



CENTRE NATIONAL D'ÉTUDES SPATIALES

2011 Ocean Surface Topography Science Team Meeting (San Diego)

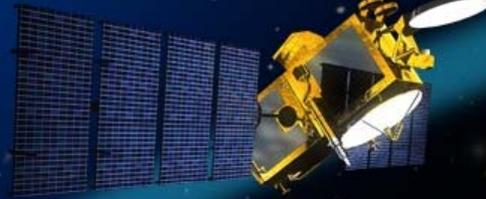


Jet Propulsion Laboratory
California Institute of Technology

Jason-1 Project Status



Jason 1
2001–Present



OSTM/Jason 2
2008–Present



Jason 3
2014



TOPEX/Poseidon
1992–2006

Glenn Shirliffe
*NASA/JPL Jason-1
Project Manager*



CENTRE NATIONAL D'ÉTUDES SPATIALES

Status of Jason-1 Mission



Jet Propulsion Laboratory
California Institute of Technology

- **Jason-1 continues to exceed all Level-1 Science Requirements, despite:**
 - Loss of reaction wheel #1 in November 2003
 - Loss of half-satellite (PMB) in September 2005 (Tx)
 - Gyro #1 anomaly in March 2010 and switch to Gyro #3 in April 2010
- **Operational Milestones:**
 - Jason-1 was maneuvered into an interleaved orbit in February 2009
 - Jason-1 began its 10th year of operations in December 2010
- **Mission Anomalies:**
 - One spacecraft safe hold 15-22 September 2009 caused by SEU (double EDAC error.)
 - No science or engineering data was lost in 2010 due to ground system anomalies
 - Gyro #1 anomaly in April 2010 was preceded by a deterioration in pointing performance
 - Star tracker unavailability during fixed-yaw caused several periods of off-nadir drift in May/July 2010. Since improvements to STR2 and swap over in October 2010, nominal pointing performance has been restored

→ Jason-1 continues to make an essential* contribution to Ocean Surface Topography

** Only 2 satellites remain on repeat track orbits since the ENVISAT orbit change in October 2010*



CENTRE NATIONAL D'ÉTUDES SPATIALES

Orbital Status Summary



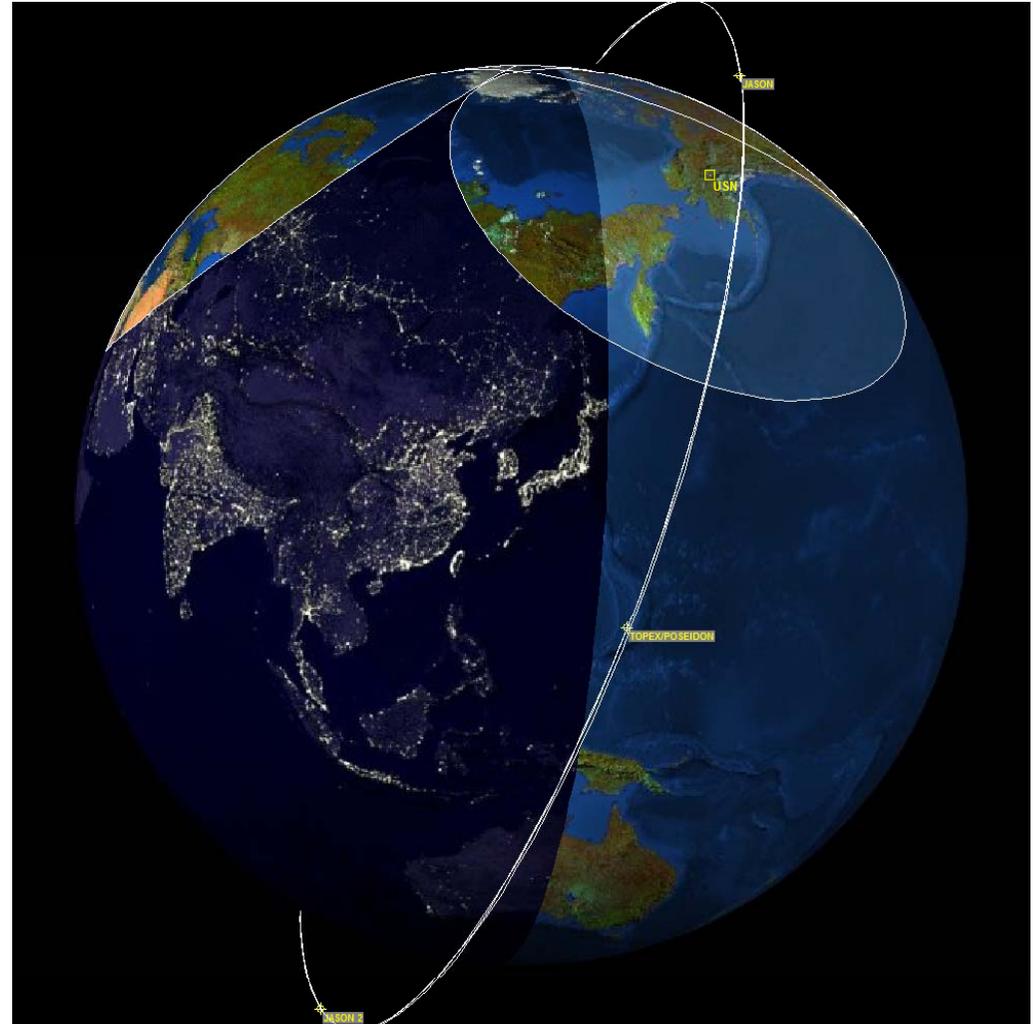
Jason-1 is on the same orbit plane as TOPEX/Poseidon (T/P) (non-operational), OSTM/Jason-2 (operational) & Jason-3 (planned).

T/P is inoperable, and has a nearly-full tank of frozen/inert hydrazine (~200kg) that cannot be depleted.

T/P could again drift very close to Jason-1 by mid-2013.

Jason-1 is single-string on several key component systems, and the permanent loss of one of these key components would end the mission and could possibly leave Jason-1 adrift.

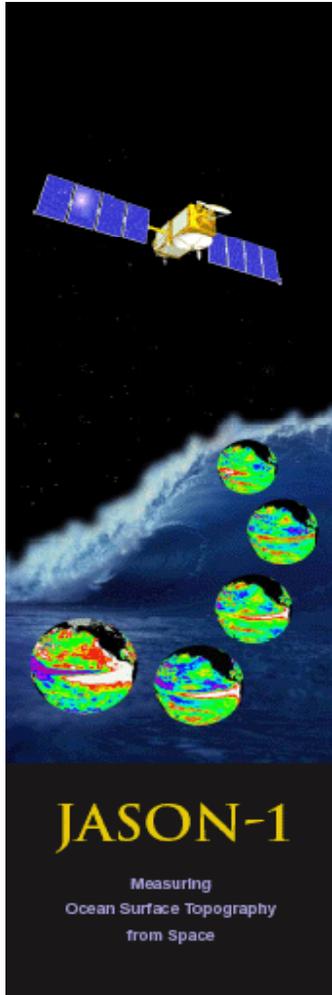
In July 2010, Jason-1 had ~22kg of hydrazine remaining onboard that could be depleted.





CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1: Major Events Since Last OSTST (Lisbon, October 2010)



- **Project Milestones**
 - Tenth Jason-1 REVEX: 5-7 April 2011 → **success**
 - Fourth NASA Senior Review: March-May 2011 → **approved**
 - CNES REDEM: April-May 2011 → **approved**
 - CNES LOS Review: May-June 2011 → **approved**
 - Joint Steering Groups: January & September 2011 → **approved**
- **Unplanned Satellite Events**
 - None
- **Unplanned Payload Events**
 - None
- **Major Ground Events**
 - None

Current Jason-1 mission status is nominal !



CENTRE NATIONAL D'ÉTUDES SPATIALES

Summary of Consensus Recommendations for Jason-1 from Last OSTST

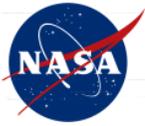


Jet Propulsion Laboratory
California Institute of Technology

At present, moving Jason-1 to a new orbit would create unacceptable error levels for users of high-resolution SSH observations. However in the long run, many will benefit from a geodetic mission, and programmatic pressure to move will likely continue to grow.

We therefore recommend that Jason-1:

- Remain in its current orbit until AltiKa data can be validated.
- After validation of AltiKa data, move to a new repeat-cycle or geodetic orbit in the range 1326 to 1286 km, or another suitable geodetic orbit within an appropriate range.



CENTRE NATIONAL D'ÉTUDES SPATIALES

Tank Depletion: Context



Jet Propulsion Laboratory
California Institute of Technology

Background:

- Jason-1 launched with 28 kg of hydrazine.
- Only 5.5 kg were used during the first 8½ years of operations.
- July 2010 depletion activities and subsequent thruster troubleshooting/testing consumed 8.5 kg
- **On 14 September 2011, ~14kg remained**

- Extension of life (2 additional years, station keeping, collision avoidance, graveyard/geodetic orbit acquisition and decommissioning activities will only require ~3-4 kg of fuel.

- Therefore, ~11 kg were considered to be excess to mission needs and posed an explosive risk that should be mitigated.



CENTRE NATIONAL D'ÉTUDES SPATIALES

Tank Depletion: Plan



Jet Propulsion Laboratory
California Institute of Technology

- Maneuvers with 4 thrusters (OCM4)
- 13 paired, alternating inclination maneuvers (+Di, -Di)
- Expectations: Di +/- 0.03°; ~1 kg
- Nominal schedule :
 - 2 maneuvers on 28-29th Sept
 - 11 maneuvers from Oct 3rd to Oct 17th (3 weeks)
 - Period selected because no sun eclipse from Oct 3rd
 - Burn times chosen to be optimal for altimetry
 - Possible additional station keeping maneuvers necessary
 - Operations in normal working days

Impacts on operational mission acceptable



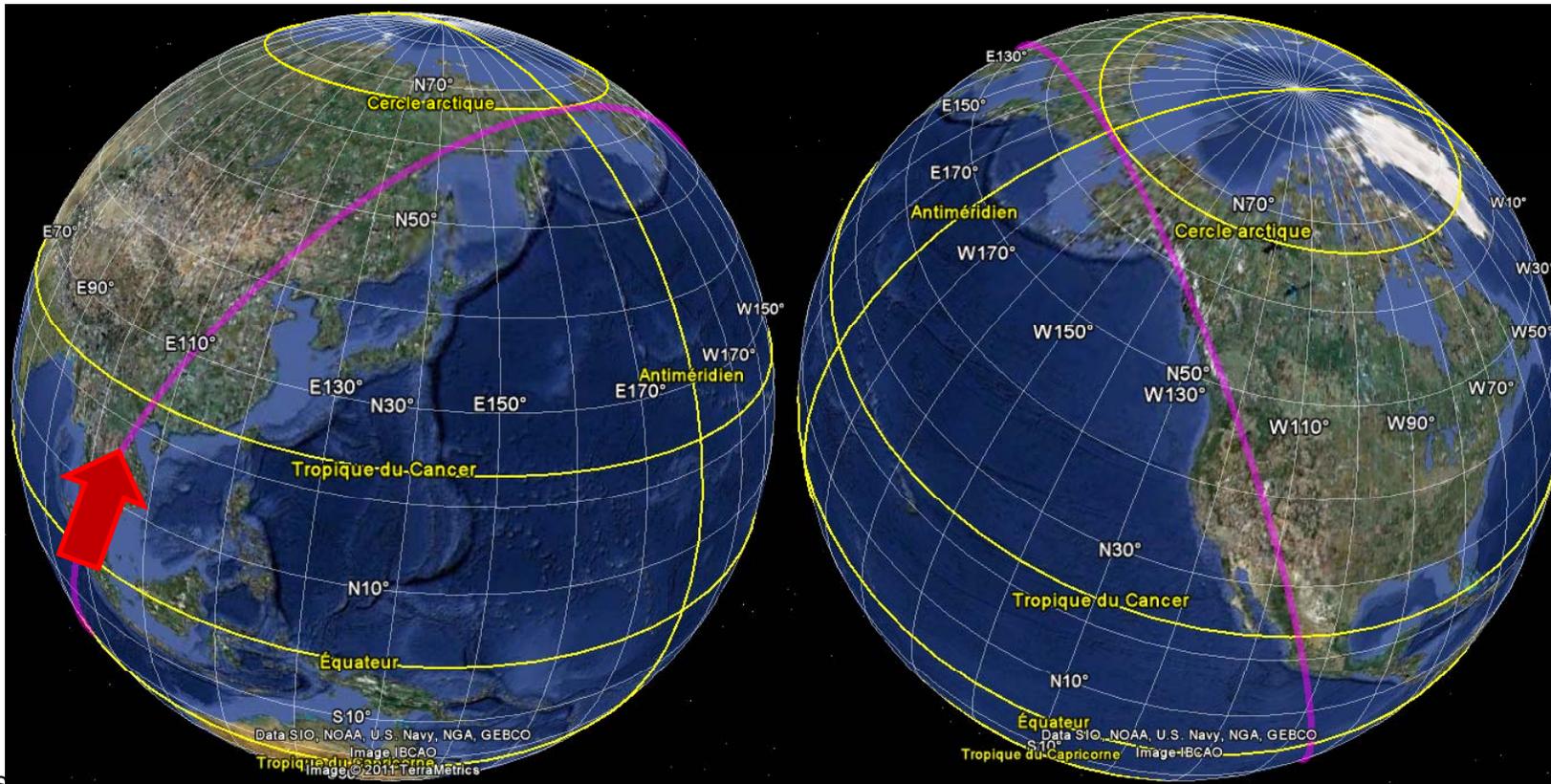
CENTRE NATIONAL D'ÉTUDES SPATIALES

Minimizing Impacts on Science Data



Jet Propulsion Laboratory
California Institute of Technology

- Maximum perturbation of about 1 revolution (8% of a daily dataset)
- Jason-1 provides no/few data over inland waters anyway
- If the maneuver  is performed before Jason-1 flies over the continents, the amount of ocean data impacted by degradation risk can be reduced to 4 – 6%
- Adding constraints on Doris visibility could help minimize the impact on OSDR SSH





CENTRE NATIONAL D'ÉTUDES SPATIALES

Significant Jason-1 Data Impacts



Jet Propulsion Laboratory
California Institute of Technology

- The previous fuel depletion campaign degraded Jason-1 science data from 20-July to 20-August 2010, affecting Science Cycles 315, 316 and 317.
- Resumption of the fuel depletion campaign again degraded Jason-1 science data from 28-September to 19-October 2011, affecting Science Cycles 358, 359 and 360.
- Due to the long maneuvers performed, the DORIS on-board navigator encountered three auto-initializations leading to gaps in the NRT products.
- A first assessment of the available IGDRs shows that less than 10% of ocean data were impacted due to maneuvers. This is less than was anticipated at the outset of the campaign.
- CALVAL cycle reports will provide you with more detailed information.
- Jason-1 has retained 3.7 kg of hydrazine to continue its essential contribution to altimetry in the years ahead, while also mitigating the mission risks to the present and future satellites in the Ocean Surface Topography constellation.



CENTRE NATIONAL D'ÉTUDES SPATIALES

Impact of Jason-1 maneuvers on IGDR data during cycles 358 and 359



Jet Propulsion Laboratory
California Institute of Technology

Data coverage

| Maneuvers | Missing ocean data | Other issues |
|--|--------------------|---|
| 2011/09 28/29 | no | |
| 2011/09 29/30 | no | |
| 2011/10 2/3 | no | |
| 2011/10 3/4 | no | ~9 hours not produced (only platform datation available - > not usable for science applications) |
| 2011/10 4/5 | no | |
| 2011/10 5/6 | no | |
| 2011/10 6/7 | 100 measurements | ~4 hours not produced (only platform datation available -> not usable for science applications) |
| 2011/10 9/10 | no | |
| Percentage of ocean data impacted | 0.009% | 2.64% |

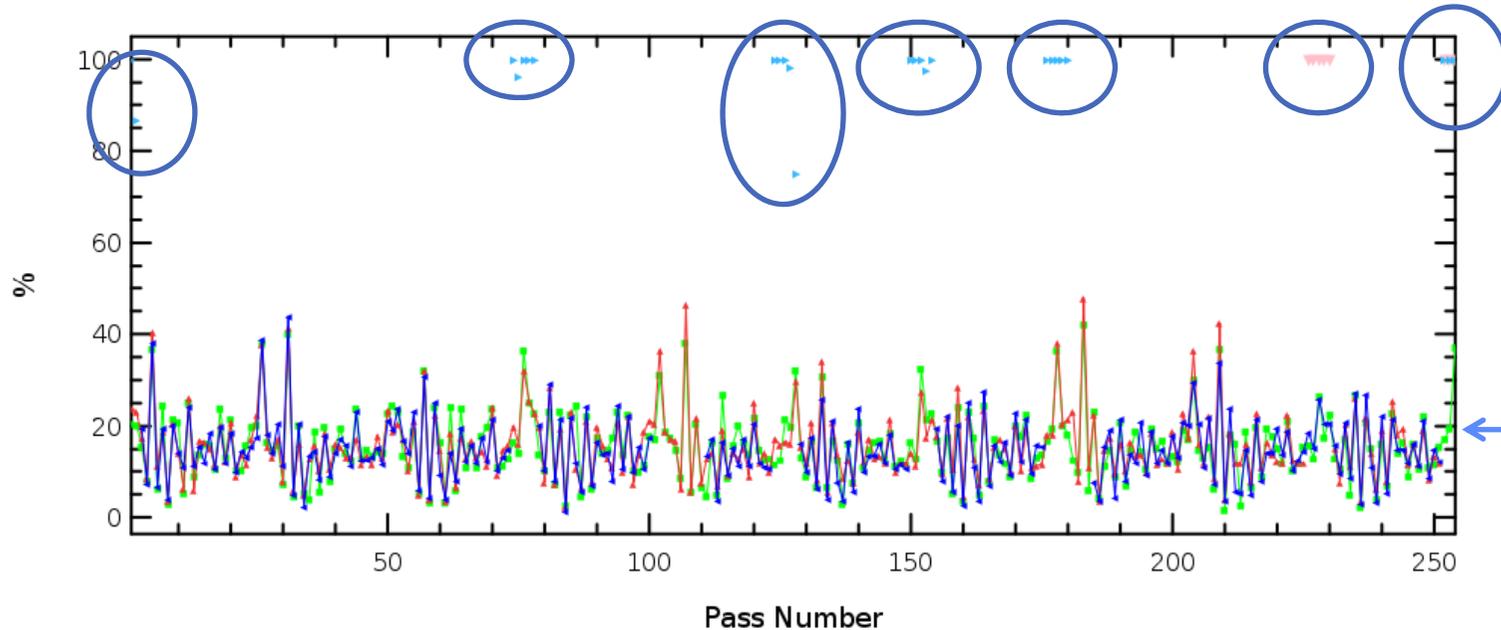
2.6% of missing ocean data due to two datation anomalies in cycles 358 – 359
 No other impacts on ocean data coverage



Invalidated Measurements



Invalidated Ocean Measure Percentage - Cycle 355,358,359
for maneuver periods and nominal periods



Measurements invalidated during maneuver periods

Nominal level of invalidated measurements

| | | | |
|-----|-------------------------|--------------|----------------|
| —●— | 355 - Without maneuvers | Mean = 15.91 | StdDev = 7.645 |
| —■— | 358 - Outside maneuvers | Mean = 15.93 | StdDev = 7.652 |
| —▲— | 358 - Maneuvers | Mean = 100 | StdDev = 0 |
| —◆— | 359 - Outside maneuvers | Mean = 14.81 | StdDev = 7.004 |
| —▲— | 359 - Maneuvers | Mean = 98.19 | StdDev = 5.376 |

Only 6.3% of ocean measurements lost (invalidated) limited to 5h maneuver windows + 2.6% of ocean measurements lost (not in IGDR) due to datation anomalies

Less than 9% of ocean science data impacted by fuel depletion maneuvers



CENTRE NATIONAL D'ÉTUDES SPATIALES

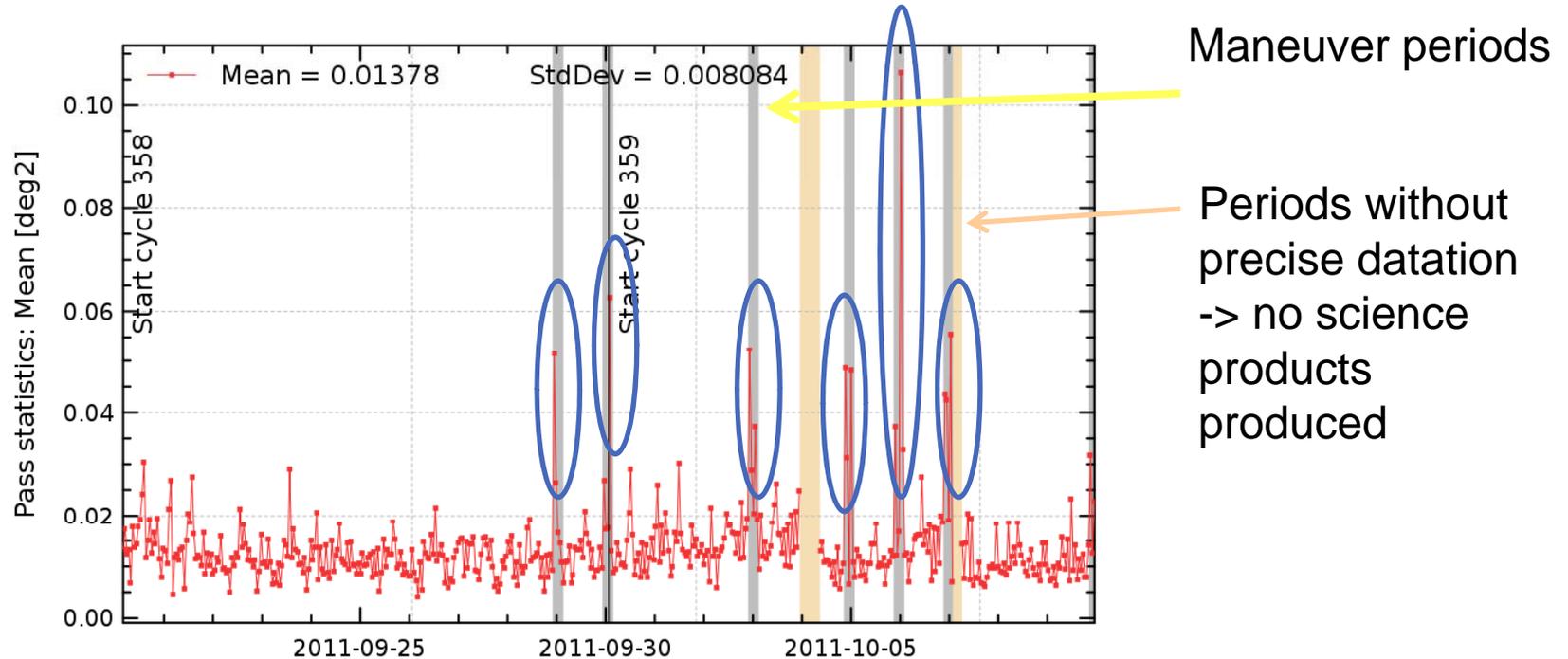
Mispointing



Jet Propulsion Laboratory
California Institute of Technology

- Mispointing is increased during maneuvers periods, but still within thresholds
- Mispointing has nominal values outside of maneuver periods

IGDR Jason-1: Apparent squared mispointing over ocean



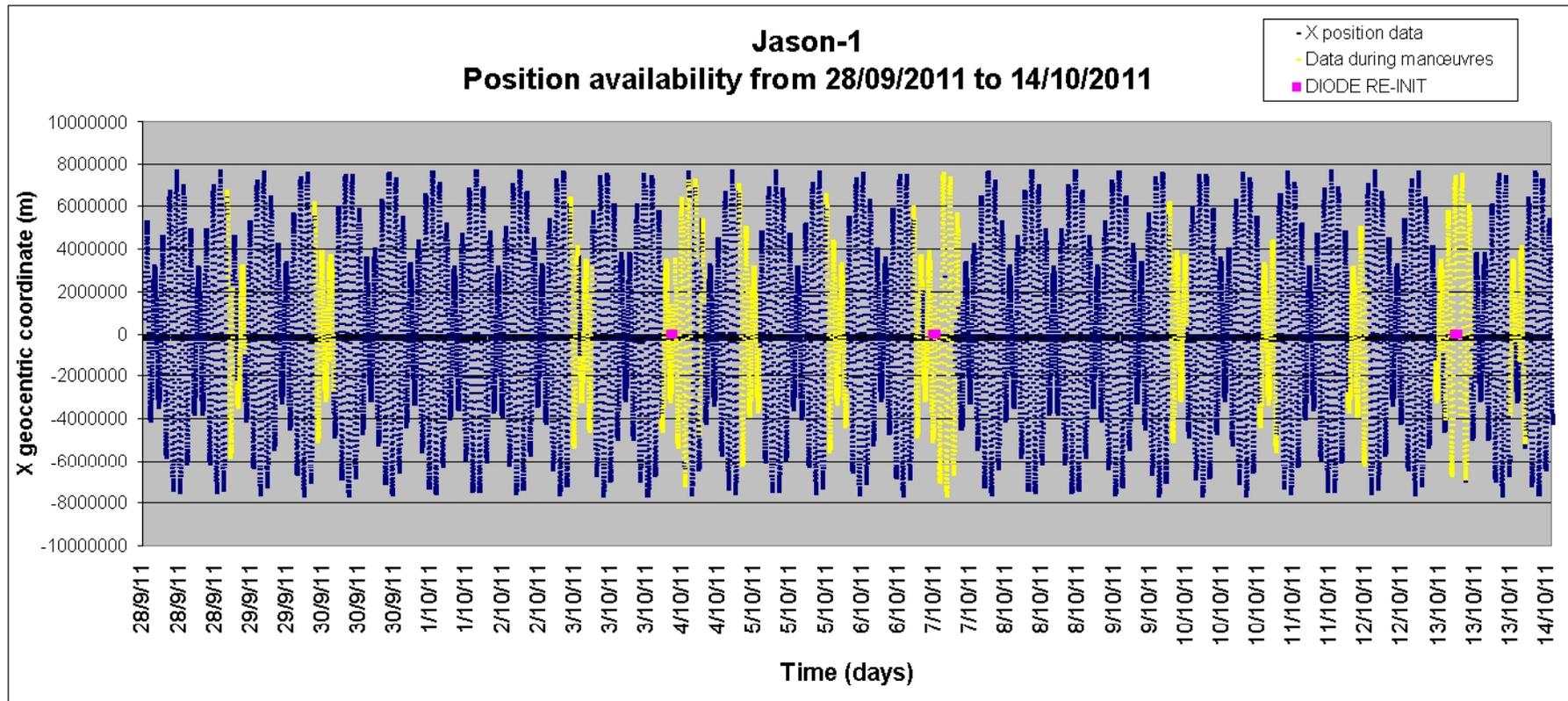
**Mispointing is only slightly impacted by maneuvers
Much better conditions than in 2010**



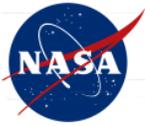
DORIS PVT DATA: (Unavailability – RED; Degraded NAV – YELLOW)



CENTRE NATIONAL D'ÉTUDES SPATIALES



Science Data will be good for IGDR & GDR



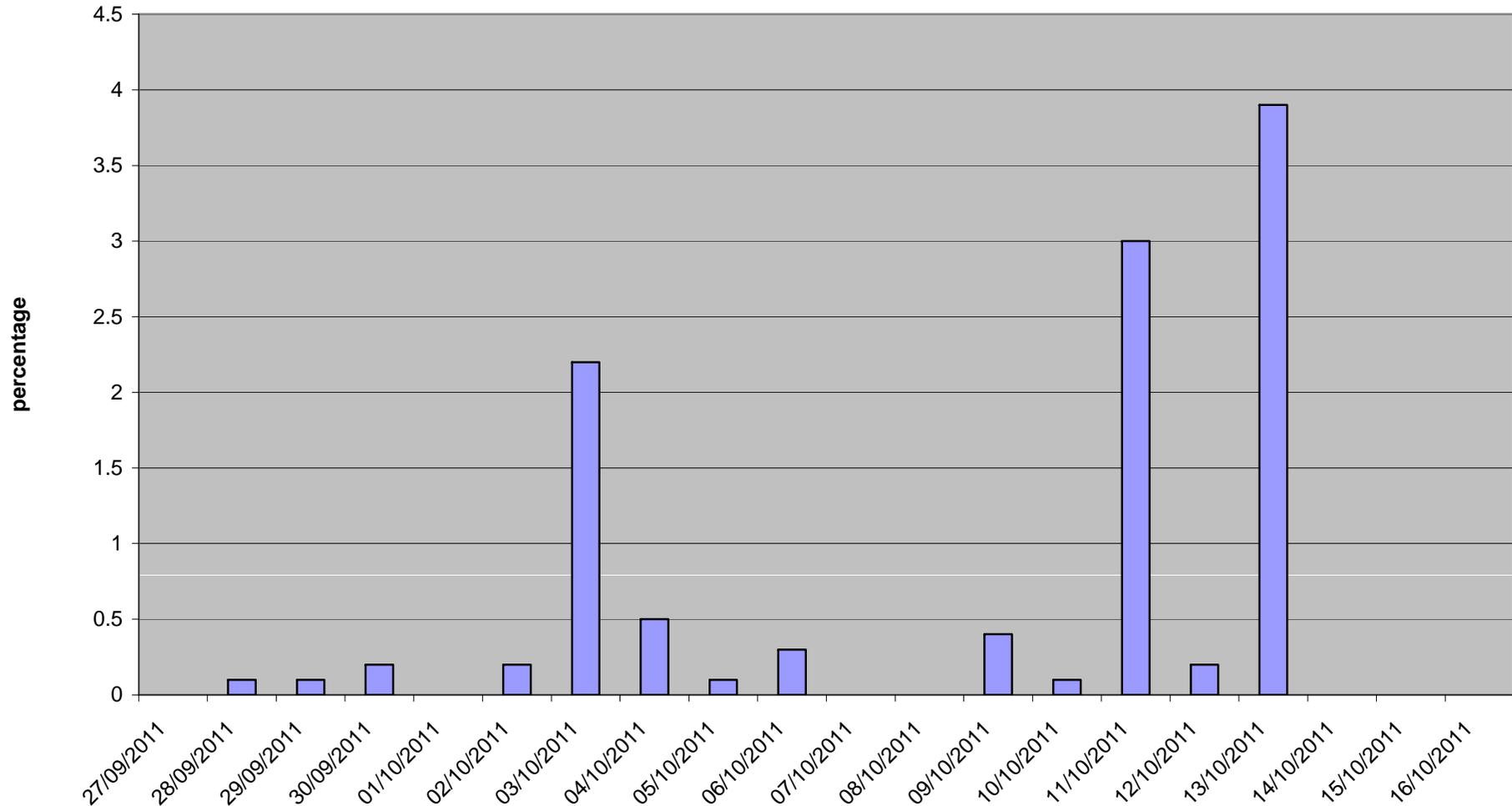
CENTRE NATIONAL D'ÉTUDES SPATIALES

OSDR Mispointing > 0.3 degrees



Jet Propulsion Laboratory
California Institute of Technology

Jason-1 - % of OSDR measurements with mispointing > 0.3° during tank depletion maneuvers
(typical value = 0)



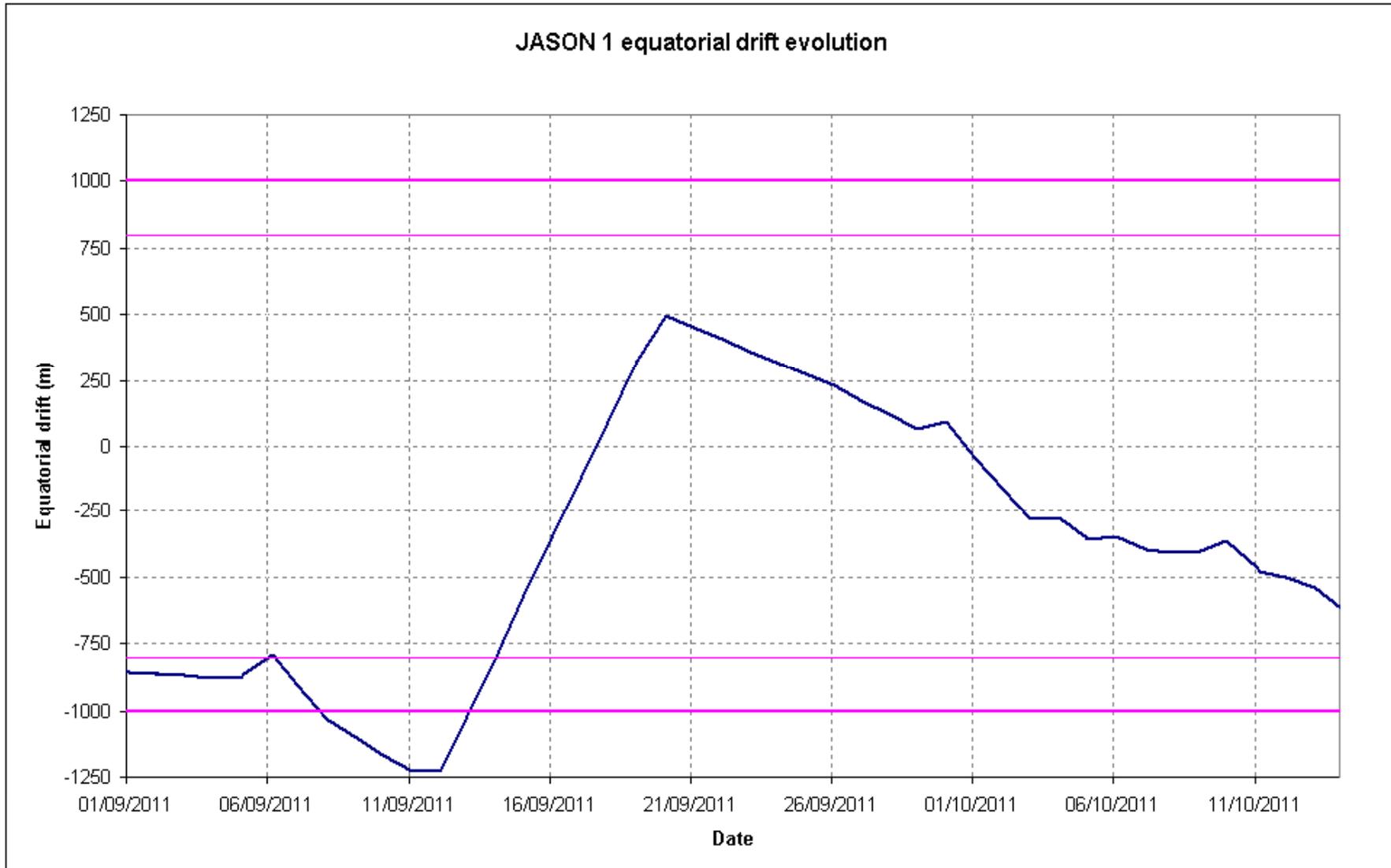


CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1 Equatorial Drift Excursions



Jet Propulsion Laboratory
California Institute of Technology





CENTRE NATIONAL D'ÉTUDES SPATIALES

Scenario and Timeline for Orbital Change



Jet Propulsion Laboratory
California Institute of Technology

- Jason-1 is now (after depletion success) authorized to continue for two more years on the 1336 km orbit.
- It is assumed that SARAL/AltiKa will launch in 2012 and that data will be validated and released by 2013.
- Due to the threat posed by TOPEX/Poseidon, Jason-1 will closely monitor its relative drift in mid/late-2013.
- In 2013, Jason-1 should be moved to the 1324 km geodetic/graveyard orbit.
- Due to the threat posed by Debris Object 35414, Jason-1 should remain operational (or maneuverable) until 2014 to avoid possible conjunctions in this graveyard orbit.
- After 2014, the threat posed by Debris Object 35414 to the graveyard orbit will begin to decrease and Jason-1 could be passivated.
- Due to the threats posed by Objects 35414 and 37379, Jason-1 should not consider any other orbit below 1324 km.

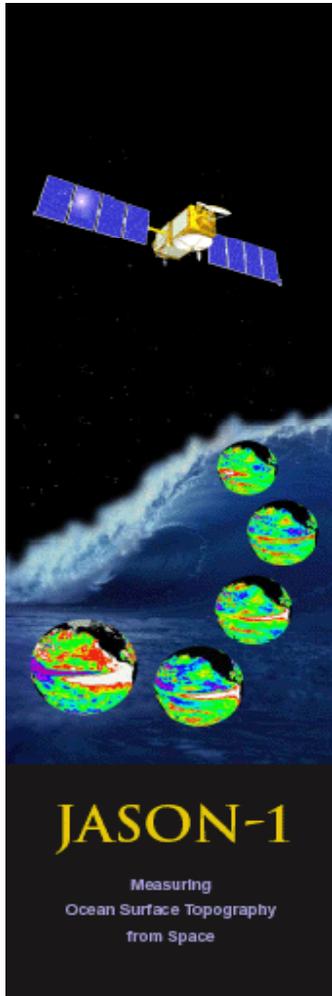


CENTRE NATIONAL D'ÉTUDES SPATIALES

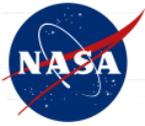
Jason-1 Instrument Status



Jet Propulsion Laboratory
California Institute of Technology



- ***CNES provided two payload instruments for the Jason-1 mission:***
 - Altimeter (POSEIDON2)
 - Doppler Radio-Positioning (DORIS)
- ***NASA/JPL provided three payload instruments for the Jason-1 mission:***
 - Microwave Radiometer (JMR)
 - Laser Retroreflector Array (LRA)
 - Turbo Rogue Space Receiver (TRSR)



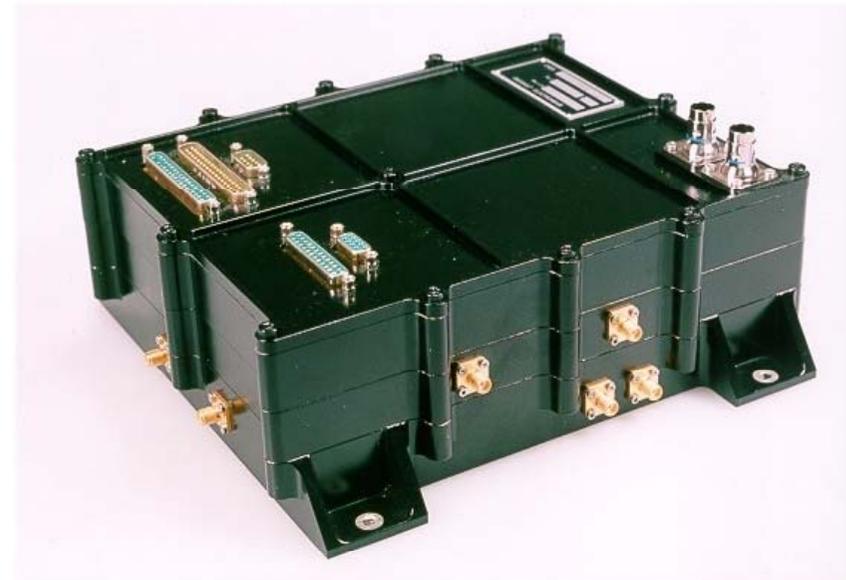
CENTRE NATIONAL D'ÉTUDES SPATIALES

DORIS Status



DORIS

- Switched from DORIS #2 to DORIS #1 on 28 June 2004 after USO instability was observed.
- DORIS #2 is now redundant
- DORIS #1 availability since last OSTST is >> 99%



DORIS IS FUNCTIONING NOMINALLY



CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1 DORIS Performance



Jet Propulsion Laboratory
California Institute of Technology

- DOPPLER MEASUREMENT
 - mean value for noise is **0.39-0.42 mm/s** (POE residuals)
 - still a “radiation USO effect” for “SAA Beacons”
 - Since Cycle 262, the SAA Effect Model for the DORIS Chain#1 has been updated to take into account the Jason-1 orbit change
- DORIS Time-tagging of PPS performances
 - is used for altimeter data
 - **accuracy is 1-2 microseconds** compared to on-board GPS (platform)
- Navigator (DIODE) performances are beta-prime dependent:
 - daily **radial RMS : 10 to 20 cm**
 - daily **3D-RMS : 40 to 70 cm**
- **Fuel depletion perturbations:**
 - **04-Oct-2011 01h44m40 UTC to 02h47m10 UTC: Auto-initialization DIODE**
 - **07-Oct-2011 02h49m00 UTC to 04h00m50 UTC: Auto-initialization DIODE**
 - **13-Oct-2011 05h07m10 UTC to 06h02m10 UTC: Auto-initialization DIODE**
 - DORIS availability since last OSTST is **>> 99%**



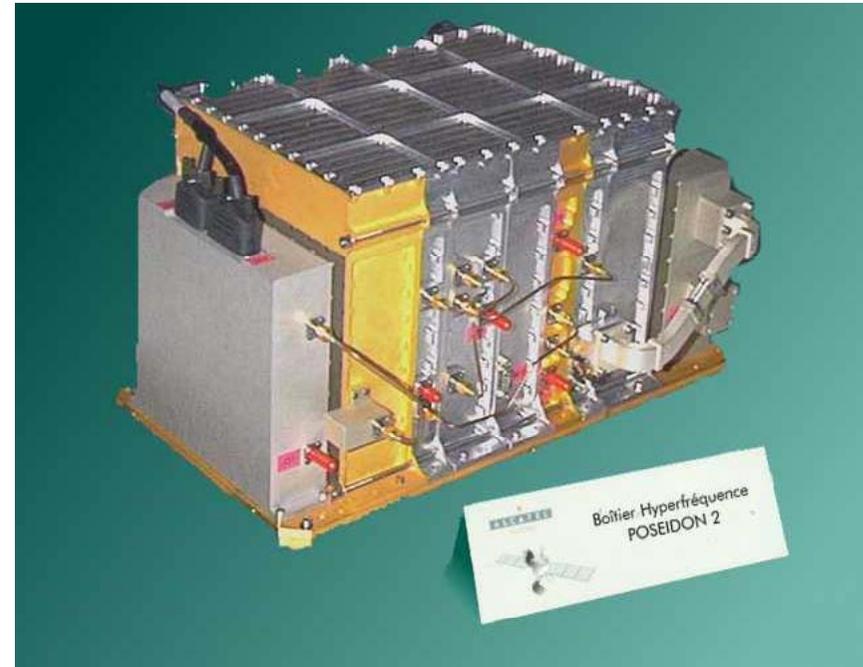
CENTRE NATIONAL D'ÉTUDES SPATIALES

POSEIDON2 Status



POSEIDON2

- Chain #1 was turned on 10 December 2001.
- Chain #2 is redundant and has never been used.
- POSEIDON2 performance is affected by attitude excursions.
- POSEIDON2 availability since last OSTST is >> **99%**



POSEIDON2-1 ALTIMETER IS FUNCTIONING NOMINALLY



CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1 Microwave Radiometer (JMR)

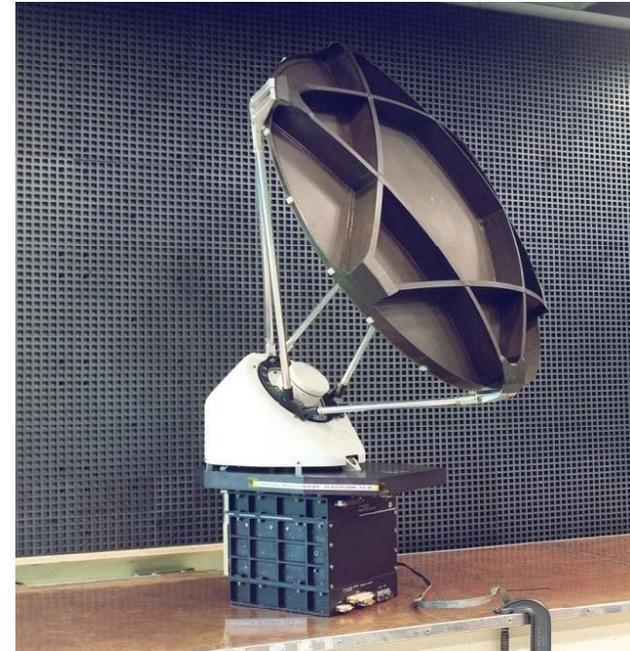


Presentation contributors:

- Shannon Brown, JPL
- Shailen Desai, JPL

Summary:

- JMR continues to operate nominally
- No Alarms
- No Commanding
- No engineering anomalies since launch
- Three confirmed science anomalies:
 - Cycle 31 and 68 anomalies was corrected in Version B GDRs
 - Cycle 136 anomaly was corrected in Version C GDRs
 - Replacement products available for Cycle 242 and Cycle 285 anomaly. Cycle 285 anomaly corrected on current GDRs.
 - No additional anomalies identified after cycle 285.





CENTRE NATIONAL D'ÉTUDES SPATIALES

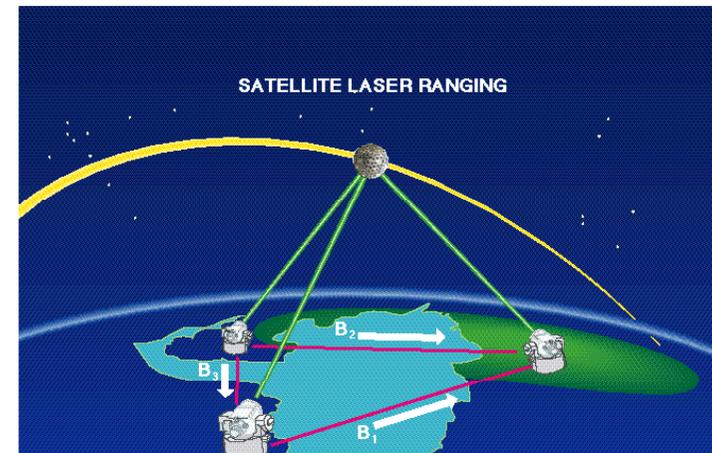
Laser Retroreflector Array (LRA)



Jet Propulsion Laboratory
California Institute of Technology

Summary:

- The LRA continues to provide returns adequate for tracking.
- SLR tracking of Jason-1 has been nominal.
- LRA Returns are the same power as Jason-2.
- The top five stations for Jason-1 tracking are:
 - Yarragadee (Australia)**
 - Zimmerwald (Switzerland)**
 - Mt. Stromlo (Australia)**
 - Changchun (China)**
 - Herstmonceux (U.K.)**
- **Additional SLR tracking was performed during the fuel depletion campaign to assist POD calculation during DORIS outages.**





CENTRE NATIONAL D'ÉTUDES SPATIALES

Turbo Rogue Space Receiver (TRSR)



- **Presentation contributors:**

- Tim Munson, Cognizant Engineer, JPL
- Glenn Shirliffe, JPL

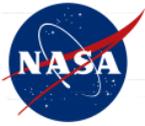
- **Science contributors:**

- Bruce Haines, JPL
- Shailen Desai, JPL
- Willy Bertiger, JPL

- **Summary:**

- TRSR1 (redundant receiver) experienced a critical failure during a software upload in September 2006 and will remain powered off.
- TRSR2 (primary receiver) experienced a critical failure during nominal operations in April 2009 and will also remain powered off.
- The TRSR instruments are NOT critical to mission success.
- **All Level 1 science and POD requirements can be met using DORIS and SLR for orbit determination.**





CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1 Payload Summary



Jet Propulsion Laboratory
California Institute of Technology

| Payload Instrument [Data Return Rating] | Current Status | Estimated Lifetime Remaining |
|--|---|---|
| Poseidon-2 [>> 99%] | Both prime and redundant sides are nominal. | > 4 years. |
| DORIS [>> 99%] | DORIS-1 unstable, (but still provides redundancy.) | > 4 years. |
| | DORIS-2 nominal. | |
| TRSR [LOST] | TRSR1 lost. (Sept-06) | No remaining life. Not mission critical. Not required for POD. |
| | TRSR2 lost. (Apr-09) | |
| LRA [100%] | Nominal, no degradation. | No lifetime limitation. |
| JMR [100%] | Both prime and redundant sides are nominal. | > 4 years. |



CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1 JPL Science Data Subsystem



Jet Propulsion Laboratory
California Institute of Technology

Summary Report since OSTST 2010:

- **No scientific changes to Jason-1 algorithms since previous OSTST Meeting.**
- Auxiliary Data changes were:
 - Two new Gaussian grid N400 and N640, disseminated May, 2nd
 - An ECMWF model change occurred on 17 May 2011. The new model is named 37r2

Significant Events/Activities:

- Feb-2011: Level-1 Operations Improvements
- Update Interface Agreement “SSALTO_JSDS_XDF_HISTO_TAI_TUC” for dissemination of the UTC/AIT bias adjustments.
- Hardware improvements resulted in faster OSD R processing

For CNES status, please refer to the 2010 CALVAL report available at:
<http://www.aviso.oceanobs.com/fr/calval/systematic-calval/index.html>



CENTRE NATIONAL D'ÉTUDES SPATIALES

JPL PO.DAAC FTP Data Distribution



| Product Name | GB | Files |
|--|----------------|-----------------|
| Jason-1 SGDR bin | 5237.3 | 622664 |
| Jason-1 GDR bin | 2247.2 | 2159602 |
| Jason-1 IGDR bin | 552.5 | 494922 |
| Jason-1 OSD R bin | 248.3 | 564021 |
| total binary | 8285.3 | 3841209 |
| Jason-1 SGDR nc | 6061.9 | 486323 |
| Jason-1 SIGDR nc | 1706.1 | 63058 |
| Jason-1 GDR nc | 4065.9 | 1047356 |
| Jason-1 GDR SSHA nc | 150.7 | 740537 |
| Jason-1 IGDR nc | 1674.7 | 420195 |
| Jason-1 IGDR SSHA nc | 9.2 | 71411 |
| total netcdf | 13668.5 | 2828880 |
| total Jason-1 project generated | 21953.8 | 6670089 |
| Jason-1 GPS NRT SSHA | 238.9 | 668191 |
| Jason-1 enhanced JMR | 85.7 | 1914146 |
| Jason-1 PO.DAAC ATG SSHA | 6.2 | 4655 |
| Jason-1 PO.DAAC SSHA | 104.5 | 1858517 |
| total Jason-1 | 22389.1 | 11115598 |

CNES also produces and distributes IGDR & GDR data.

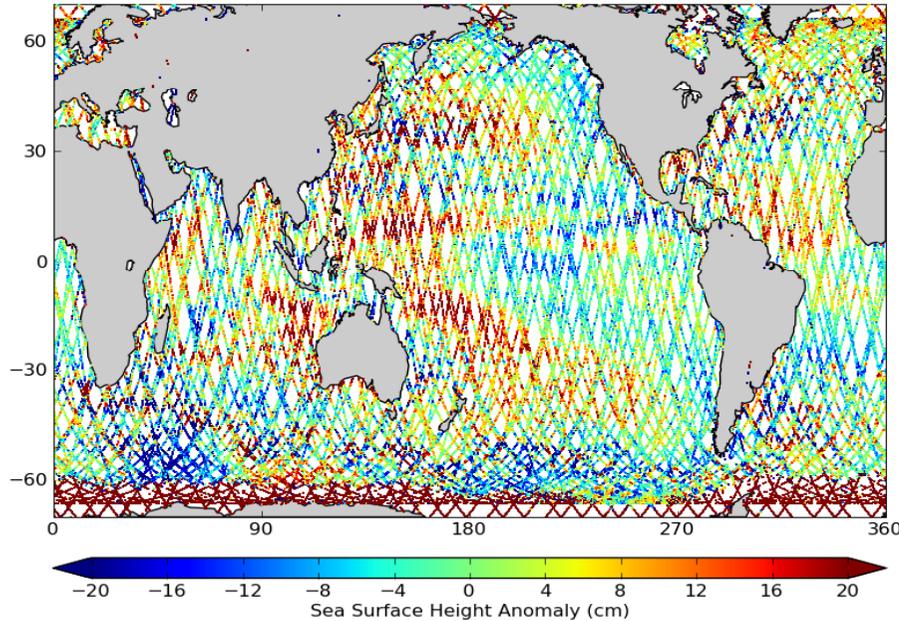


New Near-Real-Time Data Products



CENTRE NATIONAL D'ÉTUDES SPATIALES

SSHA Map Created with 3.3052-day window ending 2011-Aug-02 18:51:11 UTC
Last Available Measurements: Jason-2/Jason-1/Envisat 7.03/ 9.76/ 10.22 hrs ago.



These images illustrate the impact on overall spatial resolution of the NRT SSH measurements from the combination of the three missions. The 3-day map is especially compelling since it covers periods not covered by the respective IGDR products from these three missions.

Jason-1/Jason-2/Envisat (last 3 or 10 days):

http://sideshow.jpl.nasa.gov/sdd/JJE_SSHA_3day.png

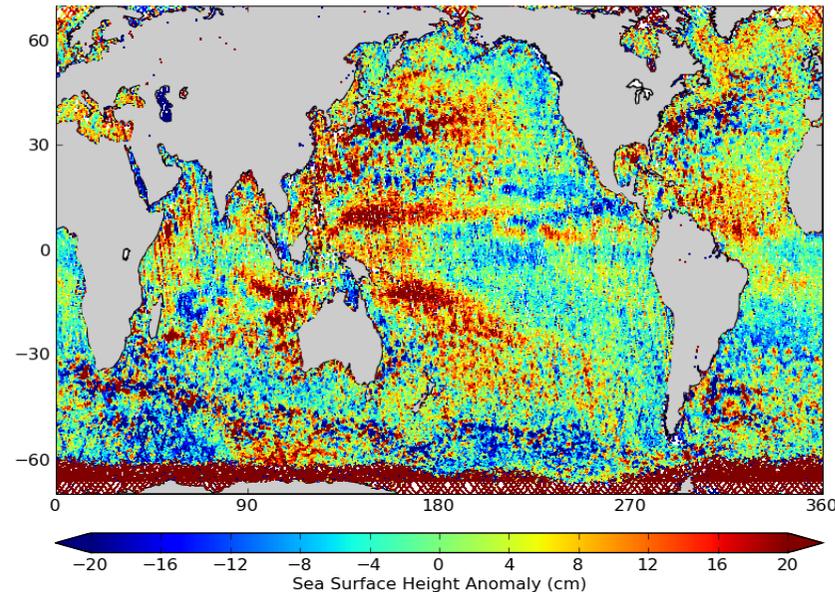
http://sideshow.jpl.nasa.gov/sdd/JJE_SSHA_10day.png

OSTST Meeting
San Diego, California

JPL has developed a NRT SSHA product that combines OSTM/Jason-2, Jason-1, and ENVISAT data.

The approach for ENVISAT is similar to what we used for Jason-1, namely using sea surface height crossovers with Jason-2 NRT SSH to compute a correction to a dynamic orbit fit to the DORIS-DIODE orbit. We are still evaluating orbit accuracy but we suspect it is ~2 cm radial RMS.

SSHA Map Created with 9.9156-day window ending 2011-Aug-02 18:42:29 UTC
Last Available Measurements: Jason-2/Jason-1/Envisat 6.88/ 9.61/ 10.07 hrs ago.



October 2011



CENTRE NATIONAL D'ÉTUDES SPATIALES

TOPEX/Poseidon, Jason-1 and OSTM/ Jason-2 Science/Outreach Success

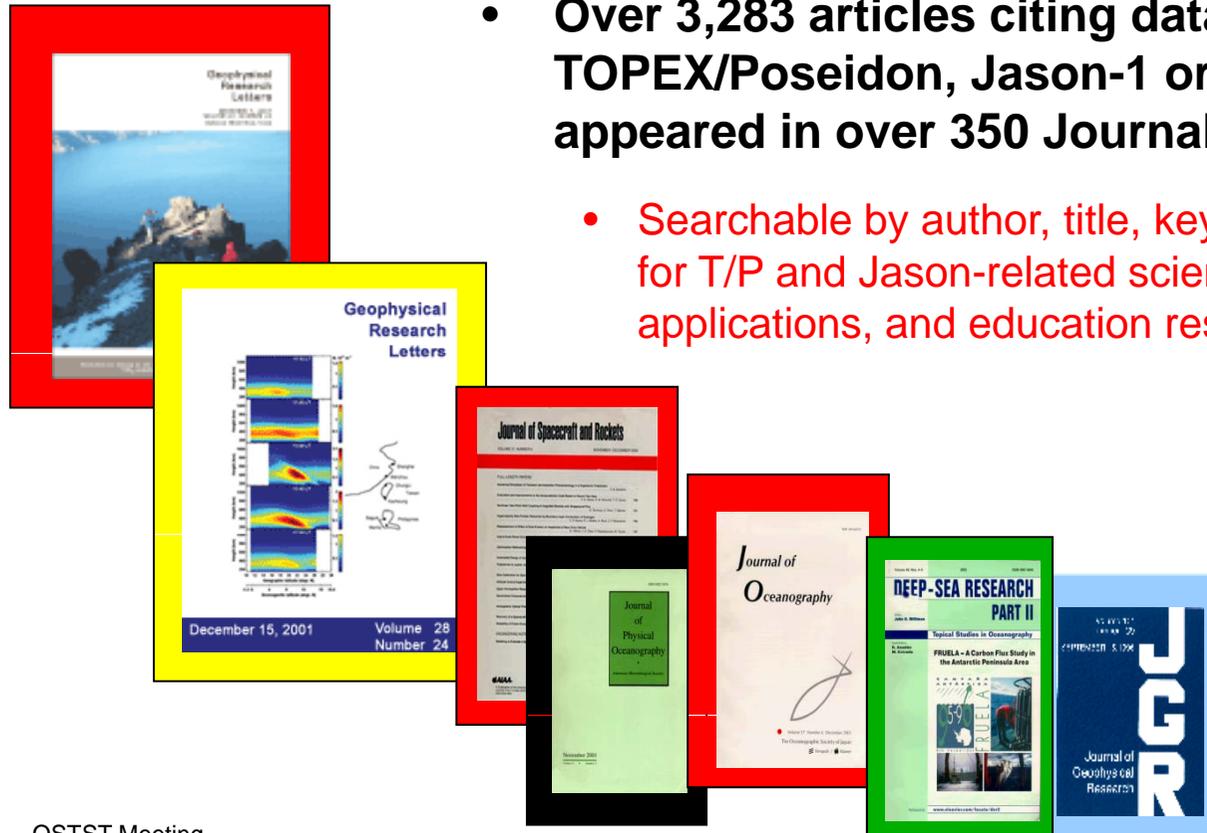


Jet Propulsion Laboratory
California Institute of Technology

T/P, Jason-1, and OSTM/Jason-2 open literature database is available on-line:

<http://sealevel-lit.jpl.nasa.gov/science/search-form.cfm>

- Over 3,283 articles citing data utilization from TOPEX/Poseidon, Jason-1 or OSTM/Jason-2 have appeared in over 350 Journals or Publications
 - Searchable by author, title, keyword, abstract, & category for T/P and Jason-related science, engineering, applications, and education research from 1990-present



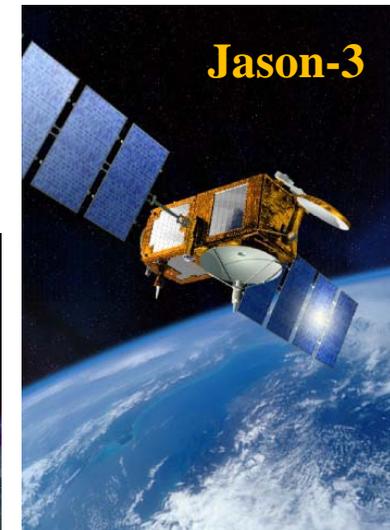
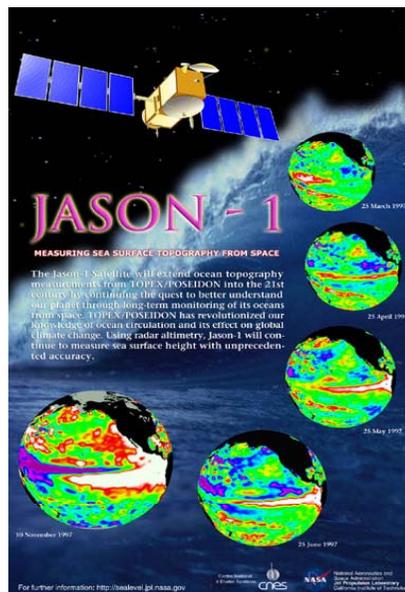
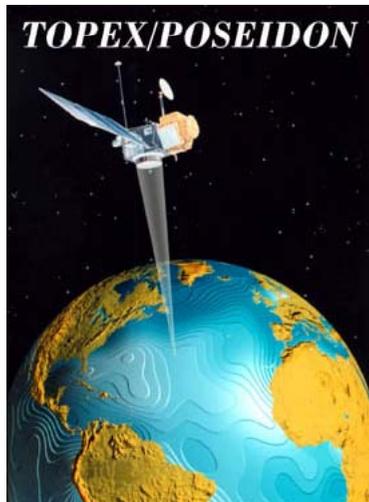


CENTRE NATIONAL D'ÉTUDES SPATIALES

TOPEX/Poseidon, Jason-1, OSTM/Jason-2, Jason-3, and SWOT: Onward and Upward!

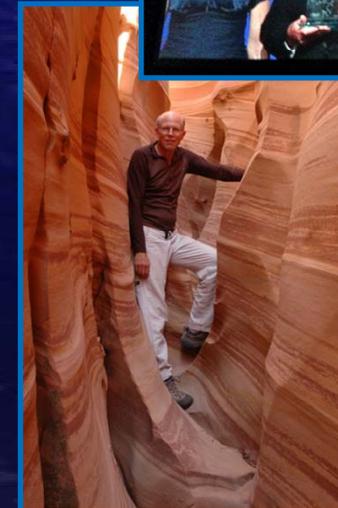


- Efforts are underway to reprocess the entire TOPEX/Poseidon dataset to GDR-C standards in NetCDF data formats.
- OSTST input will be critical to ensure that a continuous validated data record is available.
- Scientists, NASA, and CNES must continue joint efforts to demonstrate the applications and value of ocean science to the public.
- Societal benefits will define NASA/CNES strategy for long-term ocean climate observing systems.



OSTST Laurels and Accolades

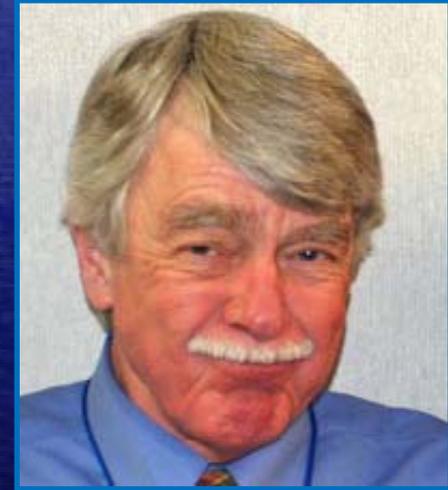
- ❖ Josh Willis (JPL) will receive the AGU *Ocean Sciences Early Career Award* in December for his 'pioneering contributions integrating global satellite and in situ ocean data for understanding climate variability and change, as well as for his leadership in the satellite altimetry community.'
- ❖ Charles Elachi (JPL Director), was inducted as a *Chevalier de la Legion d'Honneur*, one of France's highest honors.
- ❖ Bill Patzert (JPL) was honored by the American Geophysical Union with its 2010 *Athelstan Spilhaus Award* for his contributions to improving public understanding of Earth science.
- ❖ Dudley Chelton (Oregon State University), received the American Meteorological Society's *Henry Stommel Research Award* for fundamental contributions to advancing our understanding of ocean circulation and air-sea interaction. In receiving this award, he also became a Fellow of the AMS.

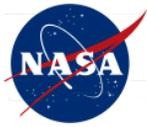


Retirements

❖ Stan Wilson (NOAA/NESDIS Senior Scientist), retired in June 2011, after 40 years of government service, at the Office of Naval Research, NASA Headquarters, and finally with NOAA where he served as Assistant Administrator of the National Ocean Service.

Stan helped pioneer the modern era of satellite oceanography through his work on the TOPEX/ Poseidon altimeter mission and more recently through his leadership of the Committee on Earth Observation Satellites (CEOS) Ocean Surface Topography Constellation.





CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1 Backup Slides



ALLEZ LES BLEUS !





CENTRE NATIONAL D'ÉTUDES SPATIALES

January 2011 Joint Steering Group (1/2)



- Requested by previous JSG of July 2010
- Objectives
 - To assess the status of the depletion operations
 - To assess alternative orbit proposed by OSTST
 - To define strategy for a potential move to an alternative orbit
 - To define future CNES-NASA JWG activities
 - To agree on a coordinated CNES-NASA mission extension request



CENTRE NATIONAL D'ÉTUDES SPATIALES

January 2011 Joint Steering Group (2/2)



Jet Propulsion Laboratory
California Institute of Technology

- Main decisions

- Acceptance of the OSTST recommendation for continuing routine operations in tandem orbit and in the future on alternate science on a “geodetic” orbit
- Approval of an emergency graveyard orbit (120 km)
- To continue Jason-1 routine operations (up to 2011 REVEX)
- To continue the investigation of the thruster #4 anomaly and to provide a status at the 2011 REVEX
- To prepare programmatic mission extension proposals

All actions closed



CENTRE NATIONAL D'ÉTUDES SPATIALES

REVEX 2011: Revised Recommendation Proposed by CNES-NASA JWG



- Orbit 1336 km, tandem
- Hydrazine for station keeping, CA and graveyard (-12 km) → 4-5kg reserve
- partial tank depletion (11-12 kg remaining to deplete)
- **Rationale**
 - SARAL/Altika validated products delay
 - LOS recommendation
 - Thruster #4 problem
- **Benefits**
 - Compliant with one OSTST recommendation (tandem before SARAL)
 - Full science return
 - LOS request 1: to continue partial tank depletion
 - Half fuel than original recommendation
 - Graveyard orbit is not the reference orbit
 - Firm schedule possible
- **Concerns**
 - LOS request 2: to leave reference orbit as soon as possible
 - ~4 kg fuel remaining



CENTRE NATIONAL D'ÉTUDES SPATIALES

Thruster #4 Underburn Concern



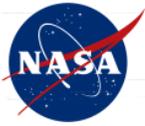
Jet Propulsion Laboratory
California Institute of Technology

Description

- At the beginning of Science Cycle 315 on 20-July-2010, a planned campaign of offsetting four-thruster inclination-change maneuvers commenced, as a risk mitigation to deplete excess fuel onboard Jason-1.
- After 8 of the 12 planned maneuvers, thruster #4 began to show systematic burn underperformance.
- CNES suspended the fuel depletion campaign until a manufacturer's investigation of the anomaly could be completed by TAS and EADS GmbH.
- No single hypothesis explained the observed under-efficiency and thermal behaviors of Thruster #4. However, there was no risk identified with resuming the use of the thruster.

Resolution/Impact

- This past summer, TAS developed a FSW patch that would immediately terminate an unbalanced 4-thruster (OCM4) maneuver.
- In September 2011, Thruster #4 was tested, recovered and calibrated.
- After JSG approval, the fuel depletion campaign then resumed on 17-Sept-2011.



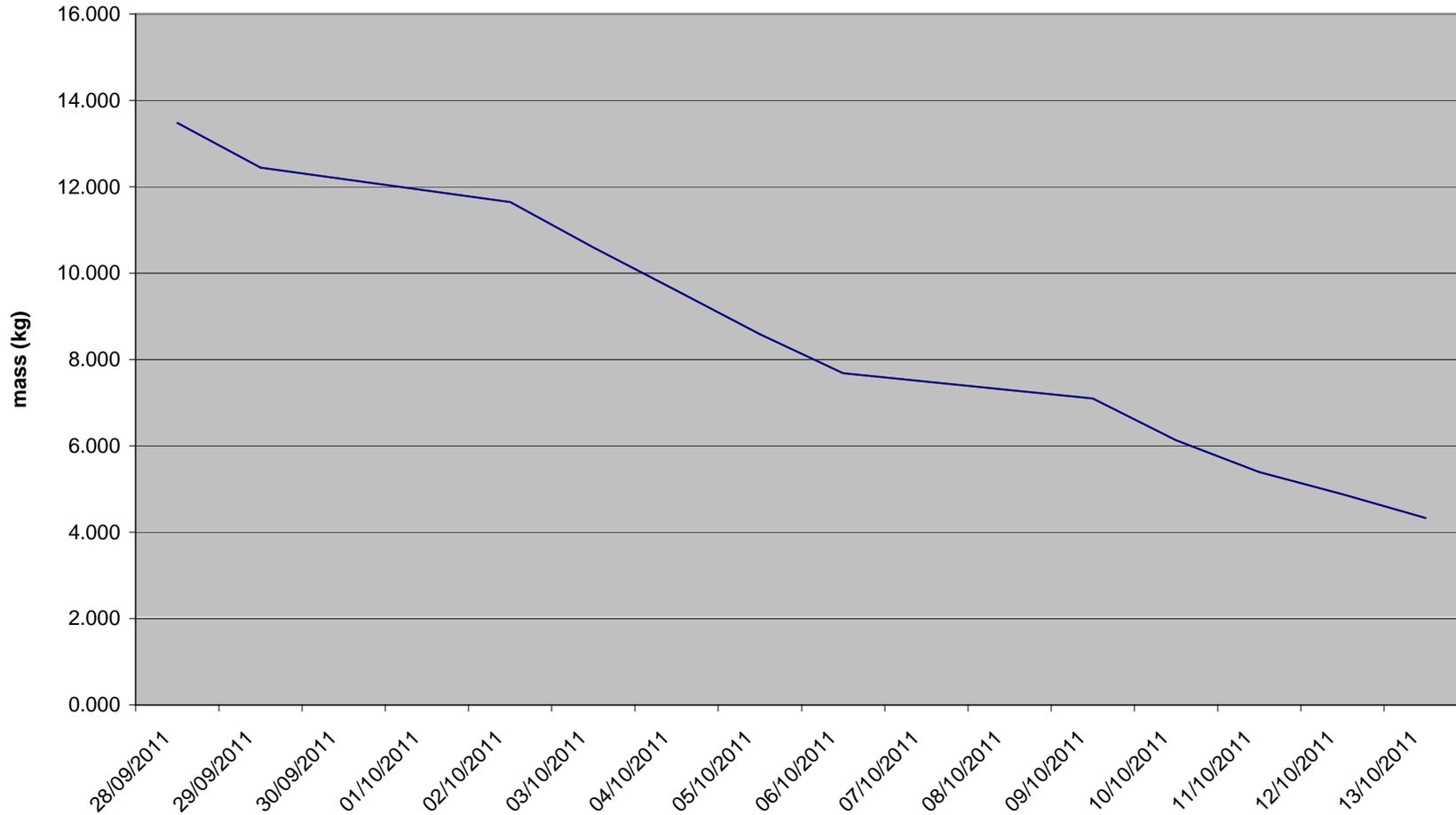
CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1 Tank Depletion Activities



Jet Propulsion Laboratory
California Institute of Technology

2011 - Jason-1 tank depletion activities





CENTRE NATIONAL D'ÉTUDES SPATIALES

Jason-1 Debris Risks



Jet Propulsion Laboratory
California Institute of Technology

- Two pieces of orbital debris were recently cataloged and attributed to Jason-1:
 - Object 35414 (2001-055F)
 - Object 37379 (2001-055G)
- It is believed that these objects were expelled from Jason-1 after a particle hit to the left solar panel in March 2002.
- Both objects are in similar but lower orbits to Jason-1 and will decay faster than Jason-1.
- Object 35414 poses a moderate risk to the 1324 km orbit from mid-2012 until 2014. (High risk to the 1287 km orbit.)
 - After 2014, the relative geometries will improve.
- Object 37379 poses a low risk to the 1324 km orbit. (Moderate risk to the 1287 km orbit.)



CENTRE NATIONAL D'ÉTUDES SPATIALES

Mission Extension: Background



PI's formally requested a 2-year extension for Jason-1 in March 2011

→ analyzed by CNES at the REvue D'Extension de Mission (REDEM) held in April 2011

→ analyzed by NASA through the Senior Review process (March-May 2011)



CENTRE NATIONAL D'ÉTUDES SPATIALES

Mission Extension: CNES REDEM Results



- Final recommendation (endorsed by CNES Steering Group):
- OK to continue Jason-1 mission up to end 2013 on the current orbit with the following constraints:
 - to resume asap depletion activities (with provision for station keeping, CA and graveyard at -12 km),
 - to leave 1336 km orbit as soon as other altimeter data are available and at least by end 2013
 - to update the “LOS” documentation with the new inputs for a formal CNES/P decision before end of 2011
 - to prepare operational procedures in case of contingency



CENTRE NATIONAL D'ÉTUDES SPATIALES

Mission Extension: NASA Senior Review Results



Jet Propulsion Laboratory
California Institute of Technology

- In March-May 2011, a Senior Review proposal was submitted to NASA HQ to extend Jason-1 operations in the current orbit until other altimeter data are available and then to move to a long-repeat geodetic orbit to continue the Jason-1 science mission.
- **Guidance is consistent with the CNES REDEM:**
- *The JASON-1 Project is directed to implement its optimal proposal for extended mission operations and data analysis (through to 2013, and beyond):*
 - *Continue to evaluate the scientific gains of obtaining additional data against the potential risks on maintaining Jason-1 in the interleaved orbit;*
 - *Plan to maneuver to the geodetic orbit mission once AltiKA is on-orbit and validated, or sooner, should the spacecraft experience additional technical anomalies.*
- *New mission requirements for the Geodetic Mission will need to be approved by NASA ESD and our CNES partner through the medium of the Joint Steering Group (JSG). The Jason-1 Project is asked to work with NASA Headquarters and the Ocean Surface Topography Science Team to assure approval of the new requirements and readiness for implementation by the Project at the direction of the JSG by January 31, 2012.*