

> OSTST meeting

> SARAL/Altika workshop

> IDS workshop

www.ostst-altimetry-2014.com

New frontiers of altimetry

Lake Constance - Germany,
27-31 October 2014

Jason-2 Project Status



Thierry Guinle, CNES
on behalf Jason-2 Project Managers

Major events since last OSTST (October, 2013)

- Project Milestones
 - Sixth Jason-2 REVEX : May 12-14, 2014 → successful
 - EUMETSAT approval for extension up to end 2017 → successful
- Satellite major events
 - None
- Payload major events
 - GPSP-A issue and switch to GPSP-B on September 8, 2014
- Ground major events
 - USG1 monitoring improvement
 - Barrow deployment OK and antenna ready for Jason-2 by end of October
 - Processing software upgrade early 2014 (TM-NRT v4.1 since 18 March '14)

Current OSTM/Jason-2 mission Status is OK

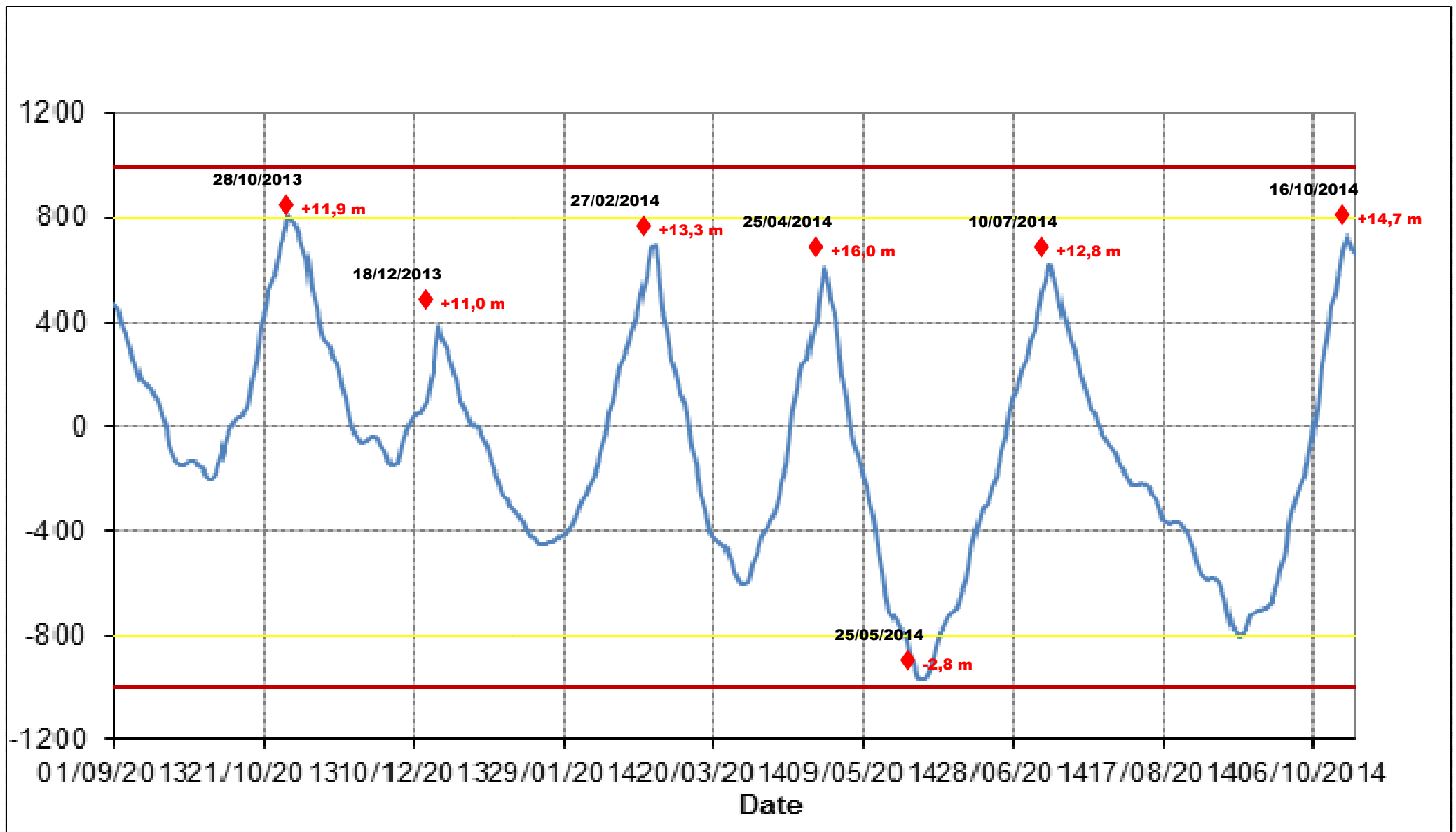
Platform Status

- The Jason-2 satellite bus is **OK**
 - Command / control , RF : **PMA : availability TBC** **PMB operational** **OK**
 - Patch for non-corrected single EDAC → uploaded in April 2014
 - On-Board Software, Mass Memory, Telemetry & Telecommand system
 - Thermal aspects: **OK**
 - Active thermal control works successfully and is sized with significant margins to meet further worst case conditions
 - Electrical aspects : **OK**
 - Satellite power and consumption are within the power, consumption and energetic budgets
 - AOCS (attitude and orbit control system) : **OK**
 - All AOCS units work nominally, AOCS control laws work as expected
- Exceptional activities :
 - Unused equipment destocking (gyro, STR) **OK**
 - STR monitoring **OK**
 - SADM expertise **OK**
 - Gyro calibration (last done in July 2014) **OK**

Jason-2 bus is fully operational after more than 6 years in orbit

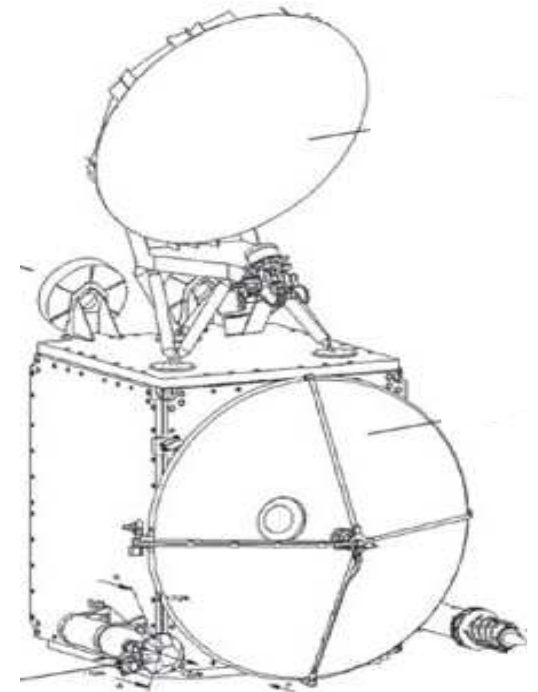
Navigation and guidance

- **Station keeping maneuvers**
 - ground tracks are maintained within $\pm 1\text{km}$ from the reference grid at Equator
 - station keeping maneuvers are made with only one thrust above land on any orbit
- **no collision avoidance maneuver**
- **propellant : ~24 kg (6 g/year)**



Payload Status since last OSTST (October, 2013)

- Core Payload
 - POSEIDON3 OK
 - 2 cycles (209 & 220) in DIODE/DEM mode
 - DORIS OK
 - AMR OK
 - GPSP-A NOK
 - Switched OFF on August 23rd, GPSP-B switched ON and operational since 10/09 → limited impact on the products
- Passengers
 - T2L2 OK
 - CARMEN2 OK
 - LPT OK

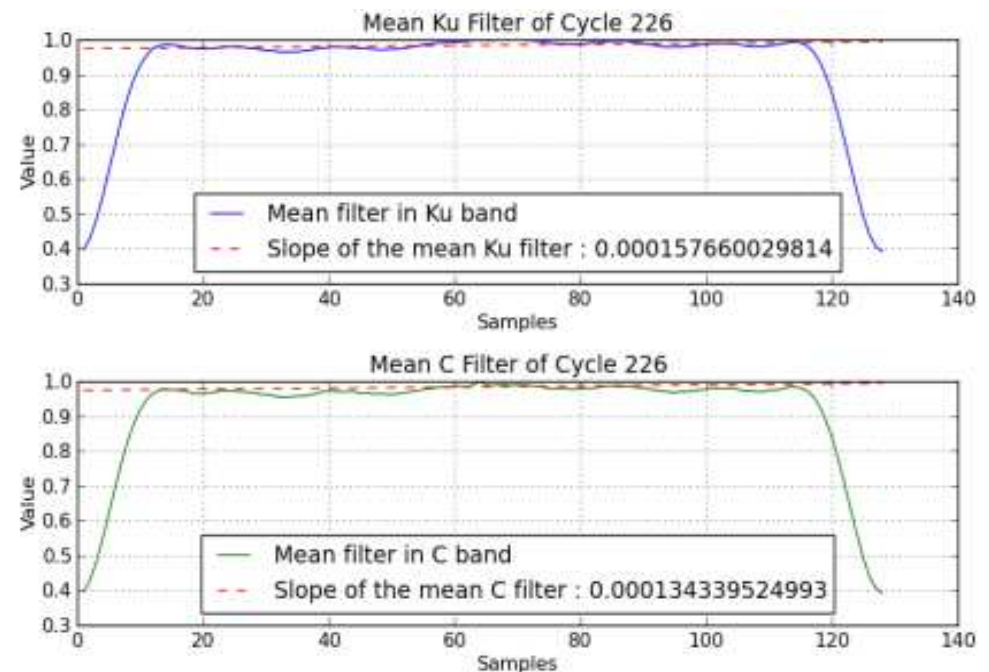
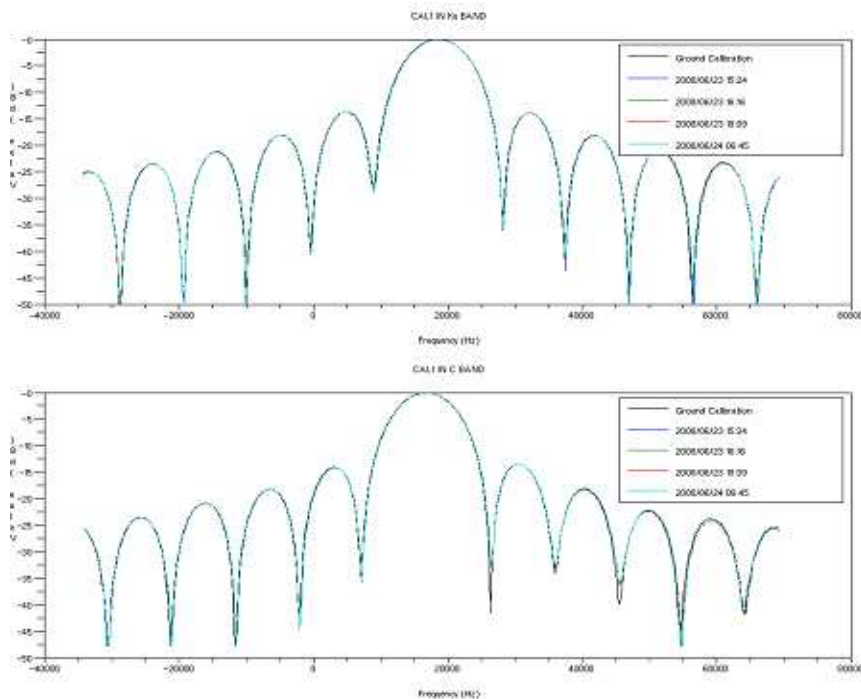


→ payload fully OPERATIONAL after more than 6 years in orbit with redundancy available for POS-3, DORIS & AMR

→ passengers perform satisfactorily

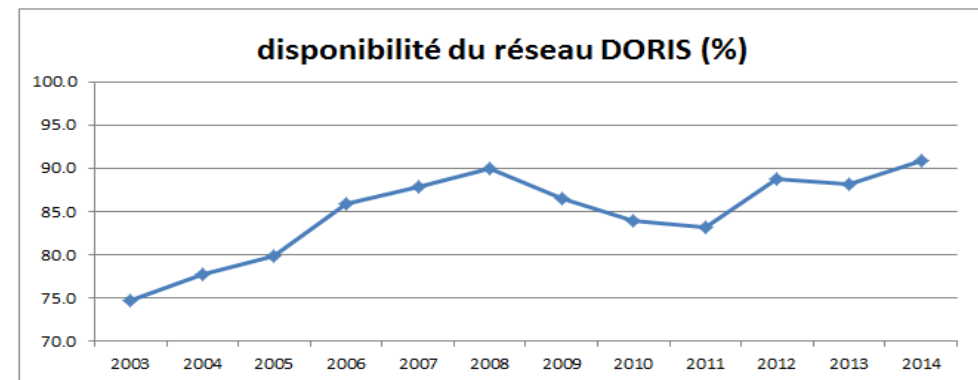
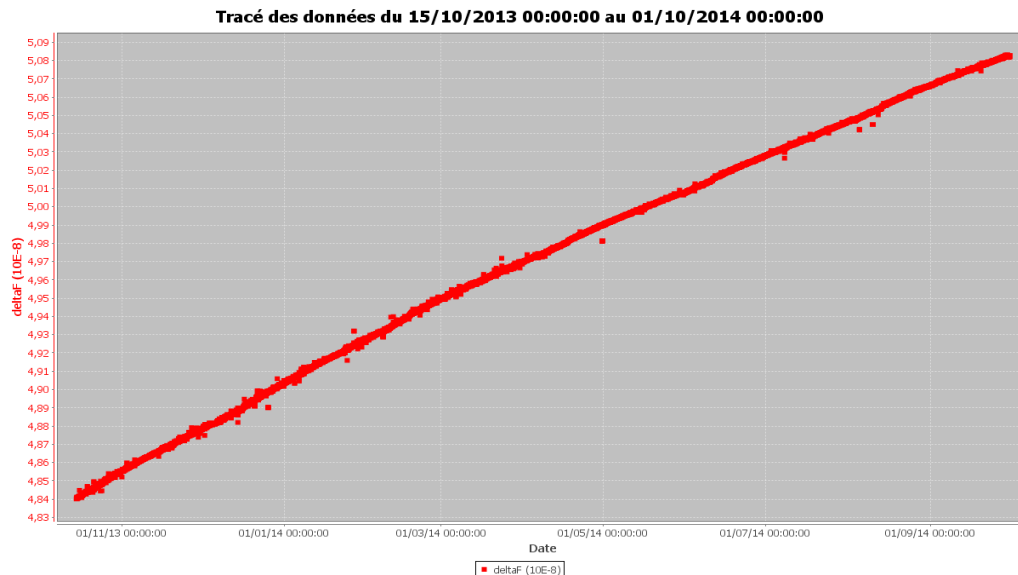
Poseidon-3

- Availability = 100% over the period
- Routine/Exceptional calibrations are OK
- CNG : Good Stability (of the order of calibration accuracy)
- Suppression of “long CAL2” calibrations



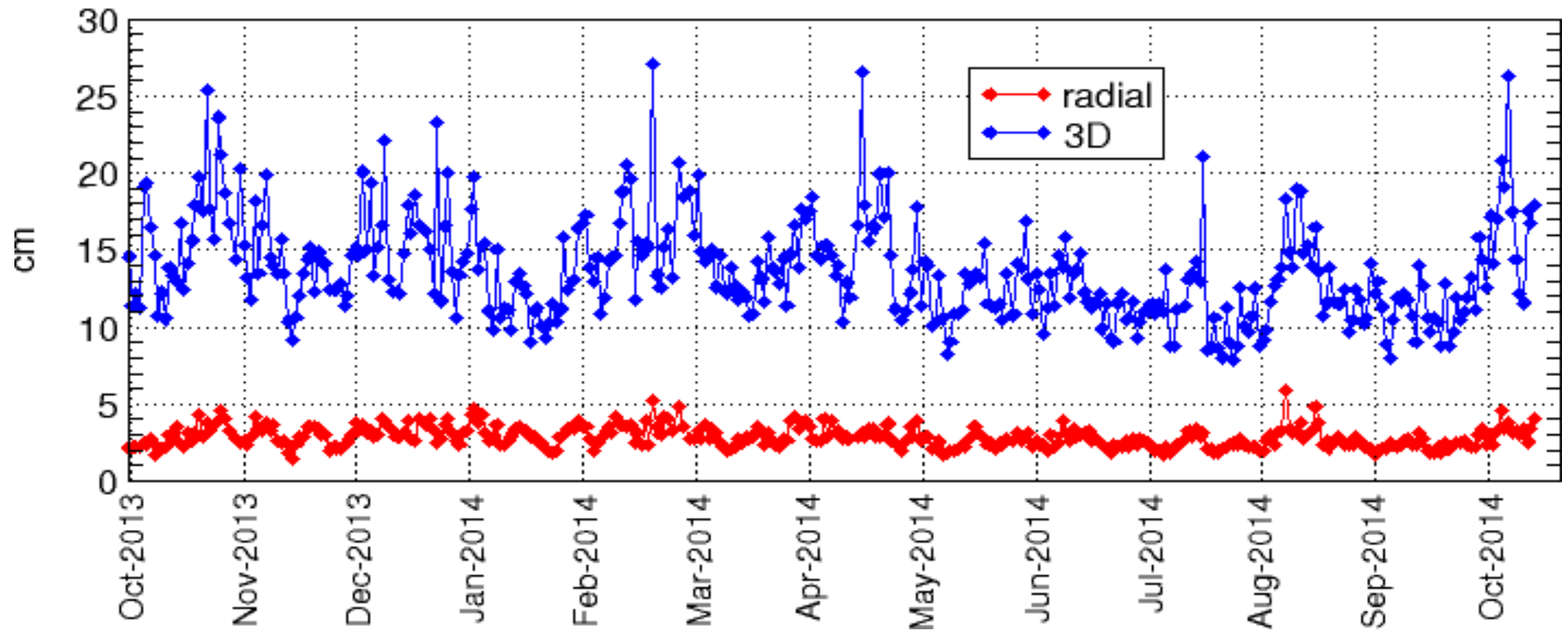
DORIS

- DORIS Availability = 100% over the period
 - One minor anomaly in January
 - Effective accuracy as compared to on-board GPS (platform) is stable :
 - 1.8 μs (OGDR & IGDR)
 - $\sim 1.5 \mu\text{s}$ (GDR)
- + very good performance of the ground network ($\sim 90\%$)



DIODE-MOE differences for Jason-2

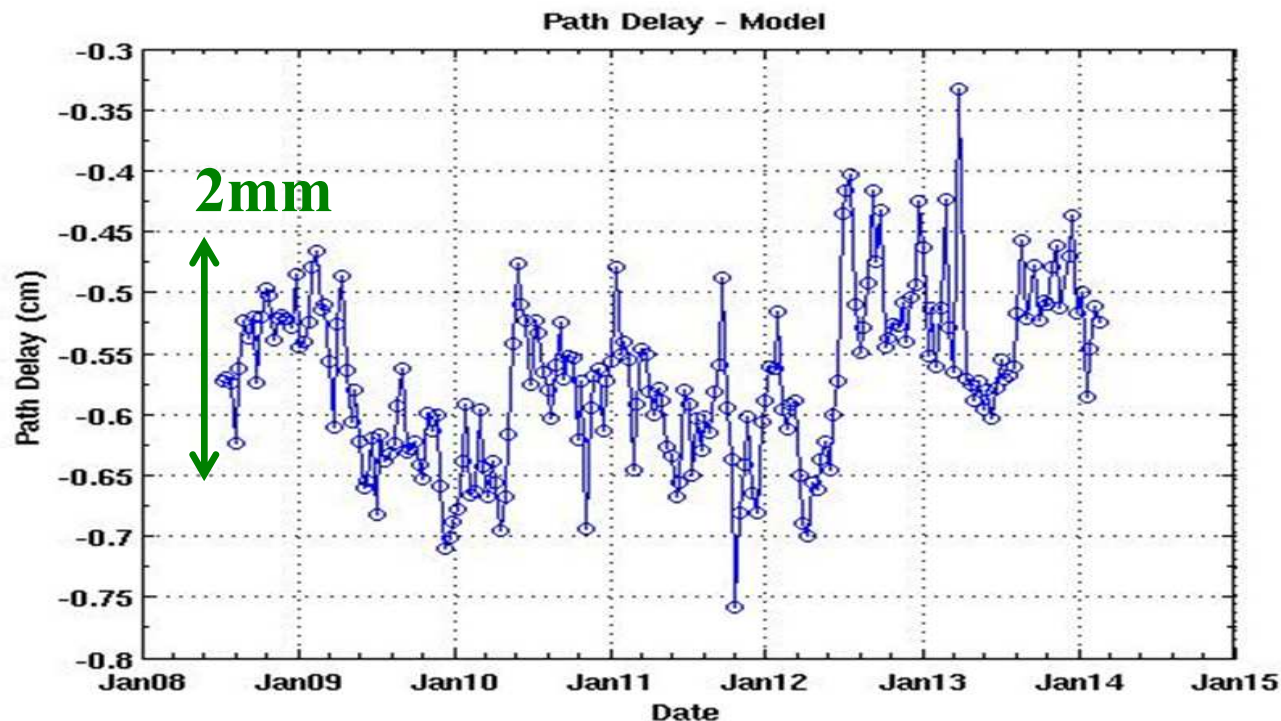
daily RMS, maneuvers excluded



➔ Performance for real-time orbit accuracy over the period is **~2.8 cm (radial rms)**

AMR

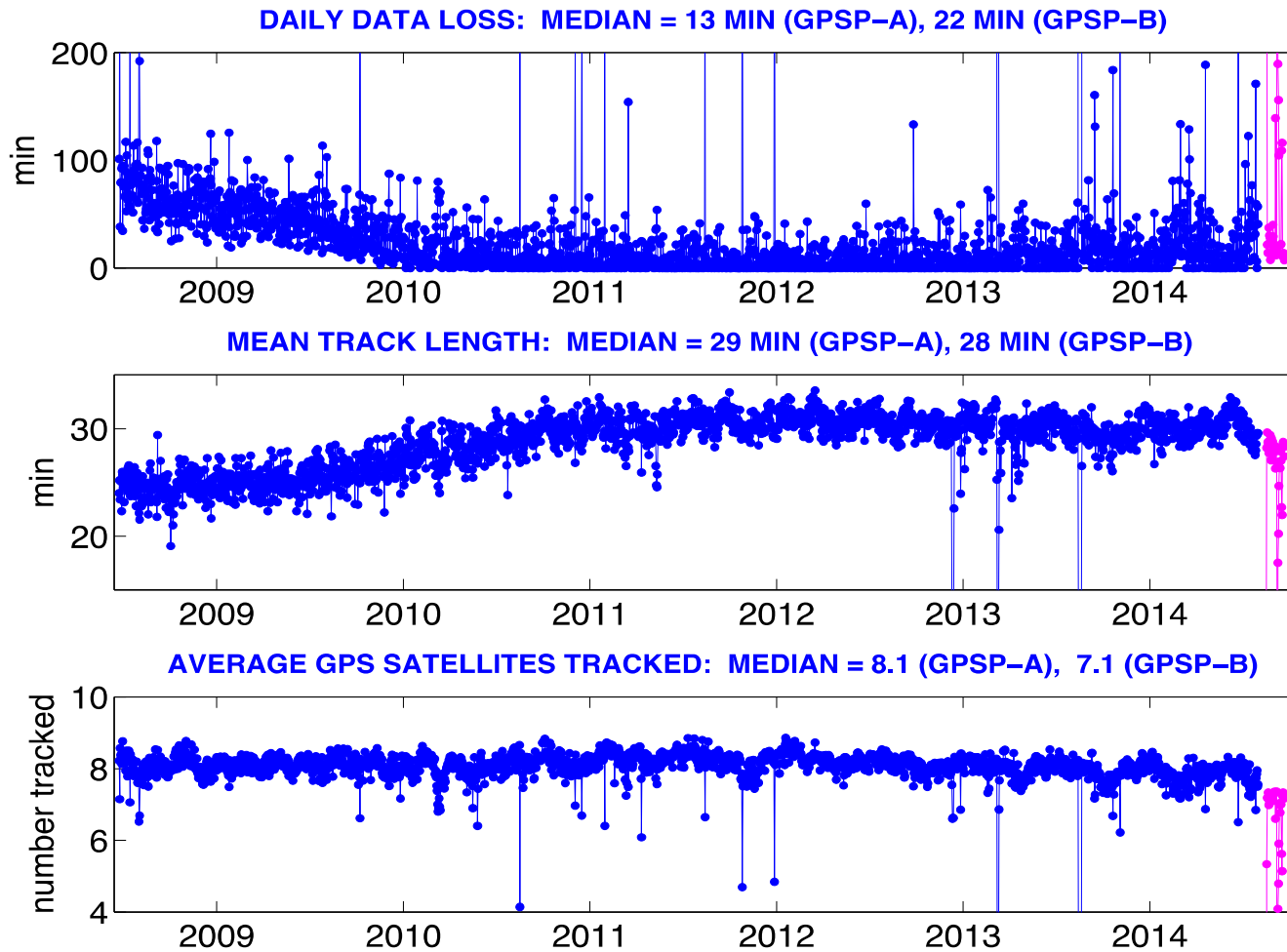
- AMR continues to provide excellent performance
- Availability = 100% over the period (total outages <70h since June 2008)
- No calibration changes implemented since February 28, 2012
- With ARCS processing the residual drift of GDR-D wet path delay (PD) is estimated to be < 1mm/year over mission life



GPSP-A & B

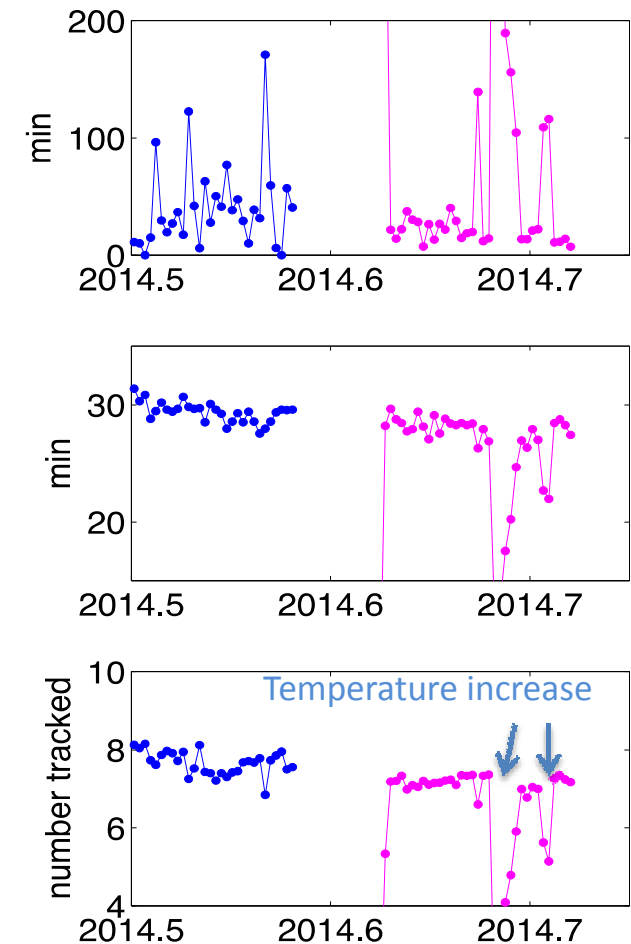
- On 23 August 2014, GPSP-A began resetting repeatedly every 31 seconds → switched OFF
- GPSP-B was powered on 26 August 2014 and did not return any POD data; few days after, it began functioning properly and outputting POD data on 10 Sept. 2014
- Degradation of the L2 frequency when the instrument temperature increases by 1°-2°C (in fixed yaw attitude; or when tracking > 8 sats)
 - Ambient payload temperature control is under investigation
- Fit residuals overlaps not as good
 - **GPSP-B PC: 27.4 cm, LC: 5.5 mm > GPSP-A PC: 22.0, LC: 3.3**
 - Antenna map needs to be updated
- Radial Overlaps not as good
 - **GPSP-B 3.5 mm > GPSP-A 1.1 mm**
 - Antenna map update; not as many satellites tracked (**8** vs. **12**)

GPSP - Tracking Performance



GPSP-B MaxSats=8; GPSP-A MaxSats=12

Zoom
2 July—14 Oct.



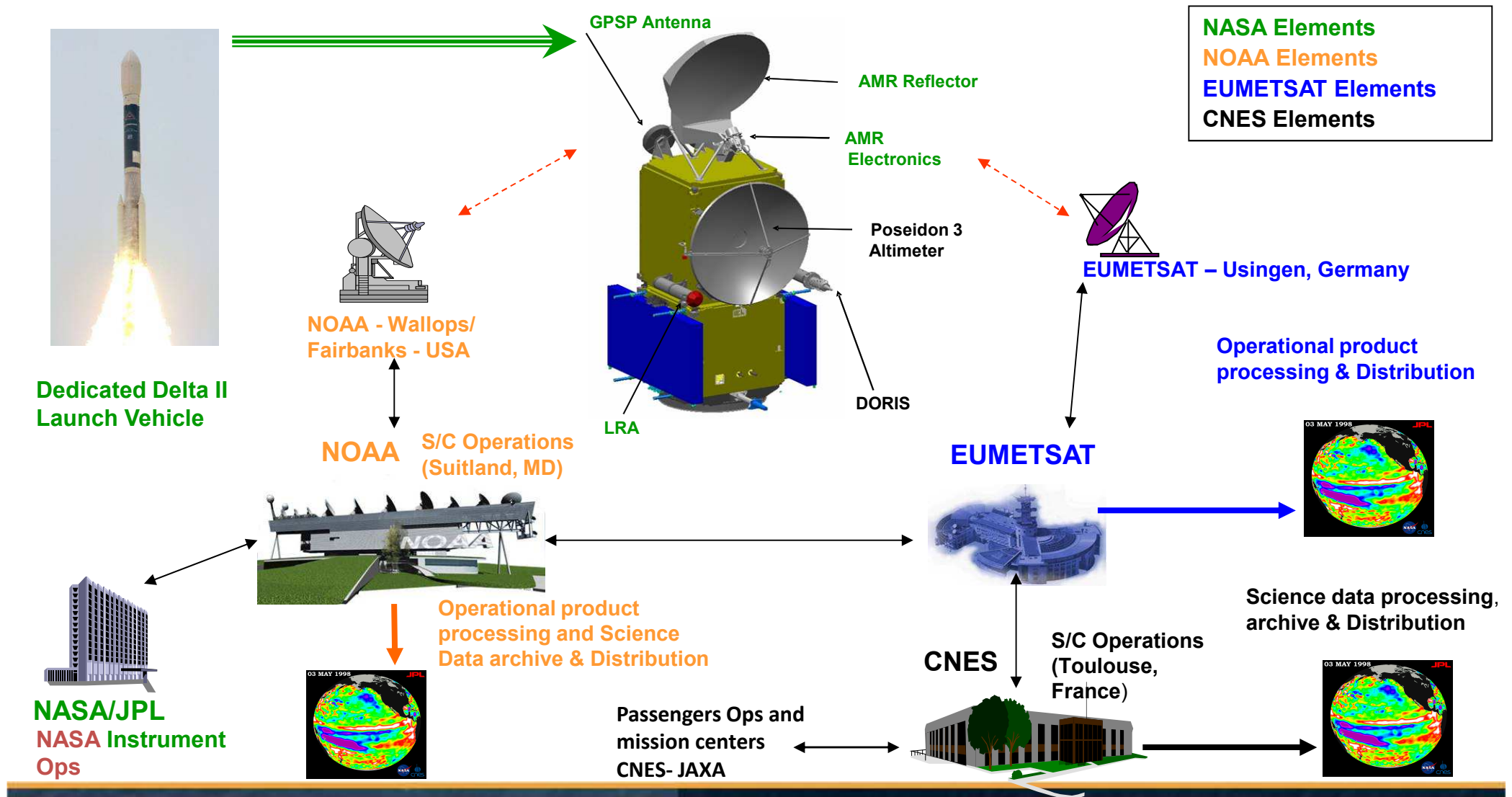
LRA Status

Summary:

- The LRA continues to provide returns adequate for tracking.
 - 100% availability since launch.
- SLR tracking of Jason-2 has been nominal.
- The top five stations for Jason-2 tracking are:
 - Yarragadee** (*Australia*)
 - Changchun** (*China*)
 - Wettzell** (*Germany*)
 - San Juan** (*Argentina*)
 - Mt. Stromlo** (*Australia*)



System elements



Ground & Operations - Status and performances

- Earth terminals :
 - Usingen (USG1) : OK
 - Wallops and Fairbanks (CDAS) OK
- Control Centers :
 - J2CCC CNES Control center OK
 - all the elements are OK
 - SOCC NOAA Control center OK
 - all the elements are OK
- Instrument Commanding and Monitoring Centers :
 - SSALTO for CNES instruments OK
 - JPL Mission facility for NASA/JPL instruments OK
 - Passengers Mission centers OK

OGDR products Status and performances

- NRT products made by
EUMETSAT Mission Center
NOAA/ESPC Mission Center
- Major changes in the period
 - **New version of TM-NRT (v4.1) software operational since March 2014**
- EUMPC : ~100% OGDR successful for PLTM1 acquired at USG
- NOAA ESPC : ~100% OGDR successful for PLTM1 acquired at CDAs
- 100 % OGDR products archived, all disseminated via EUMETCast and via NOAA dissemination services

Operational Geophysical Data Record data latency

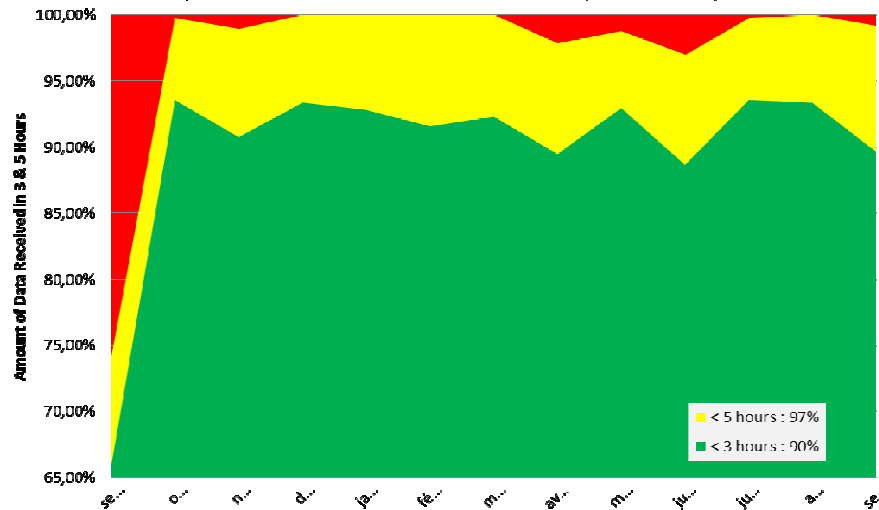
Requirements are:

- 75% of OGDR data within 3 hours from sensing
- 95% of OGDR data within 5 hours from sensing

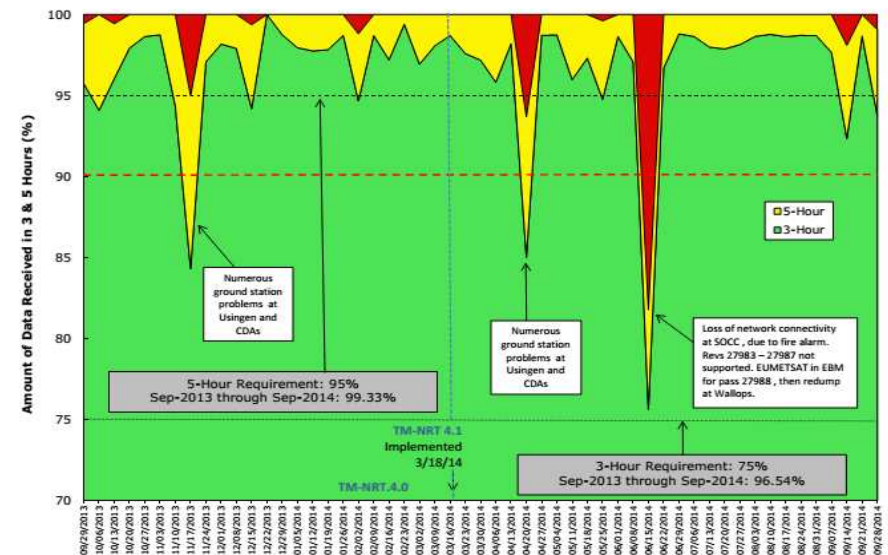
Performance (measured at EUMETCast end user level)
90 % in less than 3 hours
97 % in less than 5 hours
EUMETSAT's Inputs

Performance (measured at NOAA ESPC production level)
96 % in less than 3 hours
99 % in less than 5 hours
NOAA's Inputs

Jason-2: Sep-2013 through Sep-2014 Monthly OGDR Latency Statistics
(measured at end users EUMETCast Reception Station)

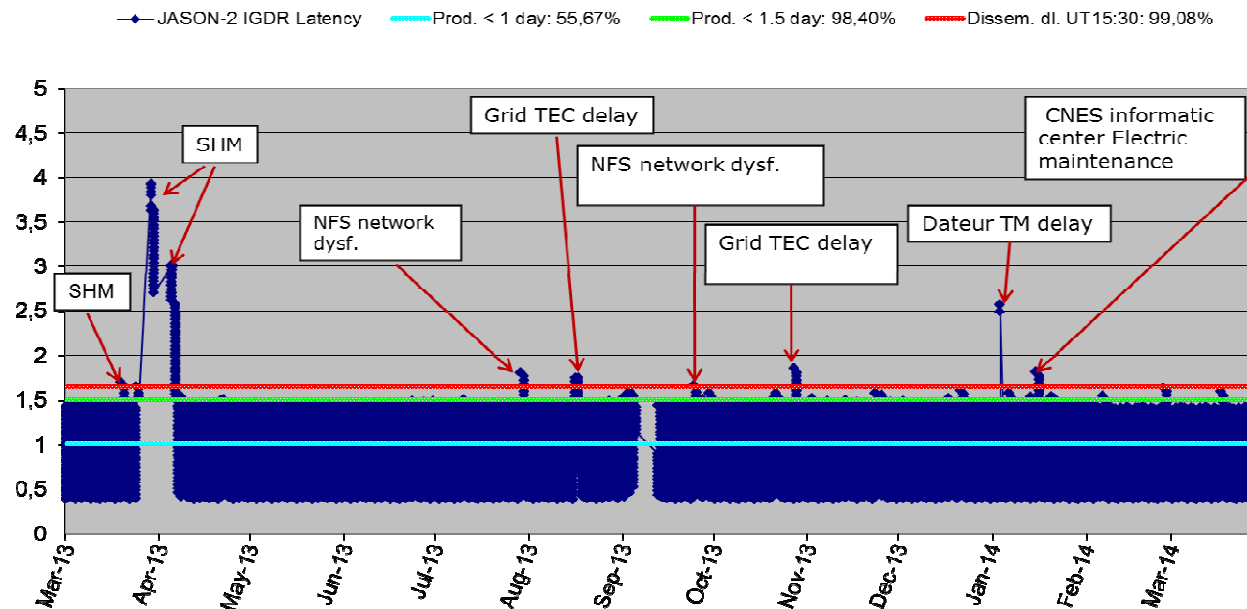


Jason-2: Sep-2013 through Sep-2014 Weekly OGDR Latency Statistics



IGDR - status and performances

- Jason-2 IGDR processing is OK (CNES : 100% IGDR successful)
- Latency : more than 98% of products available in less than 1.5 day
- 100% IGDR products archived
- all disseminated via CNES AVISO+ and NOAA dissemination services



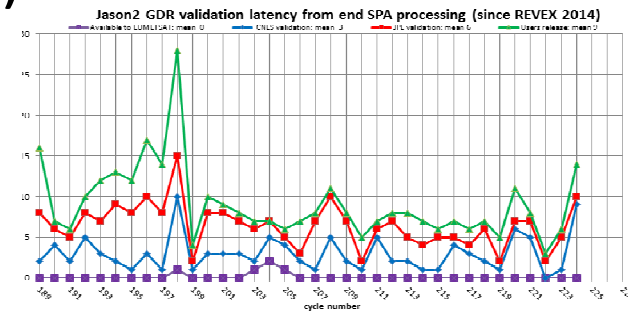
GDR - status and performances

- GDR produced by SSALTO Mission Center
- Jason-2 GDR processing is OK (latency OK)

- Systematic cross checked validation by CNES and JPL
- Cycle per cycle (and yearly) validation reports available on AVISO+

<http://www.aviso.altimetry.fr/en/data/calval/systematic-calval.html>

- 100% GDR products archived
- all disseminated via CNES AVISO+ and NOAA dissemination services



System Requirements and Performances

- Altimeter Antenna Pointing :
 - Requirement : $< 0.2^\circ$
 - pointing performance stable since launch

Typical pointing value below 0.07°

*STR1 locked in standby on
2009/02/23*

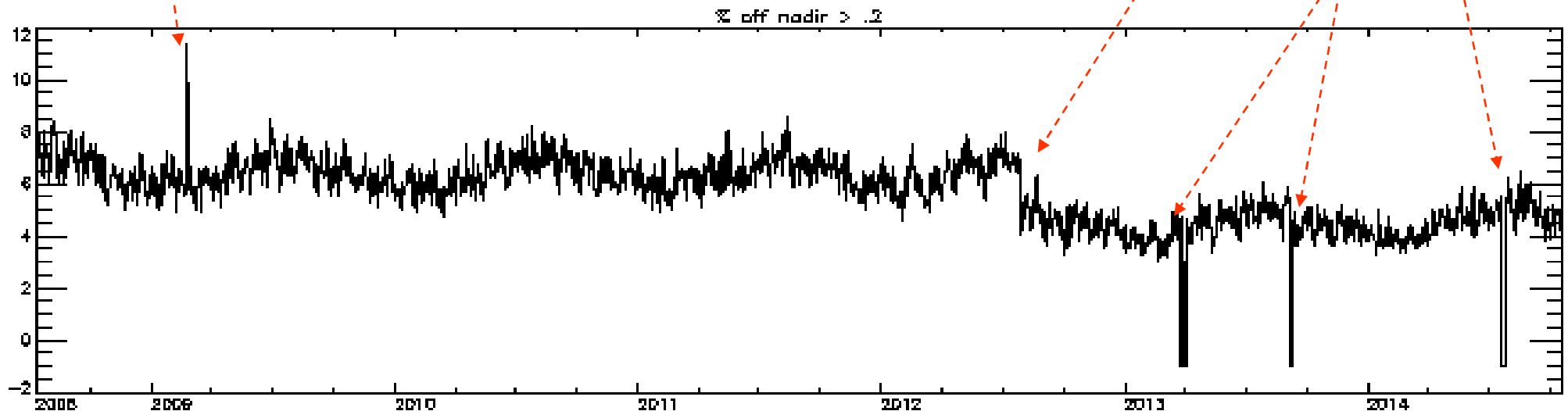
OFF Nadir

% of the points per day with mispointing $> 0.2^\circ$

GDR-D standard

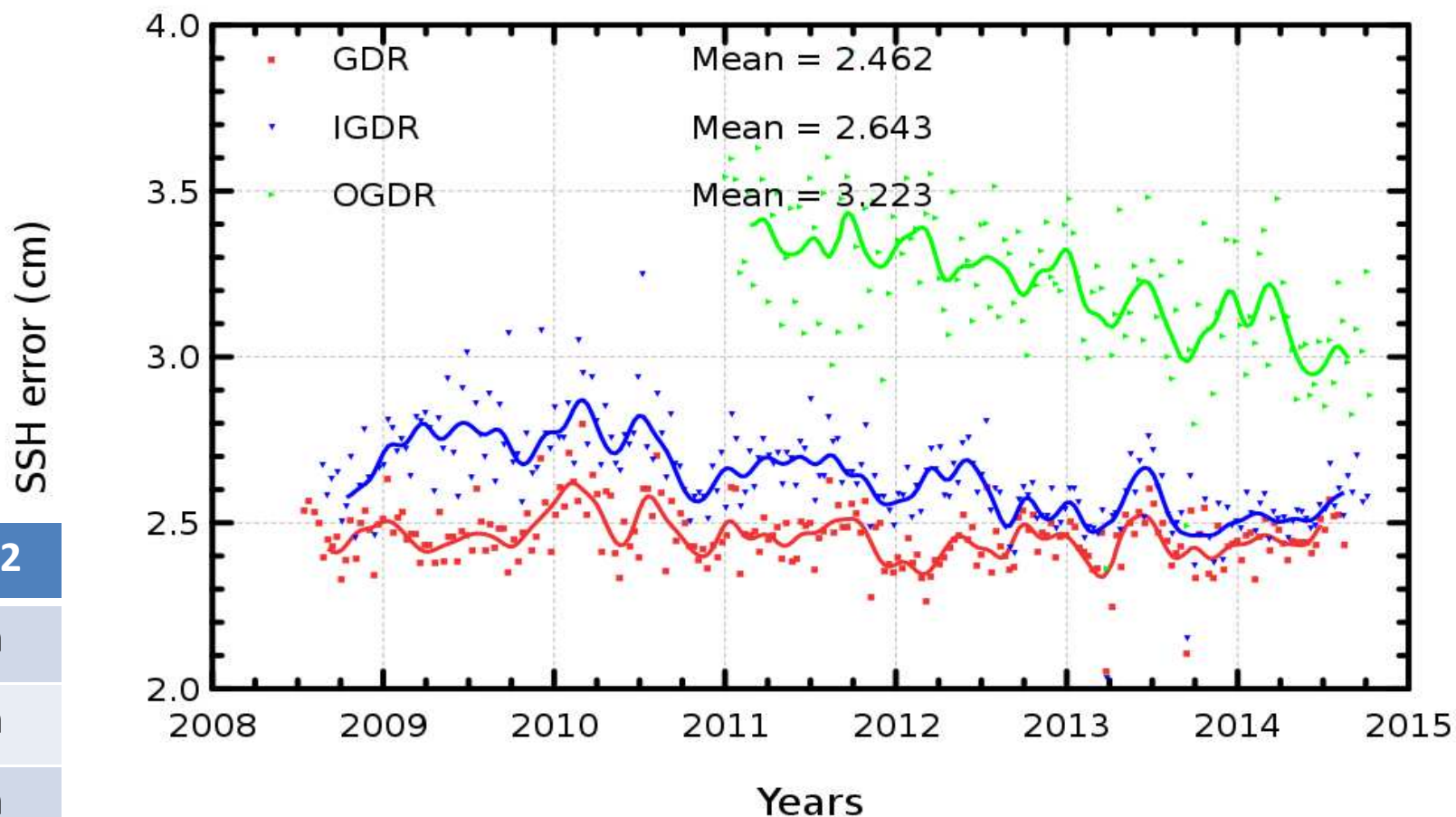
SHM

Gyro CAL



Sea-level performances

SSH error deduced from crossovers analyses using radiometer data



Products	Jason-2
GDR	2.46 cm
IGDR	2.64 cm
OGDR	3.22 cm

Sea-level budget error (error < 10 days)

Available in the annual CALVAL report

	Error budget	Specifications			Error (<10 days)			GOAL
		OGDR	IGDR	GDR	OGDR	IGDR	GDR	
Parameters and corrections for raw sea surface height calculation	Altimeter range	>1.7 cm			>1.6 - 1.7 cm			1.5 cm
	Ionosphere	1 cm	0.5 cm		>1 cm / >0.2 cm ⁱ			0.5 cm
	Sea State Bias	3.5 cm	2 cm		>0.4 cm			1 cm
	Dry troposphere	1 cm	0.7 cm		0.4-0.7 cm	0.3-0.7 cm		0.7 cm
	Wet troposphere	1.2 cm			>0.2 cm			1 cm
	Rms Orbit (radial component)	10 cm	2.5 cm	1.5 cm	>3.7 cm	>1.7 cm	>1.0 cm	1.5 cm
Altimeter parameters	Significant wave height	10% or 50 cm	10% or 50 cm		13 cm			5% or 25 cm
	Wind speed	1.6 m/s	1.5 m/s		1 m/s			1.5 m/s
	Sigma0 (absolute)	0.7 dB			0.11 dB			0.5 dB
Raw sea surface height		11 cm	3.9 cm	3.4 cm	> 4.2 cm/-	> 2.6 cm - 2.8 cm	>2.1 cm - 2.4 cm	2.5 cm
Final sea surface height		x	x	x	< 2.5 cm	< 2.7 cm	< 3.3 cm	x

Sea-level budget error (at climate scales)

Available in the annual CALVAL report

With usage of In-situ comparisons (Tide Gauges, Argo profiles)

Spatial Scales	Temporal Scales	Altimetry errors
Global Mean Sea Level (10-day averaging)	Long-term evolution (> 10 years)	$\leq 0.5 \text{ mm/yr}$
	Inter annual signals (2-5 years)	$\leq 3 \text{ mm}$
	Periodic signals (Annual, 60-days,...)	Annual $\leq 1 \text{ mm}$ 60-day $\leq 3 \text{ mm}$
Regional Mean Sea Level (2x2 deg boxes and 10-day averaging)	Long-term evolution (trend)	$\leq 2 \text{ mm/yr}$
	Inter annual signals (> 1 year)	Not evaluated
	Periodic signals (Annual, 60-days,...)	Annual $\leq 5 \text{ mm}$ 60-day $\leq 1 \text{ cm}$

System Requirements and Performances

- Data availability :
 - Requirement : The GDR shall contain 95% of all possible over-ocean data (acquisition and archive) during any 12 month period, with no systematic gaps.
- from October 2013 until October 2014
 - ⇒ **satellite unavailability** ~0 % < 4% req
 - bus : 0% altimeter : 0.01% Doris : 0% AMR : 0.01%
 - ⇒ **ground unavailability** ~0 % < 1% req

➔ **Global Jason-2 system availability : 99.9 %**

NB : GDR data availability vs theory (from 2013 annual CALVAL report)

All surfaces : 95.3 %

Over Ocean : 99.0 %

Conclusion

- Jason-2 satellite has still an excellent behavior
 - All satellite and system performances requirements are fulfilled with large margins
 - Extended Operational Routine Phase is nominal
- CNES and EUMETSAT are OK for a mission running up to December 2017 (at least !!)
- NASA/JPL and NOAA are OK up to June 2015; they will run a mission extension process in 2015
- Using Jason-1 experience, and after interleaved phase with Jason-3, one item to prepare : **“where to put Jason-2 when it will become breakable ?? ”**

thanks to all the teams (CNES, NOAA, EUMETSAT, NASA/JPL) a system running fine, with an excellent availability level

Jason-1 GDR-D reprocessing

- Activity decided during Boulder OSTST (2013)
- Not a complete reprocessing; just updating main parameters
- Conducted jointly by CNES and JPL
 - CNES
 - provide orbits
 - provide geophysical parameters
 - provide tools for creation new GDRs in NetCDF format
 - perform CALVAL on complete data set
 - JPL
 - provide reprocessed JMR series
 - perform the « reprocessing »
 - perform CALVAL on complete data set
- Schedule
 - almost all activities completed
 - release of new Jason-1 products planned early 2015



Thanks for your attention and also..... many thanks to the contributors !!

- CNES

- C. Maréchal
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