The International DORIS Service: Current Status and Future Plans

Laurent Soudarin, Pascal Willis, Richard Biancale, Pascale Ferrage, Hugues Capdeville, Jean-Michel Lemoine, Brian Luzum, Guilhem Moreaux, Carey Noll, Michiel Otten, Jérôme Saunier, Marek Ziebart
What is the IDS?

The International DORIS Service is an IAG service created in 2003

- To provide a support, through DORIS data and products, to geodetic, geophysical, and other research and operational activities

- To give access to data, derived products and informations related to the DORIS system

IDS submits DORIS solutions to IERS and participates in GGOS
## IDS products

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<td>CDDIS; IGN</td>
<td>stcd</td>
<td>IDS CC, ACs</td>
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<tr>
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<tr>
<td>Earth Orientation Parameters</td>
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<td>ionosphere</td>
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<td>10 s</td>
<td>CDDIS; IGN</td>
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<td>combination</td>
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IDS meetings

IDS Workshop: 1 every 2 year (with OSTST meeting in Europe)
Analysis Working Group (AWG) meeting: 1 or 2 every year

2016
- AWG Meeting, Delft, The Netherlands, 26-27 May 2016

2017
- AWG Meeting, London, UK, May (TBC)
- First IDS Retreat (TBD)
IDS life: latest news

- Frank Lemoine, new Analysis Center representative has been designated as the Chair of the IDS GB for 2017-2020

- CNES/CLS will operate the Combination Center for another 4-year term

- 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)
Analysis activities in progress

- Combination Center: Extension of the combined series contributing to ITRF2014 from Jan. 2015 to June 2016

- CC: construction of the so-called DPO2014 (DORIS extension to ITRF2014 for POD) based on DORIS combined cumulative solution (see poster by Moreaux et al., G41A-1006)

- Analysis Centers: implement DORIS RINEX data processing

- ACs: include Jason-3 and Sentinel-3A

- ACs: switch to ITRF2014 for IDS operational products
Analysis activities to come

- Evaluation of DTRF2014, ITRF2014 and JTRF2014

Issues to be addressed:

- DORIS scale increase in 2012 → understood
  
  (see poster by Capdeville et al., G41A-1005)

- Scale issues on SPOT-5 (sawtooth pattern)

- Increase of DORIS residuals from Jan. 2013 for all missions

- Jason-2 and Jason-3 USOs: sensitivity to radiations of South-Atlantic Anomaly

- New phase law for ALCATEL ground antenna
18 papers grouped under five themes:
(1) ITRF2014;
(2) DORIS Ultra Stable Oscillator (USO) -- Jason2;
(3) Precise Orbit Determination;
(4) DORIS System and Network
(5) Intertechnique comparisons of DORIS Products

Guest editors:
   Frank G. Lemoine (NASA/GSFC, USA)
   & Ernst J.O. Schrama (T.U. Delft, The Netherlands)
DORIS in a few words

Doppler Orbitography and Radiopositioning Integrated by Satellite

A satellite tracking system, designed for POD and high accuracy positioning

An uplift and centralized system based on:
- a network of emitting stations covering the globe
- onboard receivers able to track up to 7 stations simultaneously (DGXX receiver)
- a Control Center receiving the DORIS measurements at each satellite pass
Co-locations with other IERS techniques

45 co-locations with GNSS, 9 with SLR, 6 with VLBI
Co-locations with tide gauges

28 co-locations: 13 within a 1km radius, 4 at 1-3km, 11 at 3-10km
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 $-110\,\text{dBm}$, the DORIS beacon emits on a 2036 MHz frequency of $+40\,\text{dBm}$.
- Solutions found at Greenbelt and Wettzell 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, SAR.

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

*(see presentation of Klügel et al., IDS Workshop 2016, on IDS website; also IDS Newsletter #2)*
Network evolution

**RECENT EVENTS**
- Apr. 2016: **new station at Managua**, Nicaragua (near IGS station “MANA”)
- Jun. 2016: re-location at Kitab, Uzbekistan (major renovation to get better visibility)
- Sep. 2016: **new station at Wettzell**, Germany (4th geodetic site including all four of the techniques)

**SHORT TERM (Next 6 Months):**
- San Juan, AR: **new station in place of Santiago** (3 techniques site)
- Socorro, MX: restarting (equipment replacement)
- Easter Island, Chile: relocating (hosting migration)
- Guam, US: **new station** (near IGS station “GUUG”)

**LONGER TERM:**
- Katherine, AS: **new station in place of Port-Moresby** (3 techniques site)
- Ny-Ålesund, Spitzberg, NO: relocating to the new geodetic observatory (4 techniques site)
- Changchun, CN: **new station in place of Yuzhno-Sakhalinsk** (3 techniques site)
- Reykjavik, IS: relocating (site closure)
- Tahiti, FR: **new 4 techniques site** under construction
Developments in progress

- **4G beacon**
  New electronic (with up to-date components)
  Antenna cables allowing to install it up to 50m from the beacon
  Initial deployment could start mid 2019

- **Radio frequency characterization of ALCATEL ground antenna** (1st generation, now fully removed)
  Five Alcatel ground antenna have been characterized at CNES
  A new phase law (*) have been defined, significantly different from the phase law defined in the IDS documentation
  → To be tested by IDS ACs

*(see presentation of Manfredi et al., IDS Workshop 2016, on IDS website)*
6 DORIS receivers operating in orbit

6 DORIS missions in flight with DGXX(S) receiver (7 channels)

- **SENTINEL3A (ESA):** 814km, 98.65°  
  - February 16, 2016 → 2023 (+LR)
- **JASON3 (NASA/CNES):** 1336km, 66°  
  - January 17, 2016 → 2021 (+LR)
- **SARAL (CNES/ISRO):** 800km, 98.5°  
  - February 2013 → 2018 (+LR)
- **HY2-A (CNSA, NSOAS):** 960km, 99°  
  - August 2011 → as long as possible (+LRA+GPS)
- **CRYOSAT-2 (ESA):** 717 km, 92°  
  - April 2010 → end 2017 (+ LRA)
- **JASON2 (NASA/CNES):** 1336 km, 66°  
  - June 2008 → 2017 (+LRA+GPS)
Several more to come

<table>
<thead>
<tr>
<th>Project</th>
<th>Start Dates</th>
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<tr>
<td>SENTINEL3B (ESA), 3C, 3D</td>
<td>2018, 2020, 2025 (7 years + 3)</td>
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<tr>
<td>HY2-C, 2-D (CNSA, NSOAS)</td>
<td>2019, 2020 (3 years)</td>
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<td>HY-2 E, F, G, H To be confirmed</td>
<td>2024</td>
</tr>
<tr>
<td>JASON-CS1/SENTINEL6A (Eumetsat/NOAA)</td>
<td>2020 (7 years)</td>
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<tr>
<td>Jason-CS2/SENTINEL6B</td>
<td>2025 (7 years)</td>
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<td>SWOT (NASA/CNES) : 970km, 78°</td>
<td>post 2021 (3 years)</td>
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<td>E-GRASP/Eratosthenes : an improved version of the proposal will be submitted to the new ESA/ Earth Explorer-9 call in 2017</td>
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A secure future up to 2030+

On board instruments:
D1, D2, DX, DXs: DORIS/versions, S: SLR, G: GNSS

Past missions
Current missions
Future missions agreed/nominal lifetime
Future missions pending
Summary

- DORIS system working since 1990
  Now: 6 satellites, 57 ground stations, 45 co-locations with other IERS techniques
  Future: several more satellites to come up to 2030+, 4G beacon in development

- International DORIS Service since 2003
  Now: 6 analysis centers, 2 data centers, 1 combination center, CB, GB, AWG
  2013-2015: contribution to ITRF2014
  2016: 18 papers for DORIS special issue
  Plan for 2017:
    DORIS/RINEX format, ITRF2014-related issues to address, USO’s sensitivity to SAA...

And beyond:
- WG on NRT data
- IDS retreat 2017 to prepare the future

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

#1 April 2016

#2 July 2016

#3 December 2016
IDS web site
http://ids-doris/org

NEW: YouTube channel
IDS webservice
http://ids-doris.org/webservice

To visualize time series of DORIS-derived products
- Station positions
- Orbit residuals
- EOP
- Combination parameters (TRF scale and translations, position RMS... )