The International DORIS Service: Current Status and Future Plans

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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.
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

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Agency</th>
<th>Alt. (km)</th>
<th>Incl. (deg)</th>
<th>Dates</th>
<th>Tracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentinel-3A</td>
<td>ESA/EU</td>
<td>814</td>
<td>98.65</td>
<td>Feb. 2016 - 2024</td>
<td>DORIS+SLR+GNSS</td>
</tr>
<tr>
<td>SARAL</td>
<td>CNES/ISRO</td>
<td>800</td>
<td>98.5</td>
<td>Feb. 2013 – 2019</td>
<td>DORIS + SLR</td>
</tr>
<tr>
<td>CRYOSAT-2</td>
<td>ESA</td>
<td>717</td>
<td>92</td>
<td>Apr. 2010 – 2020</td>
<td>DORIS + SLR</td>
</tr>
</tbody>
</table>

HY-2A: GNSS data not publicly available.
A secure future up to 2030+
Pending replacement:
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 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.

Excellent collaboration between CNES/IGN and BKG to define installation requirements.
Station “WEUC” commissioned in September 2016

- Good performance: 13\textsuperscript{th} 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

Mean RMS of the MOE residuals at Wettzell: 4.14 mm
New Starec Beacons “xxxC” (like Wettzell) have 2-GHz phase center location defined to ± 1 mm. (~11 “xxxC” beacon stations already deployed)
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)

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

**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 sensitivity 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

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