# Quality of the DORIS/DIODE orbits for Jason-1, Envisat, Jason-2 … and potential improvements

- Christian Jayles (CNES),
- Jean-Pierre Chauveau (AKKA),
- Marion Chaillou (AKKA)

SEATTLE OSTST – 22, 23, 24th of June, 2009

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Jason-1

- Differences between on-board Diode and MOE orbits
- One RMS each day (except in case of manoeuver)
- Jason-1 MOE orbits are known to be better than a few centimeters RMS on the radial component (overlaps, crossovers, …)
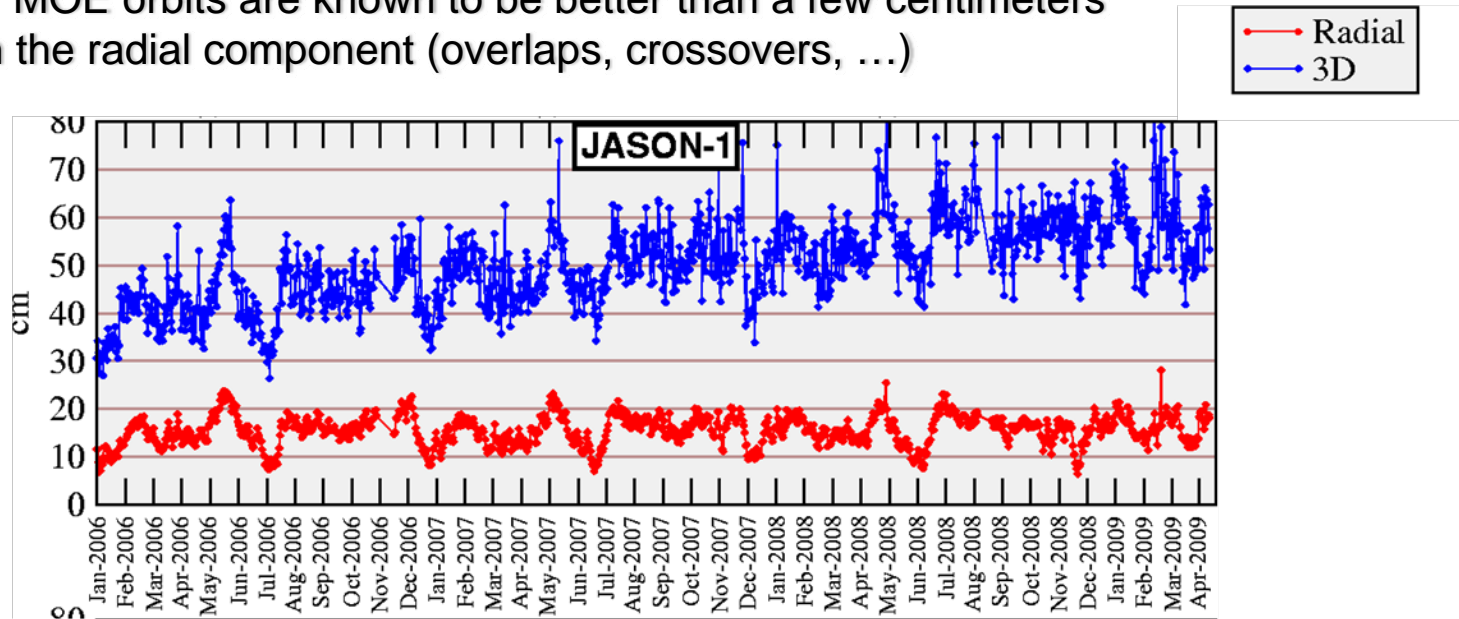
- Strong correlation with the attitude mode : Jason-1 solar radiation pressure model is not very well fitted
- 3D drift probably caused by no upload to correct the mass value on-board (and ageing of thermo-optical coefficients)
- Rather old issue of the Diode software (MINI v2_08, 2002)
- OLD PROCESSOR (31750) would not accept a modern issue of DIODE

Envisat

- Differences between on-board Diode and MOE orbits
- One RMS each day (except in case of manoeuver)
- Envisat MOE orbits are known to be better than a few centimeters RMS on the radial component (overlaps, crossovers, …)
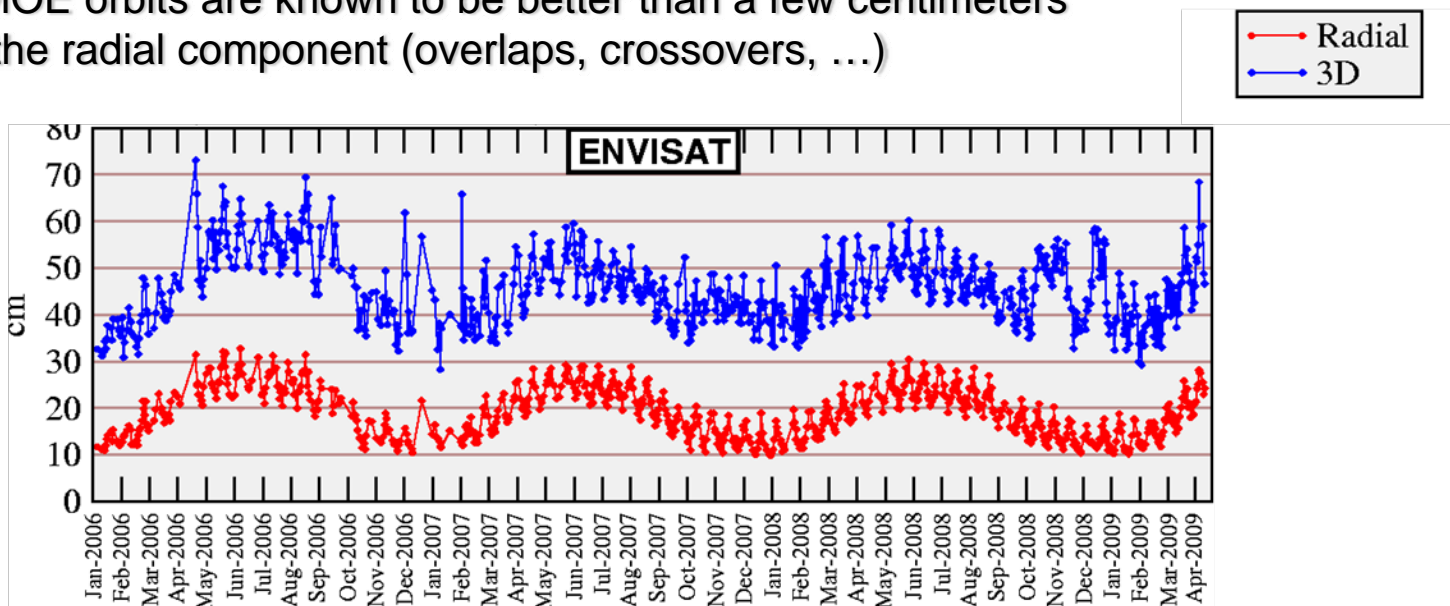
- One-year oscillations probably due to moon-sun attraction
- A shorter period (week) remains unexplained
- Rather old issue of the Diode software (GEN2 v3_00, 2003)
- An enhanced version has been designed, but not uploaded
- OLD PROCESSOR (31750) would not accept a modern issue of DIODE

DIODE on-board Jason-2

- DIODE on-board version DGXX v3.06 (jan 2008) :

- was turned ON on June 20th, 2008, … and is still operating
- No interruption for one year
  - (even during large manoeuvers)

- **Events worth mentioning**
- Drift during the first months, due to pole covariance tuning :

  understood and bypassed,

- Pertubations in the early attitude transitions, due to an error in quaternion handling :

  understood and bypassed,

- *No new perturbation since October 2008*

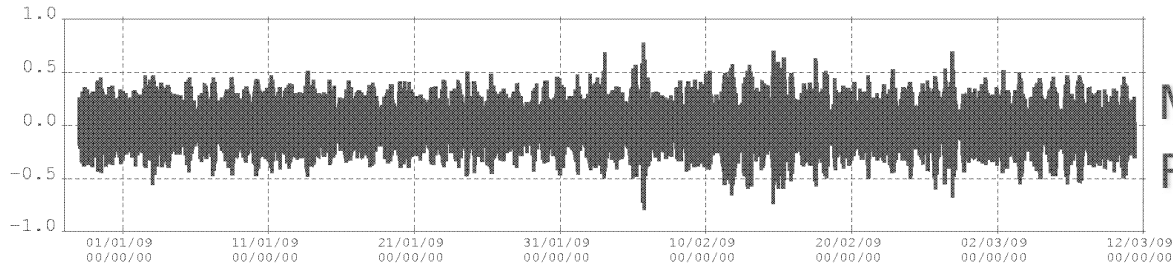- Comparison with POE on the first two months of 2009 is shown hereafter

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First two months of 2009

(Diode-POE)

Units = meters

Jason-2 on-board DIODE issue // POE, January/February 2009

STATS (m)

Cross-Track :

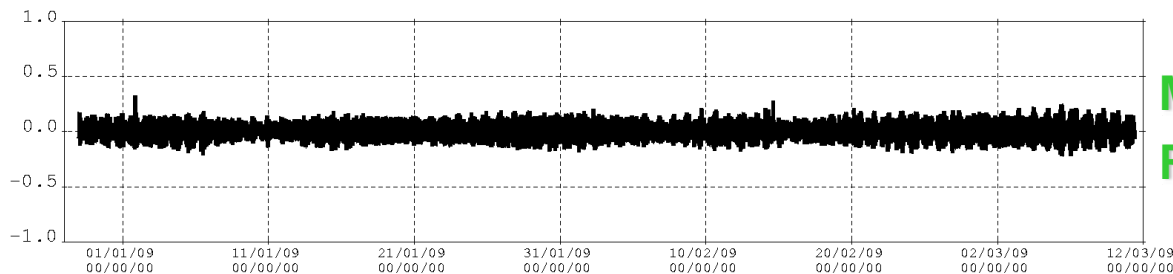MAX = 0.796

RMS = 0.200

Along-Track :

MAX = 1.096

RMS = 0.167

Radial component :

MAX = 0.324

RMS = 0.078
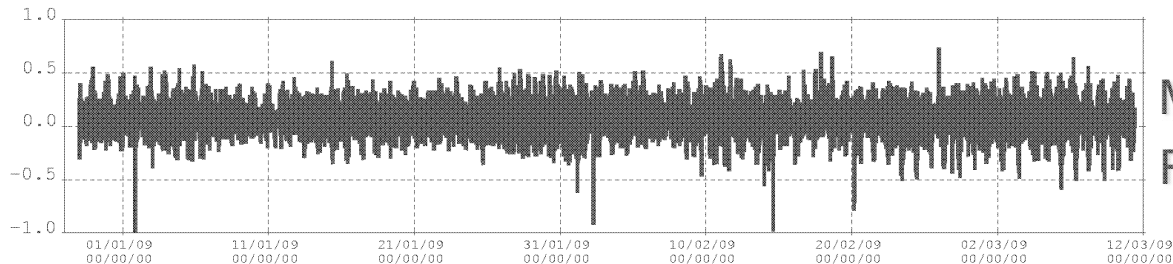
(Along-Track Mean = 0.074 m still under investigation)

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Current ground issue of the Navigation Software

- On-ground, improvements have lead to the current v4.01 version,
- **Differences with the on-board v3.06 issue :**

- (37 evolutions related to documentation, scripts or other satellites than Jason-2),

- 13 evolutions impacting DIODE/Jason-2 accuracy, especially :
  - correction of the « quaternions/radiation pressure » bug,
  - new tropospheric correction algorithm,
  - time-tagging evolutions (sensitivity wrt level, …),
  - 1st order relativity acceleration,
  - beacon editing improved (AS bit) => robustness,
  - reject low site measurements as well as low level measurements,
  - autoinitialisation algorithms little evolutions

- This issue is activated daily, with Jason-2 measurements : algorithms are ground validated

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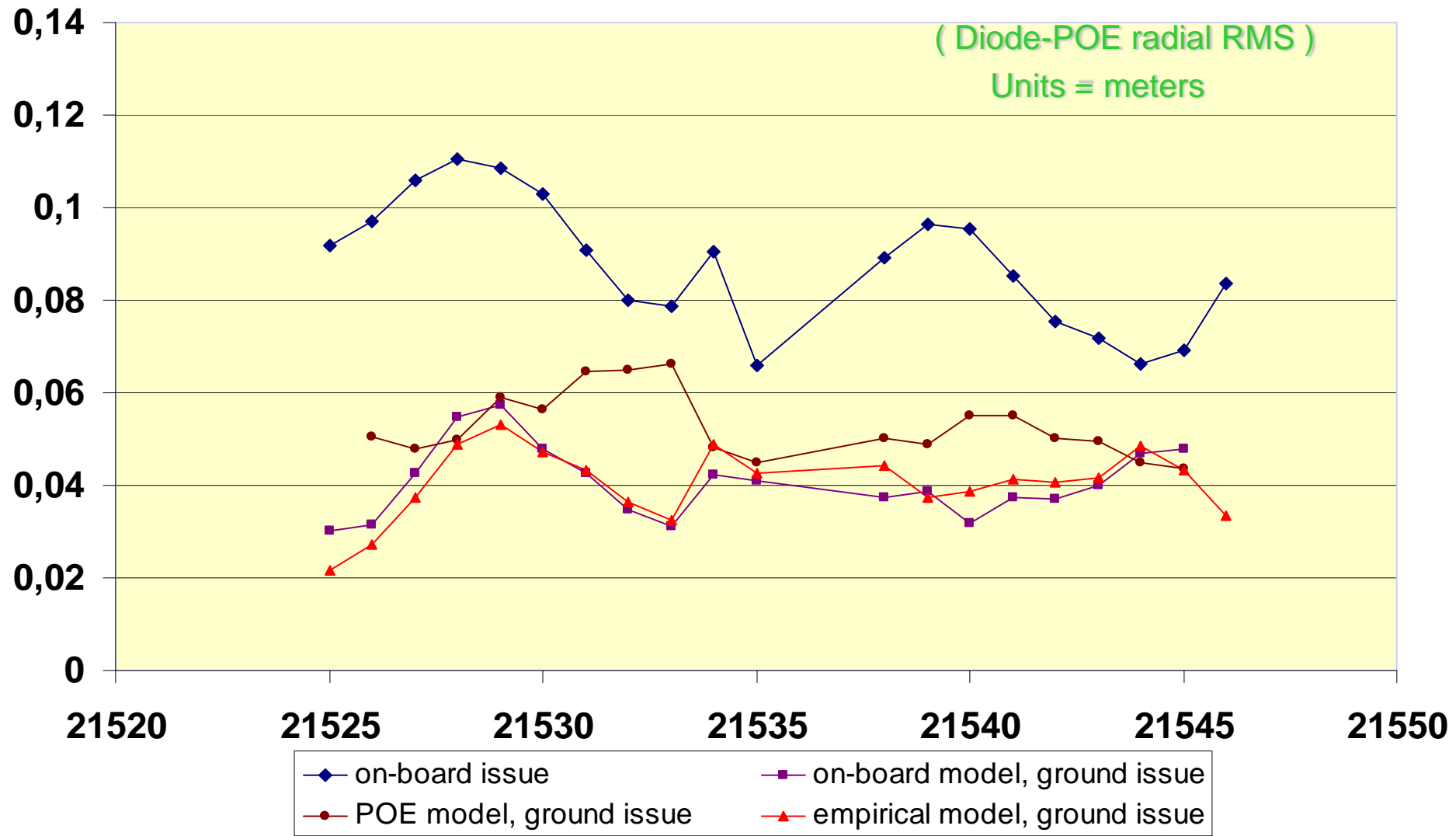
Best results obtained with v4.01 and an empirical RP model

(Diode-POE),

Radial component,

Units = meters

World record

DAY	NB POINTS	MINIMUM	MAXIMUM	MEAN	RMS	
*****	*********	**********	**********	**********	**********	
21525	1465	-0.055813	0.055617	-0.000943	**0.021509**	(0.091695 on-board)
21526	1589	-0.088252	0.055533	-0.001648	**0.027267**	(0.097065)
21527	1589	-0.096573	0.079022	-0.003047	**0.037425**	(0.105818)
21528	1589	-0.120596	0.140435	-0.002136	**0.048857**	(0.110533)
21529	1589	-0.134121	0.155448	-0.001948	**0.053124**	(0.108414)
21530	1589	-0.133933	0.126910	0.002096	**0.047352**	(0.103031)
21531	1589	-0.105840	0.103874	0.005878	**0.043400**	(0.090946)
21532	1589	-0.079140	0.085168	0.004977	**0.036238**	(0.079943)
21533	1589	-0.063988	0.073237	0.007350	**0.032594**	(0.078586)
21534	1589	-0.104126	0.101930	0.001405	**0.049006**	(0.090613)
21535	1589	-0.116960	0.114159	0.004742	**0.042724**	(0.065911)

(days 21536, 21537 : Manoeuver between cycles 16 and 17,

 TCH was not simulated in this ground test)

DAY	NB POINTS	MINIMUM	MAXIMUM	MEAN	RMS	
21538	1589	-0.181999	0.108179	0.000308	**0.044150**	(0.089071)
21539	1589	-0.087819	0.087265	0.001180	**0.037243**	(0.096495)
21540	1589	-0.082448	0.091627	0.016078	**0.038716**	(0.095353)
21541	1589	-0.099636	0.121897	0.013153	**0.041259**	(0.085193)
21542	1589	-0.116020	0.118098	0.006012	**0.040538**	(0.075469)
21543	1589	-0.118554	0.103085	0.005254	**0.041561**	(0.071700)
21544	1589	-0.118619	0.110809	0.008956	**0.048597**	(0.066365)
21545	1589	-0.122040	0.125765	0.007927	**0.043325**	(0.069024)
21546	1564	-0.082189	0.104859	0.004975	**0.033347**	(0.083625)

=> Mean quadratic error almost everyday below 5 cm RMS

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Results of different RP models, different issues

(Diode-POE radial RMS)
Units = meters

Legend:
- on-board issue
- on-board model, ground issue
- POE model, ground issue
- empirical model, ground issue

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Geographical correlation

(Diode Earth gravitation field = EIGEN GL04C)

All Tracks – Mean

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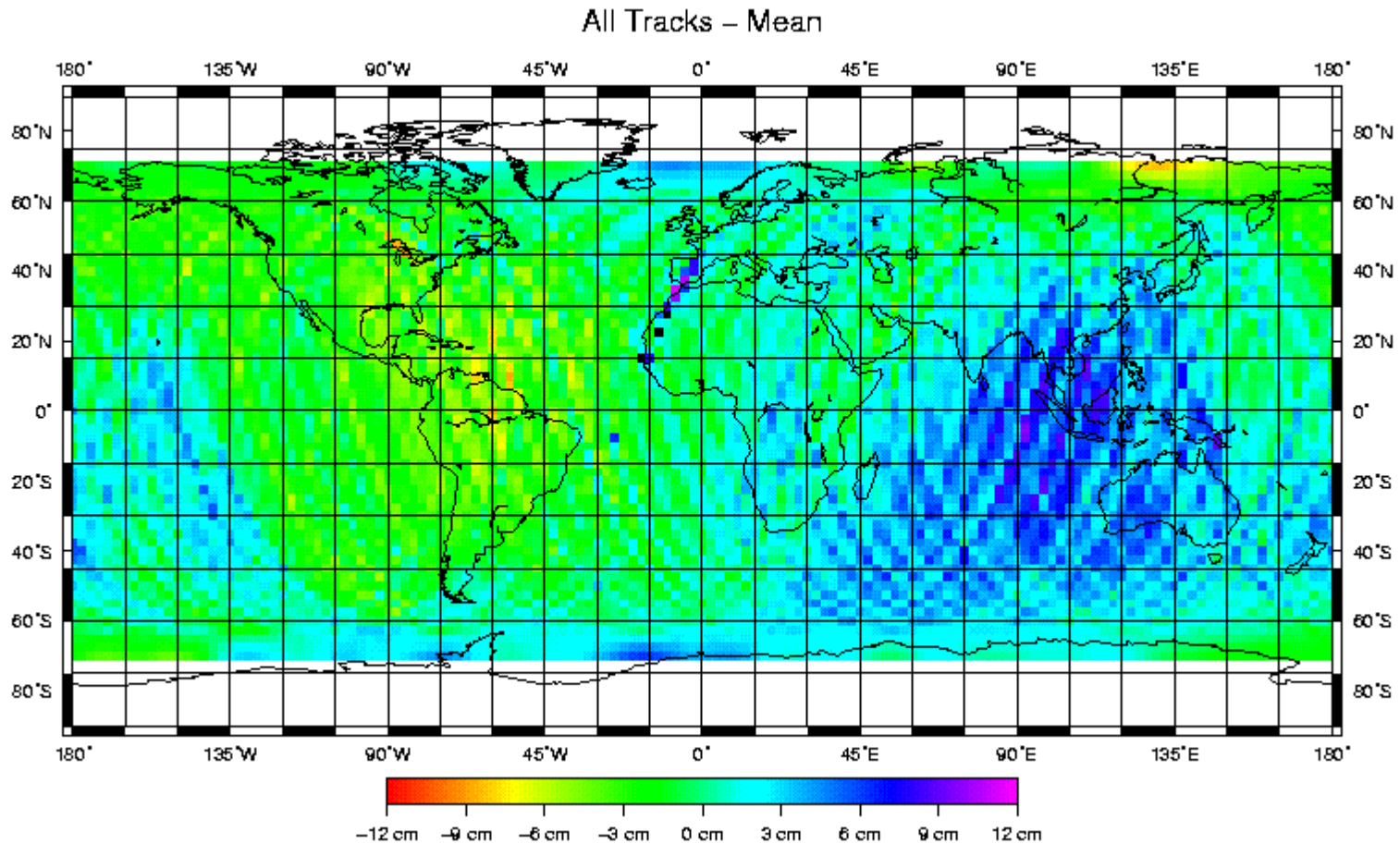
Further investigations

- ROBUSTNESS / FUNCTIONAL : Jason-2 DORIS measurements keep on being checked. Any disturbance will be analysed in details and may lead to an improvement of future issues.

- ACCURACY / MODELS :

  Comparisons with ZOOM software (POE)
  - Acceleration by acceleration
  - Residuals analysis,
  - …

cross track zoom-diode_new

- has begun, starting by … Solar Radiation Pressure

  (here the Cross-Track component)

- (of course) every evolution will be first validated on-ground

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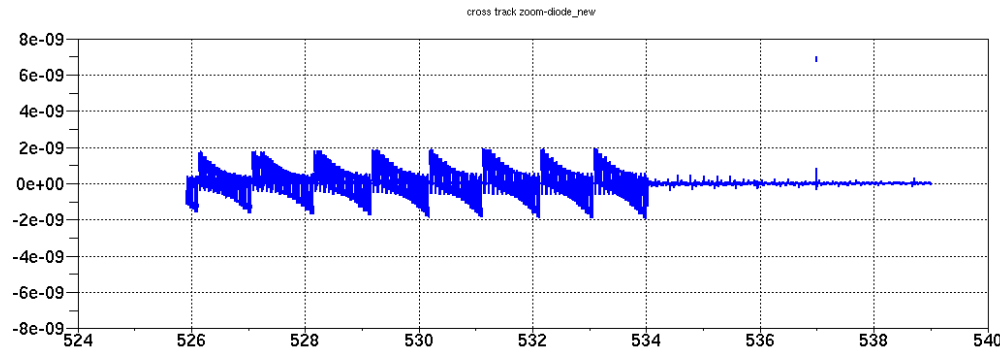
Upload v4.01 issue ?

- Upload of the new issue can be done on configuration DORIS B memory plan,
    - while DORIS A is still operating

- After completing the upload, necessity of :
    - Turn OFF the « old » issue,
    - Turn ON the new issue,
    - Let it converge (MAX 12 hours)
  => degraded of DIODE orbits / OGDR products = 12 hours MAX.

- No impact on other products (DORIS measurements, ground orbits, …)

=> if this upload is wished, we are ready

Christian Jayles