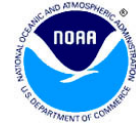




CENTRE NATIONAL D'ÉTUDES SPATIALES



OSTM/Jason-2 Mission overview

**CNES, NASA,
NOAA, EUMETSAT**



OSTST meeting – San Diego

T. Guinle - CNES

- **Project Milestones**
 - Third Jason-2 REVEX : April 5-7, 2011 → **successful**
- **Satellite major events**
 - None
- **Payload major events**
 - Core instruments : **None**
 - GPSP OBS revert upload (Feb.17th 2011) → **successful**
 - To revert patch for investigation on reset (uploaded the previous year) that proved inconclusive
 - Passengers instruments :
 - T2L2 telemetry on 1553 - loss of TM for all passengers
- **Ground major events**
 - New 14.2m Earth Terminal at Wallops → **successful**
 - Upgrade of CNES-EUMETSAT link (2 Mbit/s) → **successful**
 - ... and 2 control center outages (water failure & earthquake !!)

Current OSTM/Jason-2 mission Status is OK



- **The Jason-2 satellite bus is OK; no incident**

- 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
- Command / control , RF : **OK**
 - On-Board Software, Mass Memory, Jason2 Telemetry &Telecommand system : nominal behavior
- AOCS (attitude and orbit control system) : **OK**
 - All AOCS units work nominally, AOCS control laws work as expected

- **Satellite activities :**

- Unused equipment destocking (gyro, STR) **OK**
- STR monitoring **OK**
- SADM expertise **OK**
- Gyro calibration : **OK**
- Cross maneuver : None (on request)

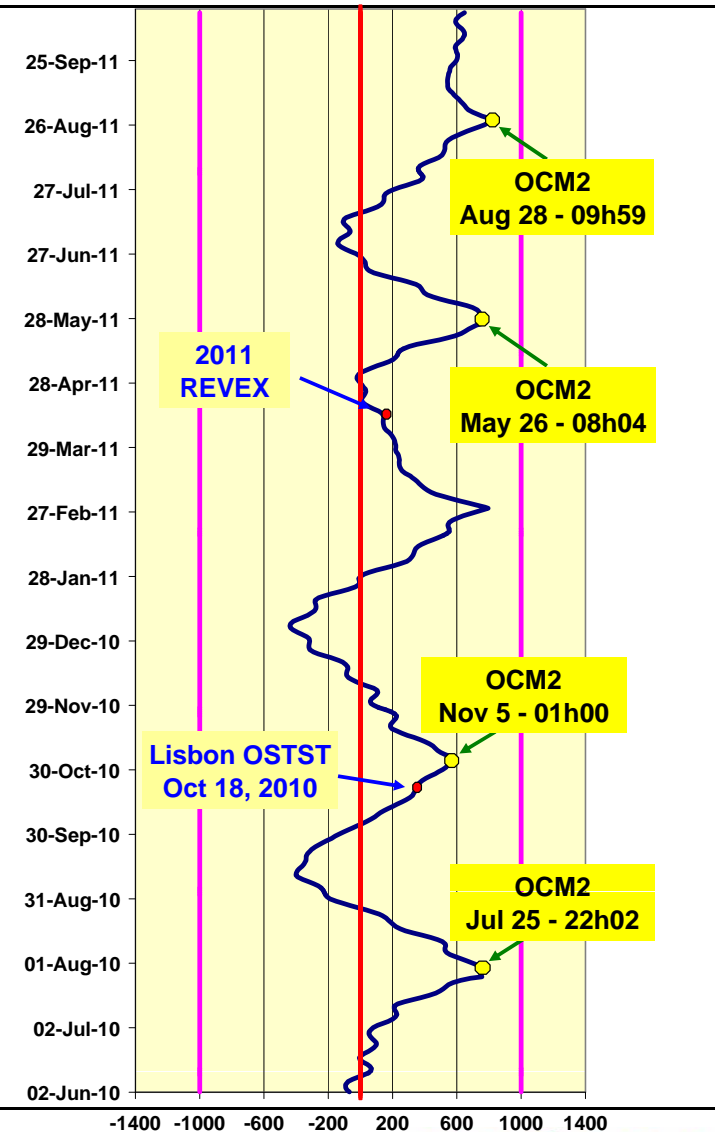
Jason-2 satellite is fully operational after more than 3 years in orbit



Station keeping maneuvers :

Equatorial Nodal Crossing requirement :
 ± 1 km from reference nodes

- Jason-2 ground tracks are maintained within ± 1 km from the reference grid
- Jason-2 station keeping maneuvers are made with only one thrust above land on any orbit
- *Remaining propellant* : ~ 24 kg



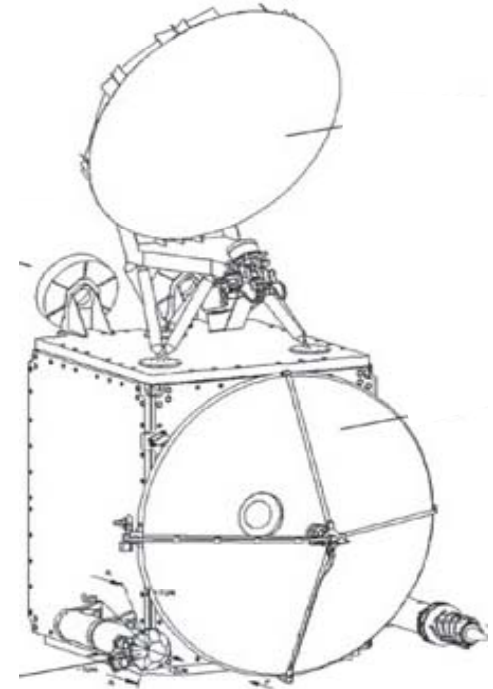
OSTM/Jason2 - OSTST San Diego - October 19th, 2011

- **Core Payload**

- POSEIDON3 OK
- DORIS OK
- AMR OK
 - 1 anomaly on Oct '10. No impact on operations. Impact on products
- GPSPA OK
 - 6 resets on the period. Procedure in place with OPS team with no impact on operations
 - GPSPA OBS revert upload for on 17th Feb.2011 (reverting unsuccessful 2010 patch for reset analysis)

- **Passengers**

- T2L2 OK
 - 2 anomalies (both recovered with reset)
 - 1 stand-by mode with FDIR 1553
 - 1 bus communication problem => PLTM2 roll-over
- CARMEN2 OK
 - 5 occurrences of the Experiment board blocking. Requires OFF/ON
- LPT OK
 - 1 minor anomaly requiring OFF/ON



**Core payload FULLY OPERATIONAL after more than 3 years in orbit
passengers perform satisfactorily**





CENTRE NATIONAL D'ÉTUDES SPATIALES



Poseidon-3 Altimeter



- **POS-3 current configuration :**

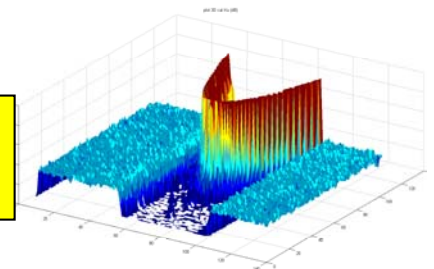
- Turn-On of chain #1 on 22 June 2008 (Chain #2 is redundant)
- POS3-1 availability is **100%**. No anomaly.
 - no measurement data when extra operations are made (daily calibrations, specific calibrations, EEPROM modification and check)
- **Tracking mode: Autonomous Tracking Mode using Diode acquisition (Median Tracker) since beginning of cycle 35 : June 14, 2009 4h30**

- **POS-3 configuration change : None since last OSTST**

- **POS3-1 operations :**

- Transponder calibration on both ascending (#109) and descending pass (#18)
- Diode/DEM tracking mode used for better accuracy and shorter unavailability (~7s of data unavailability around Gavdos Island)

→ See transponder talk in CALVAL Session for details and results :
J.D. Desjonqueres



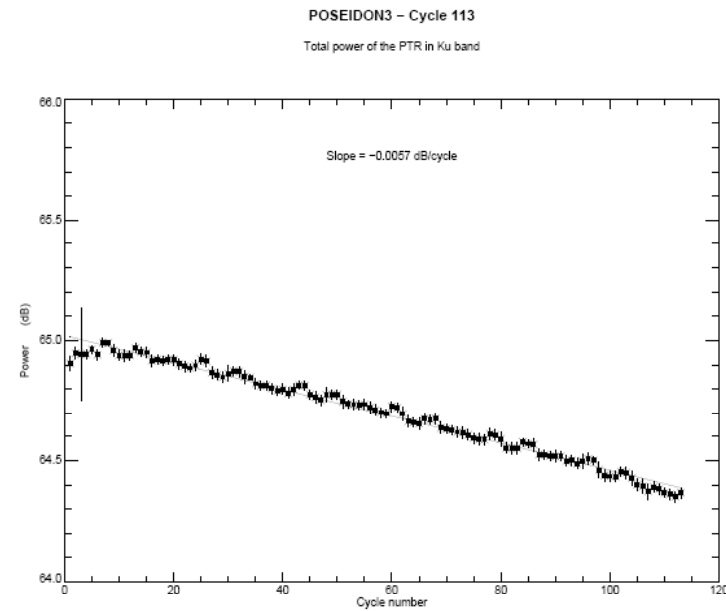
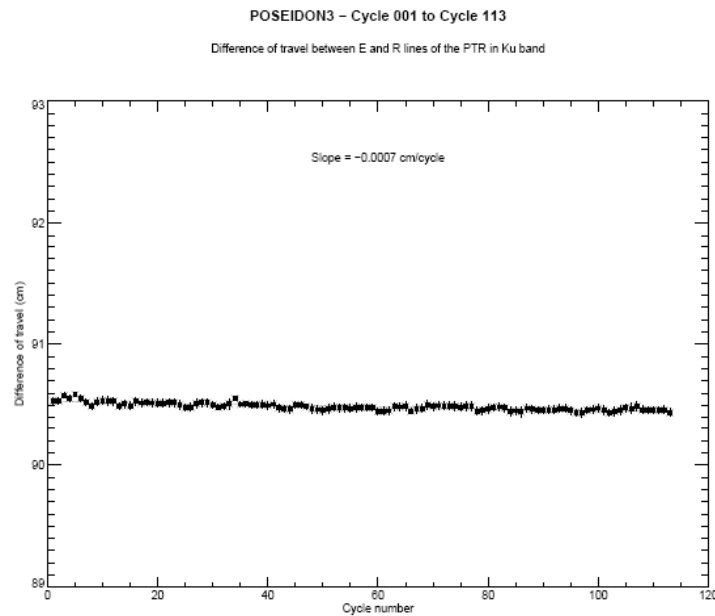
OSTM/Jason2 - OSTST San Diego - October 19th, 2011



- **POS3-1 performances :**

- Instrumental RANGE Noise is 1.8 cm at 1 Hz (at ground after MLE4 retracking).
- Stability: Calibrations are nominal (3 per day, used for data correction)
Trend due to aging is surveyed and automatically corrected in the data. It is stable and compatible with satellite lifetime with very good margins.
- Specific calibrations (every 6 months - last in August) confirm the altimeter good health

POS3-1 altimeter is functioning nominally



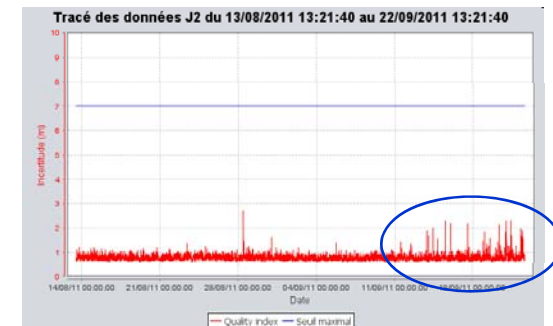
- **DORIS configuration and availability**

- No configuration change since last OSTST
 - Nominal chain : DORIS #1 (since June 2008)
 - OBSW DGXX V8.0 (on EEPROM-B and EEPROM-A) since Feb. 2010
 - Redundant Chain : DORIS #2 (OBSW DGXX V4.0)
- **DORIS availability is 100%**

DORIS receiver is functioning nominally

- **DORIS performances**

- DOPPLER MEASUREMENT
 - mean value for noise is **4.2- 5.0 mm** (POE residuals, over a 10 seconds period)
- DORIS Time-tagging of PPS performances (used for altimeter data)
 - accuracy is **1-2 microseconds** as compared to on-board GPS (bus)
- Navigator (DIODE) performances
 - daily radial RMS : **3 to 5 cm**
 - daily 3D-RMS : **10 to 20 cm**
- Some DORIS perturbations on 400 MHz channel (early October 2011)
 - periodic signal (~bi-annual); analysis in progress

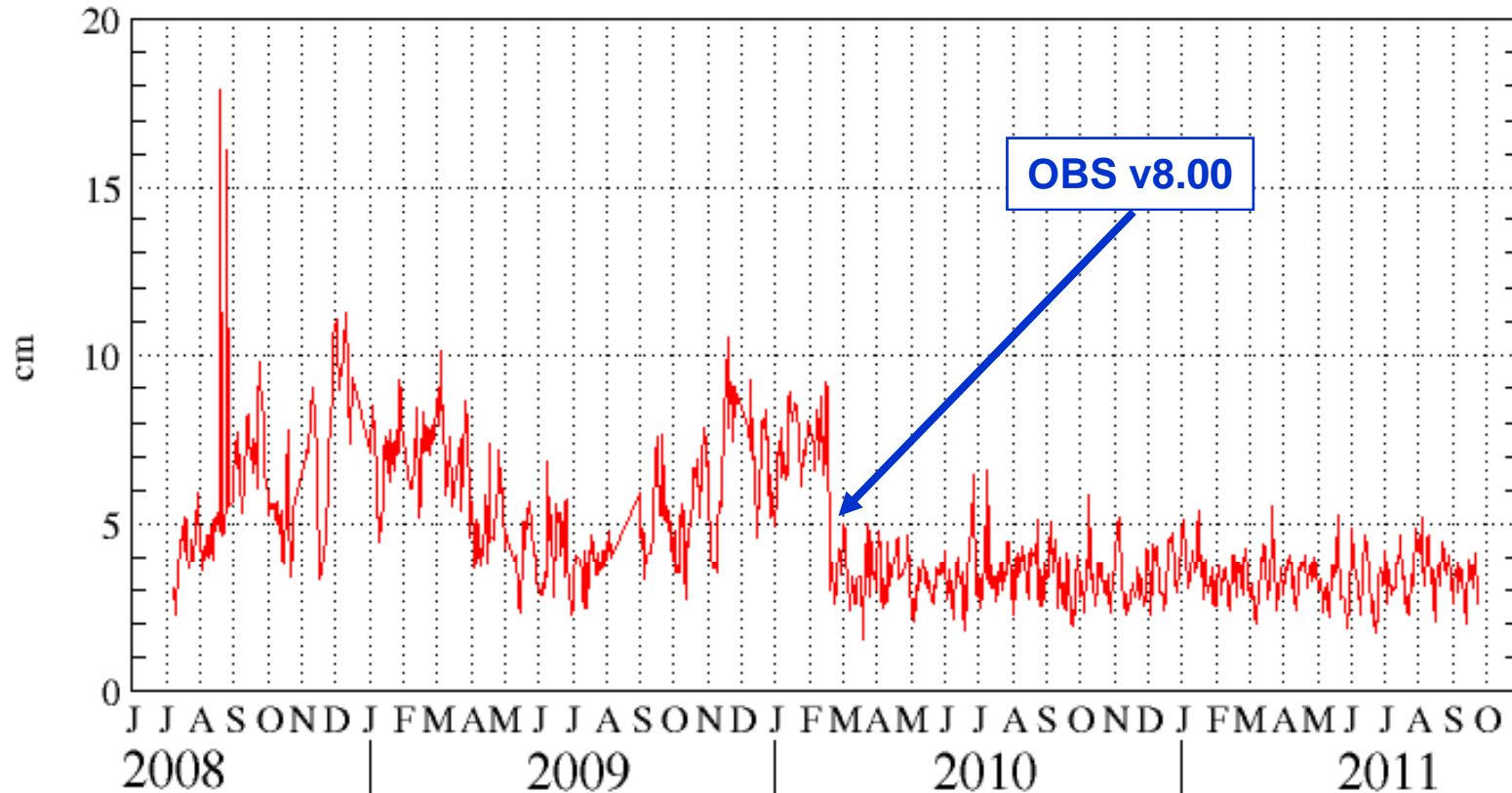


- **DORIS operations and DORIS beacon network**

- Nominal (4 Master beacons since 2009)



Daily RMS of NAV - MOE radial differences

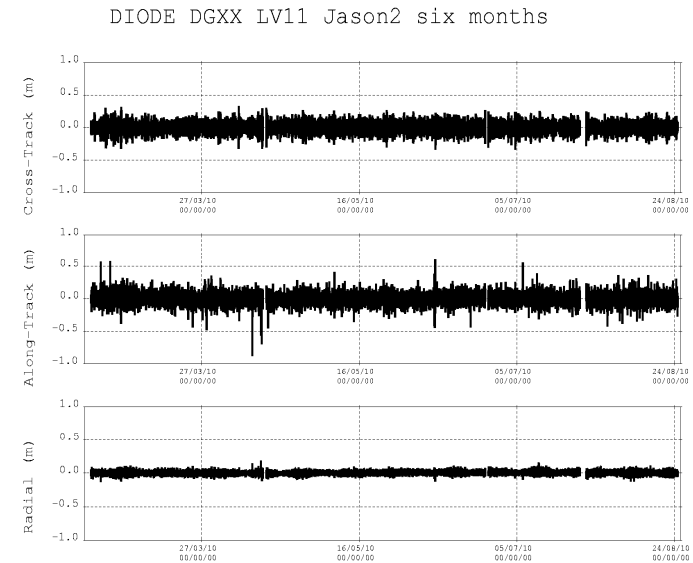


Units = cm, time span : June 2008 -> September 2011

Radial RMS ~ 3.3 cm



- **CNES release an improved version of DIODE software. For Jason-2, main evolutions are :**
 - PAPEETE as a Master Beacon
 - Hill along-track acceleration
 - Orbital Angular Position formula change
- This issue has been activated daily, with Jason-2 and CryoSat-2 measurements : algorithms are ground validated over very long periods (6 months)



A new DORIS/DIODE version (v11) is proposed for upload on-board Jason-2
Real-time orbit accuracy (OGDR) would drop from 3.3 cm RAD RMS down to 2.7 cm
=> 18 % improvement

- **Robustness and time consumption verified**
- **No change in ground segment (TRIODE is OK)**
- **Available early 2012**

→ See poster session
“NRT products : C. Jayles



- **AMR current configuration:**

- Turn-On of AMR-H on 22 June 2008 (AMR-V is redundant)
- AMR-H availability is **99.9%**
 - Two anomalies in January 2009 were believed to be due to single event upsets (SEU) effects. Both were corrected without apparent long-term issues. One minor anomaly (packet datation) in Oct 2010.
 - No further availability anomalies have been detected on the AMR.

- **AMR performance:**

- Recent calibration shifts observed in AMR 18.7 GHz channel
- 23.8 GHz channel has shifted 0.4 K around July 2009 , but otherwise stable
- 34.0 GHz channel has experienced several jumps plus drift totaling about ~6 K total with a residual of 0.8 K after ARCS processing
- Updated AMR calibration provided by S. Brown for Jason-2 GDR-D processing to remove residual drift
- **AMR continues to provide excellent performance meeting/exceeding all requirements**

- **AMR operations:**

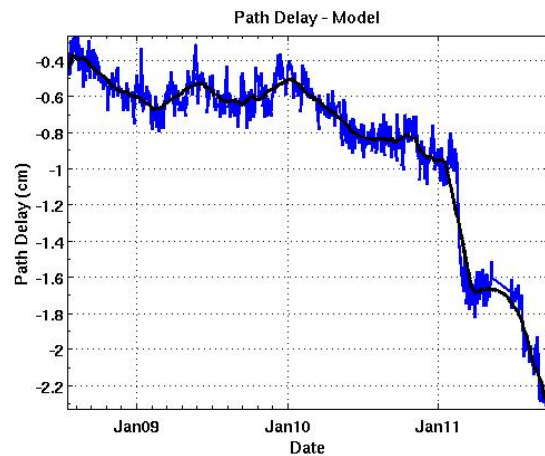
- AMR has functioned well since launch.
- Both spacecraft and AMR engineering telemetry indicate stable and nominal operation since launch.
- very simple to operate
- No TC in routine operations

AMR is functioning nominally

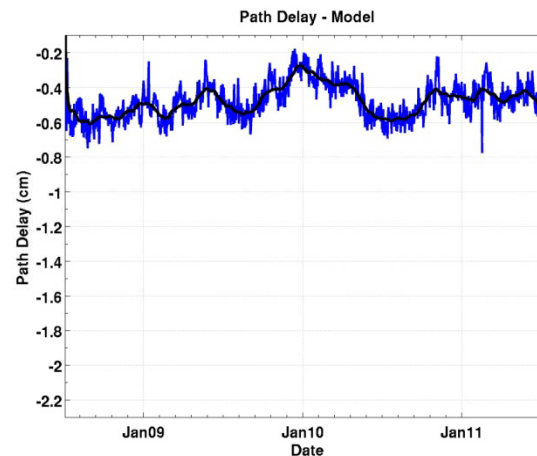


- Without ARCS processing, PDs would exhibit 7 mm/yr drift
- Drift on GDR-T product < 1mm/yr
- Drift on future GDR-D product << 1mm/yr

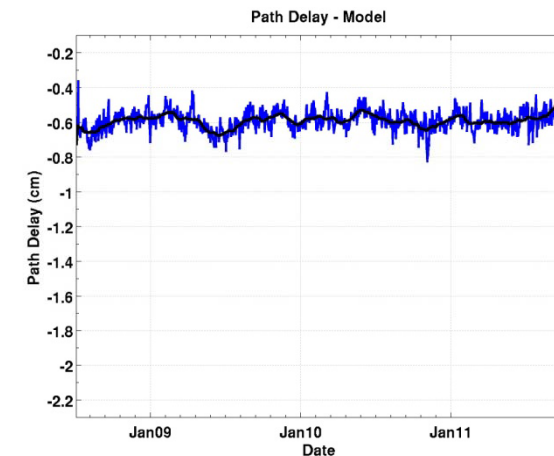
Without ARCS



GDR-T



GDR-D



- Drift in GDR wet PD estimated to be about -1mm/yr
- ARCS successful is reducing drift from 3mm/yr to < 1mm/yr
- Recalibration performed for GDR-D reduces drift over cycles 1-79 to a negligible level
- GDR-D will also include new processing to produce valid PDs in the coastal zone in addition to radiometer rain and sea ice flags
 - Currently available on AMR enhanced product (via PO.DAAC)
- 34 GHz channel continues to experience anomalous jumps
 - latest occurrence was 2K jump on 15 February 2011
 - Jumps accounted for in GDR by ARCS processing
- **AMR continues to provide excellent performance meeting and exceeding all requirements**



- **GPSP current configuration :**

- Turn-On of GPSP-A on 22 June 2008 (GPSP-B is redundant)
- GPSP-A
 - Temporal coverage of **95%** : Gaps over SAA , Similar temporal coverage to Jason-1
 - POD coverage of **100%** : Special processing required for maneuver days (dynamics) and for few specific days
- Software upload in December 2009 to allow assessment of SAA gaps
- Reverted to original software in February 2011 to try improve GPS-based orbit precision.

- **GPSP-A performances :**

- Tracking 8+ GPS satellites simultaneously (capped at 12)
- Quality of tracking data (point-to-point) is excellent
 - P1 multipath 24 cm (RMS, 10 s)
 - P2 multipath 17.5 cm (RMS, 10 s)
 - PC (ionosphere free) postfit residual 26 cm (RMS, 5-min smoothed)
 - LC (ionosphere free) postfit residual 0.7 cm (RMS, 5-min sampled)

- **GPSP-A operations :**

- Very simple to operate
- No TC in routine

GPS-based POD results are excellent

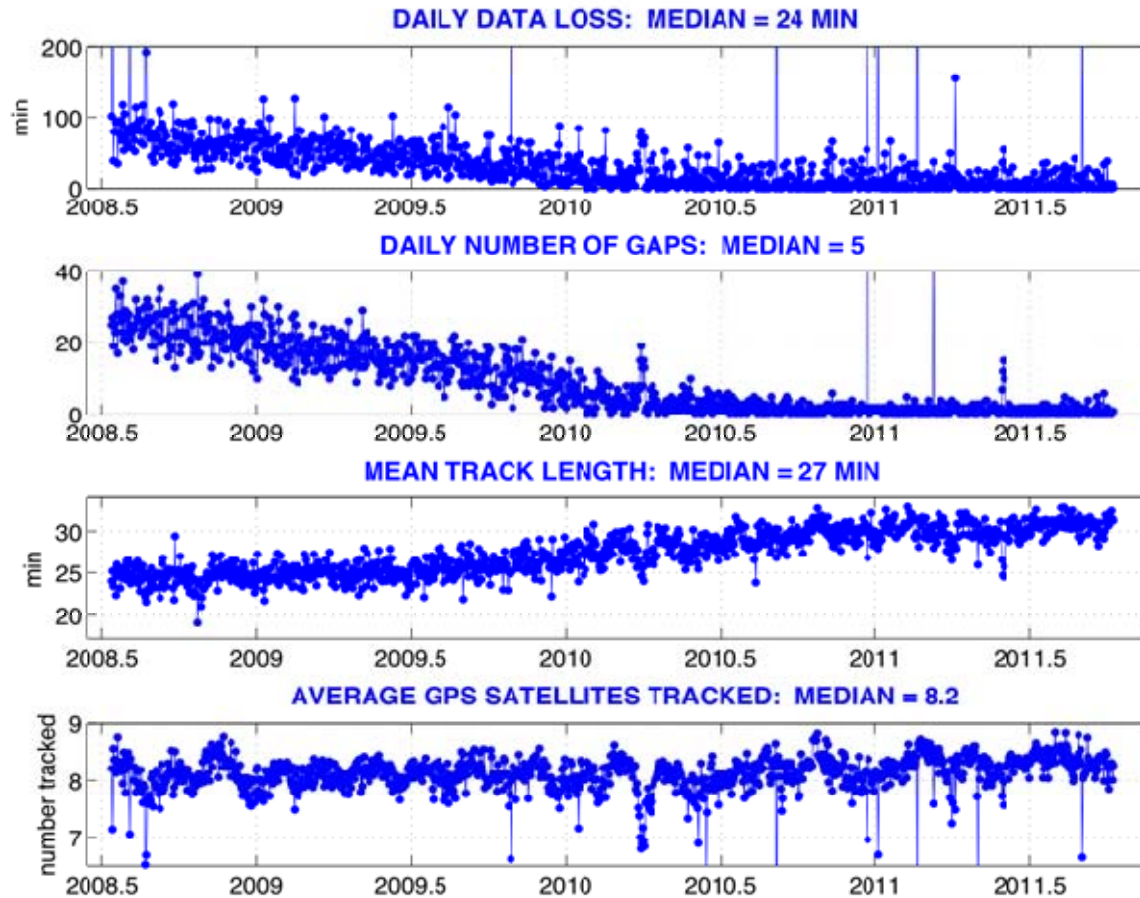
- 1.3 mm median radial RMS overlap
- 9.4 mm median radial RMS difference with GDR solution
- 7.1 mm median radial RMS difference with GSFC solution
- Near real-time POD process now on line

–< 1.5 cm radial RMS for OGDR +0 hr

–~ 1 cm radial RMS for OGDR +2 hr

GPSP is functioning nominally



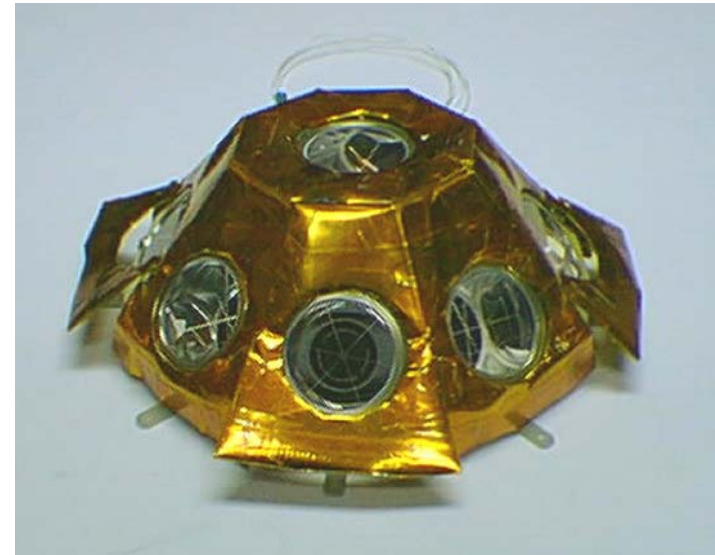


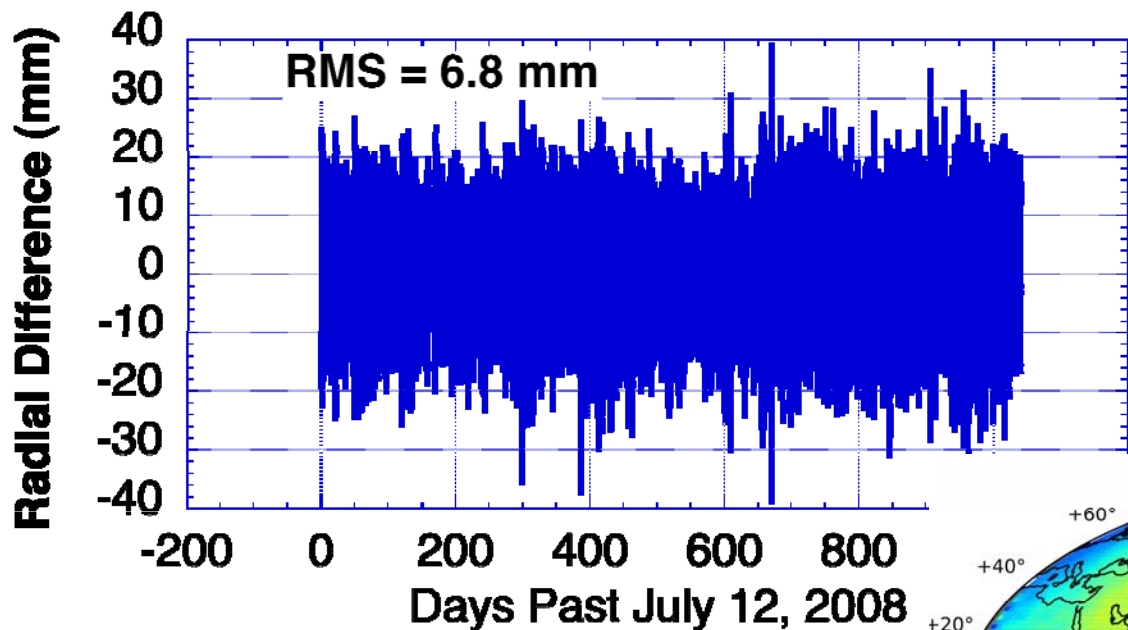
Tracking statistics
show a general
improvement over
time



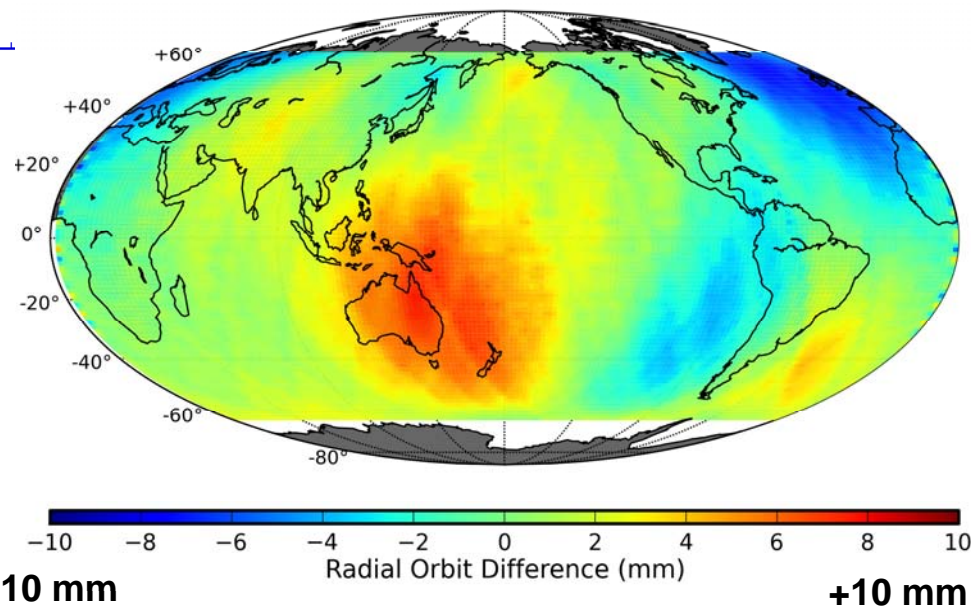
Summary:

- The LRA continues to provide returns adequate for tracking.
- SLR Tracking of Jason-2 has been nominal.
- LRA Returns are the same power as Jason-1.
- The top five stations for Jason-2 tracking are:
 - Yarragadee** (*Australia*)
 - Zimmerwald** (*Switzerland*)
 - Mt. Stromlo** (*Australia*)
 - Changchun** (*China*)
 - Herstmonceux** (*U.K.*)





Differences Sampled every 10 minutes





CENTRE NATIONAL D'ÉTUDES SPATIALES



Passengers Status T2L2



T2L2 : Time Transfer by Laser Link

- **Availability : 97%**

- Power supply anomaly on May 2011 (Triggering of FDIR), back to nominal operation after power on
- Loss of 1553 connection on June 2011, major impact on PLTM2 (loss of TM for all passengers) back to nominal operation after reset.

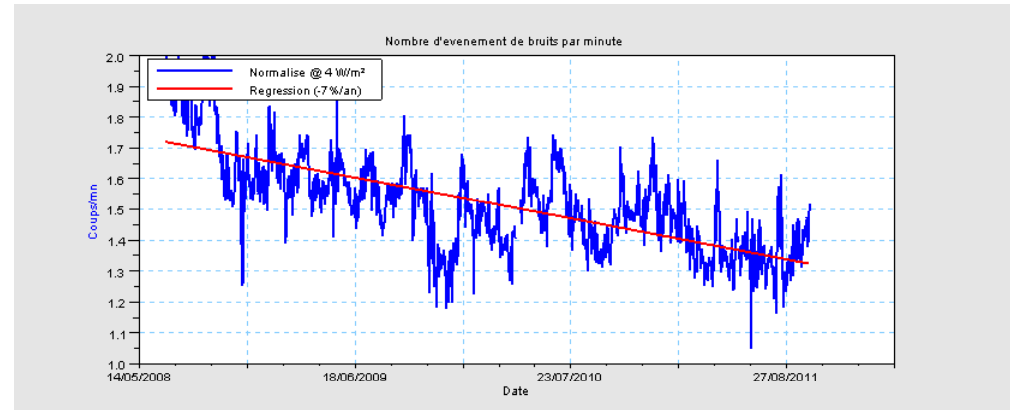
- **Performance : Nominal**

- No aging of the instrument
- No degradation of the performances
- Optical fiber : Loss of transmission due to radiations ~7% per year, no impact

- **Operations : Nominal**

- **Science : First comparisons T2L2/GPS/Two Way**

- RMS of differences lower than 2 ns over 60 day, limited by GPS/Two-Ways performances



**Instrument is fully operational after more than 3 years
of continuous operations (lifetime specification fulfilled)
T2L2 exploitation agreed until end of 2012**



CARMEN-2 : to study the influence of space radiation on advanced components (a spectrometer and an Experiment Module "MEX")

- **CARMEN-2 current configuration**

- no change since last OSTST

- **Availability :**

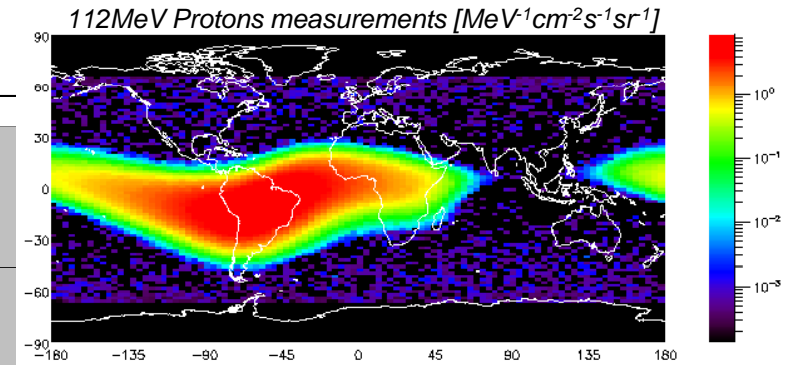
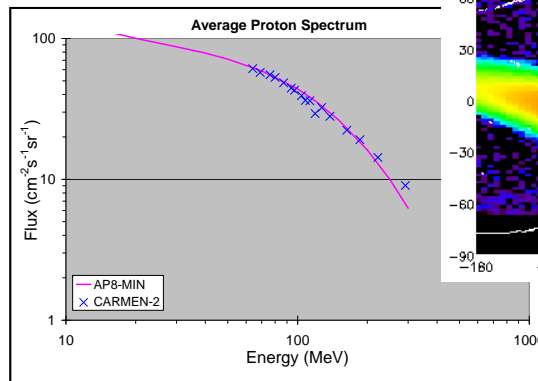
- spectrometer 97%
- MEX 85% : 4 anomalies (communication loss between MEX and CARMEN-2 processors → instrument OFF/ON)

- **Performances :**

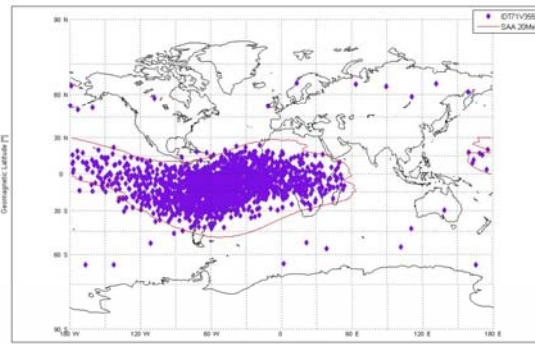
- Spectrometer : correctly calibrated, satisfies technical specifications (particles, energies) *End of the solar quiet period → First solar events have been well observed.*
- MEX : according to the experiments, good correlation between expected behavior and measurements. *Correlation with CARMEN-1 instrument (launched in June) in progress.*

- **Operations**

- nominal

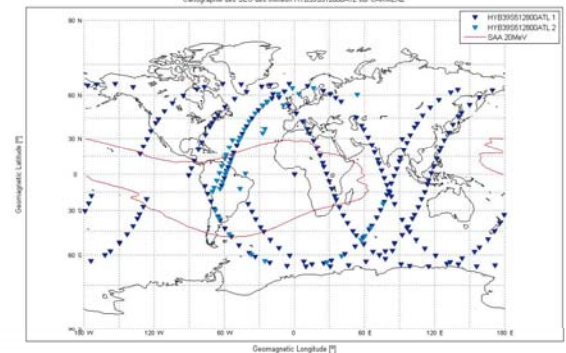


Comparison of spectra given by CARMEN-2 and AP8MIN Model taking into account anisotropy effect



Mapping of Single Event Upset observed on a memory under in-flight test

Some Single Event Functional Interrupt (SEFI) have been observed on memories that retrieve their functionality after a memory area shutdown.



Instrument is performing nominally





CENTRE NATIONAL D'ÉTUDES SPATIALES



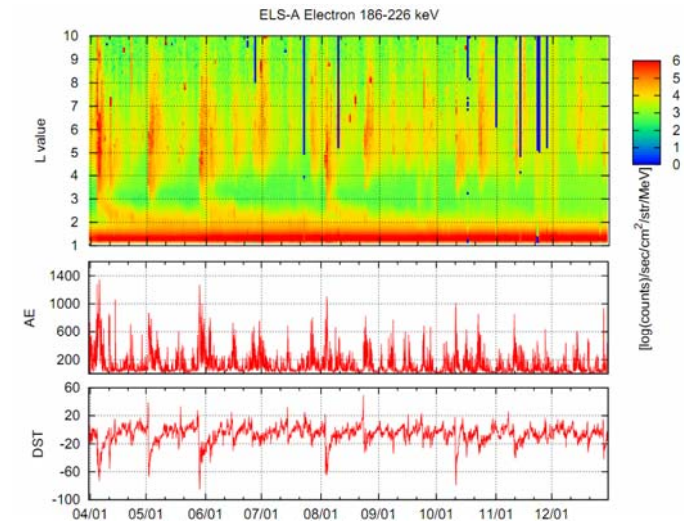
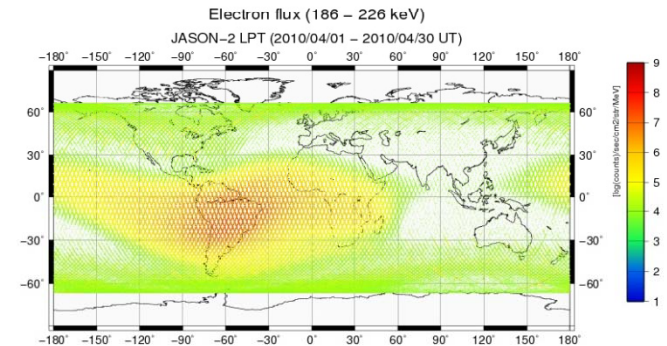
Passengers Status LPT



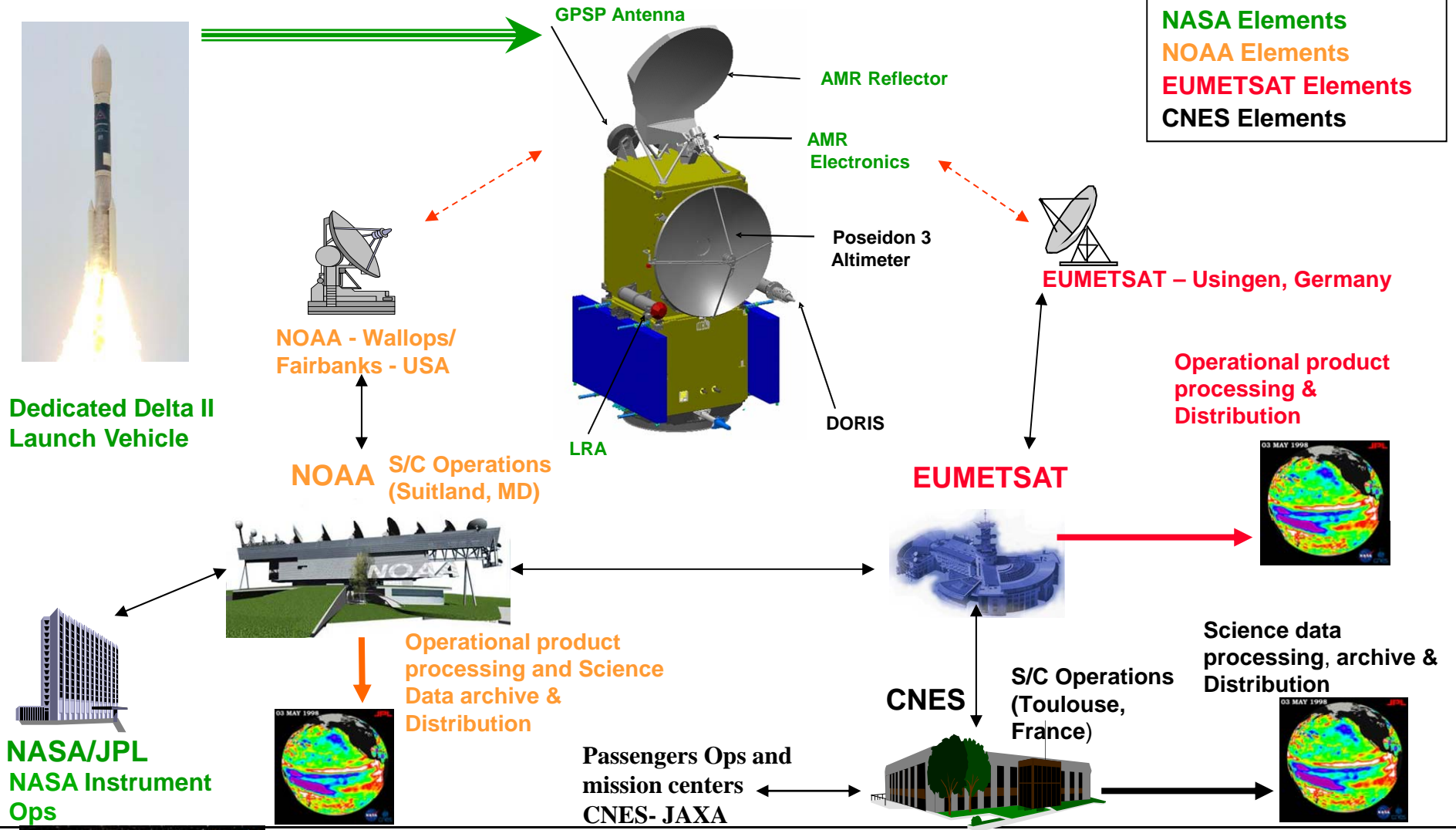
LPT : Light Particle Telescope (to measure radiation environment around the Jason-2 S/C : Electrons, protons, 4He particles)

**Instrument is performing well since launch
and is working properly**

- **LPT current configuration**
 - No change
(trigger mode of ELS-B (electron sensor) changed in 2008)
- **Availability : ~100%**
 - 1 OFF/ON required on Nov '09
- **Performances :**
 - Observed radiation enhancement due to solar flare and magnetic storm.
 - Level 1 and 2 data in CDF format are available by user's request.
 - Level 2 data will be served in JAXA's website "SEES".
- **Operations :**
 - nominal



NASA Elements
NOAA Elements
EUMETSAT Elements
CNES Elements



OSTM/Jason2 - OSTST San Diego - October 19th, 2011

- **Earth terminals :**

- Usingen (USG) :

OK

- availability is 97.8% ; increasing now
 - mainly due to anomaly on pointing affecting 1.5% of the passes
 - 2010 yearly maintenance activities

- Wallops and Fairbanks (CDAS)

OK

- New 14.2 m antenna at Wallops
 - Jason-2 Fairbanks equipments moved in Sept. '11

- **Control Centers :**

- J2CCC CNES Control center

OK

- all the elements are OK

- SOCC NOAA Control center

OK

- successful GPSP on-board software upload
 - successful transfer of GPSP1 SW to ESPC

- **Instrument Commanding and Monitoring Centers :**

- SSALTO for CNES instruments

OK

- JPL Mission facility for NASA/JPL instruments

OK

- Passengers Mission centers

OK



NRT products (OGDR)

produced by EUMETSAT Mission Center and NOAA/ESPC Mission Center

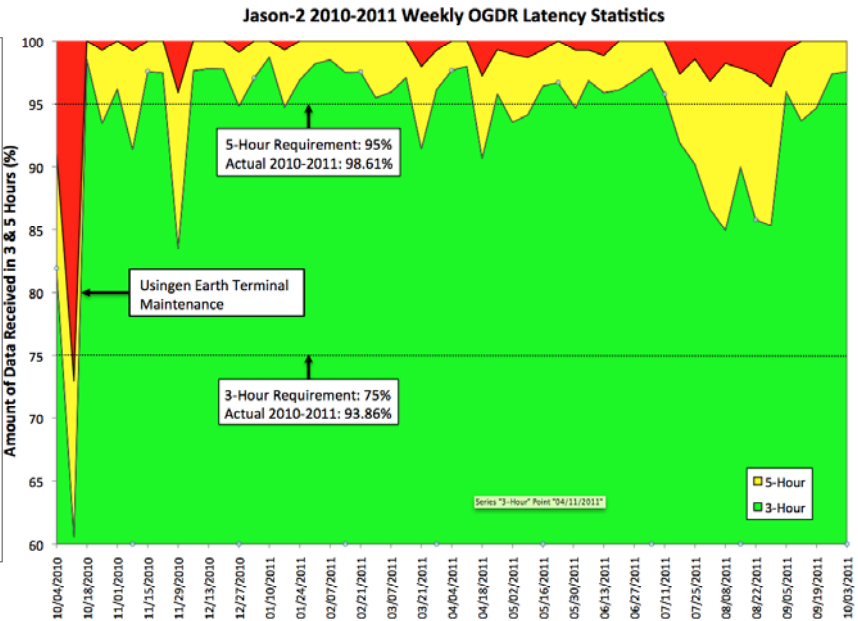
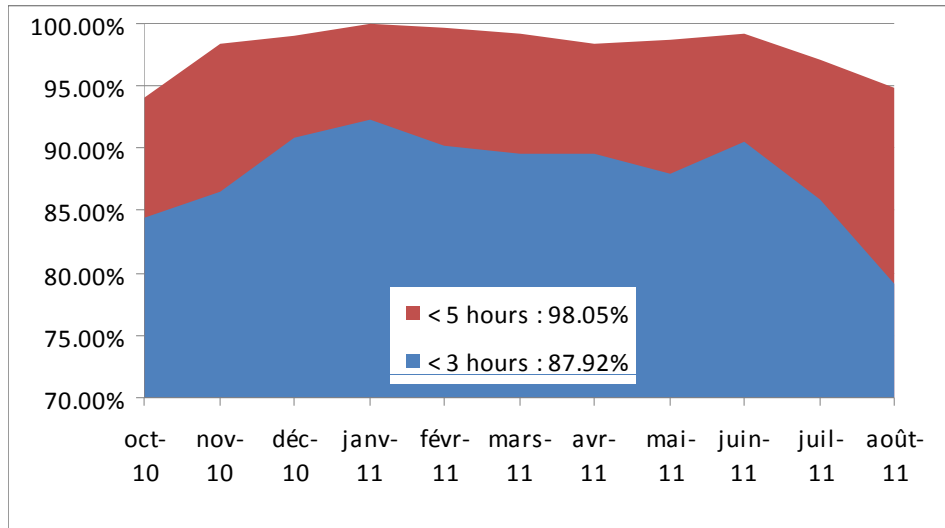
- No change in NRT software since January 2010.
 - Only one failure due to AMR incident telemetry (Oct 2010)
- **EUMPC : ~100% OGDR successful for PLTM1 acquired at USG**
- **NOAA ESPC : ~100% OGDR successful for PLTM1 acquired at CDAs**
- **100 % OGDR products archived, all disseminated via EUMETCast and via NOAA dissemination services**
- NB : an annual data quality report is produced by NOAA, see ftp://ibis.grdl.noaa.gov/pub/johnl/ostm/j2_2010-2011_nrt_quality.pdf



- **Operational Geophysical Data Record OGDR 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):
 87.92% in less than 3 hours
 98.52% in less than 5 hours
 EUMETSAT's Inputs

Performance (measured at NOAA ESPC production level):
 93.86% in less than 3 hours
 98.61% in less than 5 hours
 NOAA's Inputs



- Off line products produced by SSALTO CNES Mission Center
- Jason-2 IGDR processing is OK (CNES : 100% IGDR successful)
 - latency improved in April 2010 : now compliant with requirement
- 100% IGDR products archived
- all disseminated via CNES AVISO and NOAA dissemination services

- Jason-2 GDR processing is OK (CNES : 100% GDR successful)
 - Systematic cross checked validation by CNES and JPL
 - 116 cycles of 121 have been generated and validated.
 - For each cycle, a full validation report is produced by CNES
→ see <ftp://avisoftp.cnes.fr/AVISO/pub/jason2/gdr>

- 100% GDR products archived
- all disseminated via CNES AVISO and NOAA dissemination services
- GDR_T : 116 cycles available

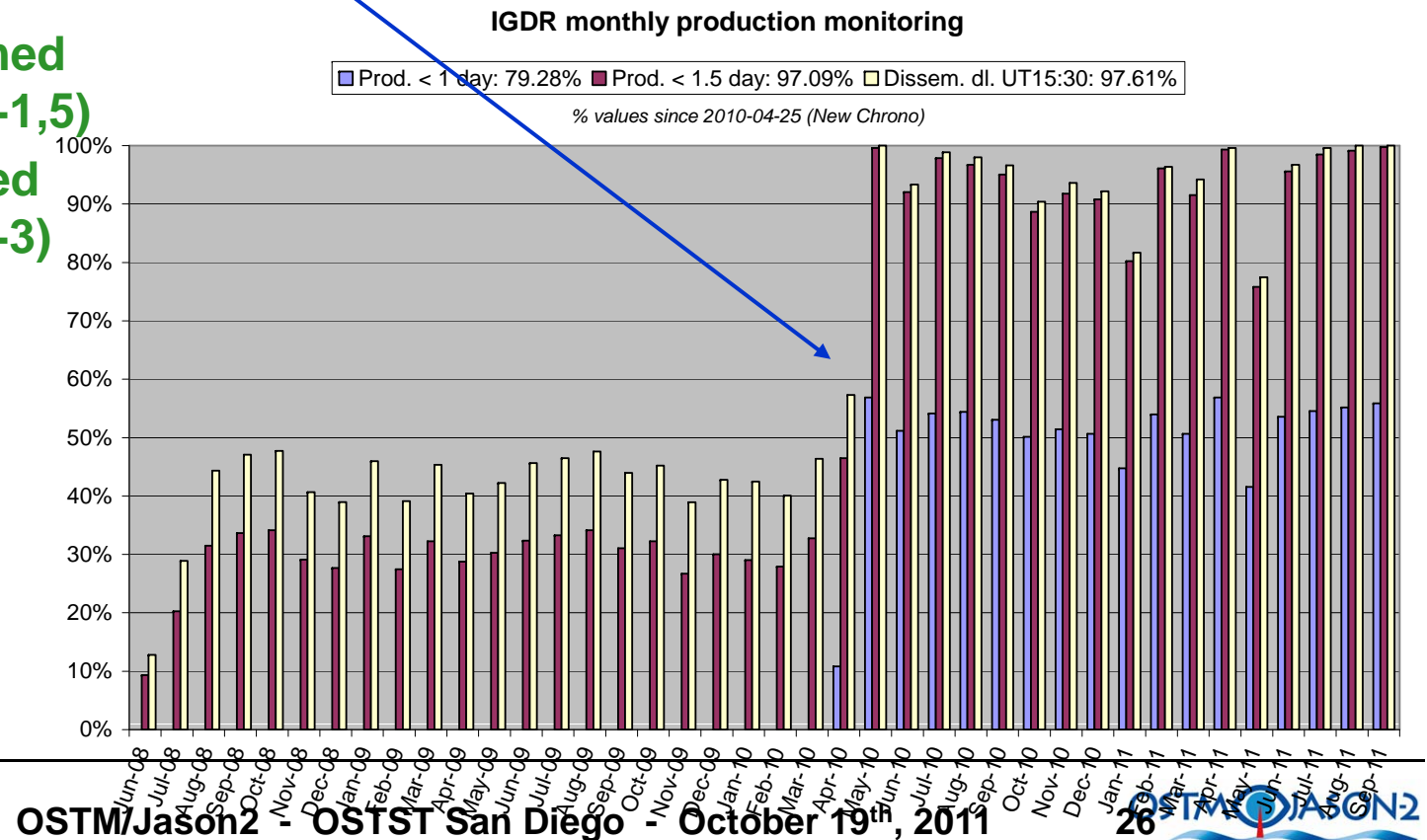


Yearly CALVAL
report available



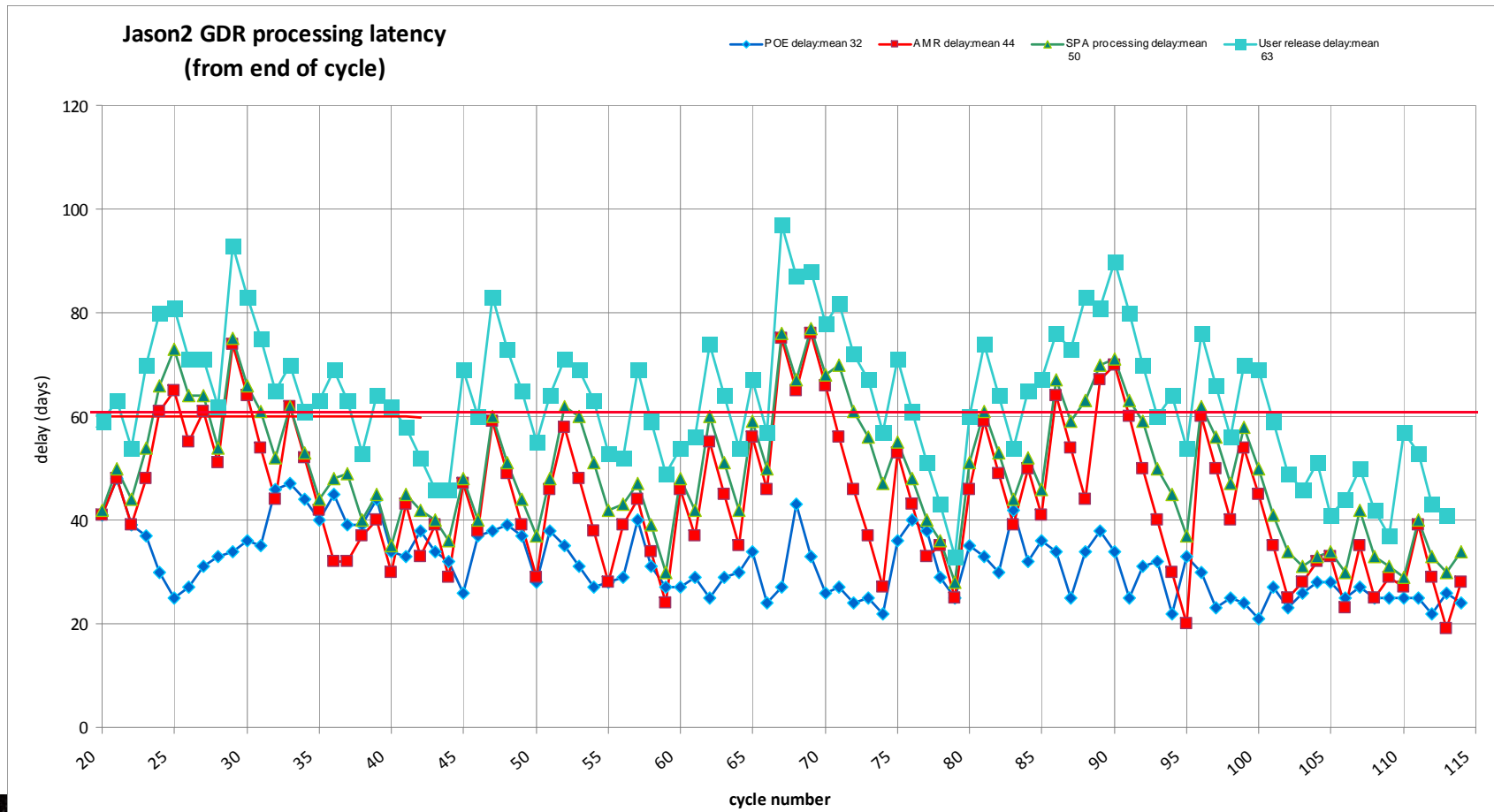
- **Interim Geophysical Data Record IGDR data latency :**
 - Requirement = IGDR production between 1 and 1.5 days
- **Actual Performance :**
 - 1.5 day since April 25th 2010

- **97.11% performed in less than (D+1,5)**
- **99.5% performed in less than (D+3)**



OSTM/Jason2 - OSTST San Diego - October 19th, 2011

- **Geophysical Data Record GDR data latency :**
 - Requirement = to deliver the best possible data to users (60 days latency)
 - Driven by POE and AMR calibration availability



- **Jason-2 data products error : among others, 2 major evolutions in ground processing software for :**
 - **Pseudo Datation Bias - Error in the datation algorithm (for TOPEX/ Jason-1 / Jason-2) of the instant of reflection of the signal by the surface : correction available**
 - **Range Bias – Explained - 18cm between Jason-2 and TOPEX/Poseidon : correction available**
 - **Correction included in next GDR version (called GDR_D)**

→ See plenary session Friday – Jason/GDR-D : N. Picot

Current figures :

		Requirements
– RMS Orbit (radial component) DIODE (vs POE) :	OGDR : 3 to 4 cm : OK	10 cm
– RMS Orbit (radial component) POE :	GDR : 1 cm : OK	2 cm
– RMS Orbit (radial component) MOE (vs POE) :	IGDR : 2 cm : OK	2.5 cm
– Altimeter noise after MLE4 ground retracking :	1.8 cm : ~ OK	1.7 cm
– Wet troposphere (J2-J1) RMS results :	0.1 to 0.8 cm : OK	1.2 cm
– Total RSS sea surface height (J2-J1) RMS results :	IGDR : 3.9 cm : OK	3.9 cm
– Significant wave height (J2-J1) RMS results :	IGDR : 0.12 to 0.24 m : OK	0.4 m
– Wind speed (J2-J1) RMS results :	IGDR : 0.2 to 0.8 m/s : OK	1.5 m/s



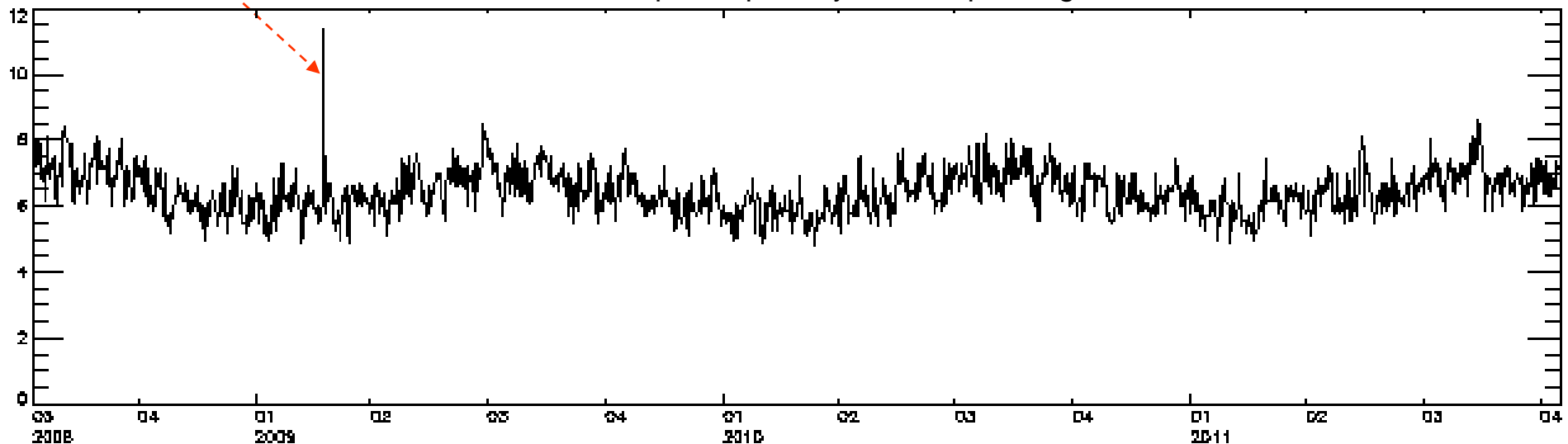
- **Altimeter Antenna Pointing :**
 - Requirement : $< 0.2^\circ$
 - pointing performance stable since launch

Typical pointing value below 0.07°

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

OFF Nadir

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



- **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 June 2010 (cycle 74) until July 2011 (cycle 110)**

- ⇒ **satellite unavailability** **0.01%** **< 4% req**
 - bus : 0% altimeter : 0.01% Doris : 0% AMR : 0%
 - POS3 : routine calibration + Gavdos
 - POS3 : exceptional calibrations
 - ⇒ **ground unavailability** **~0 %** **< 1% req**
 - loss of data at station level

➔ Global Jason-2 system availability : 99.9 %

➔ GDR data availability vs theory

All surfaces : 96.3 %
Over Ocean : 99.8 %



- 34 from Nice, 31 from Seattle, 11 from Lisbon...
- Closed actions : 68 ...

- 8 remaining items :

- Run a flag validation campaign
- Take into account the AMR calibration method on the JMR
- Simulations to see the impact of retracking on SSB
- Study the interest of adding weights on the waveforms before applying MLE-4 retracking (on simulator)
- Study the interest of using the Topex retracking (Callahan) at high frequency and not only for MSL studies.
- Study the impact of GPS measurement holes on the SAA (upload a GPS monitoring software around the SAA zone).
- Initiate an historical characterization file.
- Organize a meeting to define a clear strategy concerning the DIODE/DEM mode on-board Jason-2 and for future missions (ALTIKA, Jason-3, Sentinel-3, etc).

**Action items managed at 4
partner level by the 4 MSEs
(see MSE for more details)**





CENTRE NATIONAL D'ÉTUDES SPATIALES



Conclusion



- Jason-2 satellite has an excellent behavior
- All satellite and system performances requirements are fulfilled with large margins
- Operational Routine Phase is nominal
- Successful REView of EXploitation (REVEX) : April 5-7, 2011

thanks to all the teams (CNES, NOAA, EUMETSAT, NASA/JPL)

**→ a system running fine,
with an excellent availability level !!**



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

- **CNES**
 - **C. Maréchal**
 - **A. Krauss**
 - **R. Canton**
 - **JL. Mestre**
 - **E. Bronner**
 - **F. Bailly-Poirot**
 - **N. Picot**
 - **G. Zaouche**
 - **J.D. Desjonquères**
 - **C. Jayles**
 - **C. Tourain**
 - **P. Guillemot**
 - **E. Lorfèvre**
 - **O. Okudaira**
- **NOAA**
 - **M. Atkinson**
 - **J. Lillibridge**
- **EUMETSAT**
 - **S. Dieterle**
- **JPL**
 - **G. Shirtliffe**

... and watch the rugby match
on TV next Sunday...

