# "Validation OSSEs": Effects of measurement type and vertical and horizontal subsampling on SSH wavenumber spectra in 1/25° Global HYCOM with tides

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# Overview

CAL/VAL OSSEs in HYCOM (thanks to Jinbo, Lee, and Tom)

At NRL we have recently run a 1/25° Global HYCOM simulation with tides

- Realistic surface mesoscale variability compared with observations (Thoppil et al., 2011)
- Realistic internal tide magnitude compared with observations (Shriver et al., 2012)
- Realistic internal wave KE spectra compared with observations (Müller et al., 2015)

We use HYCOM to answer questions about the ability of different arrangements of measurement types and locations to validate SWOT observations.

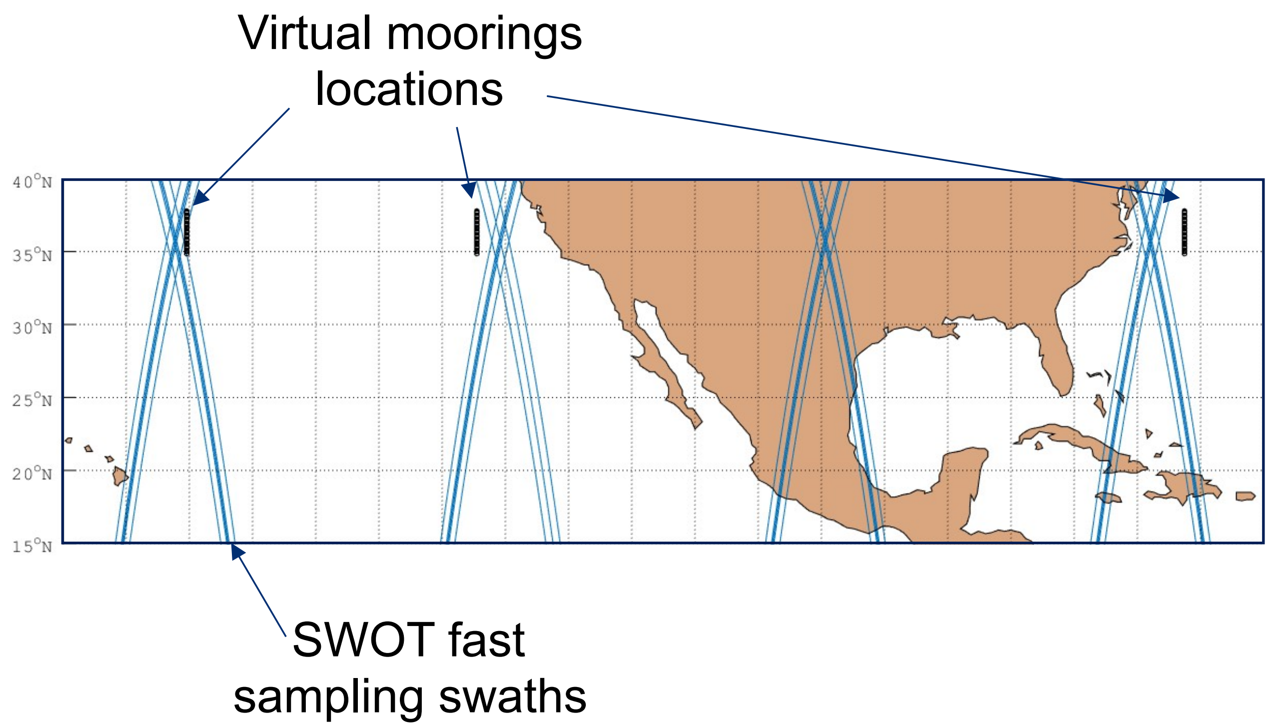
For example: If a line of moorings were used in the fast sampling Cal/Val phase, how accurately could they reproduce the true SSH wavenumber spectrum?

We use hourly T,S, and non-steric SSH output, taken from a 1/25° Global HYCOM simulation with tides, during one month (September 2014). We compute steric SSH from full-water-column output ("truth") and from a vertical subsample of 14 or 21 levels, most of them in the thermocline.

Similarly we can model the dynamic height and acoustic travel time in a region to determine the ability of PIES to reproduce the spatial and temporal variability of SSH. While the full model dataset is large, subsetted regions are easily analyzed with small matlab or python scripts.

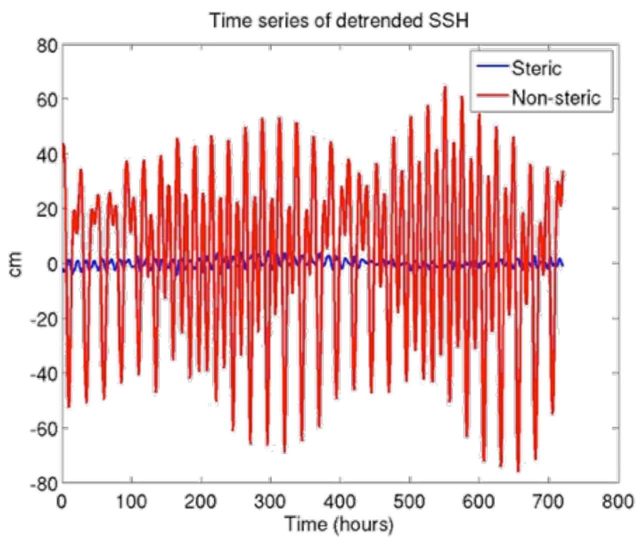
# Location of Virtual Moorings

Sampled at 30 locations, separated by 0.12 degrees (~11 km), for 1 month

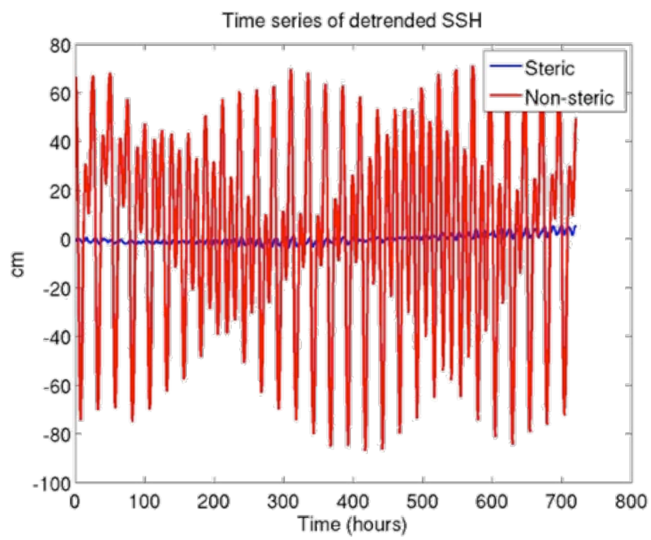


# Typical SSH time series

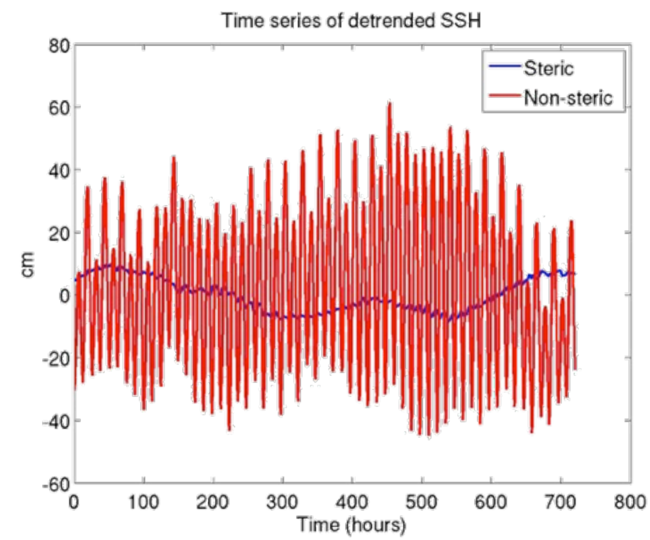
Hawaii




US West Coast



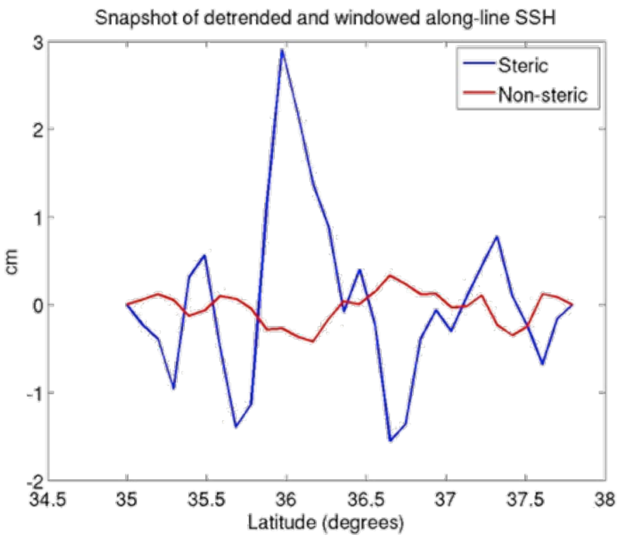

US East Coast



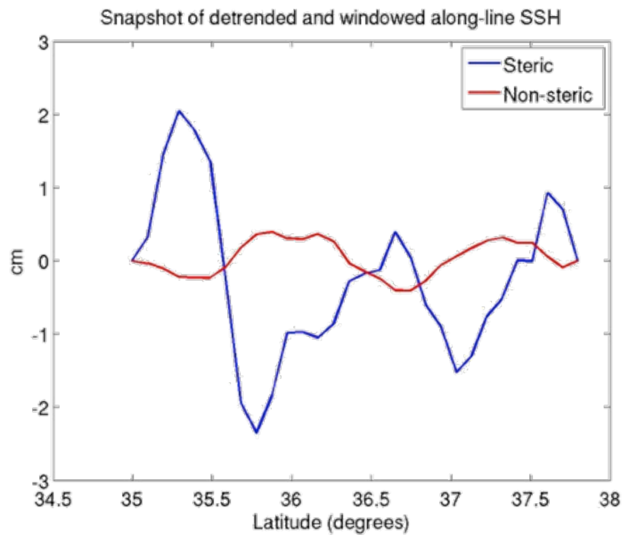

Nonsteric SSH can dominate the time series at a particular point

# Snapshot of SSH along virtual mooring lines

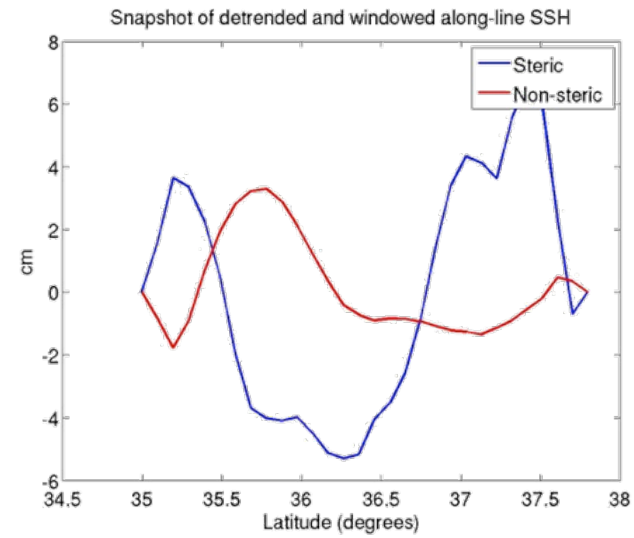
Hawaii




US West Coast



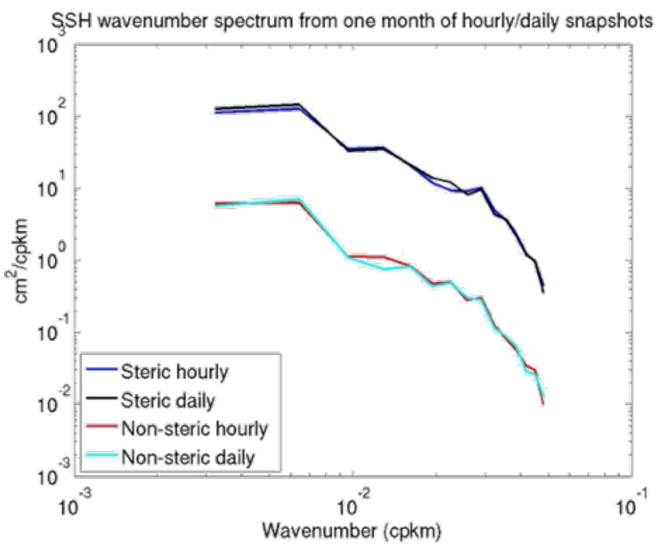

US East Coast



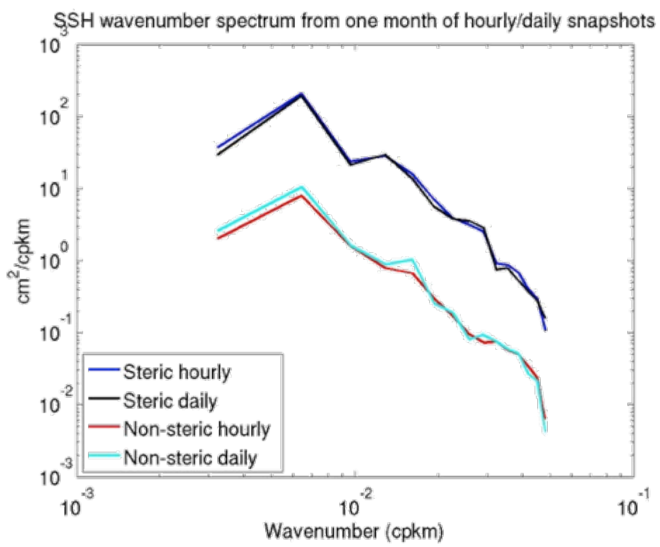

Because the non-steric SSH has such a long wavelength, the steric effects tend to dominate variations in space

# SSH wavenumber spectrum from one month of hourly and daily snapshots

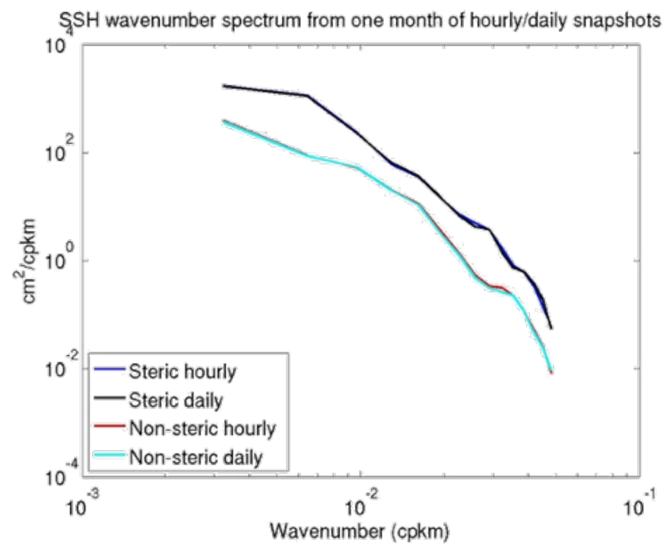
Hawaii




US West Coast




US East Coast

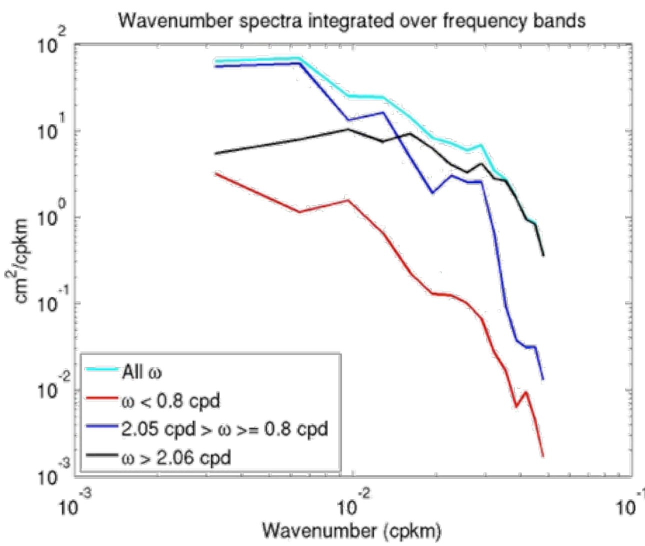



Steric component tends to dominate the wavenumber spectrum

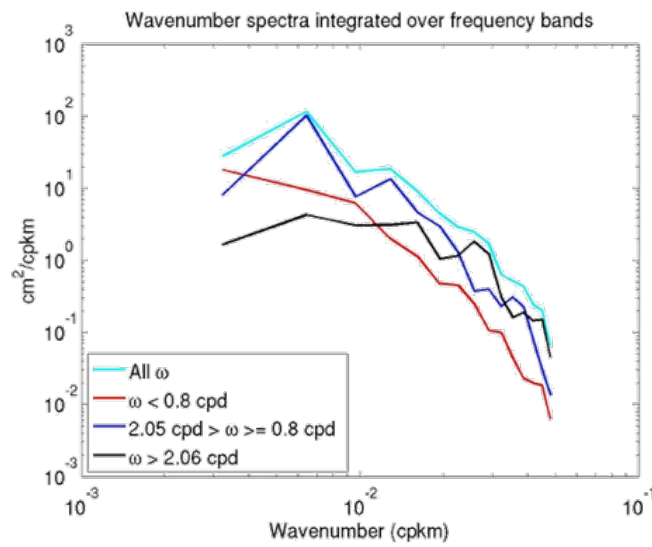
Averages of 30 daily snapshots give almost the same spectrum as averages over 720 hourly snapshots

# SSH frequency wavenumber spectrum from one month of hourly snapshots

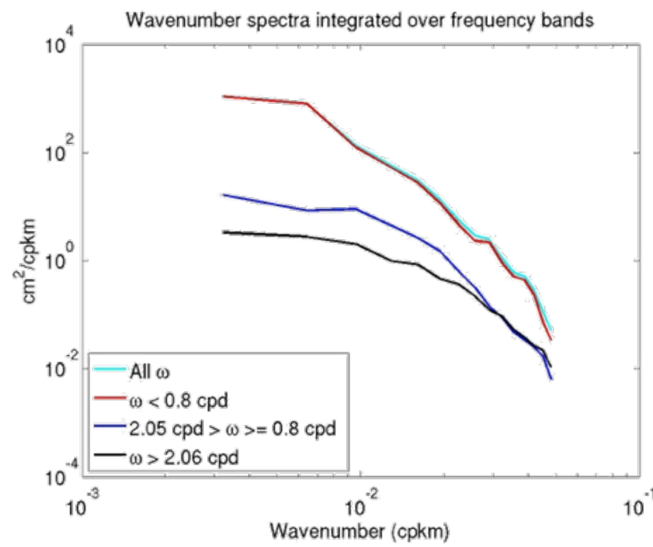
Hawaii




US West Coast



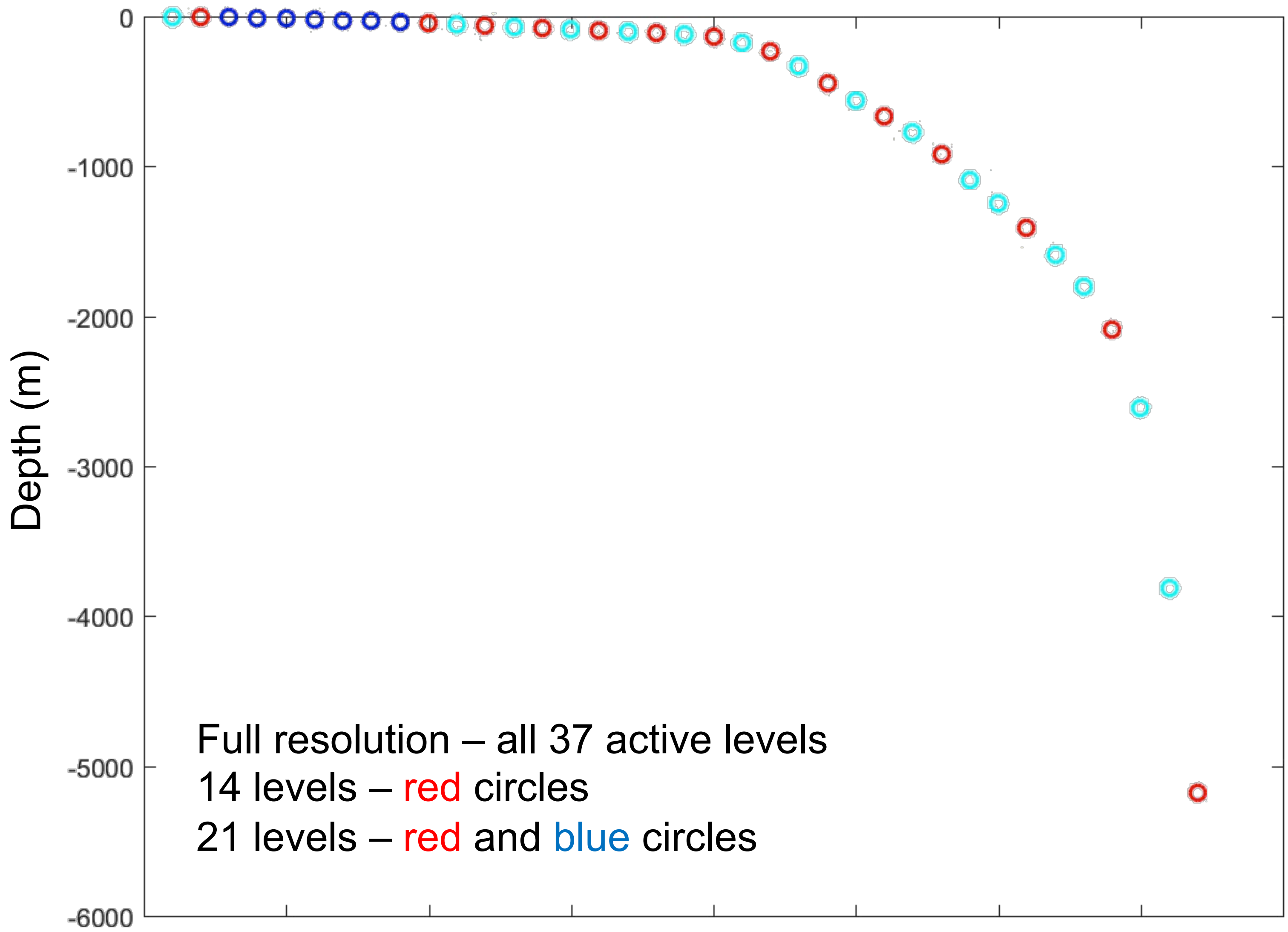

US East Coast




Hawaii – high frequencies dominate the high-wavenumber part of the spectrum

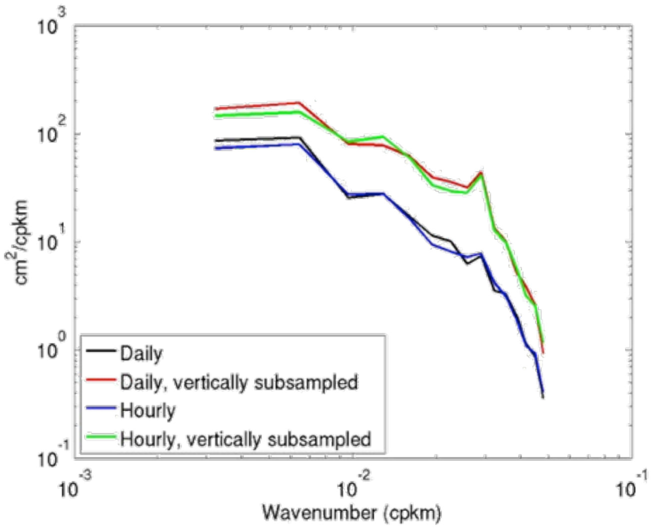
US East Coast – low frequencies dominate in Gulf Stream

# Virtual mooring vertical sampling

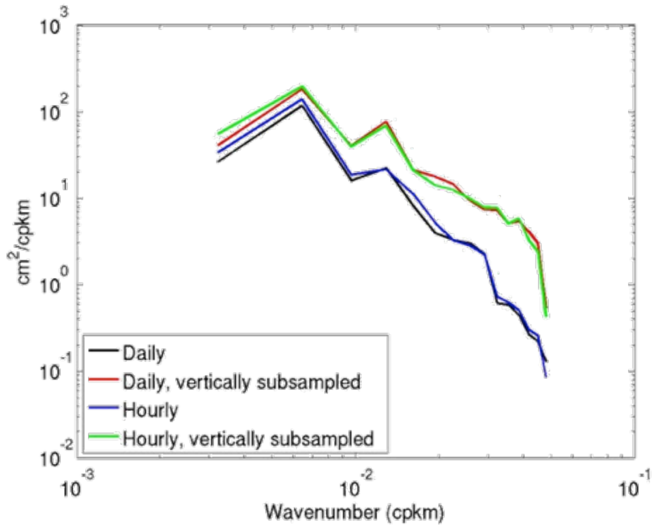


# SSH wavenumber spectrum – example of impact of vertical sampling

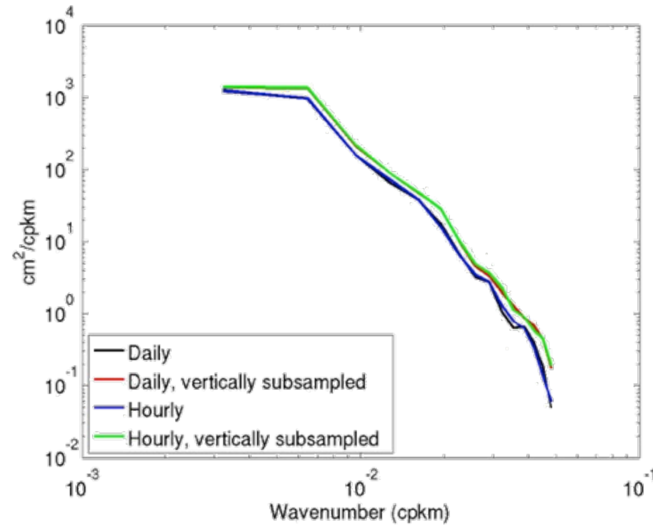
Hawaii




US West Coast




US East Coast



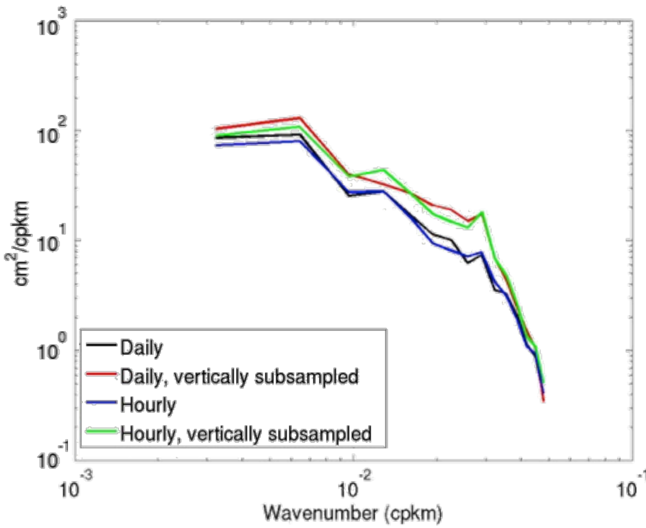

14 hourly T/S measurements (most levels in the upper ocean)

For now, the spectrum computed from the vertical subsample tends to overshoot the true spectrum, especially in Hawaii and the US West Coast, but the shape is retained.

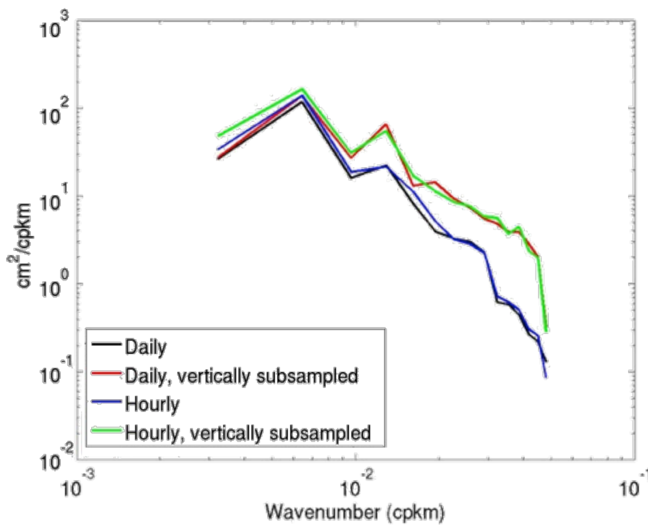
Again, 30 daily snapshots yield a similar averaged spectrum as 720 hourly snapshots.

# SSH wavenumber spectrum – example of impact of vertical sampling

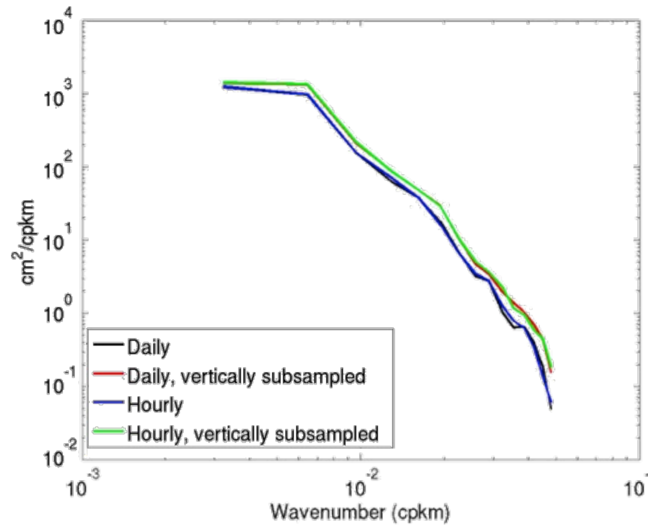
Hawaii




US West Coast




US East Coast

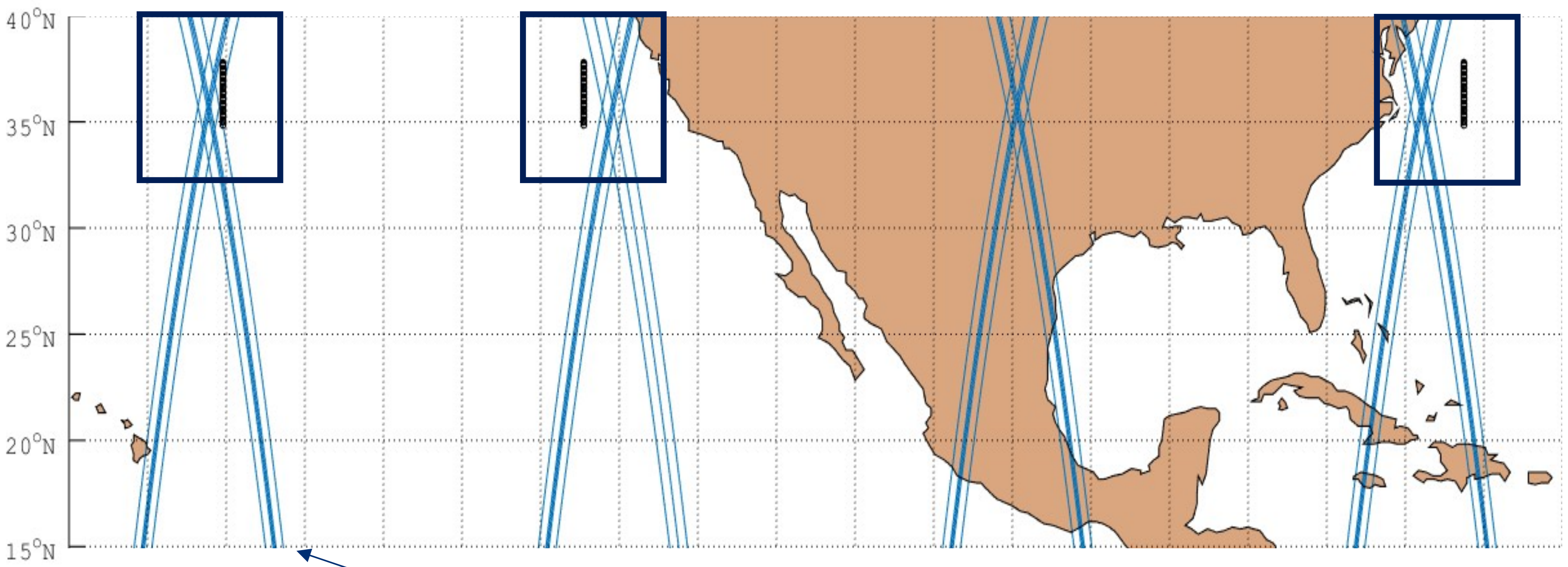



21 hourly T/S measurements (most levels in the upper ocean)

Overshoot is reduced with additional T/S measurements in upper ocean

More thought is needed to determine an optimal mooring configuration

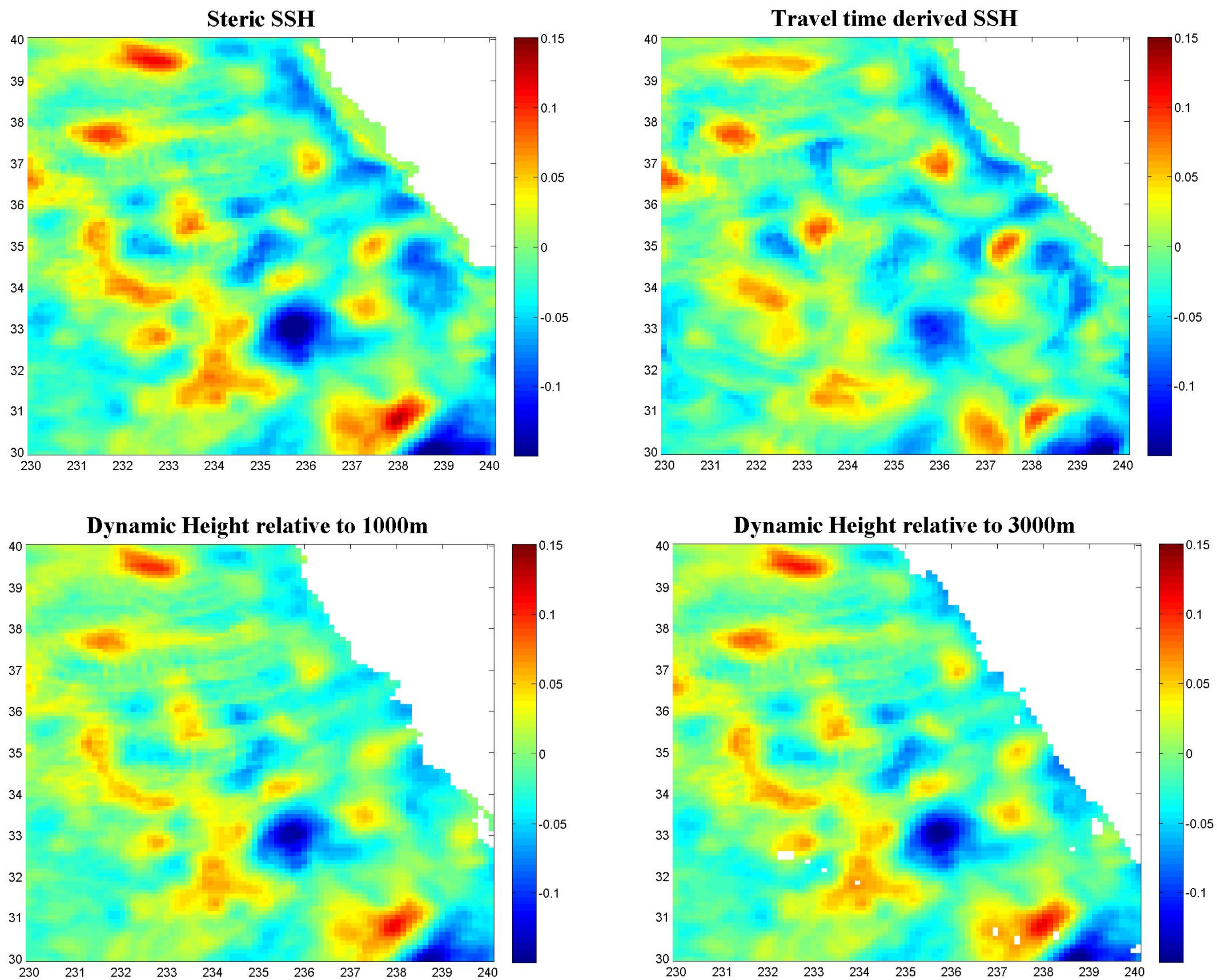
# Location of Sampling Boxes



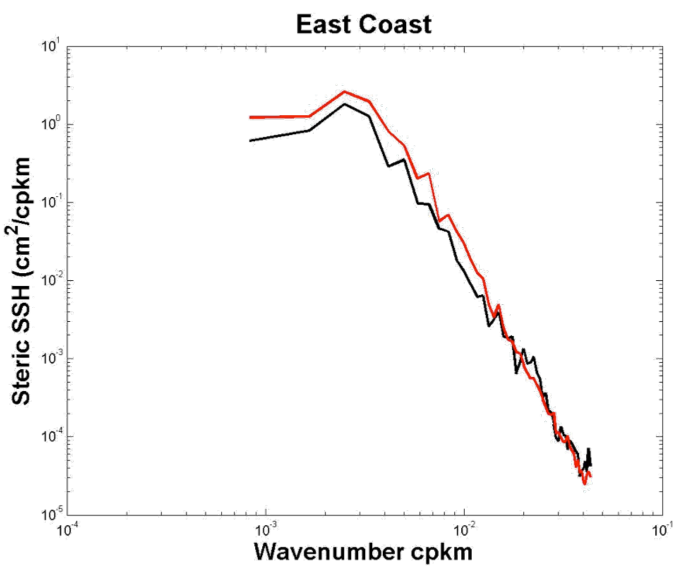

SWOT fast sampling swaths

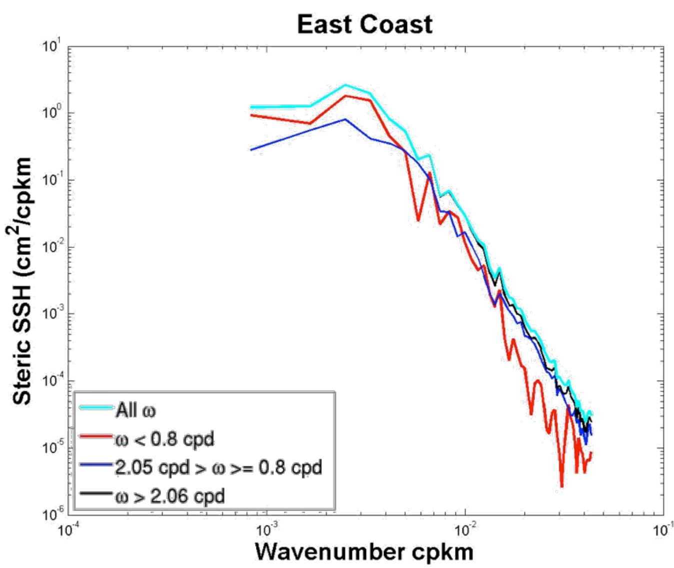
Sampled in 10° x 10° boxes around the crossovers, with points separated by 0.12 degrees (~11 km), for 1 month

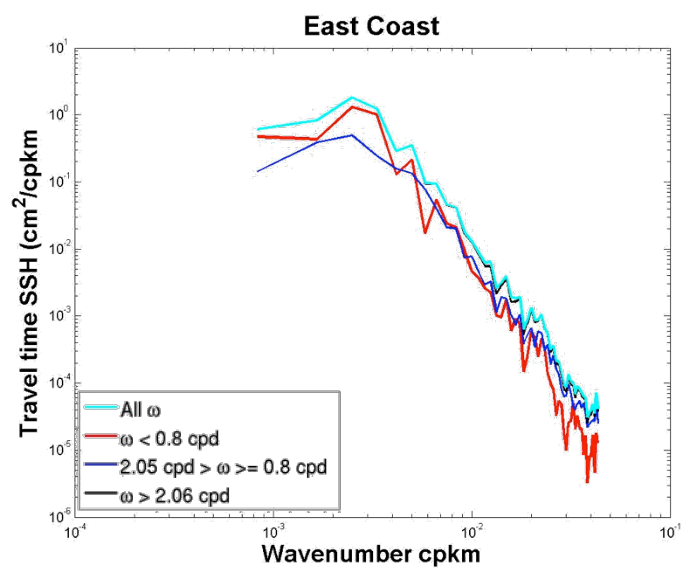
# Mapping the SSH



# SSH wavenumber spectrum – example of impact of sampling with PIES

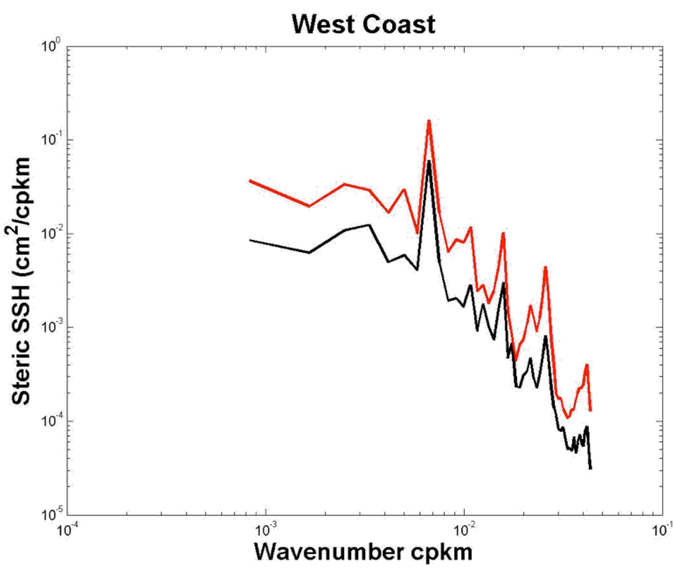


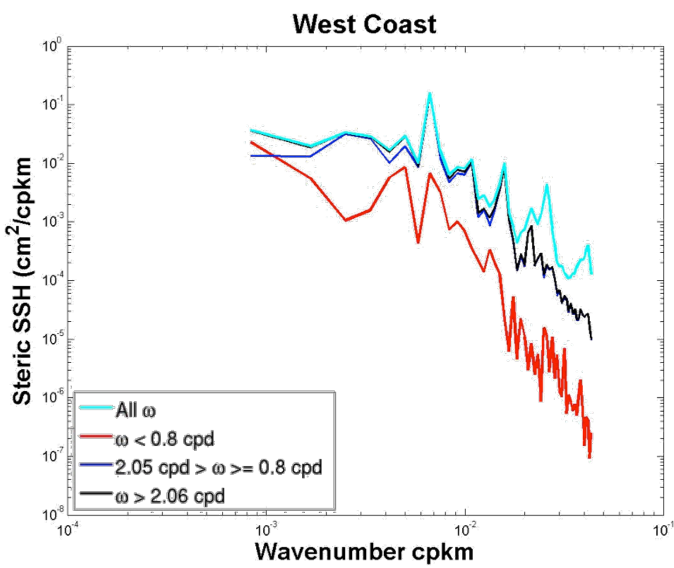



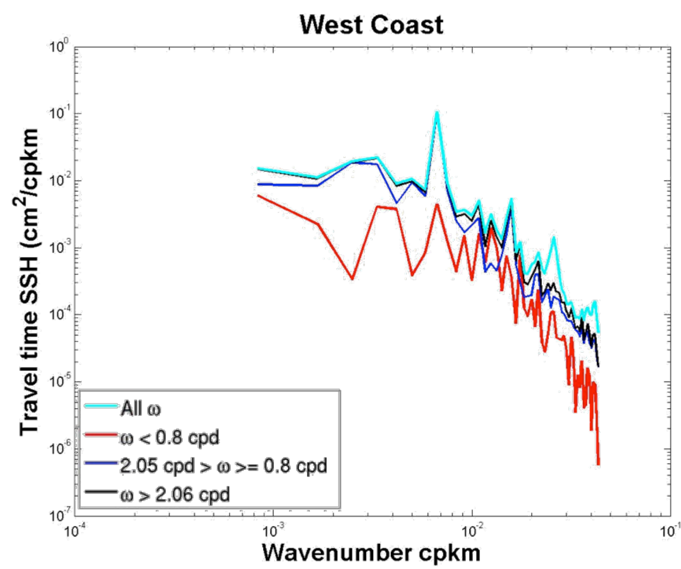




From the hourly snapshots of the model, we can calculate the acoustic travel time from the bottom to the surface and back at each grid point. The travel time anomalies can be converted into a SSH anomaly using a regress against dynamic height.

# SSH wavenumber spectrum – example of impact of sampling with PIES

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