Estimating daily Solar Radiation Pressure coefficients

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IDS meeting, Paris, June 5, 2008

SUMMARY

- Method used

- Estimated SRP coefficients (1/day, 1/satellite)

- Fixing vs estimating : Impact on results

       - TZ-geocenter

       - Station heights (Terre Adelie)

       - Precise Orbit Determination

- Conclusions

Method used

- We have this equation $\gamma_{SRP}^{Estimated}(t) = CR \cdot \gamma_{SRP}^{Model}(t)$

  Model = -macro model (this study)

  -dedicated model (eg UCL)

- Estimated parameters :

  - SRP coefficient = CR (1/day)

  - Station positions (independent from ITRF)

- Fixed parameters : (to avoid correlation)

  - 1/rev accelerations = 0 (dynamic orbit)

Solar radiation pressure coefficients

Estimated parameter (1/day) = station position + SRP coefficient
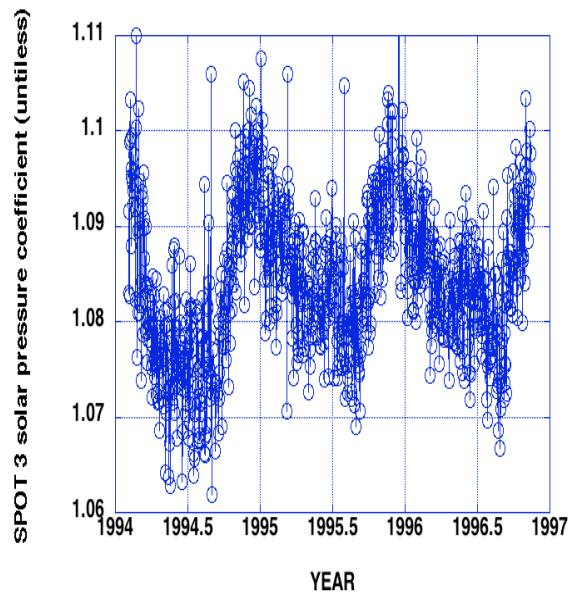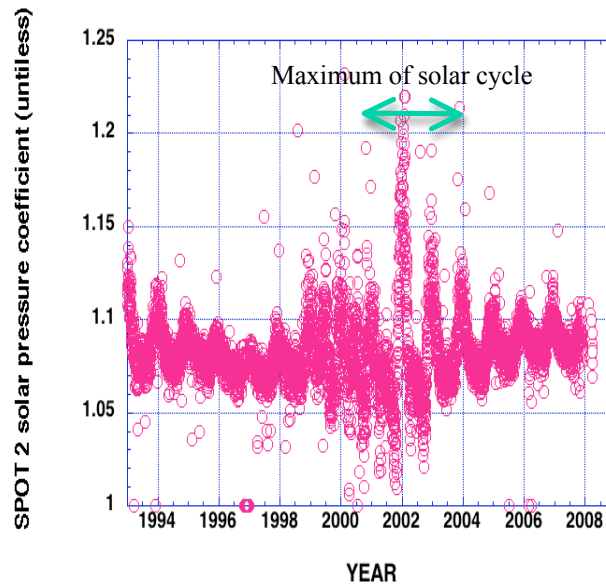Fixed parameter = 1/rev empirical accelerations = 0

JASON

TOPEX

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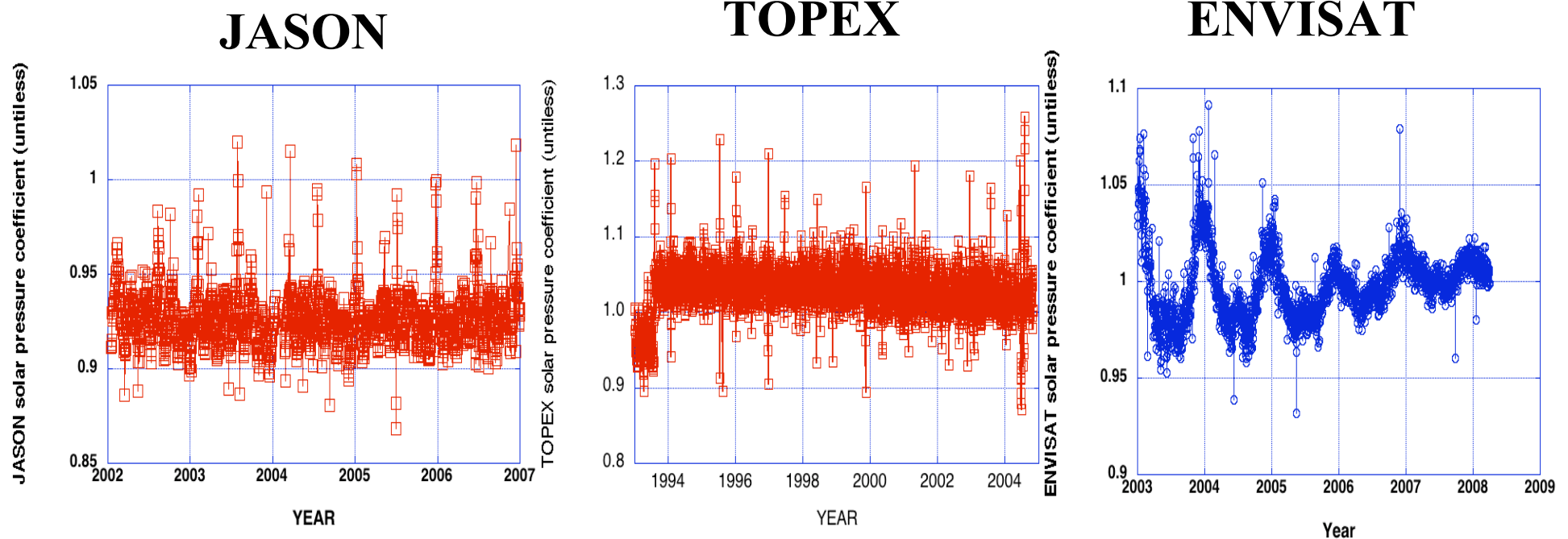
**T/P break observed on July 27, 1993
change in receiver (chained vs unchained
mode). Explanation?**

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Solar radiation pressure coefficients

Estimated parameter (1/day) = station position + SRP coefficient
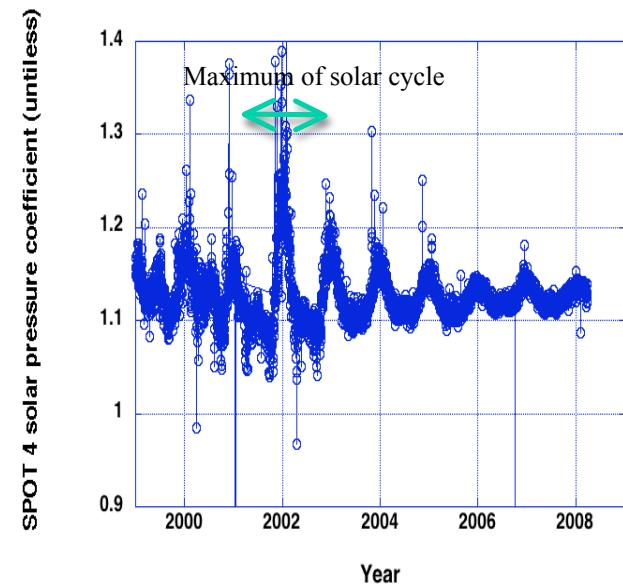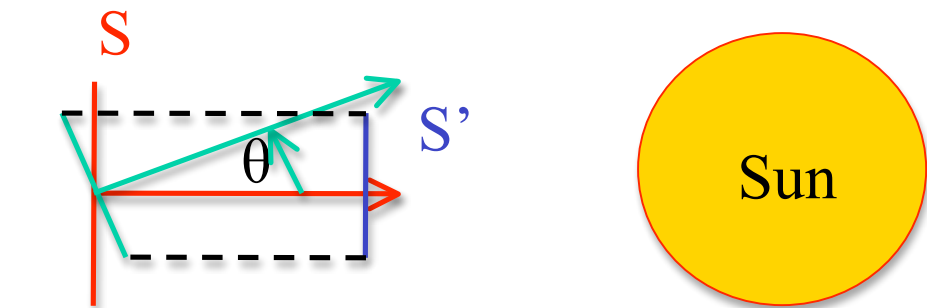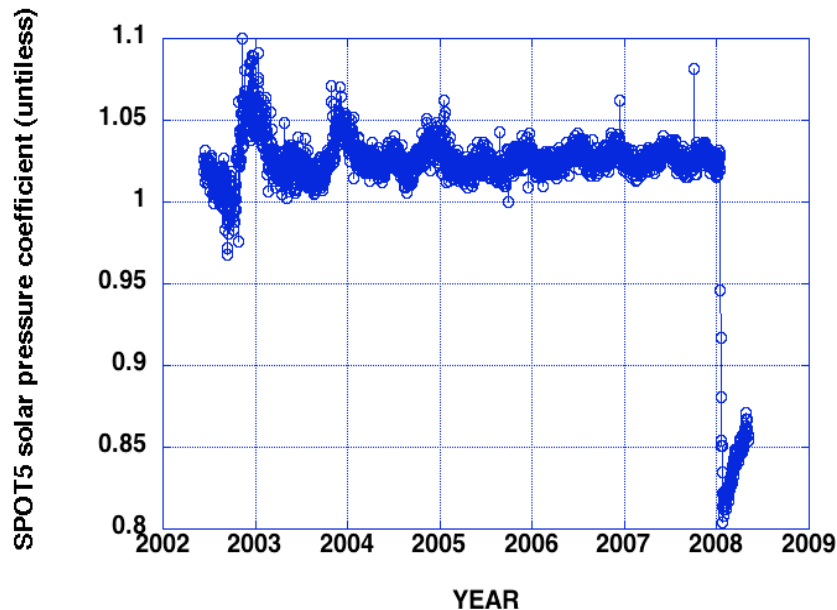Fixed parameter = 1/rev empirical accelerations = 0

Solar radiation pressure coefficient : SPOT-5 satellite

SPOT 5 break observed on January 14, 2008
Solar panel re-oriented by CNES
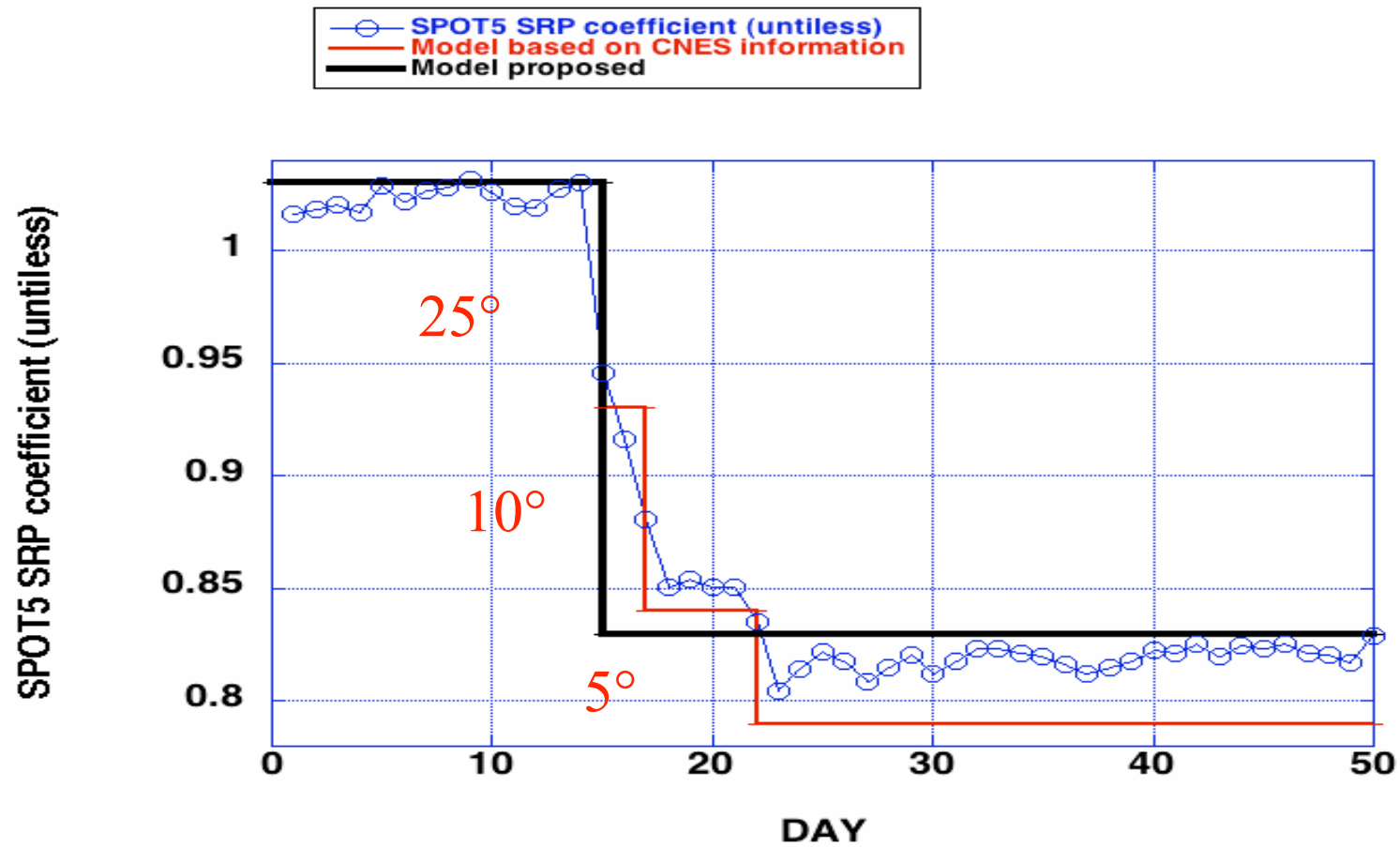
$$CR'. S = CR. S'$$
$$S' = S.\cos(\theta)$$

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

$\theta \sim 36.5° \pm 1°$ (estimated)
CNES value $= 25°+10°+5°=40°$

Re-orientation of : SPOT-5 satellite

Proposal for IDS SRP coefficients (averages over complete data set)

SATELLITE	Mean SRP	A priori SRP model	COMMENTS
TOPEX	1.03	macro-model	0.96 (< 23JUL-1993)
ENVISAT	1.02	macro-model	
JASON	0.92	macro-model	
SPOT-2	1.08	macro-model	
SPOT-3	1.08	macro-model	
SPOT-4	1.13	macro-model	
SPOT-5	1.03	macro-model	0.83 (> 14-JAN-2008)

Fixing vs estimating : Impact on results

- TZ-geocenter

- Station heights (Terre Adelie)

- Precise Orbit Determination

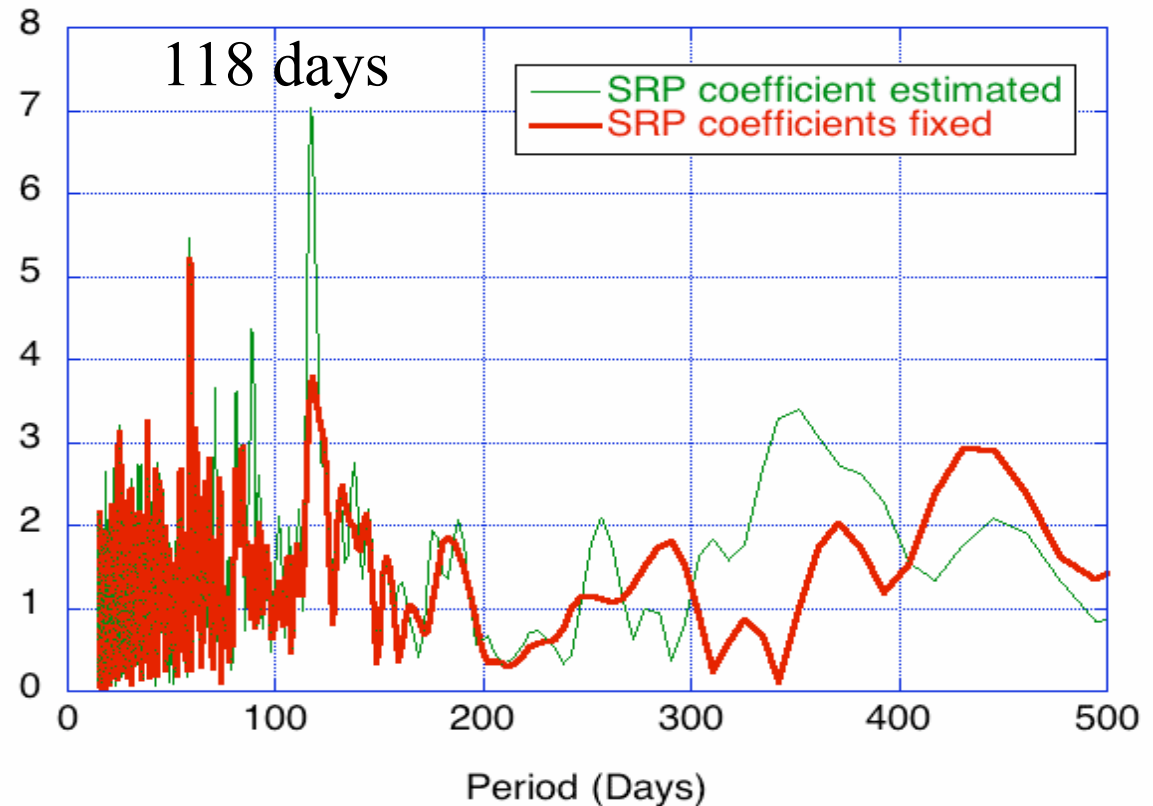# TZ-Geocenter (multi-satellite)
Estimating vs fixing daily SRP
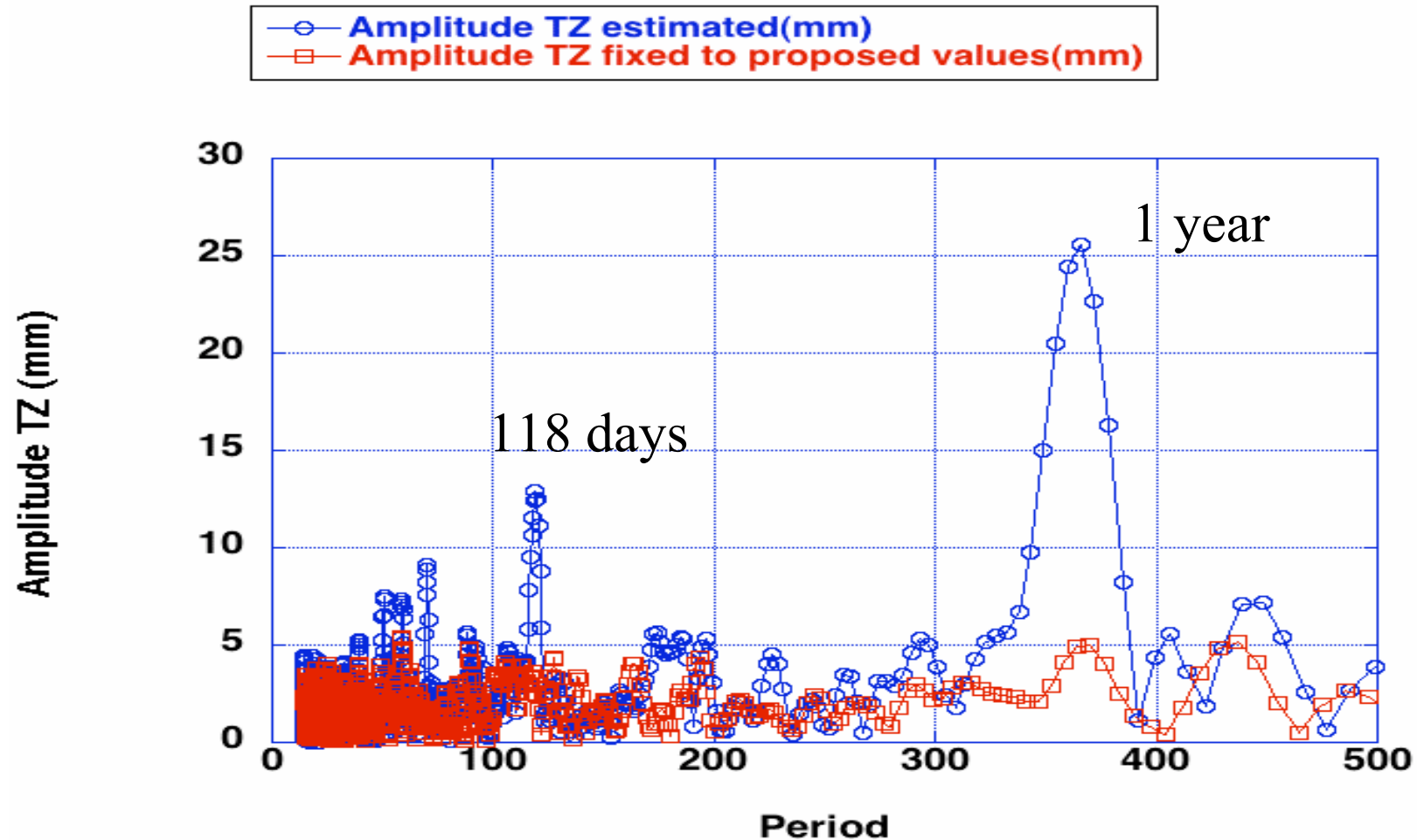
Station height time series
Terre Adelie, Antarctica (high-latitude)

118-day Problem detected before : Williams and Willis, 2006; Le Bail and al, 2006; Feissel-Vernier and al., 2007; Almavict and al; in press
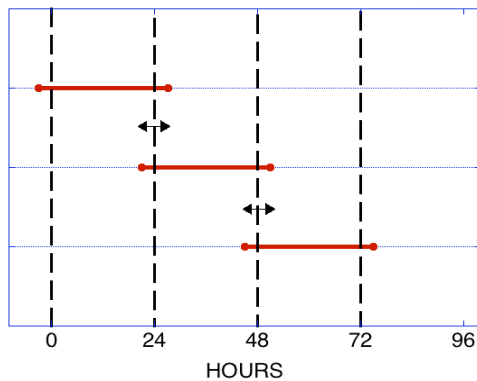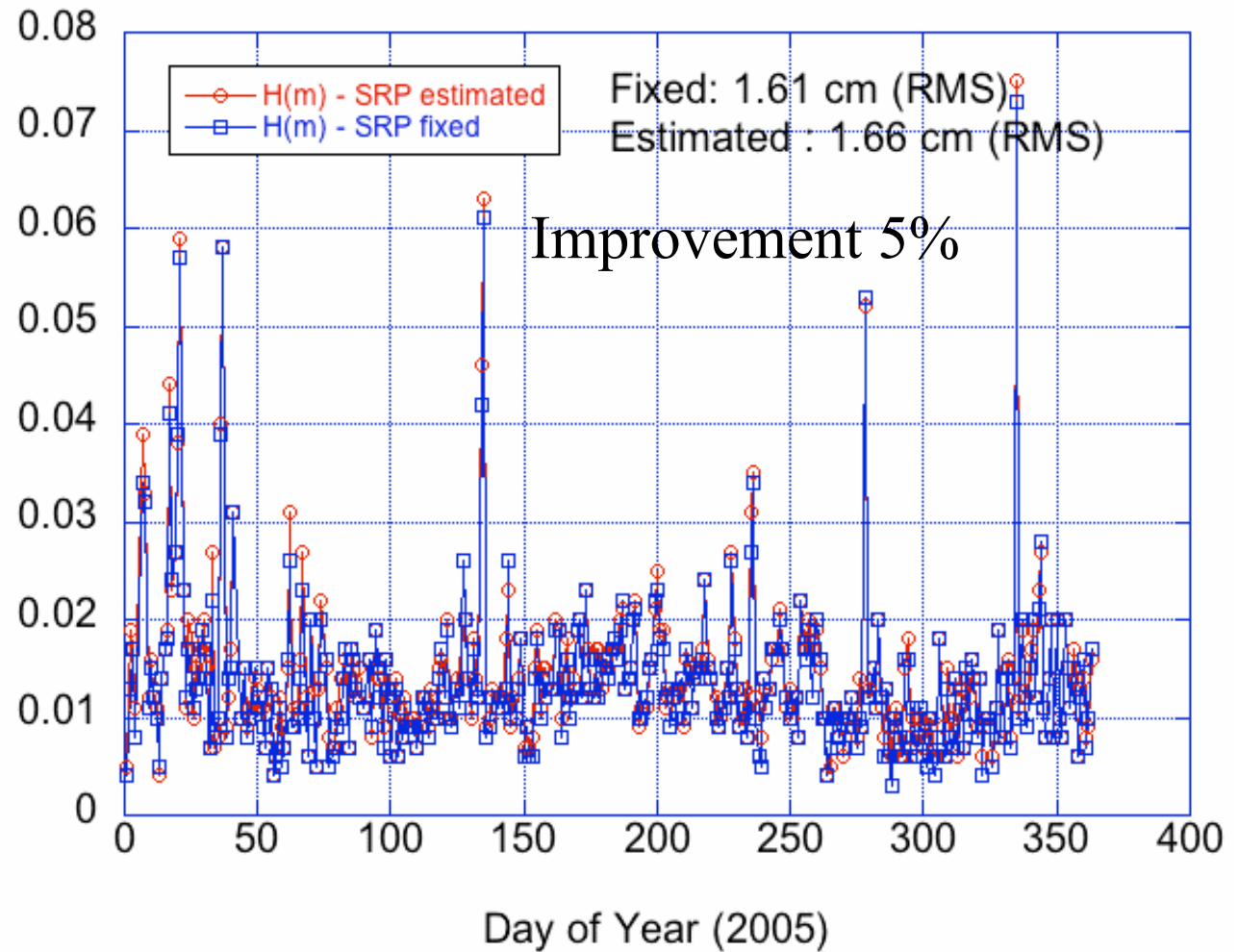
Validation for Precise Orbit Determination

ENVISAT 2005

Improvement 5%

CONCLUSIONS

- Fixing SRP coefficients provide better results :

    -TZ-geocenter

    -Station height (high latitude)

    -Precise Orbit Determination (smaller improvement)

- Proposal to adopt common values for IDS (ITRF 2008)

- Need for better SPOT SRP models (UCL initiative)

- Understanding the SRP breaks (SPOT-5 ✓ +T/P ?)