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SWOT orbit: parameters, standard and modelling updates

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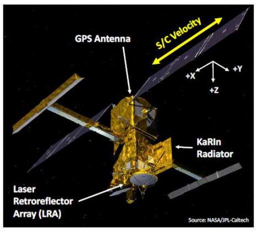
This poster will highlights current efforts made by the CNES team to improve the orbit mission. First, the update from standard F to standard G, with an improvement of the parameters. For validation SLR measurements, as well as comparison with JPL orbits are used. An analysis of self-shadowing effects, due to SWOT large appendages (solar panels, KARIn, radiators) coming out from the main central body, is also described, with a focus on the impact on empirical forces and on the orbit.

SWOT architecture

- S/C velocity along +/- Body X directions. -Y is always toward the Sun.
- One solar panel on each side of spacecraft bus along body-fixed +/- X directions.
- KaRIn radiators are located on +Y side of the spacecraft.
- Spacecraft performs yaw flips (apx. every 78 days) to keep radiator (+Y) in shade.
- Solar panels are always oriented towards –Y, taking three β-dependent positions.



β	Solar array angle
$[0° - 6°]$	$0°$
$[6° - 25°]$	$12°$
$> 25°$	$30°$

SWOT solar array pointing

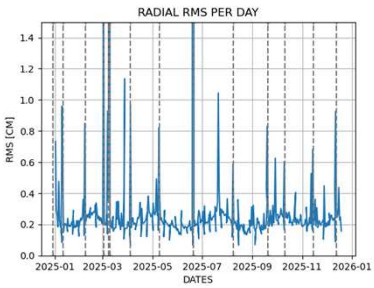
Current parametrisation for standard G

One PCV for each solar panel position (three maps)
New ambiguity fixing algorithm
SRP model: 3D SRP model taking into account self shadow effects

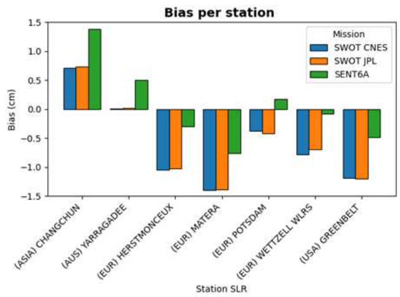
Dynamic parametrization:
1/rev: T and N per day
Bias: N per day
Drag coefficient adjusted, every 6 hours

Reduced dynamic parametrization:
Empirical constants: segments of 20 min, T and N
Absolute constraints on T 10-9 m/s2 and N 5x10-10 m/s2

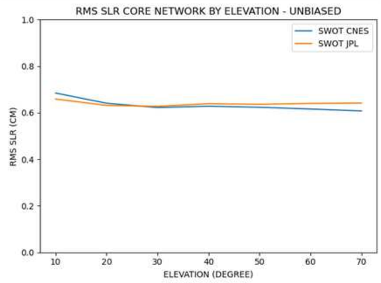
Validation with JPL orbits and SLR residuals



Radial RMS < 0,3cm, except for manoeuvers or events.
Signal due to 3D SRP modelling

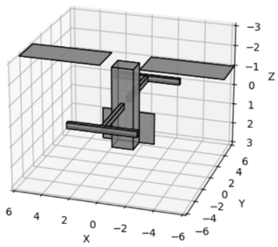


Same bias per station for CNES and JPL orbits.
Recurrent difference of ~5mm with S6 orbit



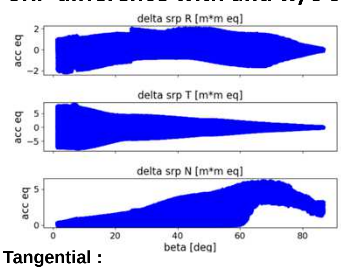
Radial rms < 7mm
Similar performances with JPL

3D SRP modelling



The model is is built based on the constructor documentation, with the main appendices:
- A cubic model for the payload
- Two solar arrays
- Karin
- Radiators

SRP difference with and w/o shadow



Accelerations are divided by the acceleration on the satellite produced by a black square of 1m² in normal lighting.
-> better aknowledge the 1/rev amplitude wrt satellite surfaces

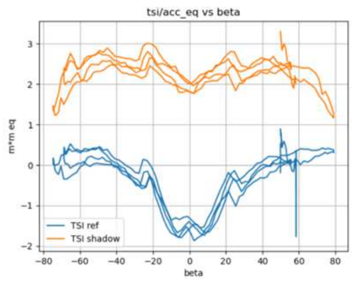
$$acc_{eq} = \frac{\Phi * s}{c * m} = 2.28\text{e}{-9}\ \text{m/s}^2$$

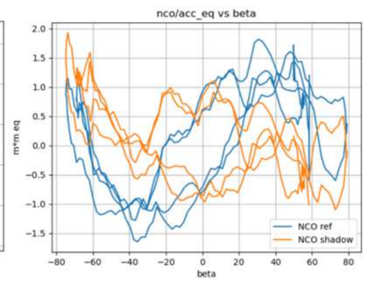
With Φ, solar flux, s, square surface, c, light velocity, m, satellite mass

Tangential :
- Strongest effect occurs at low beta angles: shadow of the panels on the ±X faces (5.4 m²).
- Shadows from the central body and the KaRIn reflector on the ±X faces of the KaRIn boom as beta increases (up to 2.3 m²).
- From around beta ~70°, the impact is less than 1 m².

Normal:
- <1m² for beta < 20°.
- The central body casts a shadow on the radiators (up to 3.4 m²).
- A bias appears at high beta angles: part of the -Y surfaces are always in the shadow.

Impact on empirical forces

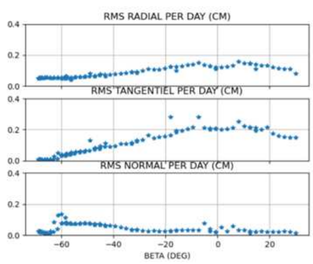




Tangential :
- Dependancy to beta and solar panel angles reduced using the self shadowing model.
- It remains a constant 1/rev componant.

Normal:
- The initial 1/rev normal forces show a sinusoidal dependency to beta angles. This is largely reduced by the new SRP model.
- It also shows a dependancy to increasing/decreasing orbits, which is not corrected by the new SRP model as it doesn't take into account these kind of effects.

Orbits difference



- Radial RMS differences up to 2 mm
- RMS differences are mainly due to model differences for frequencies > 1/rev. 1/rev components are compensated by the empirical forces

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