DORIS DATA ANALYSIS AT THE INSTITUTE OF ASTRONOMY, RAS

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ABSTRACT *- From the beginning of the DORIS mission on SPOT2 in accordance with the bilateral agreement with CNES/IGN, the Institute of Astronomy, RAS, (INASAN) actively participates in the DORIS Project by means of installation and maintenence of permanent DORIS beacons along the Russian and CIS territory. Now in the frames of Pilot Project on the "International DORIS Service" the analysis of DORIS data is carried on with the use of the JPL GIPSY-OASIS II software in a free-network multisatellites approach (SPOT2+SPOT4 +TOPEX /POSEIDON). The DORIS moduls, worked out at the IGN/LAREG were ported on the SUN SPARC workstation running Solaris 2.5.1. Below a procedure of data processing, results of weekly station positions estimation for the 14 weeks period of 1999 and a summary of data analysis are presented.*

1 - GENERAL DESCRIPTION OF THE METHODICS OF THE DORIS DATA ANALYSIS

Data processing has been made on a daily basis using 24 hours measurenments from all satellites having onboard Doris receivers (SPOT2 + SPOT4 + TOPEX/POSEIDON). The so-called free-network approach for the simultaneous estimation of orbital parameters, station coordinates and earth orientation parameters was applied. Every daily solution was obtained with the use of loose constraints in station coordinates (an apriori value of standard deviation is 100 m). For estimation of all daily station coordinates solutions in a uniqe reference frame, a specific procedure [Willis 96; Willis 97; Willis et al. 98; Dorie 97], based on a technology similar to the methodics of GPS data analysis developed at the JPL, has been used. Shortly this procedure can be described as follows:

- merging of daily solutions in the weekly solution: for that no transformation parameters are used, because daily solutions are not obtained in the well defined reference frame (loosly constrained);

- projecting of weekly solutions: this procedure applies internal constraints to the fiducial - free files of results. Projecting affects only the covariance matrix (a posteriori standard deviation of the station positions) and has no influence on the values of station coordinates [Sillard et al. 98];
- estimating of the reference solution at the mean epoch of the DORIS data (in our work the ITRF96 has been used);
- transforming of the weekly projected solutions to the reference frame solution at the epoch of measurements, this procedure allows to obtain time series of coordinates in the well defined coordinate system. The fiducial-free approach makes it possible to recalculate rapidly the time series of coordinates when better reference frame is available, without any additional orbital data processing.

2 - ANALYSIS RESULTS

The period: 11 April to 15 July 1999 (about 3 months or 14 weeks) was chosen for the analysis of DORIS data from all operating stations of the DORIS network. It should be mentioned that almost for all days during this period the measurements were available for three DORIS satellites (SPOT2 + SPOT4 + TOPEX/POSEIDON). And only for 6 days the data for two satellites in different combinations (SPOT2 + SPOT4, SPOT2 + TOPEX, SPOT4 + TOPEX) were used. Besides there were 4 days with the maneuvers of satellites. Using the procedure, described above, all derived weekly solutions were obtained in the same reference frame (ITRF96 in our case) with the accuracy depending on a quality of the DORIS solution itself and on the accuracy of the adopted reference system at the epoch of measurements. For every station the curves of site positions (latitude, longitude and height) are ploted. As an example, **fig. 1(a, b)** shows the time series of weekly DORIS positions of the BADARY (BADA) site, near Irkutsk, and Uzbek site - KITAB (KITB). Along the ***y*** axes differences between the weekly coordinates (longitude, latitude and height) and the coordinates at the mean date of the first processed week (April 14,1999) are plotted. At the **Table 1** numerical values of differencies between weekly solutions and the coordinates at the accepted mean date and their formal errors are given .

Date	**Badary site**						**Kitab site**					
Weeks 1999	ΔLat. (cm)	rms (cm)	ΔLong. (cm)	rms (cm)	ΔHeight (cm)	rms (cm)	ΔLat. (cm)	rms (cm)	ΔLong. (cm)	rms (cm)	ΔHeight (cm)	rms (cm)
16	0.00	0.63	0.00	0.95	0.00	0.86	0.00	0.68	0.00	1.31	0.00	0.98
17	14.18	0.62	0.22	0.94	-27.55	0.86	7.68	0.62	-3.45	1.13	-25.95	0.94
18	26.74	0.79	-1.89	1.12	-67.89	1.05	26.87	0.78	1.39	1.57	-42.60	1.07
19	15.77	0.62	-15.16	0.97	-34.11	0.86	11.59	0.65	2.48	1.24	-28.76	0.94
20	16.73	0.82	-9.07	1.30	-33.02	1.18	8.53	0.87	0.67	1.56	-23.57	1.28
21	17.21	0.68	-2.77	1.08	-32.47	0.96	10.50	0.69	2.22	1.28	-24.27	1.00
22	18.62	1.04	-1.82	1.57	-36.99	1.44	16.05	0.91	3.95	1.60	-33.25	1.32
23	11.78	1.03	-11.64	1.51	-33.45	1.56	12.95	0.94	2.02	1.58	-24.08	1.34
24	8.56	0.84	-2.31	1.47	-24.54	1.15	10.60	0.68	9.38	1.45	-22.34	0.93
25	14.88	0.99	-16.25	1.73	-40.10	1.45	13.27	0.92	-3.02	1.56	-24.34	1.38
26	25.67	1.06	-3.90	1.77	-66.45	1.54	27.61	0.98	2.66	1.80	-48.88	1.46
27	-7.98	1.13	-2.99	1.80	7.02	1.53	-8.29	0.95	-4.70	1.94	3.47	1.31
28	-0.79	0.70	-10.87	1.20	-19.39	1.03	-7.37	0.66	-7.03	1.21	-10.16	0.98
29	7.24	0.94	-16.18	1.44	-41.84	1.30	1.28	0.93	-7.14	1.43	-27.16	1.09

Table 1. ***Numerical values of differencies between weekly solutions and the coordinates at the accepted mean date and their formal errors for Badary and Kitab sites***

It can be seen (Fig.1 a,b) a small slope of the fitting curves of the longitude and latitude components for both sites, while a height component curve is rather stable during this 14 weeks period, but a systematic negative deviation from the positions at the mean date is evident. During such a short time interval it is impossible to estimate site velocities due to global tectonic motions and our studies will be continued for the more longer period as this information is important for geophysical and geodetic studies.

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REFERENCES:

[Dorie 97] O.Dorie,"Recherche d'une procedure optimale pour transformer les coordonnees mensuelles DORIS dans un systeme de reference mondial maintenu de maniere fiable dans le temps", Rapport de stage de DEA, Astronomie Fondamentale, Mecanique Seleste et Geodesie, Juin 1997, IGN/LAREG MS 6.

[Sillard et al. 98] P.Sillard,C.Boucher,"Algebraic minimum constraints for reference frames datum definition", submitted to J. of Geodesy, 1998.

[Willis 96] P.Willis,"Definition d'une procedure de tests visant a definir une procedure optimale pour obtenir des coordonnees DORIS mensuelles dans un systeme de reference mondial maintenu de maniere fiable dans le temps", Avril 1996, IGN/LAREG SP 3.

[Willis 97] P.Willis,"Notice utilisateur du logiciel GIPSY/OASIS pour les calculs DORIS a l'IGN", Fevrier 1997, IGN/LAREG SP 7.

[Willis et al. 98] P.Willis,P.Sillard,"Weekly DORIS solutions for stations coordinates: early results and perspectives", 27-29 April 1998,Proc. "DORIS DAYS", Toulouse, France.