The International DORIS Service: Current Status and Future Plans

Laurent Soudarin (1), Pascale Ferrage (2),

Jérôme Saunier (3), Frank Lemoine (4)

(1) Collecte Localisation Satellites, Ramonville Saint-Agne, FRANCE

(2) Centre National D'Etudes Spatiales, Toulouse, FRANCE.

(3) Institut Géographique National, St. Mandé, FRANCE.

(4) NASA Goddard Space Flight Center, Greenbelt, Maryland USA.

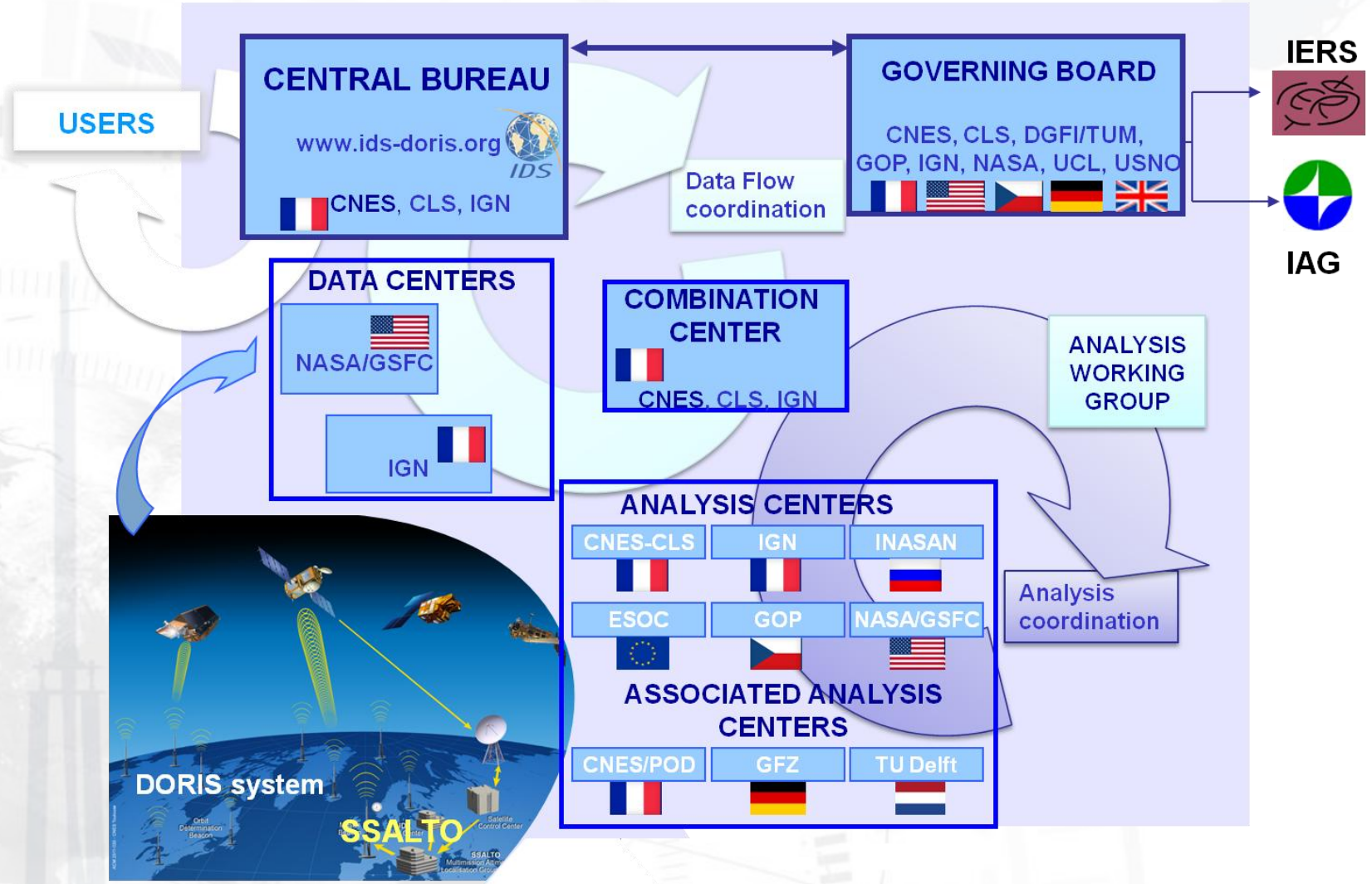
G07. Global Geodetic Observing System (GGOS) and Earth monitoring Services. Abstract: T001211

IAG-IASPEI Joint Scientific Assembly

July 30 – August 4, 2017

Kobe, Japan

IDS organization



IDS Update

- **Elections to Governing Board. New Members (as of Oct. 2017).**

  (1) Denise Dettmering (DGFI/TUM) – Member at Large

  (2) Patrick Michael (NASA GSFC) – Data Center Representative

  (3) Frank Lemoine (NASA GSFC) – Analysis Center Representative

  (Elected IDS Chairman by GB)

  (4) Petr Stepanek (GOP) – IAG Representative.

- **Creation of the WG « Near Real Time data »**

  Objective: to implement delivery of DORIS data in NRT for assimilation in ionospheric model and other potential rapid products,

  Chair: Denise Dettmering (DGFI/TUM)

- **New Associate Analysis Centers:**

  CNES/POD and TU Delft.

New Products from IDS Combination Center

Cumulative solution

- **long-term DORIS position and velocity cumulative solution updated and released every three months**
- obtained from the stacking of the weekly solution files and then aligned to the current ITRF
- a piecewise linear (position+velocity) model is used to describe the station motion

DPOD2014

- **DORIS extension of the ITRF for Precise Orbit Determination**
- Generated by IDS Combination Center from the DORIS cumulative solution
- **Contains positions and velocities of all the DORIS tracking stations, including brand new stations not already analyzed by the IDS Analysis Centers**

PRODUCTS AVAILABLE AT IDS DATA CENTERS

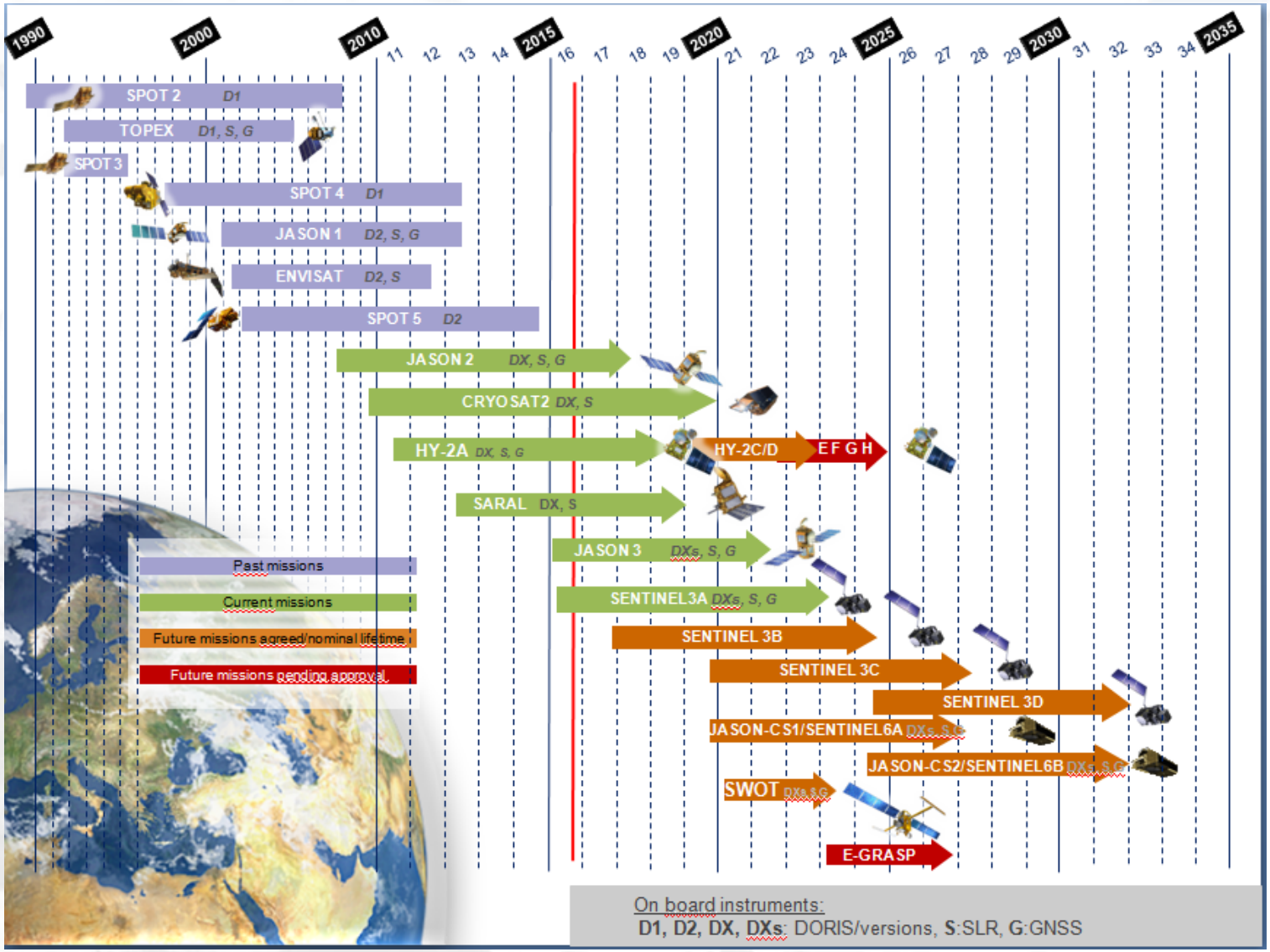
e.g. ftp://cddis.gsfc.nasa.gov/pub/doris/products

DORIS Satellite Constellation (July 2017)

Today (July 2017) 6 satellites contribute to IDS; 13 missions have contributed since 1990

Satellite	Agency	Alt. (km)	Incl. (deg)	Dates	Tracking
Sentinel-3A	ESA/EU	814	98.65	Feb. 2016 - 2024	DORIS+SLR+GNSS
Jason-2	Eumetsat/NOAA/NASA/CNES	~1310	66	Jun. 2008 - Present	DORIS+SLR+GNSS
Jason-3	Eumetsat/NOAA/NASA/CNES	1336	66	Jan. 2016 – 2022	DORIS+SLR+GNSS
SARAL	CNES/ISRO	800	98.5	Feb. 2013 – 2019	DORIS + SLR
HY2A	CNSA, NSOAS	960	99	Aug. 2011 – 2019?	DORIS + SLR + ~~GNSS~~
CRYOSAT-2	ESA	717	92	Apr. 2010 – 2020	DORIS + SLR
Jason-2: Moved to “Long Repeat Orbit”, July 3-10, 2017. HY-2A: GNSS data not publically available.					

A secure future up to 2030+



DORIS Network (July 2017)

<u>Pending replacement</u>:

Yuzhno-Sakhalinsk (11/2005)

Santiago (05/2013)

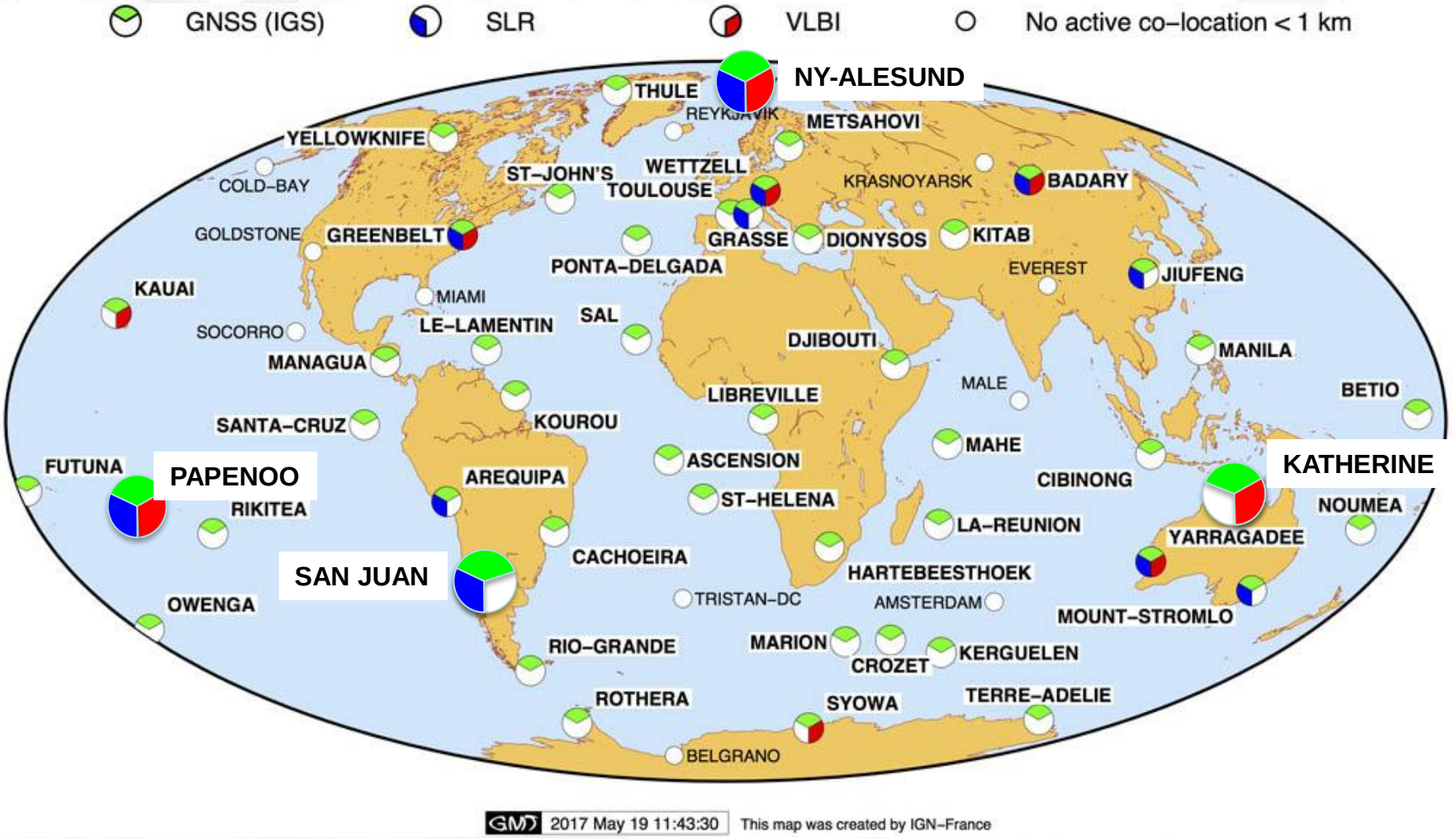
Port-Moresby (06/2013)

Easter Island (08/2015)

DORIS Network evolution

- **Scheduled in 2017**
  - **Santiago, CHL**: station re-location in Argentina, San Juan (SLR+GNSS).
  - **Guam, Mariana Islands, USA:** new site improves coverage in North Pacific
- **Planned in 2018**
  - **Rothera, Antarctica**: station re-location following refurbishment of the scientific base.
  - **Port-Moresby, PNG**: station re-location to northern Australia (Katherine)
  - **Ny-Ålesund, NOR**: station re-location 3km away (co-location GNSS+SLR+VLBI)
  - **Easter Island, CHL**: station re-location 5km away, at the airport
- **Under consideration**
  - **Northern Asia**: new site in place of Yuzhno in Manchuria (CHN)
  - **Reykjavik, ISL**: station re-location to get better performance.
  - **Papenoo, Tahiti, French Polynesia**: new 4 technique site project.
- **4th generation DORIS ground beacon**
  - Deployment could start from 2019. Will allow installation of the antenna up to 50m from the beacon

DORIS stations co-located with other IERS techniques



=> 3/4 stations co-located with GNSS; 10 with SLR; 7 with VLBI

Co-locations with VLBI

- A big challenge because of Electromagnetic Compatibility problems.
- While the VLBI system is designed to receive extreme weak signals down to –110 dBm, the DORIS beacon emits on a 2036 MHz frequency of +40 dBm
- Solutions found at Greenbelt and Wetzell with the VGOS stations after many DORIS/VLBI RF compatibility tests performed under real conditions.

DORIS @ Wettzell: a good compromise

•VLBI: enough attenuation through distance and barrier

•DORIS: Operation on demand: 25% duty cycle, no effect on satellite reception

•DORIS: elevation mask around 10°: acceptable
•Co-location: excellent ties with VLBI, SLR, GNSS.

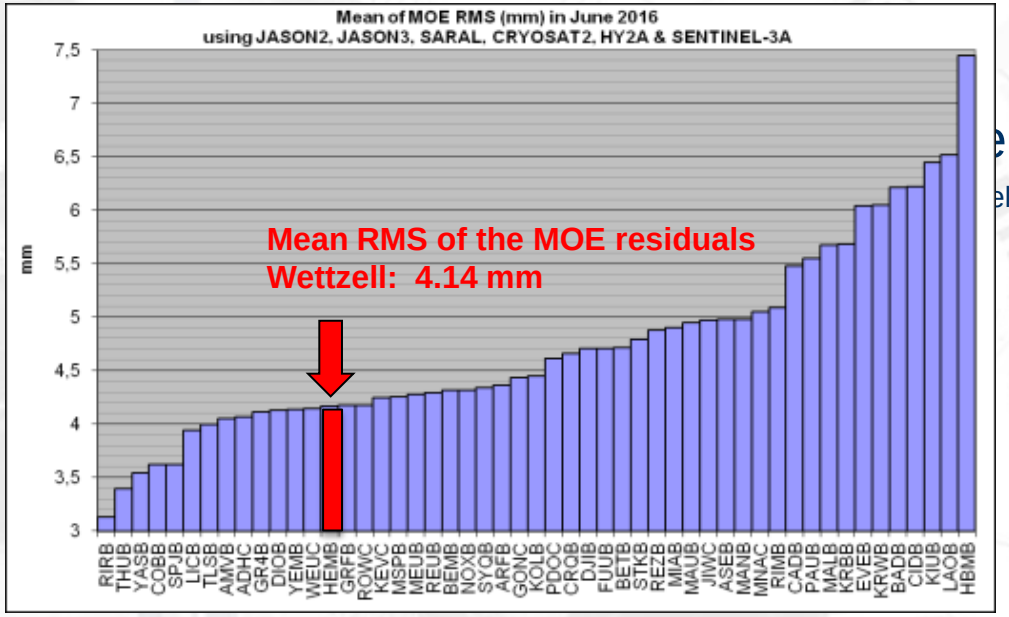
Excellent collaboration between CNES/IGN and BKG to define installation requirements

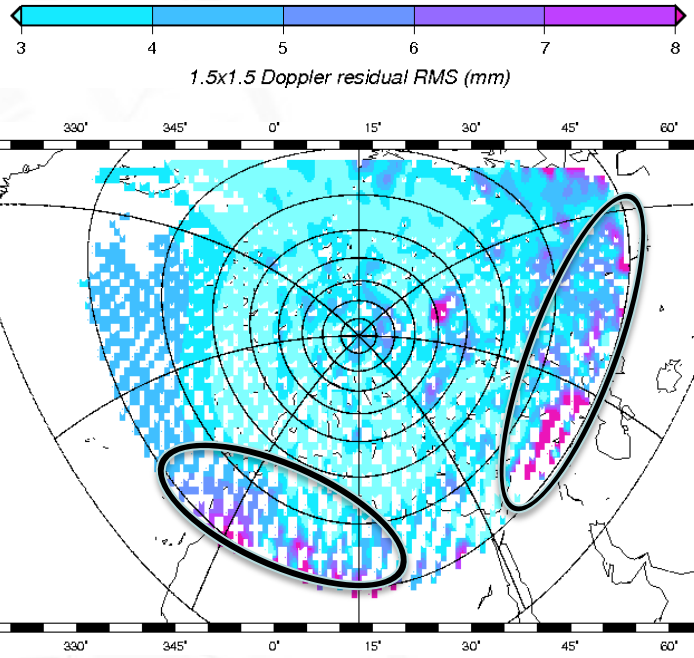
DORIS antenna « WEUC » and the 20m VLBI telescope, RTW

DORIS station at Wettzell **(WEUC)**

- Station "**WEUC**" commissioned in September 2016
- Good performance: 13th in the network ranking
  - Mean residuals RMS in the orbit adjustment processing: 4.14 mm
  - Good distribution of the MOE residuals (small degradations below 20° in S. and E. direction)

Analysis by P. Yaya, CLS





New Starec Beacons "xxxC" (like Wettzell) have 2-GHz phase center location defined to ± 1 mm.
(~11 "xxxC" beacon stations already deployed)

GONC – Goldstone

JIWC– Jiufeng

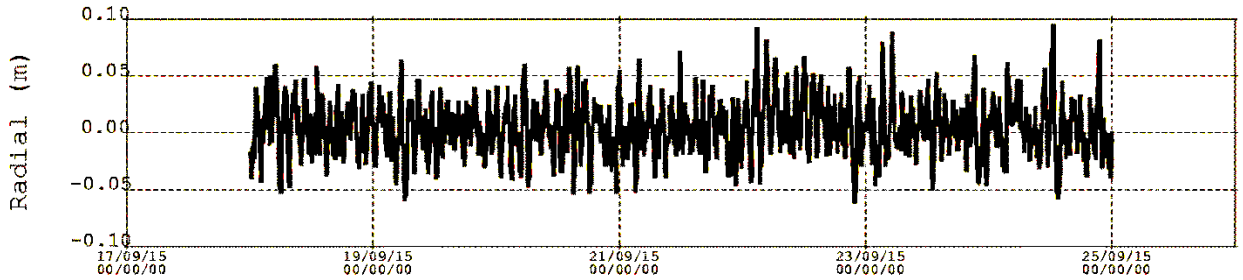
ADHC –
Terre Adélie (Antarctica)

WEUC - Wettzell

DORIS/DIODE NRT products

- Part of the DORIS instrument which calculates the satellite's position on board in real time
- This Real-Time orbit is inserted in the telemetry and in the OGDR products to allow Near Real-Time applications (e.g. altimeter data)
- New estimates with DORIS/DIODE on Jason-3 and Sentinel-3A:
  - pole coordinates and drifts
  - beacon and satellites USO frequencies.
- and drifts

→ available in Near Real Time (typically 3h)



DIODE navigation Radial component over a 7-day period, compared with POE (GDR-E). Discrepancies are plotted in meters, Radial RMS=2.5cm.

"DORIS System and Integrity Survey", C. Jayles, et al., *Adv. Space Res. 58(12)*, 15 Dec. 2016, doi:10.1016/j.asr.2016.05.032

Summary

- **DORIS system operating since 1990**

Now:

(1) 6 satellites, 59 ground stations, 45 co-locations with other IERS techniques

(2) « Beacon C » series is being deployed (control 2 Ghz phase center to +/- 1 mm.

Future: several more satellites to come up to 2030+, 4G beacon in development.

- **International DORIS Service since 2003**

Now: 6 Analysis Centers, 3 Associate analysis centers, 2 Data Centers, 1 Combination center, CB, GB, AWG.

Work in progress:

DORIS/RINEX format, ITRF2014-related issues to address, USO's sensitivy to SAA…

Future Plans:

WG on NRT data

IDS retreat to prepare the future (2018)

IDS Workshop in Ponta Delgada, São Miguel Island, Azores Archipelago (Portugal) by the end of September 2018

Contact: ids.central.bureau@ids-doris.org