

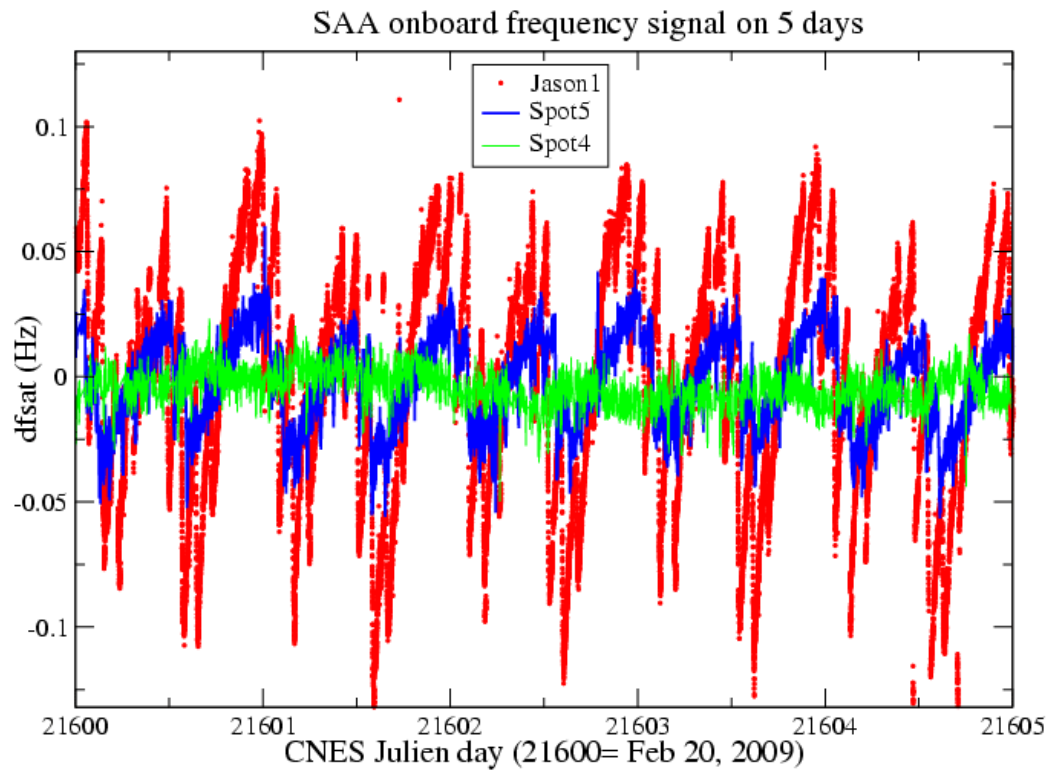
# **Testing of SPOT-5 SAA data corrective model using long time data series**

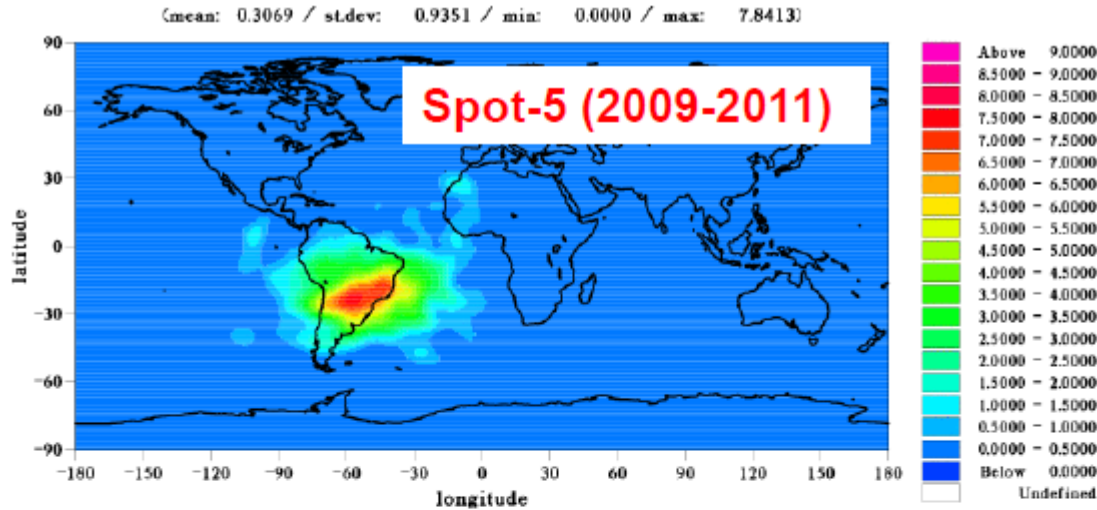
***Petr Štěpánek, Geodetic Observatory Pecný  
Hugues Capdeville, Collecte Localisation Satellites***

**IDS AWG meeting, Toulouse 28-29 May 2015**

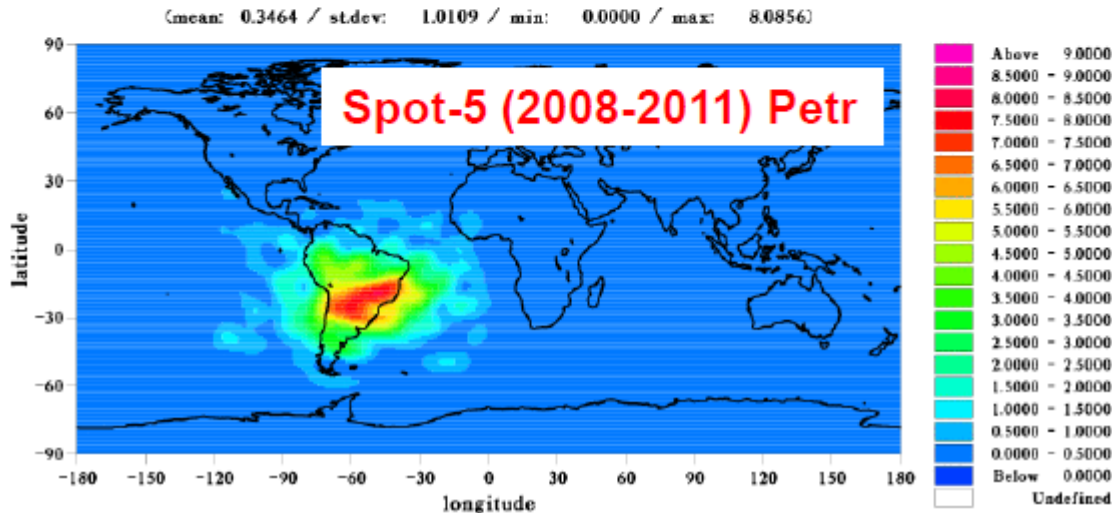
## SAA onboard Frequency signal on 5 days

- comparison for SPOT-4, SPOT-5 and Jason-1
- effect on SPOT-5 lower than for Jason-1
- but contrary to SPOT-4 significant





- CLS model**
- Grid map
  - Memory effect
  - Recovery effect



- GOP model**
- Grid map only

## GOP or GRG (LCA) SPOT-5 data corrective model ?

- ❖ data span 2011.0 – 2012.0
- ❖ SPOT-5 solution compared to S4+EN+J2+CR solution
- ❖ ZTD compared to the GNSS estimates

	Unc. (mm)	GOP (mm)	LCA (mm)
Arequipa	-68	8	10
Cachoeira Paulista	-98	-17	13
Santiago	-54	4	8
Kourou	-35	-7	-4

ZTD bias w.r.t.  
GNSS PPP

	Uncorrected			GOP corrections			Reduction %	
	Lat mm	Lon mm	Up mm	Lat mm	Lon mm	Up mm	Horiz.	Vert.
Arequipa	101	-80	-162	35	18	-39	69	76
Cachoeira Paulista	-61	128	-330	-50	123	-79	6	76
Santiago	-170	-75	-131	-49	27	-8	70	94
Kourou	90	-54	14	19	-49	-22	50	-
Ascension	58	-16	-47	9	-8	-30	80	36
St-Helene	-19	55	-26	-25	-17	-18	48	31

Stations coordinate  
Bias – GOP corrective  
model

	Uncorrected			LCA corrections			Reduction %	
	Lat mm	Lon mm	Up mm	Lat mm	Lon mm	Up mm	Horiz.	Vert.
Arequipa	101	-80	-162	33	32	-7	64	96
Cachoeira Paulista	-61	128	-330	37	101	13	24	96
Santiago	-170	-75	-131	-25	58	-24	66	82
Kourou	90	-54	14	-8	-71	-16	32	-
Ascension	58	-16	-47	29	-55	-10	-	79
St-Helene	-19	55	-26	-26	19	-4	45	85

Stations coordinate  
Bias – LCA corrective  
model

**Decision : both models strongly reduces the effect, but GRG(LCA) model achieves better overall result -> GRG (LCA) model applied in ITRF reprocessing**

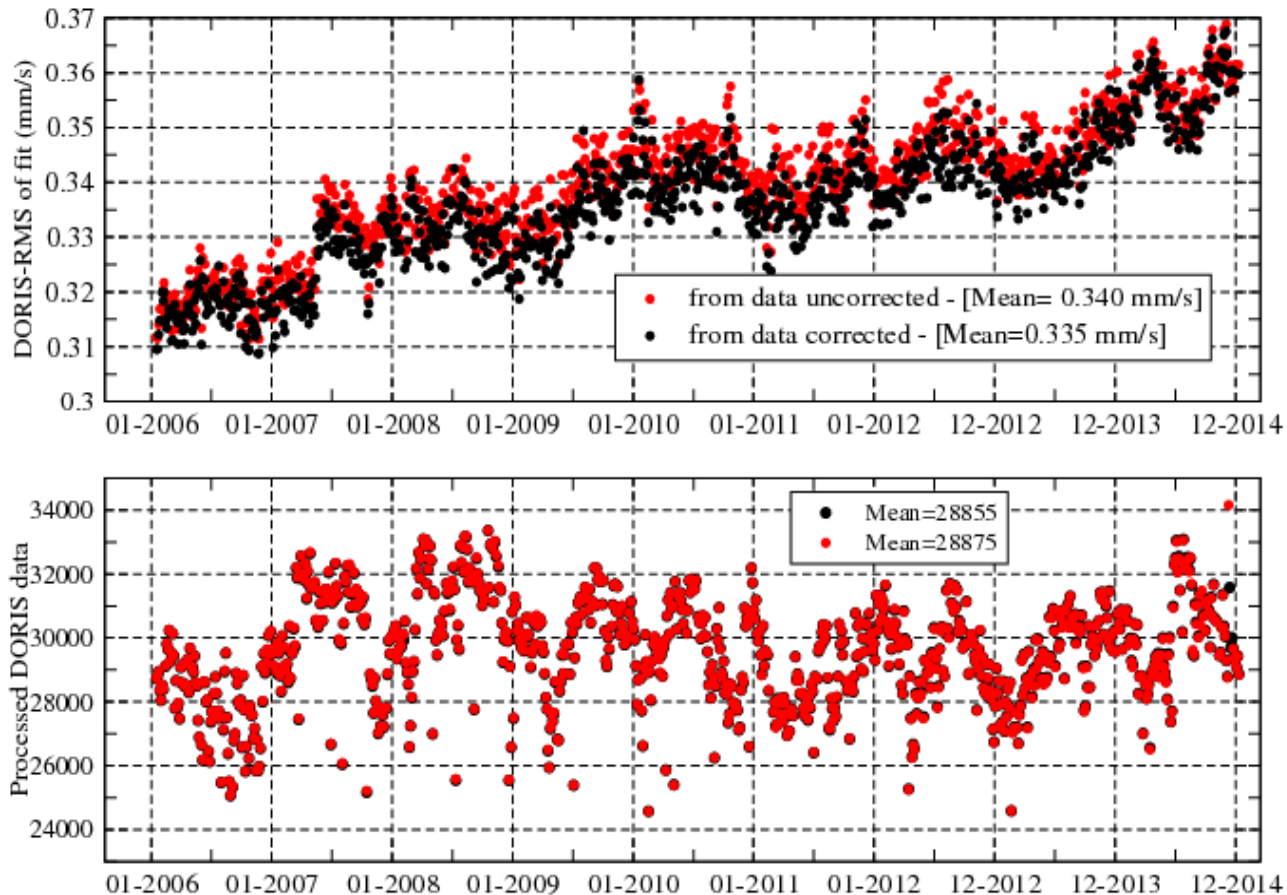
**Backup slides from AWG Toulouse 2013**

## **SPOT-5 data corrective model testing campaign**

- **Test the data corrective model on long term time span**
- **2 ACs (GRG, GOP)**
- **GRG data corrective model (official IDS corrected SPOT-5 data)**
- **GRG 2006.0 – 2015.0**
- **GOP 2006.0 – 2014.0**

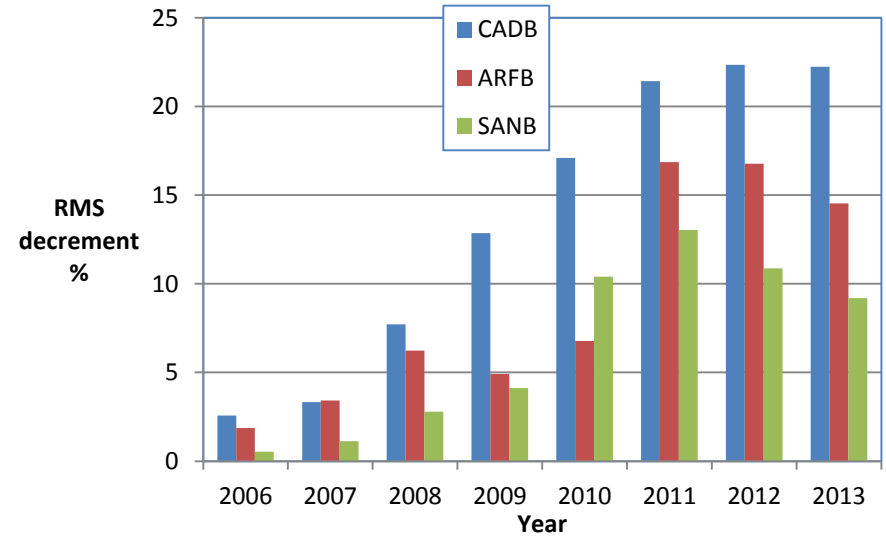
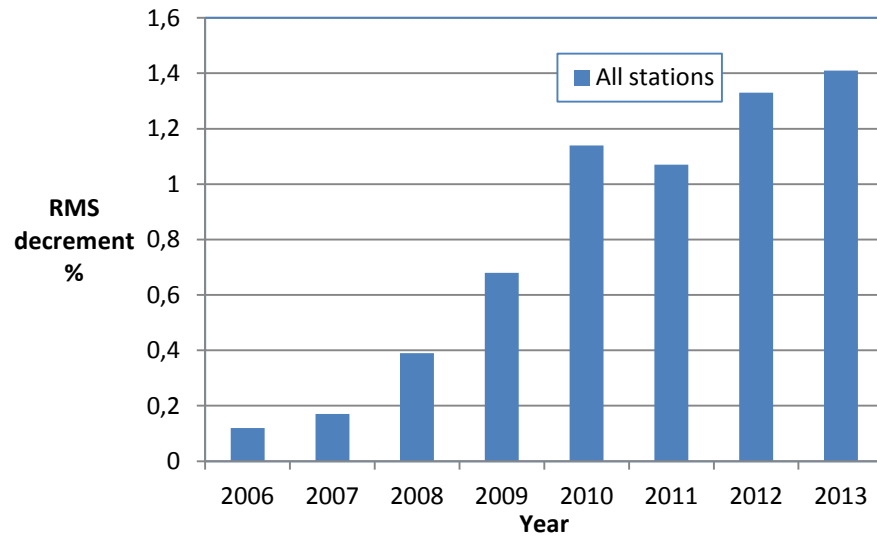
## GRG – RMS of the fit and nbr of processed data

- RMS of the fit reduced by 1.5%
- nbr of processed data only very slightly reduced



## GOP – RMS of the fit

- RMS of the fit reduced by 0.8% in average
- RMS reduction increased during the time
- For SAA stations RMS of the fit reduction up to 12%



## GOP - Arc overlap RMS

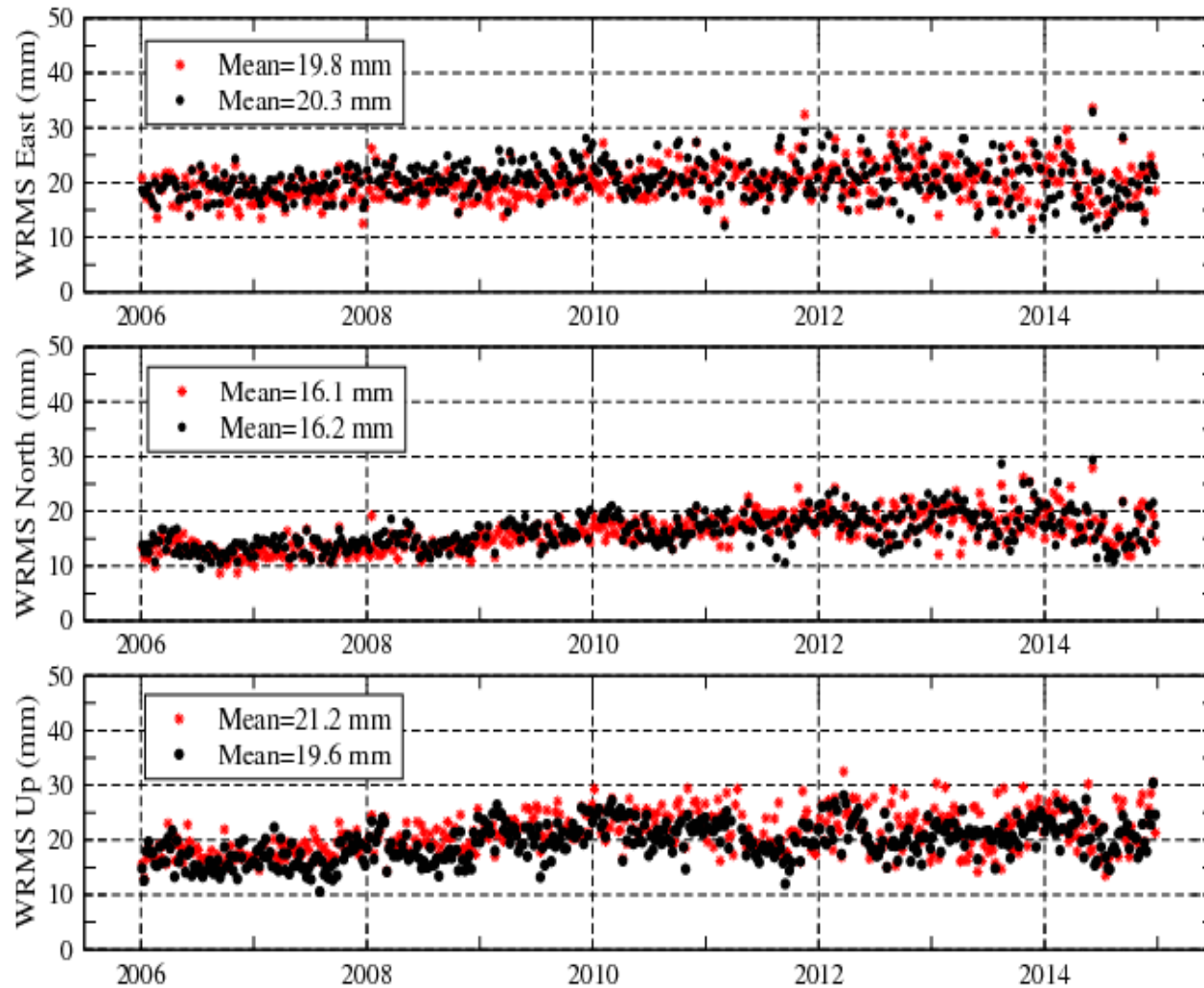
- Arc 24 hours
- Overlap only in midnight epoch

	Radial (cm)	Along (cm)	Out (cm)
Uncorrected	1.41	14.30	5.28
Corrected	1.30	12.41	3.96
Improvement	8%	13%	25%



## GRG – station WRMS, single satellite SPOT-5 solution

- Degradation in East component
- Improvement in Up component



### **GOP - repeatability RMS, complete network, multisatellite solutions**

	Noth (mm)	East (mm)	Up (mm)
No SPOT-5	14.7	19.5	18.0
SPOT-5 uncorrected	13.4	17.4	16.1
SPOT-5 corrected	13.2	17.1	15.8

### **GOP - repeatability RMS, selected stations ARFB, CADB and SANB, multisatellite solutions**

	Noth (mm)	East (mm)	Up (mm)
No SPOT-5	19.6	25.7	27.3
SPOT-5 uncorrected	19.6	26.0	27.5
SPOT-5 corrected	17.6	23.5	26.5

## **GOP - Comparison to DPOD08, multisatellite solutions**

	Noth (mm)	East (mm)	Up (mm)
No SPOT-5	17.2	21.6	20.7
SPOT-5 uncorrected	15.6	19.1	18.7
SPOT-5 corrected	15.4	19.8	18.6

## **GOP - Transformation parameters (average and std dev.), multisatellite solutions**

	Tx (mm)	Ty (mm)	Tz (mm)	Scale (ppb)
No SPOT-5	-0.9±4.5	-3.0±5.5	-19.2±28.1	2.66±1.75
SPOT-5 uncorrected	-3.2±4.4	0.1±5.3	-20.1±22.3	2.85±1.29
SPOT-5 corrected	-1.7±4.1	-1.7±5.1	-20.0±21.7	2.95±1.33

## GOP – station bias of SPOT-5 solutions w.r.t. multisatellite solution excl. SPOT-5

- High positioning bias
- Bias is rising in the time (e.g. ASDB ->ASEB)
- Good compensation by corrective model in North and Up component
- Bias in East component not reduced
- Bias in East component in geographical correction (negative for west stations, positive for others). When corrections applied, positive for “inner” stations

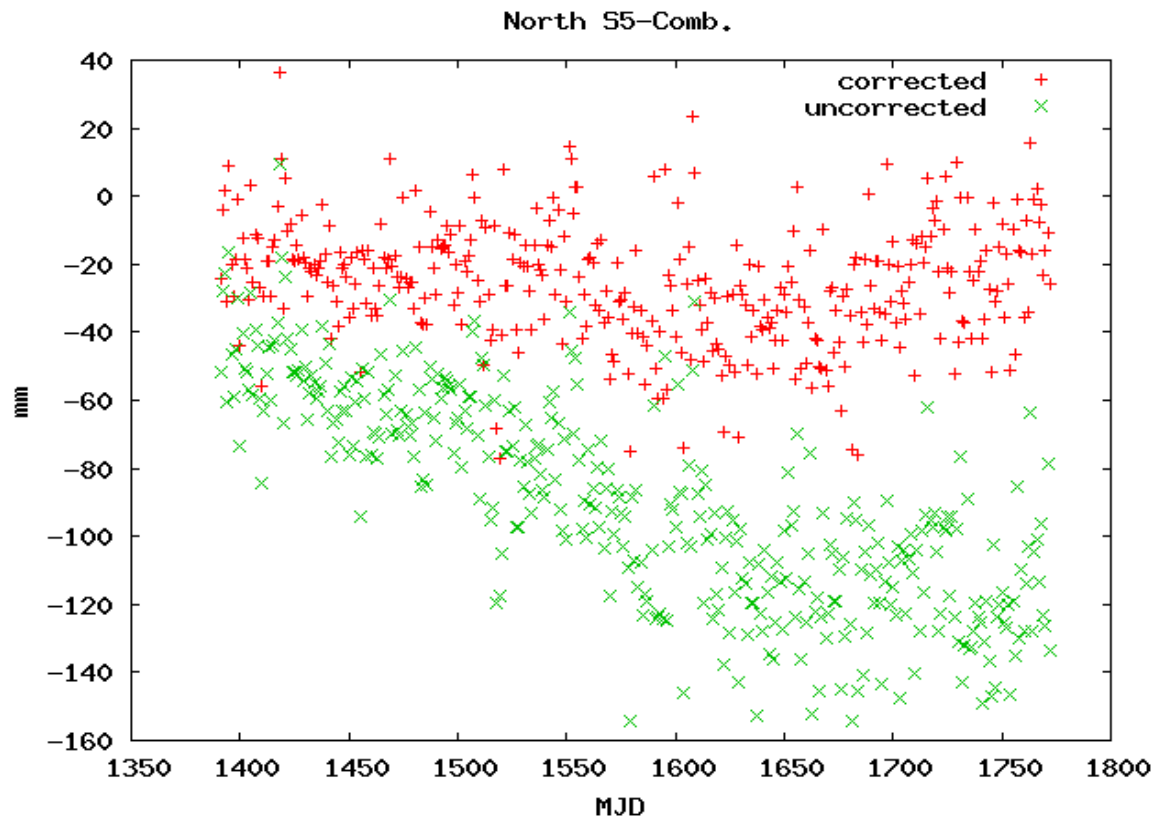
Station	Acronym	Years of observation	Nbr. of weeks	No corrections (mm)			Corrected (mm)		
				North	East	Up	North	East	Up
Arequipa	ARFB	2006-2013	382	<u>89.7</u>	<u>-56.9</u>	<u>-128.7</u>	25.5	<u>57.6</u>	-1.9
Ascension	ASDB	2006-2009	176	29.1	18.5	-25.9	12.7	-25.8	-8.3
	ASEB	2009-2013	179	<u>52.8</u>	<u>36.9</u>	<u>-44.5</u>	11.9	<u>-60.6</u>	5.5
Cachoeira P.	CADB	2006-2013	364	-29.6	<u>123.1</u>	<u>-248.1</u>	3.7	<u>126.7</u>	19.0
St. Helena	HEMB	2006-2013	388	2.3	<u>44.0</u>	-17.7	-8.8	6.0	-11.6
Kourou	KRVB	2006-2011	255	<u>71.1</u>	<u>-31.2</u>	2.0	15.3	<u>-60.7</u>	-8.7
	KRWB	2011-2013	133	<u>110.5</u>	<u>-75.0</u>	-21.4	4.6	<u>-117.6</u>	<u>-33.7</u>
Rio Grande	RIPB	2006-2008	119	-1.1	-9.4	<u>33.9</u>	11.4	-19.8	13.7
	RIQB	2008-2012	206	-14.9	<u>-36.5</u>	<u>37.0</u>	12.0	<u>-61.3</u>	4.3
	RIRB	2012-2013	87	<u>-35.8</u>	<u>-52.4</u>	<u>49.1</u>	3.9	<u>-71.7</u>	3.0
Santiago	SANB	2006-2013	377	<u>-102.2</u>	<u>-55.3</u>	<u>89.0</u>	-5.8	<u>53.9</u>	-7.5

# Station bias w.r.t. multisatellite solution (excl. SPOT-5)

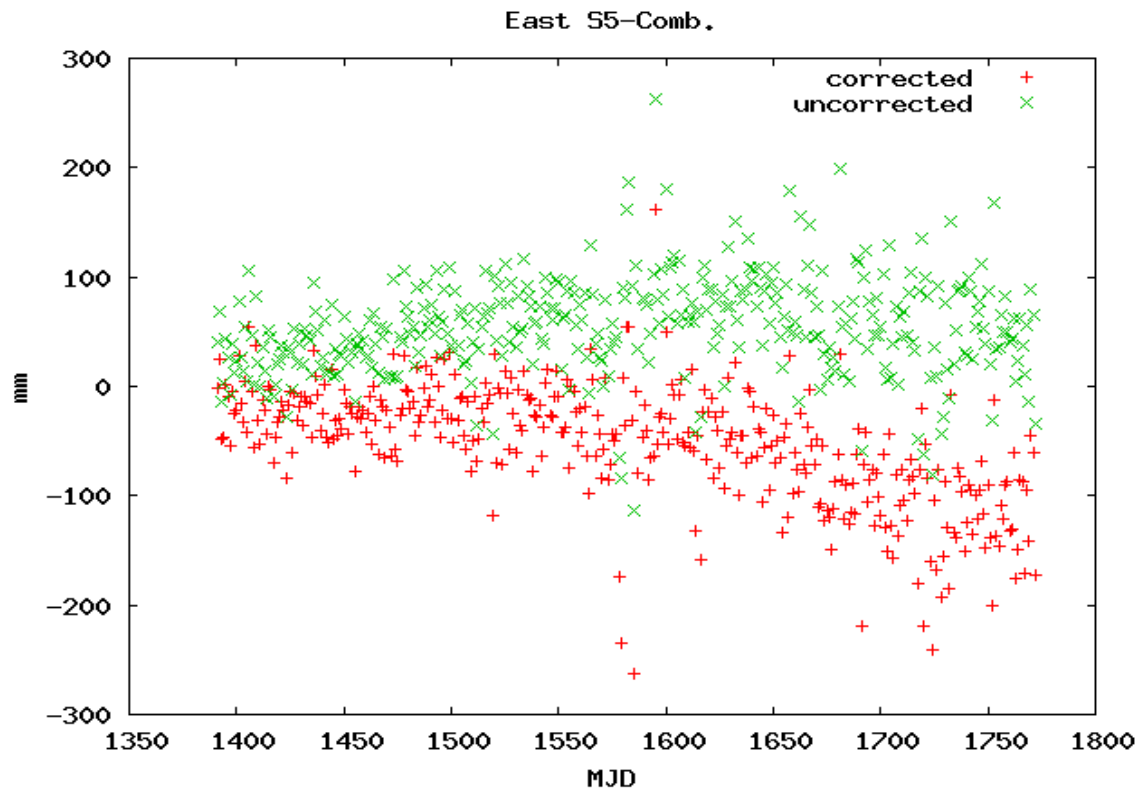
- for SAA Stations Arequipa, Santiago, Cachoeira, St. Helene, Kourou, Rio Grande, Ascension
- Single-satellite SPOT-5 solution
- SAA station positioning bias higher for GOP solution
- Corrective model has higher impact on GOP North and Up component
- GOP week-to-week comparison
- GRG yearly 2011 multi-satellite solution with ITRF 2008 velocities as the reference => GRG positioning results are considered preliminary

AC	No corrections mm			Corrected mm		
	N	E	U	N	E	U
GRG	40.8	30.4	47.3	26.2	27.2	14.0
GOP	52.1	55.0	80.5	11.1	59.9	9.3

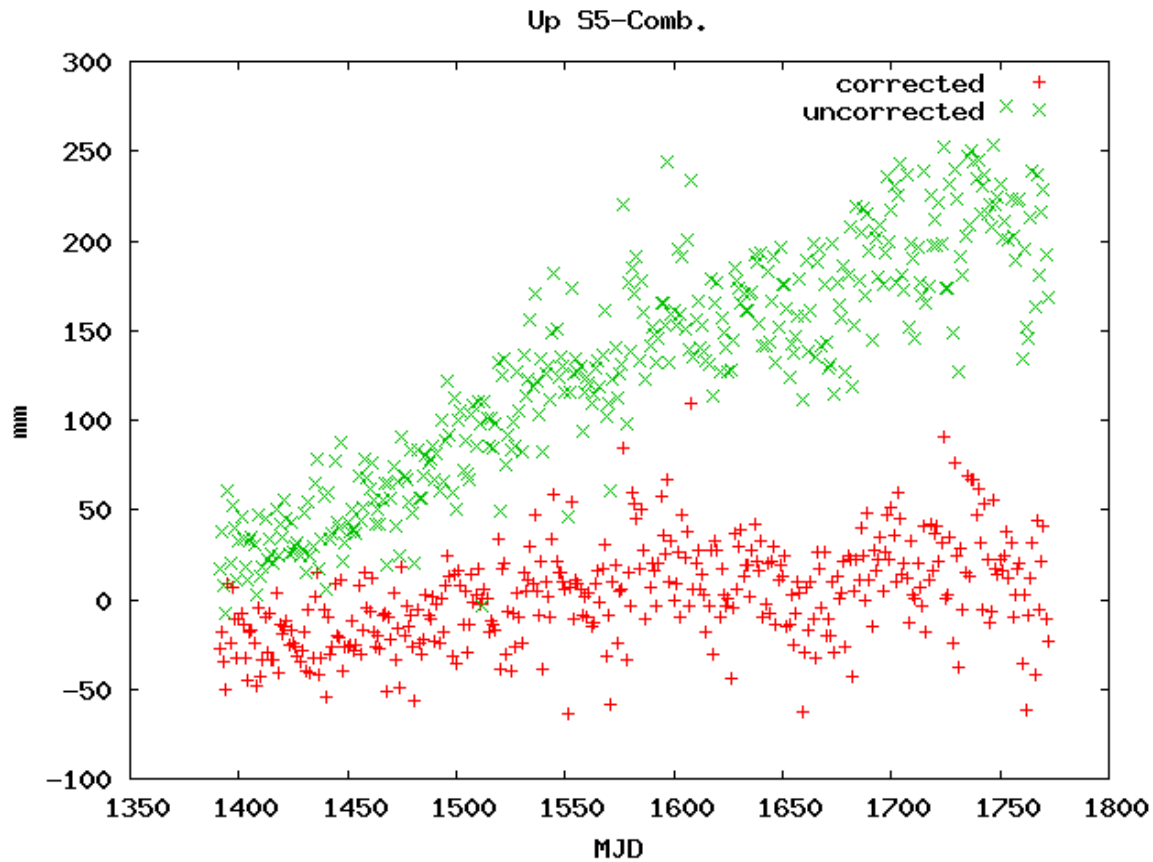
# GOP - Differences between SPOT-5 single satellite solutions and combined multi-satellite solution (without SPOT-5). Station ARFB, North component



**GOP - Differences between SPOT-5 single satellite solutions and combined multi-satellite solution (without SPOT-5). Station ARFB, East component**



**GOP - Differences between SPOT-5 single satellite solutions  
and combined multi-satellite solution (without SPOT-5).  
Station ARFB, Up component**





# Summary and conclusion

- Application of SPOT-5 data corrective model reduce RMS of the fit
- Improves station positioning in North and Up component
- does not significantly improve positioning in East component
- Testing results obtained by GOP and GRG look not being completely consistent
  - Different solution options, parameterization, station selection?
  - inconsistent approach of the result analysis?
  
- Are we satisfied with recent data corrective model?
  - not affecting recent operative solutions
  - Affecting long-term campaigns and next ITRF reprocessing
  - IDS testing campaign, more ACs, consistent analyses (combination center)?
  - possible model improvement

**THANKS FOR THE ATTENTION**