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IGN DORIS reprocessing for ITRF2008. Lessons learned and open issues

Pascal Willis (IGN/IPGP), Marie-Line Gobinddas (IGN/IPGP)

SUMMARY

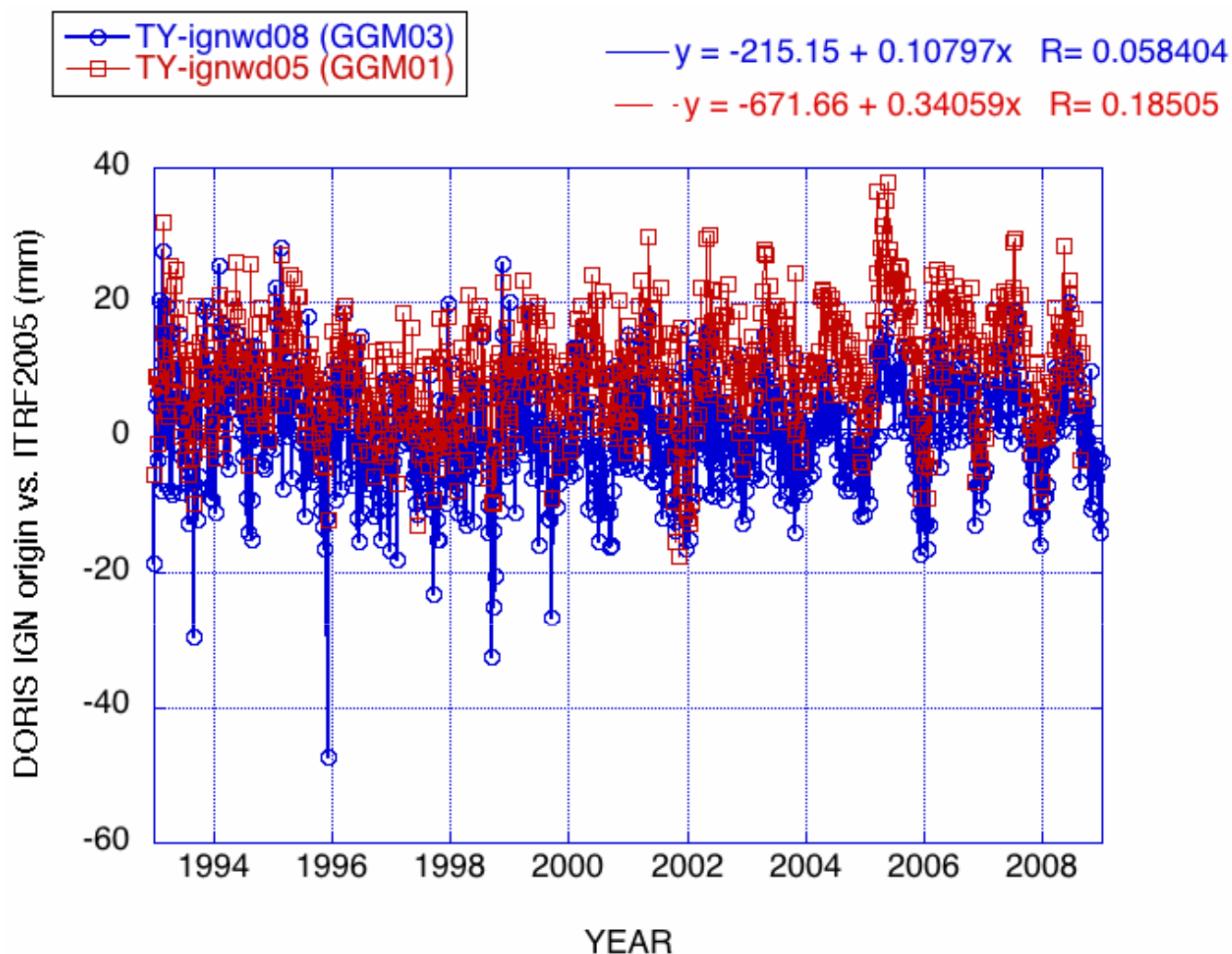
- ➔ **Major modifications in the latest ignwd08 solution**
 - Gravity field GGM03S (120*120)
 - GMF for tropospheric mapping function
 - Solar Radiation Pressure coefficient not estimated
 - Atmospheric drag estimated every 1 hour (except T/P)

- ➔ **Lessons learned and problems encountered**

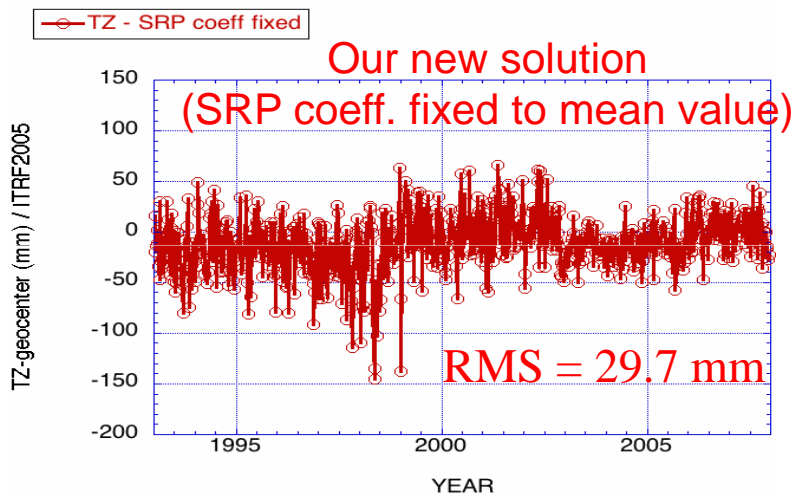
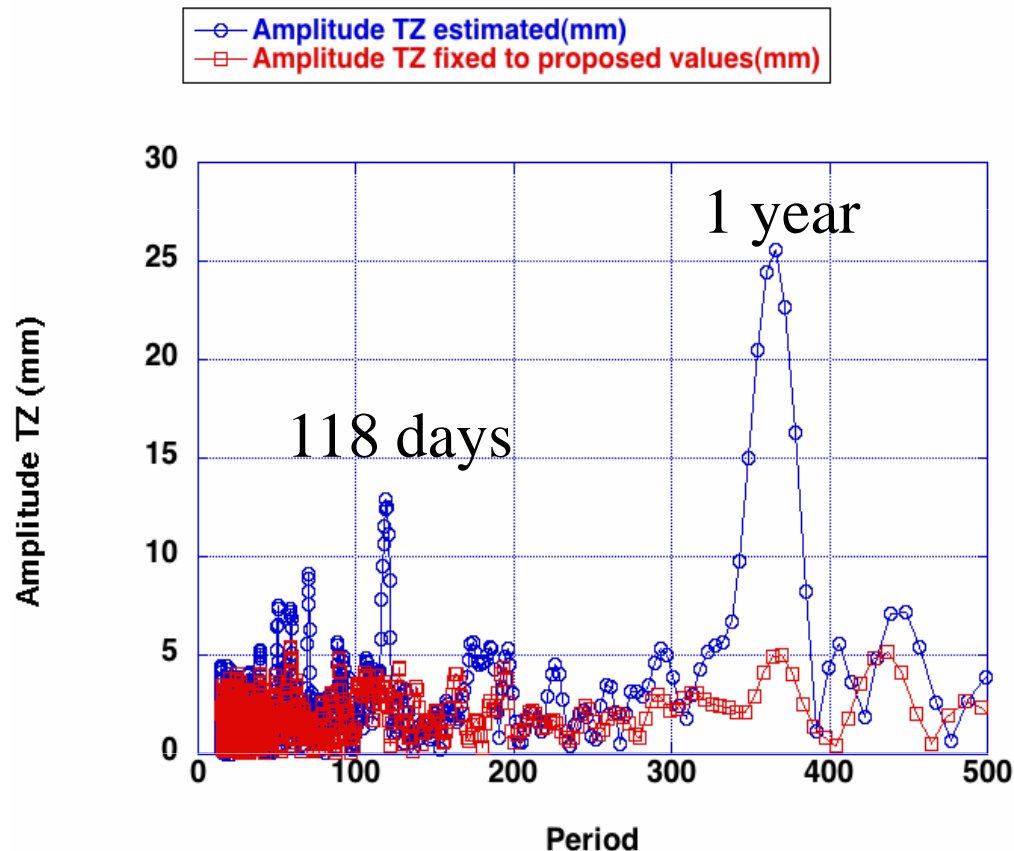
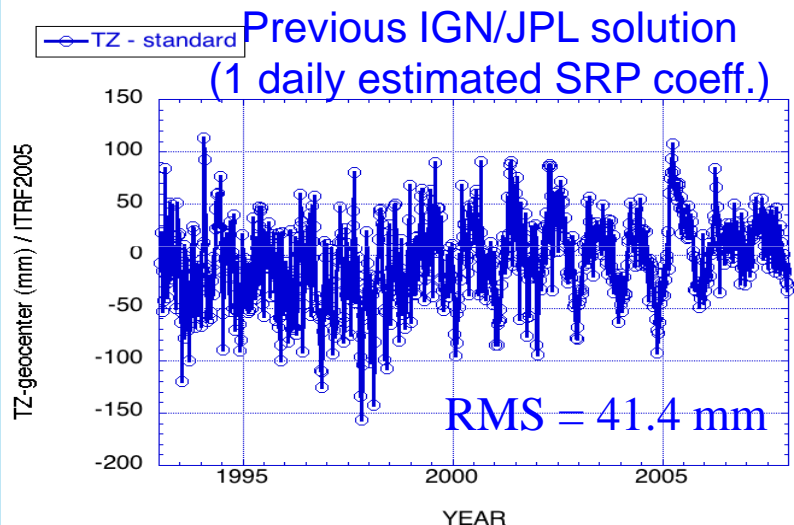
- ➔ **Open Issues**

Change in gravity field

Better alignment with ITRF2005 in Y-geocenter



TZ-Geocenter (multi-satellite DORIS solution) Estimating vs fixing daily SRP

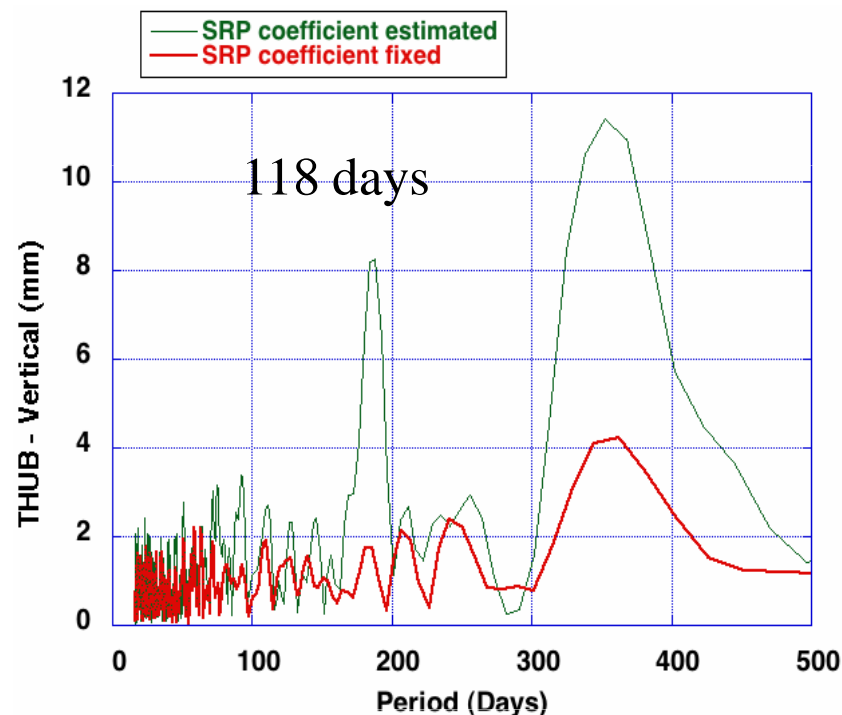
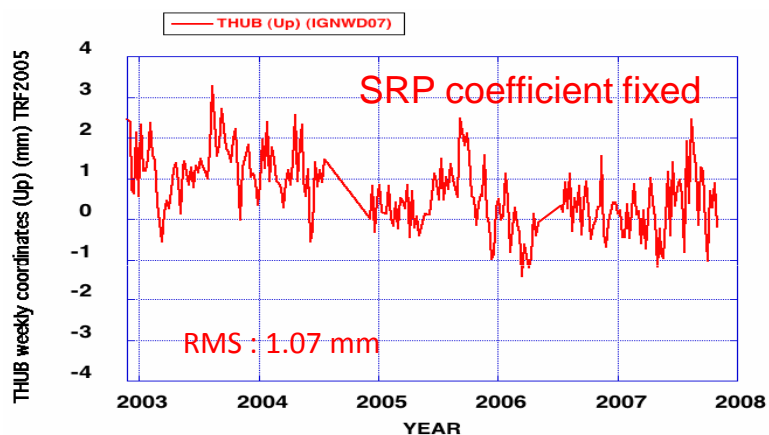
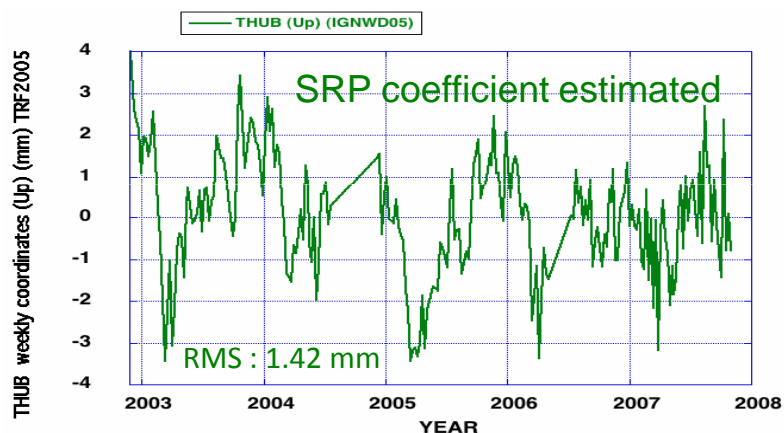


Gobinddass et al., J. Geod., in press

(no geophysical model removed)

Station height time series THUB, (high-latitude)

118-day Problem detected before : Williams and Willis, 2006; Le Bail and al, 2006; Feissel-Vernier and al., 2007; Almavict and al; 2009



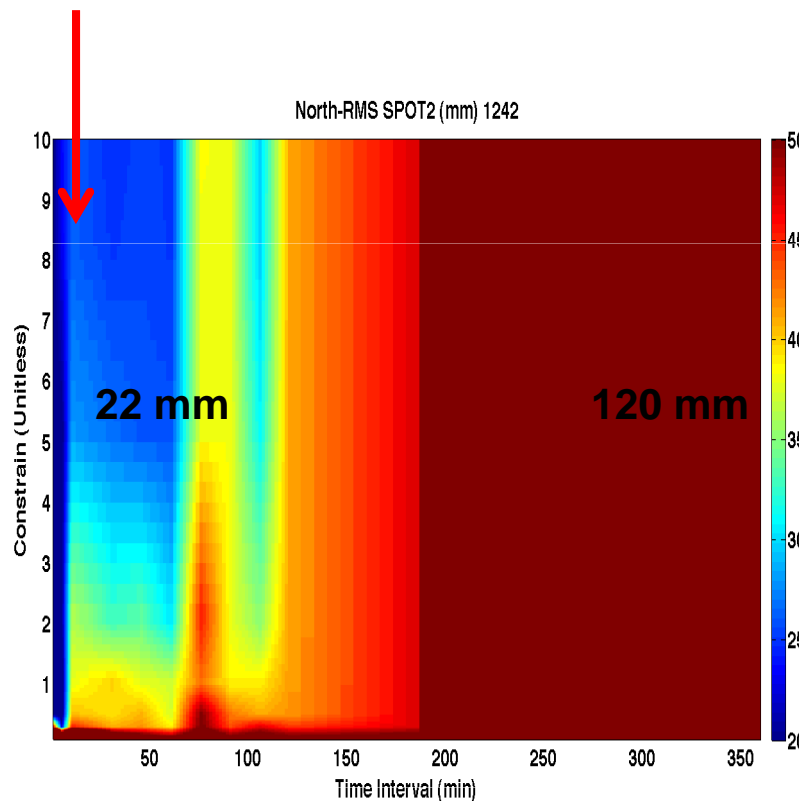
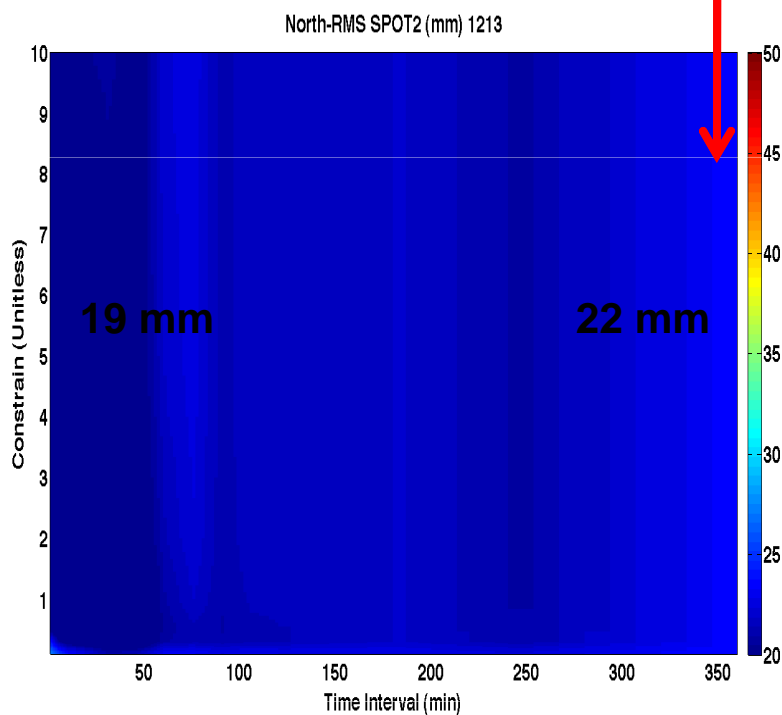
SRP fixed → 25% of improvement in THUB station vertical component

Gobinddass et al., JASR, in preparation

Weekly North RMS (toward ign07d02) SPOT2

IGN process for ITRF2005

IGN process for ITRF2005



Week #1213 : Regular week 6-12
April 2003

Week #1242 : Halloween Geomagnetic storm
26 Oct – 01 Nov 2003

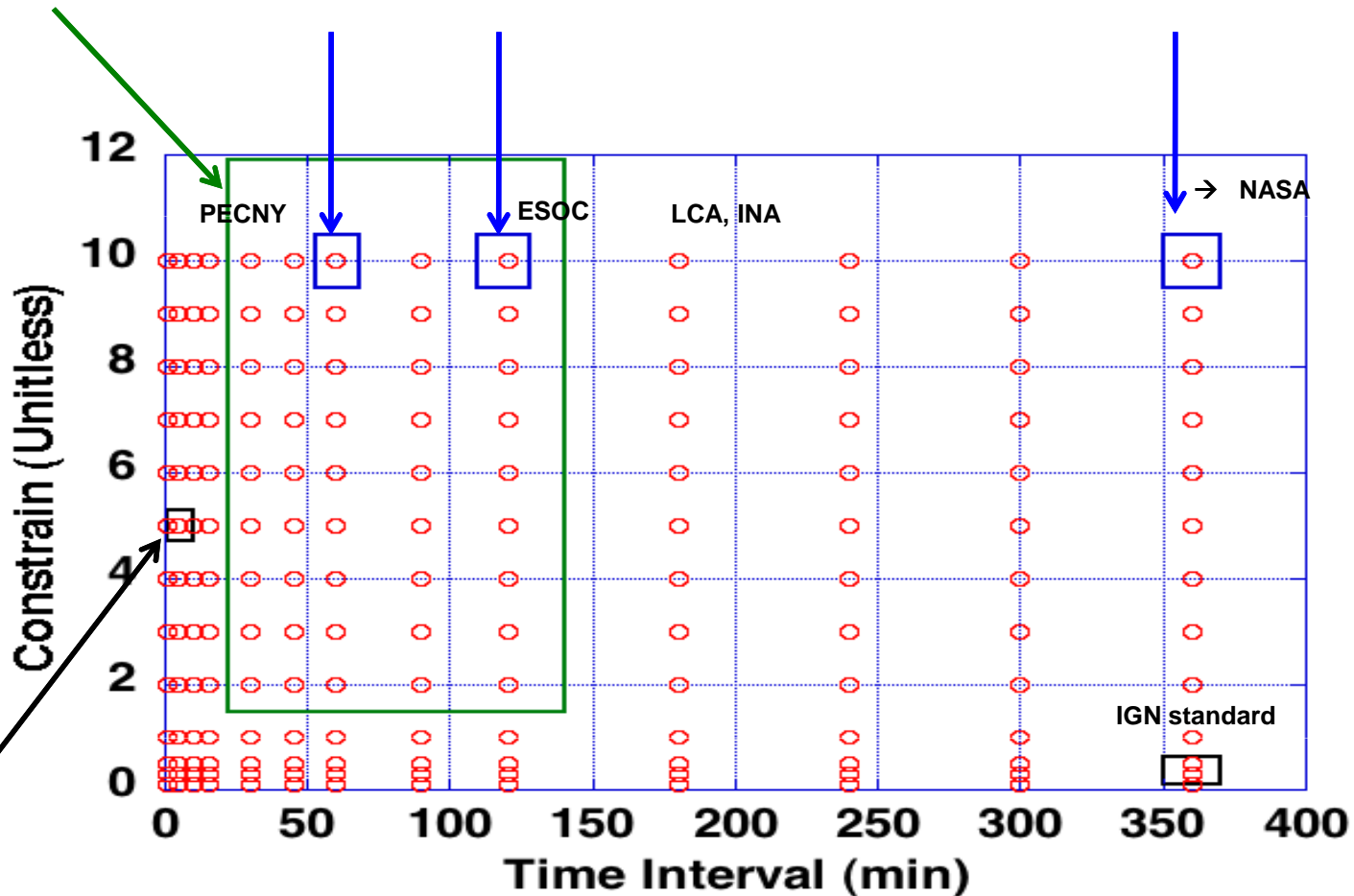
Gobinddass and Willis, DORIS Special Issue, in preparation

Is there an optimum analysis strategy?

Improved data processing
(from single-satellite analysis)

▪ Proposed strategies (1hr, 2hr)

▪ Standard (6hr) ITRF2005



Geomagnetic storm study
Willis et al. Adv. 2005

Lessons learned

- ➔ Fully automated reprocessing was needed
- ➔ A posteriori validation may still be required, especially for early years (< 2002.4)
- ➔ Generation of exceptions is still difficult (even with DPOD2005)
 - Data periods to reject
 - Renaming stations after breaks
 - ◆ (errors found in SINEX by Jean-Jacques Valette and David Coulot)
 - Deleting station with insufficient data



Open issues

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- ➔ **Geomagnetic storms**
 - (P. Willis et al., Adv Space Res., 36(3) : 522-533, 2005)

- ➔ **SPOT time tagging**
 - (P. Willis et al., Adv. Space Res., 36(3) : 486-497, 2005)
 - (Zielenski et al., J. Geod., 80(8-11):497-506, 2006)

- ➔ **SPOT4/1998 : corrupted files at CDDIS and IGN**
 - (P. Willis et al., J. Geod., 79(10-11):567-572, 2006)

- ➔ **TOPEX 1993 : change in SRP coefficient on 27-JUL-1993?**
 - (Gobinddass et al., J. Geod., 2009)

- ➔ **ENVISAT 2004: change in phase offset on 12-OCT-2004 ?**
 - (Doornbos and Willis, Acta Astronaut., 60(8-9), 611-621, 2007)
 - (Willis et al., Adv. Space Res., 39(10), 1589-1596, 2007)

- ➔ **SPOT-5 solar panel reorientation on 14-JAN-2008**
 - 40° angle properly estimated but not implemented

CONCLUSIONS

ignwd08 complete resubmission was done with GOA 5.0+

Automated weekly resubmission could resume in spring 2009

Future improvements foreseen :

- ENVISAT SRP UCL model
- use of Jason-2 data (see after)
- Troposphere: use of VMF
- ...



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BACK-UP SLIDES

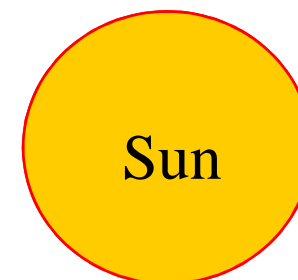
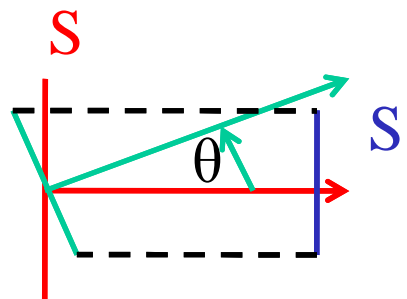
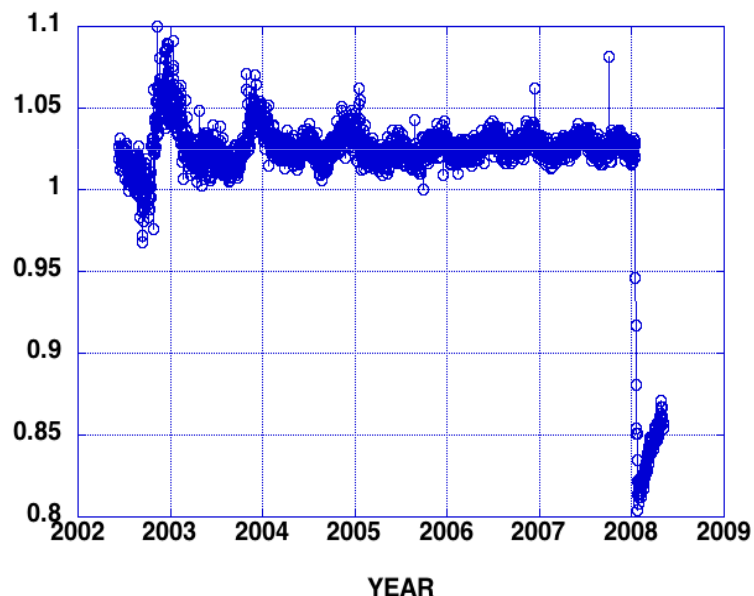


IDS AWG Meeting
Paris, 23-24 March 2009



Solar Radiation Pressure coefficient : SPOT-5 satellite

SPOT5 solar pressure coefficient (unitless)



$$CR' \cdot S = CR \cdot S'$$

$$S' = S \cdot \cos(\theta)$$

$$\theta = \cos^{-1}\left(\frac{S'}{S}\right) = \cos^{-1}\left(\frac{CR}{CR'}\right) = \cos^{-1}\left(\frac{0.83}{1.03}\right)$$

$$\theta \sim 36.5^\circ \pm 1^\circ \text{ (estimated)}$$

$$\text{CNES value} = 25^\circ + 10^\circ + 5^\circ = 40^\circ$$

**SPOT 5 break observed around
January 14, 2008
Solar panel re-oriented by CNES**



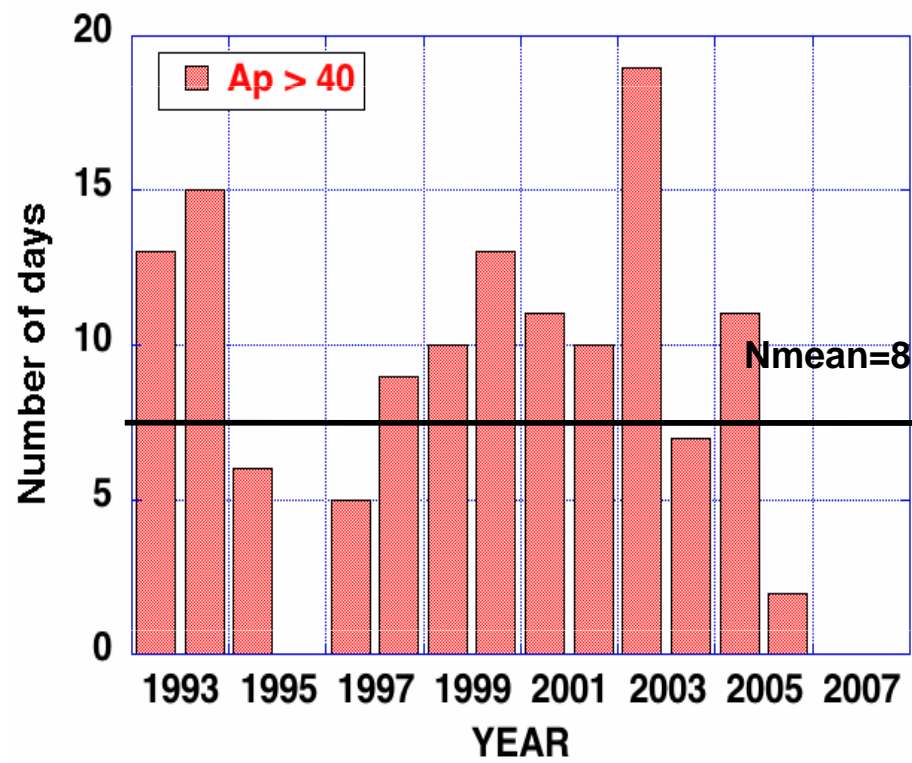
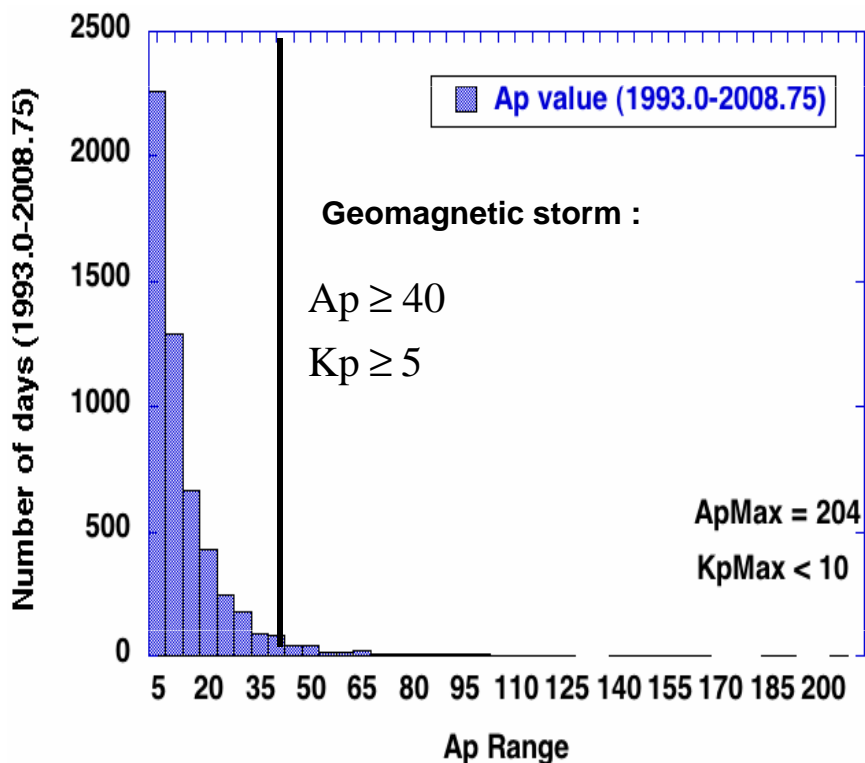
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SRP coefficient proposed at International DORIS Service (IDS) adopted by IDS on June 6, 2008

IDS = 7 Analysis center

SATELLITE	Mean SRP	A priori SRP model	COMMENTS
TOPEX	1.03 ± 0.01	macro-model	0.96 (< 23JUL-1993) 0.97=GPS value (1993 data)
ENVISAT	1.02 ± 0.02	macro-model	
JASON	0.92 ± 0.01	macro-model	
SPOT-2	1.08 ± 0.03	macro-model	
SPOT-3	1.08 ± 0.01	macro-model	
SPOT-4	1.13 ± 0.05	macro-model	
SPOT-5	1.03 ± 0.01	macro-model	0.83 (> 14-JAN-2008) Solar panel re-orientation

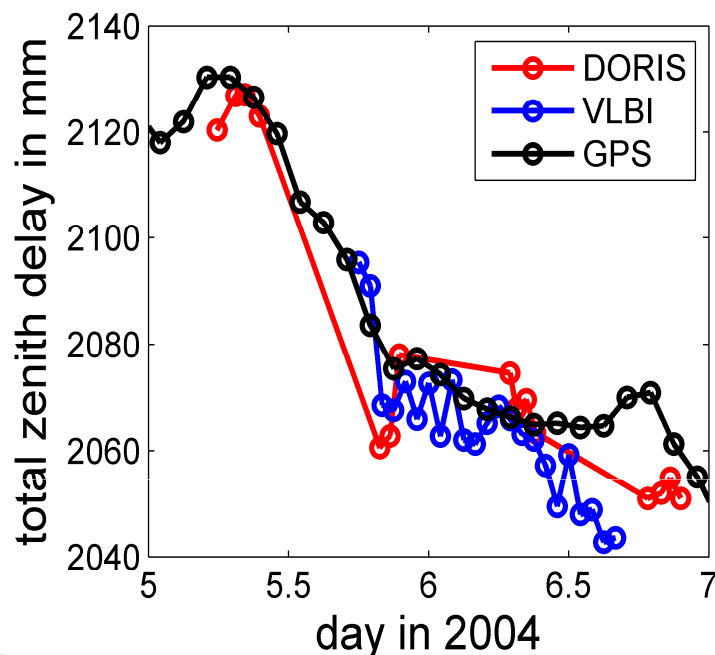
Geomagnetic storm affecting DORIS processing (1993.0- 2008.75)



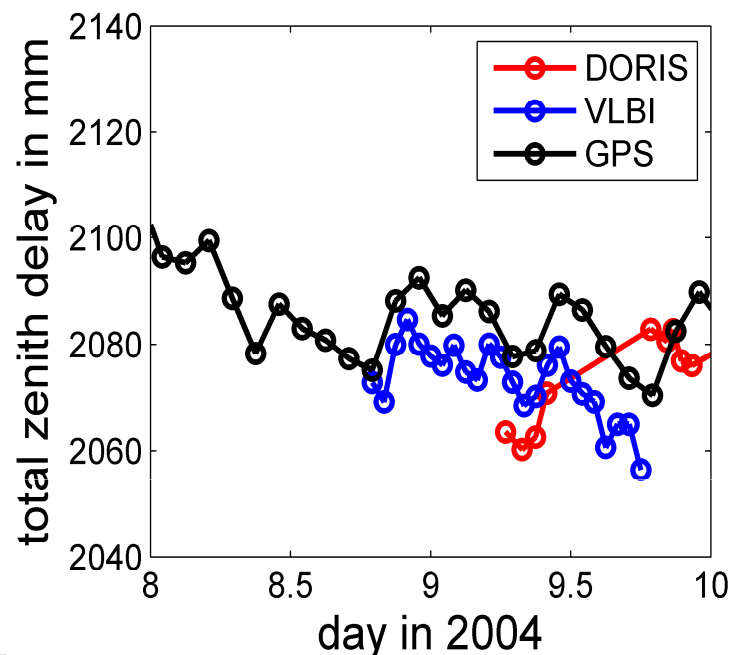
Troposphere comparisons

- DORIS, like VLBI & GPS must estimate troposphere corrections.
- Corrections are estimated pass-by-pass (typically 10-15 min, ~2X per satellite & DORIS station, and per day).

Hartebeesthoek

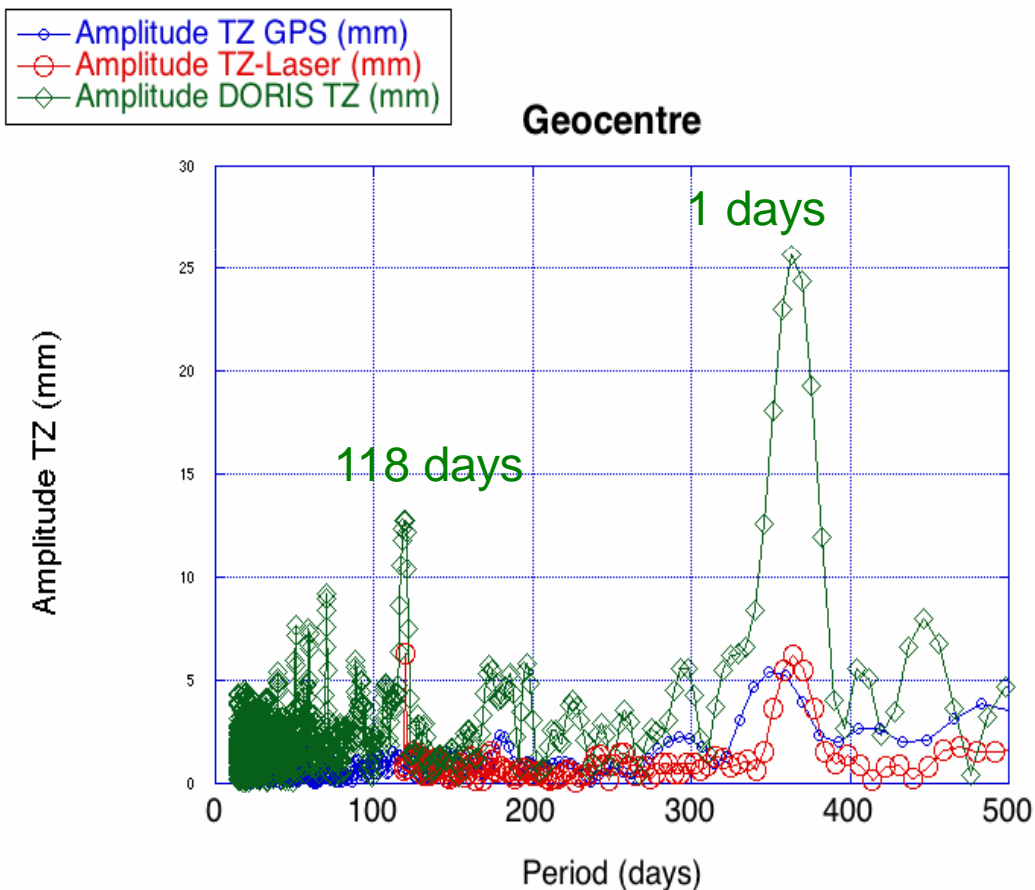


Kokee Park



Preliminary (example) comparisons from VLBI & GPS (Johannes Boehm) and DORIS (Pascal Willis).

Frequency analysis of Z-geocenter (Laser, GPS, DORIS)



Geophysics:

1 yr = \approx 5 mm

Laser/ U. Texas:

1 yr = 6 mm

GPS/ IGS (combined):

1 yr = 5 mm

DORIS/IGN

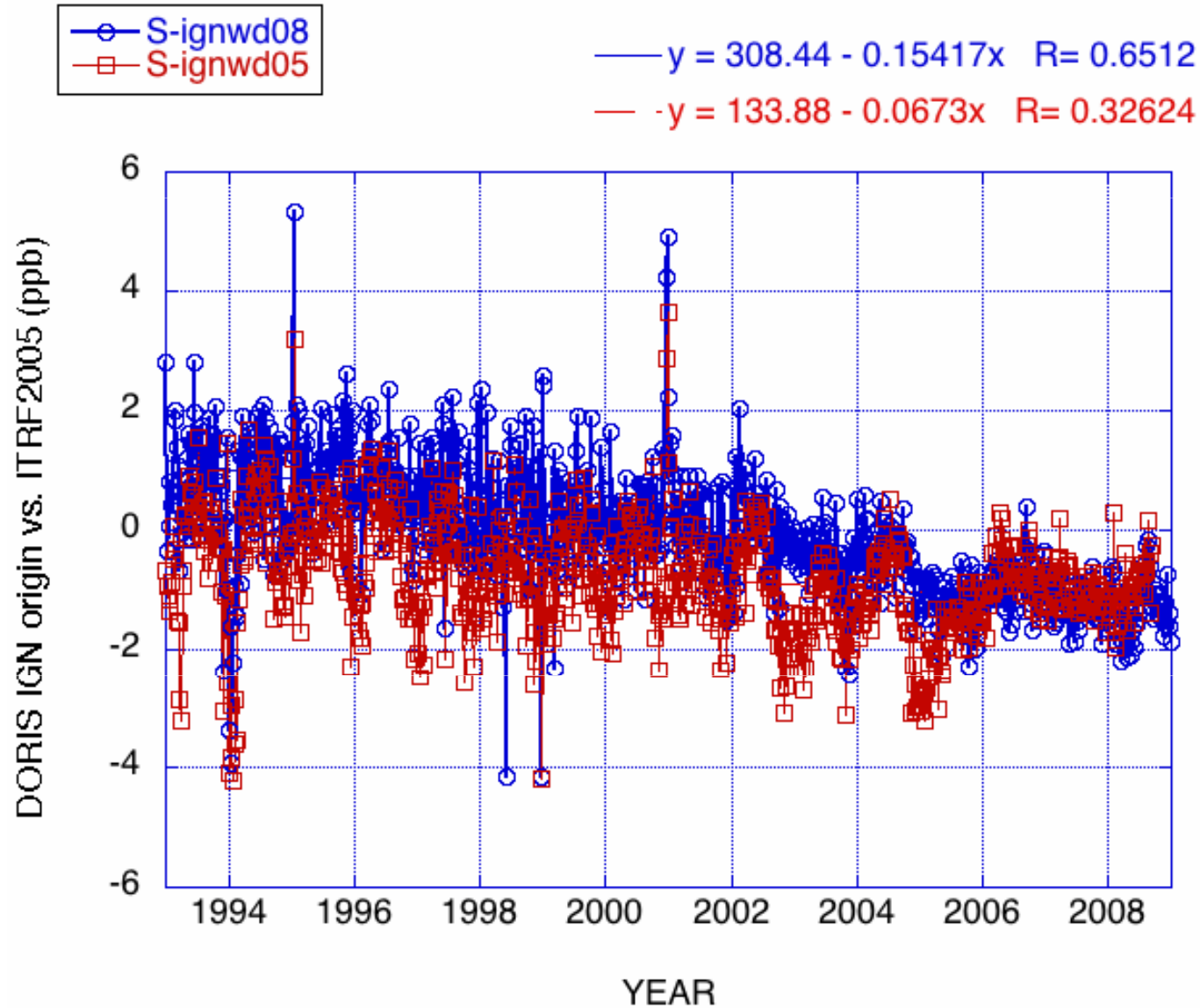
1 yr = 26 mm ???

118 days = 13 mm???

118 days = T/P draconitic period \rightarrow Pb related to Solar Radiation Pressure (SRP)

Gobinddas et al., J. Geod, in press

TRF scale

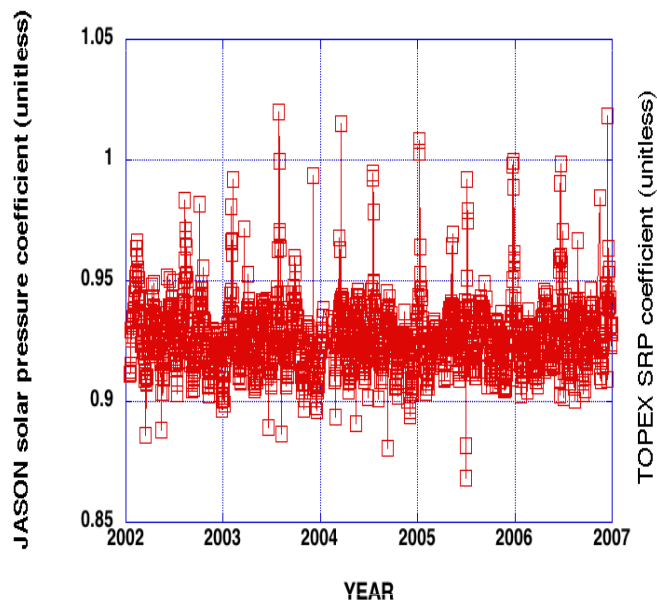


Daily estimation of solar radiation pressure coefficient

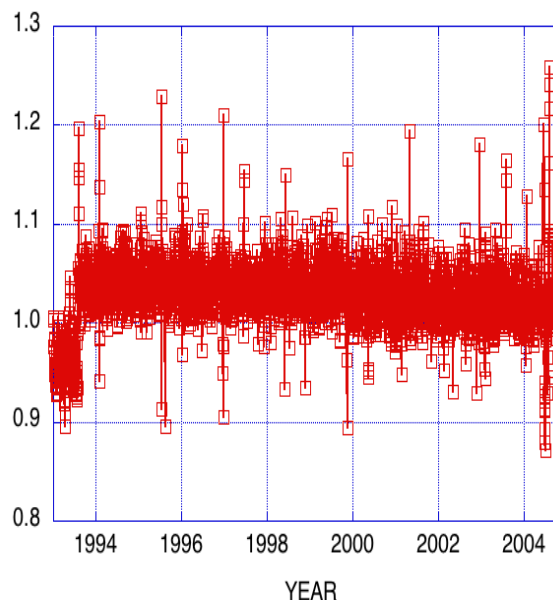
Estimated parameter (1/day) = station position + SRP coefficient

Fixed parameter = 1/rev empirical accelerations = 0

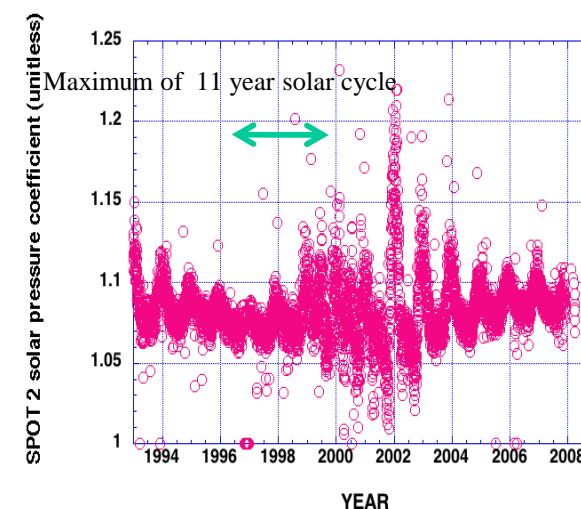
JASON



TOPEX



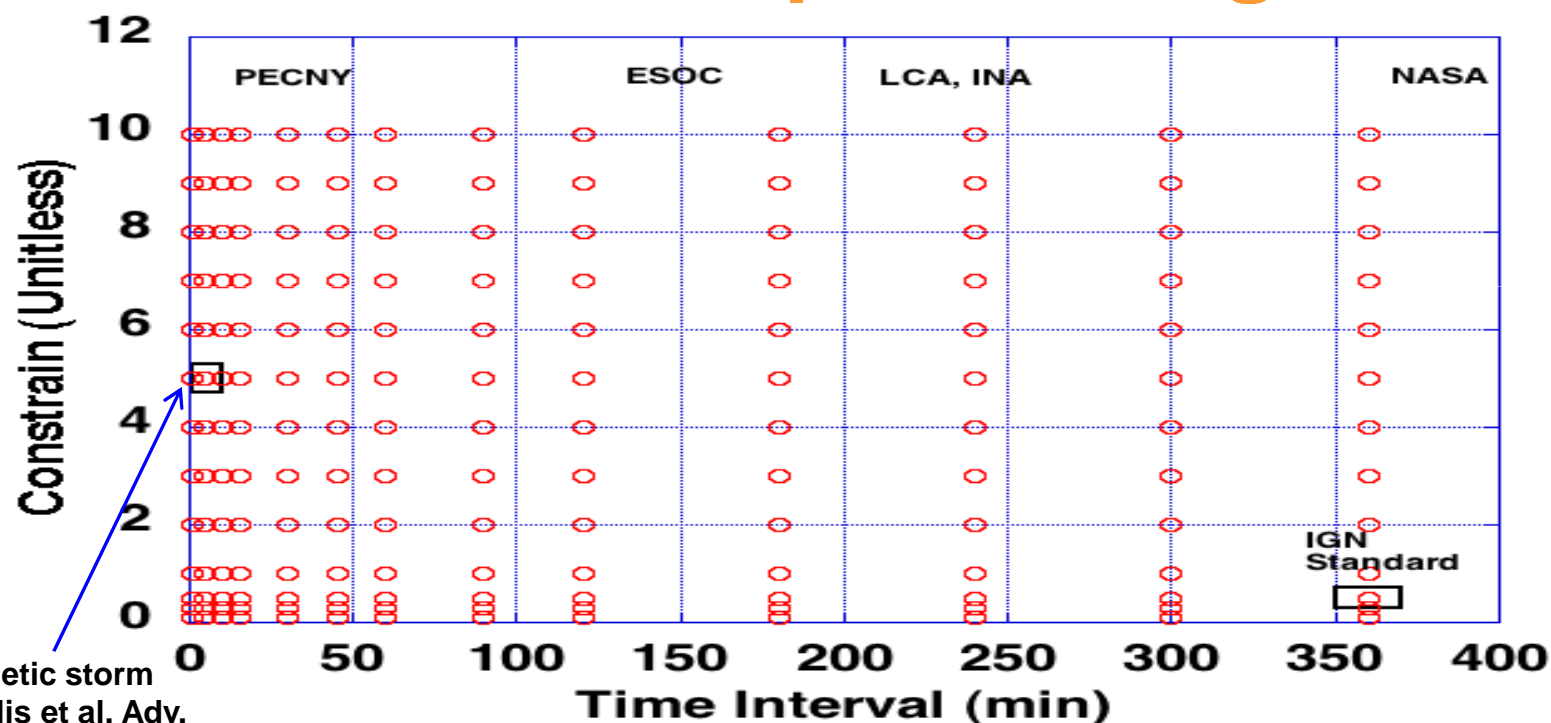
SPOT2



T/P break observed on July 27, 1993
change in receiver (chained vs unchained mode). Why?

Gobinddass et al., J. Geod, in press

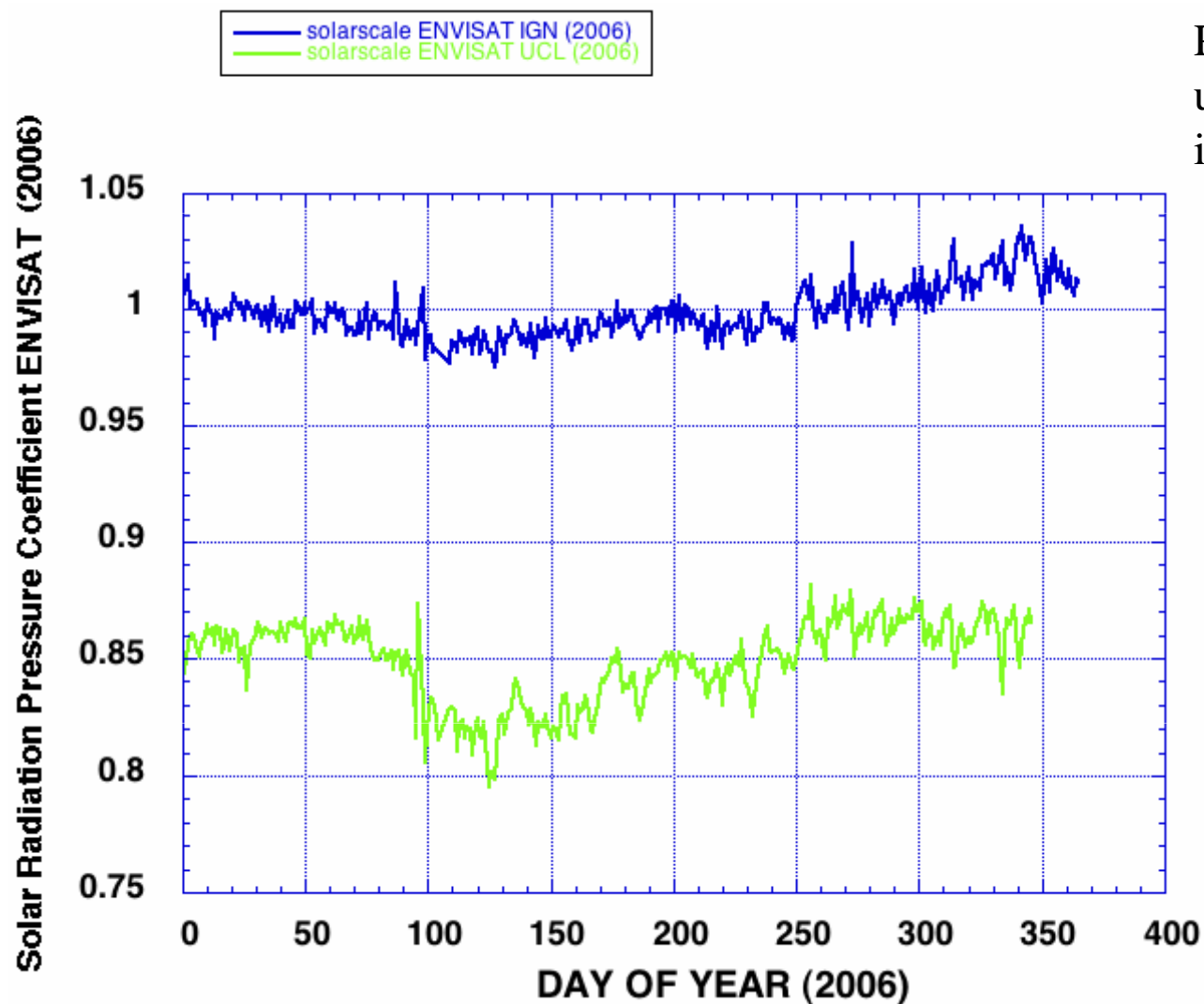
Atmospheric drag



Geomagnetic storm study Willis et al. Adv. 2005

- 1) Single satellite tests : very fast, test a large number of strategies above for a few weeks (4) in 2003
- 2) Multi satellite tests : slow, test 3 strategies for 2 complete year (1993 + 2003)

GIPSY UCL model for ENVISAT



Problem still
under
investigation