International DORIS Service:

Product and Service Status

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Introduction

- IDS accepted as service of the IAG (July 2003).
- Station renovation has substantially improved the DORIS network since its inception in the 1990's. New requirements for station quality and monument stability.
- Multiple groups contribute products on a regular basis:
  IGN/JPL, INASAN, LEGOS/CLS, SSALTO.
- New Analysis Center: GOP (Geodetic Observatory Pecný).
- Other associate or candidate AC's: IAA, Geoscience Australia, UNC.
- Contribution to ITRF2005 (*JoG: Altamimi et al., 2006*).
- Special Issue: Journal of Geodesy, Volume 80(8-11): Published November 2006.

Our challenge is continue to improve the geodetic products and transition to routine delivery of IDS products.

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Map of Current DORIS Network

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DORIS Data at the IDS Data Centers from Existing or Past DORIS Satellites

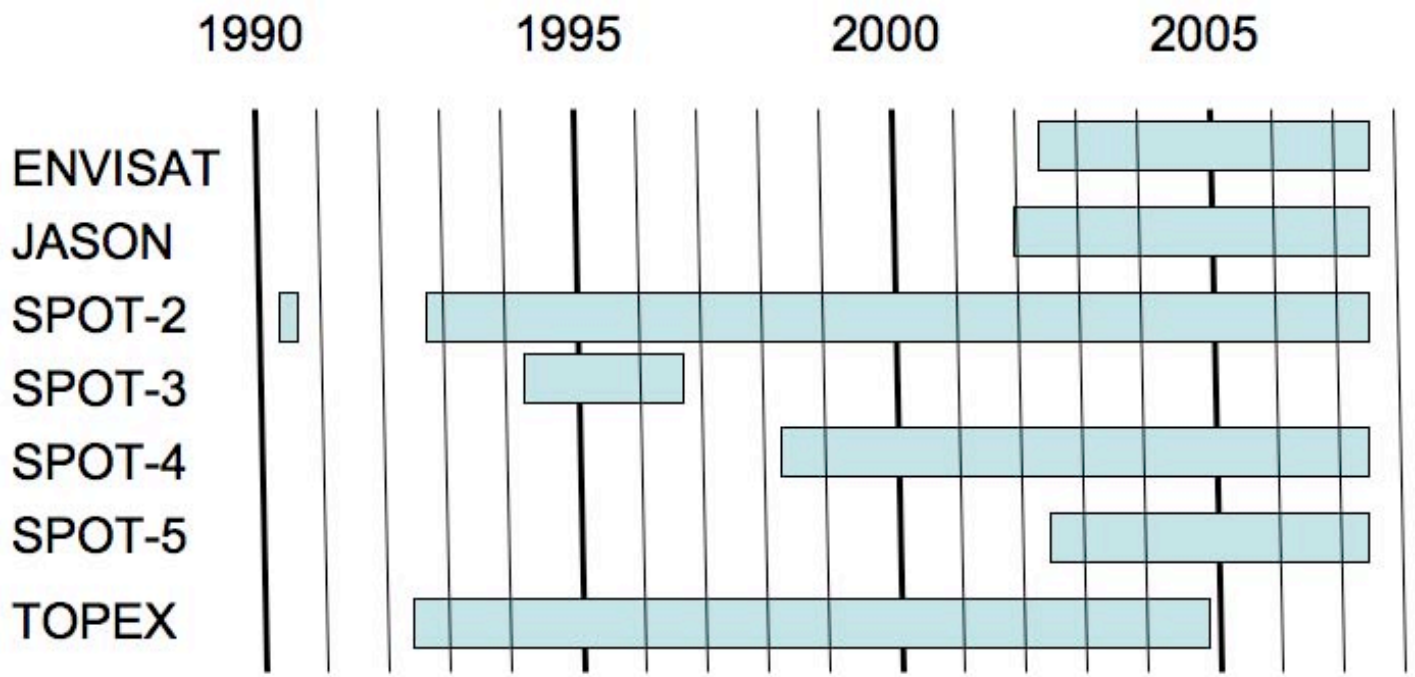

Figure From CR Geoscience, Willis et al. 2007

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Future DORIS Missions (decided)

- **JASON-2 (CNES-NASA-EUMETSAT-NOAA)**
  - -- *June 2008*
  - -- *T2/L2 (Laser Time Transfer Link), Carmen & JTD (radiation dose)*
- **CRYOSAT-2 (ESA)**
  - -- *March 2009*
- **SARAL/ALTI-KA (CNES-ISRO)**
  - -- *ISRO SSB platorm with ALTIKA & ARGOS 3 payload*
  - -- *end 2009-beginning 2010 ?*

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Future DORIS Missions (possible)

- **SENTINEL 3**
  - =>European GMES programme, ESA mission
  - =>*CNES proposal for a DORIS receiver*
  - =>*2010 ?*
  - =>*Possible proposals for other ESA missions*
- **Jason-3**
  - =>*Jason-2 follow-on*
  - =>*GMES programme 2012-2013 ?*
- **HY-2A (CNES-CNSA)**
  - =>*Altimeter, DORIS, GPS, LRA*
  - =>*2010 ?*
- **CEMIT (Small Explorer Missions proposal)**
  - =>*Possible CNES contribution: STAR accelerometer, DORIS*
  - =>*2012 ?*

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Current IDS Products (December 2007)

Product	Present AC	Previous AC (no recent solution)	Combined product
Cumulative solutions (pos./velocities)	IGN/JPL; LEGOS/CLS		No
Weekly series	IGN/JPL; INASAN; LEGOS/CLS; SSALTO; GOP*	SOD GSFC (1 yr)	-Operational (No). -Test ing progress (Valette et al., 2007, Fall AGU)
Monthly series		IGN/JPL INASAN LEGOS/CLS SSALTO	No
STCD	IGN/JPL; LEGOS/CLS; INASAN; SSALTO		
Geocenter	IGN/JPL; LEGOS/CLS; INASAN		No
EOP	IGN/JPL; INASAN		No
Orbits	LEGOS/CLS		No
Ionosphere	SSALTO		No

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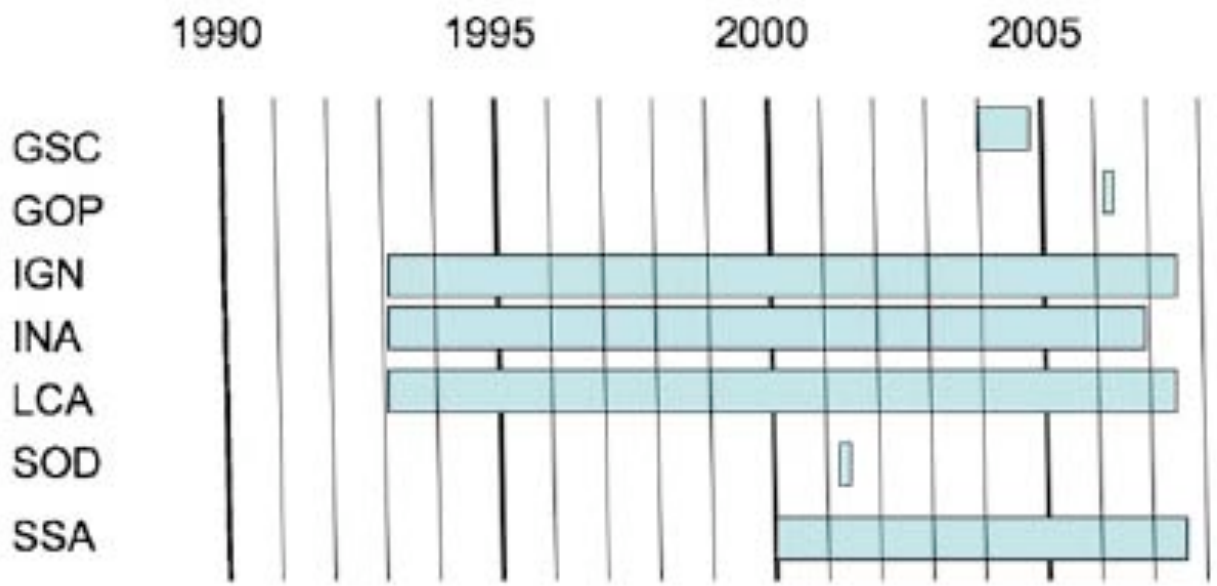

Weekly DORIS SINEX Solutions Available at the IDS Data Centers

(as of August 2007).

Figure From CR Geoscience, Willis et al. 2007

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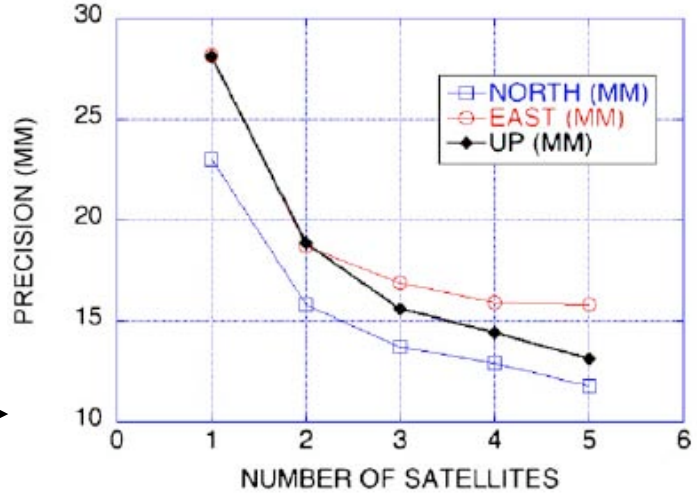
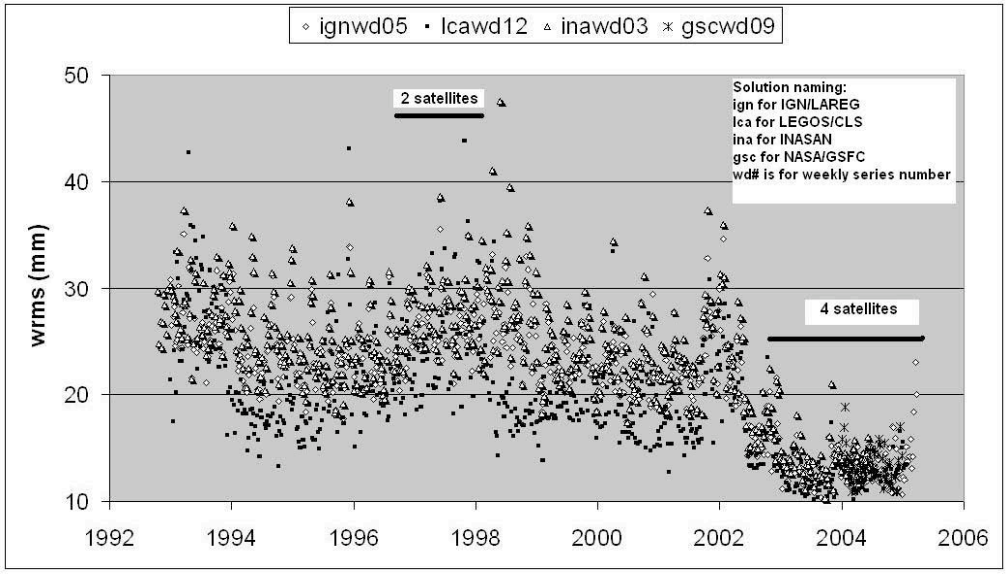
DORIS positioning precision w.r.t the number of satellites used - for one week in February 2004.
(CR Geoscience Willis et al. 2007)

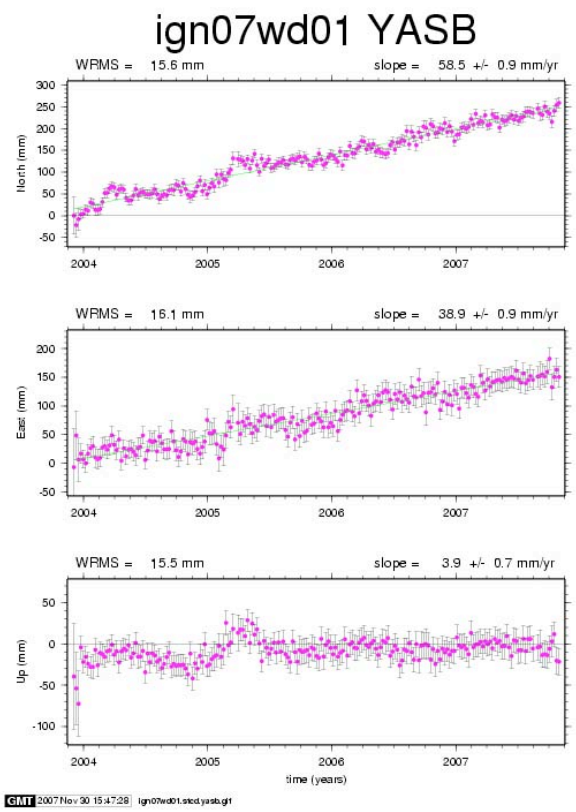




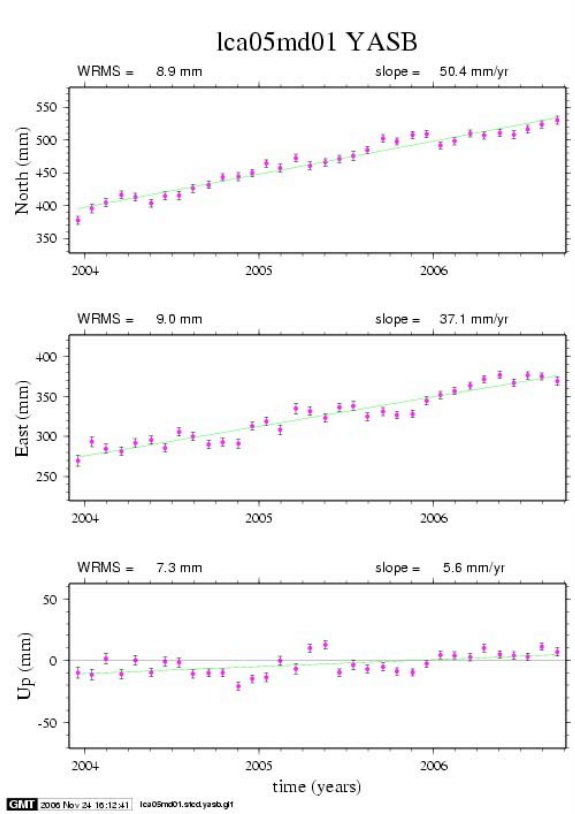
Weighted RMS of the individual weekly series combinations.
(J. Geodesy, Tavernier et al., 2006)

Station Position Coordinate Differences (STCD) (http://ids.cls.fr/html/doris/ids-station-series.php3)

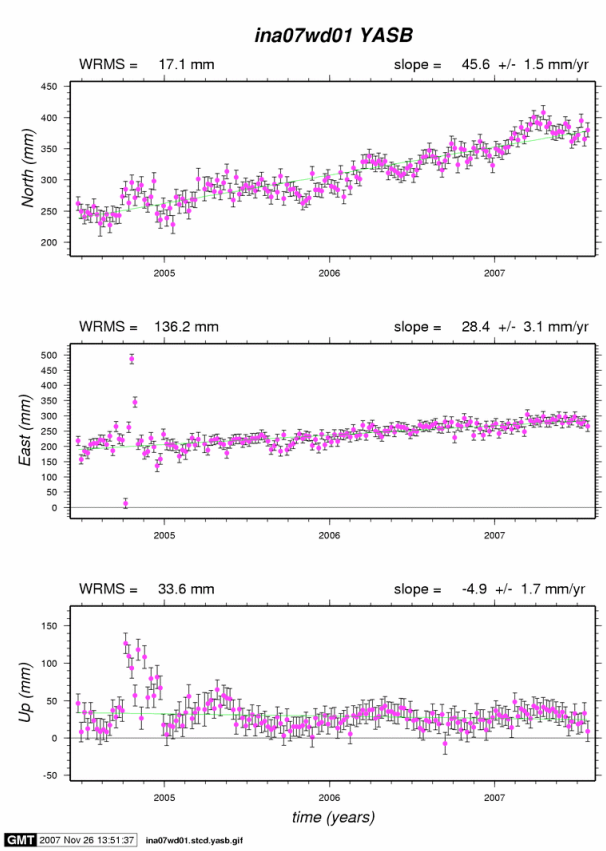
DORIS weekly solutions - IGN/JPL Analysis Center



DORIS monthly solutions - LEGOS/CLS Analysis Center



DORIS weekly solutions - INASAN Analysis Center



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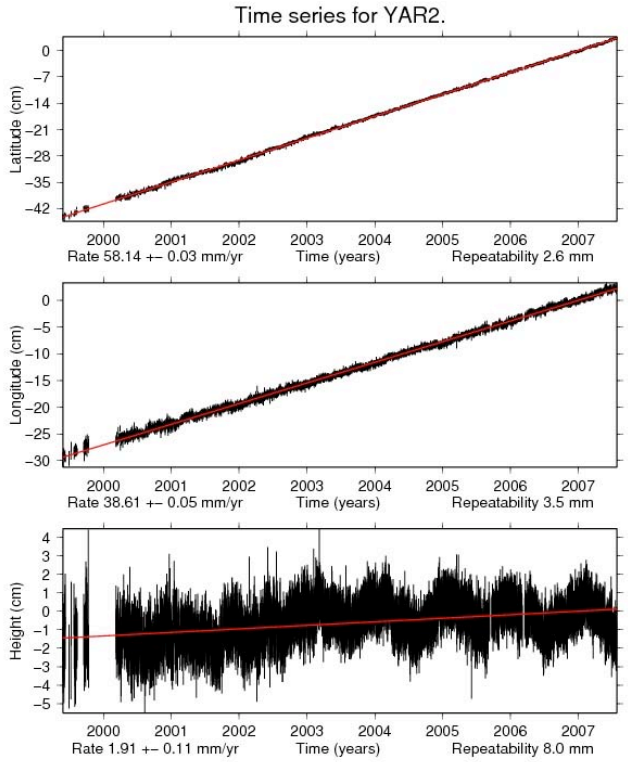


GPS Time Series Solutions for YAR2

(Heflin et al., 2007.6)

http://sideshow.jpl.nasa.gov/mbh/series.html

Station Coordinate Differences (STCD) (YASB, DORIS vs. YAR2 GPS)

Series	Latitude	Longitude	Height
IGN ign07wd01	58.5 ± 0.9 mm/yr	38.9 ± 0.9 mm/yr	3.9 ± 0.7 mm/yr
LCA lca05md01	50.4 mm/yr	37.1 mm/yr	5.6 mm/yr
INA ina07wd01	45.6 ± 1.5 mm/yr	28.4 ± 3.1 mm/yr	4.9 ± 1.7 mm/yr
GPS Heflin et al. 2007.6	58.14 ± 0.03 mm/yr	38.61 ± 0.05 mm/yr	1.91 ± 0.11 mm/yr

DORIS TRF Scale Differences From Previous Solutions

(DORIS ITRF2005 contributions)

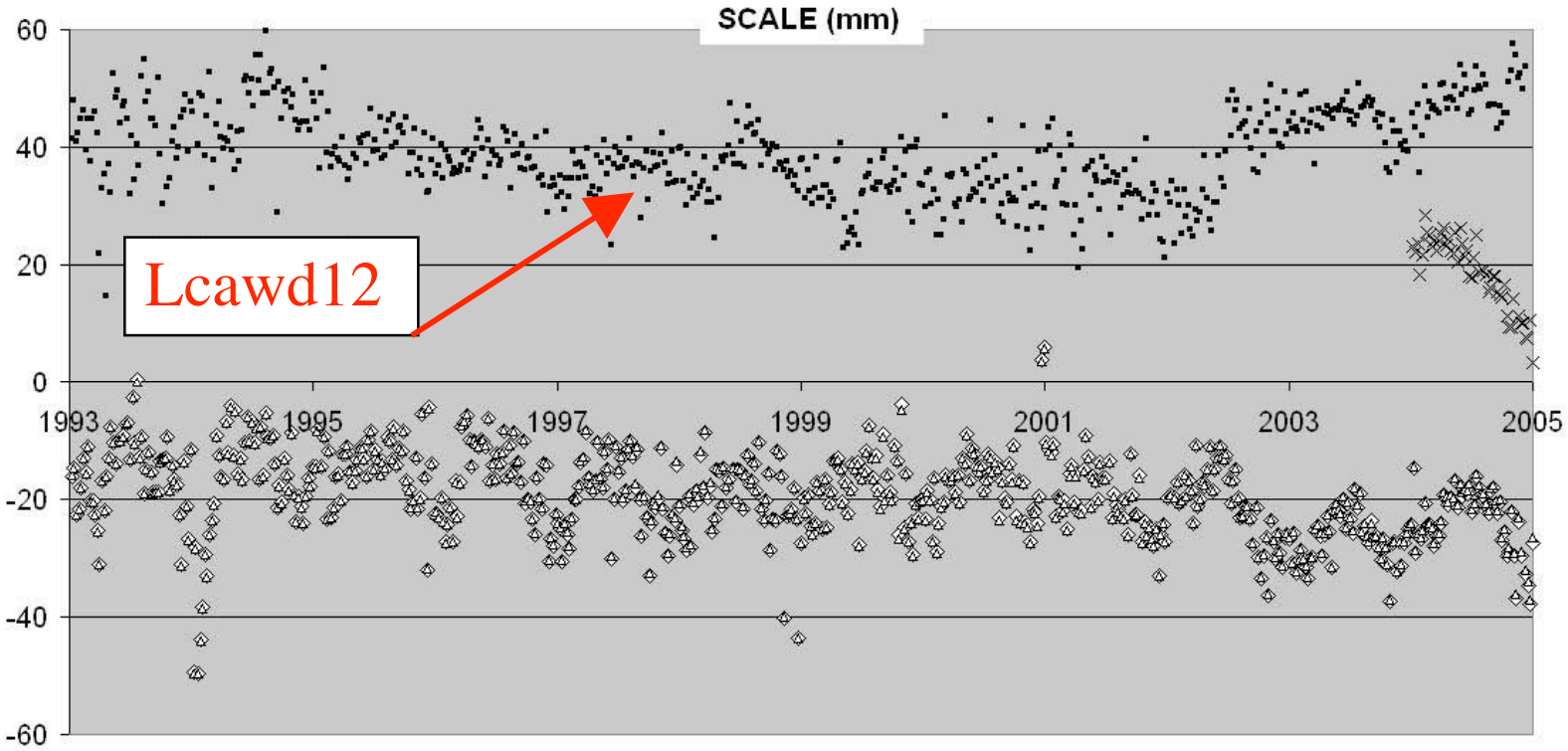
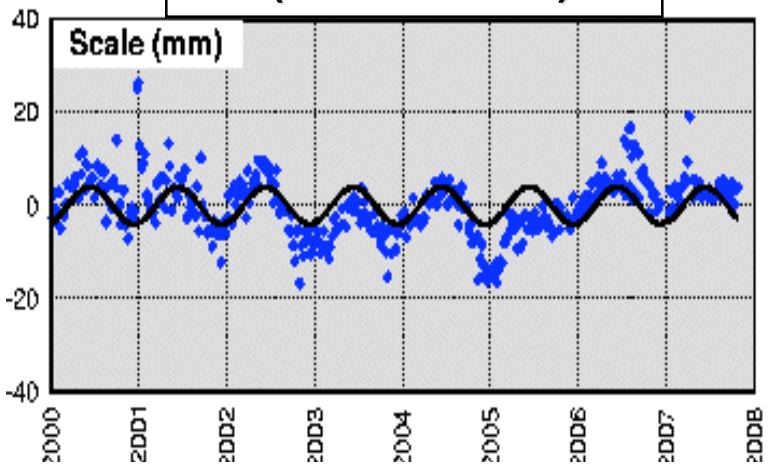


Figure 11: Scale factor of the individual weekly time series combinations from *Tavernier et al.* (2006). IGN/JPL (diamonds); LEGOS/CLS (black dots); GSFC (crosses).

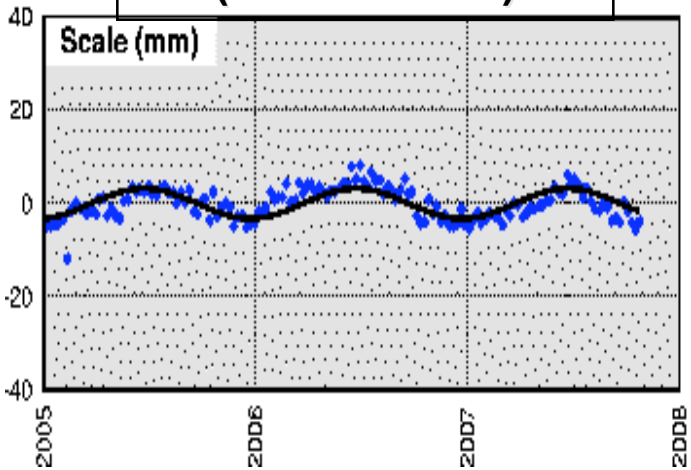
DORIS TRF Scale from new series

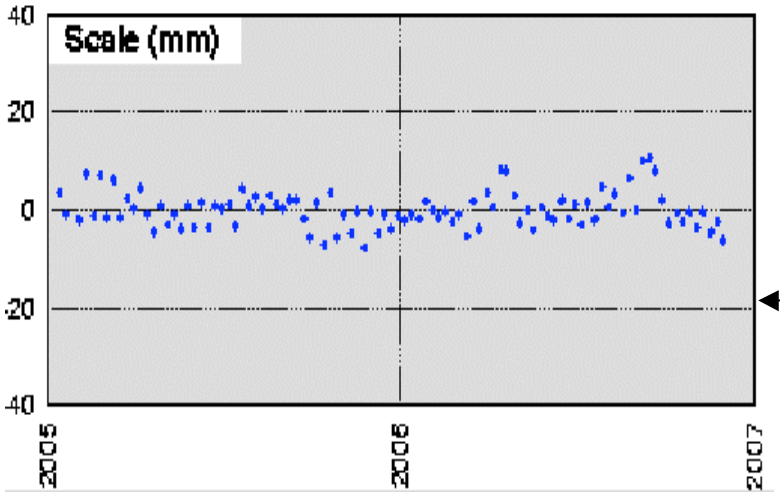
(Valette et al., AGU 2007)

IGN 2000-2007
(wd05 series)



LCA 2005-2007
(wd18 series)





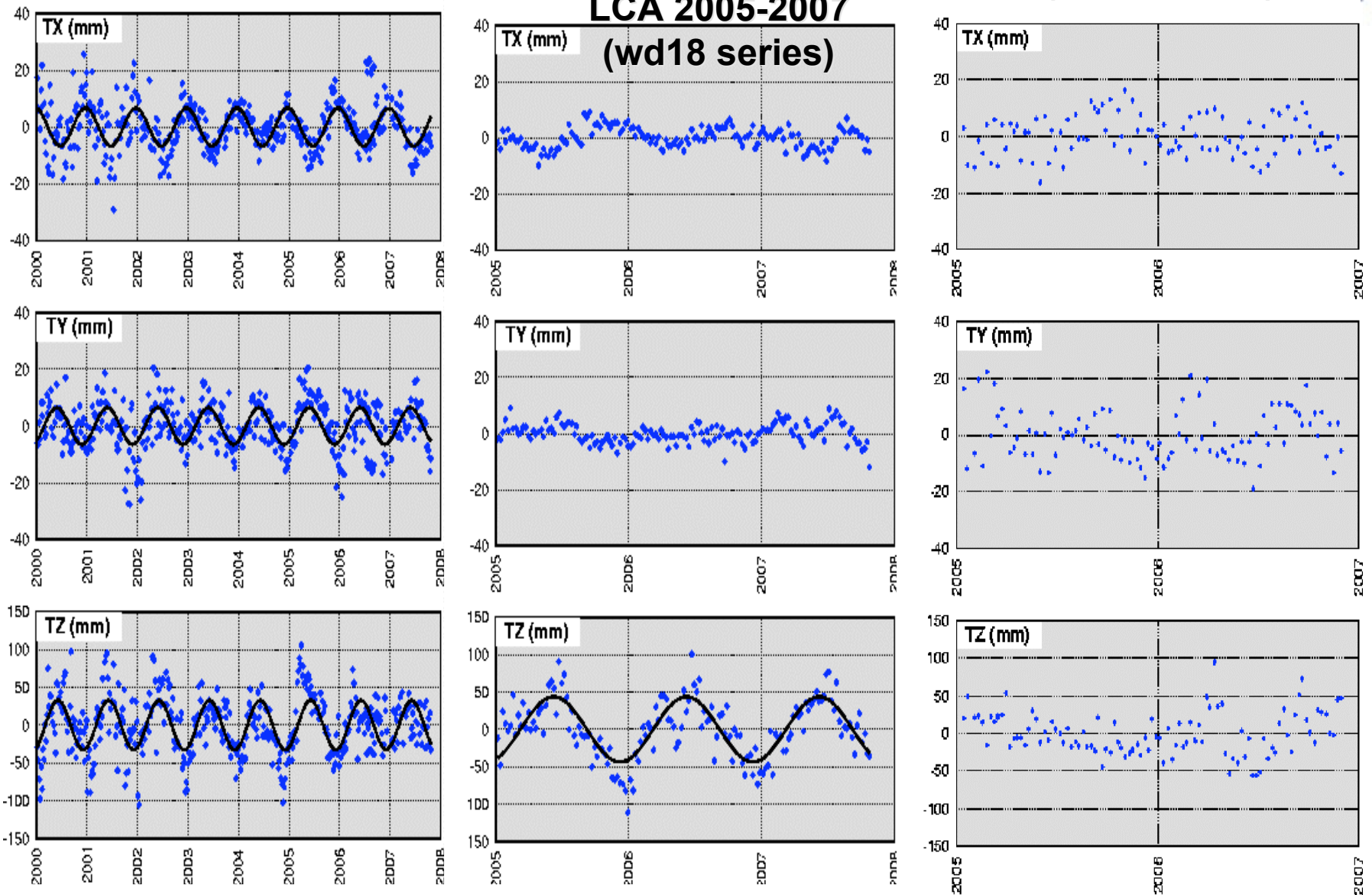
GOP 2005-2007
(wd03 series)

New IDS AC Solutions (AGU2007)

IGN 2000-2007 (wd05 series)

LCA 2005-2007 (wd18 series)

GOP 2005-2007 (wd03 series)



New AC Comparisons with ITRF2005

(Valette et al., AGU 2007)

ITRF2005 comparisons	Pos (mm)	Vel (mm/yr)
IGN (7 yrs)	6.5	2.0
LCA (2 yrs)	15.6	4.0
GOP (2 yrs)	11.1	7.1
Combined solution	7.0	5.7

SAA Effect on Jason-1 & Validation of Correction Model

Jason-1 DORIS USO not as stable as desired; Frequency is perturbed by passage through SAA (South Atlantic Anomaly), frequency is sensitive to irradiation rate and total irradiation encountered in orbit. DORIS station positioning is perturbed if Jason-1 is included in multi-satellite solutions.

(Willis et al., Adv. Space Res. 31(8), pp.1941-1946 2003; CR Geoscience, 336(9), pp. 839-846, 2004)

JM Lemoine and H. Capdeville (JoG, 2006) developed a correction model to apply to Jason-1 DORIS data. They demonstrate it improves DORIS positioning.

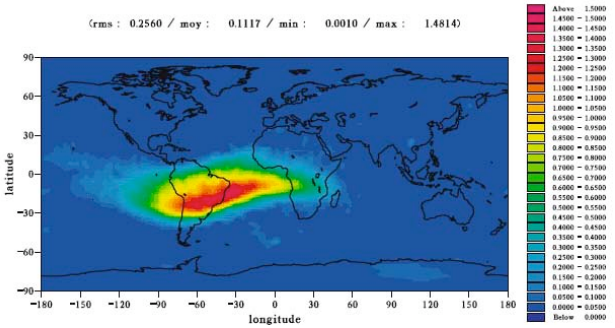
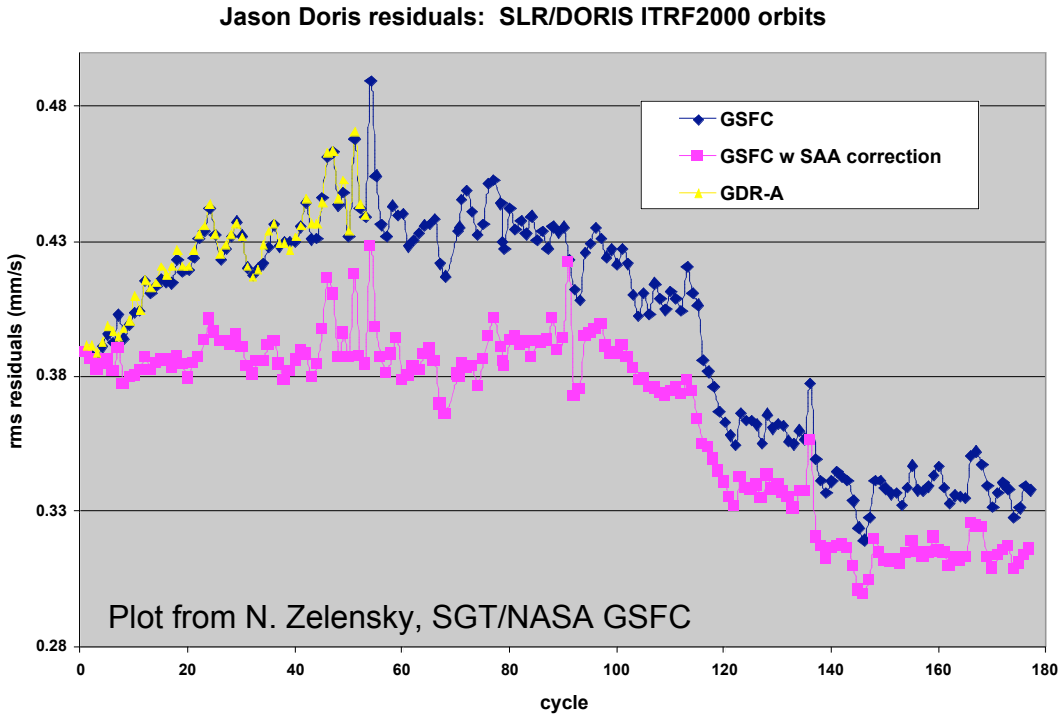


Figure from JM Lemoine et Capdeville (2006)



DORIS RMS of fit from GSFC Jason-1 orbits with ITRF2000, without, and with Jason-1 SAA correction *(Lemoine F. et al., 2007, Jason SWT, Hobart, Tasmania & Beckley et al., 2007, GRL)*.

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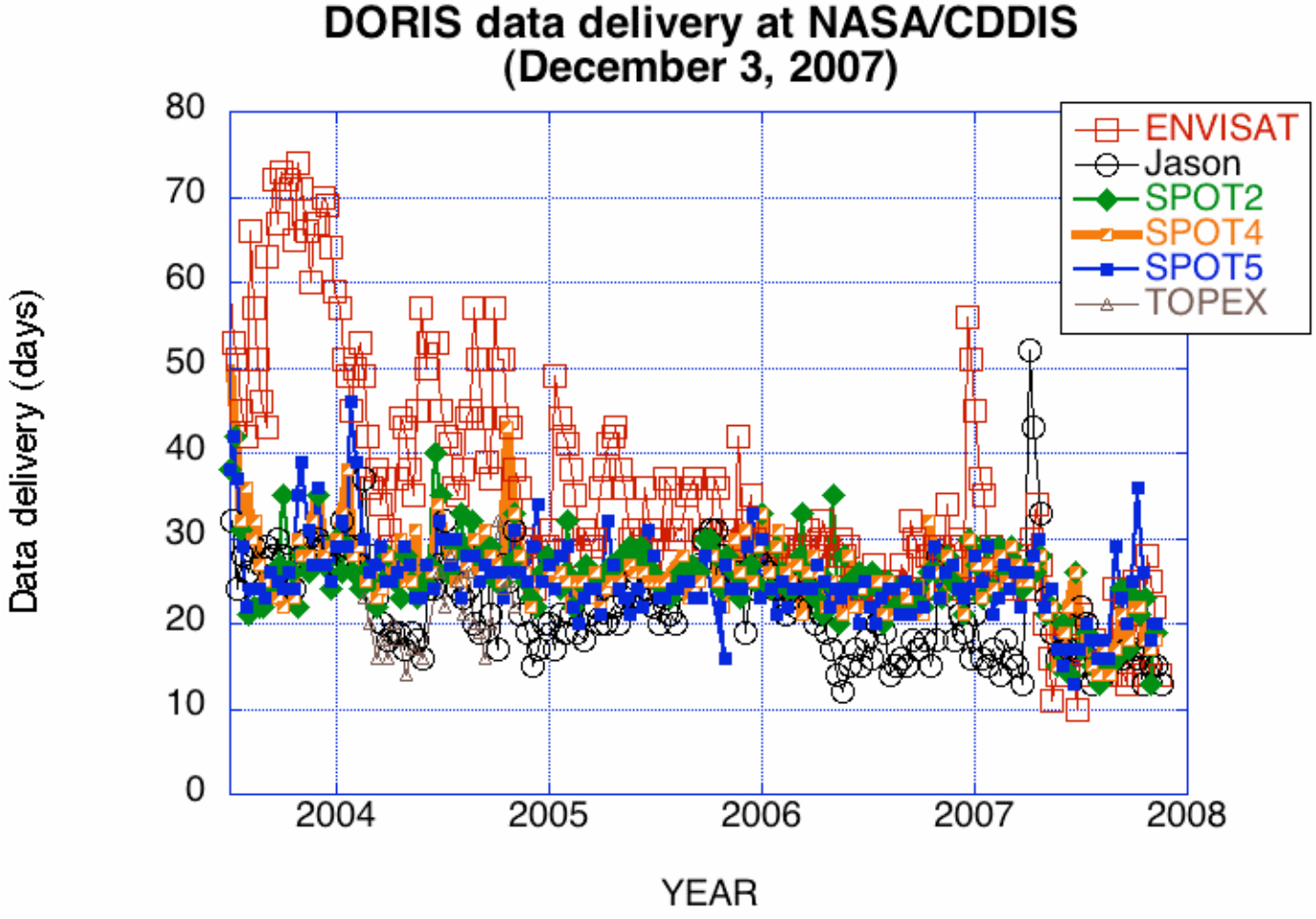


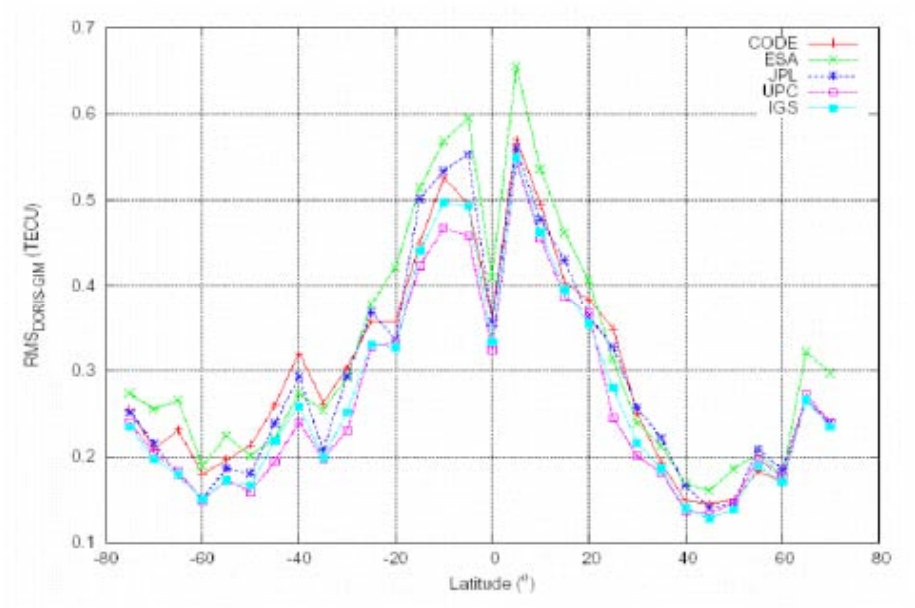
DORIS Ionosphere product (1)

- Ionosphere correction calculated routinely and part of normal data record.
- Supplementary IONO file contains additional information, including elevation angle & geometry

The format is :- for the header (for each satellite pass over a beacon) :s
atellite, beacon mnemo, number of observations, max of satellite pass elevation,
local time (deg), meteorological data : Pressure (mb), T (deg), Humidity (%)
ex : SPOT2 SALB 27 57.954 22.6091012 21 68

- for the data :
CNES julian date, second in the day of the observation (TAI),
elimination criteria,
count interval (2 GHz channel),
count interval (400 Hz channel),
Tropospheric correction (2 GHz channel),
Tropospheric correction (400 MHz channel),
Ionospheric correction (2 GHz channel),
Ionospheric correction (400 GHz channel),
Elevation angle, Azimuth, Station-satellite distance (m),
Acquisition mode,
Received power level (400 Mhz), Received power level (2 Ghz),
Ponderation (0 if eliminated or 1),
Doppler count (400 Mhz), Doppler count (2 Ghz).

DORIS Ionosphere product (2)



IONO Files Available:

Jason-1: from Aug. 2002.
Spot2/4: from Jan. 2001.
Spot5: from May 2004.
Topex: Jan. 2001- Nov. 2004.

Figure 2: Comparison of DORIS derived vertical total electron content (VTEC) for JASON in 2004 with VTEC results from different IGS analysis centers. The display indicates the RMS difference between each IGS center and DORIS for 2004. The units are TEC units (TECU). At the Jason altimeter frequency of 13.6 Ghz, 1 cm of range corresponds to 4.6 TECU. (from M. Pajares, April 2004-2005, IGS working group report)

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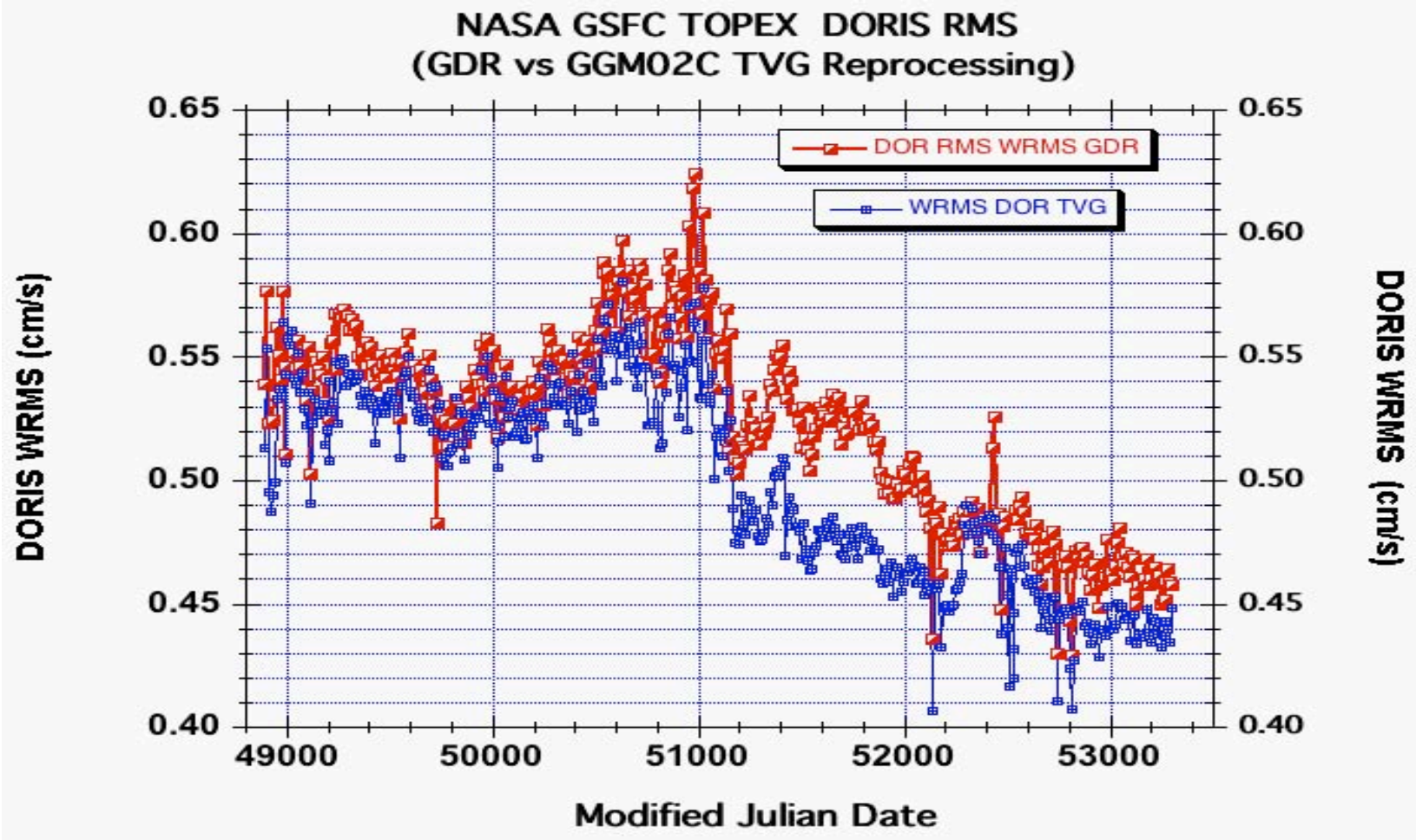
DORIS Evolution from TOPEX analysis



Conclusion

DORIS as a geodetic observing system is at a crossroads. It has achieved a level of maturity in the quality of the products that it produces. We must focus on the technical issues (e.g. modelling differences between centers) and operational issues in order to continue to refine and improve the contribution DORIS makes to satellite geodesy.

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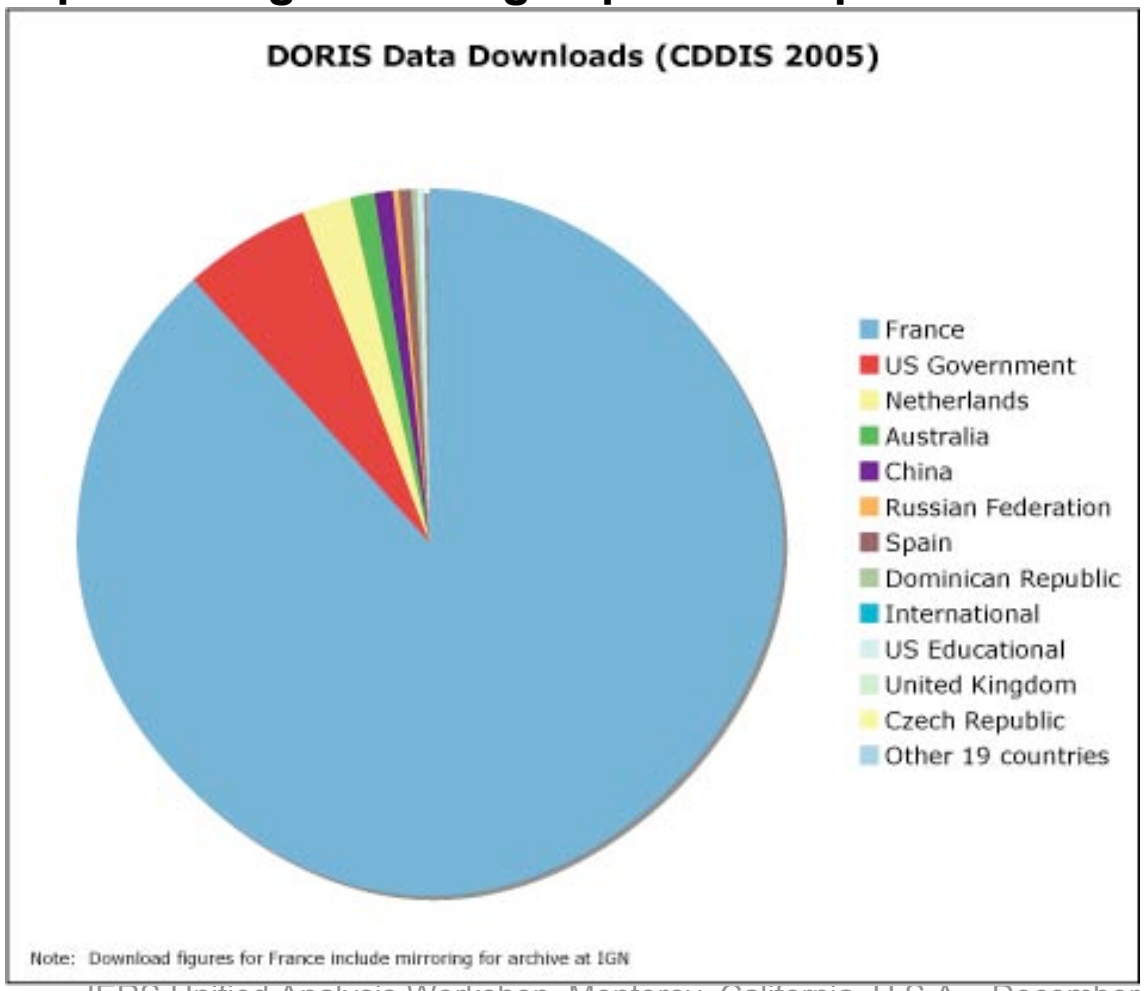
DORIS Product Downloads by Source

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



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