Explorations with the Pre-SWOT Sample Datasets

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SWOT-ST Meeting
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UNC Chapel Hill

Overview:

- Logistical details
- Verifying the *internal_tide_hret* correction
- Animations of sea level anomaly from ocean simulations
- Harmonic analysis of sample data and the long-wavelength correction

Logistical Details:

- Model outputs and simulated data for regions:
  1. Northwest Pacific MITgcm LLC4320 (PODAAC)
  2. New Caledonia MITgcm LLC4320 (PODAAC)
  3. New Zealand MOANA model (Joao Souza)
  4. California Current MITgcm LLC4320 (Jinbo Wang)
- Only the GLORYS-based files contain the *internal_tide_hret* correction, the LLC4320-based sample data does not.
- Data downloads are challenging due to the swath timestamps in the filenames, e.g.,

SWOT_L2_LR_SSH_Expert_368_003_20121111T161919_20121111T171024_DG10_01.nc.

- I used Jupyterhub with Julia + Makie graphics for the PODAAC Cloud Workshop; otherwise I've been using downloaded files.

Verifying HRET predictions in RADS and Pre-SWOT Sample Data:

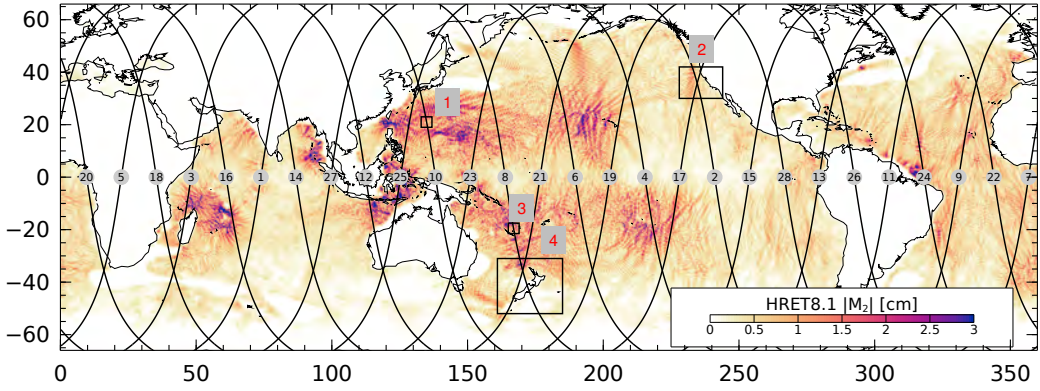
- In May 2022, Richard Ray found a compiler-dependent bug in the Fortran software on my website for making predictions with HRET.
  Symptom: too many locations with zero HRET predictions.
- The software has been corrected and updated.
- Predictions for Jason-3 in RADS have been verified.
- Predictions for the GLORYS-based SWOT sample data have been verified.

Key questions to be answered with SWOT:

- How realistic are our maps and predictions of phase-locked baroclinic tides?
- What is the magnitude and character of non-phase-locked baroclinic tidal variability?
- Can we usefully improve the accuracy of maps of baroclinic tidal properties using SWOT?

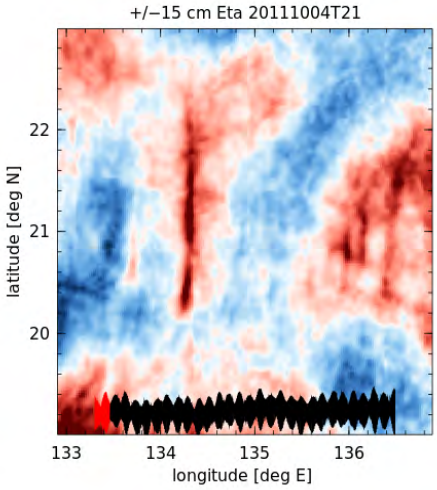
– concerned with what we can learn *from* SWOT, rather than dwelling on what tidal predictions can do *for* SWOT.

SWOT Cal/Val Orbit Tracks and Regions



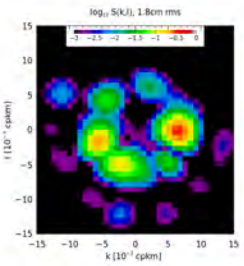
1 West Pacific – 2 California Current – 3 New Caledonia – 4 New Zealand

LLC4320 West Pacific



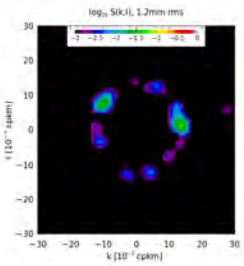
Spatially filtered SSH

external player



M_2 PSD

external player

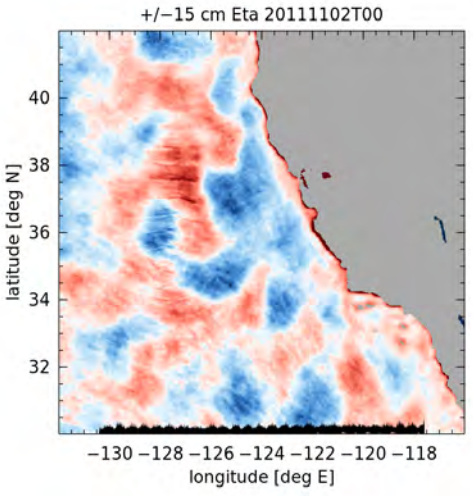


M_4 PSD

external player

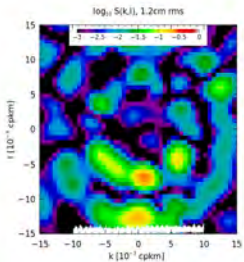
[Click “external player” if the animation does not start after clicking the image.]

LLC4320 California Current



Spatially filtered SSH

external player



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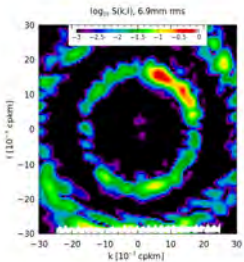
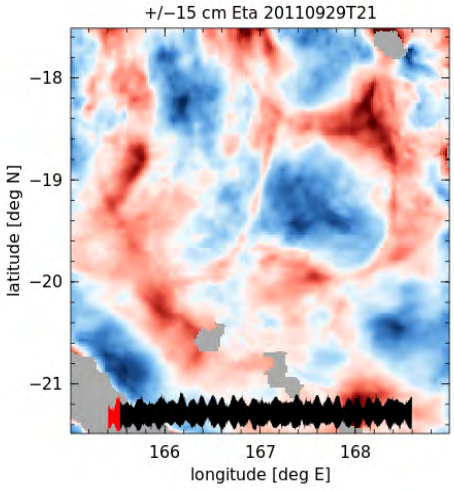


M_4 PSD

external player

LLC4320 New Caledonia



Spatially filtered SSH

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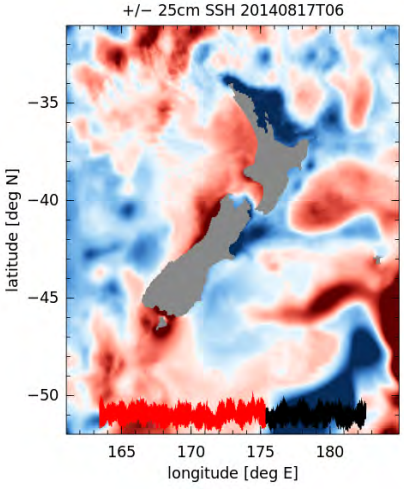
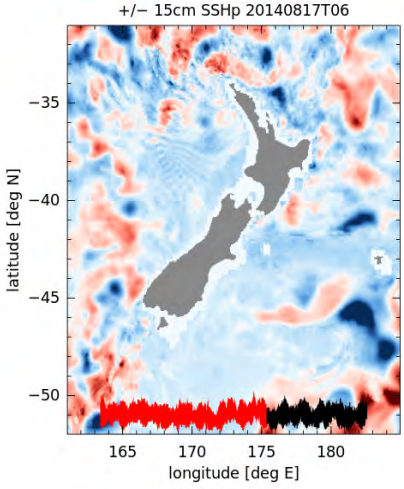
MOANA (ROMS)



Spatially filtered SSH

external player



Modal projection

external player

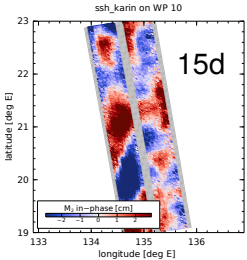
SWOT Tidal Alias Periods [days]

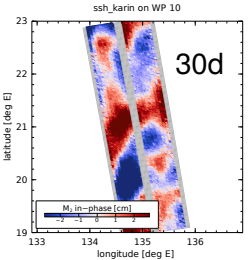
tide	Cal/Val Orbit (0.99349d)	Science Orbit (20.8646d)
M_2	12.4	66.0
S_2	76.3	77.0
K_1	262	266
O_1	13.0	52.9
M_4	6.2	56.7
$M_2 \times O_1$	262	266

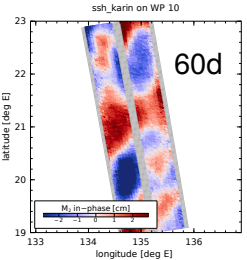
Next: What do snapshots of M_2 look like, based on 15d, 30d, 60d, and 90d time series?

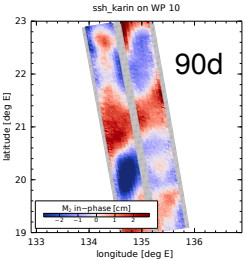
O_1 is suppressed by removing long-wavelength signals.

Harmonic Analysis of Simulated Data: Western Pacific



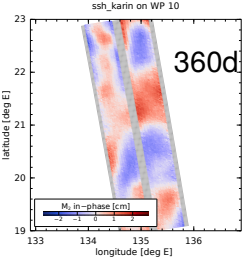




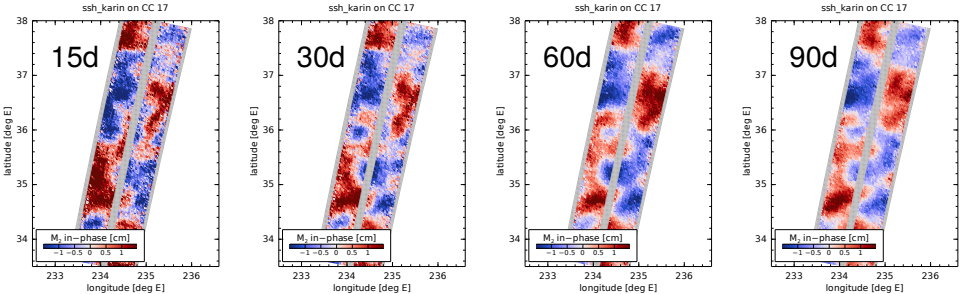


Two effects with more cycles:

1. $N^{-1/2}$ reduction of uncorrelated noise.
2. Reduction of non-phase-locked signals.



Harmonic Analysis of Simulated Data: California Current Region



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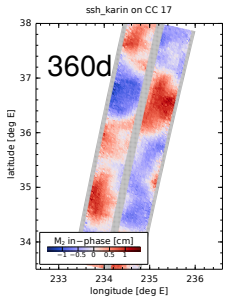
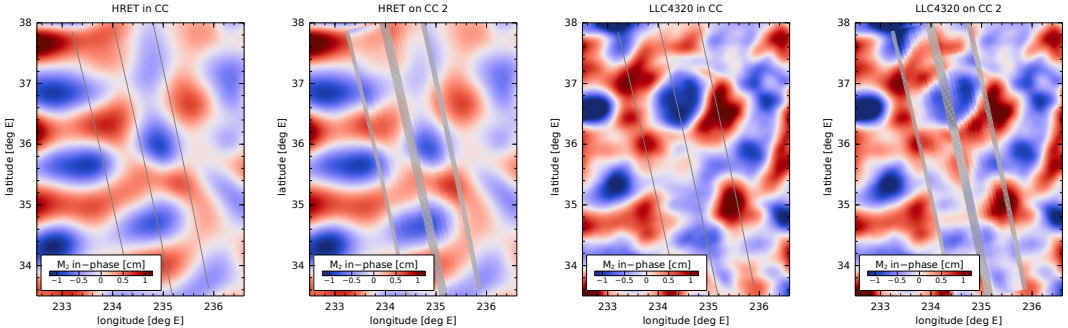
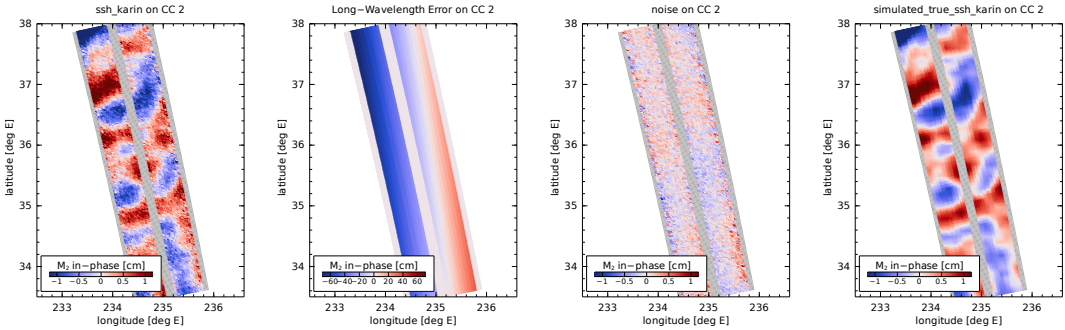


Tides and Long-Wavelength Error (LWE): California Current Region

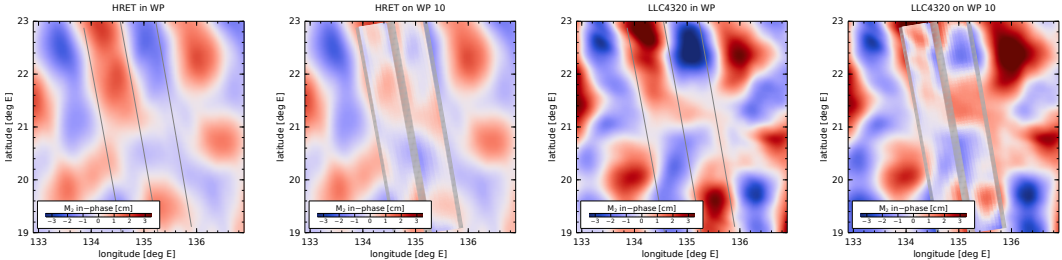


Estimate LWE with $a_{00} + a_{10}x + a_{01}y + a_{11}xy + a_{20}x^2 + a_{02}y^2$ on each side of the swath.

Tides and Long-Wavelength Error: California Current Region



Tides and Long-Wavelength Error: West Pacific Region



Baroclinic tides project onto the simple-minded LWE correction in this region.

Summary

1. Models exhibit sharp-crested baroclinic tides. SWOT should quickly reveal the presence or absence of these waves.
2. During the 1-day repeat orbit phase, we can expect to identify unambiguous baroclinic tides in many regions using time series as short as 15 days.
3. Tidal modulations should also be visible, limited by the 90 days mission duration.
4. Strategies for removing long wavelength error need more investigation.