satellite information for the specific frequencies. Thereby, the naming of the frequencies follows the RINEX 3.0 convention.

A full documentation and format description is available at <http://www.gfz-potsdam.de/pb1/IERS/sinex_v202.pdf>.

Special Meetings and Conference Sessions on Combination Issues

- IERS WG on Combination during EGU General Assembly 2006, Vienna/Austria
- EGU 2006, Vienna: Session G4 "Interactions between the three pillars of space geodesy: surface geometry, Earth rotation and the gravity field", chaired by M. Rothacher and H. Drewes
- GGOS Workshop, 08–09 October, 2006, Munich
- IAG Symposium on Geodetic Reference Frames (GRF2006), 09–13 October, 2006, Munich: Session "Combination of Space-Techniques", chaired by M. Rothacher and D. Angermann
- IERS Workshop on Global Geophysical Fluids, 06–07 December, 2006, San Francisco

Reference

Tesmer V., Thaller D., Steigenberger P., Rothacher M., Krügel M. (2006): Can low-latency UT1 estimates be improved by combining VLBI intensive and daily GPS sessions? Presented at EGU General Assembly 2006, Vienna

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