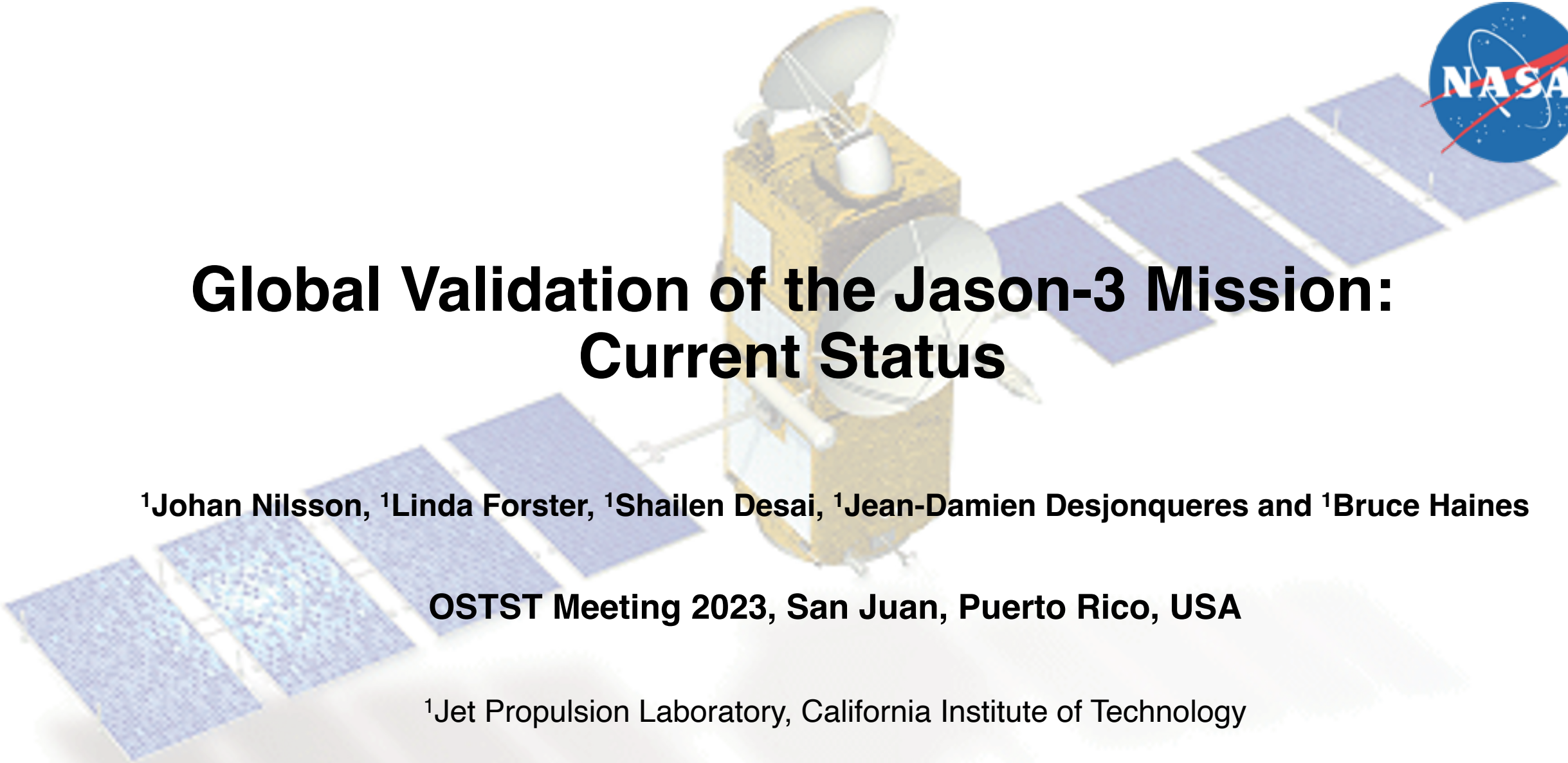


Global Validation of the Jason-3 Mission: Current Status

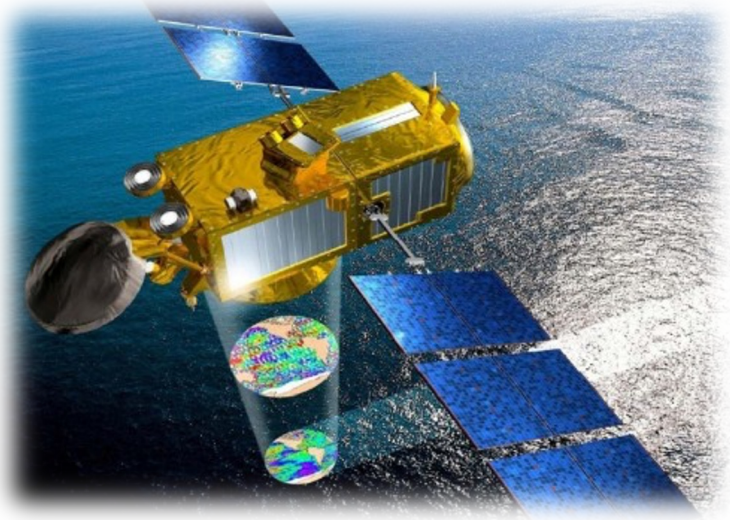
[1]Johan Nilsson, [1]Linda Forster, [1]Shailen Desai, [1]Jean-Damien Desjonqueres and [1]Bruce Haines

OSTST Meeting 2023, San Juan, Puerto Rico, USA

[1]Jet Propulsion Laboratory, California Institute of Technology

Jason-3 Mission and Characteristics

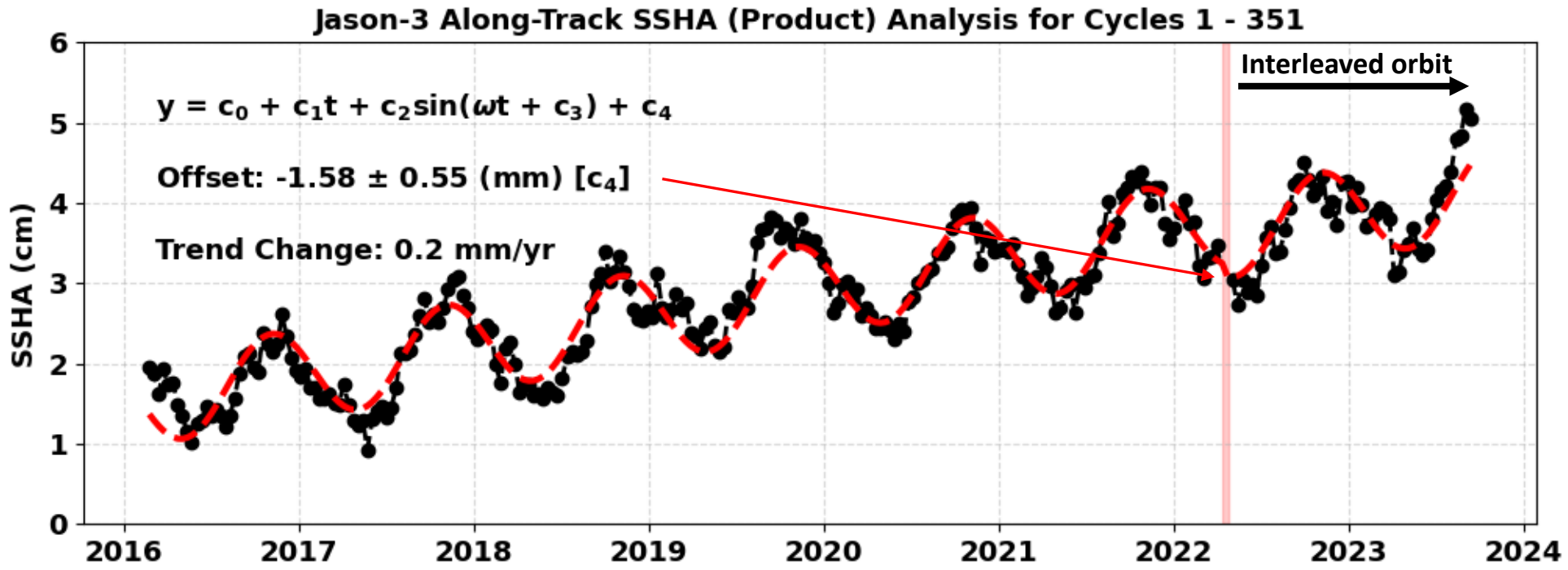
- Launched in January 2016
  - Currently 8-years in operation
- Poseidon-3B radar altimeter
  - Measurement: Sea Surface Height (SSH)
  - Goal: SSH RMS error of less than 3.4 cm.
- 10-day repeat orbit
  - Coverage ±66 degrees in latitude
- Interleaved orbit since April 2022
  - 18 months in the new orbit configuration
  - Focus on switch from reference to interleaved orbit



Outline

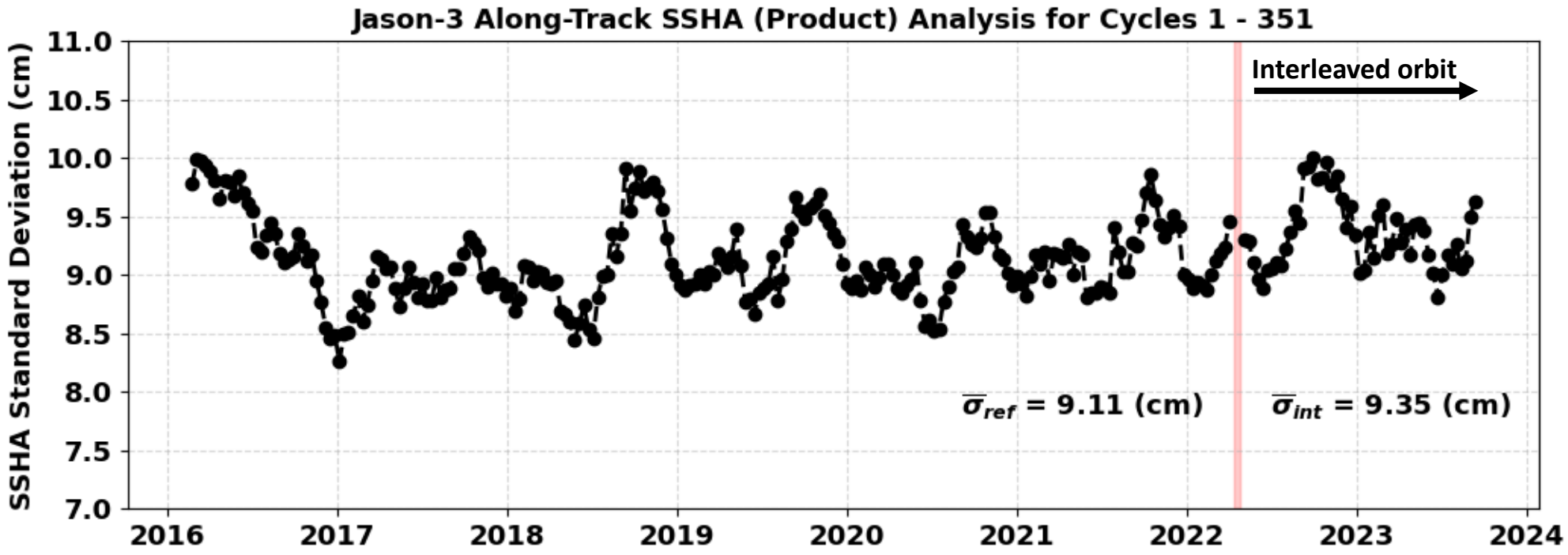
- Evaluate the Quality of the GDR-F Product over Ocean
  - Sea Surface Height Anomaly
  - Significant Wave Height (Ku - C Band)
  - Wet Troposphere Correction (AMR - Model)
  - Crossover Analysis (Error and Average)
- Ongoing Work and Analysis
  - Comparison of orbit solutions
  - Evaluation of observed signals

Sea Surface Height Anomaly



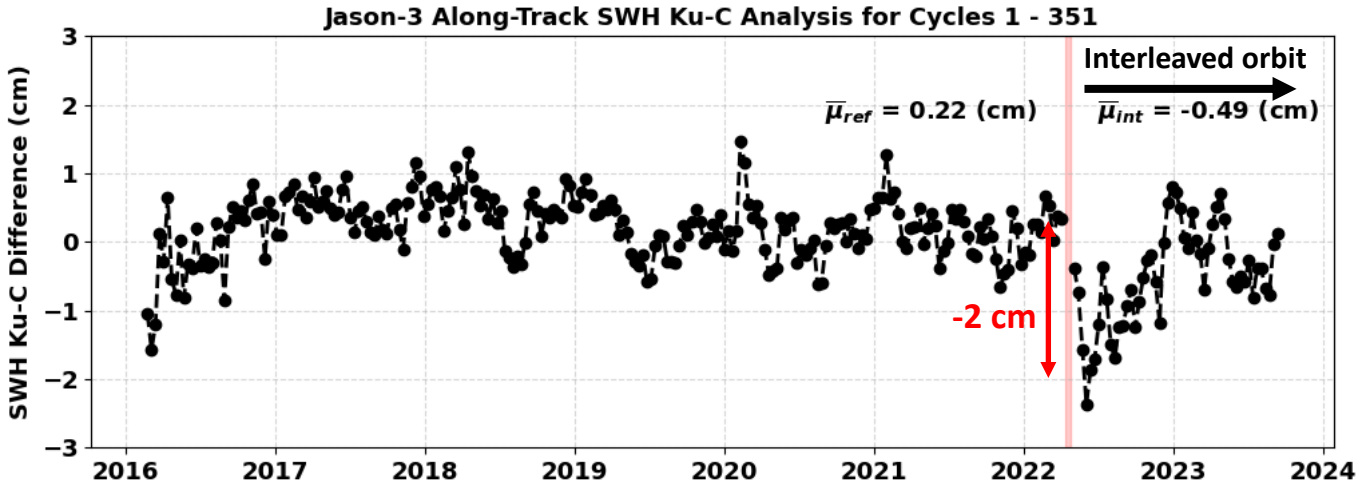
Along-track analysis of global SSHA measurements fit with a correspond trend, seasonal (annual) **and reference/interleaved offset term**. Model suggests small negative offset of 1.6 ± 0.6 mm post switch to the interleaved orbit.

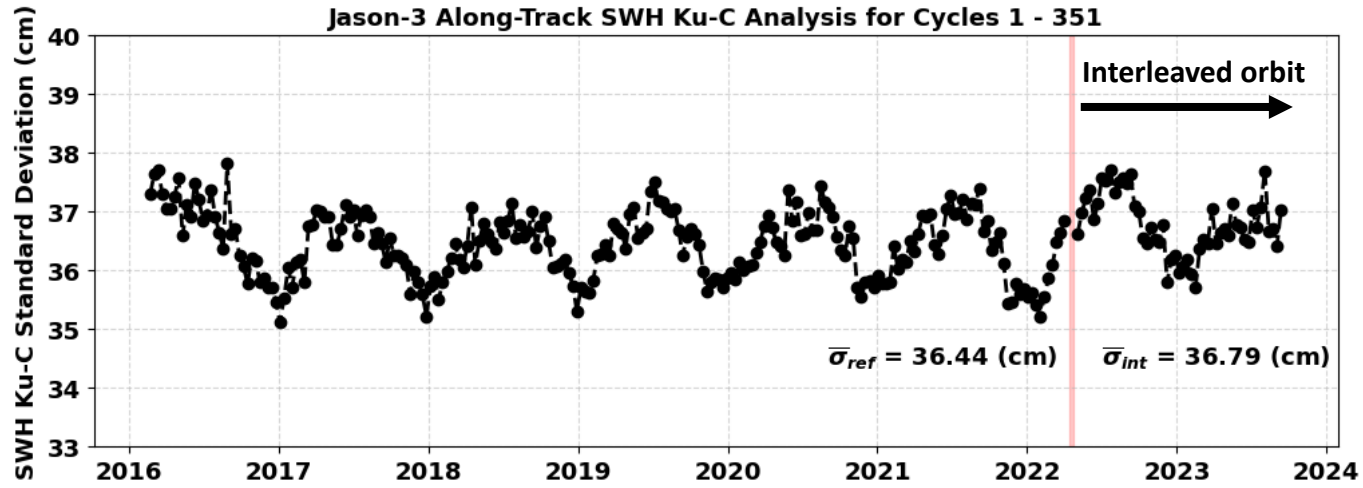
Sea Surface Height Anomaly: Standard Deviation



Inter-cycle standard deviations of global SSHA measurements. Indication of a small increase in standard deviation after switch to the interleaved orbit of **2.6%**

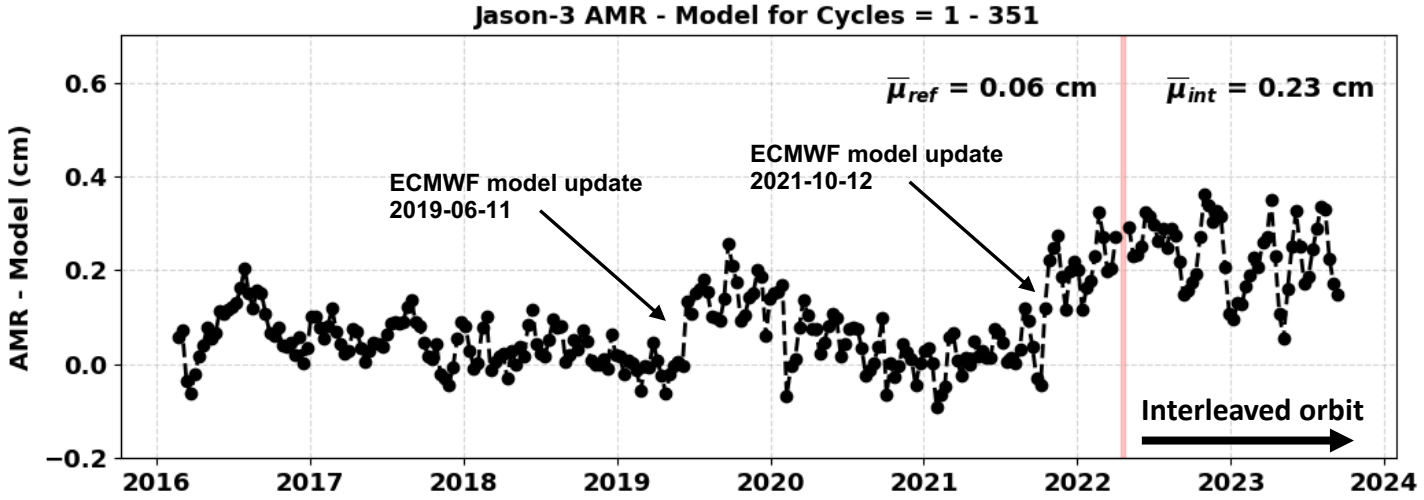
Significant Wave Height: Ku - C Band Difference

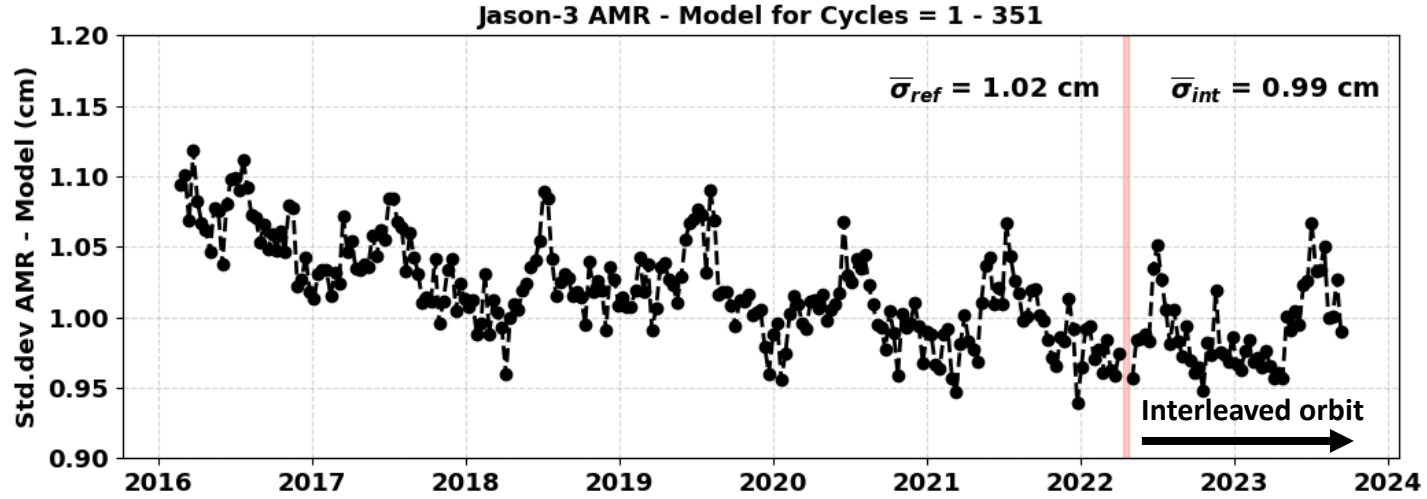




- Observed change in Ku-C band difference of **-2 cm** after change to interleaved orbit.
- Observed positive trend after switch to interleaved orbit in Ku-C band differences.
- Trend stabilizes after 1–year to the reference orbit value.

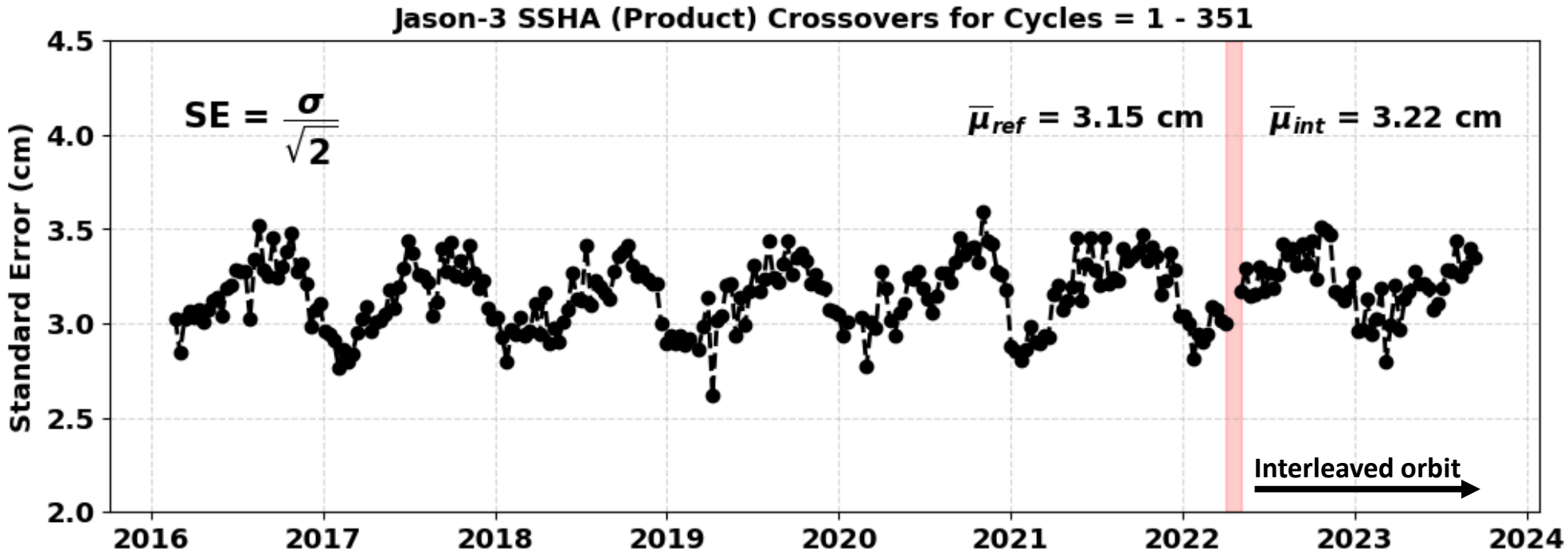
AMR Wet Troposphere Correction Stability Compared to ECMWF Model





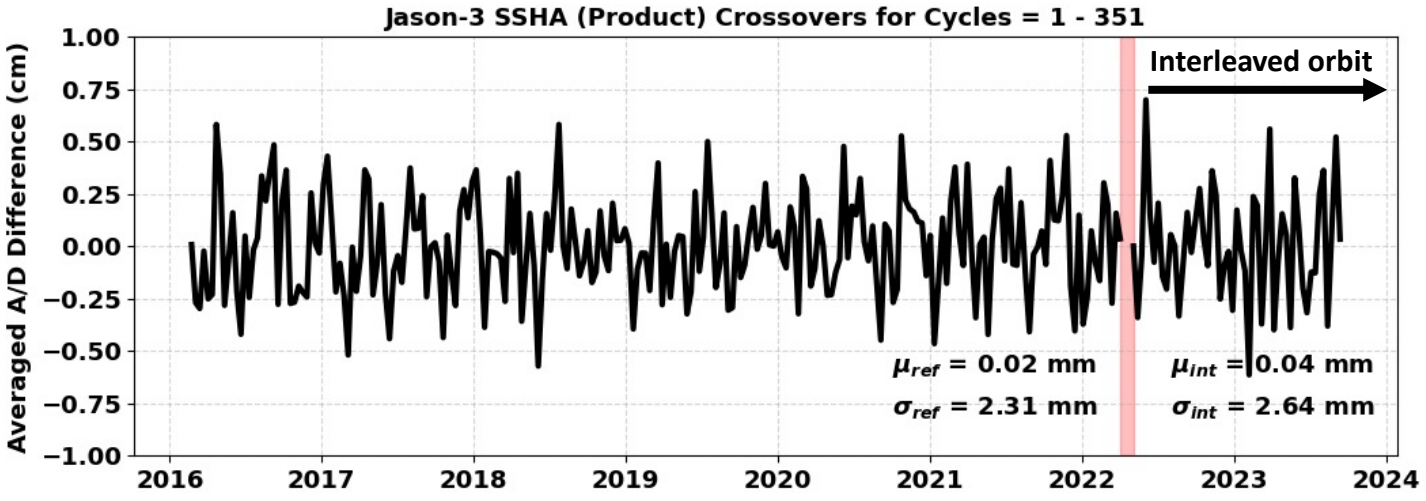
- ECMWF Model updates are visible in the averages.
- Average difference is 0.6 mm in the reference orbit and 2.3 mm in the interleaved orbit.
- Decrease in standard deviation as a function of time with annual variations.
- New AMR drift correction available from Shannon Brown

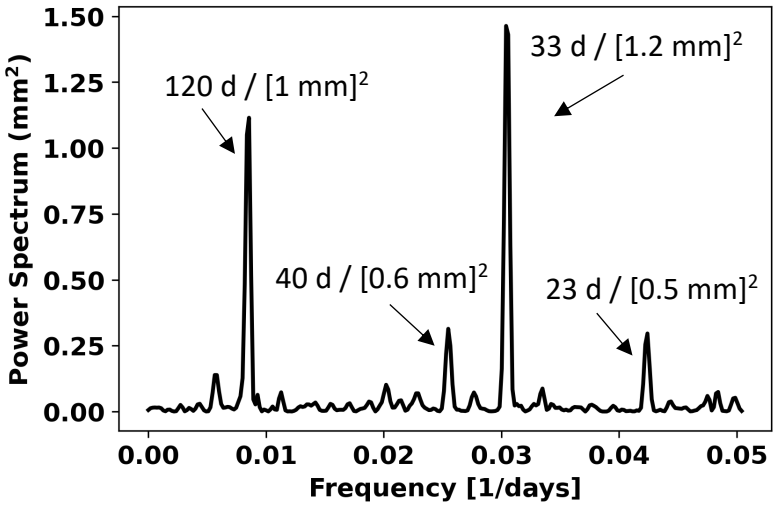
Standard Error from SSHA Crossover Differences



Cycle standard error estimated from global crossover analysis separated by reference and interleaved orbit. Indication of small increase in error from after switch to interleaved orbit of **2.2%**. Inline with what was observed from the SSHA along-track analysis.

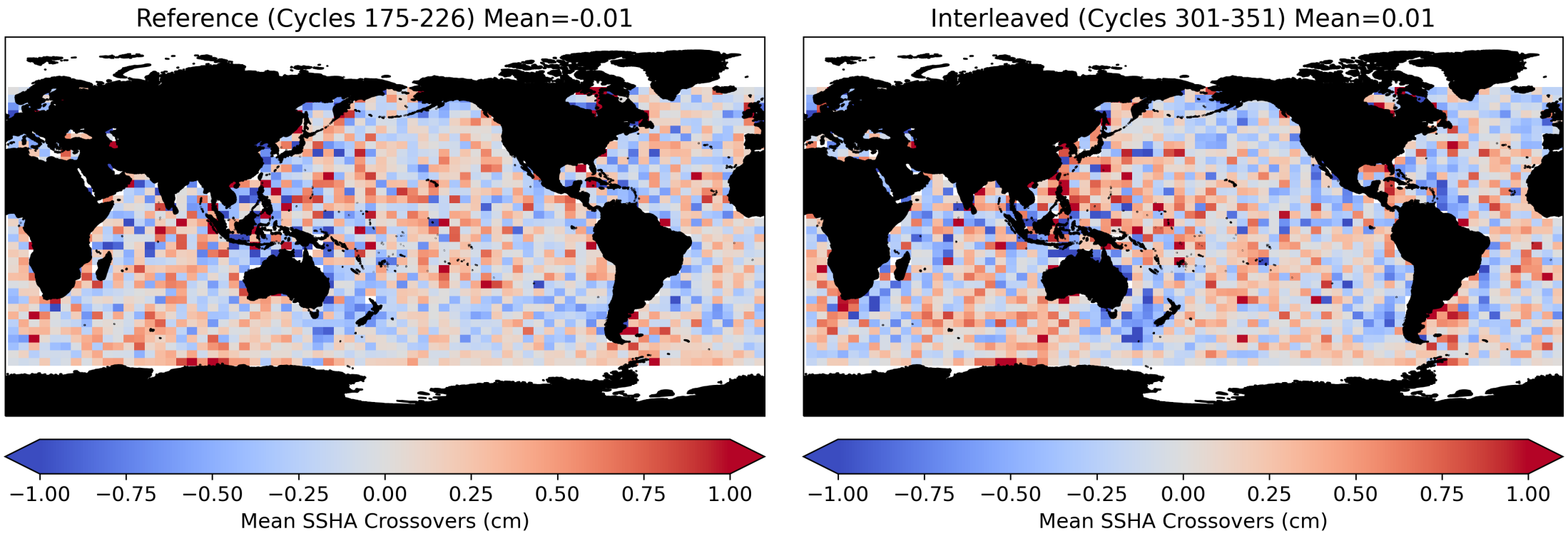
Averages of SSHA Crossover Differences





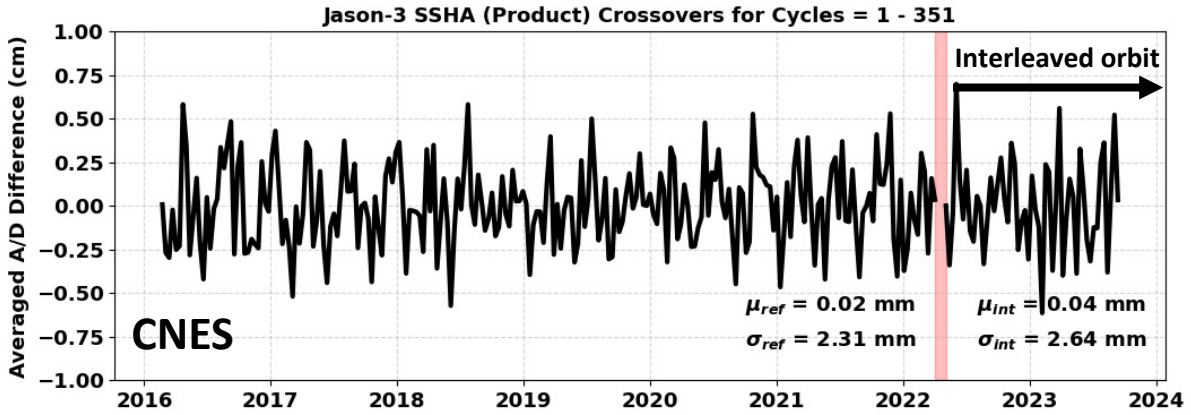
Cycle averages of SSHA A/D crossover differences with associated power spectrum. Signal content suggest residual effects of unmodelled beta-prime orbit variations and ocean tides. Largest observed signal corresponds to 33 days (J1 tide alias period) (1.2 mm) followed by 120 days (beta-prime) (1 mm).

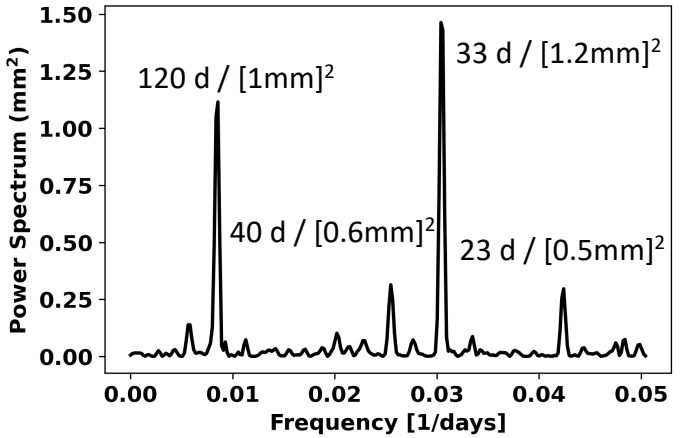
Spatial Pattern of SSHA Crossover Difference Averages

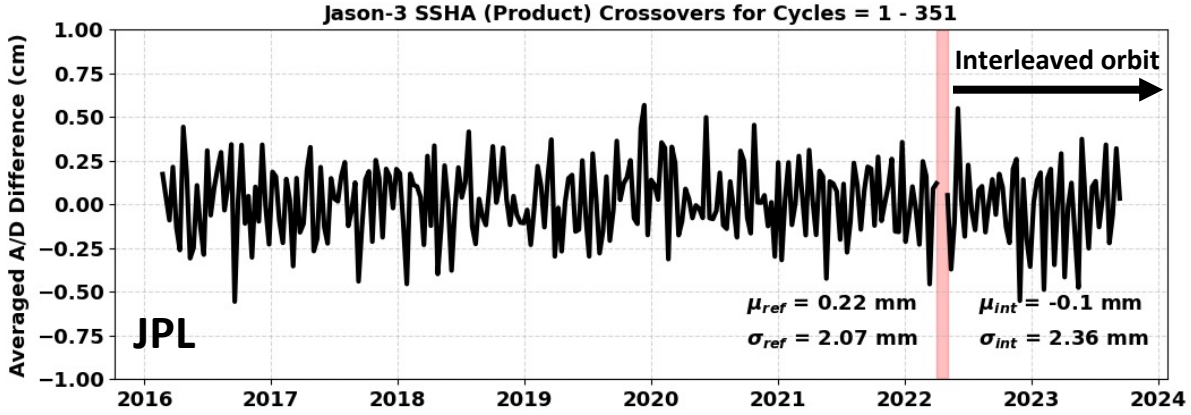


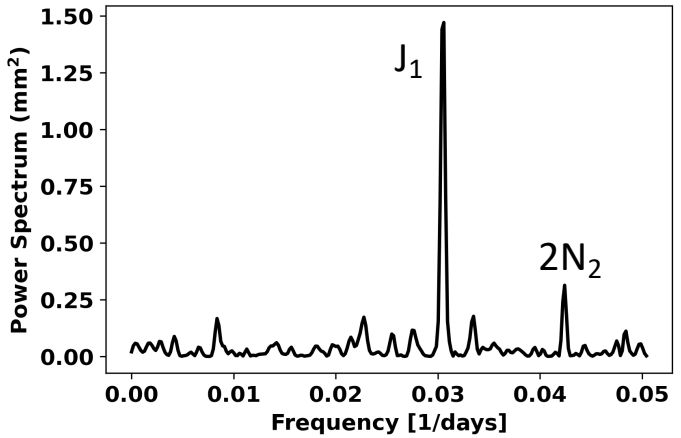
Spatial pattern of SSHA crossover difference for the reference (cycle 177-226) and interleaved orbits (cycles 301-351). No significant pattern observed in the difference between the two orbit configurations

SSHA Crossover Differences: Product (CNES) versus JPL Orbit Solutions



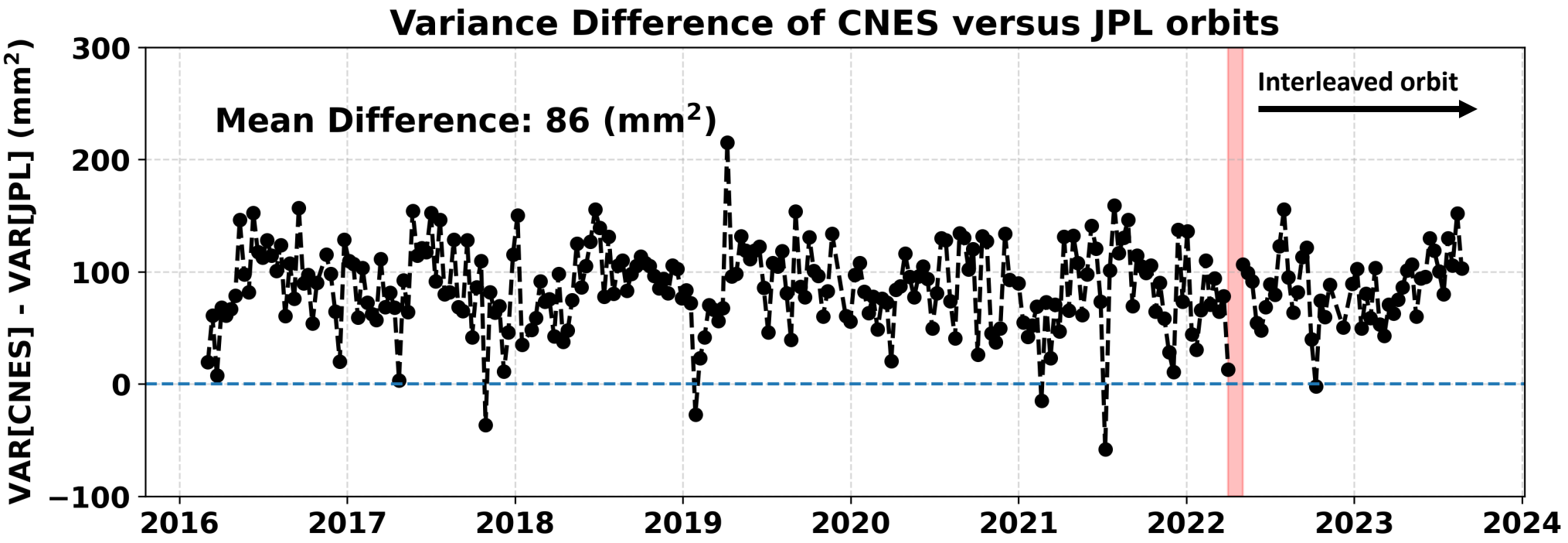






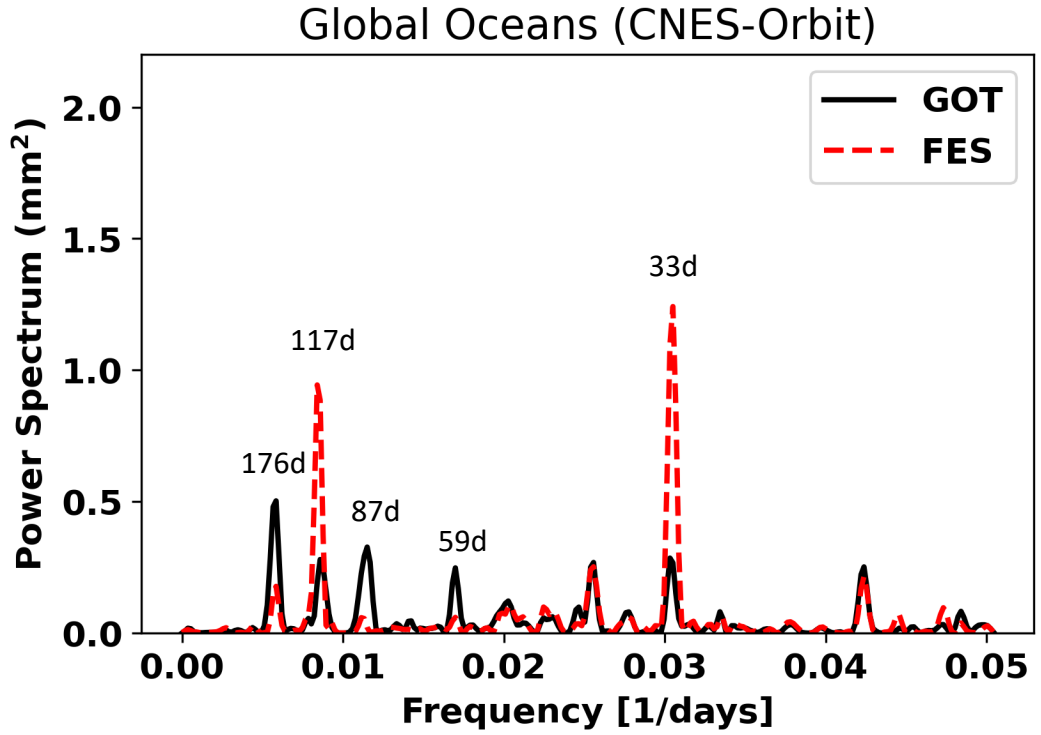
SSHA product shows 120 and 40 day beta-prime signals not seen when using the JPL orbit solution (**pure GNSS solution**). Large 33 and 23-day signals observed in both solutions using the product ocean tide model (**FES2014**); possibly residual ocean tides (**J_1 = 32.7d and $2N_2$ = 22.5d aliasing periods**)?

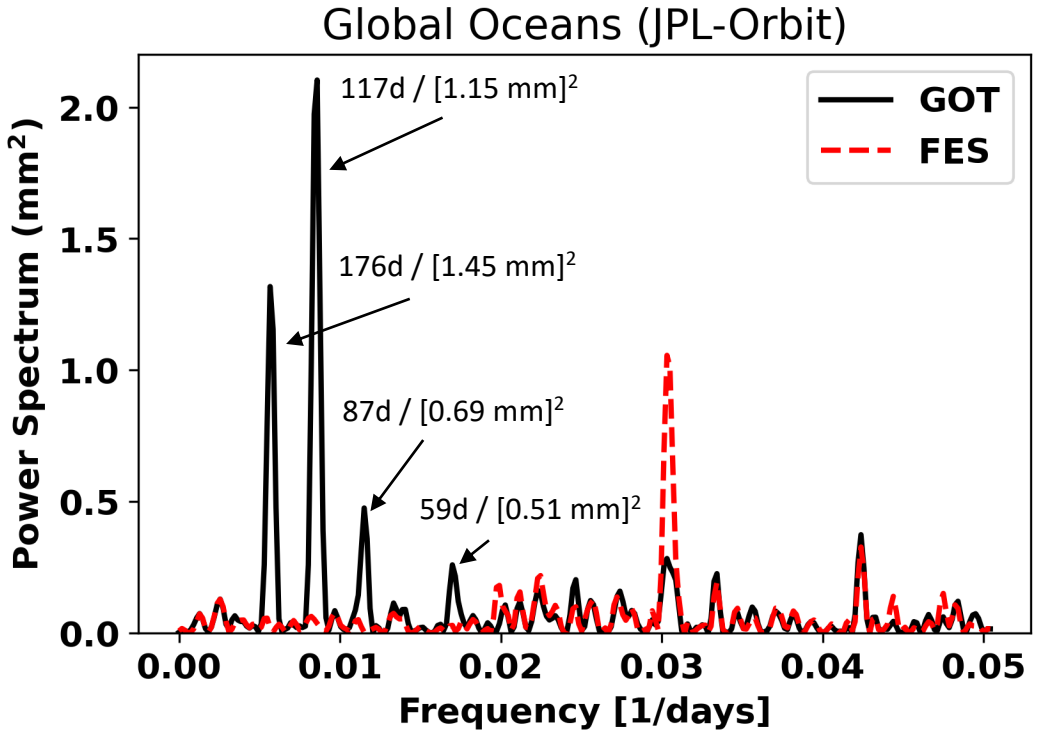
SSHA Crossover Variance Difference: Product (CNES) versus JPL Orbit



Lower crossover variance when using JPL orbit solution: 86 mm^2.
Consistent from reference to interleaved orbit.

Switching Ocean Tide Models: FES2014 to GOT4.10c





Replacing the FES2014 ocean tide model with the GOT4.10c model shows reduction of J_1 tide constituent on a global level but also the 120-day beta-prime signal. However, it also introduces small signals at 87 and 59 days related to P_1/K_2 and S_2/M_2 tides or possible orbit errors. When using the JPL orbit solutions the beta-prime variations or **other tide constituents** are re-introduced in the solution, but the influence of the J_1 tide is reduced.

Summary

- Jason-3 Performance are Within Defined Parameters:
  - *No major impact on performance after change to interleaved orbit.*
  - *Observed change in SWH after orbit change; stabilizing after 1-year.*
  - *Overall good system performance*
- Ongoing Work and Analysis:
  - *JPL orbit solution shows lower beta-prime dependency.*
  - *Ocean tide model errors and perhaps geographically correlated orbit error at tidal frequencies observed in crossover differences (CNES and JPL).*
  - *We are sensitive to difference in ocean tide models globally*
  - *Performance provides opportunity to evaluate orbit solutions and ocean tide models.*

Thanks for your attention!

Questions?

Backup Slides

Hemisphere Dependency