ON THE USE OF DORIS DATA FOR DETERMINATION OF THE EOP AND GEOCENTER MOTION

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ABSTRACT. This paper presents results of the global DORIS network processing, carried out at the INASAN Analysis Center with the use of measurement data from the "old" satellites (SPOT2 +SPOT4 + TOPEX/POSEIDON) having onboard DORIS receivers for the time period April, 1999 - June,2002. Data analysis was performed with the use of GIPSY/OASIS2 software. The free-network approach for a simultaneous estimation of orbital parameters, station coordinates and Earth's orientation parameters has been applied. Time series of weekly values of Geocenter motion are in good agreement with the results of IGN/JPL analysis center. A regression analysis and a simultaneous estimation by the least square method, have been used for an estimation of the constant term ,linear trend, semi-annual and annual amplitudes and phase of the original time series. Time series of the "geocenter motion" are obtained by the "geometric" method with the use of Helmert transformation of the coordinates of all DORIS stations to the ITRF2000.

The DORIS system was developed by CNES and IGN to meet science and operational user requirements in very precise orbit determination and high accuracy location of ground beacons for point positioning. The main features of the DORIS system are the high accuracy of the Doppler measurements, worldwide and homogeneous distribution of ground beacons, excellent orbital coverage. DORIS data are also relatively simple to process, and this makes DORIS a good technique for the purpose of operational determination of site positions and polar motion. More detailed description of the methods used at the INASAN Analysis Center for DORIS data processing has been described in our previous works [Kuzin S. P. and S. K. Tatevian, 2000; 2002]. The station coordinates are estimated on daily basis using three satellites (SPOT2, SPOT4, TOPEX). In addition to station coordinates, we estimate simultaneously the orbital parameters and several other parameters (EOP, tropospheric corrections, clock drifts offsets) with a free-network approach and weakly constraining the apriori station coordinates to a 100 meters sigma. Then daily solutions are combined into weekly solutions, projected (removing of the indetermination due to loosely definition of the terrestrial reference frame) and transformed to a well defined reference frame using 7 parameters of Helmert transformation. The results of the transformation operation provide simultaneously the coordinates (and full-covariance matrix) and also the estimated 7 parameters of the transformation. Three translations parameters and scale factor are more significant as compared with 3 rotational ones as they can provide information on possible physical variations of the geocenter due to different seasonal mass redistribution in the Earth system and due to unstability of the unit of the length that is usually biased by unmodelled effects (ionospheric correction).

We have recomputed DORIS data from all operating beacons of the DORIS network for the period 11.04.1999–01.06.2002 (3 years 2 months, 164 weeks). The data for the satellites having manoeuvres during the processing periods were deleted. All weekly solutions were derived in the same reference frame (ITRF2000) with an accuracy depending on a quality of the DORIS solution itself and on the accuracy of the adopted reference system at the epoch of measurements. Time series of weekly DORIS solutions for coordinates of about forty DORIS stations were obtained. In a whole a repeatability of station coordinates are estimated at the level of 30 mm and standard deviations 1.5–5.0 cm. It can also be seen that besides systematic drift, there are temporal variations depending on the site location and the type of equipment.

Time series of weekly geocenter variations with respect to ITRF00 are shown at Fig.1 for the same time period as stations coordinates. The data have been analysed through the harmonical analysis in order to determine short and long-periodic signals. A constant term and the trend have been estimated in order to express the time series in a common reference frame. For the annual and semiannual variations of the geocenter the amplitudes and phases (refer to 1993.0) are presented in the table 1.

Table 1: Annual and semiannual amplitudes and phases of geocenter variations.

Component	**Annual**		Semiannual		**Trend**
	A, mm	***Phase, deg***	***A, mm***	***Phase, deg***	***mm***
X	5.5 ± 0.2	112.6 ± 5.5	1.3 ± 0.2	157.9 ± 22.6	-1.7 ± 0.1
Y	4.1 ± 0.3	345.8 ± 7.9	6.1 ± 0.5	190.9 ± 3.4	-0.8 ± 0.1
Z	11.5 ± 0.5	322.3 ± 19.1	6.4 ± 2.7	177.6 ± 25.4	1.7 ± 0.7
S (scale)	0.3 ± 0.5	278.1 ± 11.0	0.6 ± 0.05	170.4 ± 6.5	-0.02 ± 0.01

Annual and semiannual phases are referred to 1993.0

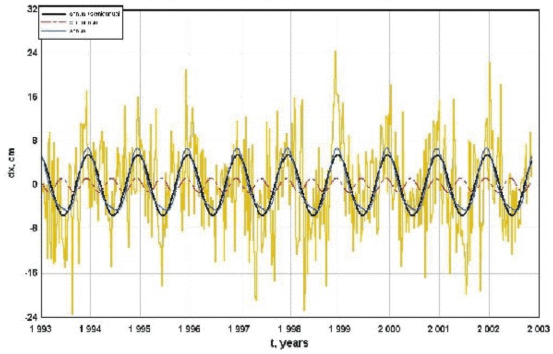
The obtained values are comparable in amplitudes with the results from previous DORIS geocenter analysis [C.Boucher, P.Sillard, 1999]. The phases are different. The greater amplitude for z may be caused by the dominance of seasonal mass redistributions between the northern and southern hemisphere [H. Montag, 1999]. Additionally to the annual and semiannual signals several other more shorter periods (a fortnight and of one to four months) were found and it must be noted that the amplitudes of some short-periodic signals are comparable with the amplitudes of the semiannual signals.

SUMMARY

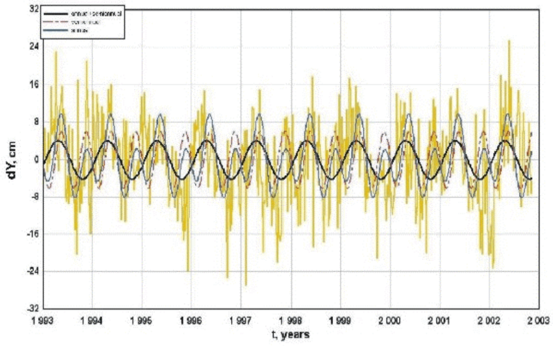
Center of mass variations must be properly accounted for in the realization of the tracking station locations within the reference frame, that is especially important for the altimeter measurements of sea-level and plate tectonics studies. Geocenter motions as determined using DORIS data, are of the order of 7-10 mm in each coordinate, but secular trends in the geocenter components may be more carefully surveyed for long-term measurements of sea-level change and some other geophysical phenomena.

Due to relatively simple technique of data processing, DORIS is a good technique for the purpose of operational determination of the polar motion. But as the satellites, having on board DORIS systems, are not specially dedicated to the geodynamic studies, the best precision on polar motion now is in the range of 0,5-0,8 milliarcseconds. Improvements in the accuracy of

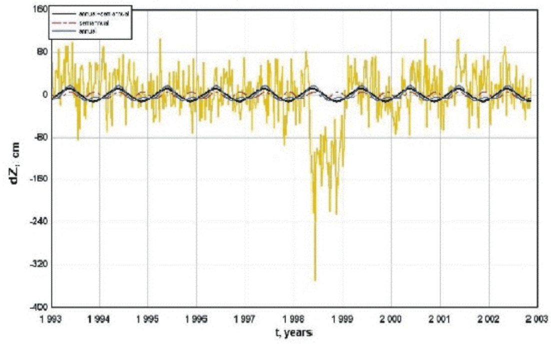
DORIS weekly geocenter variations (TX component) compared to ITRF00 with
superimposed annual, semiannual and annual+semiannual curves



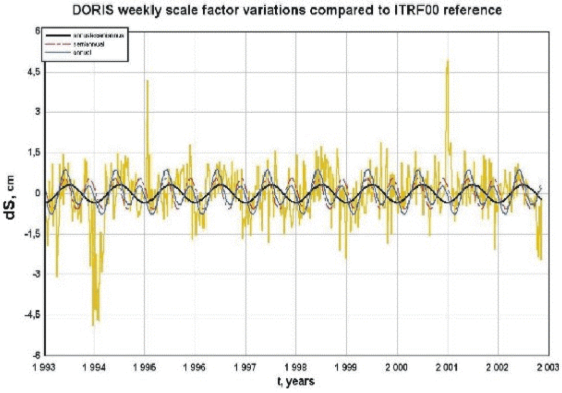
DORIS weekly geocenter variations (TY component) compared to ITRF00 with
superimposed annual, semiannual and annual+semiannual curves



DORIS weekly geocenter variations (TZ component) compared to ITRF00 with
superimposed annual, semiannual and annual+semiannual



DORIS weekly scale factor variations compared to ITRF00 reference



the DORIS polar motion monitoring are anticipated with the launch of new spacecrafts equiped with new receivers, which will provide lower measurement noise and better accuracy of orbital parameters.

Our investigations will be continued for the analysis of more longer time series of stations coordinates, EOP and geocenter variations.

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