



Estimating DORIS drag coefficients : toward an optimum IDS analysis strategy ?

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SUMMARY



- Background (atmospheric drag)
- Scientific goals and method used
- Results
 - Plots comparison between strategies
- Conclusions and plans for the future

Estimating drag coefficient

$$\gamma_{Drag} = \mathbf{CR}(t) \cdot \left(\frac{1}{2m} CV_{sat} \cdot \rho_{atmos} \cdot V^2 \right)$$

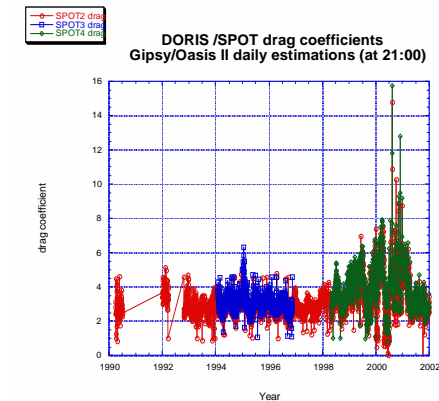
CR = headvyside function (time interval)

ρ_{atmos} = atm. density =DTM 94

Problems :

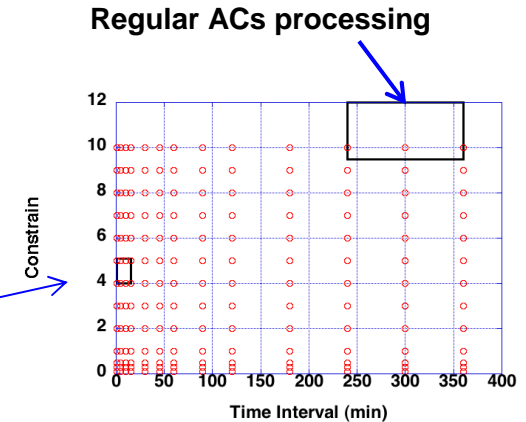
- ACs use different time interval (4hr or 6 hr for SPOTs and ENVISAT+ 12hr or 24hr / higher altitude = T/P + Jason)

- specific case of geomagnetic storms, 29 Oct. 2003 – 01 Nov. 2003 (Willis et al., Adv Space Res, 36(3) : 522-533, 2005)



This study

Geomagnetic storm study
Willis et al. Adv. 2005



- **Primary goal:**

- Is there an optimum choice for the time interval?
- Will it work in all cases (including geomagnetic storms)?
- Satellite dependency (with altitude)?

- **Other goal :**

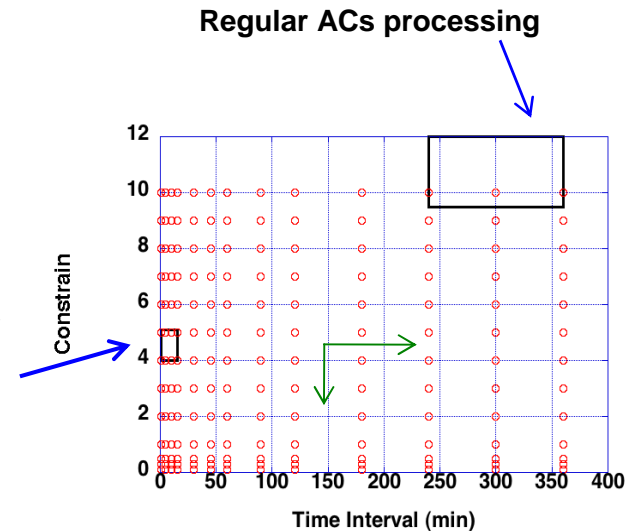
- Should we constrain the a priori value?
- Other estimation methods in GOA? White noise, colored noise, random walk?

- **Method:**

- Process actual DORIS data in 2003 for four weeks (1213, 1216, 1242, 1248)
- Single satellite processing
- Use different processing strategies and compare results (in time interval / constrain domain)

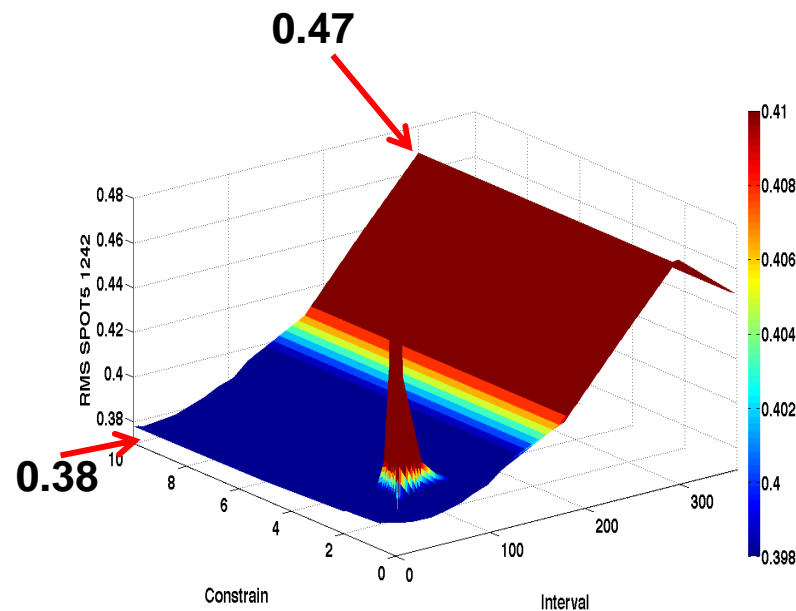
Results

Geomagnetic storm study
Willis et al. Adv. 2005

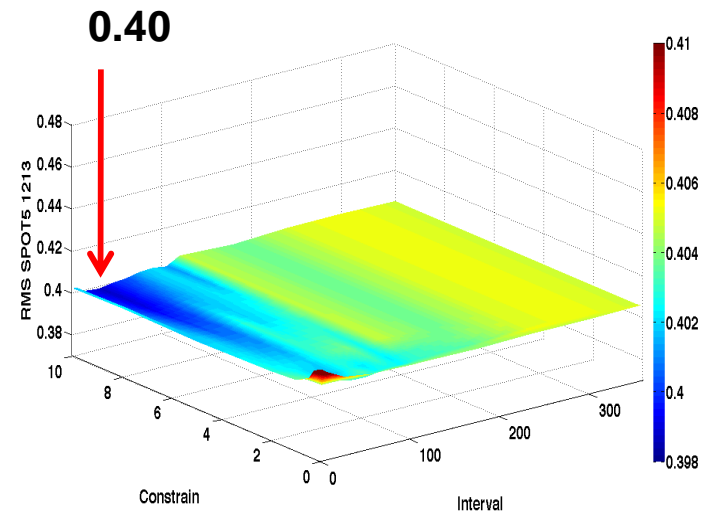


- Different types of results
 - Internal consistency
 - (DORIS) Doppler residuals (in mm/s)
 - External consistency
 - Chi2/DOF (merging 7 days into weekly solutions)
 - XYZ weekly residuals vs. ITRF2005 (IGN07D02)
 - Polar Motion = XP, YP daily results vs. GPS/JPL

Daily DORIS Doppler RMS (internal consistency)



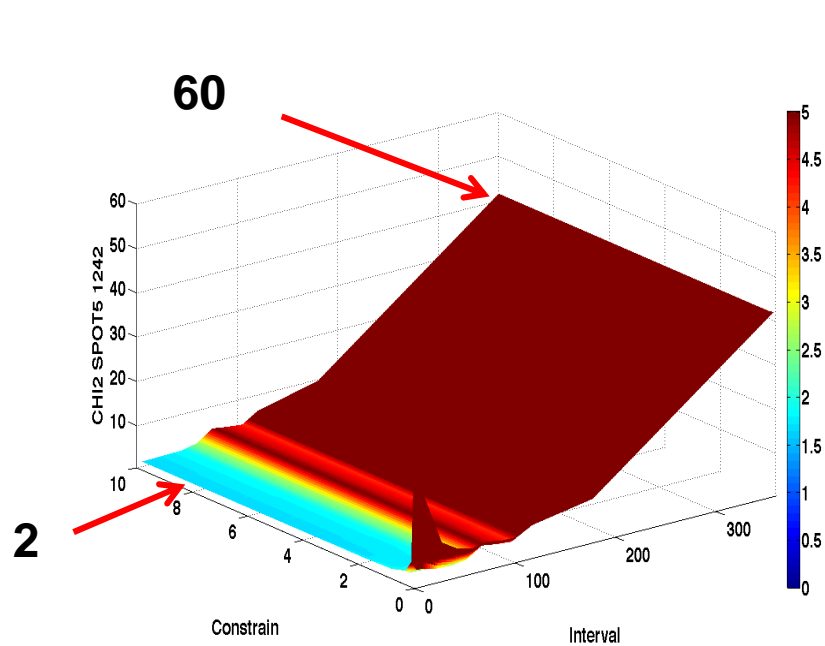
Week #1242
(26 OCT- 01NOV 2003)
(Halloween geomagnetic storm)



Week #1213
(regular
week)

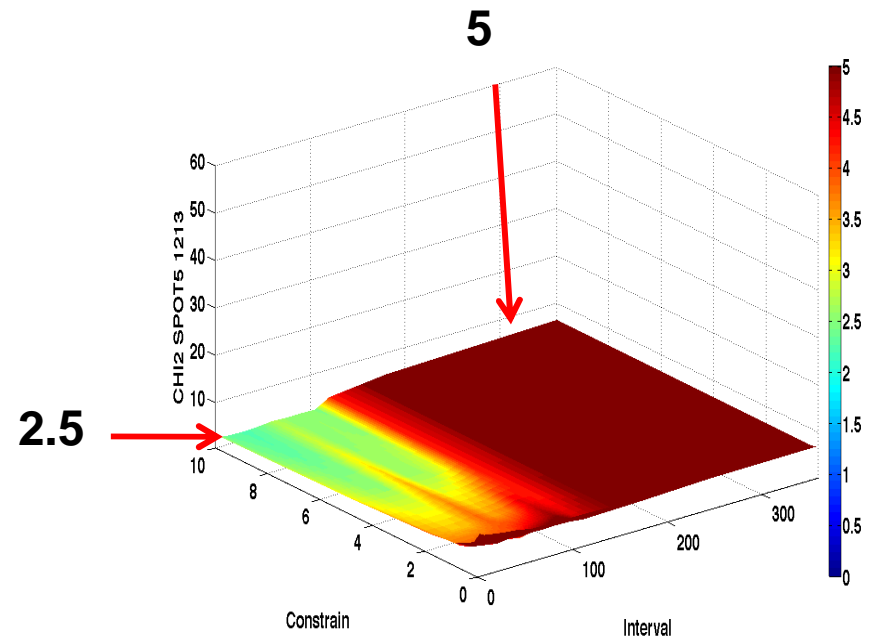
Weekly Chi2/DOF (merging daily SINEX into weekly SINEX) SPOT5

For smaller interval CHI2 is close to 1



Week #1242

November 12-14, 2008

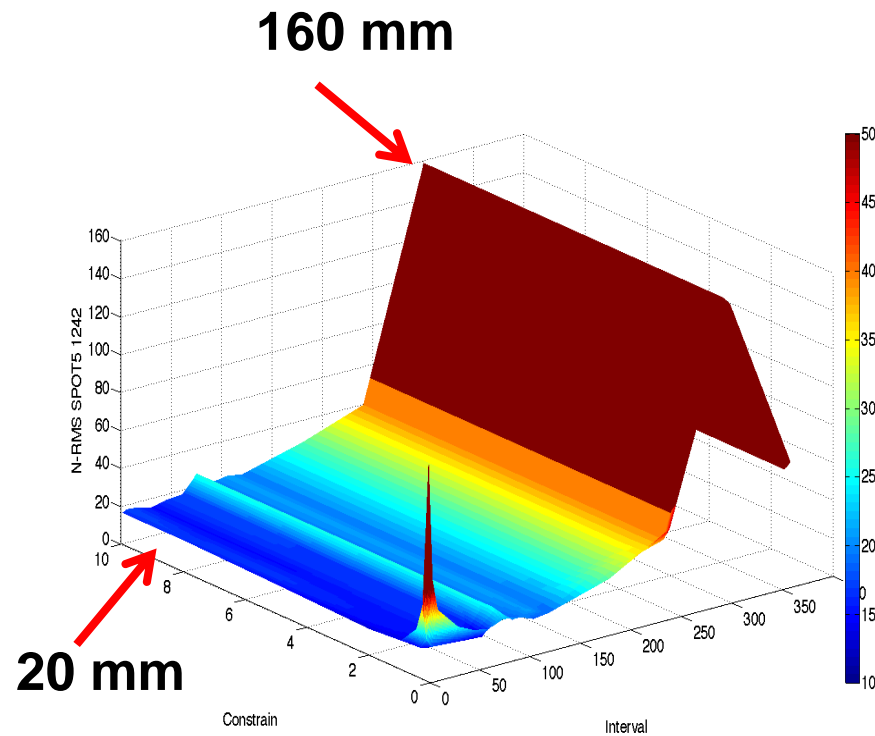


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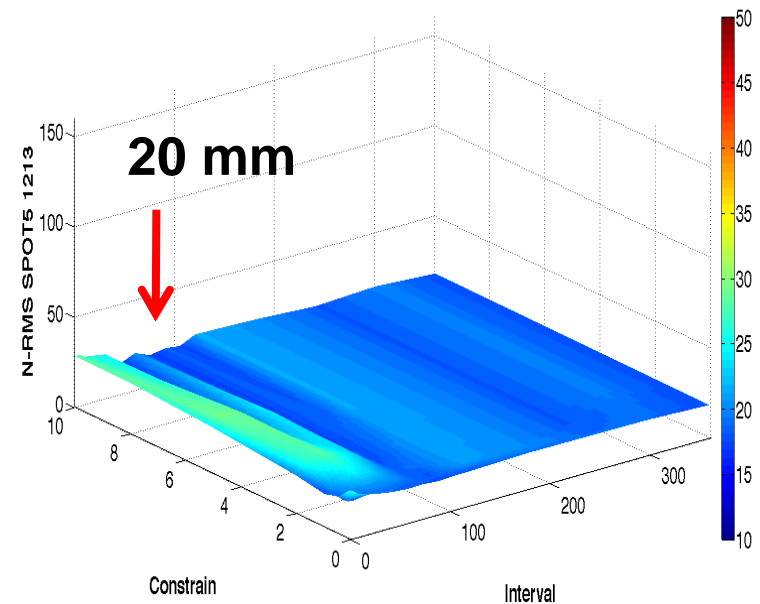
7/17

Weekly North RMS (toward ign07d02) SPOT5



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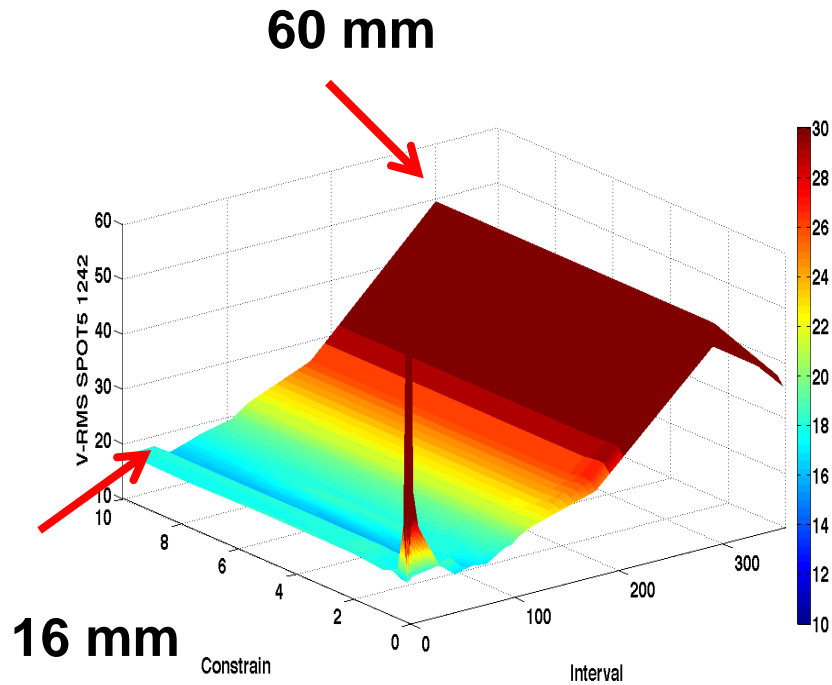


Week #1213

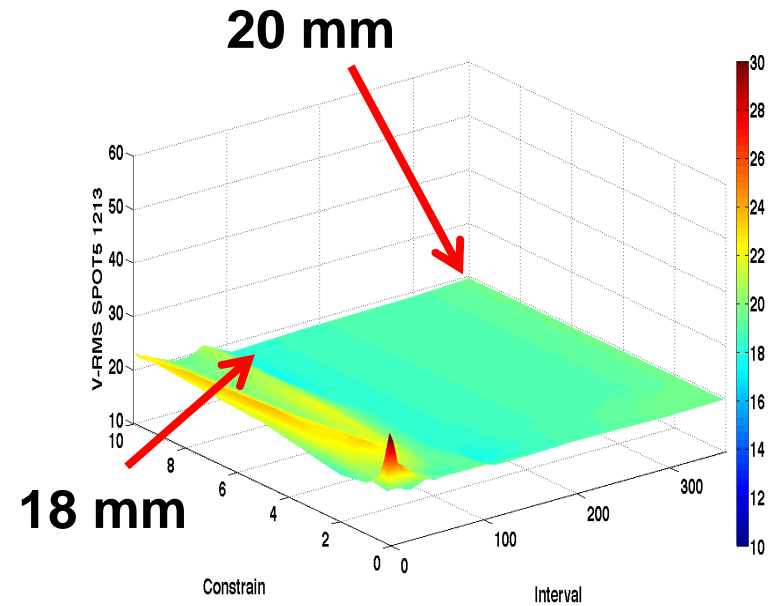
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Weekly Vertical RMS (toward ign07d02) SPOT5

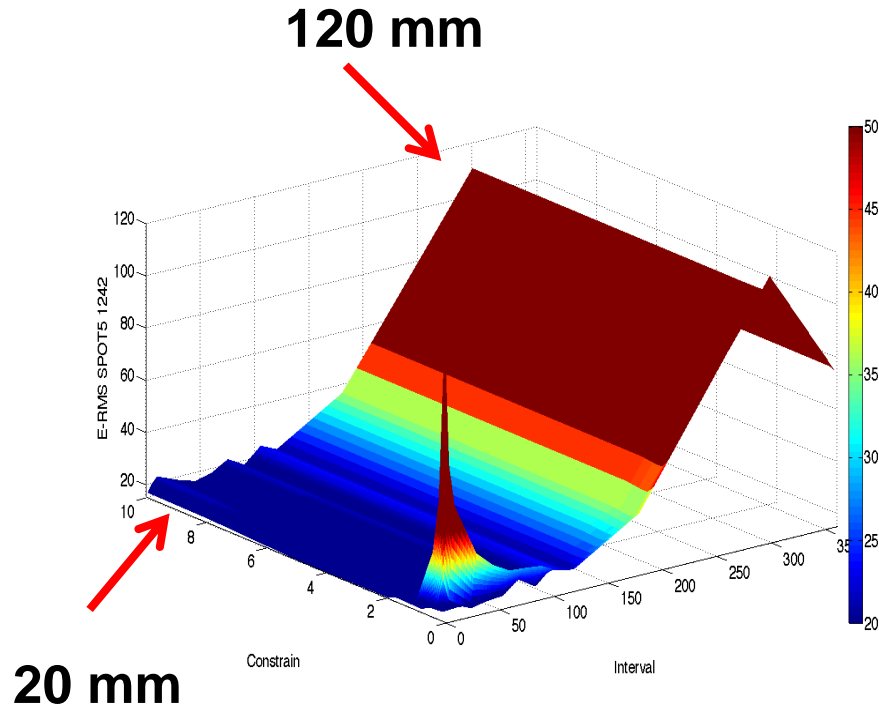


Week #1242

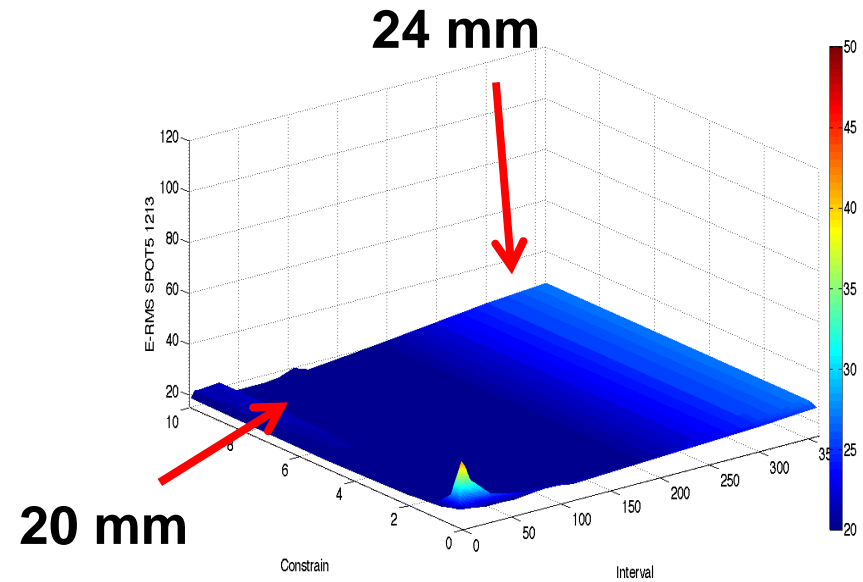


Week #1213

Weekly East RMS (toward ign07d02) SPOT5



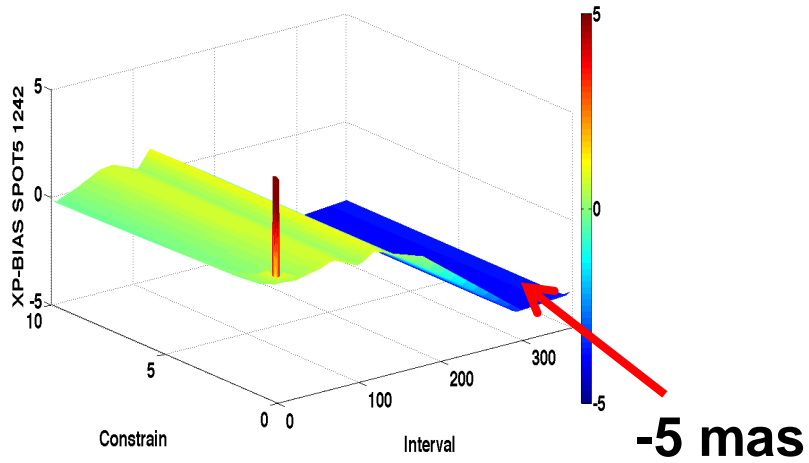
Week #1242



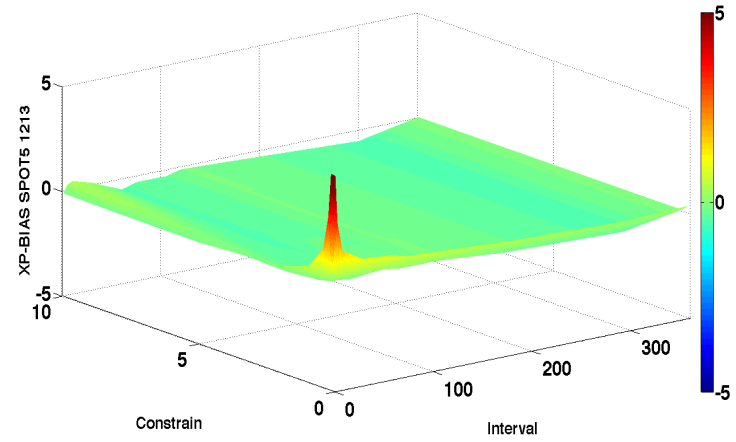
Week #1213

Daily Pole / bias vs GPS SPOT5

XP

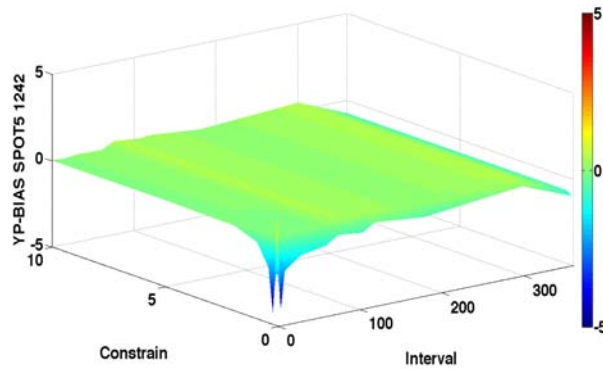


Week #1242



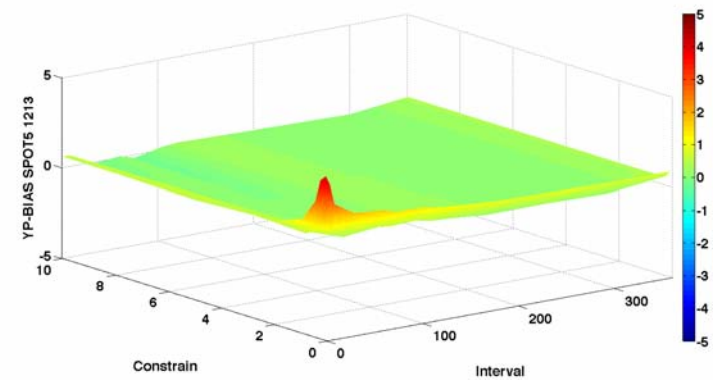
Week #1213

YP



November 12-14, 2008

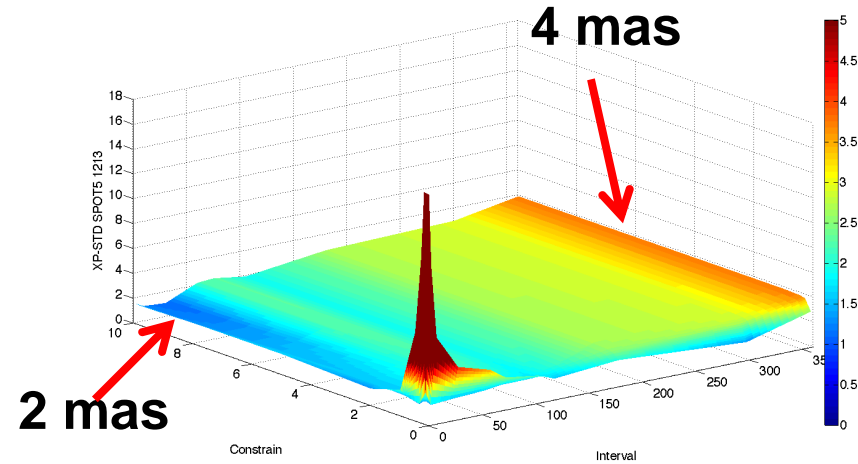
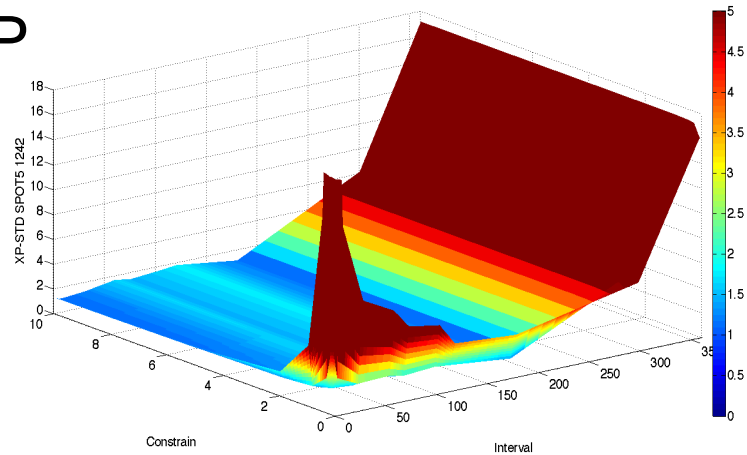
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Daily Pole standard deviation SPOT5

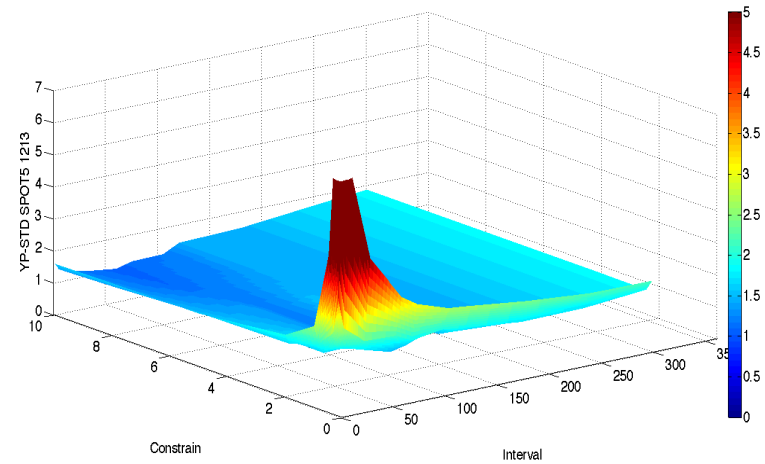
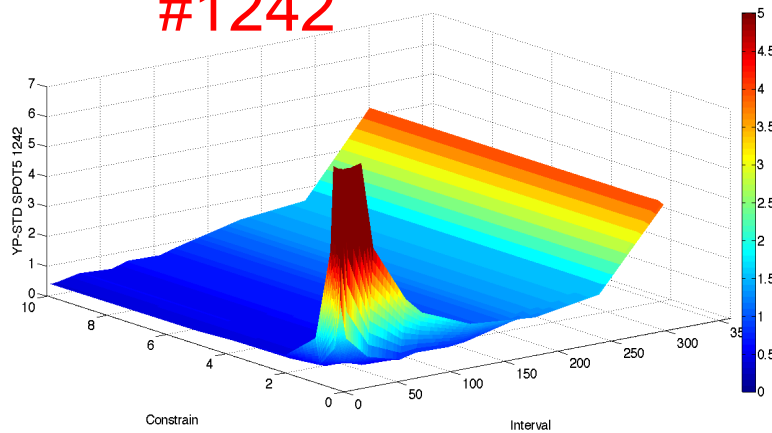
XP



Week #1242

Week #1213

YP



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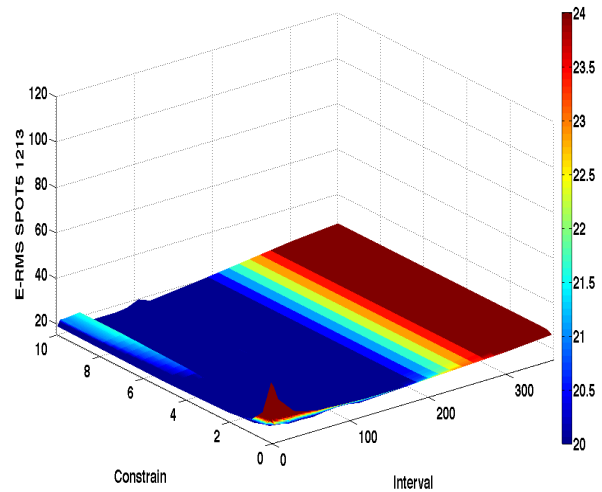
Are these results comparable for other satellites ?

- Station coordinates (East) RMS
- XPole precision (after removing bias)

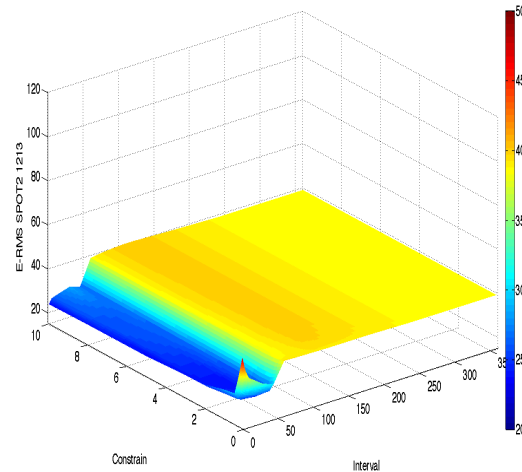
(quiet atmospheric conditions = week # 1213)

Weekly East RMS (toward ign07d02)

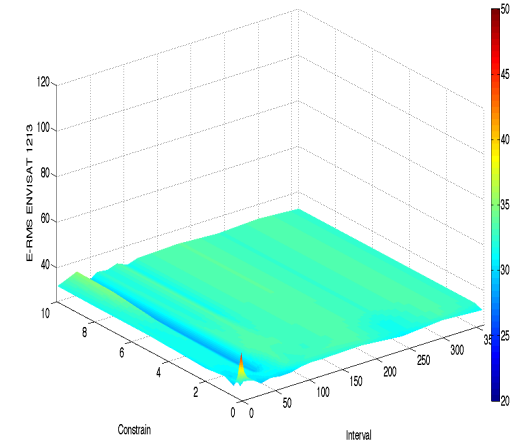
Week #1213



SPOT5



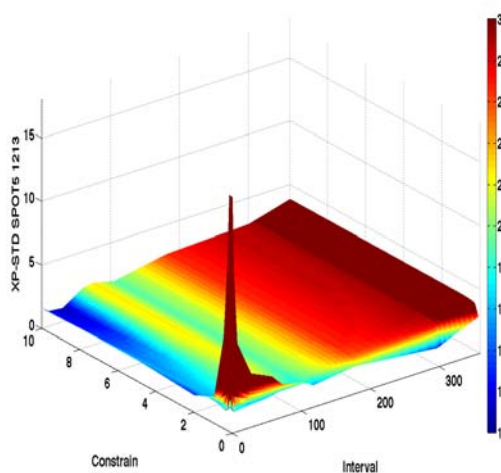
SPOT2



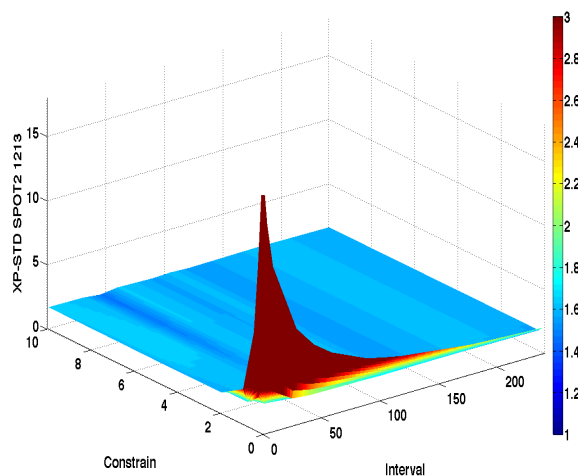
ENVISAT

XPole RMS (after removing bias)

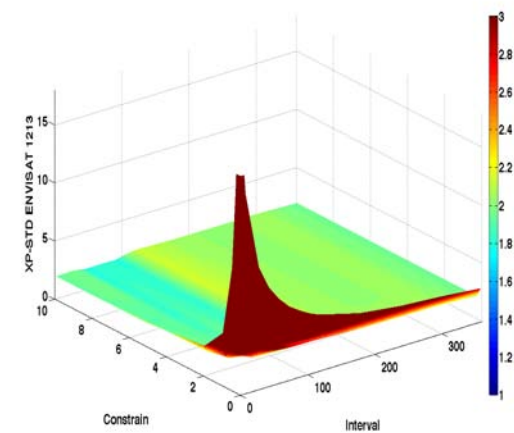
Week #1213



SPOT5



SPOT2



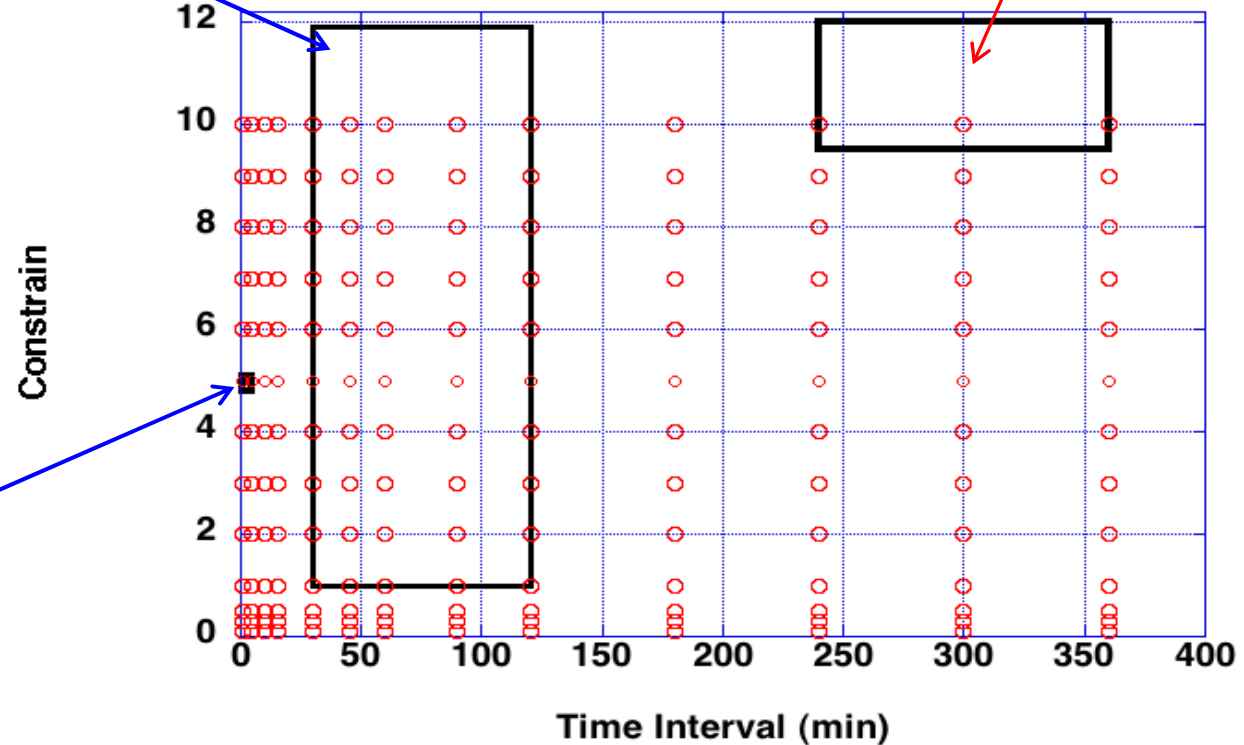
ENVISAT

Is there an optimum analysis strategy ?

Proposed strategy
(this study)

Regular Acs
processing

Geomagnetic
storm study
Willis et al. Adv.
2005



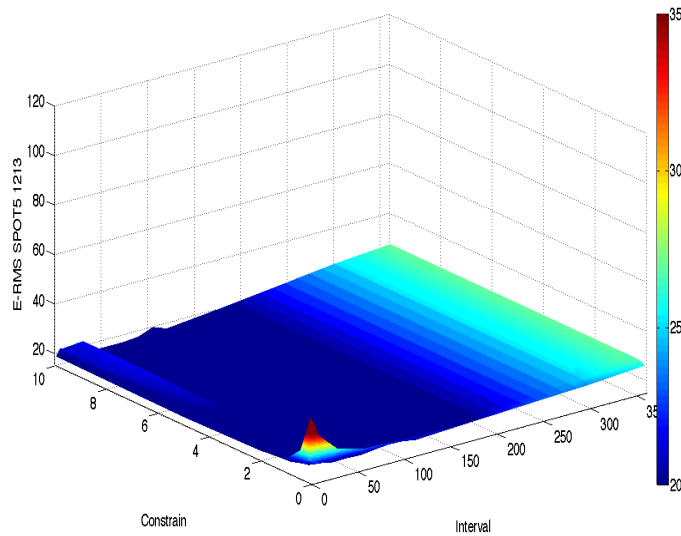
Conclusions and future work

- Estimating drag coeff more frequently provides better geodetic results (typ. 30 mn - 2 hr) for lower satellites (SPOTs + ENVISAT)
- Unique data processing in view of ITRF2008 is possible (also solves problem related to geomagnetic storms)
- Constraining a priori drag value does not make too much difference. Regular least squares is OK
- Need more data processing to refine exact value (with only 2-3 possible strategies): old data + maximum 11yr solar cycle + recent data

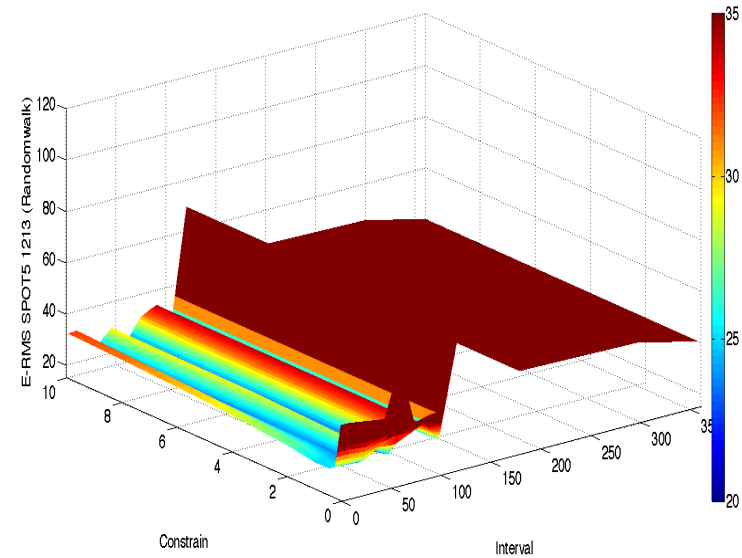
Largest Kp values (atmospheric perturbations)

Value of Kp	Weeks	Year	Date
349	1405	2006	21/12/06
328	1141	2001	24/11/01
324	1245	2003	20/11/03
315	1296	2004	10/11/04
314	1296	2004	09/11/04
313	983	1998	09/11/98
313	1296	2004	08/11/04
310	1139	2001	06/11/01
308	721	1993	04/11/93
304	1242	2003	31/10/03
302	1242	2003	29/10/03
295	1137	2001	22/10/01
295	1032	1999	22/10/99
279	1082	2000	05/10/00

Whitenoise/ Randomwalk : SPOT5

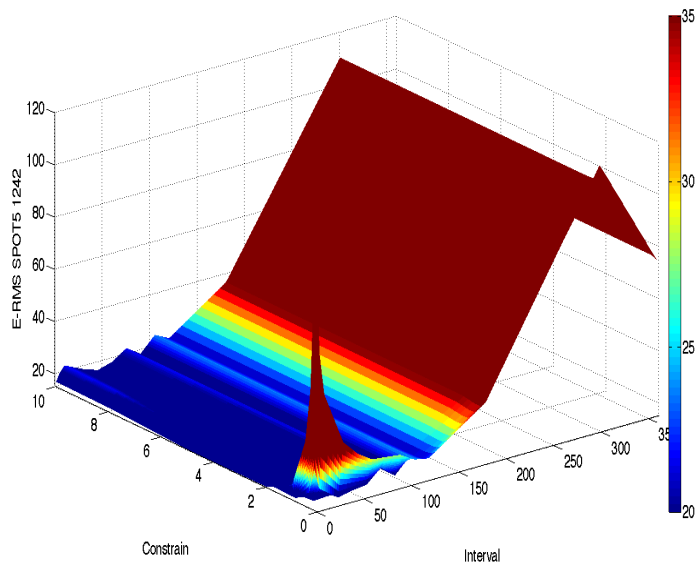


Week #1213, Whitenoise

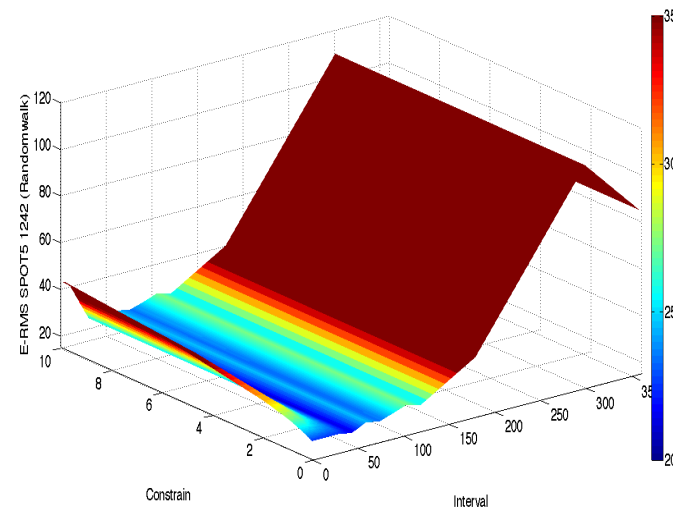


Week #1213, Randomwalk

Whitenoise/ Randomwalk : SPOT5



Week #1242, Whitenoise

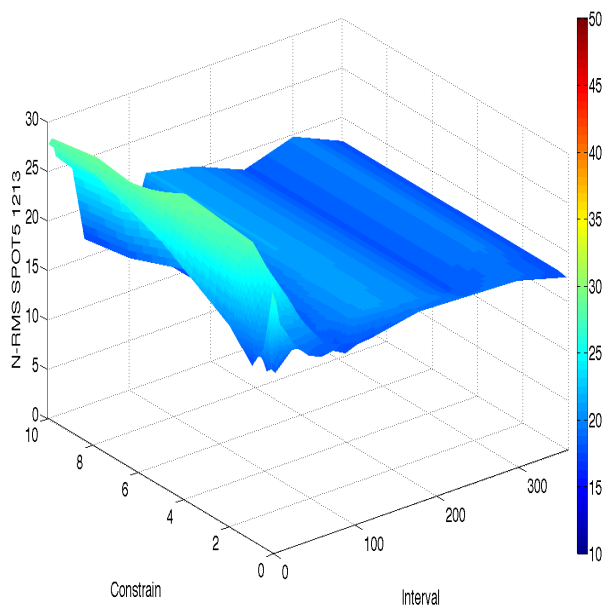


Week #1242, Randomwalk

Geomagnetic storm week Kp= 304

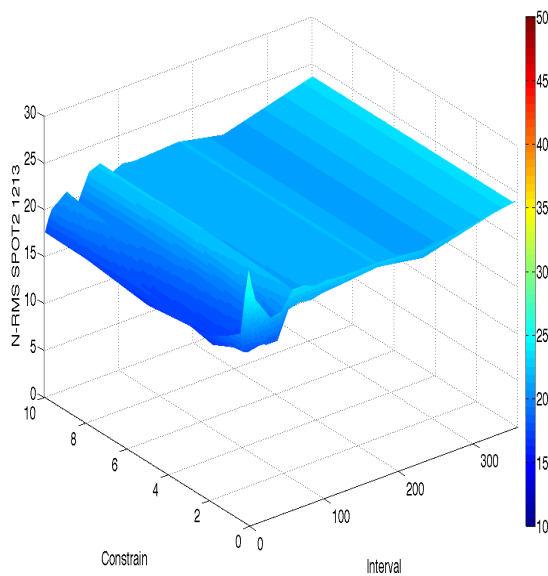
Weekly North RMS (toward ign07d02)

Week #1213



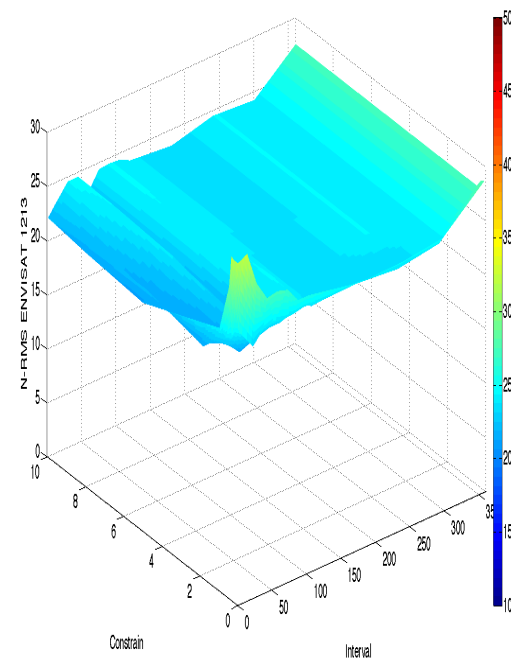
SPOT5

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SPOT2

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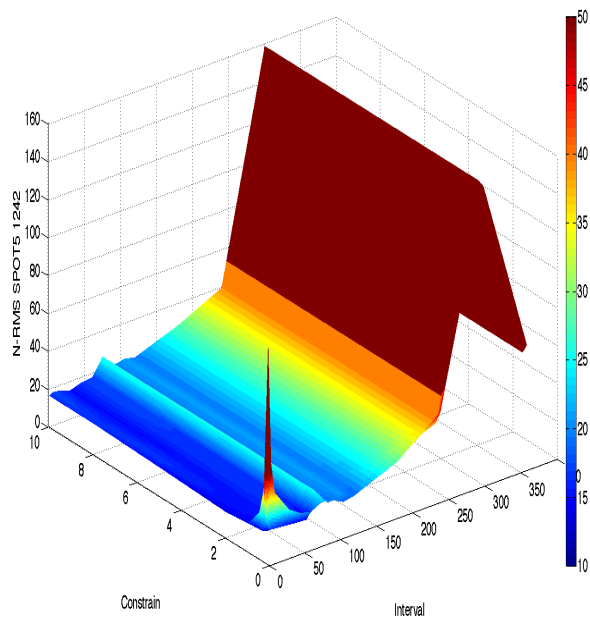


ENVISAT

21/20

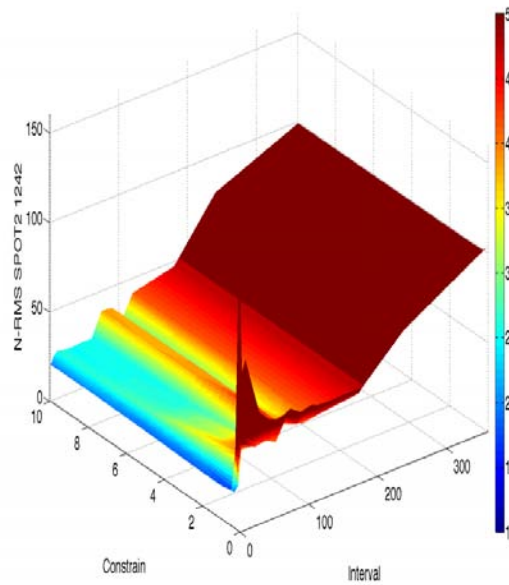
Weekly North RMS (toward ign07d02)

Week #1242



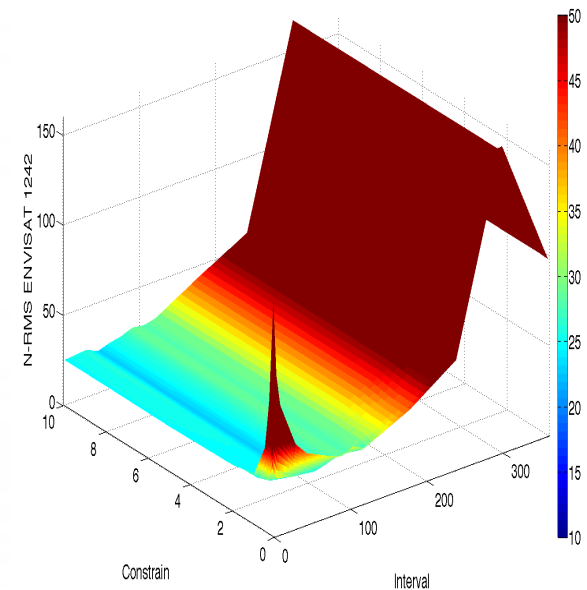
SPOT5

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2008



SPOT2

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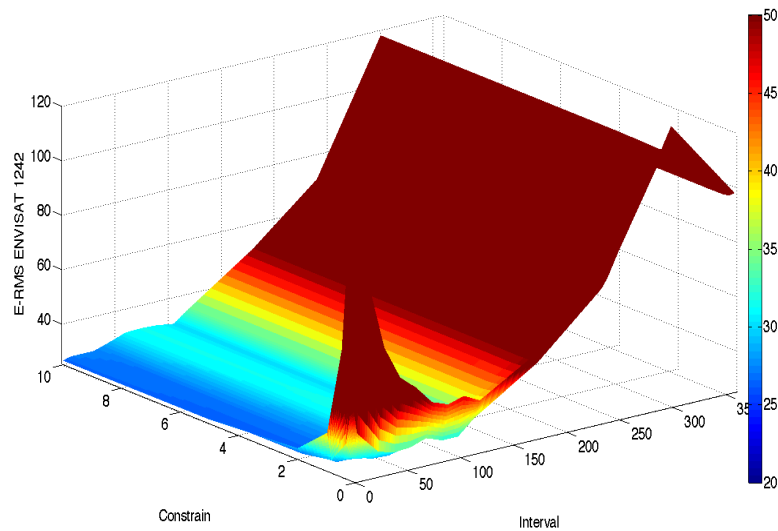


ENVISAT

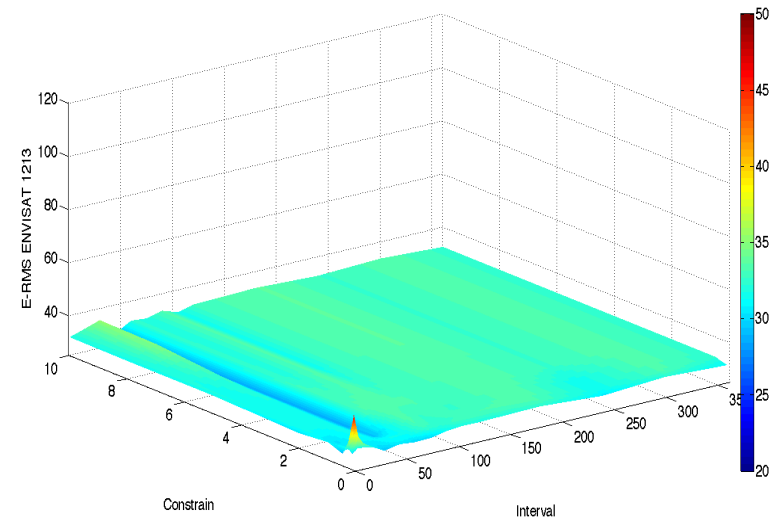
**Geomagnetic storm
week Kp= 304**

22/20

Weekly East RMS (toward ign07d02) ENVISAT

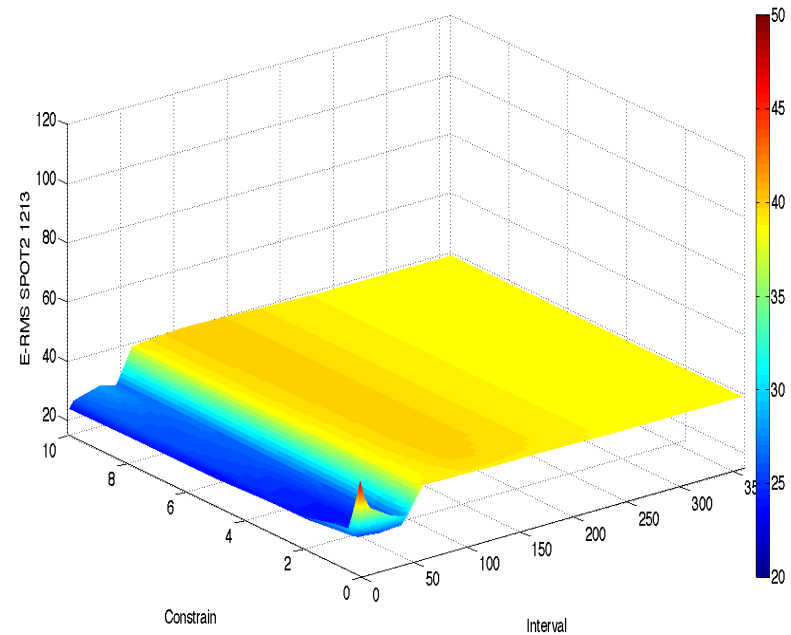
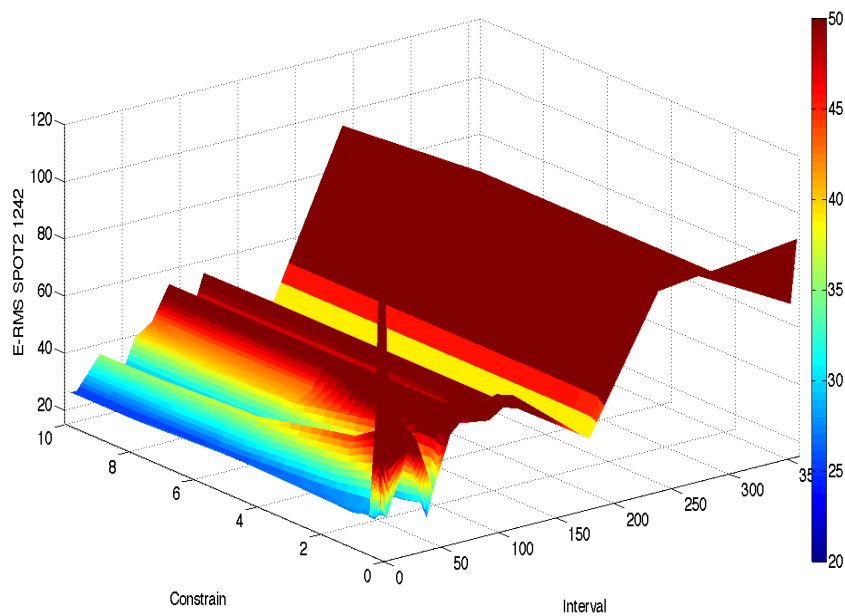


Week
#1242



Week #1213

Weekly East RMS (toward ign07d02) SPOT2



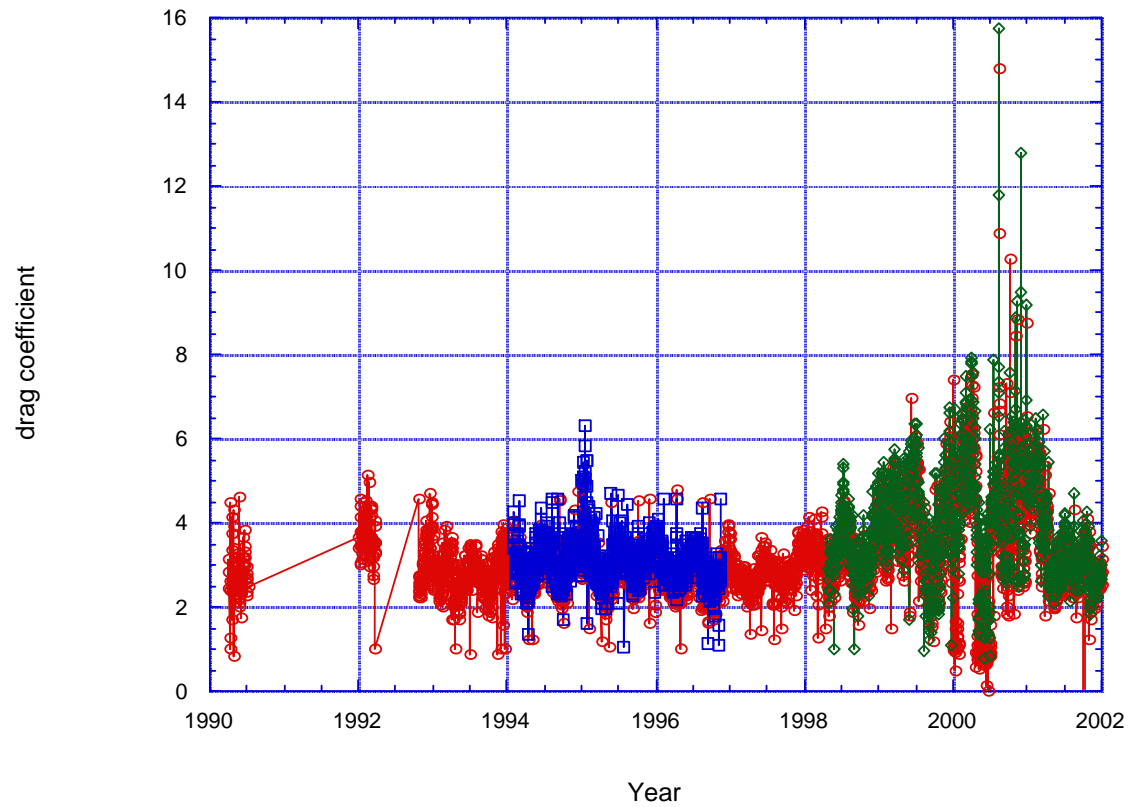
Week
#1242
Geomagnetic storm week Kp= 304

Week #1213

Drag Coefficient



**DORIS /SPOT drag coefficients
Gipsy/Oasis II daily estimations (at 21:00)**



Thank you for your attention !!!



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