COMBINATION OF SPACE GEODESY TECHNIQUES FOR MONITORING THE KINEMATICS OF THE EARTH

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ABSTRACT. In the framework of activities of the International Earth Rotation and Reference Systems Service (IERS) Combination Research Centres (CRC), the french *Groupe de Recherche en Géodésie Spatiale (GRGS)* studies the benefit of combining four geodetic techniques (SLR, VLBI, GPS and DORIS) at the measurement level in order to obtain a global and consistent solution for Earth Orientation Parameters (EOPs): polar motion xp and yp, universal time UT and celestial pole offsets in longitude and obliquity $d\psi$ and $d\epsilon$ with a six-hour sampling, as well as weekly station positions. A one-year test period (the year 2002) has been chosen to prove the power of such a combination moreover worked out in a homogeneous global terrestrial reference frame. All techniques were processed in the same computational framework (GINS/DYNAMO) so with the same *a priori* models and *a priori* values for parameters. The optimal relative weights between each geodetic technique were obtained with an optimal variance component estimation method.

1. METHOD OF COMBINATION

The test period chosen for the combination is the year 2002. More precisely, this period begins on December 30, 2001 (Julian Date 2 452 273,5) and ends on January 01, 2003 (Julian Date 2 452 643,5). The GINS software provides the sensitivity of measurements with respect to parameters of interest, through weekly normal matrices per technique. In our case, these parameters are EOPs and positions of GPS, SLR, DORIS and VLBI stations. Each week, normal matrices of the four techniques are used to obtain a "four-technique" normal matrix. This processing is carried out in two steps. In the first step, the four matrices are used to compute the relative weights between techniques with an optimal variance component estimation method [5]. These four relative weights are used in the second step to gather the four individual normal matrices in a global weekly normal matrix taking into account the quality of each technique.

The weekly normal system so obtained can not be solved for without any additional information on parameters (EOPs every six hours and station positions every week). We so give these supplementary informations as constraints on parameters ("continuity constraints" on EOPs and minimum constraints for station positions [6]) which allow us to invert the normal system and to obtain the final solutions. The EOP offsets are computed with respect to the IERS time series *EOPC04* [2] corrected with the diurnal and sub-diurnal model of [4]. The station position offsets are computed with respect to ITRF2000 positions [1] corrected with models of IERS conventions [3].

2. RESULTS FOR EOPS

There is no absolute method to evaluate the quality of EOP time series. Usually, the quality assessment of time series is done through comparisons with other series and/or with theoretical models. In our case, we choose to compare the one-day and six-hour sampling combined time series with each individual series through the weighted RMS of the estimated offsets (Table 1).

	dx_p	dy_p	dUT		dx_p	dy_p	dUT
GPS	0.079	0.083	0.009	SLR	0.146	0.131	0.019
DORIS	0.706	0.551	0.122	VLBI	0.363	0.363	0.009
C_{1D}	0.075	0.070	0.010	C_{6H}	0.442	0.433	0.013

Table 1: Weighted Root Mean Squares of the individual and combined EOP time series. Units are mas for x_p and y_p and ms for UT. The names C_{1D} and C_{6H} correspond respectively to the combined series with a one-day and a six-hour sampling.

The RMS of the individual series are in good agreement with those usually obtained by the IERS analysis data centres. The C_{1D} series present a RMS of $0,07/0,08$ *mas* for the pole coordinate offsets in agreement with the GPS series. The RMS of dUT for the C_{6H} series is really small. This shows that our combination process takes advantage of the characteristics of each technique. So the dUT series seem to be mainly influenced by the VLBI technique which is known as the best one for this parameter.

The analysis of the combined series of EOPs with a six-hour sampling shows that our method of combination at the measurement level is working. Furthermore this method provides a global and consistent solution of EOPs and station positions simultaneously with a satisfactory sampling. This kind of computation seems to be the future for Reference System realization and maintenance.

3. REFERENCES

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