

3.4.4 International DORIS Service (IDS)

General The IDS website URL is <http://ids.cls.fr/html/about_ids.html>. The IDS Terms of Reference are available at <<http://ids.cls.fr/html/organization/tor.html>>. The present organization of the IDS is similar to that of the other technique-oriented services. It is described at <http://ids.cls.fr/html/report/Organization_IDS_030701.pdf>.

Network The DORIS permanent network is shown in Figure 1. Site logs are available at <<http://ids.cls.fr/html/doris/sitelog.php3>>.

In 2007 only one station was completely renovated in order to improve the long term stability of the antenna support: Toulouse, France. This was the last Alcatel antenna in the network: now all antennas in the network are the Starec model. At six stations (among which some recently renovated) the antenna support was modified, so as to remove the N-type bent adaptors located at the base of the antenna. These N-type bent adaptors are suspected of causing power loss in the long term. Finally, the equipment of the station at Papeete (French Polynesia) was completely replaced (including a third generation beacon), and the antenna was included in a global geodetic survey of this three-technique IERS co-location site (<http://lrs.gsfc.nasa.gov/docs/Tahiti_surveyreport_0710.pdf>).

The total number of DORIS stations in the permanent tracking network remains 57. Figure 1 depicts the current co-location between DORIS stations and other IERS techniques.

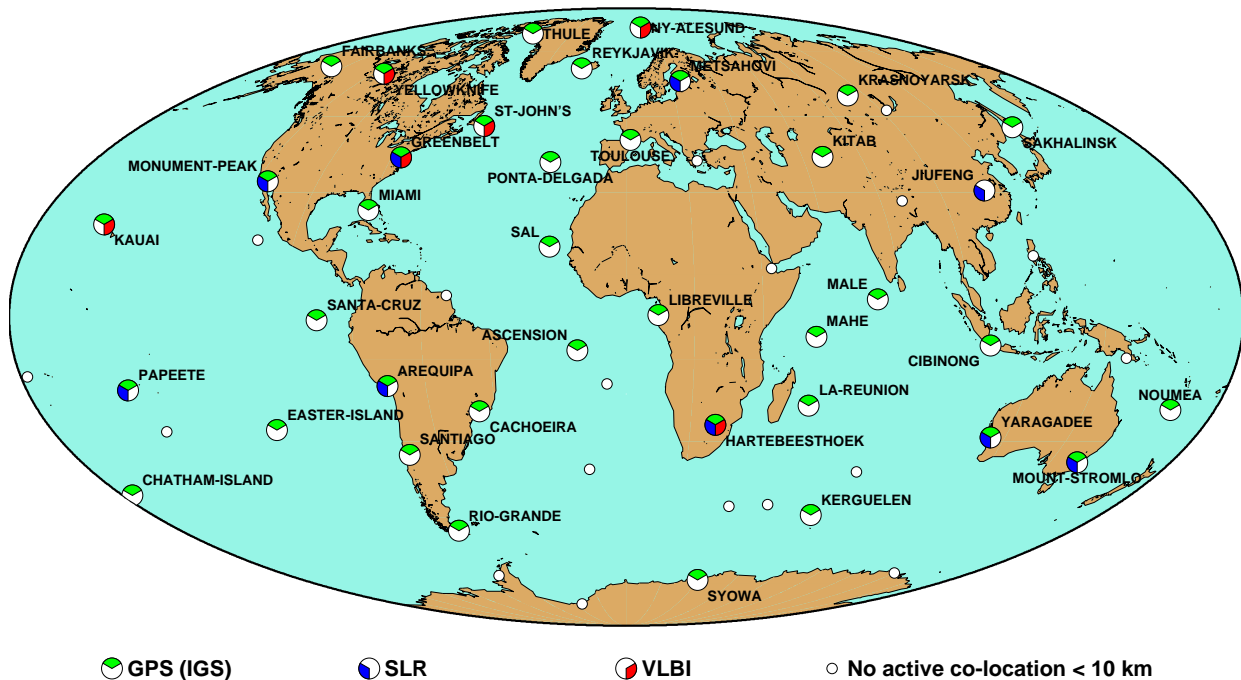


Fig. 1: DORIS Network co-locations with GPS, SLR & VLBI

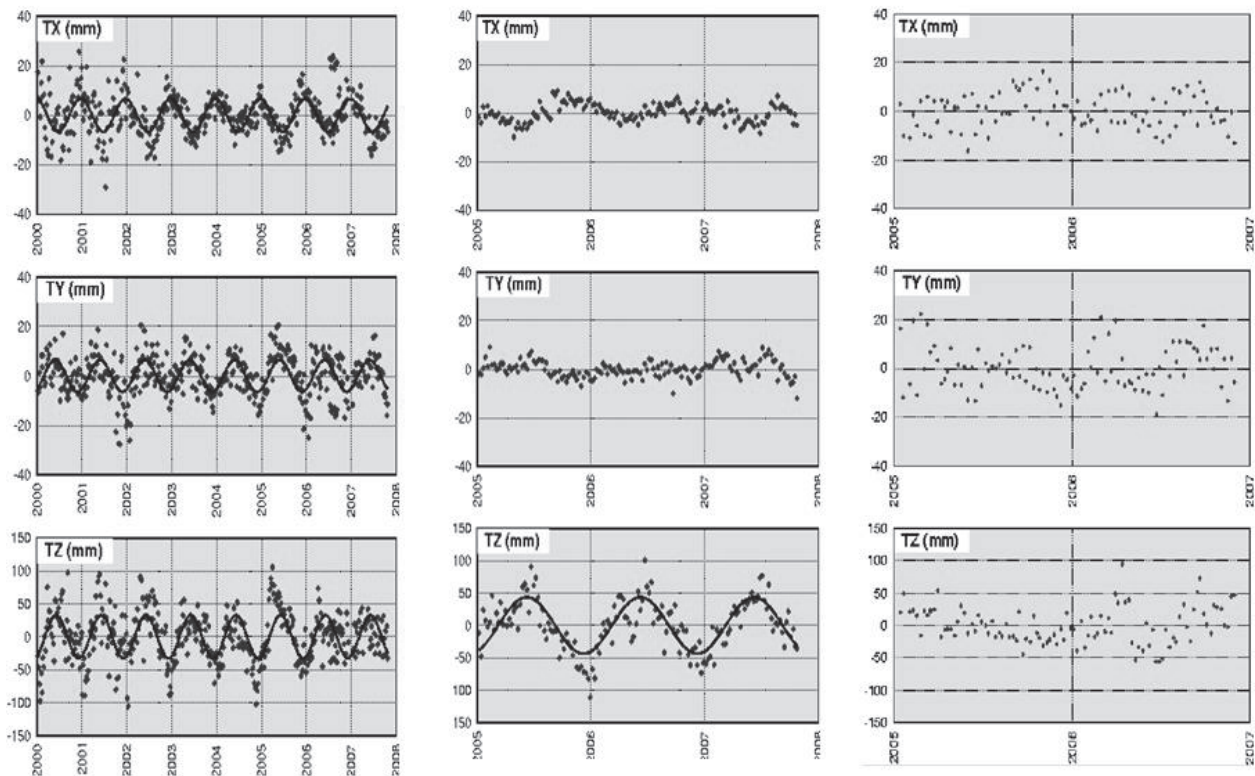


Fig. 2: Geocenter parameters (T_x , T_y , T_z) from three analysis center solutions: **Left**, IGN wd05; **Center**, LCA wd18, and **Right**, GOP wd03.

Space Segment

Three new oceanography and cryosphere observation missions will carry DORIS receivers, which will help to ensure continuity of DORIS data. These missions include Jason-2 (NASA/CNES/NOAA/EUMETSAT) scheduled for launch in June 2008, Cryosat 2 (ESA) scheduled for launch in March 2009, and ALTI-KA (joint with the CNES and ISRO, the Indian Space Research Organization) scheduled for launch in 2009-2010. The current DORIS on-orbit DORIS satellite constellation includes: SPOT-2 (in orbit since 1990), SPOT-4, SPOT-5, ENVISAT, and Jason-1. Possible missions (not yet approved or finalized) include SENTINEL-3 (European GMES Program, ESA for 2012), Jason-3 (Jason-2 follow-on for 2012-2013), HY-2A (joint altimetric mission with CNES and the China Space Agency to include a DORIS receiver, GPS receiver and Laser Retroreflector for 2010).

Analysis Activities

The International DORIS Service has been in operation since 2003. Over the last four years receivers on the SPOT 2-4-5, ENVISAT and the JASON-1 satellites have provided DORIS Doppler data from a global network of about 50 stations. The number of Analysis Centers (AC) who have processed the data and have high level experience has progressively risen. Among them, two AC's: IGN using GYPSY/OASIS software and LEGOS/CLS using GINS/DYNAMO software

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now provide solutions of station coordinates and EOP's on a routine basis to the IGN and NASA CDDIS data centers. INASAN also processes DORIS data using GYPSY/OASIS software and submitted SINEX files to the ITRF2005 solution. The two newest DORIS analysis centers, include Geoscience Australia (GA) using the NASA GEODYN software and the Geodetic Observatory Pecny (GOP) using the BERNESE software. The GOP has adapted software not originally designed to process DORIS data. The performance reached by the new analysis centers in orbit and station positions determination is very encouraging. The availability of geodetic solutions from different algorithms and software packages allows us to efficiently contribute to cross-comparison of the solutions and to the improvement of the DORIS technique.

The results of some of the preliminary tests with the new test series is illustrated in Figure 2. Some of the general conclusions from the analysis are: (1) Z translation variations are still very high; (2) Systematic yearly effects remain in the translation (IGN & LCA, black curves have annual period); (3) TRF parameters for GOP are more scattered than others; (4) Scale factors (not shown) have close behaviour (this marks an important improvement for LCA since ITRF2005); (5) more generally WRMS (not plotted here) are between 10 to 15 mm after 2003 (4 satellites available) and at the same level for each AC. The AC cumulative solution comparisons with ITRF2005 are summarized in Table 1.

Table 1: New Analysis Center Solution Comparisons with ITRF2005

ITRF2005 comparisons	Pos (mm)	Vel (mm/yr)
IGN (7 yrs)	6.5	2.0
LCA (2 yrs)	15.6	4.0
GOP (2 yrs)	11.1	7.1
Combined solution	7.0	5.7

Since the SINEX contributions of the Geodetic Observatory Pecny (GOP) are clearly on par with that of the other analysis centers, they have been welcomed into the IDS as an operational analysis center, and we look forward to their contribution for the next ITRF realization.

SAA Effect on Jason-1 and Validation of Corrective Model

It has been known for some time that the Jason-1 DORIS USO is not as stable as desired. The frequency is perturbed by passage through the South Atlantic Anomaly (SAA). The frequency is sensitive to irradiation rate and the total irradiation encountered in orbit. DORIS station positioning is perturbed if Jason-1 is included in multi-satellite solutions. (Willis *et al.*, *Adv. Space Res.* 31(8), pp. 1941–1946, 2003; *CR Geoscience*, 336(9), pp. 839–846, 2004). JM Lemoine and H. Capdeville (*J. Geodesy*, 2006) have developed a correction model to apply to Jason-1 DORIS data. They have demonstrated that it improves DORIS data analysis. The NASA GSFC Precision Orbit Determination team has also tested the SAA model on the entire time series of Jason-1 orbits (computed with both DORIS and SLR). The results of these tests are illustrated in Figure 3, depicting the Jason DORIS RMS of fit to 10-day orbit solutions with and without the SAA correction. The SAA correction applied over 177 test cycles, improves the RMS of fit from 0.4078 mm/s to 0.3740 mm/s, the SLR fit from 1.482 cm to 1.440 cm, and the independent altimeter crossover fit from 5.585 cm to 5.578 cm (Beckley *et al.*, *Geophys. Res. Lett.*, 2007).

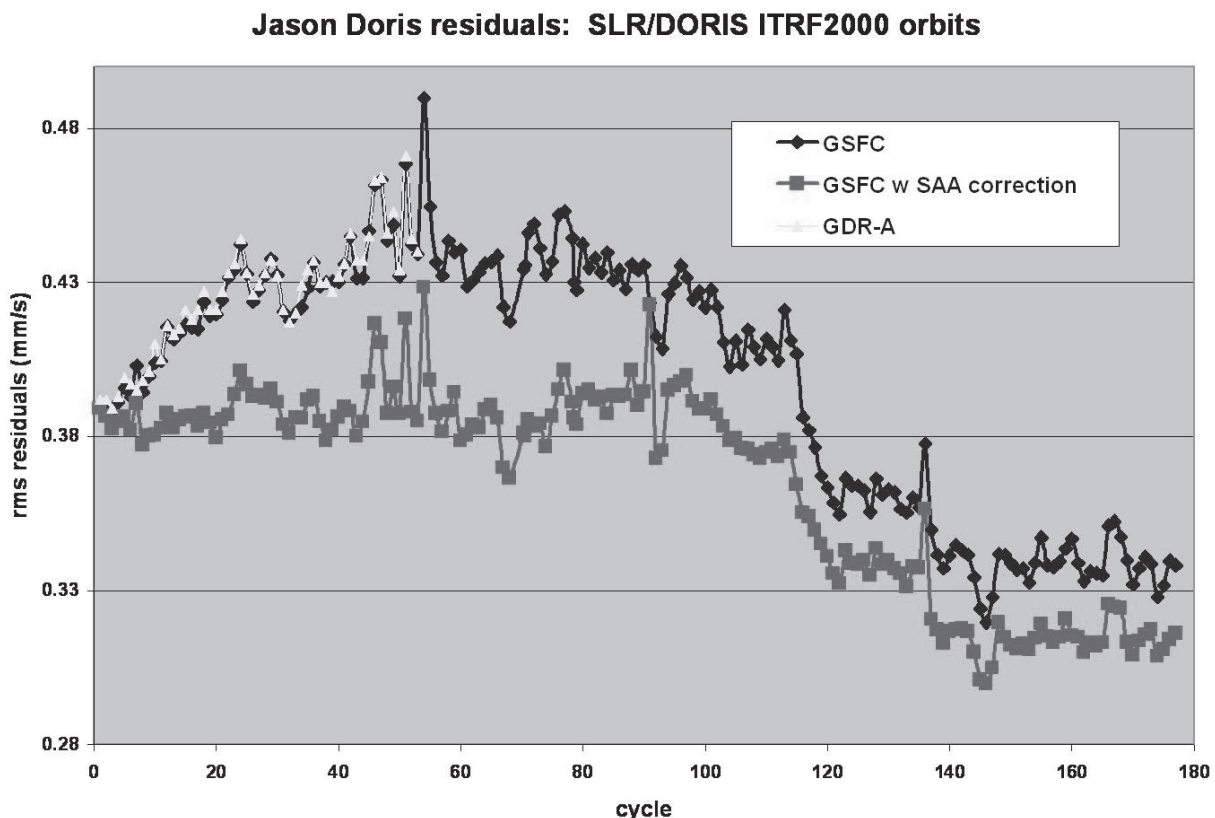


Fig. 3: Jason-1 DORIS residual RMS of fit for cycles 1–177; in blue without the SAA correction; in magenta with the SAA correction. (Computations courtesy of NASA GSFC POD center, presented at Jason Ocean Surface Topography meeting, Hobart, Tasmania, March 2007).

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While we have confirmed that the POD for Jason-1 is improved using the SAA model, we cannot say that the SAA model corrects the frequency aberrations sufficiently to allow the Jason-1 data to be used in IERS combinations. At present Jason-1 data are omitted (as was the case in ITRF2005). Some experiments are planned in 2008. Since we know that the number of satellites in a DORIS solution decisively affects the EOP and station position quality, it is possible that it would be advantageous to include Jason-1 data (corrected by the SAA model) in future solutions, but only for 2002, the year both SPOT-5 and ENVISAT were launched.

DORIS Data Delivery Latency

The latency of data delivery to the IDS data centers (IGN and the NASA/CDDIS) affects the rapidity with which operational analysis of the DORIS data can be performed for EOP and weekly station position. With the current DORIS format, the delivery of the data depends on final preprocessing by the CNES POD team. As can be seen in Figure 4, this latency has in the past been around 25 days for most satellites. In mid-2007, a dramatic improvement was observed with data latency now on average around 15 days.

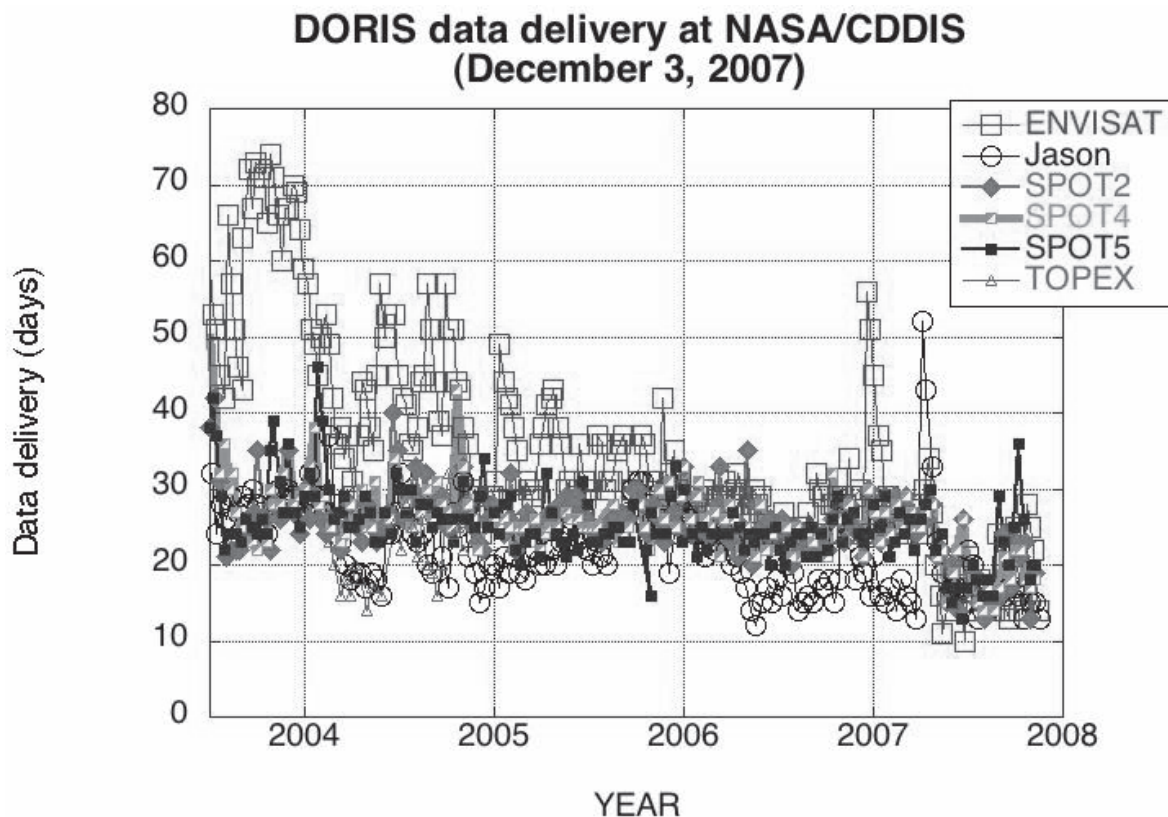


Fig. 4: DORIS data delivery latency to the NASA/CDDIS for all DORIS satellites. Note the dramatic improvement in latency in mid-2007.

DORIS Citation

We request that users of DORIS data and products use the following new citation, from the DORIS article in the Journal of Geodesy special issue (November 2006):

Tavernier, G., Fagard, H., Feissel-Vernier, M., Le Bail, K., Lemoine, F., Noll, C., Noomen, R., Ries, J.C., Soudarin, L., Valette, J.J., Willis, P. (2006), The International DORIS Service: genesis and early achievements, *Journal of Geodesy* 80(8–11), pp. 403–417, DOI: 10.1007/s00190-006-0082-4.

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