Discussion Points for Splinter Sessions

Project Scientists

Ocean Surface Topography Science Team Meeting (OSTST)

7–11 November 2023
San Juan, Puerto Rico

Future planning for Jason-3

The current plan for the Jason-3 mission extension includes a 2nd tandem phase in 2025 with Sentinel-6MF to reduce the uncertainty in the mean sea level record, which the OSTST had recommended.

What happens after that?...

In light of the early results from SWOT, should we consider changes to the recommended plan?

- Interleaved phase (April 2022 to early 2025)
- Tandem phase (4-6 months)
- Long-repeat orbit (2 complete cycles, ~2 cycles)
- Final orbit

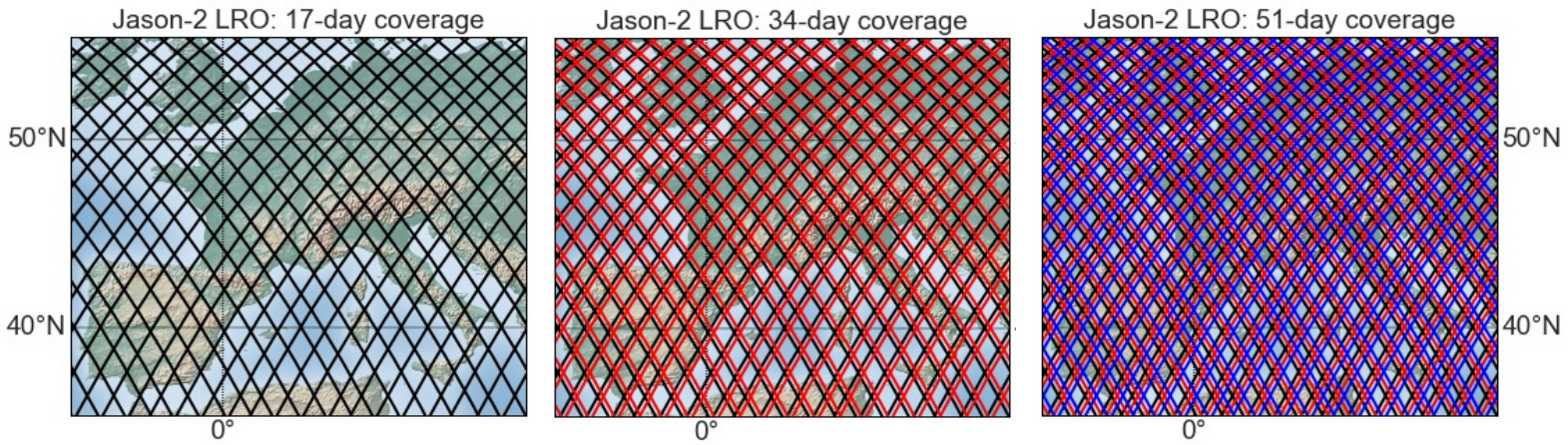
The Long Repeat Orbit

The Long Repeat Orbit (LRO) accommodates both geodetic science (e.g. mean sea surface, geoid) and operations (model assimilation)

It is approximately 27 km below the reference orbit and has sub-cycles (near-repeat) and cycle (exact repeat):

- Sub-cycle: 4 nodal days - 3.97 days - 51 revolutions (beneficial for sea state and mesoscale)
- Sub-cycle: 17 nodal days - 16.86 days - 217 revolutions (beneficial for sea state and mesoscale)
- Sub-cycle: 81 nodal days - 80.31 days - 1034 revolutions
- Sub-cycle: 145 nodal days - 143.77 days - 1851 revolutions
- Cycle: 371 nodal days - 367.84 days - 4736 revolutions (fine grid of approximately 8-km, per cycle)

Each period of 17 days yields a geographically regular grid of 434 passes (approx. 180 km at the Equator). Due to the presence of the 81-day sub-cycle, subsequent grids are shifted in longitude by approximately 40 km (resolution of the 81-day sub-cycle). The same phenomenon exists with the 4-day and 17-day sub-cycles (780 km grid translated by 280 km every 4 days) and other sub-cycles.



Jason-1 Geodetic Mission and Jason-2 LRO coverage

The GM for Jason-1 lasted 406 days. The GM for Jason-2 was planned to provide ground-tracks with a systematic spacing of 4 km after 2 years and potentially 2 km after 4 years.

J2 ceased operation in October 2019 after 2 years of Geodetic Mission (with gaps) but still improved high resolution gravity recovery.

<u>Current Jason-3 plan:</u>
Complete the 2-km grid

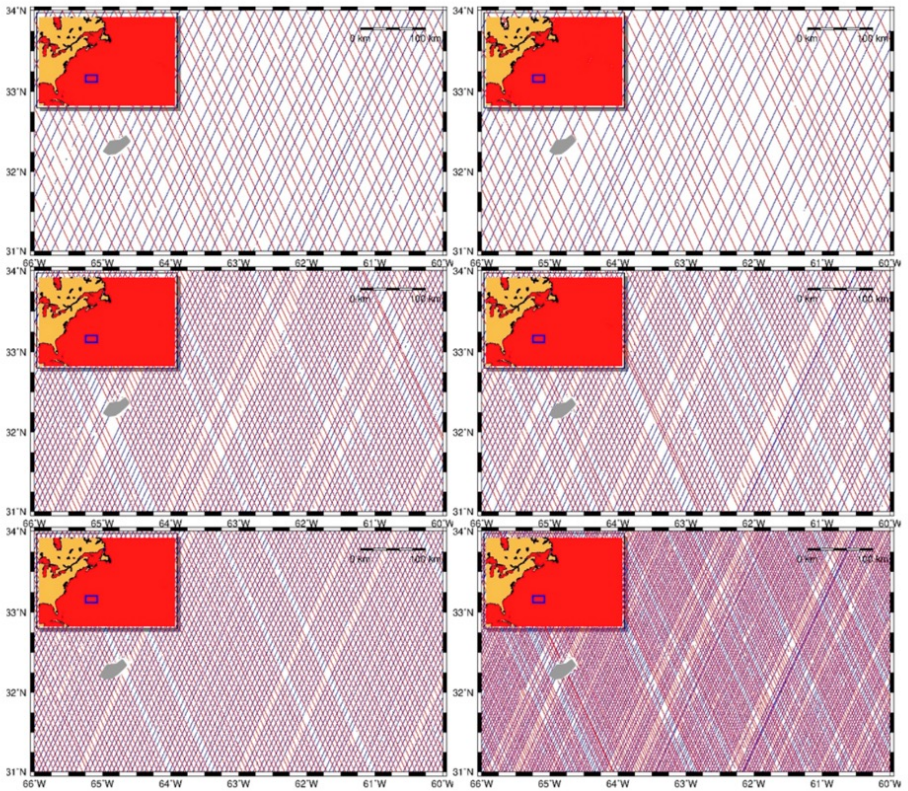


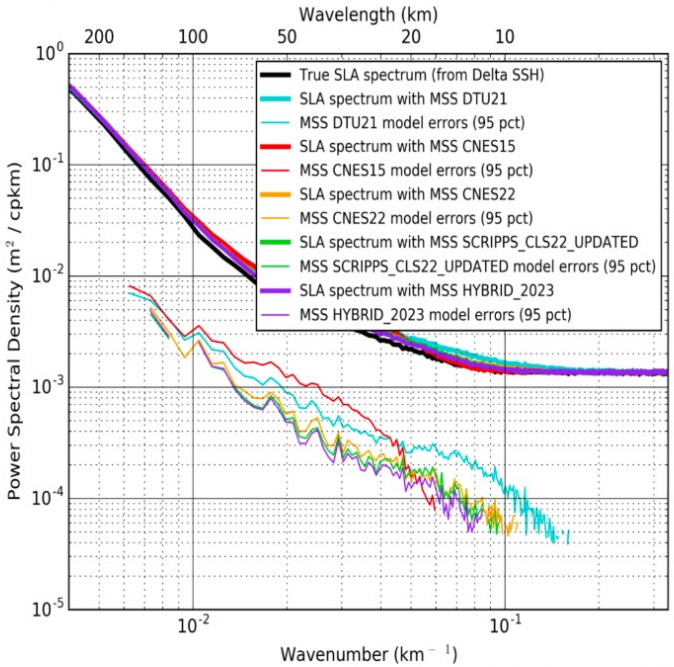
Figure 1. Geographic distribution of Jason Geodetic Mission (GM) altimeter measurements for a section in the NW Atlantic Ocean close to Bermuda (in grey). Upper left: J1 sub-cycle 1. Upper right: Jason 1 sub-cycle 2. Center left: J2 LRO Cycle 1. Center right: Jason 2 LRO cycle 2. Lower left: J1 Entire GM. Lower right: Jason 2 Entire GM (Both LRO cycles).

Andersen et al. 2021

Prelim SWOT MSS results

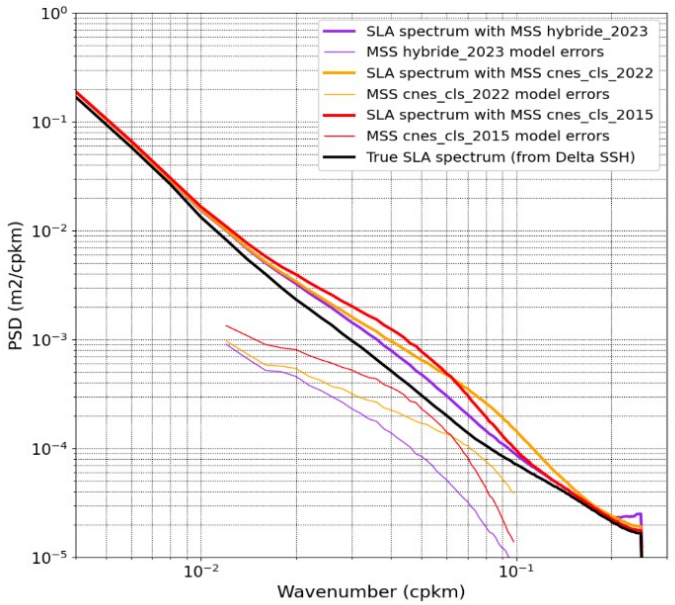
Estimation of the mean MSS error over the global ocean

Sentinel-3A LRRMC used for validation



CNES_CLS_2015
CNES_CLS_2022
HYBRIDE_2023
DTU_2021
SIO_2022

SWOT KaRIn used for validation



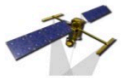
➔ Consistent results obtained with SWOT and S3A measurements at wavelengths ranging [70, 20km].

➔ Low noise level on SWOT = high potential for error estimation at short wavelengths (< 20km)

➔ **Preliminary results with SWOT that need to be consolidated**

Pujol et al. 2023

Prelim SWOT MSS results



Futures MSSs deduced from SWOT measurements

SWOT can be used to estimate a new MSS below the swath position.

A MSS error model prediction was proposed by Dibarboure et Pujol (2021; https://doi.org/10.1016/j.asr.2019.06.018):

Depends on 3 main parameters :

- The measurement noise level
- The repetitivity of the measurement
- The number of cycles (temporal period) available to compute the MSS

➔ They modulate the commission errors (i.e. residual noise or small-scale ocean variability) in the MSS

	MSS error level at short wavelength (in % of SSHA variance)			
	18% (~error of the up-to-date MSS models)	**9% (half the error of up-to-date MSS models)**	**< 5%**	**<2%**
	MSS SWOT can be used for future SWOT measurements (not used in MSS computation)	*MSS SWOT can be used for future and past measurements*		
SWOT CalVal phase (1-day repeat)			90 cycles (~3 months)	130 cycles (~4,3 months)
SWOT Scientific phase (21-day repeat)	9 cycles (~6 months)	18 cycles (~12 months)	26 cycles (~1,5 years)	52 cycles (~3 years)

Tab: Temporal period required to reach a defined MSS error level at short wavelength

Pujol et al. 2023

Future planning for Jason-3

Questions to be discussed:

- Is Long-Repeat Orbit (LRO) still necessary?
- If not, which kind of mission phase (after tandem) will make better return for the communities?

Options:

1. Go to the LRO orbit after the second tandem (current baseline)
2. Return to the interleaved orbit until Sentinel-6 MF joins Jason-3 on the interleaved track in ~2026
   - Should there be a third tandem?
   - And which kind of mission phase after that?
3. Go to another orbit phase after the second tandem
   - Which kind of mission phase is preferred?

Please provide strong arguments for your preferred solution.

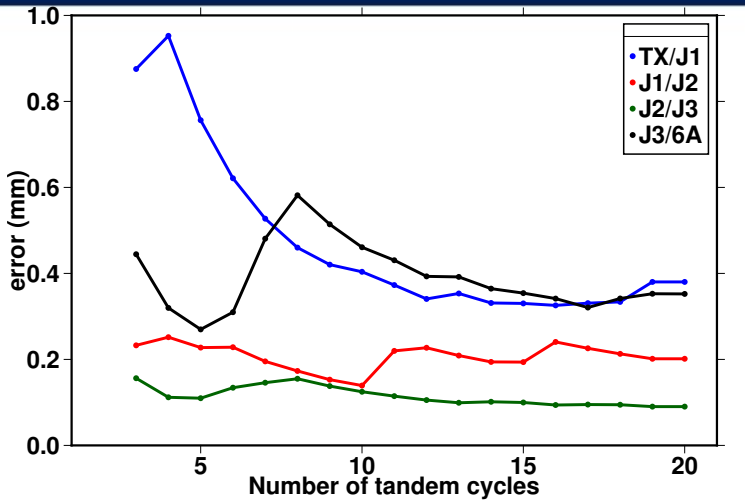
Climate requirements on reference missions (S6 and S6 Next Gen)

1) Require multiple tandem phases?

Will requiring the tandem phases require future missions to remain in the reference orbit?

2) Change the intermission bias requirement?

The current requirement for S6 is 1 mm, which may be too large for climate science.



3) New system stability (drift) requirements?

Climate science question	Accuracy in GMSL rates ($mm\,yr^{-1}$)	Accuracy in GMSL acceleration ($mm\,yr^{-1}$ per decade)	Accuracy in regional sea-level rates ($mm\,yr^{-1}$)
Closing the sea-level budget	Detection[a,b]: ±0.1 Quantification[a,b]: ±0.02	–	Detection[c,d]: ±0.3 Quantification[c,d]: ±0.07
Detecting and attributing the signal in sea level that is forced by GHG emissions	Detection[b,e]: ±1.5 Quantification[b,e]: ±0.7	–	Detection[d]: ±0.5 Quantification[d]: ±0.1
Estimating the EEI	Detection[d,f]: ±0.1 Quantification[d,f]: ±0.03	Detection[d,g]: ±0.5 Quantification[d,g]: ±0.1	

Meyssignac et al. 2023

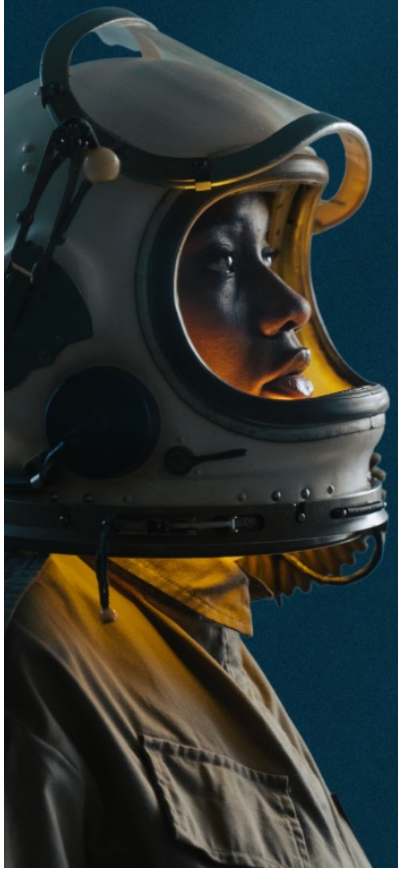
Future of the OSTST

The OSTST meeting is transitioning to an international forum for *all missions* with an emphasis on the reference missions.

- Increasing number of missions and instruments
- Satellite-specific (commissioning) meetings will stay
- More communities: oceanography, coastal, geodesy, hydrology, cryosphere
- Climate impacts from travel
- Virtual/hybrid/in-person meetings (potentially alternating)

Discussed at previous OSTST

- Please provide feedback to Project Scientists during the week.



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vol I. Sea Level Rise 2023

Online incubator
November 6th till December 6th

Jet Propulsion Laboratory
California Institute of Technology

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JPL

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6 masterclasses
(Google,Singularity, NYU, NBA)

1 winner
to present at JPL in 2024

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