3.7.2 Working Group on Combination at the Observation Level

Introduction

The IERS "Combination at the Observation Level" (COL) Working Group was created in the course of 2009. Its charter is available at <http://www.iers.org/WGCOL>. Its main objective is to bring together groups able to perform combinations of space geodetic techniques (DORIS, GNSS, SLR and VLBI) at the level of observations searching for an optimal strategy to simultaneously solve for geodetic parameters, in particular Earth Orientation Parameters, terrestrial and celestial reference frames. This implies to improve the accuracy, the time resolution and the overall consistency of the geodetic products derived. The COL road map has been defined as follows:

1) review the approach of the various groups and their capability to process two or more techniques.

2) elaborating benchmarks to intercompare results between groups from the same data set.

3) insuring SINEX compatibility between techniques and with the international technique services and IERS.

4) establishing common processing standards for all techniques in order to guarantee homogeneity and consistency.

5) optimizing and unifying parameterization for instance for tropospheric parameters in order to minimize globally the degree of freedom of the whole inverse system and to reach consistency.

6) studying the appropriate weighting between techniques and the use of local ties or identical satellites tracked by several techniques.

7) studying stabilization methods and looking for high temporal resolution of parameters.

8) evaluating and comparing results to search for compatibility between groups.

9) organizing routine operations for a new TRF realization, either in the framework of the next ITRF or as ITRF assessment.

Points 1 to 5 have been treated so far.

Progress of the project

Two meetings were organized in 2011. The first one was held during the EGU meeting period. Its objective was first to review the strategy to be applied and standard models to be adopted for the inter-comparison benchmarking campaign corresponding to the VLBI CONT08 intensive campaign extending from 10th to 30th August 2008. The actions to carry out were:

- Make available the a priori gravity field
- Make available FES2004 model with a list of additional side band waves for interpolation and extrapolation

- Implement IERS Conventions 2010 in the various software packages

A list of satellites to consider in the processing was set up:

- SLR: Lageos and Lageos 2
- DORIS: SPOT 4, SPOT 5, JASON, ENVISAT
- GNSS: GPS and GLONASS
- Multitechnique SLR+DORIS+GPS: JASON 2

Specifications concerning parameters to be estimated in the processing:

- EOP, daily sampling, parameterization for polar motion: piece-wise linear or offset + drift
- Station coordinates: 1 set per week in Cartesian coordinates
- Tropospheric zenith biases per pass or 2hrs + horizontal gradients per day
- Antenna phase centres estimates for DORIS and GPS
- No atmospheric loading are applied

The IERS COL-WG organized another meeting at Paris Observatory on 21–22 November 2011. Activity reports were presented by the various analyses centres taking part in the activities: AIUB / BKG, DGFI, ESOC, GFZ, GRGS, ASI, GSFC, TUW and by the two Combination centers: GRGS and DGFI. Discussions followed on the road map and a proposal to iterate the test period. The pertinence of the strategy adopted was discussed as well as the objectives to be reached in the future planning of the work.

Demonstration is now based on weekly combined modified SINEX files containing unconstrained normal equations of station coordinates, Earth rotation parameters from all space geodetic techniques (SLR/LLR, GNSS, VLBI, DORIS) and in addition nutation parameters, quasars coordinates for VLBI, and this over 3 weeks including CONT08 period.

Combinations and validations were performed by the combination centres: SLR by AIUB, DGFI and GRGS. VLBI by DGFI, OPA and TUW. GNSS by AIUB and GRGS. DORIS is at present only provided by GRGS. Multi-technique combination results were compared to DTRF2008 and EOP 08 C04.

The future planning of the project was extensively discussed. Technical points as listed thereafter were addressed.

- *Test period*
  The COL-WG decided to extend the tests to the CONT11 period (11 September to 1 October 2011).

- *Data set*
  Rather than providing the exact same data set per technique to all groups (what does happen to be difficult, mainly for GNSS), it was recommended that groups use the same station set per technique. These lists of stations provided by the ACs have been made available via the COL-forum.
- *A priori models*
  An updated gravity field model to be used for the CONT11 campaign period was provided.
  As for the model delivered for the CONT08 period, it includes some averaged departures from atmospheric gravitational effect (from ECMWF) as well as from oceanic circulation effect (from MOG2D) over the 3 weeks of the campaign. The Ray-Ponte atmospheric tide model should be used. It should be compared to the Bode-Biancale model used by GRGS and GFZ. Rolf Koenig provided the ocean tide loading model (by Scherneck). The GPT/GMF tropospheric delay models should be used for the electromagnetic techniques and the Mendes-Pavlis model for light. All these models were made available through the COL forum.
- *Parameterization*
  Daily EOP and nutation parameters can be either piece-wise linear (at 0hr) or offset + drift (at 12hr). The NRO nutation corrections in X and Y should be implemented and used in all software packages.
  A priori values for wet tropospheric zenithal delays should be present every 2 hours and northward/eastward gradients per day, at least for a few co-located stations whose list is put on the forum (Hartebeesthoek, Concepcion, Greenbelt, Mount Stromlo, Tahiti, Kokee Park, NyAlesund, …). Antenna phase centres for DORIS and GPS should be present as well.
- *SINEX files compatibility*
  Most of discrepancies are now solved. However it can still be improved by satellite names, processing description (e.g. models).
- *Interpolation*
  As proposed in 2010 meeting the Gerstl's paper on interpolation methods was provided by DGFI and put onto the forum.
- *Weighting*
  OP provided variance factors obtained by the Helmert's variance component estimation method for all normal equations.
- *Comparison strategy*
  It was proposed that ACs check the SINEX files per technique from now on.

- *Miscellaneous*
  The discussion of the COL participation in the next ITRF2013 proposal was delayed.

Participants in working group activities

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