International Doris Service

IDS REPORT 2012

IERS Directing Board Meeting #55

San Francisco, California, USA

December 2, 2012

Outline

1. **Satellite Constellation Status.**
2. **Network Status.**
3. **DORIS data and Data Center Status.**
4. **DORIS Ground Antenna RF Characterization**
5. **SPOT-5 SAA Data Issues.**
6. **IDS Analysis Summary**
7. **Elections to IDS GB.**
8. **Future IDS meetings.**

Report by Frank Lemoine, with contributions from Pascale Ferrage, Pascal Willis, Laurent Soudarin, Carey Noll, Jérôme Saunier, Guilhem Moreaux, Petr Stepanek, Cédric Tourain

DORIS Constellation Status - Current Missions

DGXX DORIS Receiver (7 channels)

- **HY2A:** *(CNSA, NSOAS),* 960 km, 99° August 2011 ➔ 2014.5.
- **CRYOSAT-2:** *(ESA),* *717 km, 92°* April 2010 ➔ end 2013.
- **JASON-2:** *(NASA/CNES),* *1336 km, 66°* June 2008 ➔ 2013+.

DGM DORIS Receiver (2 channels)

- **SPOT-5:** *(CNES),* *830 km, 98°* May 2002 ➔ 2015.
- **JASON-1:** *(NASA/CNES),* *1336 km, 66°* Dec 2001 ➔ 2013.

D1G DORIS Receiver (1 channel)

- **SPOT-4:** *(CNES),* *830 km, 98°* March 1998 ➔ mid-2013

DORIS Constellation Status - Future Missions (All DGXX)

- **SARAL/ALTIKA:** *(ISRO, CNES)*, 800 km, 98.5° Feb. 2013 (5 yrs).

- **SENTINEL3A (GMES):** *(ESA), 814 km, 98.6°* mid 2014 (7.5yrs+5)
- **SENTINEL3B**. 2017

- **JASON-3:** *1336 km, 66°* mid 2014 (5 yrs+)
  (Eumetsat/NOAA/NASA/CNES)

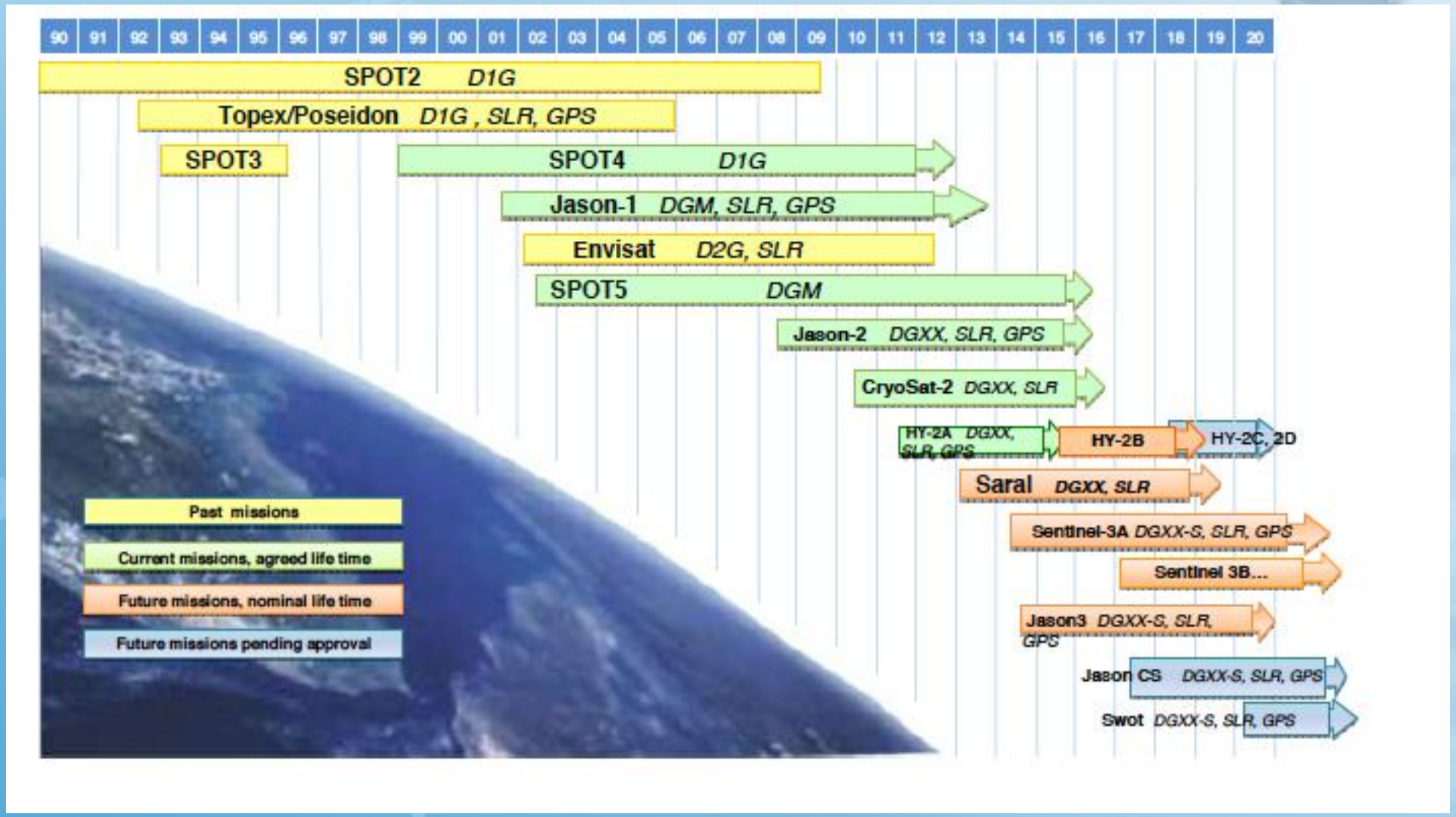
- **HY2B, HY2C § , HY2D § :** *(CNES),* 2014,2016,2018 (3yrs)

- **JASON-CS § :** *(Eumetsat/NOAA), 1336 km, 66°* 2017 (7 yrs)
- **JASON-CS(B)** 2023 (7 yrs).

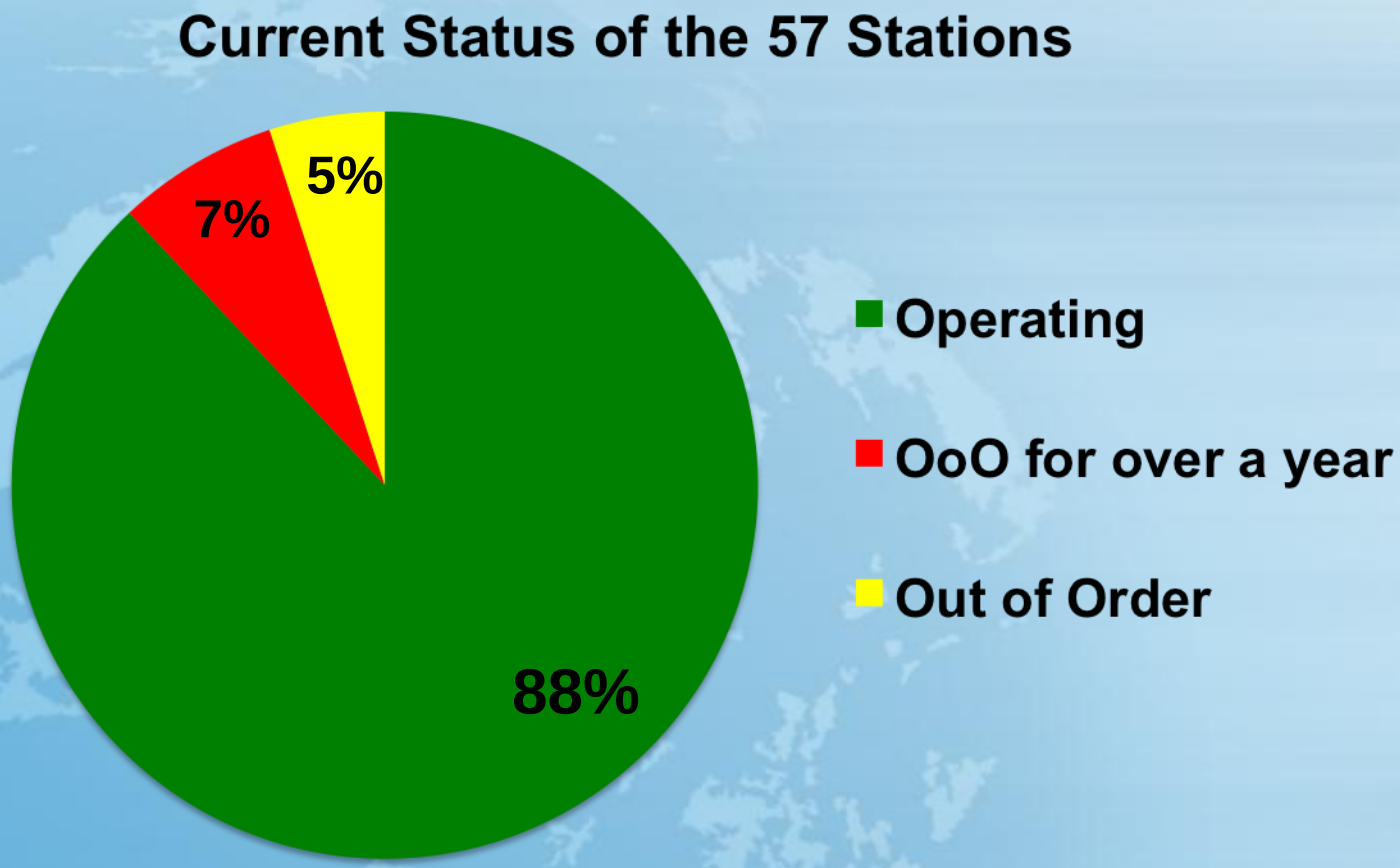
- **SWOT § :** *(NASA/CNES), 970 km, 78°* 2020 (3 yrs)

§ Mission awaiting approval.

DORIS CONSTELLATION SUMMARY



Network status



<u>Out of order for over a year</u>:
Yuzno-Sakhalinsk *(11/2005)*; **Santa Cruz** *(06/2009)*; **Soccoro** *(10/2009)*; **Monument Peak** *(02/2010).*

Network evolution

- SHORT RUN (NEXT 6 MONTHS)
  - Mahé: antenna moving, local tie survey (new GNSS station)
  - St John's: major renovation
- LATER
  - Chatham: station moving (host agency office move in June)
  - Goldstone: new station in place of Monument Peak
  - Miami: definitive shutdown (interferences with TV-mobile)
  - Hokkaïdo: new station in place of Sakhalinsk, co-location GNSS+VLBI
  - Major renovations: Socorro, Kitab, Easter
- 4th generation beacons
  - maintain in operational conditions of the Network until at least 2025
  - study started , development 2014 - 2015
  - deployment from 2016

IDS DATA CENTER AND DATA FLOW UPDATE

- **New satellite data (DGXX instrument):**
  - –Jason-2, CryoSat-2, HY-2A.
  - –Data archived in DORIS and RINEX formats.
- **Envisat Data Reissue:**
  - –Error in ionosphere correction field for early data (through cycle 255)
  - –Data reissued early May-2012 and announced in DORISmail 0823.
  - –DORIS time bias (could be up to 8msecs in older data) also corrected.
- **POE orbits (in SP3 format)**

-CNES-SSALTO; LCA; GSC.

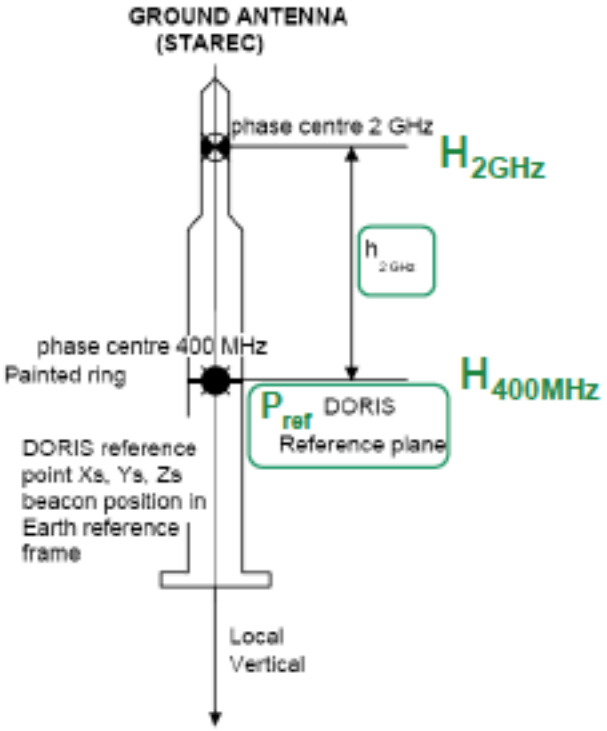
- **SINEX Series:** All DORIS ACs deliver at least quarterly, if not more frequently; Deliveries (generally) documented in DORISReports.

DORIS Ground Antenna Characterization (1/2)

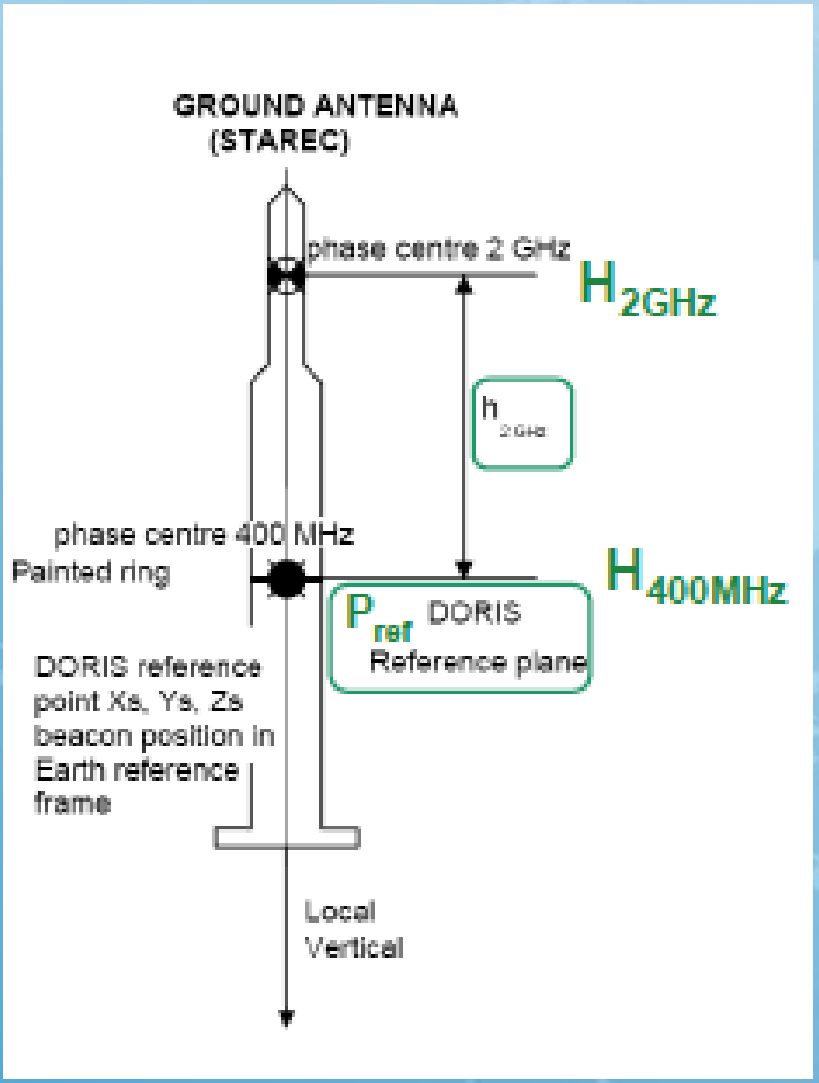
- **Request from IDS Governing Board (Lisbon, 2010) to characterize phase center offset and variations of DORIS Ground Antennas.**
- **CNES has completed this activity for the STAREC antenna on seven different Starec antennae that were available. (***see Cédric Tourain presentation; IDS Workshop, Venice, Italy September 2012***)**

DORIS ground antenna : **STAREC**

- Specification document :
  - modeling of DORIS instrument (CO-SP-DO-OP-2460-CN)
  - Available on IDS site ftp://ftp.ids-doris.org/pub/ids/satellites/DORIS_instrument_modelling_1G_envisat.pdf
- Total size : 974 mm
- Reference plan : P_{ref} Doris Reference plan
- H_{2GHz} : 2036.25MHz Phase center : **487mm** / P_{ref}
- H_{400MHz} : 401.25MHz Phase center : **0mm** / P_{ref}



DORIS Ground Antenna Characterization (2/2)



Results:

1. **2 Ghz phase center: Manufacturer specification Href = 487 mm; Actual measurement = 470 mm (17 mm of discrepancy!).**
2. **400 Mhz phase center:**
   No change.
3. **Phase variation w. elevation: Some change.**
4. **Next steps:**
   - **Analyze impact on DORIS solutions.**
   - **Study Alcatel antennas (few models available).**

SPOT-5 SAA Effect on DORIS data (1/2)

1. **<u>Origin:</u> A quartz oscillator impacted by high-energy protons (e.g. in SAA) will be perturbed by Amplitude A, and df/dt, and undergo an exponential relaxation.**
2. **If Oscillator is annealed prior to launch → minimal or no effect. Jason-2 (no problem): For Jason-1 the effect is known since launch (***not included in geodetic solutions at present***).**
3. **Petr Stepanek (GOP) showed SPOT5 also has SAA effect, and it manifests itself in height discrepancies in estimates for stations in vicinity of SAA (***South America stations, e.g. Cacheoira Paulista, Arequipa, Santiago***). Effect is smaller than on Jason-1.**
4. **<u>Solutions</u>:**

   I. No mitigation (perturbed positions and velocities of these stations – this happened in ITRF2008).

   II. Delete data from affected stations (degrade orbits for SPOT-5)

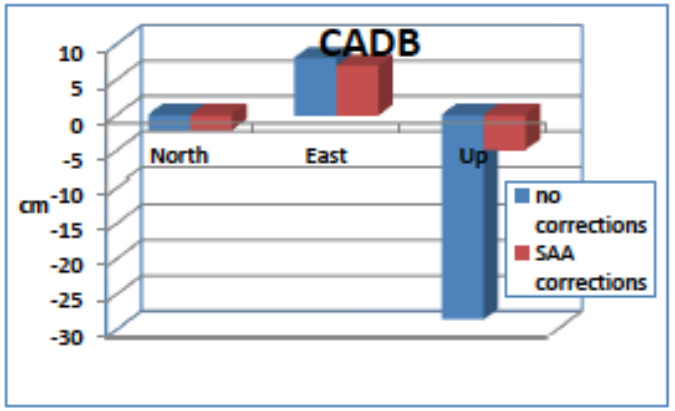
   III. Adjust SPOT-5 stations but exclude SPOT-5 SAA stations from weekly combination.

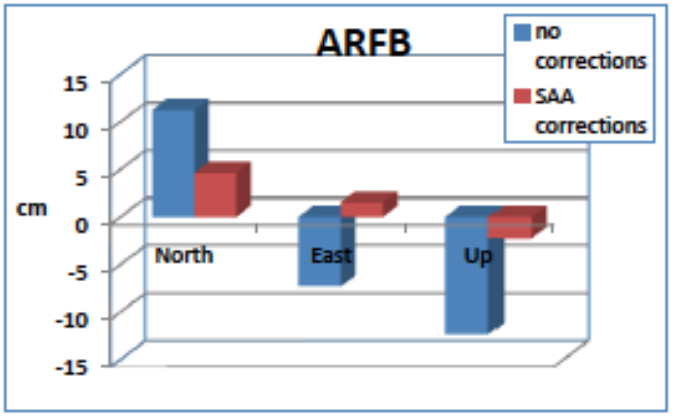
   IV. Apply correction model as for Jason-1 (*Petr Stepanek/GOP and Hugues Capdeville/CLS have developed test models***).**

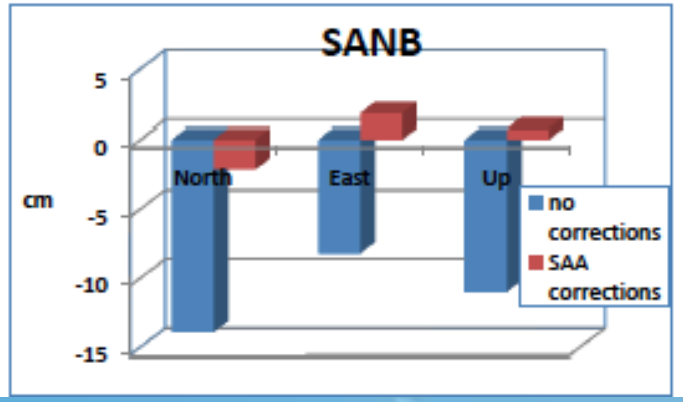
SPOT-5 SAA Effect on DORIS data (2/2)

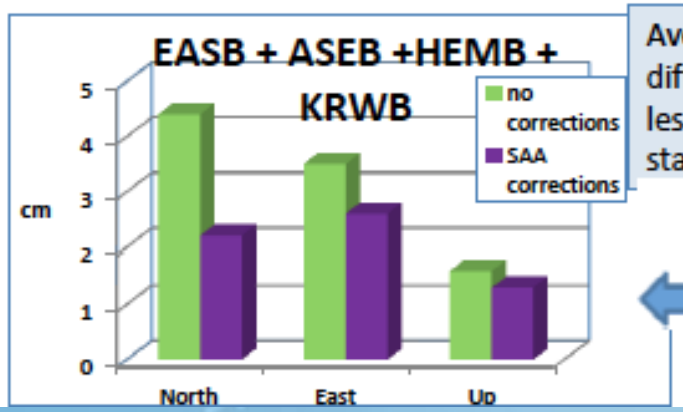
Station coordinates

- Differences between SPOT-5 solution and multi-satellite solution (excluding SPOT-5)
- March-April 2011
- Differences strongly decreased applying SAA corrections









Average absolute differences for less affected SAA stations

(from **Stepanek et al., Current research activities at GOP DORIS AC, Venice, Sept 2012**),

Analysis Update

1. **7 active DORIS analysis centers (ESA, GAU, GOP, GSC IGN, INA, LCA). GFZ has also expressed interest and has attended DORIS AWG meetings.**
2. **DORIS ACs routinely submit SINEX solutions each quarter (e.g. 3/30, 6/30, 9/30, 12/30) which are now processed by IDS Combination Center (Guilhem Moreaux, CLS Toulouse).**
3. **In the past year we have conducted campaigns to analyze the contributions of individual satellites (Jason-2, Cryosat2, HY-2A), and to analyze the EOP contributions of DORIS data (more results on next slide).**
4. **AWG meetings in Prague (June 2012) and Venice (with IDS workshop, September 2012).**
5. **<u>ITRF2013 Preparations</u>:**

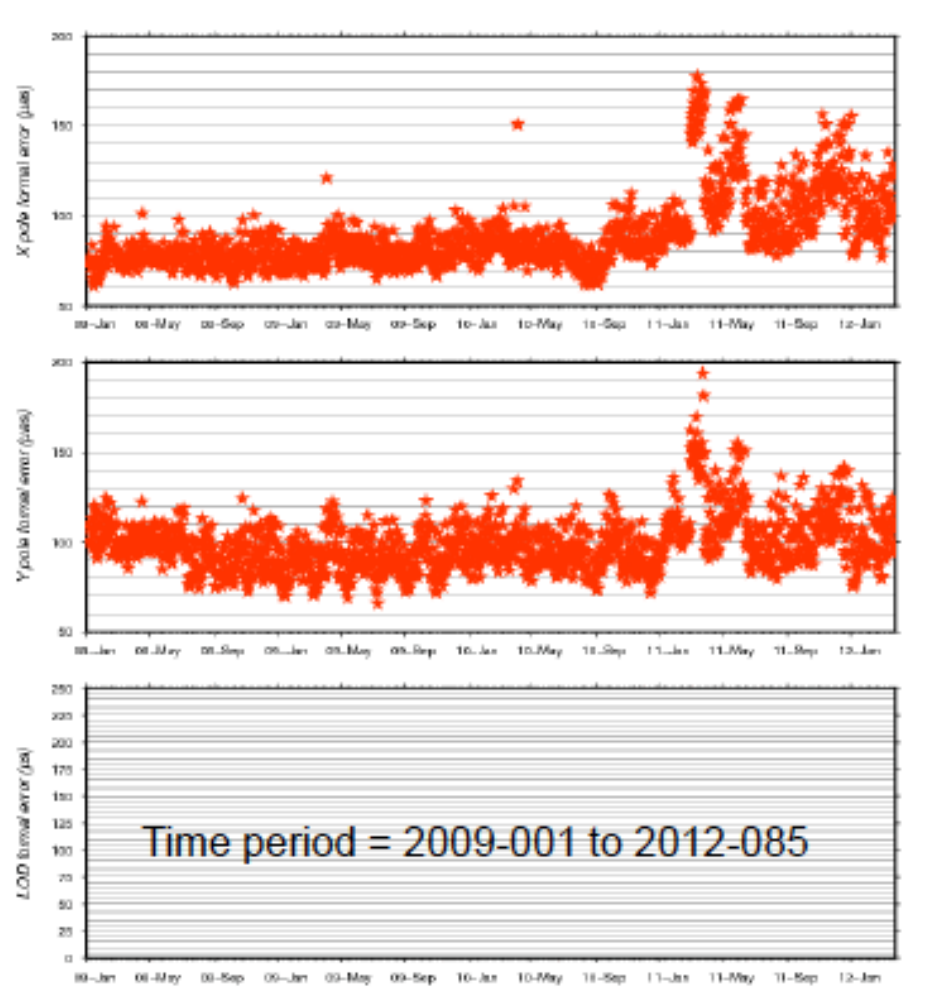
I. Require all ACs to reprocess data with updated geophysical models (*eg new gravity models, estimation of daily station troposphere gradients, updated nonconservative force models, and revalidated attitude models***).**

II. Conduct test combinations over discrete periods for validation.

III. Conducted orbit intercomparison between ACs which revealed each AC had individual modelling problems on at least one satellite.

IV. By routinely doing combinations and validating complete SINEX series (ESA, GOP, LCA, IGN), Combination Center is validating procedures to produce a new IDS Combination as well as providing feedback to ACs.

New EOP Results from DORIS



Differences with IERS C04:
For 1556 days (2009-2012)
Xpole: mean, (*std*):
96.2µas (*108.2µas*)
Ypole: mean, (*std*):
109.0 µas (*141.9µas*)

- **Big improvement due to Jason-2 data (since July 2008).**
- *Individual AC's have disparate signals in their EOP time series, and some show 60-day beta prime signal (Jason-2). Need for improvement at AC level.*

(from **Guilhem Moreaux et al., Research activities at IDS Combination Center IDS Workshop, Venice, Sept 2012)**

Elections to IDS Governing Board

• **3 postions up for elections under new Terms of Reference (***modified for clarity, and to allow for overlap between new and old members)***.**

Analysis Center Representative: Pascal Willis.

Data Center Representative: Carey Noll *(only candidate)*

At Large member: Richard Biancale.

IDS GB meeting Tuesday December 4, 2012 @ San Francisco.

Next IDS Meetings

IDS AWG – Toulouse, March-April 2013 (Before EGU)

IDS AWG – Washington DC, NASA GSFC, October 2013.

IDS Report / IERS Directing Board meeting, San Francisco, Dec. 2, 2012

http://ids-doris.org