



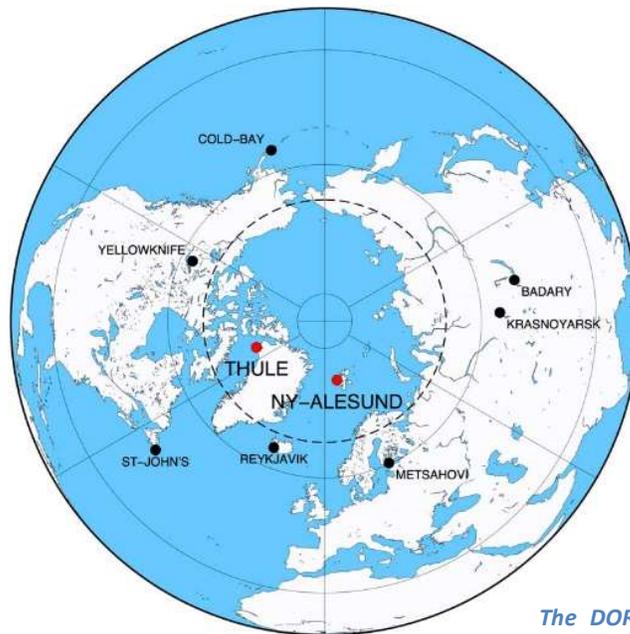
DORIS stations in Polar Regions, an ongoing challenge for continuous operation

Jérôme Saunier (IGN)

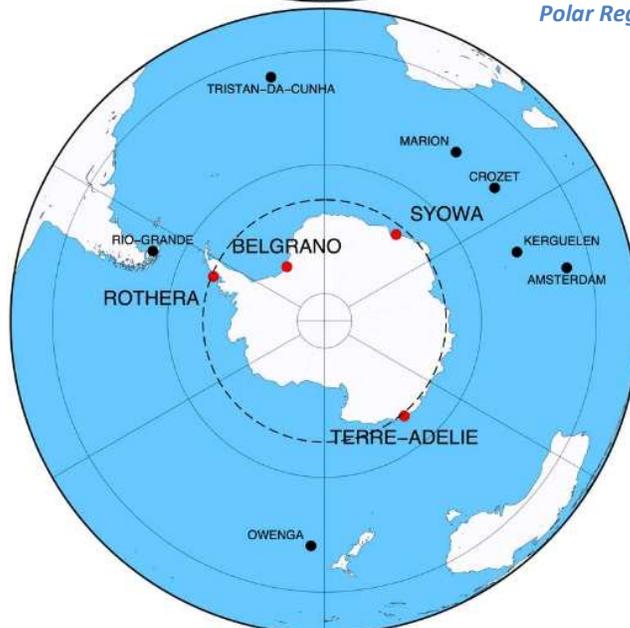
The DORIS network currently has six stations located in the Polar Regions: two in the Arctic (Ny-Ålesund in Svalbard and Thule in Greenland) and four in the Antarctic (Belgrano, Rothera, Syowa and Terre-Adélie). These regions are marked by the Arctic Circle and the Antarctic Circle located at a latitude close to 66° that corresponds to areas inside which the Sun does not rise or does not set at least once a year at winter or summer solstice: the center of the Sun is continuously below/above the horizon during at least one 24-hour period.

Because of the adverse living conditions, these regions have no permanent inhabitants. Only scientific research facilities set up there, strange places dedicated to peace and polar science...

In addition to the six DORIS stations in the Polar Regions, we could include those located in the sub-Antarctica islands: Amsterdam, Crozet, Kerguelen and Marion Islands that experience the same conditions: remote locations with a harsh climate.



The DORIS stations in the Polar Regions (red bullets)



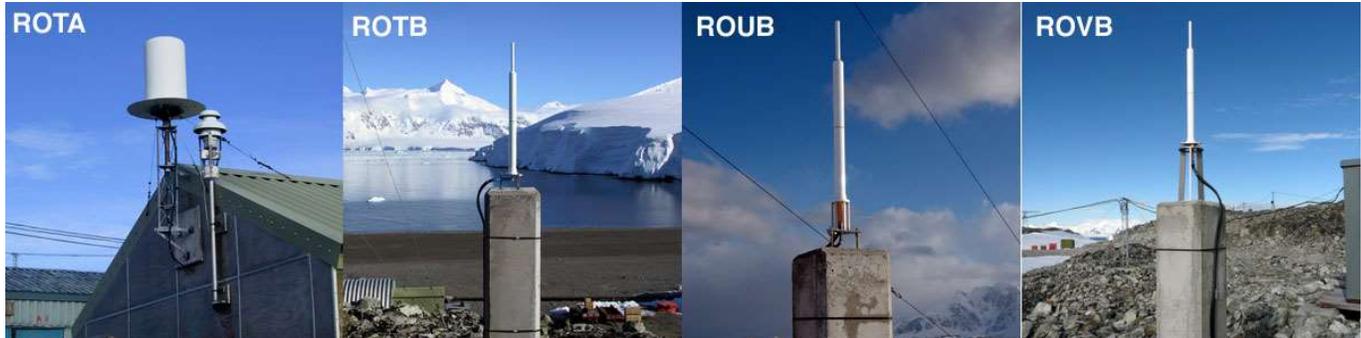
Focus on Rothera on the Antarctic Peninsula

The DORIS station at Rothera has been located since 1992 at the British Antarctic Survey (BAS) base on Adelaide Island, off the west coast of the Antarctic Peninsula. The staff on-site includes marine and terrestrial biologists, meteorologists, electronics

engineers and a logistics team. The main activities are biological research and the acquisition of data to monitor the climate change. A particular focus of study is the stability of the West Antarctic Ice Sheet (see below insert about the BAS). Teams rotate regularly, and on-site personnel drops to only 20 people in the austral winter (vs. an on-site presence of 100 people during the austral summer).

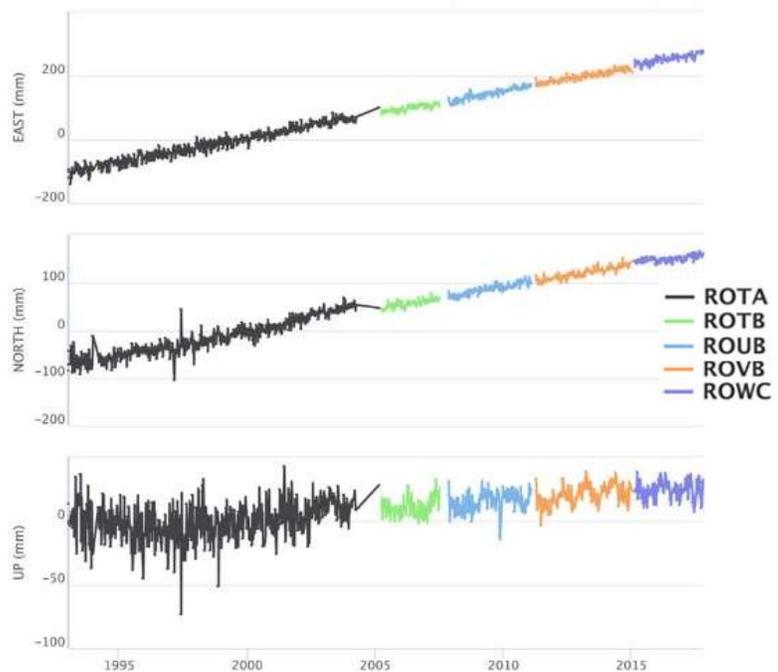
Notwithstanding these local constraints, the DORIS station relied on perfect maintenance to remain in an operational state.

Today, with more of 1200 number of weeks (23+ years!) of recorded data and with only a few short service interruptions, this DORIS station is rated as being among the most active and long-lived of the network.



Successive stages in the station evolution from ROTA (1992) to ROVB (2015)

Initially installed on the gable of a pre-fab structure (acronym "ROTA"), the station was moved and completely renovated in 2005. The antenna was set up on a new monument 260 m away, a concrete pillar anchored into the bedrock (acronym "ROTB"), designed to improve the station coordinates stability. Many other stations of the DORIS network were also renovated around this time with this objective in mind. Afterwards, on two occasions, the antenna support structure (metallic interface) was changed in 2007 ("ROUB") and 2011 ("ROVB") to better comply with the DORIS system requirements. In order to avoid any disruption in the position time series, high precision local surveys were carried out each time between the successive antenna locations. Due to the need to repair and extend the wharf, which requires the quarrying of a large quantity of rock, the DORIS station was relocated 70 m away, from the hill adjacent to the wharf, on February 27th, 2018.



Time series of DORIS site Rothera. These plots show the successive antenna positions and the continuous service of the station. The early time series is noisier due to the antenna type (Alcatel), the poorer stability of the monument, as well as the smaller number of satellites (2-4) in the DORIS satellite constellation from 1993-2002. The quality of the time series improves after installation of the new concrete monument. In addition, the expansion of the satellite constellation after 2002 and the increased number of observations from multi-channel DORIS satellite receivers also contribute to improve station repeatability. The velocities for the site are: 15.4 mm/yr East; 8.6 mm/yr North; 1.8 mm/yr Up.

The plot can be viewed and downloaded with the plot tools of the IDS web service at <https://apps.ids-doris.org/apps/stcdtool.html?site=ROTHERA>



Rothera DORIS station, ROXC, after relocation on Feb. 27, 2018

The BAS team provided valuable technical assistance before and during the operation, so that all work was carried out within the prescribed deadlines. The best location for the antenna was determined in accordance with the DORIS system requirements, in particular to have a clear view of the sky and the required monument stability. The new infrastructure necessary for housing the DORIS equipment is especially appropriate for operation under extreme conditions. A small prefab

hut (1 m³) big enough to house the electronics and instrument racks was set up on a concrete slab. This low-roofed shelter is less vulnerable to high winds and can more easily maintain a constant indoor temperature. The presence of DORIS stations in Polar Regions is important for Earth observation satellites and contribution to the climate change and global warming studies, such as the vertical movement of the Antarctic continent (including vertical motion from Glacial

Isostatic Adjustment or Post-glacial rebound and rebound of the land surface from recent melting of nearby glaciers). As DORIS-equipped satellites are in low Earth orbits with a high inclination angle (polar orbits), these stations are overflown very often and thus, contribute significantly to the precise orbit determination of these satellites. The robustness and the continuous service of these DORIS stations in the Polar Regions are invaluable.

Therefore, we welcome and recognize the efforts of all the local teams to keep the DORIS stations operating in such places where activity is so often constrained by harsh weather conditions. At Rothera, temperatures generally vary from -25°C to +5°C, and the station is affected by gale force winds for 70 days a year. Access to Rothera is by air (from the Falkland Islands or Punta Arenas, Chile) or by sea. The sea crossing from Port Stanley, Falklands lasts four days and occurs at least twice each summer to bring vital supplies, including food and fuel.

THE HOST AGENCY IN SHORT

David G. Vaughan, Director of Science, BAS



**British
Antarctic Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

British Antarctic Survey (BAS) is a UK national research organization. It delivers and enables world-leading interdisciplinary research in the Polar Regions. Its skilled science and support staff based in Cambridge (UK), Antarctica and the Arctic, work together to deliver research that uses the Polar Regions to advance our understanding of Earth as a sustainable planet. It operates five stations in Antarctica and sub-Antarctica islands, and annually deploys its two ships and five aircraft to Antarctica. Through its extensive logistic capability and know-how, BAS facilitates access for the British and international science community to the UK polar research operation. Numerous national and international collaborations, combined with an excellent infrastructure help sustain a world leading position for the UK in Antarctic affairs. British Antarctic Survey is a component of the Natural Environment Research Council (NERC). NERC is part of UK Research and Innovation.

<https://www.bas.ac.uk/>

DORIS on Sentinel-3B: and now seven!

CNES

A new DORIS instrument came to join its fellows a few months ago. It operates onboard Sentinel-3B which was launched in April 2018. With Jason-2, Cryosat-2, HY-2A, Saral, Jason-3, and Sentinel-3A, there are now seven active DORIS instruments, all the same DGXX generation.

Sentinel-3 is an European Commission mission designed to measure sea surface topography, sea- and land-surface temperature, and ocean- and land-surface color. Sentinel-3 is one of a series of missions, each covering a different aspect of Earth Observation and monitoring. Sentinel-1 is a SAR-dedicated satellite while Sentinel-2 is carrying an optical payload.

DORIS is part of the payload for the precise orbit determination of the Sentinel-3 satellites, together with a GNSS receiver and a Laser Retro Reflector (LRR). The DORIS DGXX instrument, developed by CNES, is able to track up to seven beacons simultaneously. It was shown that real-time accuracy of the DORIS navigation solution (DIODE) on Sentinel-3 is about 3.5 cm. DIODE is used to drive the open loop tracking mechanism of the SRAL altimeter. The Sentinel-3 GPS

receiver contributes to satellite control, provides accurate on-board timing and provides the measurements for the final POD analysis. The Laser Retro Reflector (LRR) is a passive device that acts as a target for laser tracking measurements performed by dedicated ground stations. The off-line POD performance is approximately 1 cm on the radial direction (nadir), as for the Jason satellites. The combination of both GPS and DORIS measurements in POD processing improves the final performance on the three directions.

Sentinel-3B was launched in April 2018 with a Rockot launcher and is currently in its commissioning orbit. It is in tandem with its twin Sentinel-3A (30 seconds ahead, corresponding to ~223 km). The mid-term topography review was held in the CNES premises on July 11-13 and showed that the satellite, instruments and ground processing are fully in line with mission requirements. The In-Orbit Commissioning Review will be held on October 16-17 at ESRIN. Products will be released widely after this review.



Sentinel-3 (source ESA)

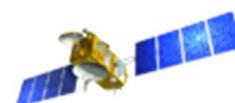
Jason-2, ten years after

CNES

On June 20th, the CNES, NASA, EUMETSAT and NOAA OSTM/Jason-2 marked its 10th year in orbit; completing 47,000 orbital revolutions of our planet. The mission continues to provide the altimetry community with high-quality products despite a few periods during which it is unavailable due to the ageing of some components.

In July 2017, Jason-2 was placed on a Long Repetitive Orbit (LRO) at an altitude of roughly 1309.5 km. One year after (when the first geodetic cycle was completed), Jason-2 was again moved to an “interleaved LRO” (i-LRO) so that more precise results are available for geodetic purpose. With the i-LRO, the ground track is now in the middle of the grid defined by the LRO.

Jason-2 coverage and products quality remains excellent and operational. Teams are doing their utmost to ensure the best possible data availability.



IDS meetings: a time to remove the nose from the grindstone

Guilhem Moreaux, Laurent Soudarin (CLS)

IDS retreat



Participants of the retreat, in the heart of Gascogne

After 15 years of activity, the IDS organized its first retreat on June 13 and 14 at Château de Mons, near the small town of Caussens, in Gascony, in the Southwest of France (country of the Musketeers and Armagnac). In addition to the members of the IDS Governing Board, eleven people including outside members of IDS such as Christian Bizouard (Observatoire de Paris), Klaus Börger (University of Bonn), Pierre Exertier (OCA), Oliver Montenbruck (DLR), Paul Poli (SHOM) were asked to work on the strengths, weaknesses, opportunities and threats of the IDS. To support the general discussions dealing with how to grow or to increase

the visibility of the IDS, five subjects of special interest (possible evolution of the DORIS technology, Precise Orbit Determination, interest in ionospheric-tropospheric derived products, DORIS geocenter and pole estimations, IDS scientific goals and organization) were addressed. The IDS retreat committee would like to thank all the attendees for the frank and opened discussions. From the minutes of all the discussions, the IDS Governing Board will write a preliminary version of the IDS strategic plan. The next step will be consultation with the DORIS system stakeholders. Then, the first IDS strategic plan including both medium and long-term actions will be made available by early 2019.

IDS Analysis Working Group meeting

A meeting of the Analysis Working Group (AWG) was organized at CNES, Toulouse, on June 11, in conjunction with the 7th Copernicus POD QWG meeting dedicated to Sentinel-3 that also took place at CNES on June 12. It was the opportunity for the participants of both meetings to share their results and to have fruitful discussions.

For the AWG, the priority #1 is the implementation of RINEX/DORIS processing by all the Analysis Centers to consider the DORIS data of the last satellites Jason-3, Sentinel-3A and

Sentinel-3B, crucial for the contribution to the next ITRF.

In response to the consultation for the preparation of the next ITRF solution sent by the IERS, the IDS has proposed an ITRF2020, considering the following steps:

- assessment of the new standards/models;
- start of the data re-processing in the second half of 2019 for at least 6-8 months to

reprocess the full history of DORIS observations;

-finally, evaluation and elaboration of the combination by the Combination Center for 9 to 12 months.



Participants of the AWG and Copernicus POD QWG

IDS life

IDS workshop 2018

The next IDS workshop is organized in conjunction with an exceptional Symposium on "25 Years of Progress in Radar Altimetry" and the annual Ocean Surface Topography Science Team (OSTST) meeting. These events will be held over 6 days, from 24 to 29 of September 2018 in Ponta Delgada, São Miguel Island, Azores Archipelago (Portugal)... just a few steps away from the DORIS station hosted by the Universidade dos Açores.

The final program is now available on the meeting website: <https://www.altimetry2018.org/>

IDS elections

Two positions in the IDS Governing Board will be renewed for the term 2019-2022:

- (1) Analysis Coordination,
- (2) Member at Large.

The elections will take place as follows:

- Sept.-Oct. 2018: nomination process of candidates
- Nov. 2018: vote by the IDS associates

IDS activity report 2017

The work of the IDS components between January and December 2017 is documented in the report available now on the IDS website at:

https://ids-doris.org/documents/report/IDS_Report_2017.pdf

Reminders

A complete list of **DORIS-related peer-reviewed articles** is regularly updated and available in the DORIS bibliography of the IDS website at:

<http://ids-doris.org/report/publications/peer-reviewed-journals.html>

DORIS products and IDS data are free, and no subscription is needed to get them. Find the **tables of Data & Products** at:

<https://ids-doris.org/ids/data-products/tables-of-data-products.html>

Presentations given at DORIS and IDS meetings (Workshops, AWG meetings) can be found on the page "**Meeting presentations**" at:

<https://ids-doris.org/ids/reports-mails/meeting-presentations.html>



Photo album of the IDS retreat, in the country of the Musketeers

IDS Newsletter

IDS

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