ESTIMATION OF THE DORIS PHASE CENTER LOCATIONS FOR THE CURRENTLY FLYING ALTIMETER MISSIONS

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Scope of the study

- Estimation of the distance between the satellite CoM and the DORIS receiver phase center
- Check the consistency between DORIS and the other tracking systems (SLR or/and GPS)
- Missions/Arcs
  - CryoSat-2, HY-2A, OSTM/Jason-2, Saral/AltiKa over 2015
  - Jason-3: 1-26
  - Sentinel-3A: 1-29

Radial and cross-track offsets
Estimation

DORIS

- Adjustment of a constant acceleration over an arc
  → **Perturbation in displacement, from the Hill equations**
- DORIS-only dynamic orbits
- + empirical accelerations

GPS, SLR

- Adjusted GPS phase center or LRA reference point offsets
- GPS-only or SLR-only dynamic orbits

Radial and cross-track offsets

Effect of the low-elevation measurements

Mean (cm)	Saral	
	A	B
Radial	**-3.3**	**-2.3**
Cross-track	-0.5	-0.6

Test A: Initial processing
Test B: Processing with

- low-elevation measurements + weighting function
- estimation of horizontal tropospheric gradients

The estimated radial bias is sensitive to whether the low-site measurements are used or not.

⟶ **Overestimation of 1cm for Saral**

Radial and cross-track offsets

Effect of the SAA

Mean (cm)	Jason 2 (FY)			Jason 3 (FY)		
	A	B	C	A	B	C
Radial	-2.1	**-1.1**	**-0.9**	-2.6	**0.0**	**0.4**
Cross-track	-0.3	-0.2	-0.1	-0.3	-0.2	0.0

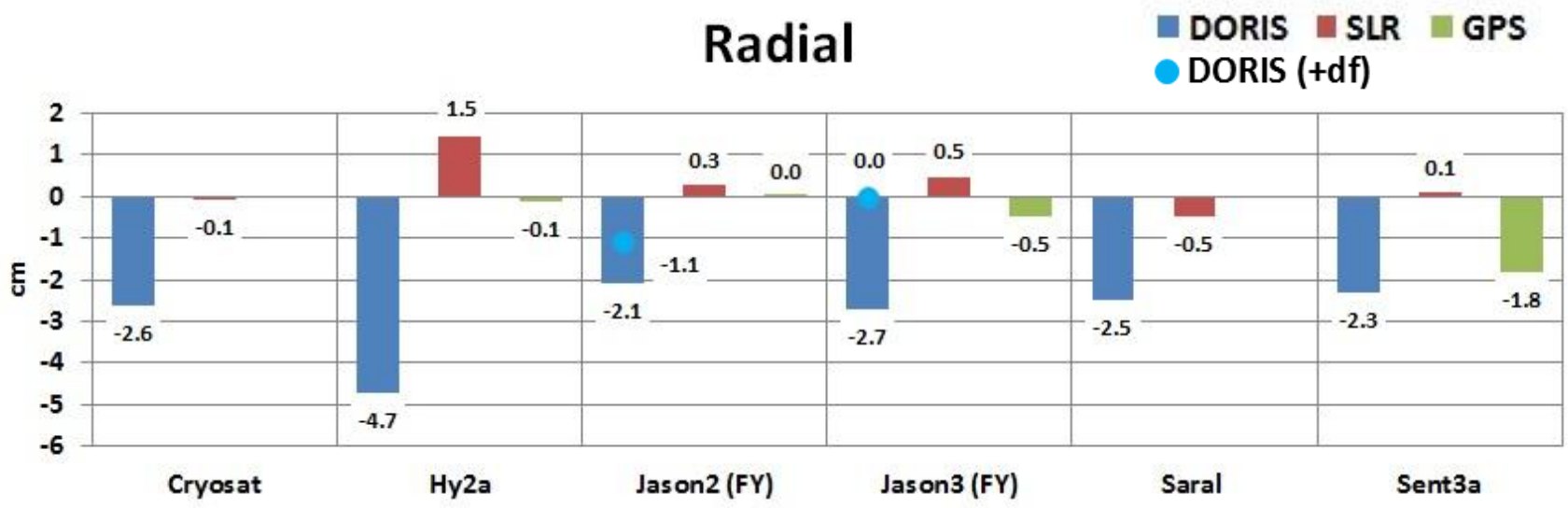
Test A: With all DORIS stations
Test B: With adjusted frequency drifts for the SAA stations
Test C: Excluding SAA stations

The sensitivity to the SAA affects the estimation in radial.

⟶ **Gain of 1.0 cm for Jason-2**
⟶ **Gain of 2.6 cm for Jason-3**

Radial and cross-track offsets

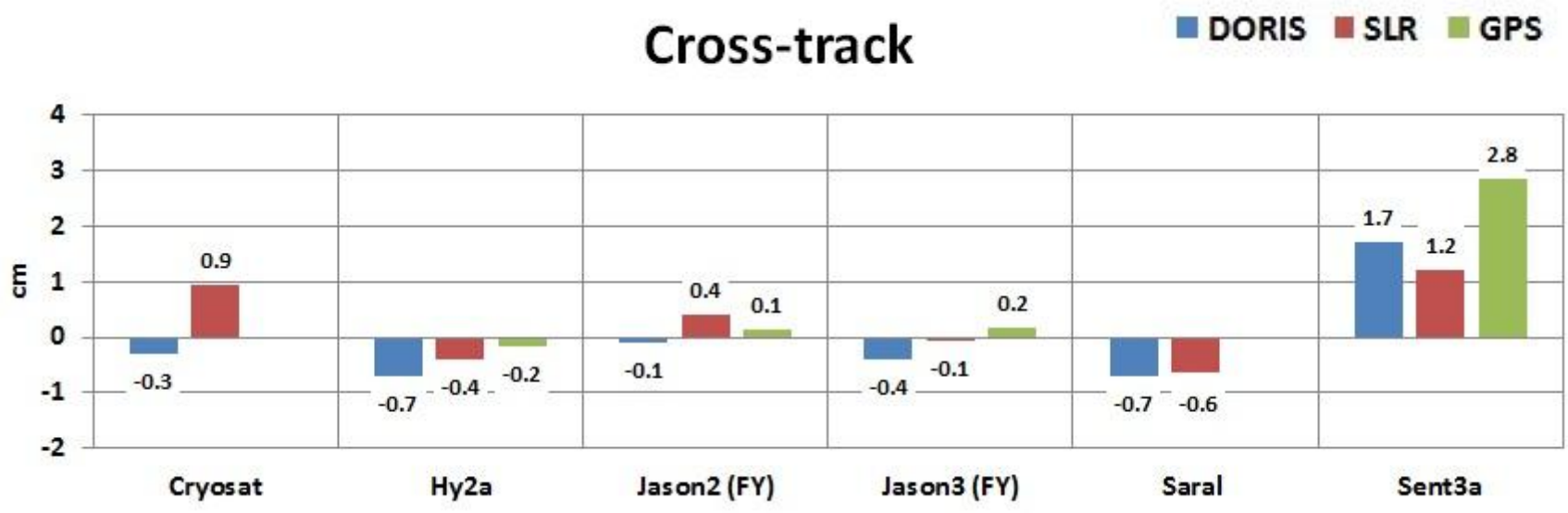
Consistency between the tracking systems



- A - 2.5cm DORIS offset is observed
  - ⟶ **No effects on the radial orbit performances**
  - ⟶ **Effects on the estimation of DORIS stations heights ?**
  - ⟶ **Effects on the reference frame scale factor ?**
- For HY-2A, a - 4.7cm DORIS bias is observed (→ 4.41cm).
- No GPS or SLR offset, except for HY-2A (SLR) and Sentinel3-A (GPS)

Radial and cross-track offsets

Consistency between the tracking systems



- For Sentinel-3A, the 3 tracking systems observed a “large” bias
  - ⟶ **Errors in the solar radiation pressure model ?**
  - ⟶ **Errors in the location of the CoM ?**
- No significant DORIS, SLR or GPS offsets for the other missions.

Relative along-track offsets

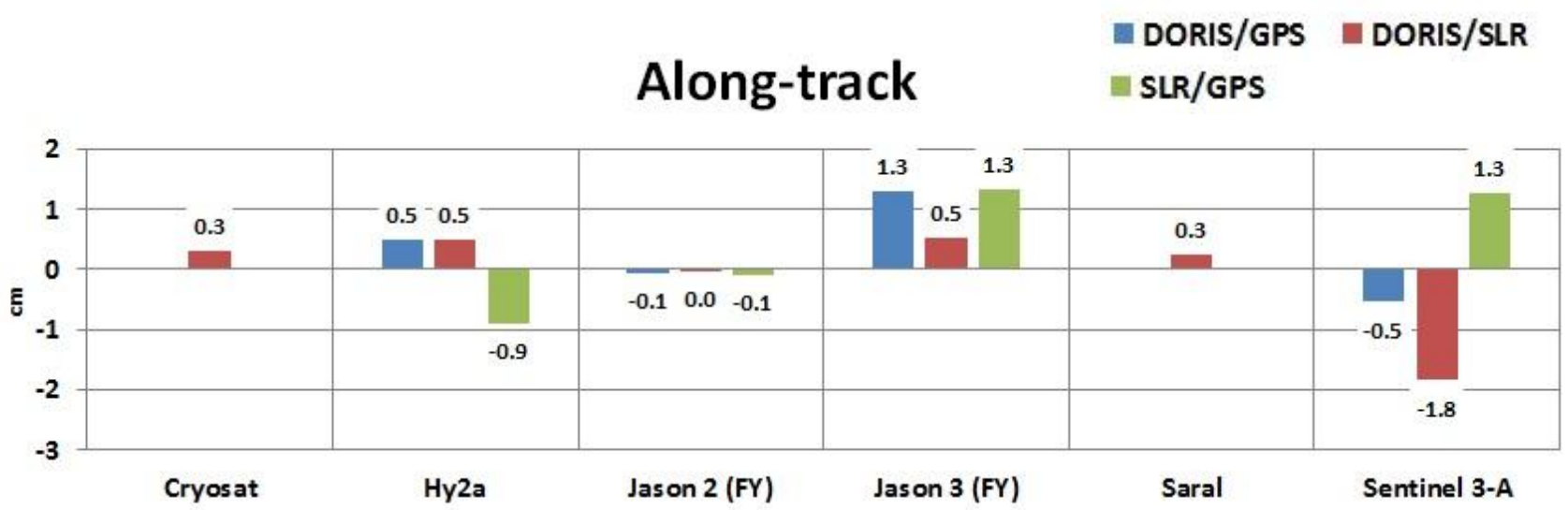
Estimation

- Use the other tracking systems to observe the DORIS phase center location
  - DORIS + SLR, DORIS + GPS and SLR + GPS
  - Dynamic orbits

- Adjusted parameters
  - Location of the GPS phase center
  - Location of the LRA optical center

Relative along-track offsets

Consistency between the tracking systems



- Good consistency for Cryosat, Jason-2, Saral (and HY-2A?).
- For Jason-3, DORIS and SLR are consistent but the GPS phase center seems biased (or may be due to GPS data screening).
- For Sentinel-3A, DORIS and GPS are consistent but the LRA optical center position seems biased.

Conclusion

- A DORIS phase center offset of -2.5 cm, observed radially for several missions may affect the reference frame scale factor.
- DORIS is consistent with the other tracking systems along-track.
- There is no significant cross-track offset, except for Sentinel-3A, probably due to a bias in the location of the CoM.

THANK YOU FOR YOUR ATTENTION

ADDITIONAL MATERIALS

Radial and cross-track offsets

Estimation

- Hill equations solved for a constant acceleration adjusted over an arc

$$\delta_R(t) = -\frac{C_R}{3n^2} + \frac{2\,C_T}{n}\,t$$

$$\delta_T(t) = -\frac{3C_T}{2}\,t^2$$

$$\delta_N(t) = \frac{C_N}{n^2}$$

  - Along-track unobservable
  - Coupling between the radial and along-track directions

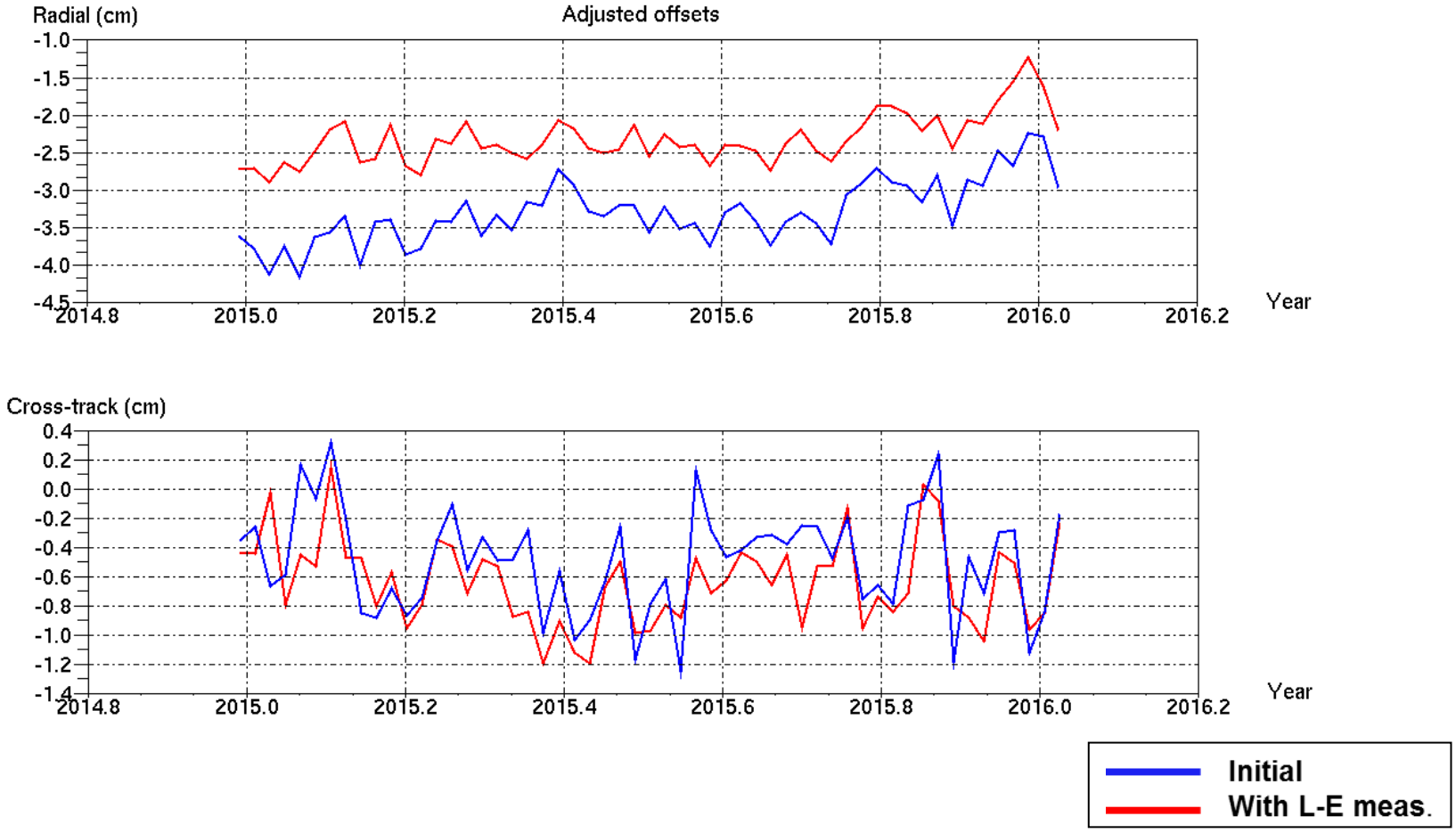
    → **Constrain C_T**

- Coupling between the cross-track direction and the solar radiation pressure model

  → **Empirical accelerations**

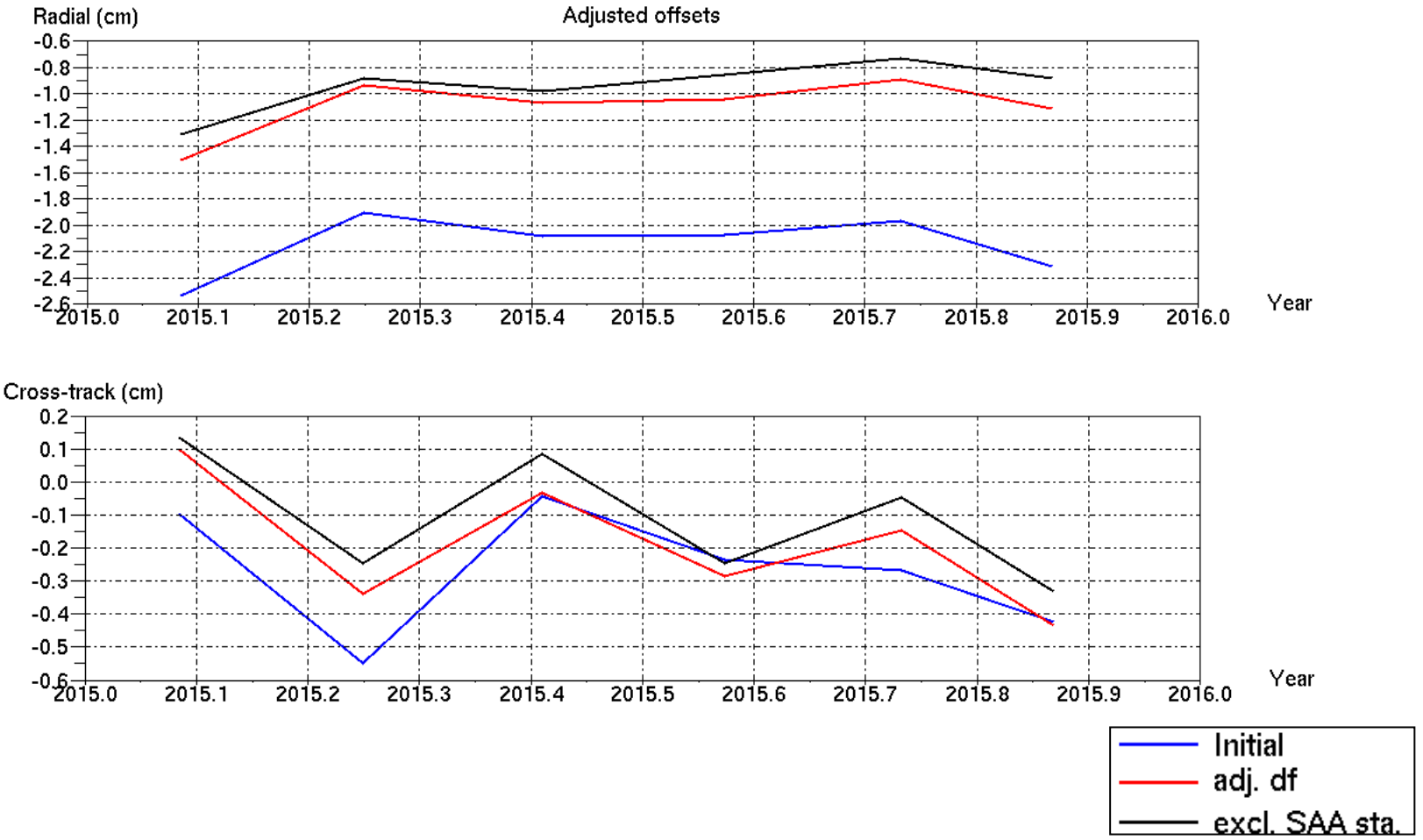
Effects of low-elevation measurements

Saral



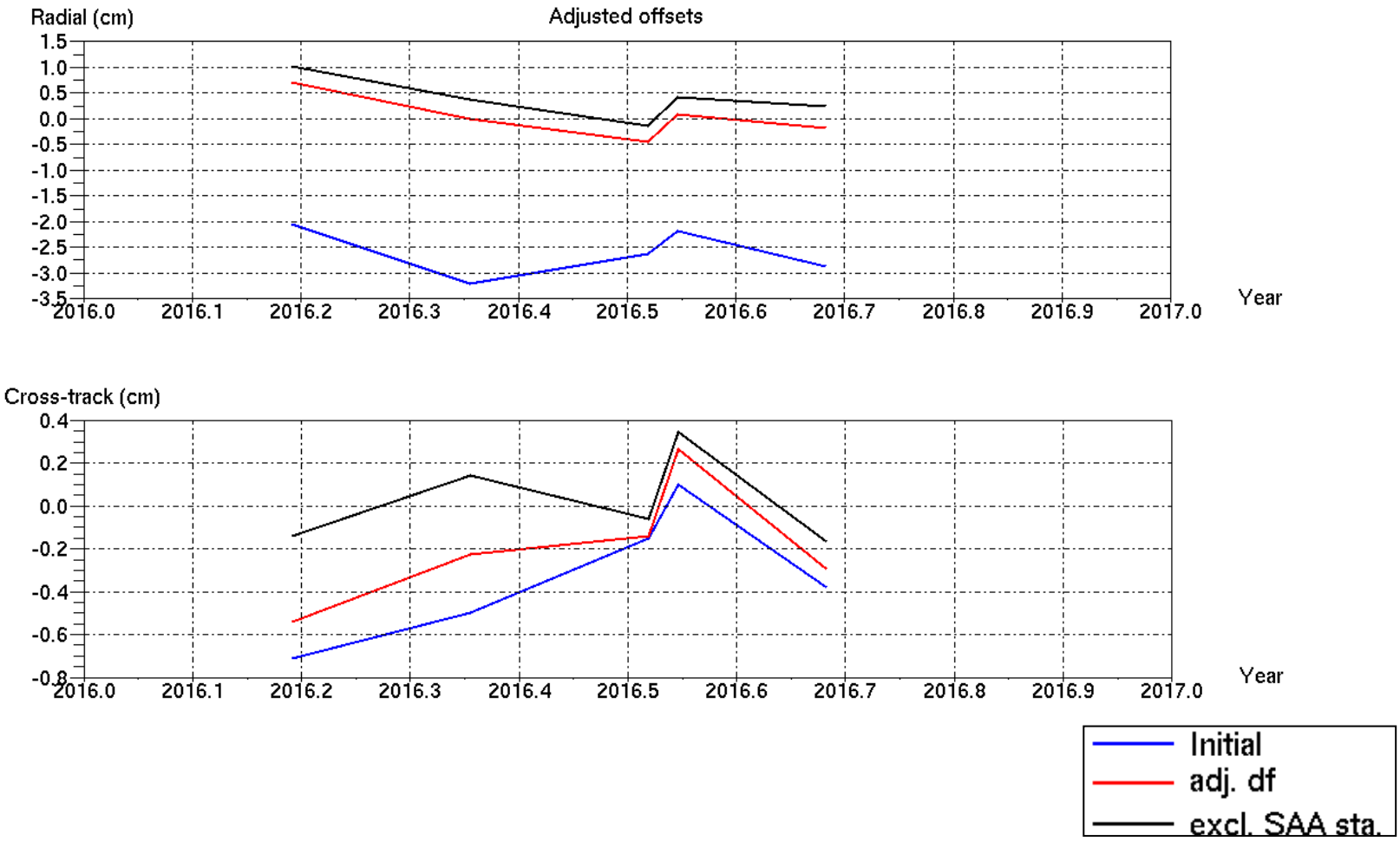
Effects of the SAA (1)

Jason-2 (Fixed-Yaw regime)



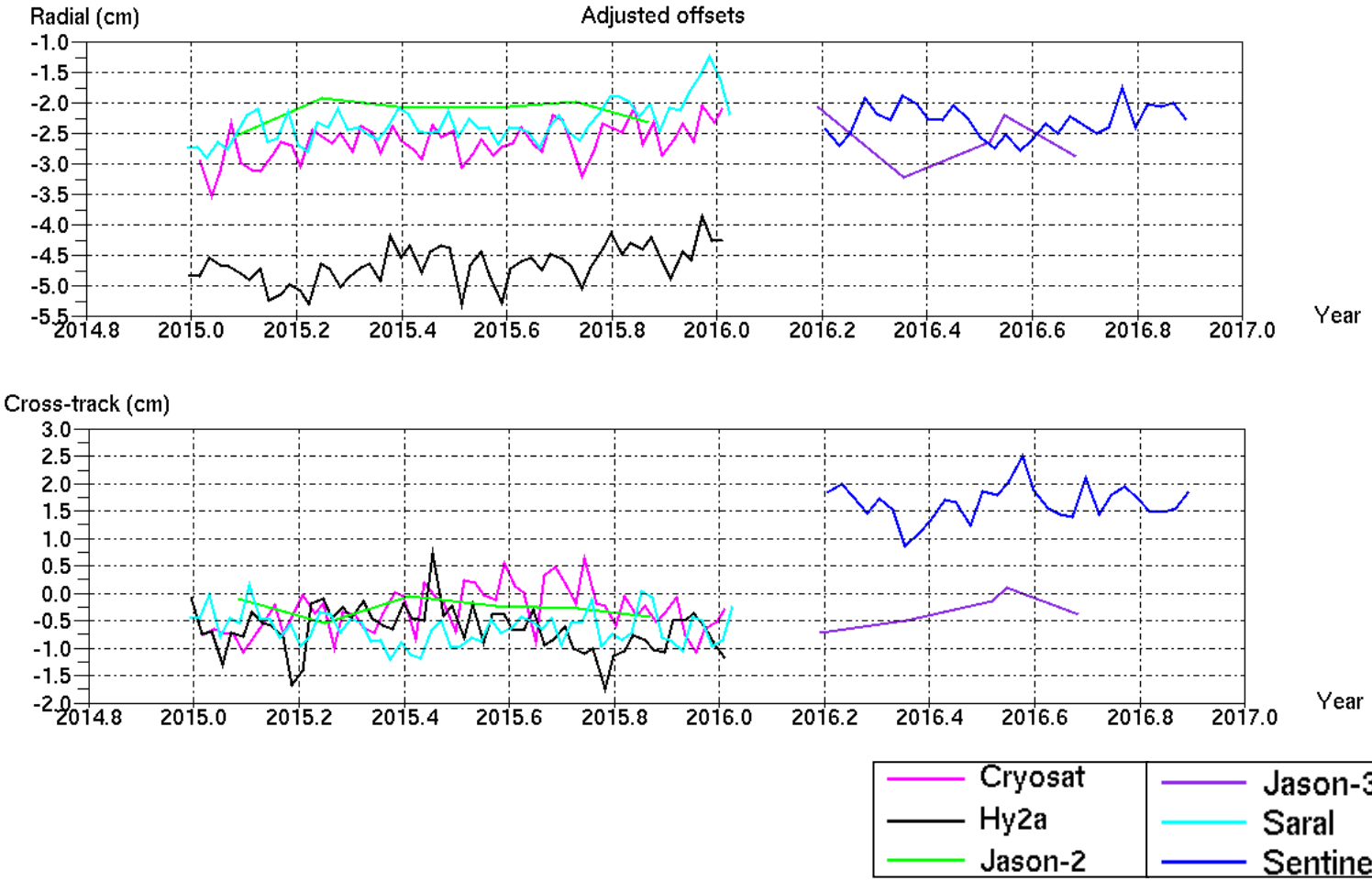
Effects of the SAA (2)

Jason-3 (Fixed-Yaw regime)

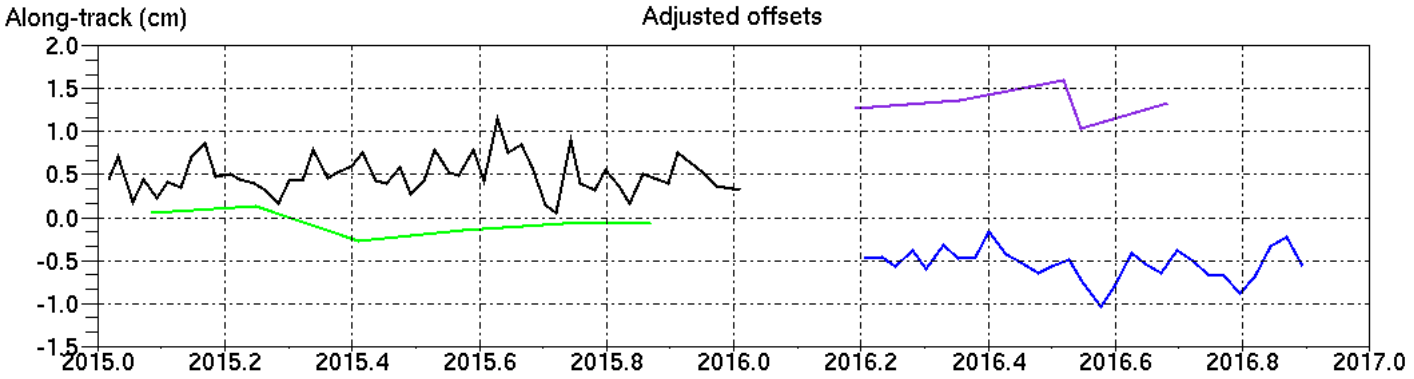


Radial and cross-track offsets

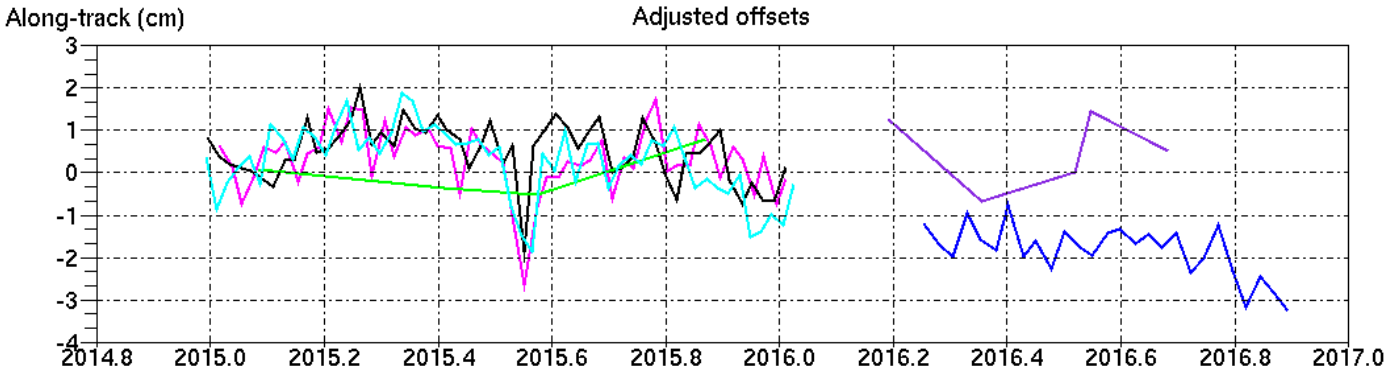
DORIS phase center offsets



Relative along-track offsets

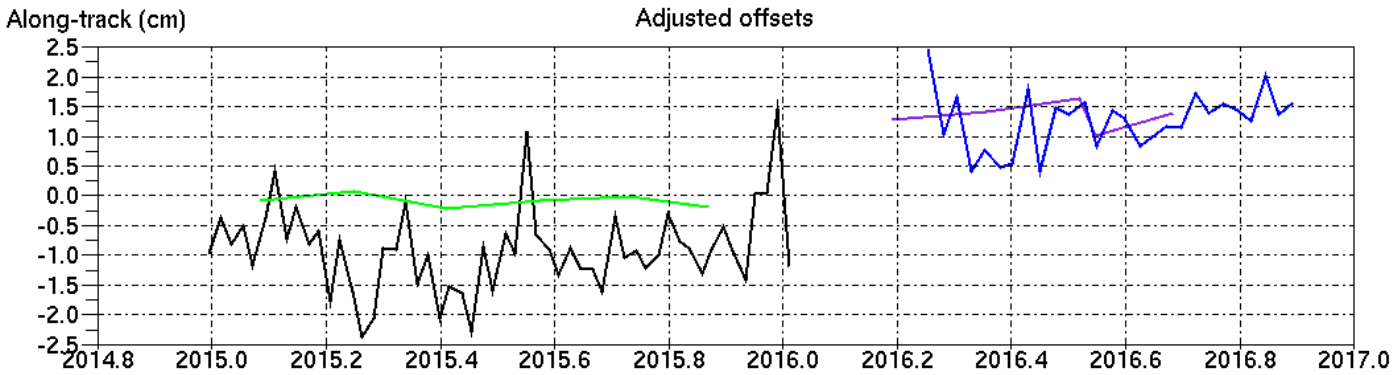


DORIS seen by GPS



DORIS seen by SLR

Relative along-track offsets



SLR seen by GPS