The International DORIS Service: almost 20 years old

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EGU23-15885 G2.3

IDS is approaching 20 years.

The IDS was implemented on July 1st 2003 under the umbrella of the International Association of Geodesy (IAG).

Since then it has guaranteed access to DORIS data and derived products for the user community thanks to a reinforced structure with:

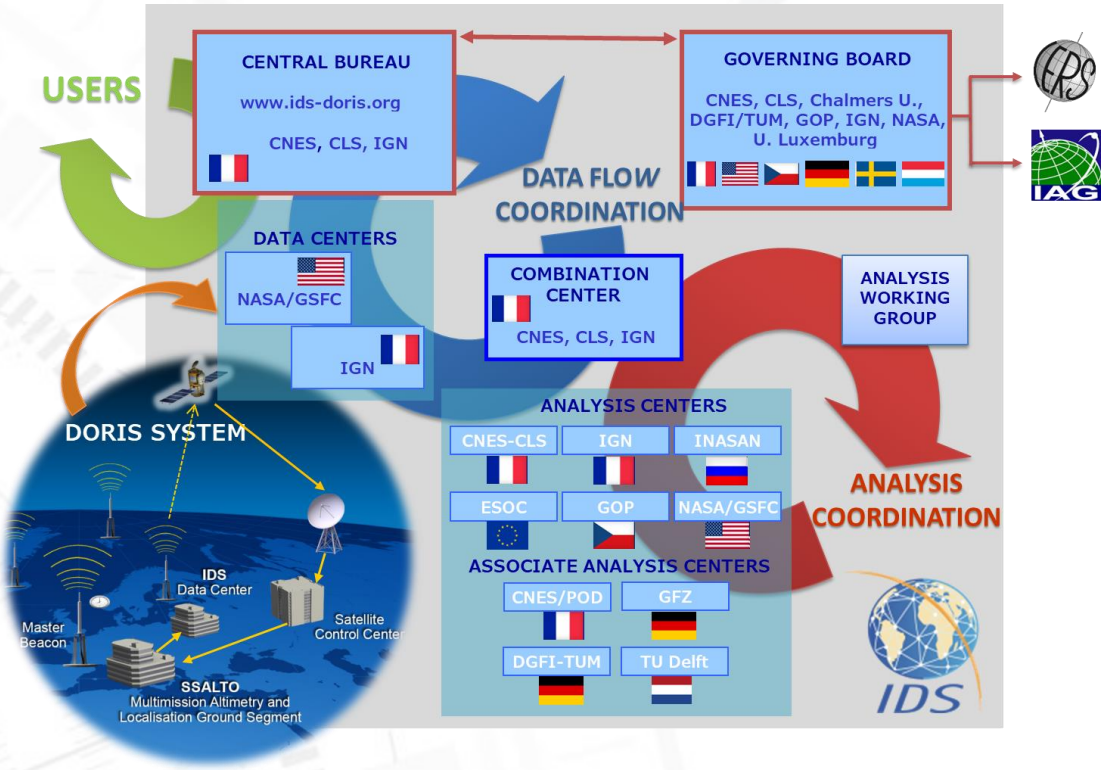
-two Data Centers,

-six Analysis Centers,

-four Associate Analysis Center,

-a Combination Center,

and several partner groups.



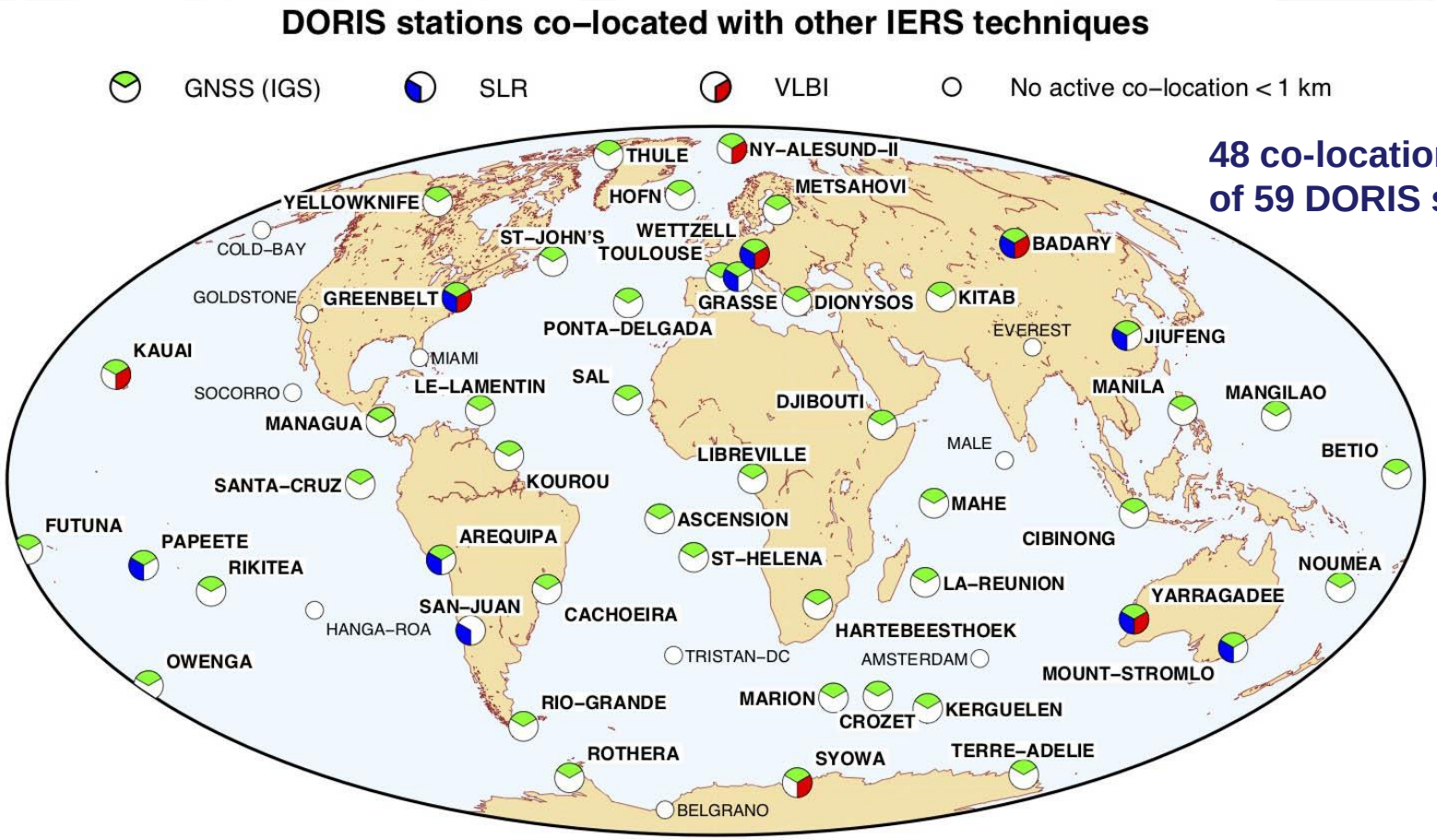
For some years now, the IDS has aimed to :

-grow the community,

-extend the DORIS applications,

-improve the technology, the infrastructure and the processing.

Current DORIS network

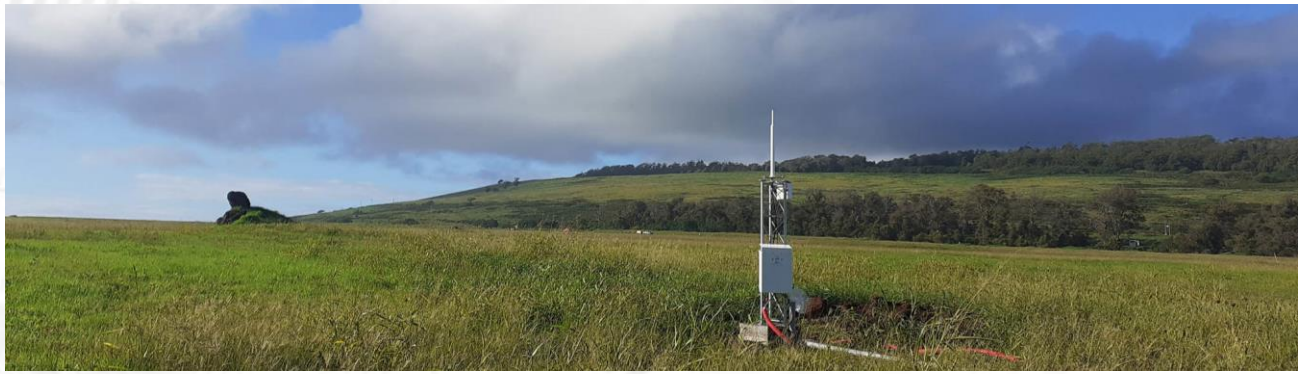


48 co-locations out of 59 DORIS sites

- **Good rate of stations in operation: 90%** (6 stations down)
- More than half of the network stations equipped with the 4th generation beacon (deployment started from mid 2019)
- Gradual replacement of the Starec B antenna with Starec C: 26/59 stations equipped

DORIS network evolutions

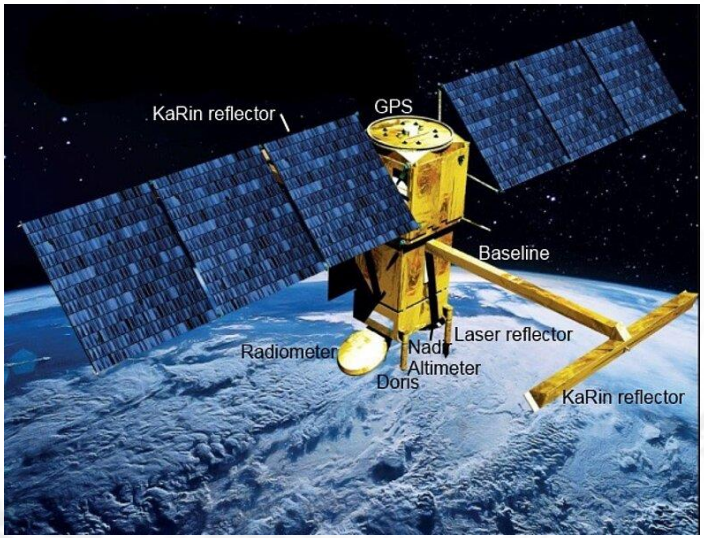
- **Recent Events**
  - April 13th, 2023: a new DORIS station at Hanga Roa (Easter Island)



- **Short Term (2023)**
  - New station installation in Katherine (NT, Australia): co-location with VLBI and GNSS
  - New station installation in Gavdos Island (Crete, Greece): ESA calibration site

- **Long Term**
  - New station in Ulaanbaatar (Mongolia)
  - New station in Changchun (China): co-location with SLR and GNSS

A new DORIS instrument in orbit

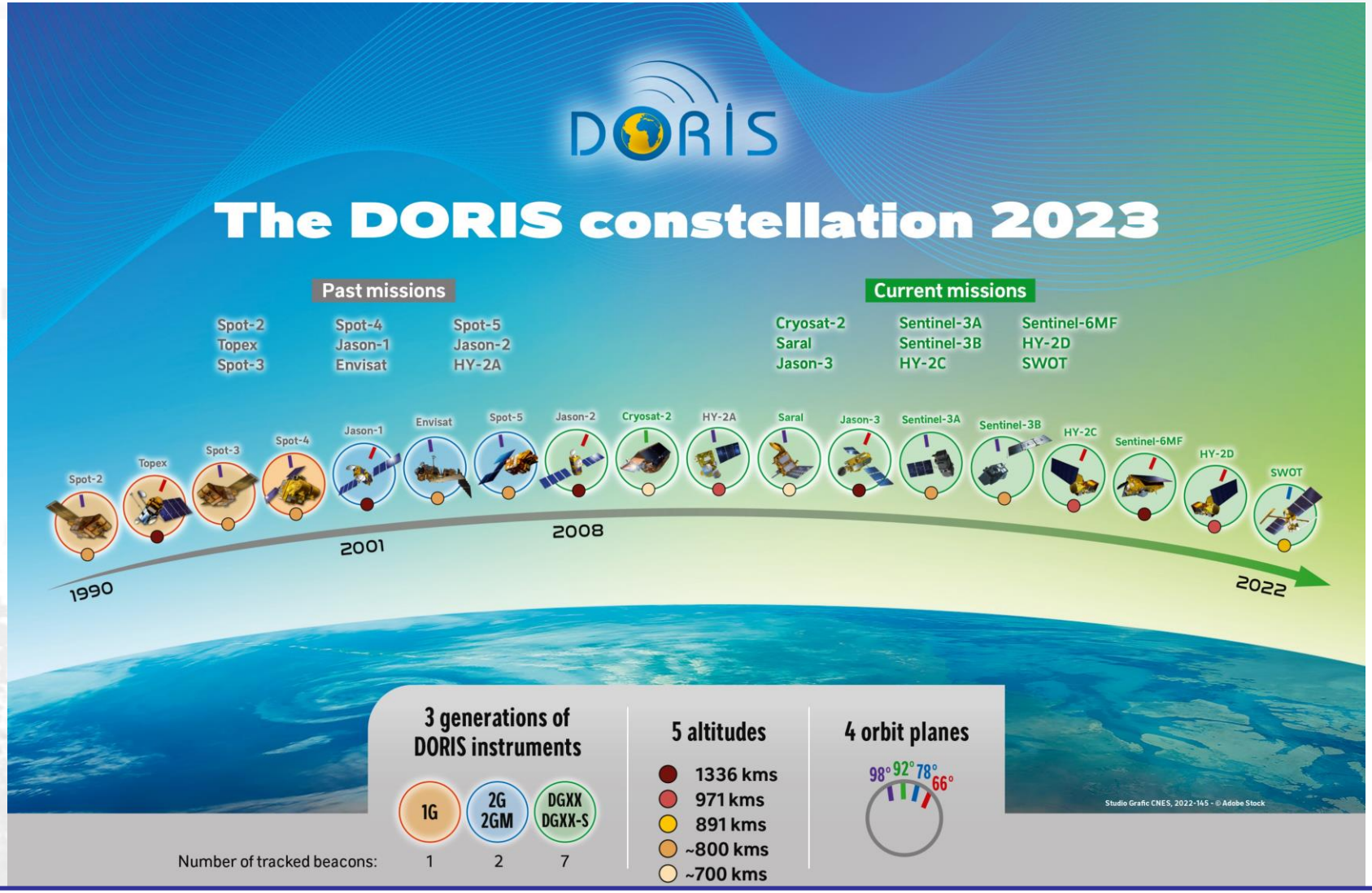


Surface Water and Ocean Topography

- Launched Dec. 16, 2022
- NASA/CNES mission + contributions from Canadian and UK space agencies
- Altitude 860 km, inclination 77 deg
- KaRin, a wideswath interferometric altimeter in Ka-band
- addresses ocean and hydrology objectives

DORIS on SWOT

- DORIS was switched on on 11 January 2023
- DGXX-S receiver including the **DIODE navigation software** which processes the DORIS measurements to produce an estimation of the satellite orbit in real-time with a precision of a few centimeters.
- DIODE estimated orbit **used to drive** the open loop tracking mechanism of **the nadir altimeter Poseïdon-3C** supplied by CNES
- NEW:DIODE **provides a 20-second prediction of the satellite position to KaRIn**, thus enabling better altimeter data acquisition in areas like coastal zones, inland waters and ice.



18= 9 +9 !

Nine past missions between 1990 (launch of SPOT-2) and 2020 (end of mission of HY-2A).

Nine DORIS instruments currently in operation, all the same DGXX generation, on board satellites launched between 2010 (Cryosat-2) and 2022 (Swot). A record !

Next missions and opportunities

❑ Next missions

Agreed

>Sentinel-3C (2025)

>Sentinel-3D (2 years later)

>Sentinel-6B (end 2025)

Pending approval

>Sentinel-6C (2030?)

>HY-2E and F

❑ Opportunities

- **ESA missions CRISTAL, Sentinel-3NG**: waiting for decision & confirmation about DORIS onboard
- **ESA Phase A GENESIS** (4 geodetic techniques: DORIS, GNSS, SLR and VLBI)
- **CNES Phase 0 study : DORIS / Galileo**

Challenging because of the altitude (20 000km)

C. Manfredi, V. Garcia, P. Ferrage: DORIS System status and future missions. IDS Workshop 2022

Publications

DORIS special issues:

2006 *Journal Of Geodesy*

2010 *Advances in Space Research*

2016 *Advances in Space Research*

→ **2023** *Advances in Space Research*: **soon published**

IDS Newsletters

since 2016

- Articles about the missions, the network, analysis results, IDS life
- Distributed by email and available on IDS web site

The IDS Newsletter #10 has just been released


IDS

10

Newsletter of the International DORIS Service April 2023

DORIS is on SWOT

A new satellite recently joined the constellation of DORIS satellites. It is SWOT, launched on 16 December 2022. There are now nine active DORIS instruments. Never before have so many DORIS instruments been in operation simultaneously.

SWOT (Surface Water Ocean Topography) is a joint project developed by NASA and Centre National d'Etudes Spatiales (CNES) with contributions from the Canadian Space Agency (CSA) and United Kingdom Space Agency. Thanks to its new technical concept, a wide-swath interferometric altimeter named KaRin for Ka-band Radar interferometer, the SWOT mission is the first satellite to address both ocean and hydrology objectives. It constitutes a major system design change for space altimetry.

SWOT includes the 18th DORIS receiver contributing to IDS and provides the DORIS constellation with a 4th orbit plane (78°). The instrument, a type DGXX-S receiver as on Jason-3, Sentinel-3A and Sentinel-3B, includes the DIODE navigation software (DORIS Immediate On-Board Determination) which processes the DORIS measurement to produce an estimation of the satellite orbit in real-time with a precision of a few centimeters.

On SWOT, the estimated orbit is used to drive the open loop tracking mechanism of the nadir altimeter Poseidon-3C supplied by CNES, and for the first time, DIODE also provides a 20-second prediction of the satellite position to KaRin, thus enabling better altimeter data acquisition in areas like coastal zones, inland waters and ice.

SWOT (© CNES / MIRA PRODUCTIONS)

DORIS was switched on on 11 January 2023 and very quickly the analysis of DIODE's calculations showed excellent performance for orbit determination and time tagging. Once again, the instrument has proven its autonomy and reliability.

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Contributions and feedback are welcome at any time

Please send them to:

ids-central.bureau@ids-doris.org

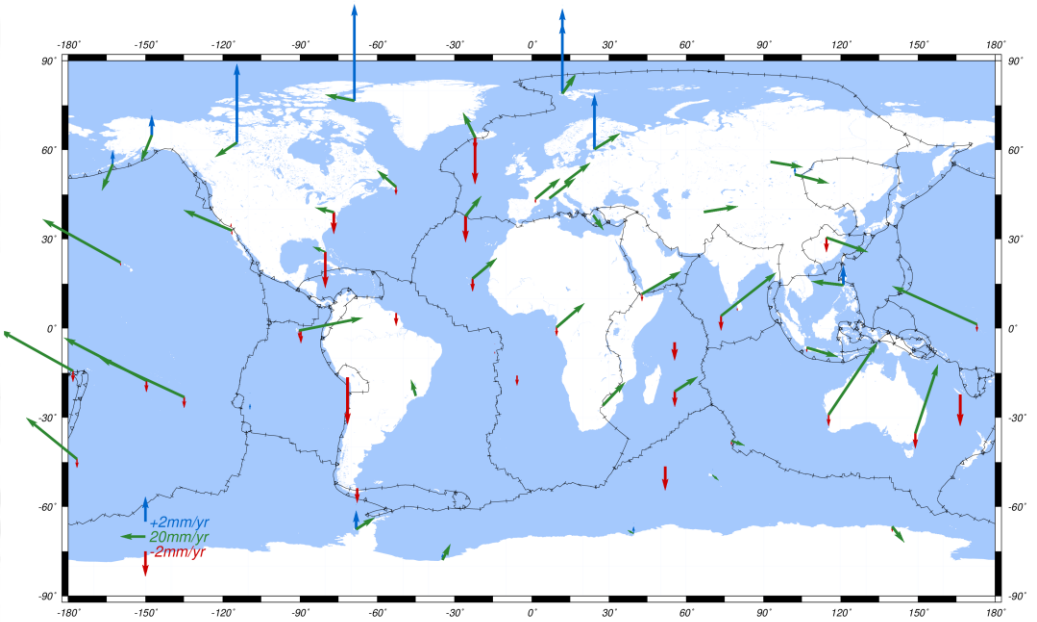
The editors reserve the right to edit all contributions.

Analysis activities

IDS contribution to the ITRF e.g. ITRF2005, ITRF2008, ITRF2014 and now ITRF2020

The DORIS combined solution for **ITRF2020** is based on weekly DORIS solutions

- from 4 operational IDS Analysis Centers: ESA/ESOC, Geodetic Observatory Pecný, CNES/CLS, NASA/GSFC
- using the observations from 14 DORIS satellites (from SPOT-2 to Sentinel-3B).



Horizontal and vertical DORIS ITRF2020 velocities with formal error less than 1 mm/yr

DPOD2020 a DORIS extension of ITRF2020 for Precise Orbit Determination

Addition of new stations to the tracking network after the end of the ITRF defined time span

✓ Shows good level of agreement with ITRF2020 as well as with DORIS-to-DORIS and DORIS-to-GNSS surveyed ties.

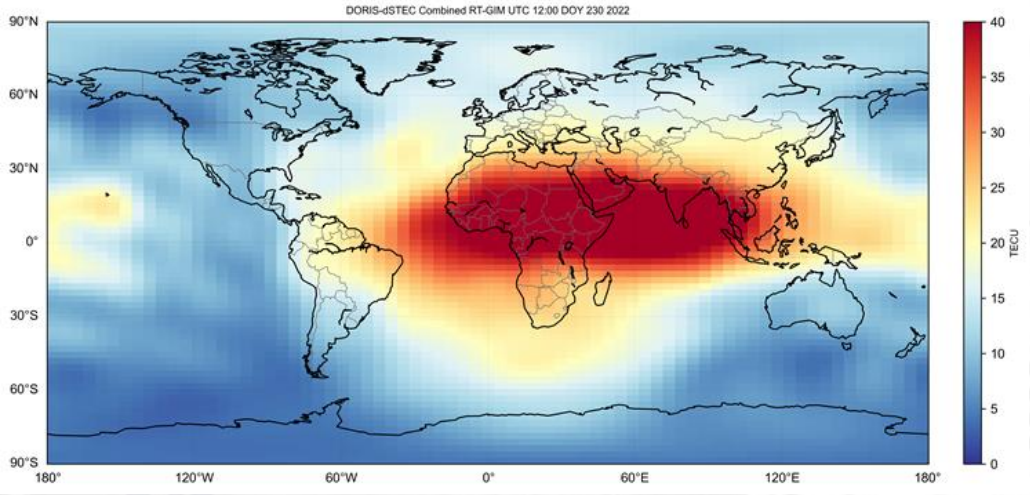
✓ Shows slight better POD performance compared to DPOD2014 and ITRF2020.

See Poster by G. Moreaux et al.
Mon, 24 Apr, G2.2, EGU23-3452

Analysis activities

Applications for ionospheric modelling (IDS WG NRT data)

- CNES made available DORIS data from the Jason-3 satellite in near real time (NRT) with a delay of a few hours.
- These data are perfectly suited for an independent validation of Real-Time Global Ionospheric Maps (RT-GIM) derived from GNSS measurements
- They can also be used to weight the models of individual data centres for combination.



Distribution of global total electron contents generated by DORIS-dSTEC combined RT-GIM on UTC 12:00 of DOY 230, 2022

See Poster by N. Wang et al.
Fri, 28 Apr, G1.3, EGU23-7575

Next step: make NRT DORIS data available for additional satellite missions (Sentinel-3A, Sentinel-3B, Sentinel-6A) and possibly also reduce the latency times.

This would then result in numerous further applications for ionospheric modelling.

Analysis activities to come

- ITRF2020 implementation in the DORIS data processing
- Processing DORIS data from HY-2C, HY-2D, Sentinel-6MF + SWOT
- Following the ITRF2020 processing:
  - Continue to analyze TRF Origin and Scale factor from single-satellite solutions to identify potential issues (wrong center of massvalue, USO sensitivity to SAA, …)
  - Use of quaternions for both bus and solar panels to help reducing the draconitic signals
  - Refine the mitigation strategy to reduce effect of South Atlantic Anomaly on station position estimation
  - Adopt updated geopotential model (eg. cnes_grgs_rl05 gravity model)
  - …

IDS future plans

- **A 2nd DORIS station for the IDS**

Call for participation issued in 2022 with aim at encouraging institutions and agencies involved in geodesy to express their interest in hosting a DORIS station and developing scientific collaboration with IDS.
The results of the proposal review will be announced in the next few weeks
→ **Soon a new IDS station**

- **Next IDS AWG meeting**, Fall 2023 (TBD), Paris, France

- **Next DORIS days in 2024**

The first “DORIS days” organized in November 2021 were introductory courses to give non-practitioners in DORIS the opportunity to broaden their knowledge of the DORIS technique as well as to provide information on IDS products.
→ **The next edition will be a training on DORIS data processing.**

- **IDS 20th anniversary**

A celebration will be organized in Berlin on the occasion of the IUGG