

Two new DORIS instruments in orbit

Pascale Ferrage, Cécile Manfredi (CNES)

A dozen satellites have supplied DORIS data to the international scientific community since 1990. With six satellites currently flying DORIS instruments, including the two new missions just in orbit, Jason-3 and Sentinel-3A, and with future missions in development, the DORIS contribution is guaranteed up to 2030 and beyond.



Credits D. Ducros

Jason-3 was launched on January 17, 2016. By succeeding Topex/Poseidon, Jason-1 and Jason-2, Jason-3 extends the high-precision ocean altimetry data record to support climate monitoring, operational oceanography and seasonal forecasting. The orbit is the traditional T/P-Jason orbit -non-sun-synchronous, 1336 km, 66° inclination. Three location systems are on board: DORIS DGXX-S, Laser Reflector Array and GPS payload. Since mid of February, Jason-3 has been flying in tandem with Jason-2, and its DORIS data are available on the IDS Data centers.

The **Sentinel-3A** satellite was launched on February, 16, 2016. Sentinel-3A fits into the Copernicus program, a joint project between ESA and European Union. It will be dedicated to Earth monitoring and operational oceanography.

Sentinel-3 is carrying three location systems (DORIS DGXX-S, GNSS and Laser Retroreflector). Its orbit is similar to Envisat (814.5 km, 98.65°).



Credits J. Huart

New features in DGXX-S:

Hardware has been designed to be as similar as possible to previous DGXX receivers. Only a few obsolete components were replaced, noticeably the new processor LEON 36 MHz processor allowing powerful on-board computation.

The software has been more deeply improved, in different directions:



After checking that all the satellite elements are working well, controllers will calibrate the instruments to commission the satellite. The mission is expected to begin operations in few months. Then the DORIS data will be available to IDS Data Centers.

- Creation of a Quasi-Static Zone (QSZ) for the management software, making it completely generic,
- Better on-board editing of perturbed measurement and DIODE contribution to Space Integrity Survey,
- Improved modeling for navigation software (Earth albedo, ocean tides, Moon-Sun positions, Earth Gravity field,...),
- More precise management of the Satellite attitude (solar array for Jason-3, “geosteering” model for Sentinel3)
- New Extra-Fine tuning
- New Auxiliary Data telemetry (Real Time pole & frequencies estimation)
- New services to altimeters (altitude variation rate for Jason-CS, Karin data for SWOT).

DORIS back in Goldstone

Jérôme Saunier (IGN)

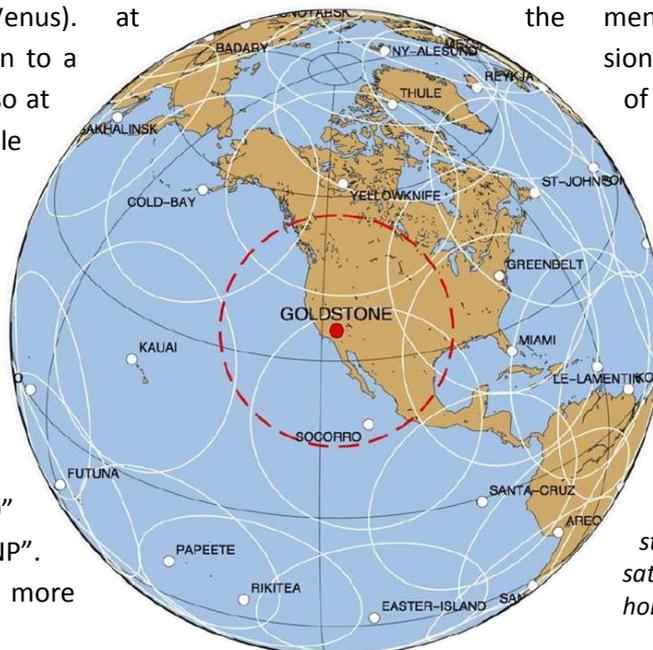


« GONC » and its transmitting environment

A new DORIS station, “GONC”, was installed last year (2015) at the Goldstone Deep Space Communications Complex (GDSCC) in California. The DORIS station is located adjacent to 250 m from DSS station 13 (Venus). The installation marks a return to a well-known site, which was also at one time occupied by mobile Satellite Laser Ranging (SLR) systems. DORIS actually occupied this site at Goldstone between 1988 and 2004 but the station was moved 300 km south to Monument Peak (east of San Diego, California) for co-location with the SLR tracking station “7110” and the GNSS station “MONP”. Geodetic sites where two or more

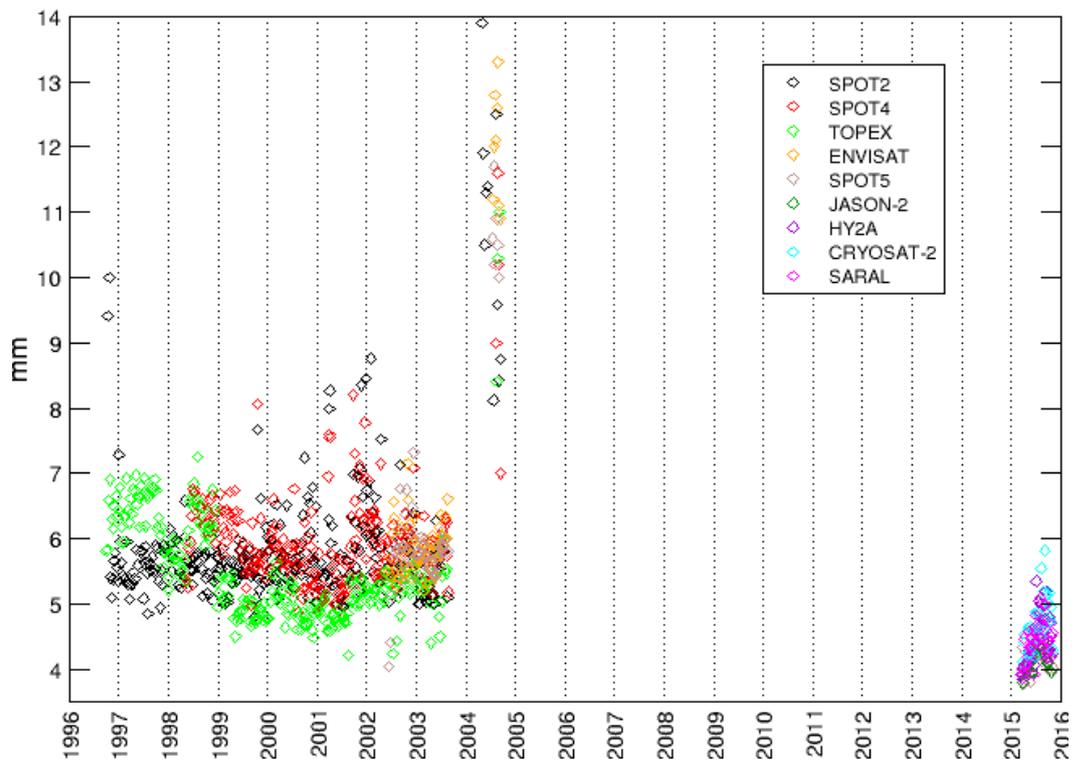
space geodesy instruments are closely co-located are essential for the determination of the International Terrestrial Reference Frame. Unfortunately, following insoluble conflict at the

2 GHz frequency with a nearby TV microwave relay system, which manifested itself after the US switched to digital television transmissions in 2009, the DORIS station of Monument Peak had to be decommissioned in 2010 after only 4 1/2 years of service. After discussion with NASA, it was determined that the remote location of the GDSCC in the heart of the Mojave Desert was then the best-suited option to ensuring a peaceful and safe environment for the DORIS station.



Visibility circle around Goldstone station for Low Earth Orbit (800km) satellite with 12° cut-off angle over the horizon

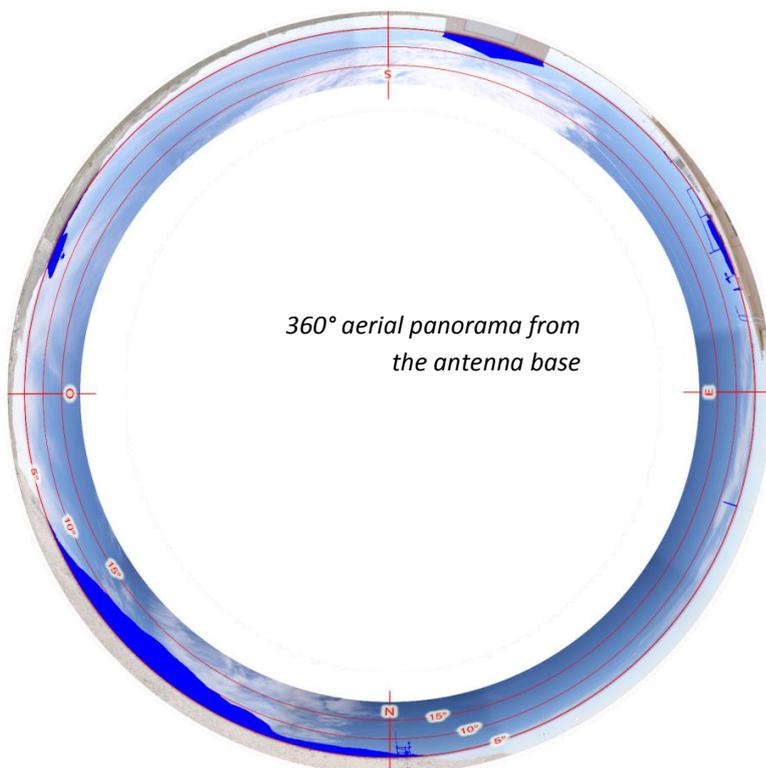
The return to service of DORIS in California is of great importance for the development of altimetry data products. A gap in coverage leads to degradation in orbit determination, which affects both the real-time orbits computed by the DIODE instrument on-board the DORIS-equipped satellites, as well as for the precise orbits that are computed later. This much-awaited station fills a hole in the DORIS data coverage over the northern Pacific Ocean. For Jason-2 and Jason-3, the Goldstone DORIS beacon provides direct tracking coverage while overflying the Harvest Platform altimeter calibration site in the Pacific Ocean not far from Santa Barbara, California. In addition, we observe that performance has improved compared to that obtained by the



Goldstone DORIS/POE RMS (courtesy of Philippe Yaya, CLS)

previous Goldstone DORIS station ten years ago: significant improvement can be seen in the Doppler data residuals in the DORIS POEs (Precise Orbit Ephemerides), which decrease by about 20%. The residuals of the precise orbit adjustment on

the Doppler measurements are good indicators of a ground station's performance with respect to the orbit determination quality. Even if this result is partially explained by the improvement of measurements and models achieved over the last ten years, a large part should be attributed to improvements in the antenna environment and the accuracy of the a priori station coordinates. This new station better complies with the current system requirements: suitable environment and a stable monument for the antenna.

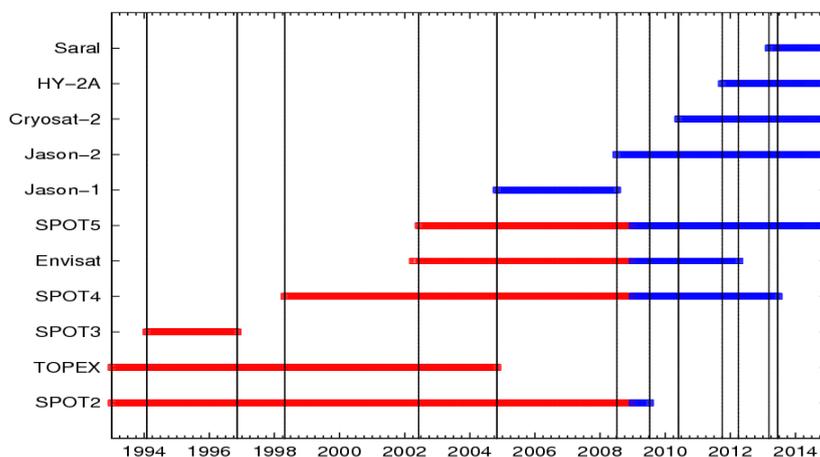


Our thanks to all Venus Station team at GDSCC for their active participation in the installation, and to JPL and NASA for their support dedicated to this project.

DORIS contributes to the International Terrestrial Reference Frame

Guilhem Moreaux (CLS)

Late February 2015, in the context of the 2014 realization of the International Terrestrial Reference Frame (ITRF2014), IDS delivered to the International Earth Rotation and Reference Systems Service (IERS) a set of 1140 weekly solution files including station coordinates and Earth orientation parameters. Since ITRF94, DORIS is one of the four fundamental geodetic techniques contributing to the realization of the International Terrestrial Reference System. The new series IDS 09, generated by the IDS Combination Center, is the combination of multi-satellite weekly solutions from the six IDS Analysis Centers over the time span from January 1993 to December 2014. The data come from eleven DORIS satellites: TOPEX/Poseidon, SPOT-2, SPOT-3, SPOT-4, SPOT-5, Envisat, Jason-1, Jason-2, Cryosat-2, Saral and HY-2A. The combination process yields a network of 160 stations located at 71 sites with 38 sites located in the



Time evolution of the DORIS constellation for ITRF2014 (red = ITRF2008 constellation - red + blue = ITRF2014 constellation). Vertical lines correspond to starting and ending dates of the DORIS missions

northern hemisphere and 33 in the southern hemisphere. For reference, the IDS network for ITRF2008 included 130 stations located at 66 sites with 34 (resp. 32) sites in the northern (resp. southern) hemisphere. The five new sites are: Betio, Cold Bay, Grasse, Socorro in the northern hemisphere and Rikitea in the southern hemisphere. Coordinate time series of all the DORIS stations from the

Analysis Centers and the Combination Center can be interactively visualized through the IDS web service (ids-doris.org/webservice). Thanks to the new capabilities of the latest generation of the DORIS onboard receivers, to the modernization of the DORIS ground network as well as to the modeling improvements, the IDS 09 series shows an internal position consistency of 10 mm or better after mid-2008.

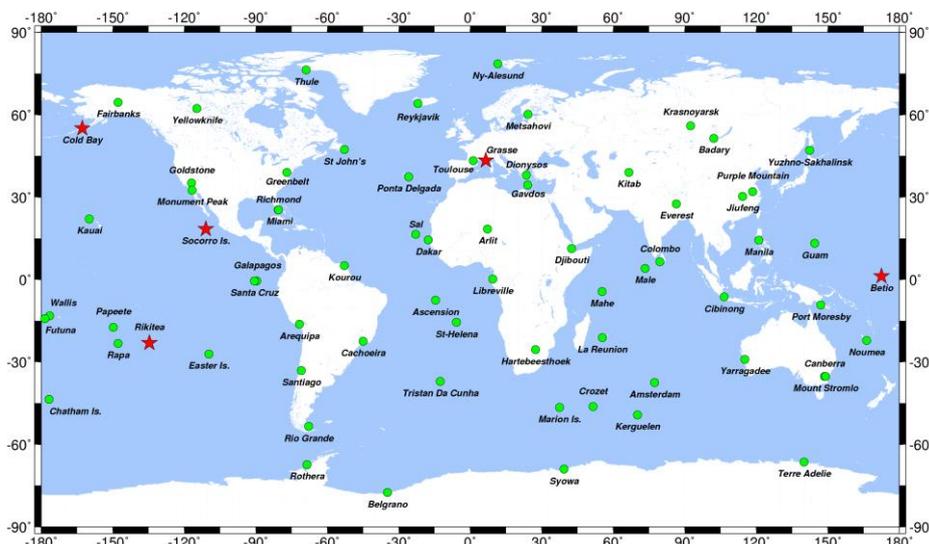
More details in:

Moreaux, G., Lemoine, F.G., Capdeville, H., et al., 2016.

The International DORIS Service contribution to the 2014 realization of the International Terrestrial Reference Frame.

DORIS special Issue*, [Advances in Space Research](#), doi: [10.1016/j.asr.2015.12.021](https://doi.org/10.1016/j.asr.2015.12.021)

* in preparation



Geographical distribution of the DORIS stations included in the IDS contribution to ITRF2014 (red stars indicate new sites with regards to ITRF2008).

GFZ first Associated Analysis Center

At its meeting in October 2015, the IDS Governing Board has decided to accept GFZ (German Research Centre for Geosciences) as an Associated Analysis Center, following the recommendation of the Analysis Coordinators, on the basis of GFZ's DORIS analysis activities.

Groups interested in accessing this status are invited to contact the Analysis Coordination (ids.analysis.coordination@ids-doris.org)

IDS Meetings 2016

26-27 May 2016, Delft, Netherlands.
IDS Analysis Working Group meeting at the TU Delft, Faculty of Aerospace Engineering.

31 Oct. – 1 Nov. 2016, La Rochelle, France.
IDS workshop 2016, in conjunction with the OSTST 2016 and a SAR altimetry workshop

Visit the meeting web page at

<http://ids-doris.org/meetings/ids-meetings.html>

IDS component renewal

➤ Combination Center

The selection of the Combination Center for 2017-2020 is established as follows:

- April-May 2016: Call for Participation
- End of August: submission deadline of expressions of interest
- Autumn: selection of the new team.
- January 1st 2017: start of the four-year term of the Combination Center

➤ Positions within the Governing Board

Three positions in the IDS Governing Board will be renewed for the term 2017-2020:

- (1) Data Center representative,
- (2) Analysis Center representative,
- (3) Member at Large.

The elections by the IDS associates will be held in autumn 2016



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