Jason-3 Mission Overview

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Presented by G. Zaouche (CNES)

SUMMARY

- **Jason-3 LEOP , orbit acquisition and assessment phase overview**

- Jason-3 project status and performances
  - »Main events
  - »Satellite bus
  - »Payload Instruments
  - »Ground and operations
  - »Products

- Conclusion

Jason-3 Project Status : Remember : last status at Reston OSTST

- From the satellite arrival at VAFB on **June 18, 2015** the Jason-3 Launch campaign activities have been successfully exercised for a Launch date : **Aug 9, 2015**
- But the Launch campaign has been stopped on **June 28, 2015** due to F9 launch mishap and the satellite has been stored at Vandenberg from **July 10, 2015**

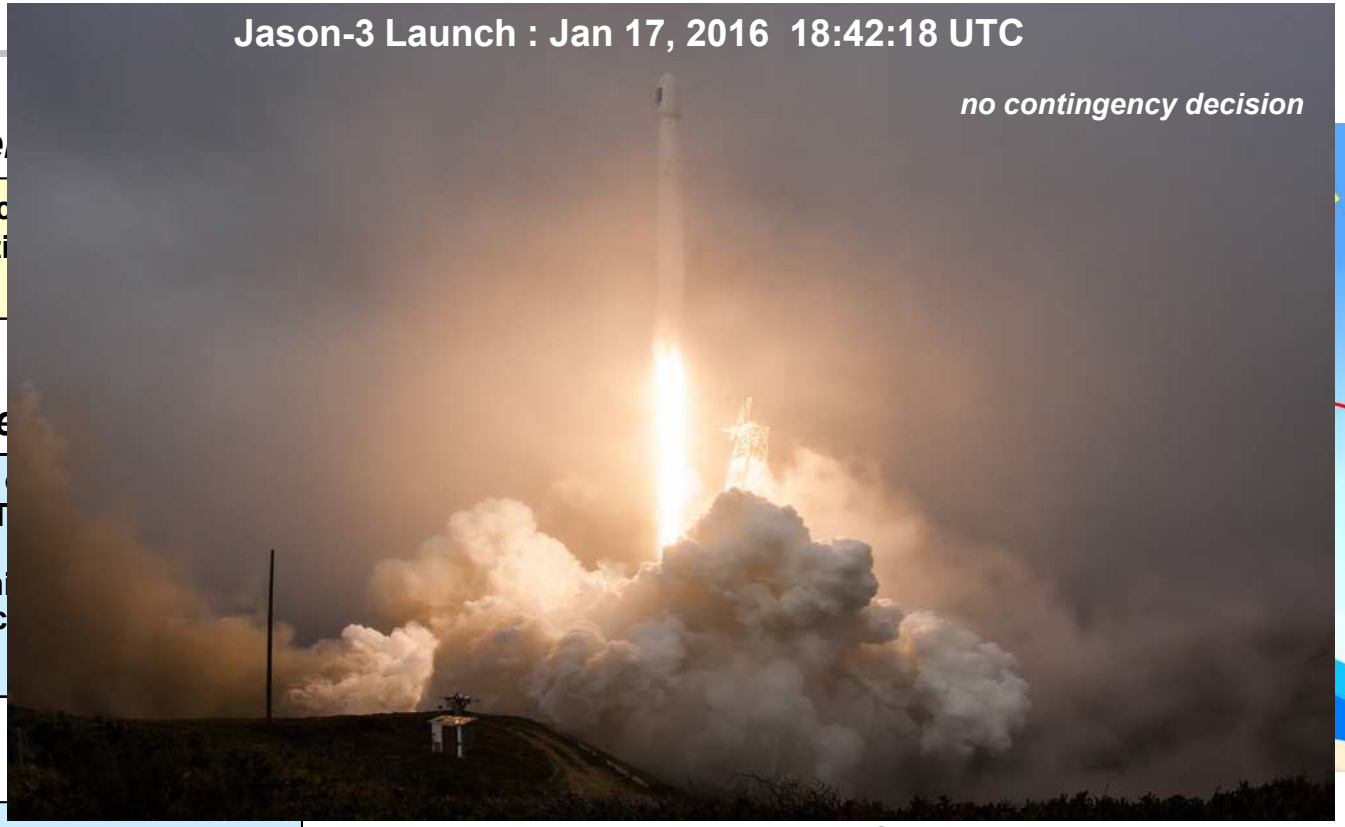
- **Jason-3 status at "Reston" OSTST (mid Oct 2015):**
  - ***NASA and SpaceX working towards completing Falcon-9 investigations and return to flight plans and operations***
  - ***A potential launch window exists for mid-late Dec pending the launcher readiness***
  - ***Satellite and Ground are ready for this window***
  - ***Projects are evaluating opportunities in 2016 for alternative launch windows***

- Launch campaign restarted **Nov 9, 2015** without any confirmed launch date and then has been split in several steps !!!

- Finally, after the "Launch Readiness Review" held on Jan 15, 2016,

JASON-3 was successfully launched on Jan 17, 2016 from Vandenberg Air Force Base (California).

JA3 Mission Summary



Science Measureme

Global sea surface height to an accurac
10 days, for determining ocean circulati
change and sea level rise

Mission Objective

- Provide continuity of high precision
topography measurements beyond T
JASON-1 and JASON-2
- Provide a bridge to an operational mi
the continuation of multi-decadal oc
measurements

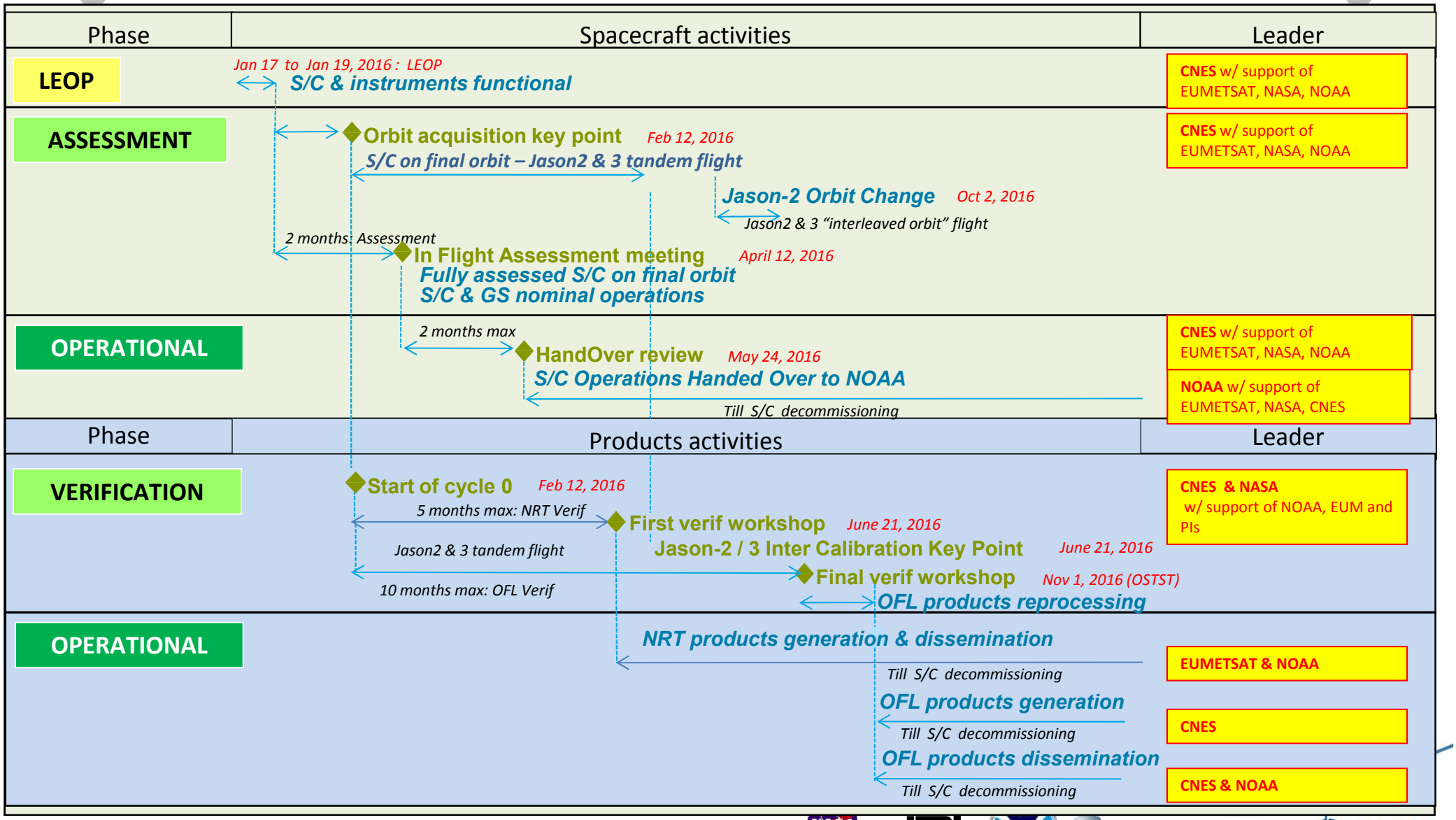
Instruments

- Core Mission:
  - Poseidon-3B Altimeter
  - DORIS (Precise Orbit Determination System)
  - Advanced Microwave Radiometer (AMR)
  - GPS Payload (GPSP)
  - Laser Retro-reflector Array (LRA)
- Passengers:
  - JRE (Carmen3 + LPT)

Mission Overview

- Launch Date: 17 Jan 2016
- Launch Vehicle: Falcon 9 (SpaceX)
- Proteus Spacecraft Bus provided by CNES
- Mission life of 3 years (goal of 5 years)
- 1336 km Orbit, 66º Inclination

Jason-3 Phases



Jason-3 LEOP from Jan 17, 2016

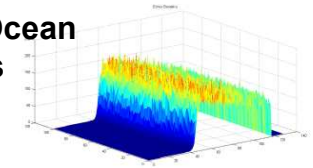
	Days after launch	Date	time UTC	Event
Platform	0	17/01/2016	18:42:18	Launch
	0	17/01/2016	19:28:35	Separation
	1	18/01/2016	3:44:29	GPS PF ON
	1	18/01/2016	5:39:53	DORIS ON
	1	18/01/2016	9:29:56	GYROS OP
	1	18/01/2016	9:36:23	GPS PF ON (OFF-ON)
	1	18/01/2016	10:03:33	STR OP
	1	18/01/2016	11:49:39	GPS PF ON (WARMSTART)
	1	18/01/2016	12:02:50	RW OP
	1	18/01/2016	19:51:24	GPS PF ON (OFF-ON)
	1	18/01/2016	22:15:44	***STAM HELIO***
	2	19/01/2016	0:00:16	***RDVC (STAM GEO)***
	2	19/01/2016	0:00:16	DORIS : automatic execution of DIODE SADM commands (in G2 daily MIBA)
	2	19/01/2016		***BETA= 0°***
	2	19/01/2016	10:12:30	***AOCS NOM***
	2	19/01/2016	10:21:35	DORIS : start of jamming
	2	19/01/2016		***NOM Reduced CC***
	2	19/01/2016		***Platform is operational***
Instruments	2	19/01/2016	16:12:29	POS3B ON (POS3B-1)
	2	19/01/2016	16:16:45	POS3B : PRI patch -25 km
	2	19/01/2016	16:17:04	POS3B : Mode DIODE acquisition / autonomous tracking
	2	19/01/2016	16:40:13	POS3B : first single calibration sequence (CAL1 I2+Q2, CAL1 I+Q, CAL2)
	2	19/01/2016	18:10:09	CARMEN3 ON
	2	19/01/2016	18:13:52	CARMEN3 : ON AMBRE
	2	19/01/2016	18:14:31	POS3B : Mode Autonomous Acquisition / autonomous tracking
	2	19/01/2016	22:17:57	OCM2 calibration
	3	20/01/2016	9:58:26	AMR ON (AMR-H)
	3	20/01/2016	10:37:07	GPSP ON (GPSP-B)
	3	20/01/2016	14:37:39	LPT ON
	3	20/01/2016	14:37:39	LPT : mode COUNT (default)
	3	20/01/2016	14:39:27	AMR : AMR command Nom-Op
	3	20/01/2016	14:39:41	GPSP : command Get Dir
	3	20/01/2016	15:00:00	***Assessment activities start (End of LEOP)***

Injection orbit : -25,9 km
(target -25 km below the nominal one)

DORIS ON : 18 Jan 05:39

POS3B ON : 19 Jan 16:12

First Over Ocean Echoes



1rst OGDR available on 19 Jan 19:21 !!

CARMEN3 ON : 19 Jan 18:10

AMR ON : 20 Jan 09:58

GPSP ON : 20 Jan 10:37

LPT ON : 20 Jan 14:37

*Global LEOP duration ≈ **2 days 20 hours** in 24/24*

Jason-3 status after LEOP

- As the teams have had so much fun during the first 2 LEOP days, satellite got into SHM configuration 5 days later due to limits conditions of an on-board time correction
  …. to allow the team to run again a new SHM/LEOP sequence ☺ : **successful**

*Global SHM recovery duration ≈ **2 days 16 hours** in 8/24*

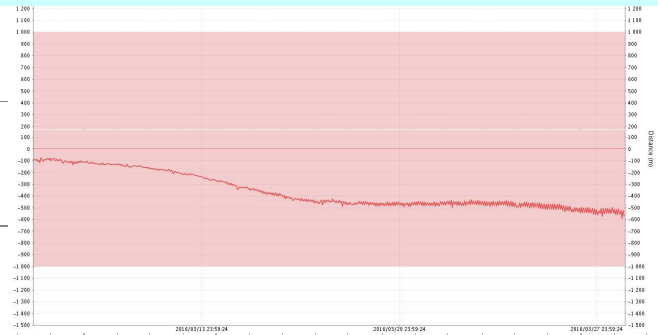
- Satellite :
  - Platform fully nominal with an excellent behavior
    - » Uploading successfully “platform GPS” software mid Mar 2016
  - All Instruments are fully operational and perform satisfactory
- **Satellite performance in flight environment meets all mission requirements**

- Ground and Operations :
  - Collision avoidance detection activated successfully for the mission
  - All ground stations US and Europe work fine – No TM gaps – 100% TC sent and received
  - All the control centers and mission centers are operational
  - Products available immediately
- **Ground performance meets all mission requirements**

Thanks to the LEOP "dream team" in Toulouse !

Mission orbit acquisition : sequence of maneuvers

- **Jason-3 "Orbit acquisition" summary**
  - Req : Same orbit as Jason-2 : ➔ **OK**
  - Req : 1 minute to 10 minutes ahead or behind Jason-2 : 80s behind ➔ **OK**
  - Req : Same reference ground track as TOPEX/ Poseidon, Jason-1 and Jason-2 : ➔ **OK**
  - Req : Duration requirement : 30 days maximum : 9 OCM4 maneuvers !
    25 days since Launch (including SHM recovery !) ➔ **OK - Feb 12, 2016**
  - Hydrazine mass : 22.963 kg (consumption around 5 kg) : ➔ **OK**
  - First station keeping maneuver done on **Feb 23, 2016**



Jason-3 assessment activities

26	12/02/2016	**1:11:09**	**start Cycle 0**
26	12/02/2016		ILRS laser shots on LRA (official activation)
26	12/02/2016	9:56:32	CARMEN3 : AMBRE science mode activation
27	13/02/2016		Start of PF routine expertise
29	15/02/2016	8:04:28	POS3B : Mode Diode + DEM (with automatic transitions)
29	15/02/2016	14:04:28	POS3B : Mode DIODE Acquisition /autonomous tracking
30	16/02/2016	16:07:00	POS3B : calibration CNG steps : complete sequence of 87 CAL1 I+Q on earth
31	17/02/2016	**10:28:45**	**start Cycle 1**
31	17/02/2016		POS3B : Mode DIODE Acquisition /autonomous tracking
32	18/02/2016	4:30:00	CARMEN3 : AMBRE HK (weekly calibration sequence)
36	22/02/2016	16:58:00	STR monitoring
37	23/02/2016	2:45:00	OCM2 station keeping maneuver (Da=13 m)
38	24/02/2016	4:06:00	Cross-maneuver #1
39	25/02/2016	4:30:00	CARMEN3 : AMBRE HK (weekly calibration sequence)
41	27/02/2016	**8:27:17**	**start Cycle 2**
	01/03/2016	3:00:00	LPT : start calibration for 48 h (TBC)
44	01/03/2016	16:02:00	GPSP : max stat drops concern resolution
46	03/03/2016	4:30:00	CARMEN3 : AMBRE HK (weekly calibration sequence)
51	08/03/2016	**6:25:50**	**start Cycle 3**
	08/03/2016		***BETA= -15°***
51	08/03/2016	20:00:00	GYROS : destocking gyro3
51	08/03/2016	22:14:41	Gyros scale factor and misalignment calibration
52	09/03/2016	0:08:33	***yaw steering -> yaw fix***
52	09/03/2016	11:15:00	STR : destocking STR2
53	10/03/2016	4:30:00	CARMEN3 : AMBRE HK (weekly calibration sequence)
53	10/03/2016	6:40:00	PCE destocking
54	11/03/2016	05:09:50	AMR calibration maneuver
54	11/03/2016	5:12:32	AMR : AMR calibration
56	13/03/2016	8:00:00	MAG/CSS monitoring
	14/03/2016	19:10:57	***yaw flip (around BETA= 0°)***

NEW ON JA3

15/03/2016	7:15:07	POS3B : blocked in WAIT mode
15/03/2016	7:15:26	LPT in 1553 STANDBY mode
15/03/2016	7:15:30	CARMEN3/AMBRE in 1553 STANDBY mode
15/03/2016	7:15:34	GPSP in 1553 STANDBY mode
15/03/2016	7:15:38	AMR in 1553 STANDBY mode
15/03/2016	7:15:42	POS3B in 1553 STANDBY mode
15/03/2016	7:15:46	DORIS in 1553 STANDBY mode
15/03/2016	7:17:06	GPS PF OFF
		Upload of GPS platform updated OBSW
16/03/2016	11:47:00	GPS PF ON
16/03/2016	13:44:16	uploading of updated parameters for STR1 and gyros to correct misalignments
16/03/2016	19:35:12	Gyros scale factor and misalignment calibration
17/03/2016	8:02:11	***NOM CC***
17/03/2016	8:04:58	DORIS OPERATIONAL (DORIS1)
17/03/2016	8:05:14	POS3B OPERATIONAL (POS3B-1)
17/03/2016	8:03:00	POS3B : WAIT mode unblocked
17/03/2016	8:03:00	POS3B : Mode Acquisition DIODE (autonomous tracking)
17/03/2016	8:05:22	AMR OPERATIONAL (AMR-H)
17/03/2016	8:05:29	GPSP OPERATIONAL (GPSP-B)
17/03/2016	8:05:36	CARMEN3/AMBRE OPERATIONAL
17/03/2016	8:05:48	LPT OPERATIONAL
17/03/2016	15:00:00	GPS expertise
18/03/2016	**4:24:23**	**start Cycle 4**
18/03/2016	20:34:00	POS3B : transponder calibration (Kantanos)
19/03/2016	5:00:32	Cross-maneuver #2
20/03/2016	17:51:00	***BETA= +15°***
20/03/2016	22:00:05	***yaw fix -> yaw steering***
23/03/2016	10:35:23	AMR : AMR commands (SW reset + configuration)
23/03/2016	20:46:00	POS3B : DEM Patch (transponder calibrations sites)
23/03/2016		**Platform In Flight acceptance meeting**
24/03/2016	4:30:00	CARMEN3 : AMBRE HK (weekly calibration sequence)
25/03/2016	9:30:15	AMR : OFF/ON + configuration

		start Cycle 5
		POS3B : transponder calibration (Kantanos)
		B : test for transponder calibration (Rieux-Volvestre)
		Altimeter mispointing maneuver (roll)
		Altimeter mispointing maneuver (pitch)
		MEN3 : AMBRE HK (weekly calibration sequence)
		LPT : start calibration for 48 h
		POS3B : modification of daily calibrations (Each sequence = CAL1 I+Q, CAL2)
		S3B : test for transponder calibration (Lagarde)
		OCM2 station keeping maneuver
		Cross-maneuver #3
06/04/2016	6:05:00	POS3B : calibration CNG steps : complete sequence of 87 CAL1 I+Q
06/04/2016	18:10:00	Patch for Diode/DEM propagation delay modification in BDR (RAM)
07/04/2016	**0:21:26**	**start Cycle 6**
07/04/2016	**0:21:22**	POS3B : routine mode = Diode DEM (automatic switch between DEM and autonomous tracking)
07/04/2016	4:30:00	CARMEN3 : AMBRE HK (weekly calibration sequence)
07/04/2016	16:32:56	POS3B : transponder calibration (Kantanos)
08/04/2016	04:44:30	Expertise CAL2 (2 sequences)
12/04/2016		**JASON-3 system In Flight acceptance meeting**

NEW ON JA3

All PF equipment destocking and checking, tests of all instruments modes, expertise and tuning of all instruments parameters, POS3B transponder calibration, 4 satellite cross maneuvers from Feb 24 to Apr 20, Laser ILRS activation, …..

New features and activities on JASON-3

- **New on Jason-3** : DORIS start “Auxiliary” packets, POS3B mode Diode+DEM with automatic transitions, AMR on-board calibrations, “Altimeter mispointing” maneuver, …

- **AMR on-board « cold sky » calibration** NEW ON JA3
  - Attitude maneuvers on the pitch axis (+Ysat axis), magnitude 80° , over lands, in yaw fix with the satellite in sun eclipse
    ⇒One AMR calibration every 2 months, duration about 6 min (nominal case)
  - First one done on March 11, 2016 : ➔**OK**
  - Then on May 12 – July 12 – Sep 5 : ➔**OK**

See **Shannon Brown** presentation : **(Plenary Session) AMR cold sky calibration**

- **“Altimeter mispointing” maneuver** NEW ON JA3
  - Specific configuration of “cross maneuvers”
    - either in pitch or roll, with same mispointing angles (0.3°)
    - Longer duration : 5 min instead of 1 min after stabilization at 0.3°
  - Roll and Pitch maneuvers done on March 31, 2016 : ➔**OK**

SUMMARY

- Jason-3 LEOP , orbit acquisition and assessment phase overview

- **Jason-3 project status and performances**
  - **Main events**
  - **Satellite bus**
  - **Payload Instruments**
  - **Ground and operations**
  - **Products**

- Conclusion

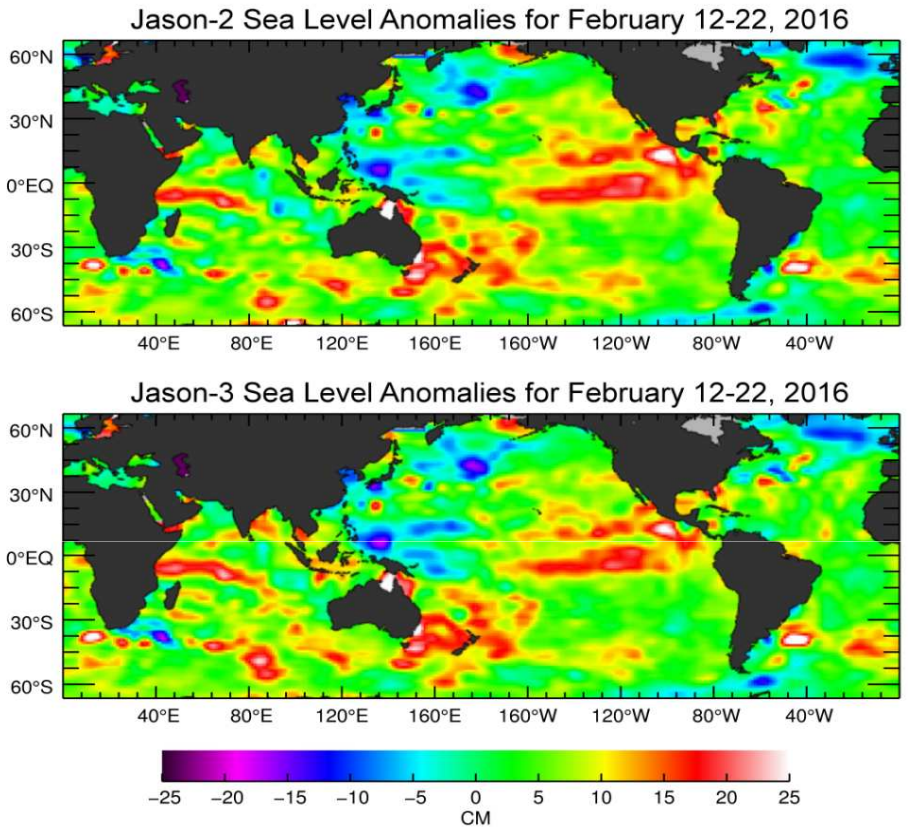
Main Project events after JASON-3 launch 1/2

- Ja3 on the nominal orbit : **Feb 12, 2016**

👍☺ Feb 15, 2016 : Start of OGDR delivery to PI's

👍☺ Mar 9, 2016 : Start of IGDR delivery to PI's

- Ja3 Platform In-flight Acceptance (RQV) meeting (TAS-CNES) at Cannes : **Mar 23, 2016 ➔OK**



- Ja3 "In-flight Acceptance Review" IAR (4 partners) at Toulouse : **Apr 12-13, 2016 ➔OK**
- Ja3 MSE CALVAL meeting (4 partners) at Toulouse : **Apr 15, 2016 ➔OK**
- Ja3 NOAA "Hand-Over Review" (4 partners) at Suitland : **May 24, 2016 ➔OK**
  - ✦effective operations handover : **June 1, 2016**

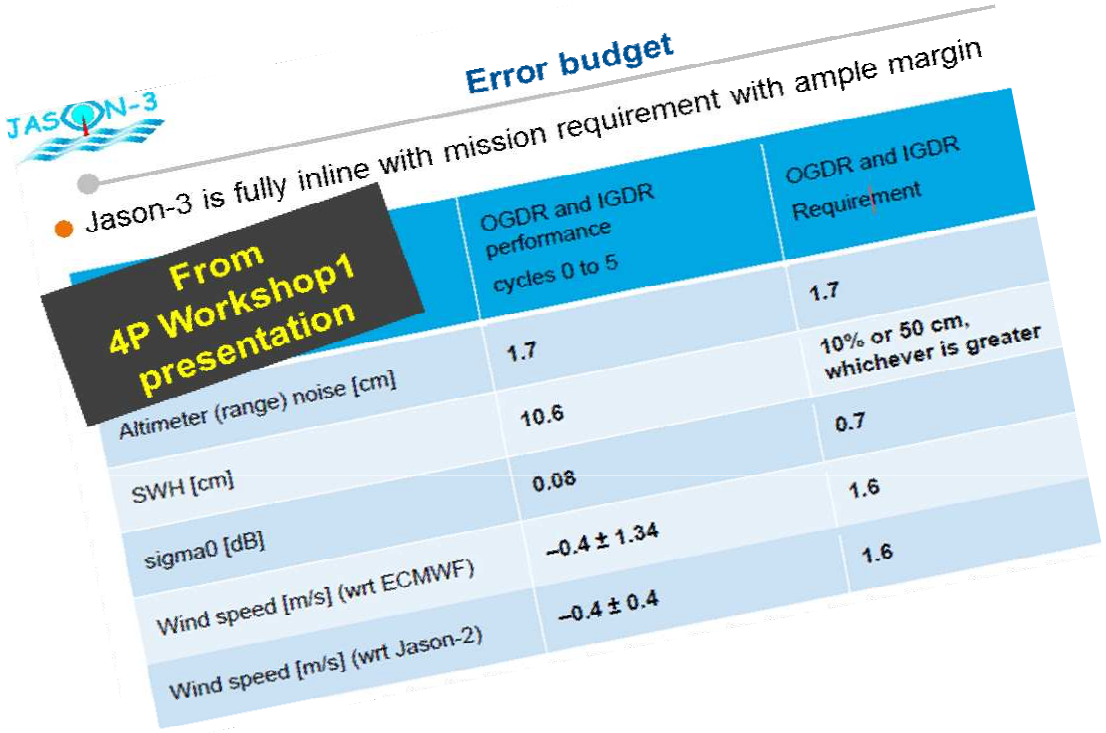
Main Project events after JASON-3 launch 2/2

- Workshop 1 "WS1" (4 partners) for JA3 OGDR/IGDR release to users : **June 21, 2016**
  - ➔ **JA3 reference mission** ➔**OK**

☺ June 30, 2016 : Start of OGDR and IGDR delivery to users

☺ beg July 2016 : PEACHI products available for evaluation

☺ Sep 19, 2016 : Start of GDR delivery to PI's



- **Workshop 2 "WS2" (4 partners) in the Ocean Surface Topography Science Team yearly on Nov 1, 2016 for JA3 GDR release to users**

Jason-3 Satellite Bus in-flight performances

Thermal

- Thermal behavior fits the predicted one ➔**OK**
- Satellite thermal control is well sized for the rest of the mission lifetime ➔**OK**

AOCS

- AOCS equipment and functions (guidance, orbit control and attitudes maneuvers,…): nominal behavior and good performances – sat pointing compliant with Req. ➔**OK**

Power

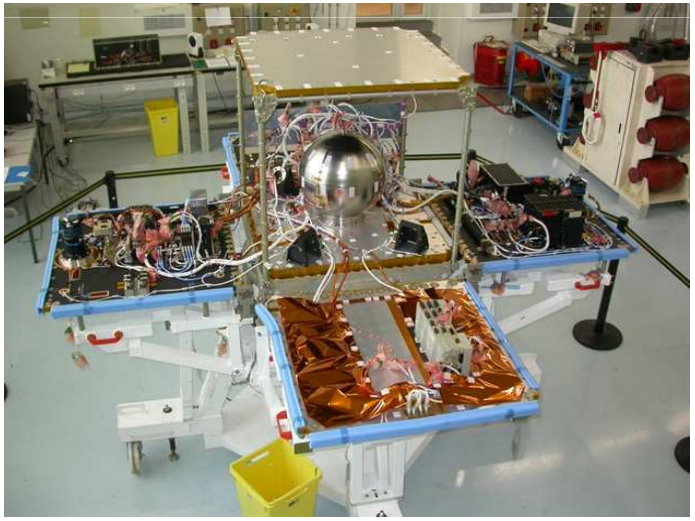
- Power and energy budget : nominal behavior within the prediction ➔**OK**
- Solar panel and battery management : idem ➔**OK**

RF

- Jason3 TT&C system (on board equipment and ground stations network) : nominal behavior within the prediction ➔**OK**

Command/control

- DHU and OBSW behavior as expected ➔**OK**
- Mass Memory : rates as expected, volumes nominal ➔**OK**
- FDR : all either expected or explained. Current on-board FDIR thresholds show adequate margins ➔**OK**



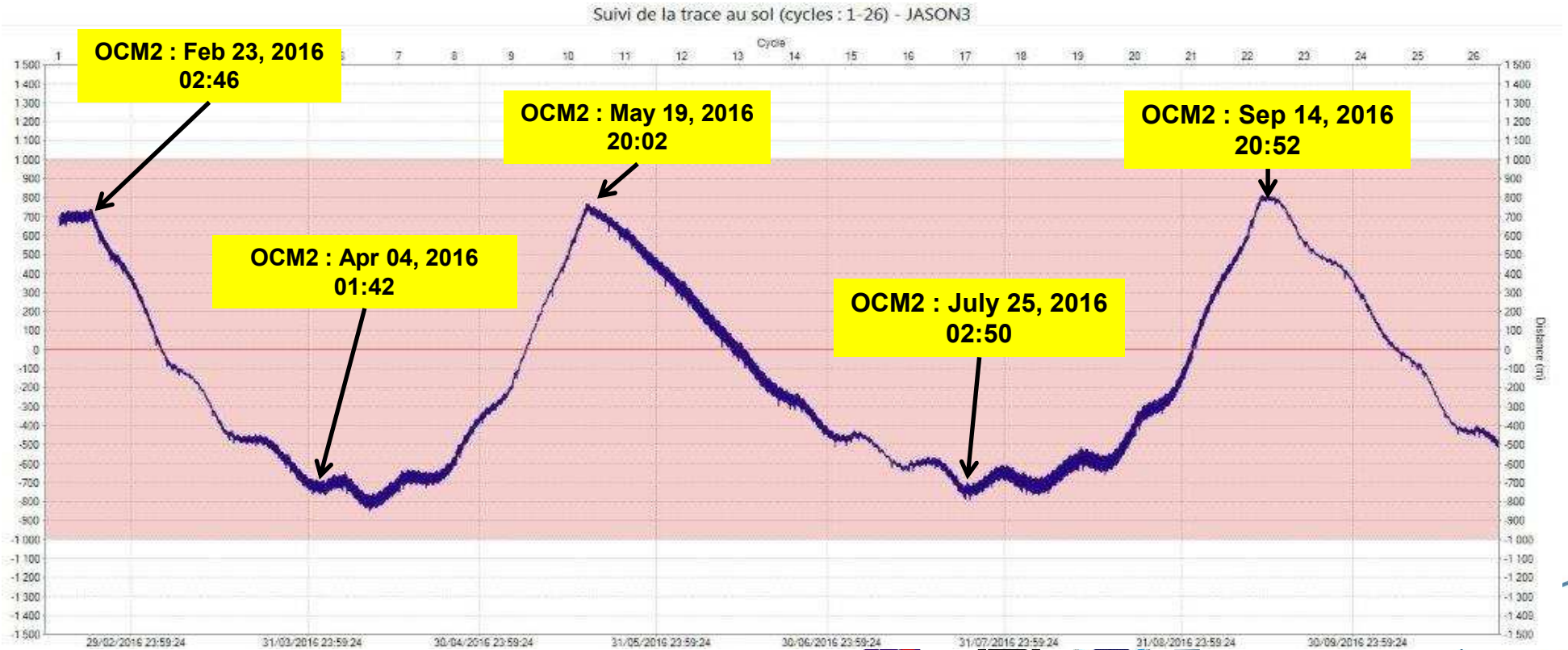
Satellite performances in flight environment meet all mission requirements and even beyond

Jason-3 Station keeping

Station keeping maneuvers :

- Req : Equatorial Nodal Crossing requirement : +- 1 km from reference nodes

- Jason-3 ground track from Feb 2016 to mid Oct 2016: ➔**OK**
  - maintained within ±1km from the reference grid



Jason-3 Payload status

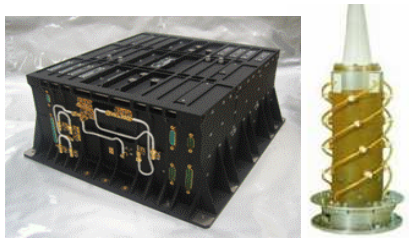
The Jason-3 Payload works well

- Core Payload
  - POS3-B-1 : ➔**OK**
  - DORIS-1 : ➔**OK**
  - AMR-H : ➔**OK**
  - GPSP-B : ➔**OK**
  - LRA : ➔**OK**

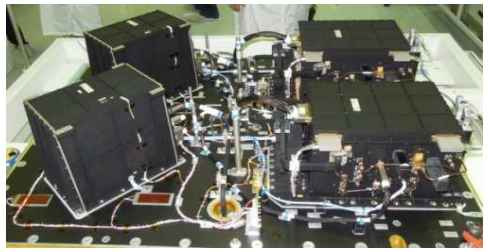
- Passengers
  - CARMEN3 (+AMBRE) : ➔**OK**
  - LPT : ➔**OK**

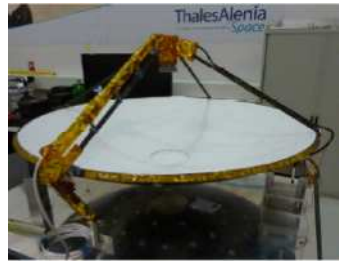
  (Ground adaptation for Packet ID corrupted)

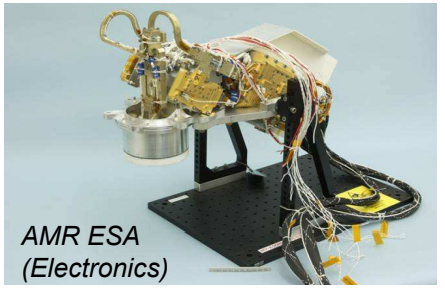
DORIS



POS3B







- **Payload performances meet all mission requirements**

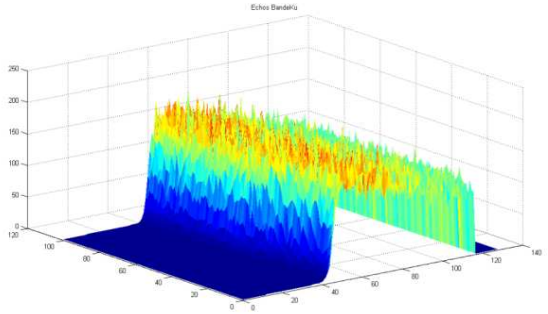
  ➔Jason-3 CORE PAYLOAD is FULLY OPERATIONAL with all redundancy available after 9 months of mission

  ➔Jason-3 passengers perform satisfactory

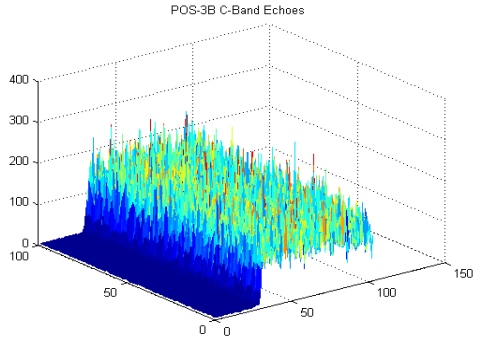
Jason-3 POS3B Altimeter instrument status

- All modes (acq autonomous, acq diode, tracking, dem, …) ➔**OK**
- All transitions have been tested including automatic transitions ➔**OK**
- X maneuvers calibrations demonstrates a good PF pointing

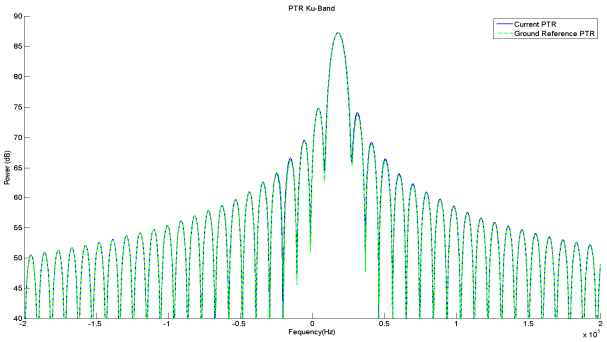
First Ku-Band Over Ocean Echoes



First C-Band Over Ocean Echoes



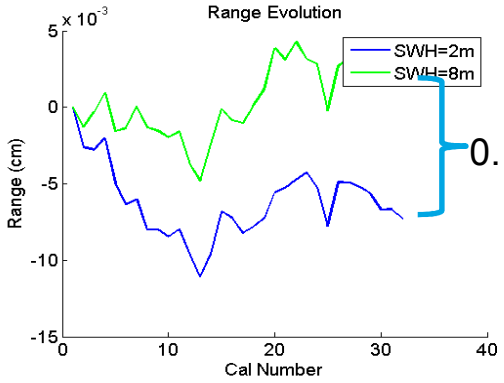
✦All kind of Calibrations exercised with a good agreement with ground results ➔**OK**



CAL1
Ku-Band PTR

ood agreement between Cal1 I&Q and I2+Q2.
I&Q is more accurate, Cal1 I&Q validated as
minal calibrations mode :
ly I&Q only after Mar 31 ➔**OK**

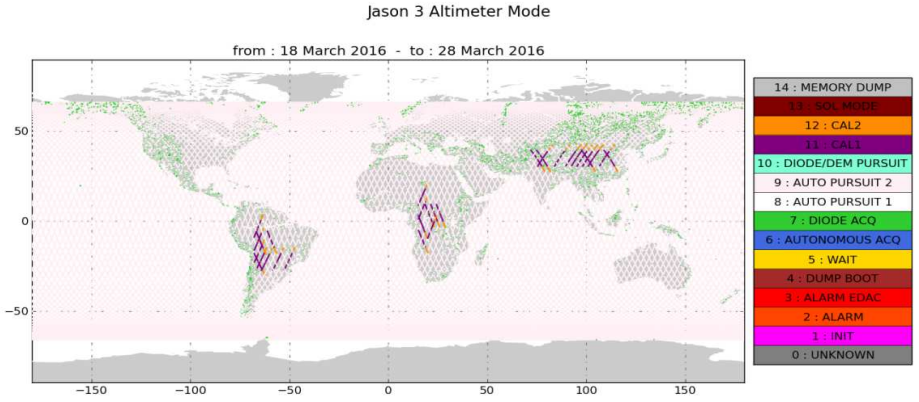
NEW ON JA3



See **JD Desjonqueres** presentation :
(Instrument Processing)
Jason-3 / Poseidon-3B first results

✦Very good stability of the altimeter along the orbit OK ➔**OK**

Jason-3 POS3B Altimeter performances

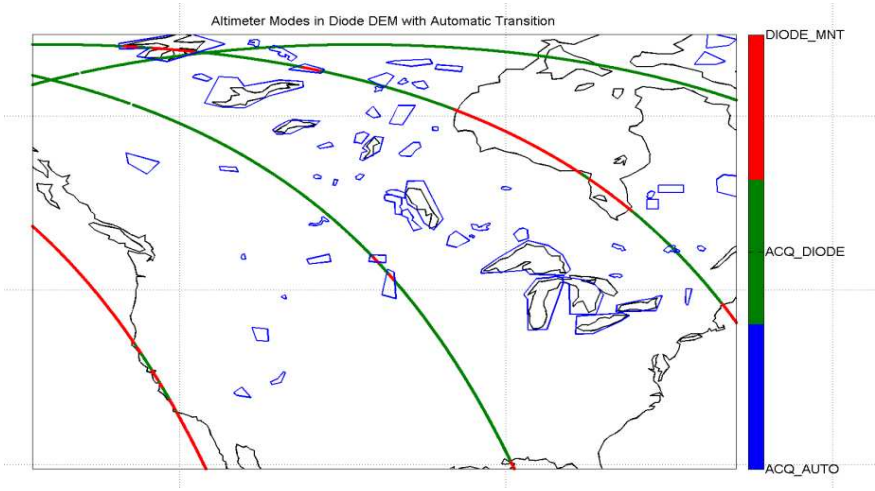


- Altimeter in Tracking Mode > 96% ➔**OK**
  - ✦Loss of tracking in same regions as for J2
  - ✦J3 measurements availability is very similar to J2

- SNR is as expected : 21.6 dB ➔**OK**
  - ✦close to Jason-2 SNR 21.1 dB
- Echoes position is very stable over oceans with almost no dependency to SWH and the CAG gain loop reacts correctly to change of echoes sigma0 and shape ➔**OK**

NEW ON JA3

- Automatic switch from Diode/DEM to Autonomous Tracking wrt Satellite Position **-> OK**



witch between modes is coherent to the
rface and targets
o loss of tracking or measurement anomaly over
eans with a very good coherency
he new Diode/DEM mode is functionally validated

See **JD Desjonqueres** presentation :
(Instrument Processing)
Jason-3 / Poseidon-3B first results

Jason-3 POS3B : Noise budget

- Noise performances are compliant to Jason-3 Req ➔**OK**
  - ✦in line with Jason-2

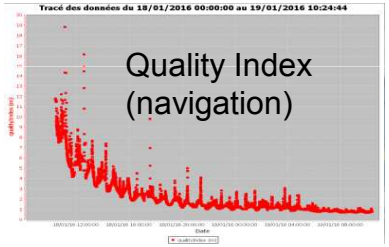
Alti	H 1/3 = 2 m	H 1/3 = 4 m	H 1/3 = 6 m	H 1/3 = 8 m
Requirement for Range	1.7	2.4	2.8	3.3
InFlight Noise Estimation with MLE4 Retracking for Range (cm)	**1.603**	**2.095**	**2.605**	**3.218**
Requirement for SWH (cm)	50	50	60	80
InFlight Noise Estimation with MLE4 Retracking for SWH (cm)	**10.31**	**11.9**	**14.11**	**16.23**
Requirement for Sigma0	0.7	0.7	0.7	0.7
InFlight Noise Estimation with MLE4 Retracking for Sigma0 (dB)	**0.080**	**0.081**	**0.083**	**0.087**

Conclusion

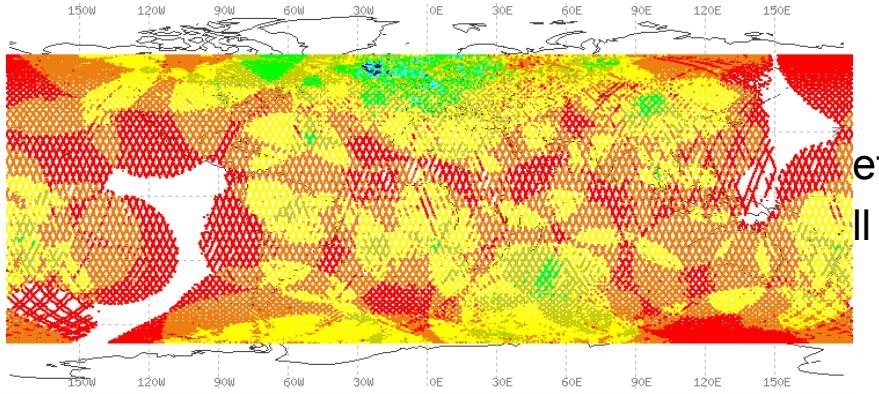
- **Global behavior is excellent**
- Functionally : no concern
- Very good “Measurement Performances” in terms of :
  - ✦Availability (tracking)
  - ✦Noise
  - ✦Along Orbit stability

Jason-3 DORIS instrument status

- DORIS functioning nominally and engineering telemetry OK since powered-on ➔**OK**
- All Operational interfaces and instrument modes perfectly well exercised ➔**OK**
  - ✦jamming, auxiliary data
  - ✦maneuvers and solar array TC well received and processed by Doris
  - ✦TM and TC : OK
- Fast convergence of Doris (less than 5 hours) thanks particularly to the very good state of the network of beacons ➔**OK**



- DORIS realized measurements ➔**OK**

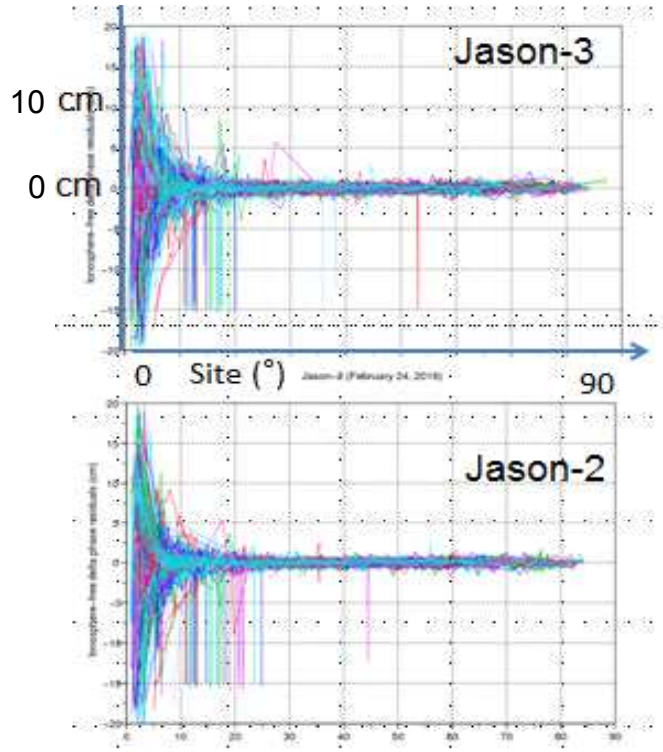


etwork Coverage : 93.68%

ll Measurement Units “UT” are working

Jason-3 DORIS performances

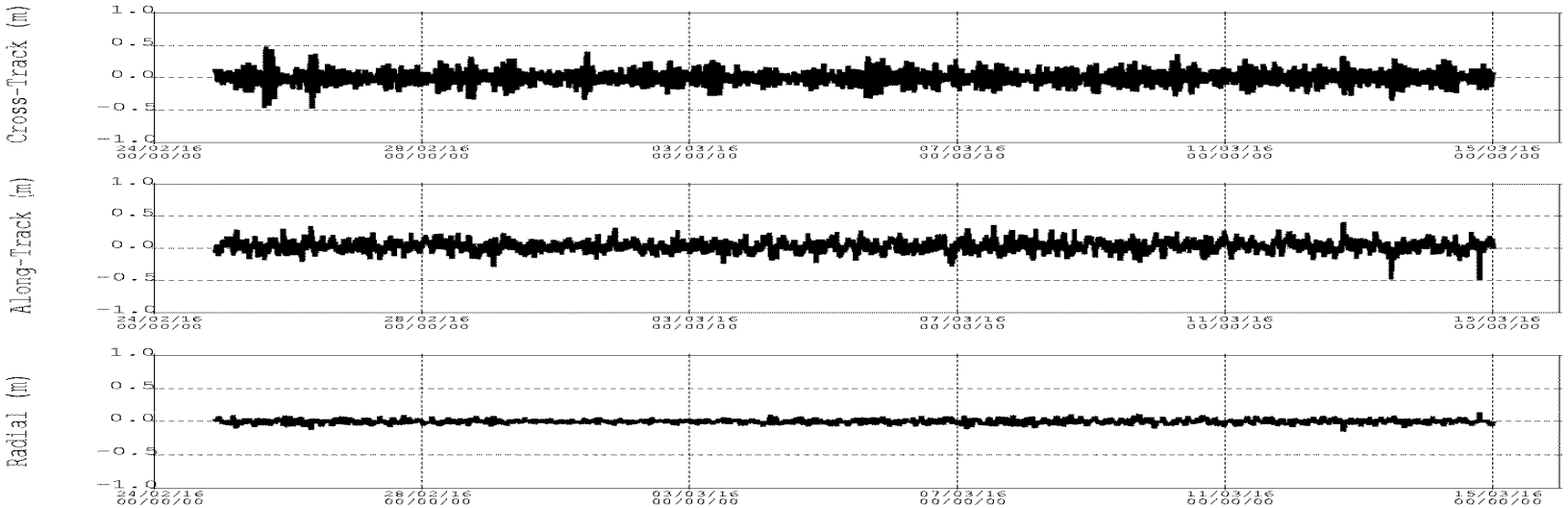
- Datation : ➔**OK**
  - Mean noise : 2.1 µsec (Req : 7 µsec)
  - Time restitution accuracy is 1 to 2 µsec (Req : 5 µsec)
- Doppler on board performances : ➔**OK**
  - Iono free delta phase residual compared with POE is about 4.5 mm over 10 sec.
  - Doris/Jason-3 quite same performance than on Jason 2
- USO and Radiations : ➔**OK**
  - JA3 sensitivity (inside specifications) is stronger than JA2 (2.5x more) , much weaker than JA1 (10x less).
  - No impact on altimeter measurement, almost no impact on orbits (bypass exist, A. Couhert)
  - Impact on SAA stations localization (IDS). Correction by a model TBD should minimize.
- Earth Pole Coordinates Estimations ➔**OK** **NEW ON JA3**
  - Through the new TM packet “AUXILLIARY”
  - Results show very good coherency by comparing with IERS Earth Pole coordinates



See **Ch Jayles** presentation :
(IDS) DORIS-DIODE : Real-Time Earth Pole Coordinates computed in space

Jason-3 DORIS/DIODE performances

- Comparison with POEs – Feb/Mar 2016 (Req : 0.05 m) ➔**OK**



MEAN = -0.0008
RMS = 0.1037

MEAN = 0.0316
RMS = 0.0810

MEAN = -0.0026
RMS = 0.0291

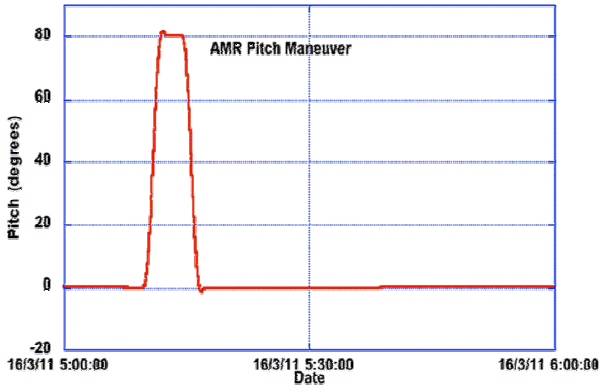
Conclusion

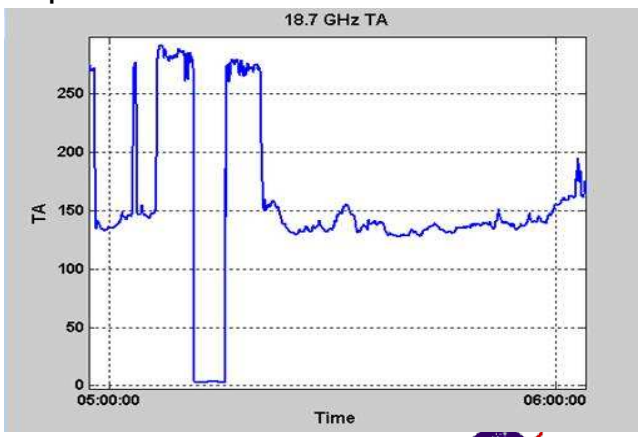
- **Doris behavior is nominal and satisfactory**
- Instrument performances are very good and as expected
- Navigation / datation performances are exactly as expected

Jason-3 AMR Radiometer instrument status

- AMR functioning nominally since powered-on, engineering telemetry is nominal ➔**OK**
  - First time ever 2 identical radiometers have flown in tandem
- Detailed AMR thermal model update is in-process to support possible tuning/optimization of heater control circuit parameters; in the meantime, all measurement objectives are met without any optimization ➔**OK**
- SEU : Periodic bursts observed in early March. No instrument anomalies or SEUs have occurred since April. SEU effects can be expected to continue to occur on orbit, probably at a similar rate to Jason-2 AMR.

- Performed 4 cold sky calibration maneuvers to date to improve long-term stability ➔**OK**
  - Enables absolute gain calibration and precise noise diode inter-calibration on 2.7K sky background





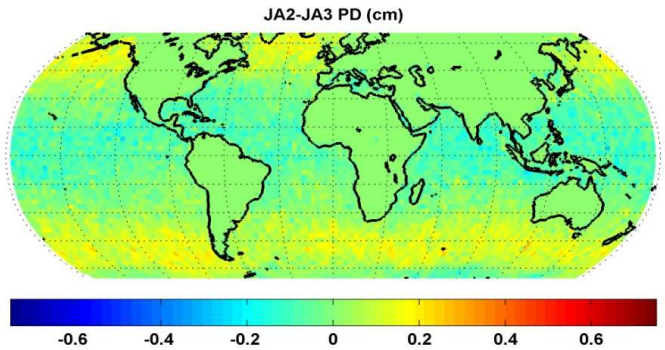
See **Shannon Brown** presentation : **(Plenary Session) AMR cold sky calibration**

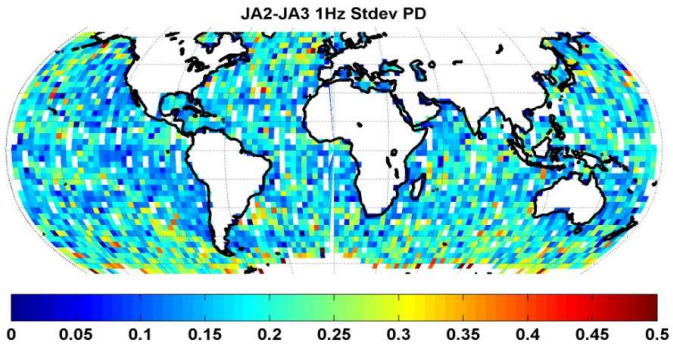
Jason-3 AMR Radiometer performances

- Excellent agreement at 1Hz level with Jason-2 AMR ➔**OK**
  - Primary Science Requirement: *contribution of wet troposphere path delay to the overall altimeter-derived sea surface height error budget shall be less than 1.2 cm*
  - 1Hz PD error between JA2 and JA3 assessed after drift re-calibration
  - Mean 1Hz PD error is 0.25 cm. Previous studies have shown JA2 AMR error to be less than 0.5cm, meaning JA3 PD error is no worse than 0.6 cm
  - Preliminary estimate is that JA3 AMR is meeting 1.2 cm req. ➔**OK**
- Drift in noise diodes evident which is removed on GDR using cold sky data supplemented by on-Earth references

See **S. Brown** presentation : **(Instrument Processing) Ja3 AMR Post-Launch Performance Assessment**

Jas-2–Jas-3 AMR Mean ΔPD [cm]





Jas-2–Jas-3 AMR 1Hz RMS PD [cm]

Conclusion

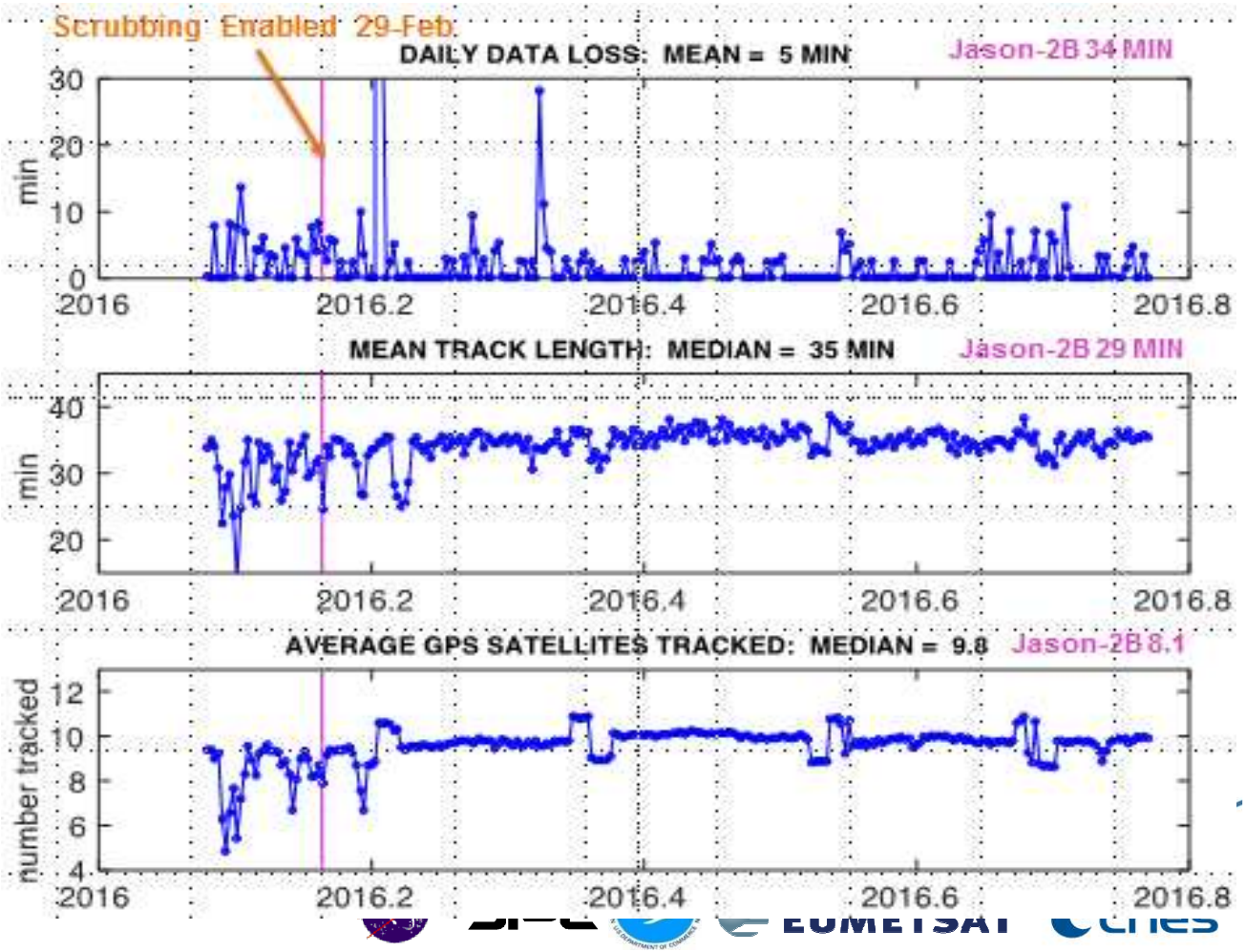
- **Overall assessment is that AMR is healthy and performing well**
- Cold Sky pitch maneuvers are achieving AMR objectives

Jason-3 GPSP instrument status

- GPSP functioning nominally since powered-on, engineering telemetry is nominal ➔**OK**

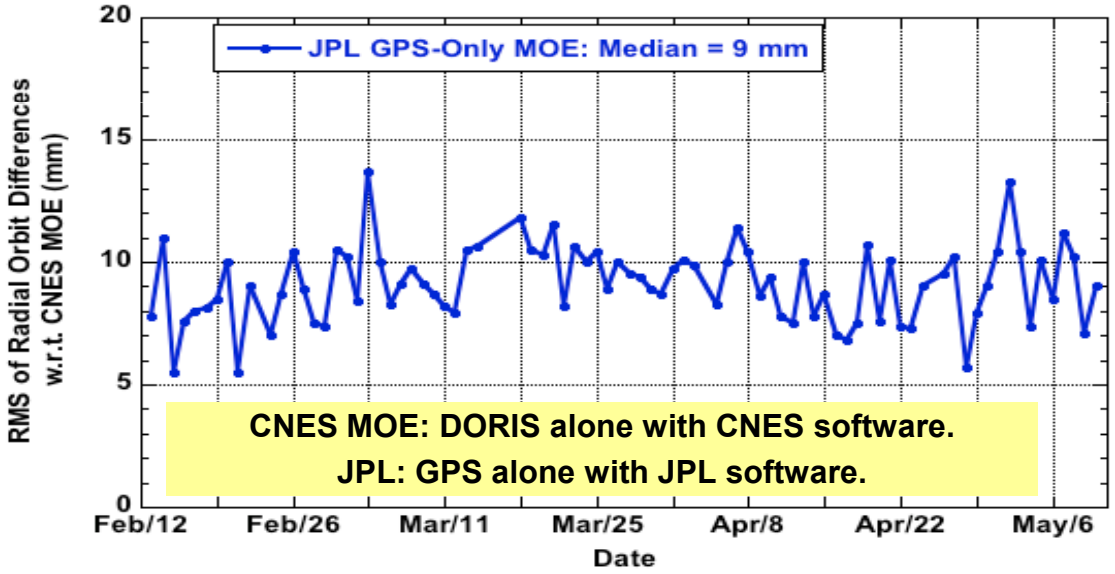
- Occasional SEU-induced resets occurred (3-4 times/week).
  Since Scrubbing mode was enabled in early March, overall instrument performance has been excellent with SEU-induced faults within the FPGA quickly corrected to recover full performance without requiring instrument resets ➔**OK**
  - ✦Scrubbing mode will remain enabled for operations

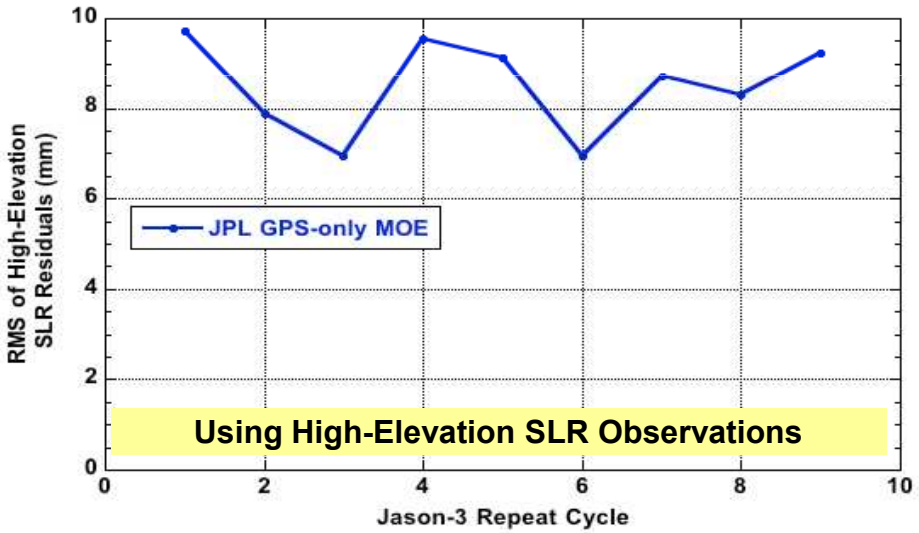
- Tracking up to 12 satellites simultaneously and routinely more than 8 on average ➔**OK**



Jason-3 GPSP instrument performances

- Req : *The GPSP shall be designed as a non-mission critical instrument to provide precise orbit estimates accurate to 2.5 cm (RMS, radial component) to support POD performance.*
  - ✦Goal: *Meet or exceed performance of Jason-2/OSTM GPSP. Continued support of radial orbit accuracy of < 1 cm (RMS).*
- Comparison of independent orbit solutions as measure and assessment of Orbit accuracy shows that GPS-data support sub-cm radial orbit accuracy ➔**OK**

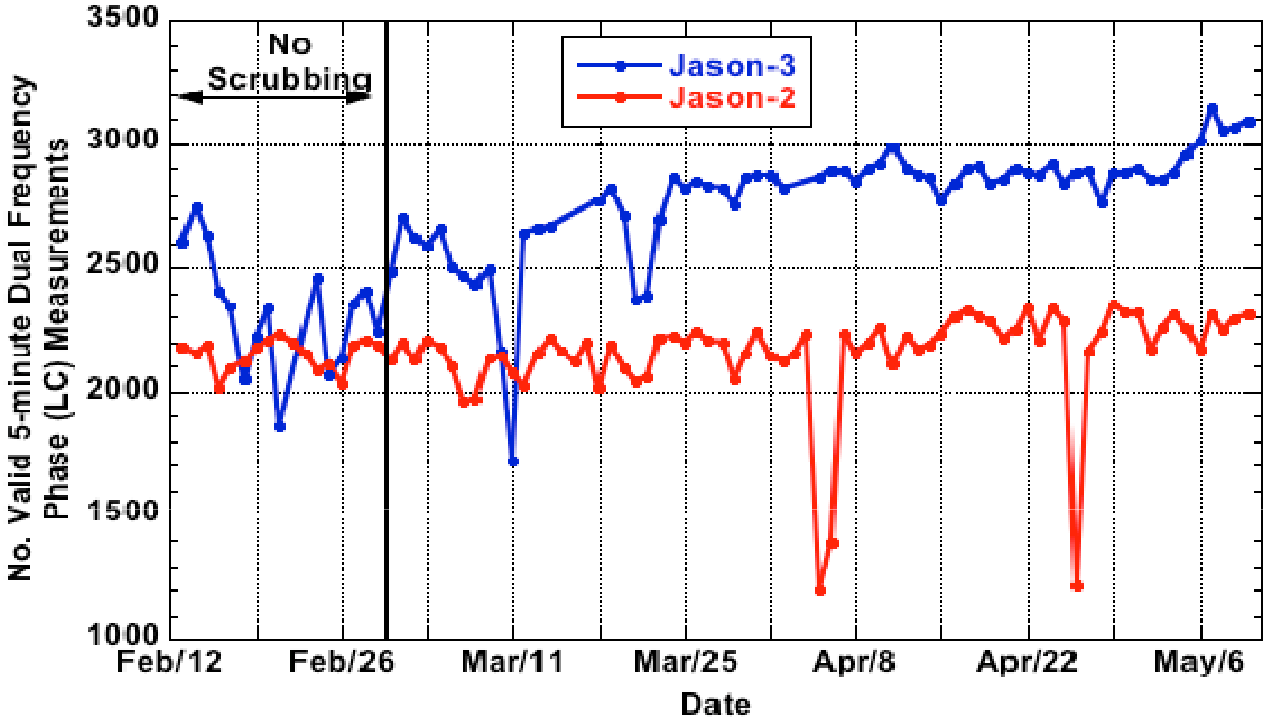




See **POD** presentations
E. Jalabert : **Jas-2 (OSTM) and Jas-3 POD Status**
Frank Lemoine : Status of Precise Orbit Determination for altimeter satellites at GSFC
Willy Bertiger : Precision Orbit Determination For The Current Jason Missions Using GPS

Jason-3 GPSP instrument tracking data

- Tracking Data Availability (5-Minute Phase Measurements) ➔**OK**

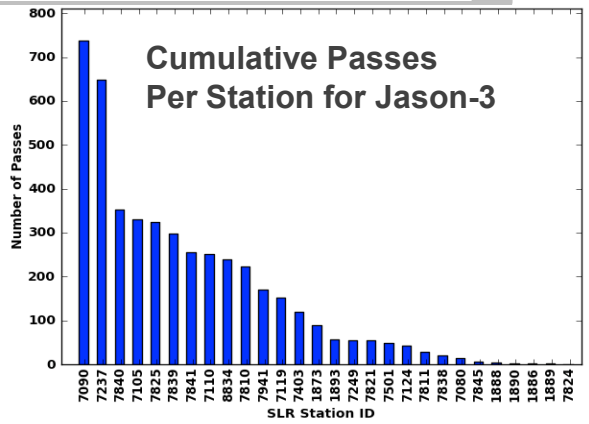


Conclusion

- **Instrument is healthy and functioning nominally**
- Scrubbing mode minimizes occasional resets due to SEUs
- Early performance results of Jason-3 GPSP indicates capability to meet mission requirements and capacity to support radial orbit accuracy of 1 cm (RMS)

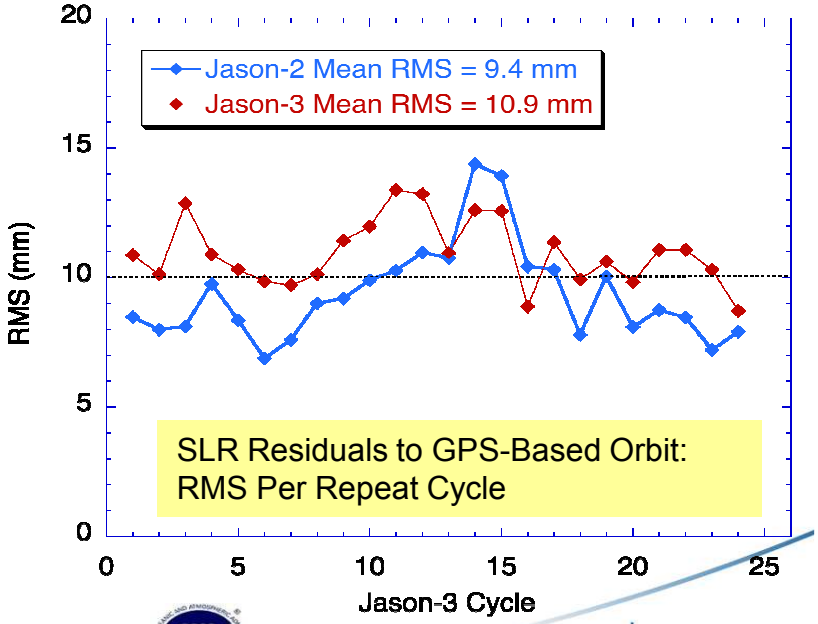
Jason-3 SLR/LRA instrument

- Laser ranging array (LRA) is passive (No electronics or SW)
- Copy of Ja1 & Ja2 LRA system, supporting cm-level ranging
- Tracking of Jason-3 and Jason-2 high priority for International Laser Ranging Service (ILRS)
- LRA returns are the same power as Jason-2 ➔**OK**



Performances

- Initial POD studies indicate LRA supports accuracy of 1 cm, or better. ➔**OK**
  - Jason-2 and Jason-3 comparable
  - Radial agreement between JPL GPS-only orbit solutions and withheld SLR data is typically better than 1 cm.
  - Reflects both orbit errors (from GPS solutions) and SLR errors (from LRA and stations)..



Conclusion

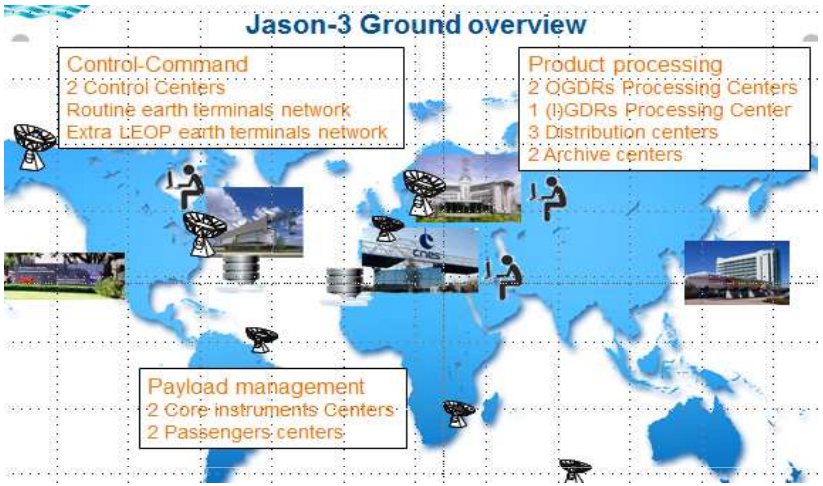
- **SLR Tracking of Jason-3 is nominal**
- Performance of Jason-3 LRA are nominal

See **POD** presentations **about SLR/LRA**

Jason-3 Ground System status

Ground system elements

- Very good behavior of all J3GS stations ➔**OK**
- Network status is excellent with margins ➔**OK**
- Control Centers (CNES&NOAA) are operational ➔**OK**
- Instrument Command & Monitoring Centers (SSALTO, JPL MC) work fine ➔**OK**
- Data Volumes are as expected ➔**OK**
- TM availability in the final archive ➔**OK**
- TC to satellite : ~ 110 TC/day nominal and specific TC upload (DEM, …) successful ➔**OK**



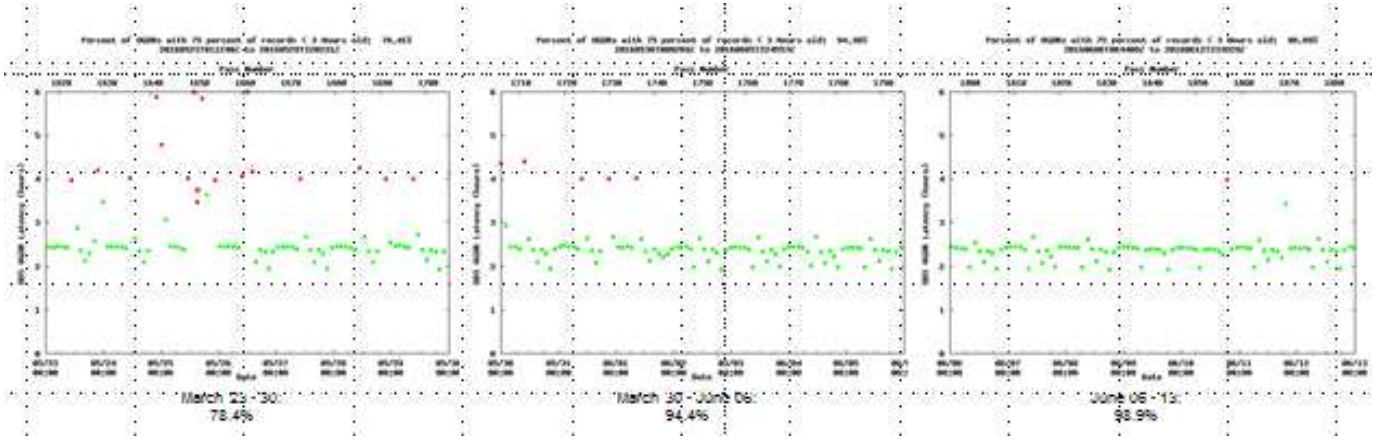
- **J3GS: Good performances and robustness**

Operations

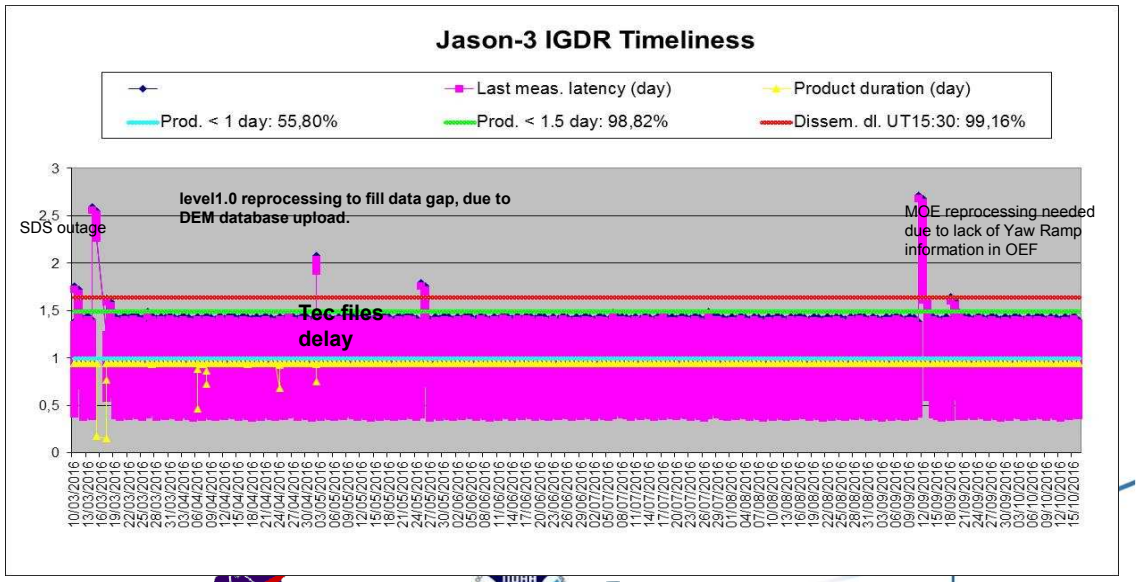
- All the in-Flight assessment specific operations are completed
- Long term monitoring is defined and in place
- Routine operations and procedures are exercised
- All the NOAA/EUM/CNES JA2/JA3 operations are merged
- **J3GS 4 partner operations : good overall coordination and cooperation !**

Jason-3 Ground System Products

- OGDR
  - Ja3 OGDR processing is OK (NOAA&EUM: 100%) ➔**OK**
  - Latency : as expected met since NOAA handover end of May :~98% ➔**OK**
  - All disseminated via EUM and NOAA dissemination services ➔**OK**



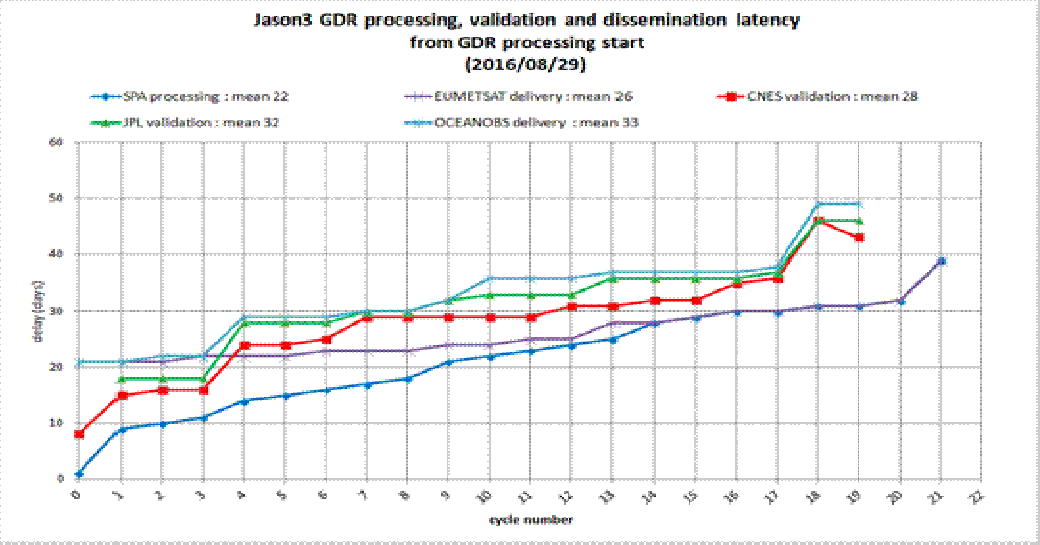
- IGDR :
  - Jason-3 IGDR processing is OK (CNES : 100% IGDR successful) ➔**OK**
  - Latency : more than 99% of products available in less than 1.5 day ➔**OK**
  - 100% IGDR products archived ➔**OK**
  - All disseminated via CNES AVISO+ and NOAA dissemination services ➔**OK**



Jason-3 Ground System Products - GDR

- GDR processing started on Aug 29, 2016
- 100% GDR products archived ➔**OK**
- Start of GDR delivery to PI's on Sep 19, 2016 ➔**OK**
- All disseminated to Eumetsat and PIs via OCEANOBS server ➔**OK**

OSTST "WS2" to assess JA3 GDR ta quality



- PEACHI : **P**rototype for **E**xpertise in **A**ltimetry, **C**oastal, **H**ydrology and **I**ce
  - Prime objective of PEACHI Jason-3 is to ensure and demonstrate the quality of new algorithms (such as the numerical retracking) before possible implementation into Jason-3 operational ground segment. Results are very promising.

See **Inst Process : Measurement and retracking** presentations
S. Le Gac : **First results from the PEACHI Jason-3 prototype: a processing laboratory for innovative altimetry products based on Jason-3 data**

See **Regional and Global CAL/VAL** presentations
R. Shah : **Evaluation of numerical retracking from the Jason-3 peachi product**

SUMMARY

- Jason-3 LEOP , orbit acquisition and assessment phase overview
- Jason-3 project status and performances
  - »Main events
  - »Satellite bus
  - »Payload Instruments
  - »Ground and operations
  - »Products
- **Conclusion**

Jason-3 Conclusion 1/1

Jason-3 works fine

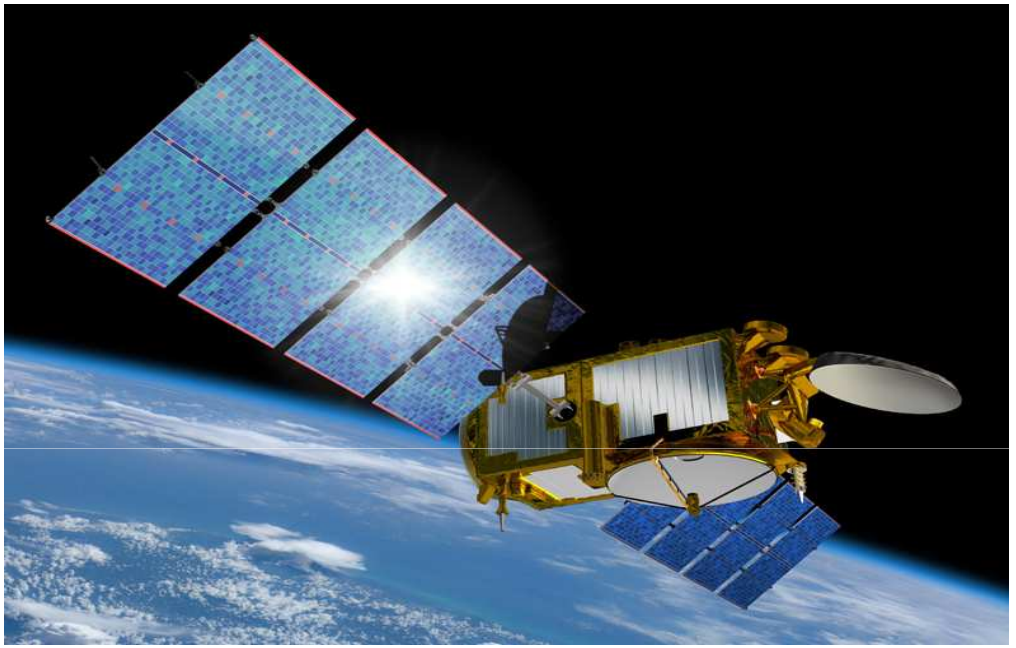
- Launch : Jan 17, 2016
- LEOP and Assessment Phases nominal
- JASON-3 satellite and ground system have an excellent behavior
- All satellite and system performances requirements are fulfilled and some with large margins

- Operational Routine Phase is nominal
- Successfully completed all mission reviews

Jason-3 Conclusion 2/2

Jason-3 is “operational” at satellite, instruments and ground levels

- Verification Phase close to the end to allow GDR Products distribution to USERS according to the current OSTST conclusions



After nine months … a system running fine, with an excellent availability level

A 4 partner project ... a very exciting adventure !!!!
Thanks to all the project teams (CNES, EUMETSAT, NASA, NOAA)

Backup Slides

Changes and new features wrt OSTM/Jason-2 (1)

System : AMR in-flight cold-space calibration

- Lisbon OSTST recommendation, San Diego OSTST decision
- Satellite pitch maneuvers (80° off nadir).

This change is completed and validated

Satellite

- Slight modification of satellite OBSW (Tx OFF for safety improvement, PIM structure panels).

Completed and validated

POS3B (Altimeter)

- Implementation of a single mode with on-board automatic transitions between DIODE/DEM tracking and autonomous tracking, with respect to the satellite position.
- POS3B DEM upload is now possible without mission interruption.

Completed

DORIS

- New generation DGXX-S taking into account lessons learned from Jason-2
- Change of DORIS antenna location for compliance with potential launch vehicles
- Improvement in modeling the Solar Panels position

Completed

AMR (Radiometer)

- Mostly recurring design with improvement of the instrument thermal control and stability (lesson learned from Jason-2 experience)

Completed

Changes and new features wrt OSTM/Jason-2 (2)

GPSP

- Different receiver but with same basic design as on JASON-1/2
- Not mission critical but applying further updates for radiation hardened parts and shielding

Completed

Launcher

- Launch vehicle : Falcon 9 (SpaceX)
- New Payload Processing Facility (PPF) at Vandenberg : SpaceX PPF
- Launcher compatibility demonstrated in summer 2014 : completed
- Launch Campaign : exercised until end of June 2015 – re-exercised in several steps until the launch on Jan 17 : completed

Ground :

Capability to operate simultaneously JASON-2 and JASON-3 :

- Addition of stations for the “formation flight” phase : Barrow (NOAA) and Usingen2 (EUM)
- JASON-2 and JASON-3 operations “merging” (were planned after the launch)

NOAA JA2 ground has been merged into NOAA JA3 Ground : Completed

Product Processing :

- Development of a “digital retracking” to be used for Jason-3 GDR allowing to take into account the actual instrument features before launch and in-orbit and to better estimate the low sea states.

Completed

« Level-1» driving requirements

- Provide minimum 3 years of precise measurement of ocean surface topography
- Launch in to the same orbit as Jason-2
- Fly within +/- 1 km of the same 9.9-day repeating ground tracks as Jason-2.
- Maintain at least the same measurement accuracy as Jason-2 for the Sea Surface Height (3.4 cm RSS, goal 2.5 cm)
- As a goal, maintain the stability of the global mean sea level measurement (drift < 1 mm/year)
- Maintain the accuracy of significant waveheight
- Minimize any relative bias from Jason-2 to less than 5mm.
- Conduct a verification phase of the mission of up to 10 months (with a “formation flight” with JASON-2 if it is still functioning)
- Collect and process more than 95% of all possible data
- Process all over-ocean data into Geophysical Data Records and make data available to the user community.
- After the verification phase, deliver the operational products according to their data latency
- Maintain for Jason-3 products at least the same content, accuracy and timeliness as Jason-2 products

Performance requirements

Changes compared to Jason-2 are in red

	OGDR 3 hours	IGDR 1.5 days	GDR 60 days	GOALS
Altimeter Range RMS	**4.5 cm**	**3 cm**	**3 cm**	**2.25 cm**
RMS Orbit (radial)	5 cm *(a)* *(Ja2 : 10 cm)*	**2.5 cm**	**1.5 cm**	**1 cm**
Total RSS sea surface height	6.8 cm *(Ja2 : 11 cm)*	3.9 cm	3.4 cm	2.5 cm
Significant wave height	**10% or 0.5 m *(b)***	**10% or 0.4 m *(b)***	**10% or 0.4 m *(b)***	**5% or 0.25 m *(b)***
Wind speed	**1.6 m/s**	**1.5 m/s**	**1.5 m/s**	**1.5 m/s**
Sigma naught	**0.7 dB**	**0.7 dB**	**0.7 dB**	**0.5 dB**
System drift				**1 mm/year *(c)***

(a) Real time DORIS onboard ephemeris *(b)* Whichever is greater

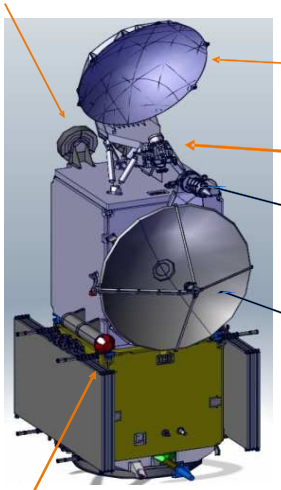
(c) Jason 3 shall measure globally averaged sea level relative to levels established during the cal/val phase with zero bias +/- 1 mm (standard error) averaged over any one year period

Jason-3 System elements

U.S. Elements
European Elements

Dedicated Launch Vehicle : Falcon9

GPSP Antenna



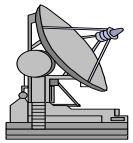
AMR Reflector

AMR Electronics

DORIS Antenna

Poseidon 3B Altimeter Antenna

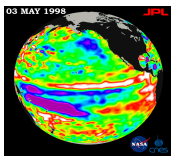
LRA



NOAA - Wallops/ Fairbanks – Barrow - USA

NOAA S/C Operations (Suitland, MD)

NASA/JPL
NASA Instrument Ops

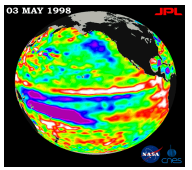


Operational product processing and Science Data archive & Distribution

EUMETSAT – Usingen, Germany

EUMETSAT

Operational product processing & Distribution

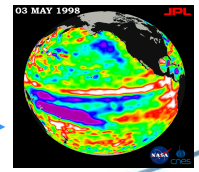


CNES

S/C Operations (Toulouse, France)

Passengers Ops and mission centers CNES- JAXA

Science data processing, archive & Distribution



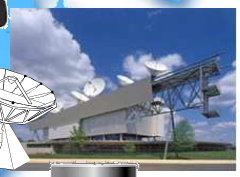
Mission orbit acquisition : sequence of maneuvers

Numero de manoeuvre	Couple_pro	Date	Da_demande	Di_demande	Da_realise	Di_realise	Efficacite	Masse_av	Masse_ap	DV_1_prevu	DV_2_prevu	Duree_effect_1	Duree_effect_2
1	[1]	19/01/2016 22h18m00s267	62.5 m	0.0 deg	52.84 m	-7.0E-5 deg	0.8454	28.0272 kg	28.0202 kg	[-0. ~m/s, 0.0146164679396404 ~m/s,	[-0. ~m/s, 0.0146119178337872 ~m/s,	4.0 s	4.0 s
2	[1, 2]	21/01/2016 22h39m10s851	0.0 m	-0.00598 deg	4.01 m	-0.00577 deg	0.9652	28.0155 kg	27.8359 kg	[-0. ~m/s, 0. ~m/s, -0.375298448095369 ~m/s]	[-0. ~m/s, 0. ~m/s, 0.376031246199746 ~m/s]	51.625 s	52.125 s
3	[1, 2]	28/01/2016 22h44m50s231	10105.46 m	0.0 deg	9980.28 m	4.0E-5 deg	0.9876	27.8722 kg	26.7431 kg	[-0. ~m/s, 2.3655176552638 ~m/s,	[-0. ~m/s, 2.36476077662216 ~m/s,	337.0 s	352.5 s
4	[1, 2]	31/01/2016 21h37m25s302	10018.82 m	0.0 deg	10084.14 m	-2.0E-5 deg	1.0065	26.8448 kg	25.7306 kg	[-0. ~m/s, 2.33853812338589 ~m/s,	[-0. ~m/s, 2.33872886695139 ~m/s,	363.75 s	378.875 s
5	[1, 2]	02/02/2016 03h34m57s881	9985.08 m	0.0 deg	9990.37 m	-3.0E-5 deg	1.0005	25.8618 kg	24.7554 kg	[-0. ~m/s, 2.32648692745307 ~m/s,	[-0. ~m/s, 2.32696546972615 ~m/s,	384.875 s	399.5 s
6	[1, 2]	03/02/2016 20h52m42s762	6801.61 m	0.0 deg	6756.76 m	-3.0E-5 deg	0.9934	24.8789 kg	24.1274 kg	[-0. ~m/s, 1.58281933592747 ~m/s,	[-0. ~m/s, 1.58285049404131 ~m/s,	277.375 s	284.0 s
7	[1, 2]	04/02/2016 21h03m57s319	0.0 m	0.00431 deg	-0.72 m	0.0043 deg	0.9987	24.2086 kg	24.0604 kg	[-0. ~m/s, 0. ~m/s, 0.270282521311211 ~m/s]	[-0. ~m/s, 0. ~m/s, -0.269897939933838 ~m/s]	50.375 s	50.5 s
8	[1, 2]	07/02/2016 22h34m44s804	-9588.44 m	0.0 deg	-9606.75 m	-3.0E-5 deg	1.0019	24.0937 kg	23.035 kg	[-0. ~m/s, -2.23388835950504 ~m/s,	[-0. ~m/s, -2.23413745834028 ~m/s,	412.5 s	425.5 s
9	[1, 2]	09/02/2016 23h24m35s904	-870.72 m	0.0 deg	-877.89 m	0.0 deg	1.0082	23.15 kg	23.0538 kg	[-0. ~m/s, -0.203127657069241 ~m/s,	[-0. ~m/s, -0.203206713826015 ~m/s,	40.25 s	40.375 s
10	[1, 2]	11/02/2016 22h18m29s042	-855.25 m	0.0 deg	-860.58 m	0.0 deg	1.0062	23.0573 kg	22.9628 kg	[-0. ~m/s, -0.199607985149785 ~m/s,	[-0. ~m/s, -0.199711858294155 ~m/s,	39.375 s	39.5 s
11	[1]	23/02/2016 02h45m53s750	11.84 m	0.0 deg	13.08 m	2.0E-5 deg	1.1045	22.9786 kg	22.9773 kg	[-0. ~m/s, 0.00550570326984456 ~m/s,		2.5 s	
Numero de manoeuvre	Couple_pro	Date	Da_demande	Di_demande	Da_realise	Di_realise	Efficacite	Masse_av	Masse_ap	DV_1_prevu	DV_2_prevu	Duree_effect_1	Duree_effect_2

Jason-3 Ground overview

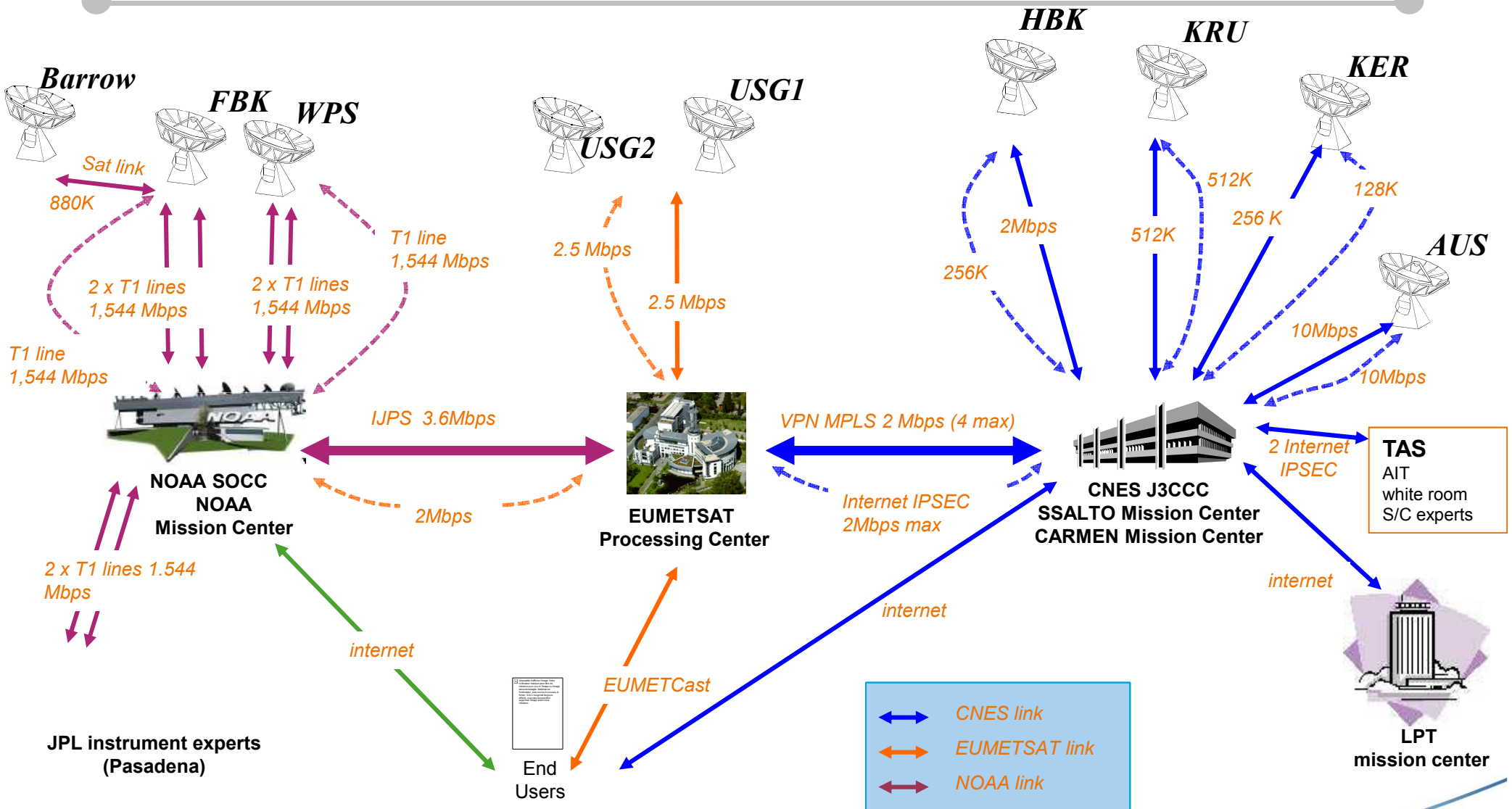
Control-Command
2 Control Centers
Routine earth terminals network
Extra LEOP earth terminals network

Product processing
2 OGDRs Processing Centers
1 (I)GDRs Processing Center
3 Distribution centers
2 Archive centers



Payload management
2 Core instruments Centers
2 Passengers centers

J3GS DCN


Barrow
FBK
WPS
USG1
USG2
HBK
KRU
KER
AUS
Sat link
880K
T1 line
1,544 Mbps
2 x T1 lines
1,544 Mbps
2 x T1 lines
1,544 Mbps
T1 line
1,544 Mbps
2.5 Mbps
2.5 Mbps
2Mbps
256K
512K
512K
256 K
128K
10Mbps
10Mbps
IJPS 3.6Mbps
2Mbps
VPN MPLS 2 Mbps (4 max)
Internet IPSEC
2Mbps max
2 Internet
IPSEC
NOAA SOCC
NOAA
Mission Center
EUMETSAT
Processing Center
CNES J3CCC
SSALTO Mission Center
CARMEN Mission Center
TAS
AIT
white room
S/C experts
2 x T1 lines 1.544
Mbps
internet
internet
internet
EUMETCast
JPL instrument experts
(Pasadena)
End
Users
LPT
mission center
CNES link
EUMETSAT link
NOAA link

Jason-3 Level2 Product files

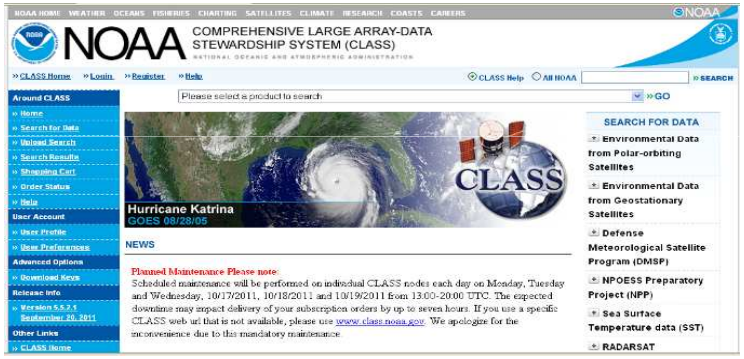
Product	OGDR	IGDR	GDR
Processed by	**NOAA and EUMETSAT**	**CNES**	**CNES**
Disseminated by *Systematic – Electronic*	**NOAA and EUMETSAT**	**NOAA and CNES**	**NOAA and CNES**
Latency	**3-5 hours**	**1.5 days**	**~ 60 days**
1-Hz	**OGDR-SSHA**	**IGDR-SSHA**	**GDR-SSHA**
1-Hz 20-Hz	**OGDR** **OGDR-BUFR**	**IGDR**	**GDR**
Waveforms	**-**	**S-IGDR**	**S-GDR**
Structure	**segment**	**pass**	**pass**
Packaging	**segment**	**day**	**cycle**

No change compared to Jason-2 ! Current standard : GDR-D
JASON-3 will have benefit from any Jason-2 products improvement

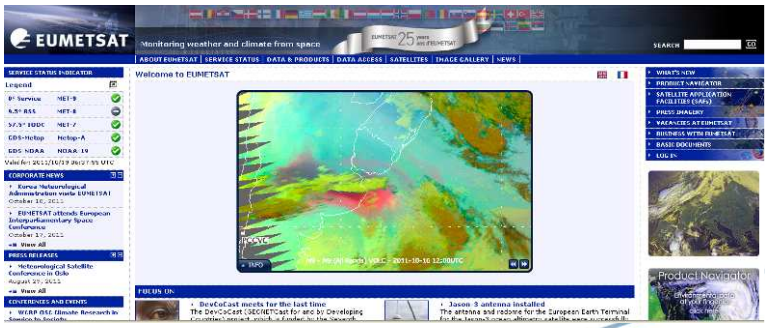
Products Web sites for Jason-3

- On CNES side, archiving and dissemination of offline Jason-3 products via :
- AVISO CNES Data Center
  http://aviso-data-center.cnes.fr/ssalto
- AVISO offline data user satisfaction survey performed each year

- On NOAA side , archiving and dissemination of offline Jason-3 products via :
- NODC: www.nodc.noaa.gov/SatelliteData
  for NRT OGDR, as well as IGDR and GDR
- CLASS: www.class.noaa.gov
  for OGDR, IGDR, GDR and all auxiliary data
- GTS: Global Telecommunication System
  (alternative option for reception of BUFR products)



- On EUMETSAT side, archiving and dissemination of J3 near-real-time products via:
- The Earth Observation Portal available on www.eumetsat.int (retrieval of archived products).
- EUMETCast: Satellite Broadcasting System (reception of disseminated products).
- GTS: Global Telecommunication System (alternative option for reception of BUFR products).



Jason-3

System performances synthesis (preliminary assessment)

at April 12, 2016

V.Couderc

2016, April 12

Data availability

Requirements

- *The GDR shall contain 95% of all possible over-ocean data (acquisition and archive) during any 12 months period, with data loss allocated as follow :*
  - » *Poseidon 3B* *1.0%*
  - » *AMR radiometer* *0.5%*
  - » *POD system (DORIS)* *0.5%*
  - » *Other S/C elements* *2%*
  - » *Ground system* *1%*

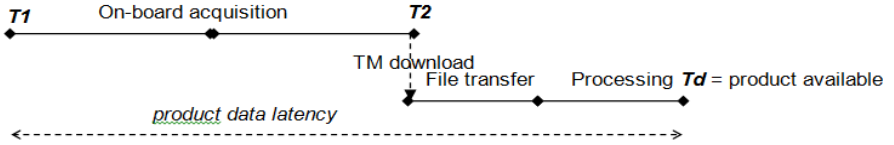
Actual data unavailability (from Jan 17th to March 31st, 2016)

- ✦Global : 4.056 % ***compliant***
  - » POS3B 0%
  - » AMR 0%
  - » POD system (DORIS) 0%
  - » Other S/C elements 4.018 % (SHM and GPS OBSW upload)
  - » Ground system 0.038 % (*see ground presentations*)
- ✦Without OBSW GPS upload : 1.297 %

No more significant data unavailability in routine : detailed figures will be provided for the next JA3 REVEX

Products latency

- OGDR ***compliant***
  - *Requirement : 75% within 3 hours*
    95% within 5 hours



  - OGDR latency within 3H
    - » From 12/02/16 (beg. cycle 0) to 31/3/16 : 78.42 % (latency computed according “PROPRO-005” ground requirement) ⇨ compliant with 75% within 3H.
  - OGDR latency within 5H
    - » From 12/02/16 (beg. cycle 0) to 31/3/16 : 93% of OGDR were available within 5H
    - » From 18/3/16 to 31/3/16 (with correction of latency degrading factors): 99.43 % of OGDR were available within 5H
  - Figures to be consolidated over longer period of operations
- IGDR ***compliant***
  - *Requirement : within 1 to 1.5 days maximum*
  - CNES SSALTO : less than 1.5 day
- GDR
  - *Requirement : within 60 days*
  - distribution not yet started, latency verification to be done later

see also ground presentations

Orbit and navigation

Orbit

- *Requirement : Jason-3 will have the same reference ground track as TOPEX/Poseidon, Jason-1 and Jason-2*
- Actual orbit : Jason-3 and Jason-2 satellites are time-phased on the same ground track, with Jason-3 behind Jason-2 (separation 557 km = 1 m 20 s on ground track) ***compliant***

Mission navigation

- *Requirement : Orbit Acquisition in 30 days maximum*
- Actual orbit acquisition duration : 25 days (including SHM recovery) ***compliant***

- *Requirements on station keeping (+/- 1 km longitude band wrt reference ground track at each equatorial node, eccentricity < 0.00025, maneuvers above land with one thrust)*
- Actual orbit : station keeping maneuvers are performed on a regular basis to maintain JASON-3 orbit and ground track in these requirements ***compliant***

See mission analysis presentation

Core mission instruments : POS3B

Nadir pointing of the altimeter beam ***compliant***

- *Requirement : Altimeter electrical boresight (Ku band feed) pointed to the nadir with an uncertainty < 0.2 ° (3 σ), end-to-end specification*
- After correction of GPS datation and STR1 alignment, platform pointing performances are significantly in the requirements
- Bias under evaluation through cross-maneuvers and altimeter mispointing maneuvers:
  - "cross maneuvers" (for example man-X #3 April 5, 2016)
    - 0.01831° theta (pitch) and -0.00513° phi (roll) : total Angle 0.0003616 deg2
  - altimeter mispointing maneuvers (March 31, 2016) : see backup slides
    - 0.0164743° theta (pitch) and 0.0106897° phi (roll) : total Angle 0.0003857 deg2
- Mean bias will be corrected through G2 guidance commands if needed

See AOCS presentation

Core mission instruments : POS3B

Altimeter performances *(see POS3B presentation)*

- All in-flight noises estimations are ***compliant***
  - ✦similar results between POS3 and POS3B : no degradation

Alti		H 1/3 = 2 m	H 1/3 = 4 m	H 1/3 = 6 m	H 1/3 = 8 m
Range (cm)	req.	1.7	2.4	2.8	3.3
InFlight Noise Estimation with MLE4 Retracking for Range (cm)	JA3	1,603	2,095	2,605	3,218
	JA2	1.6	2,10	2,62	3,18
SWH (cm)	Req.	50	50	60	80
InFlight Noise Estimation with MLE4 Retracking for SWH (cm)	JA3	10,31	11,9	14,11	16,23
	JA2	10,15	11,78	14,18	16,14
Sigma0 (dB)	Req.	0,7	0,7	0,7	0,7
InFlight Noise Estimation with MLE4 Retracking for Sigma0 (dB)	JA3	0,080	0,081	0,083	0,087
	JA2	0,080	0,083	0,085	0,087

Long-term electronics stability :

- ✦Requirement : 1 mm drift / year (goal)
- ✦To be assessed later

- Measurements over coastal zones (2 km from coast), continental waters (lakes/rivers) and over sea ice (goal)
  - ✦To be assessed later, after cycles with DIODE/DEM as nominal altimeter mode

Core mission instruments : AMR

Radiometer AMR *(see JPL presentation)*

- Wet troposphere path-length delay : ***compliant***
  - » *Requirement : accuracy of 1.2 cm (1 σ) (goal = 1.0 cm)*
  - » In flight preliminary AMR PD estimate: < 0.6 cm
- Radiometer path delay drift :
  - » *Requirement : 1 mm over any one-year period*
  - » To be assessed within a few months (expected stabilization)
- Sigma0 atmospheric attenuation correction for ocean scenes (1 σ)
  - » *Requirement :*
    - *Non-precipitating conditions : < 0.007 db (C-band) and < 0.05 db (Ku-band)*
    - *Precipitating conditions : < 0.05 db (C-band) and < 0.5 db (Ku-band)*
  - » To be assessed later
- Drift error in sigma0 correction :
  - » Requirement : max 0.0025 dB (C-band) and 0.015 dB (Ku-band) over any 2-month period
  - » To be assessed later
- Periodic radiometer calibration :***compliant***
  - » *Requirement : cold space view through the AMR main reflector*
  - » AMR calibration maneuver done every 2 months

Core mission instruments : DORIS

DORIS *(see DORIS DIODE and POD presentations)*

- DORIS as a frequency reference unit for altimeter measurements : ***compliant***
  - Requirement : On-board, the altimeter shall use the DORIS USO as frequency reference unit, with a long-term relative stability better than +/- 1 10^{-6} over 5 years
  - JA3 DORIS chain 1 USO long-term stability over 5 years estimated to 1.8 10^{-7} (JASON-2 USO ≈ 2.5 10^{-8} over 5 years, REVEX 2015)
  - Requirement for ground processing : DORIS USO frequency shall be determined with an accuracy better than 10^{-10} at any altimeter measurement date
  - In-flight : DORIS USO frequency noise around 1 10^{-11}

- DORIS derived orbit (radial component): ***compliant***
  - Requirement
    - » for real-time on-board DIODE orbit : 5 cm (used for NRT products)
    - » 2.5 cm (1 σ) for the IGDR and 1.5 cm for the GDR, with a goal to 1 cm
  - In flight performance :
    - » Around 2.5 cm RMS radial for real-time orbit (JASON-2 : ~2.7 cm in average, REVEX 2015)
    - » Around 1 cm for MOE DORIS-orbits (SLR RMS residuals at high elevation)

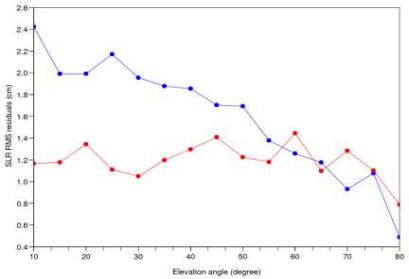
Core mission instruments : GPSP, LRA

GPSP ***compliant*** *(see JPL and POD presentations)*

- ✦Goal: GPSP measurements through six or more non-redundant, independent GPS channels, giving a precise orbit estimate accurate to 2.5 cm (rms, radial component)
- ✦ In flight performance :
  - » GPSP can track minimum 8 satellites (average)
  - » Precision is below 1 cm (RMS of radial orbit diff. with CNES MOE)

LRA ***compliant*** *(see JPL and POD presentation)*

- Requirement : overhead measurements to an accuracy of ± 1 cm (1σ) over the range of incidence angles
- In-flight preliminary assessment: independent SLR RMS residuals vary from 2.4 cm (5 deg) and 0.6 cm (high elevation)



Time-tagging

see DORIS presentation

- DORIS satellite ephemeris time tagging ***compliant***
  - Requirement : accuracy better than 7 µs after ground processing (100 µs in real time, 10 µs goal)
  - Performance : DORIS on-board elementary datation mean noise is 2.1 µs microseconds (JASON-2 1.8 µs, REVEX 2015)

- DORIS elementary doppler performance :
  - Mean value for noise : Iono free delta phase residual compared with POE is about 4.5 mm over a 10 sec period (JASON-2 : 4.1- 4.6 mm, REVEX 2015)

- Satellite reference pulse is time-tagged by DORIS ***compliant***
  - Requirement : Precision better than 5 microseconds in TAI time reference frame
  - Performance : Time restitution accuracy is 1 or 2 µs (after GPS OBSW patch…) (JASON-2 : same level of precision)

Science

Science Ground processing

- Orbit Determination ***compliant*** *(See POD presentation)*
  - *Requirement : for radial orbit component (orbit based on tracking data DORIS+GPSP)*
    - *2.5 cm RMS for MOE*
    - *1.5 cm RMS for POE (1 cm as a goal)*
  - In-flight preliminary performances :
    - 0.6 to 1.2 cm RMS for MOE (JASON-2 0.8 to 1.6 cm RMS, REVEX 2015)
    - POE validation has been starting, first results are at sub centimeter level

- Geophysical corrections (*See OGDR and IGDR quality presentations)*
  - For OGDR/IGDR, performances assessment is nearly completed with very good results
  - GDR performances are under work, to be assessed during workshop 2 at OSTST (Oct 2016)

Error budget

- Jason-3 is fully inline with mission requirement with ample margin

From 4P Workshop1 presentation

	OGDR and IGDR performance cycles 0 to 5	OGDR and IGDR Requirement
Altimeter (range) noise [cm]	**1.7**	**1.7**
SWH [cm]	**10.6**	**10% or 50 cm, whichever is greater**
sigma0 [dB]	**0.08**	**0.7**
Wind speed [m/s] (wrt ECMWF)	**–0.4 ± 1.34**	**1.6**
Wind speed [m/s] (wrt Jason-2)	**–0.4 ± 0.4**	**1.6**