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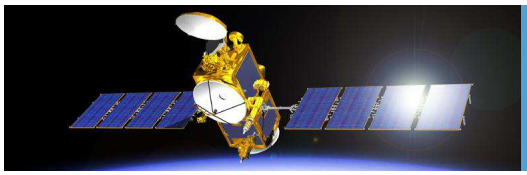
CNES CENTRE NATIONAL D'ÉTUDES SPATIALES

POE-F reprocessing of Jason-1 CNES precise orbit solutions



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INTRODUCTION

The CNES POD team reprocessed and made available Jason-1 precise orbits in the latest POE-F standards over the full decadal mission (January 2002 – June 2013). Jason-1 CNES orbit solutions are now consistent with those off the other past and present satellites of the altimeter constellation, all available in the same standards. We present the processing evolutions on the early GPS+DORIS and then DORIS-only periods following the loss of its GPS receivers. We also provide comparisons, with respect to the previous orbit standards and JPL solutions, as well as independent validations of the orbital performances with measurement residuals and altimetry crossovers.

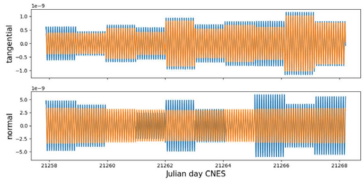
MAIN STANDARD EVOLUTION

	POE-E	POE-EF
Gravity field model	EIGEN-GRGS.RL03-v2.MEAN-FIELD Ocean tides: FES2012 Ocean/atmosphere: 6hr NCEP pressure fields + tides from Biancale-Bode model	EIGEN-GRGS.RL04-v1.MEAN-FIELD Ocean tides: FES2014 Ocean/atmosphere: 3hr dealiasing from GFZ AOD1B
Displacement of reference points	Ocean loading: FES2012 Pole tide: IERS2010	Ocean loading: FES2014 Pole tide: new linear mean pole model
Geocenter variations	Seasonal model from John Ries applied to DORIS/SLR stations	Full non-tidal model (Couhert et al., 2018 and Couhert et al., 2020) applied to DORIS/SLR stations and GPS satellites
Terrestrial reference frame	Extended ITRF2008 GPS constellation: JPL solution IGS08	Extended ITFR2014 GPS constellation: CNES/CLS solution IGS14
Estimated DORIS measurement parameters	Per pass : one frequency bias, one troposphere zenith bias (GPT/GMF model)	Per pass : one frequency bias and drift (« SAA stations »), one troposphere zenith bias. (GPT2/VMF1 model) Per arc: station heights and horizontal troposphere gradients

EMPIRICAL ACCELERATION

Doris + GPS	Doris-only	Geodetic (Doris only)
Cycles 1 -> 169 2002 -> 2006	Cycles 170 -> 374 2006 -> 2012	Cycles 500 -> 537 2012 -> 2013

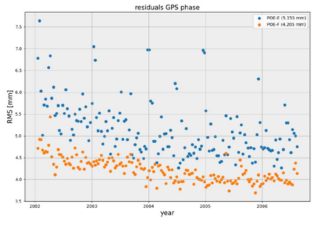
On 2006, Jason-1 lost its nominal and redundant GPS receivers. Because the remaining DORIS instrument (version D2 at that time) had only two channels, we applied with the POE-F standards a tighter constraint on the daily once-per-revolution cross-track empirical accelerations.

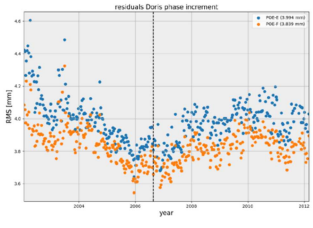


Indeed, along the cross-track direction, the limited observability of the measurements leads to noisy variations in the estimated empirical acceleration of the POE-E orbits. Most of them have no physical cause. The more stringent constraint of the POE-F orbits results in significantly smoother variations.

VALIDATION OF THE NEW ORBITS AND RESULTS

Post-fit DORIS and GPS residuals

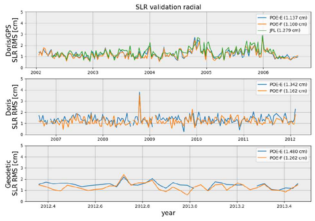


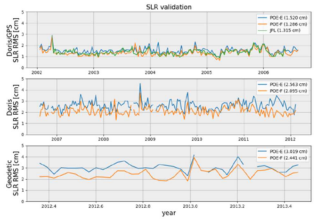


- The RMS of GPS residuals is significantly reduced with the new POE-F standards and also more stable.
- The RMS of DORIS residuals is slightly improved over the full mission.

Independent SLR residuals

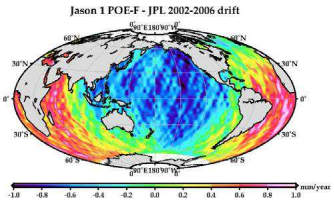
Laser residuals are used to assess the orbit performances. We used a sample of the SLR network stations used is 7090 (Yarragadee), 7105 (Greenbelt), 7119 (Haleakala), 7501 (Hartebeesthoek), 7810 (Zimmerwald), 7839 (Graz Lustbuehel), 7840 (Herstmonceux), 7941 (Potsdam), having stable measurements and a good geographical coverage.

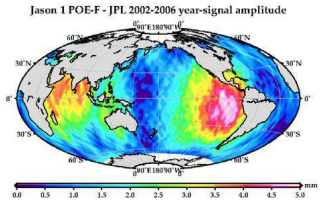




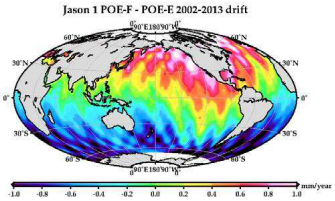
Strong reduction of SLR RMS residuals between the POE-E and POE-F orbit solutions, especially for the DORIS-only phase (5-6 mm improvement 3D and 1-2 mm in the radial direction) due to the update of the empirical acceleration constraints.

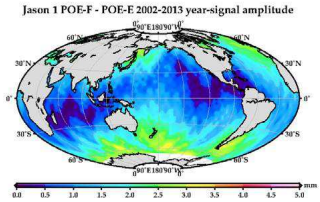
Geographically correlated radial orbit differences w.r.t. JPL orbits



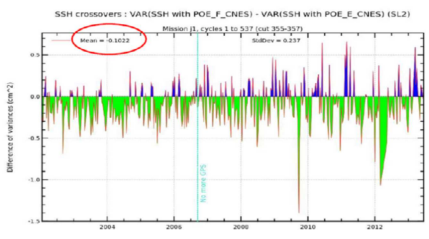


Geographically correlated radial orbit differences w.r.t. POE-E orbits





Altimetry crossovers



Courtesy of Hélène Roinard (CLS)

The variance of Sea Surface Height crossovers is reduced by 10 mm² between the POE-F and POE-E orbits, with a consistent improvement over all the mission duration.

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