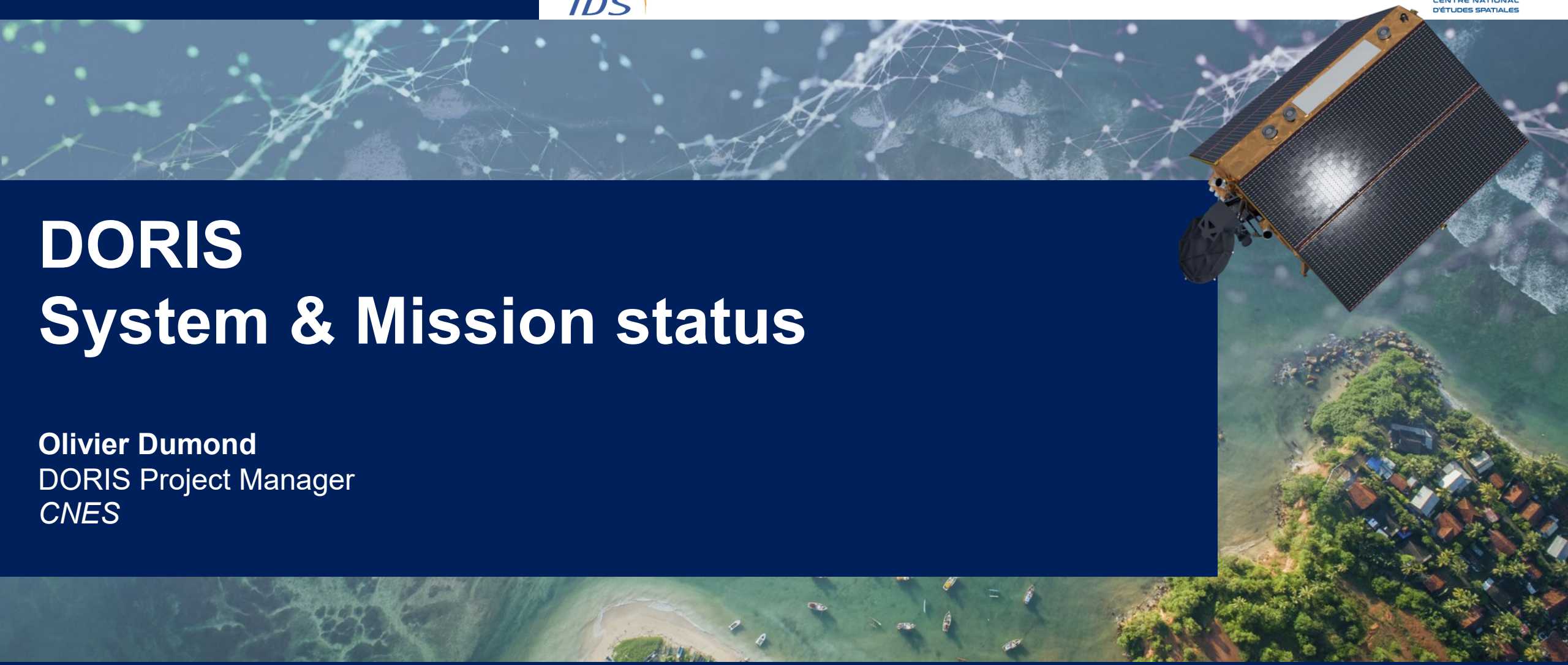
IDS Workshop **2026**



DORIS
System & Mission status

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IN PARTNERSHIP WITH

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New B4G in Kanpur (India)

Courtesy: IGN

History of DORIS Mission

System developed for precise altimetry born in July 1992 with the launch of the TOPEX/POSEIDON satellite resulting from a NASA/CNES cooperation

- **Prior demonstration with DORIS/SPOT2 launched in January 1990**
- **Operational today on 10 scientific satellites**

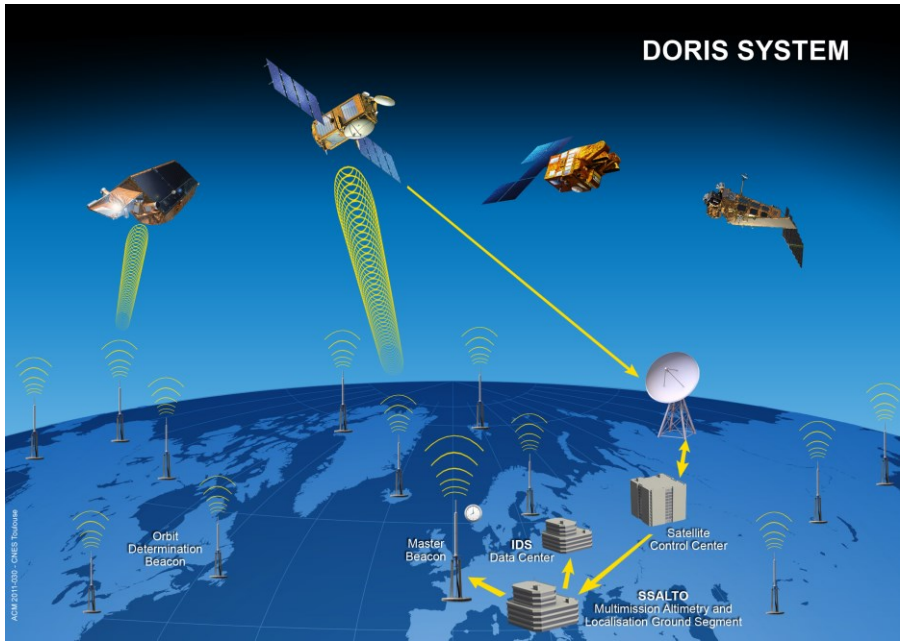
Legacy missions performed on the ground in deferred time (in TAI/UTC time scales):

- **Centimetric orbit determination (for altimetry i.e. ocean dynamics)**
- **Sub-centimetric ground positioning, one of the 4 geodetic techniques of the International Terrestrial Reference Frame (ITRF)**

Real-Time missions provided on board (in TAI/UTC time scales):

- **Sub-meter orbit determination in ITRF, also in inertial J2000 to within a few meters**
- **Timing of an event (top Pulse Per Second etc.) to within a few microseconds**
- **Standard frequency reference 10MHz stable to 10e-12 over 900s**

DORIS System



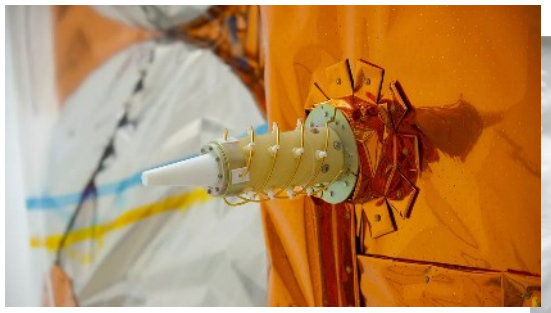
Ground segment

~60 sites, beacons DORIS 400M/2GHz, incl. :

4 Master beacon / time

1 Time beacon

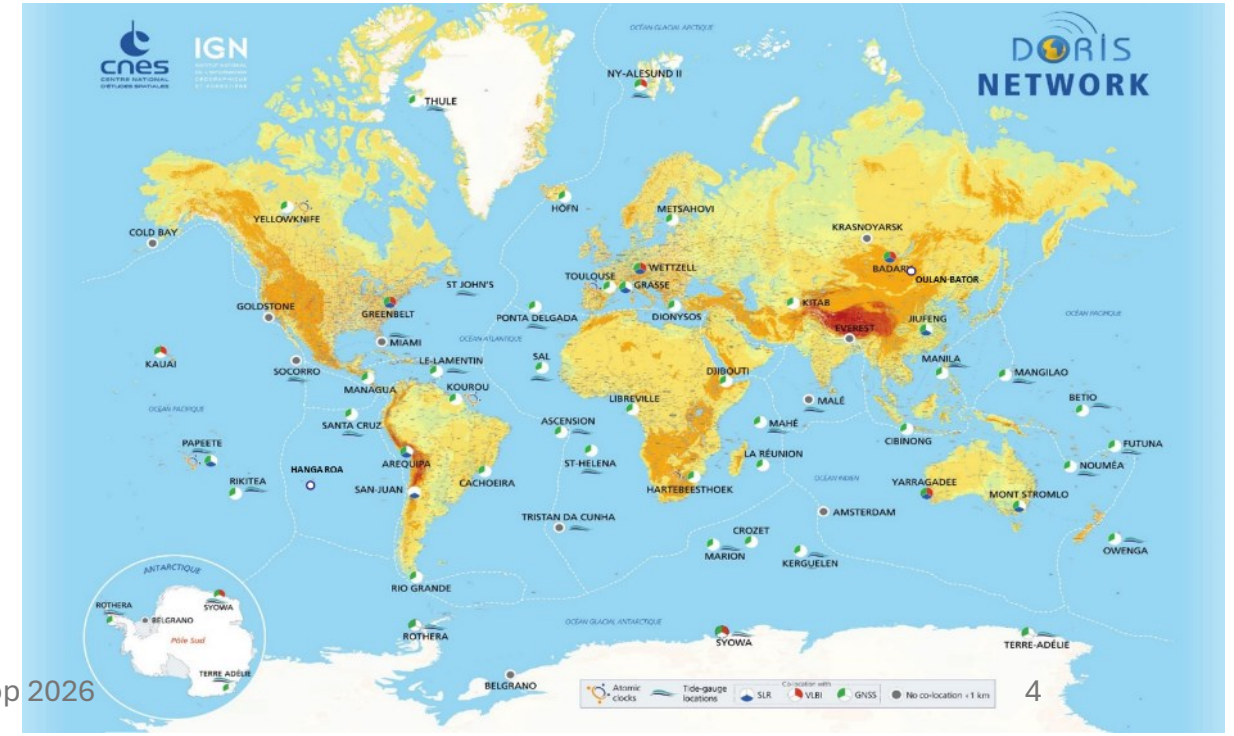
+ Multi-mission centre SSALTO



Space segment:

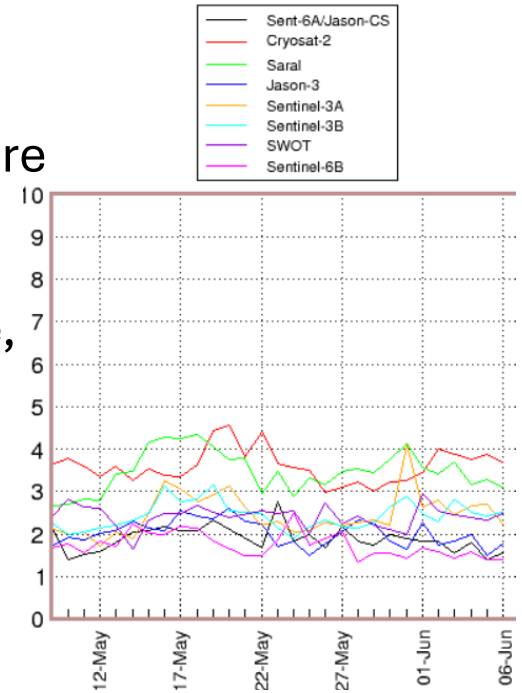
Redunded bi-frequency receiver: 400MHz and 2GHz

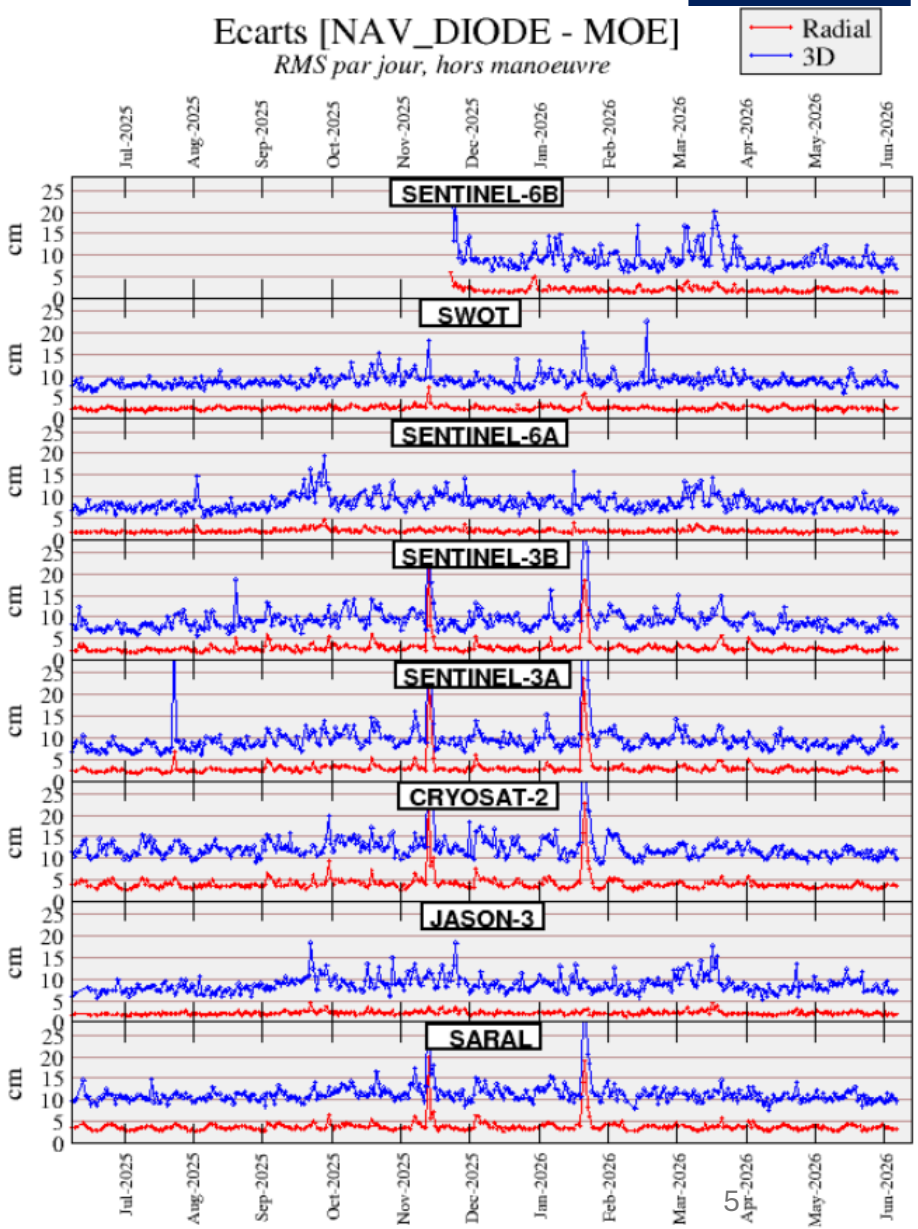
Antenna UHF/S



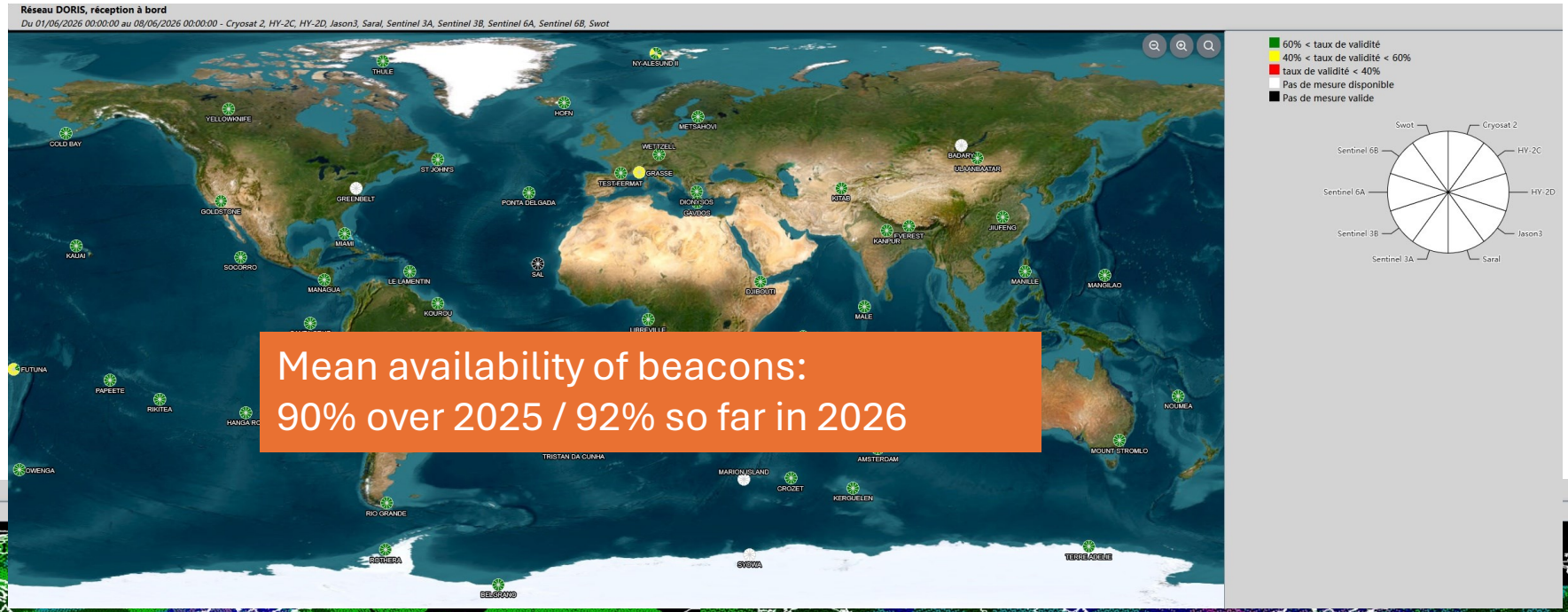
DIODE Navigator

- **DIODE (DORIS Immediate Orbit DEtermination) is an onboard real-time navigation software**
- It uses the Doppler phase measurements and timing measurements performed by the DORIS receiver
- Software developed since 1992 by CNES with technical assistance from AKKA then CLS
  - Used since 1998 (SPOT 4)
  - Integrated into the DORIS flight software
  - Autonomous operation
  - Excellent availability and performance, notably comparing the DIODE orbit and the Medium Orbit Ephemeris calculated on the ground



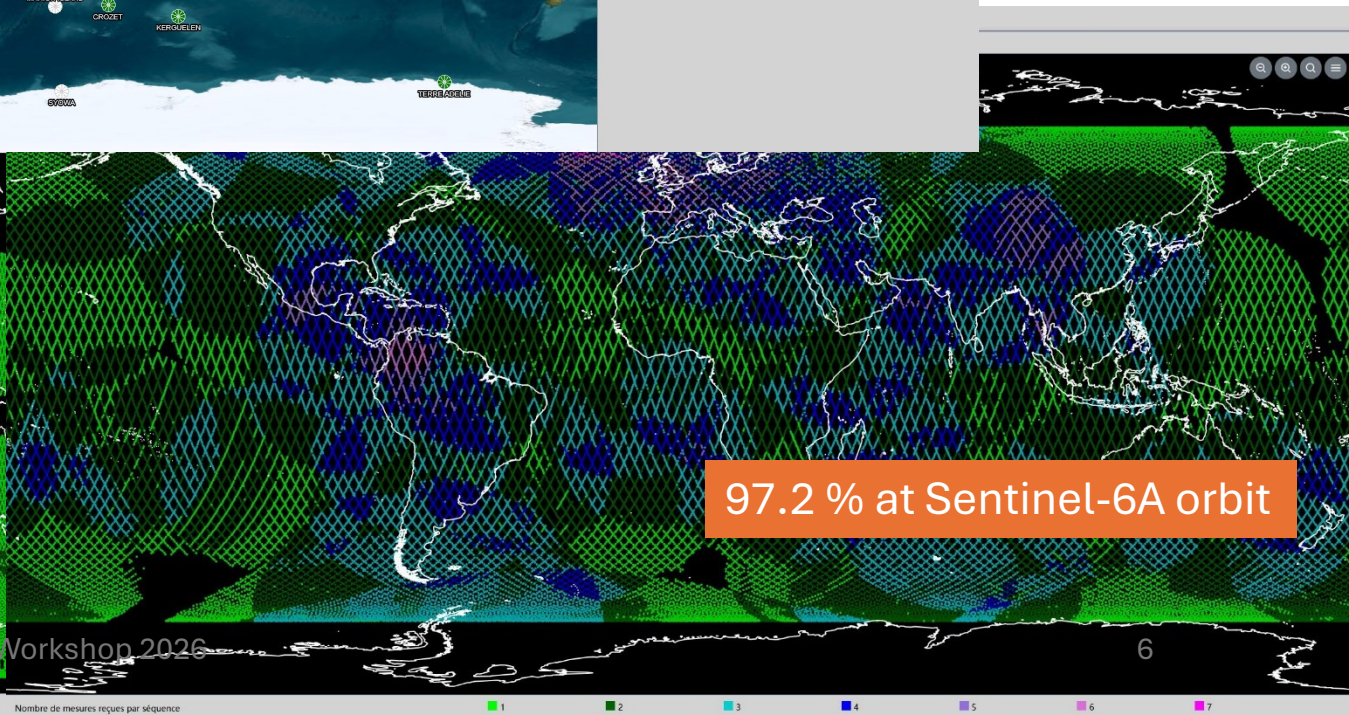


System coverage and availability



Mean availability of beacons:
90% over 2025 / 92% so far in 2026

83.5 % at Sentinel-3A orbit



97.2 % at Sentinel-6A orbit

DORIS "Constellation"




1990 2000 2010 2015 2020 2025 2030 2035

IDS Workshop

SPOT 2, SPOT3, SPOT4, SPOT5 D1 / D2

TOPEX D1, S, G

JASON 1, JASON 2 D2 / DX, S, G

ENVISAT D2, S

HY-2A DX, S, G

CRYOSAT2 DX, S

SARAL DX, S

JASON 3 DXs, S, G

SENTINEL-3A DXs, S, G

SENTINEL-3B DXs, S, G

SENTINEL-3C DXs, S, G

SENTINEL-3D DXs, S, G

SENTINEL-3NGT NEO, S, G

HY-2C DX, S, G

HY-2D DX, S, G

HY-2E DX, S, G

HY-2F DX, S, G

HY-2G, next gen DXs => NEO, S, G

JASON-CS2/SENTINEL-6MF DXs, S, G

JASON-CS2/SENTINEL-6B DXs, S, G

SWOT DXs, S, G

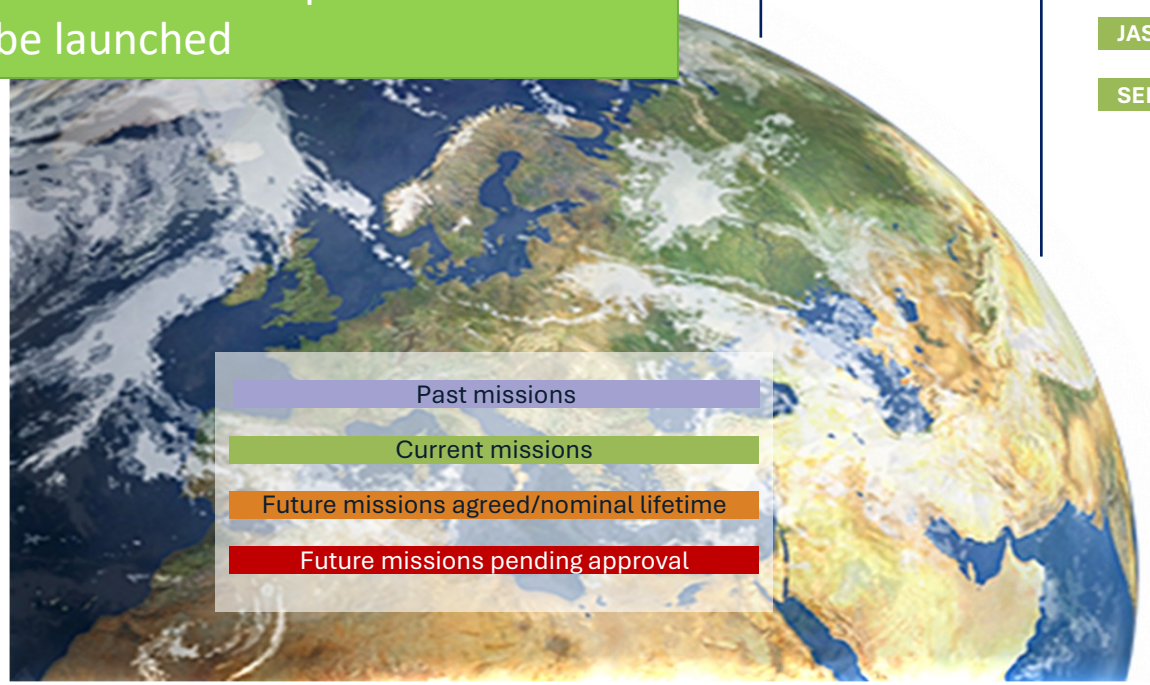
SENTINEL-6NG NEO, S, G

GENESIS DX, S, G

Today and future missions

10 instruments in exploitation

5 to be launched



Past missions

Current missions

Future missions agreed/nominal lifetime

Future missions pending approval

On board instruments:

D1, D2, DX, DXs, NEO (in development): DORIS/versions, **S**:SLR, **G**:GNSS

Today's mission

Missions in progress – the oldest – **nb=3**

- CRYOSAT-2 : 2010 => mission end planned in 2028
- SARAL : 2015 => prolongation each year (2028)
- Jason-3 : 2015 => mission end planned in 2 years (2028)

Missions in progress – the youngest – **nb=7**

- Sentinel-3A, B : 2016 / 2018
- Sentinel-6MF, B : 2020 / 2025
- HY-2C, D : 2020 / 2021
- SWOT : 2020

UPCOMING MISSIONS

Missions in AIT, launch preparation

- HY-2E : 07/2026
- Sentinel-3C : 10/2026
- HY-2F : 2027
- GENESIS : 2029
- Sentinel-3D : > 2030

Missions under discussion (for DORIS)

- Sentinel-6NG : > 2030
- Sentinel-3NGT : > 2030

Advantages and Perspectives

Performance

- Onboard real-time orbit determination (DIODE module) performed onboard with:
  - -> Decimetric 3D precision
  - -> Ability to provide an extrapolated position in the absence of beacon signal, with precision depending on the duration
- Autonomous and dual-frequency system: Doppler measurement is done on 2 frequencies (UHF: 401.25 MHz and S: 2.03625 GHz), the most performant and weighted for processing is the measurement at 2 GHz
- A network of beacons managed by CNES: deployment of next-generation beacons currently being finalized; guaranteed sustainability until at least 2035

Development of new receiver and antenna

- Optimized mass/volume and cost
- Performances maintained
- Better configurability (redundancy, performances, coupled with GNSS)

R&T Mixed DORIS/GNSS Receiver

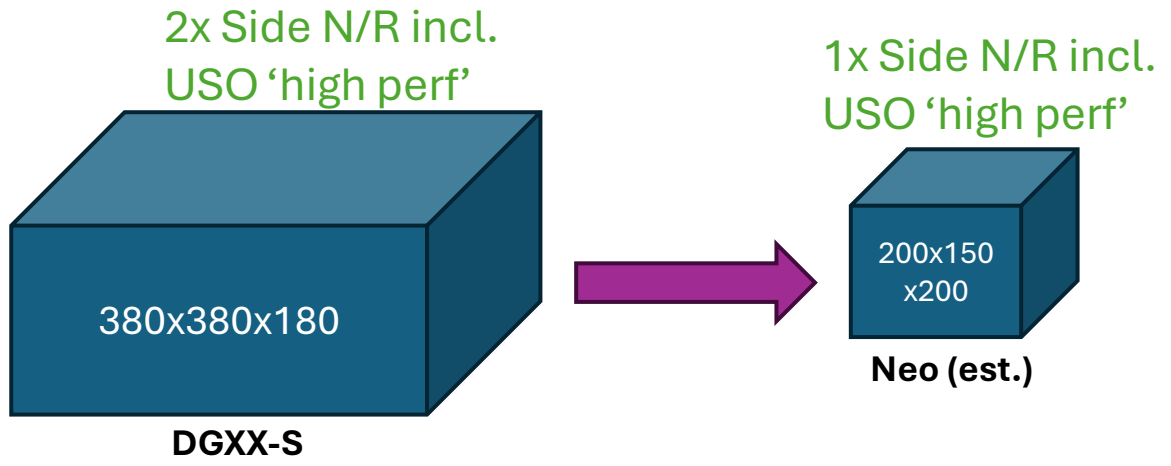
- First study completed
- Paved the way for new receiver development
- Ongoing reflection for the follow-up

Next DORIS Receiver and Antenna

DORIS NEO will represent the 5th generation of the DORIS receiver, featuring a technological breakthrough with the DGXX-S model.

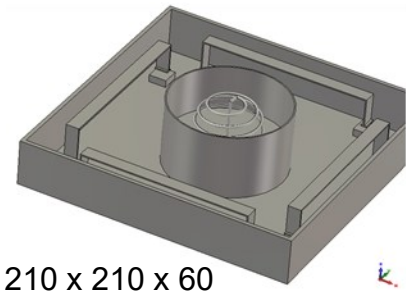
This new design incorporates a modernized architecture based on Software-Defined Radio (SDR), enhancing flexibility and performance. Key improvements include:

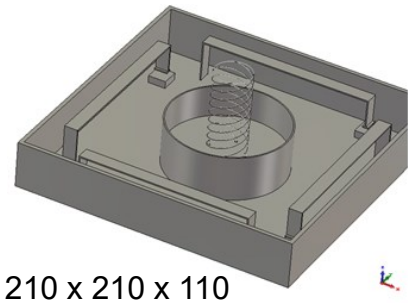
- **Enhanced modularity**, allowing for either redundant or single-chain configurations.
- **Two ranges of OCXO/USO** (Allan deviation from 10^{-13} to 10^{-12}), ensuring high precision.
- **Maintained functionalities and performance** for high-precision applications.
- **Expected availability**: Q1 2030.



New antenna design

- **More compact and lighter** while compensating for expected performance degradation through processing corrections (phase law).
- **Pre-studies conducted with CNES**, leveraging heritage from the Argos-Neo design.
- **Expected availability**: Q1 2030.



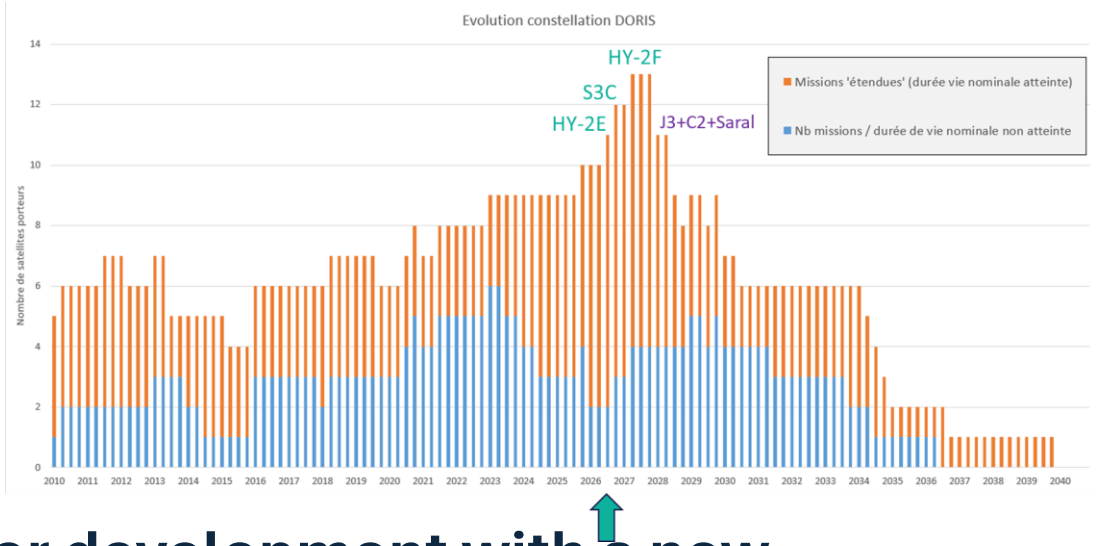


Dimensions in millimeter

Conclusions

The DORIS ground system is in excellent health in terms of performance and availability, offering very good coverage and is ready to support both current and upcoming mission lifetimes.

The number of DORIS instruments in operation is increasing, with a record target of up to 13 instruments in the coming years.



An onboard system (Receiver + Antenna) is under development with a new approach to ensure its compatibility with various applications, while maintaining a high level of performance for altimetry and geodesy.