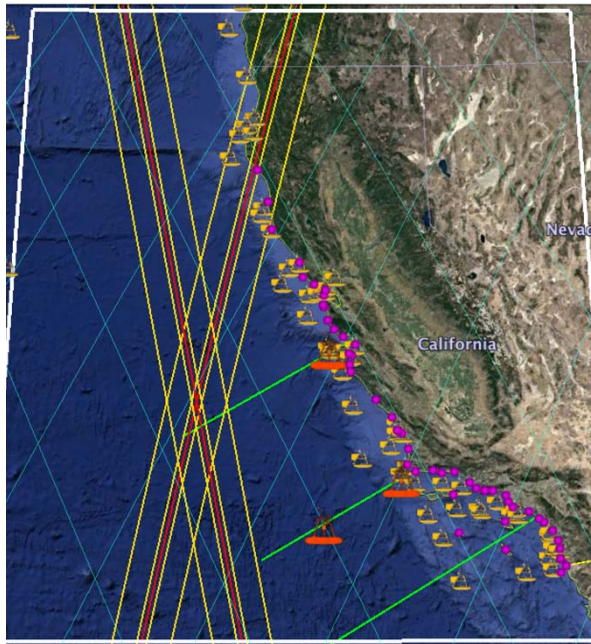
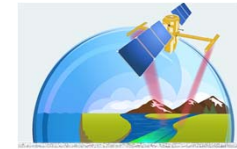


High-frequency and high-wavenumber variability in the California Current: Evaluating model requirements for SWOT assimilation



Sarah Gille¹,
Matthew Mazloff¹, Jinbo Wang²,
Teresa Chereskin¹, Bruce Cornuelle¹, Dimitris Menemenlis²,
Marcello Passaro³,
Cesar Rocha⁴

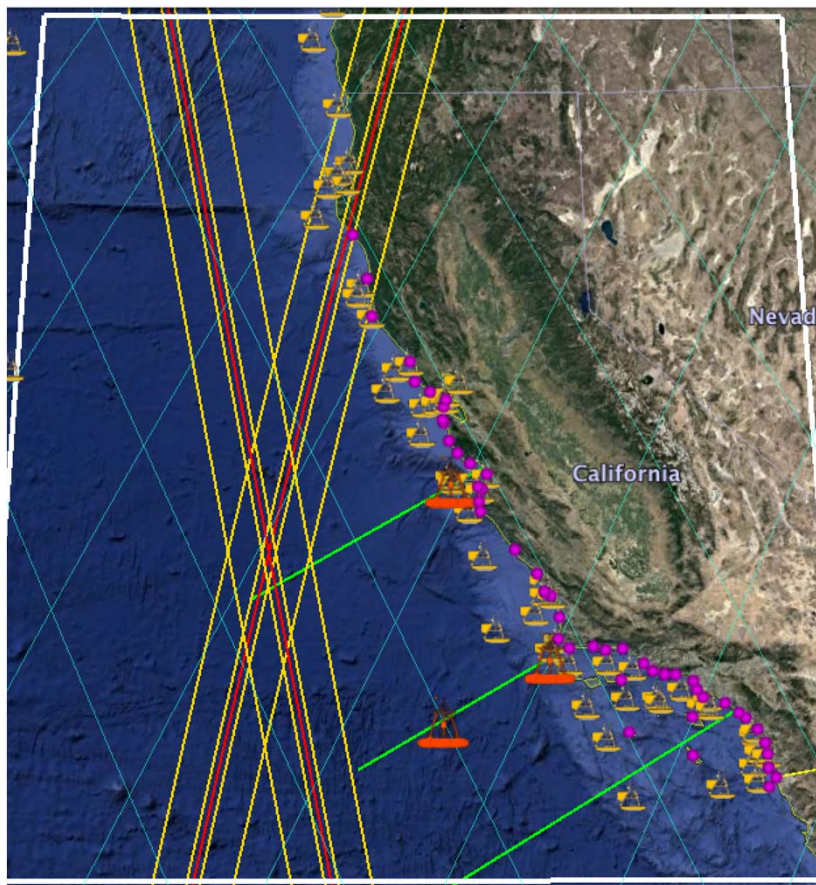
¹Scripps Institution of Oceanography,

²Jet Propulsion Laboratory

³Technischen Universität München

⁴Woods Hole Oceanographic Institution

California Current: Test bed for SWOT



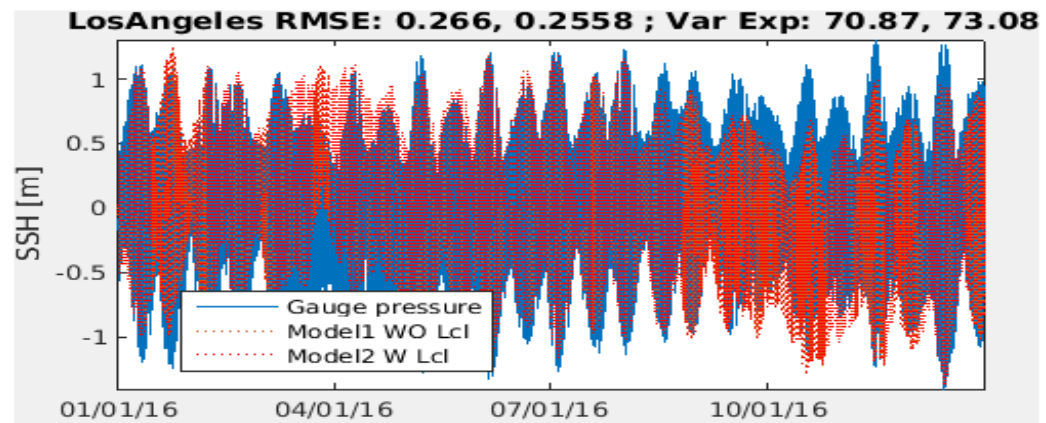
Goal: Develop regional version of MITgcm to assimilate SWOT's high-wavenumber measurements

Build on existing regional ECCO machinery and network of observations

- SWOT (**swath boundaries**)
- Nadir altimetry (**Jason**)
- **Moorings**
- **HF radar**
- Buoys (**NDBC**)
- **Glider lines**

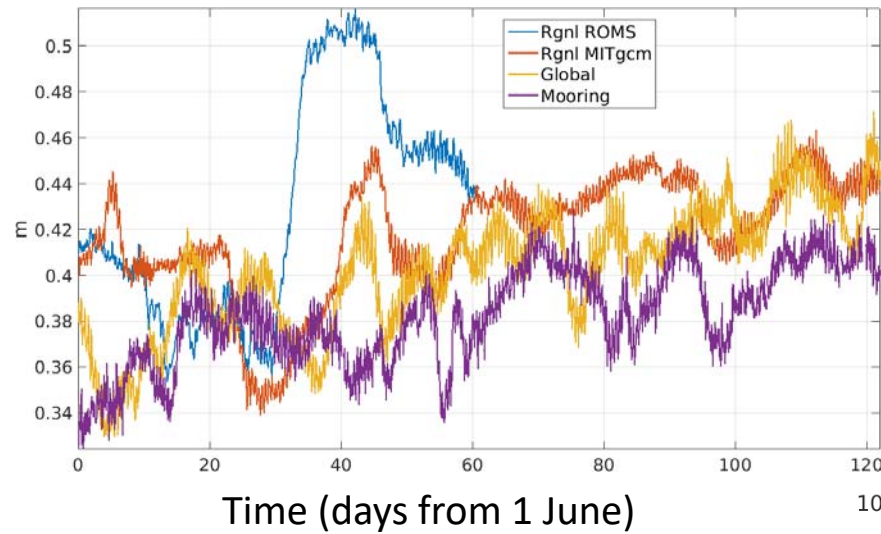
Regional MITgcm built to match MITgcm (I1c4320) global model

- ~2 km resolution
- Tidal forcing on boundaries and surface
- 90 vertical levels allows internal waves to propagate

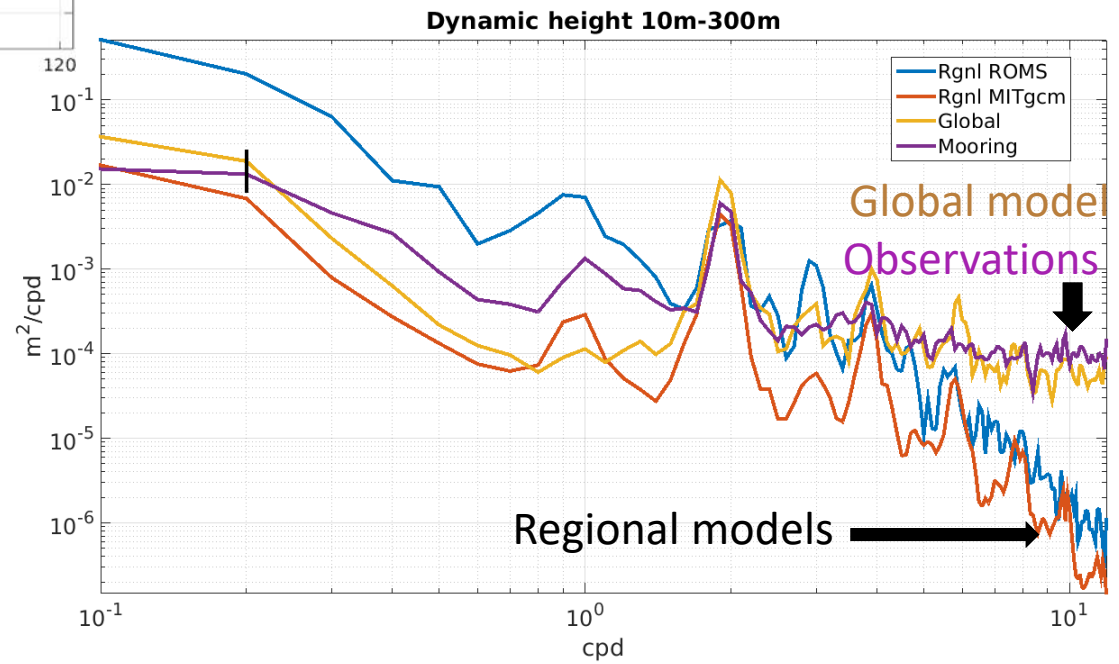


Tide in 2016 for Los Angeles replicates major features of tide gauge observations

MBARI M2 mooring (June-Sept) Dynamic height



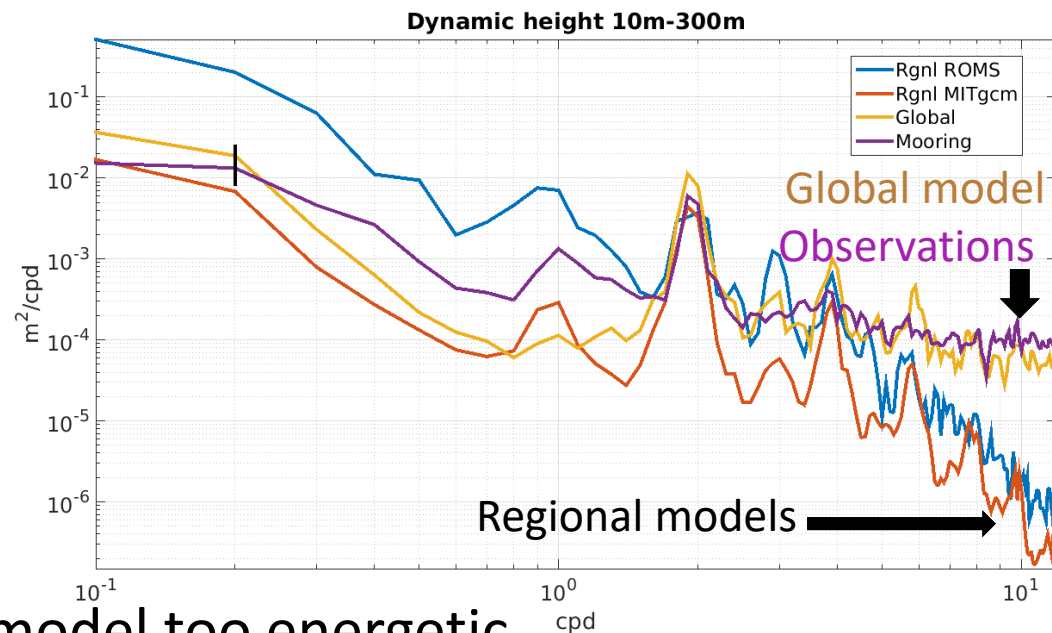
Frequency spectra



Can a regional model generate enough internal wave energy?

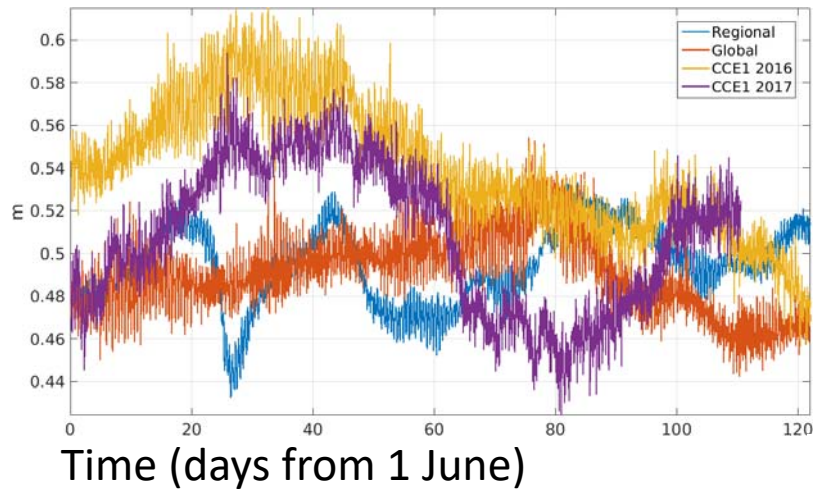
Regional tests

- **Mooring** has high-frequency energy
- **Global model (Ilc4320 MITgcm)** replicates mooring energy
- Regional **MITgcm** and **ROMS** missing high-frequency energy



Hypotheses:

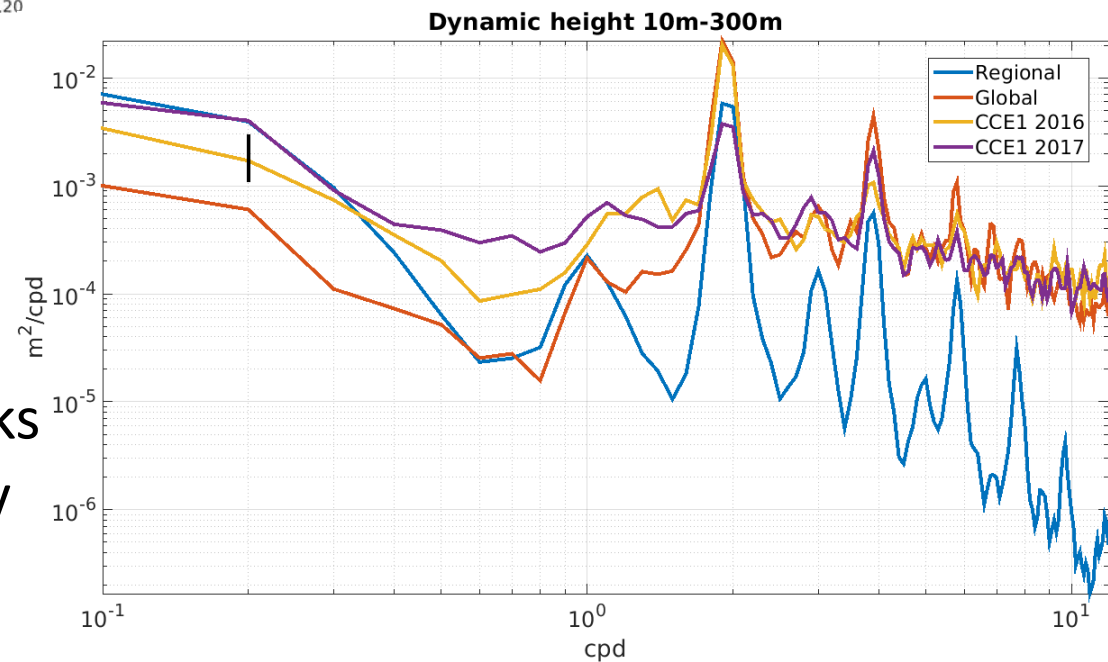
- Mooring data noisy; global model too energetic
- Interannual variability in observations
- Open boundaries don't let in enough energy



CCE1 mooring (June-Sept)

- 2016 and 2017 differ,
- ... but spectra similar

- Global model replicates mooring,
- ... but regional model lacks high-frequency variability



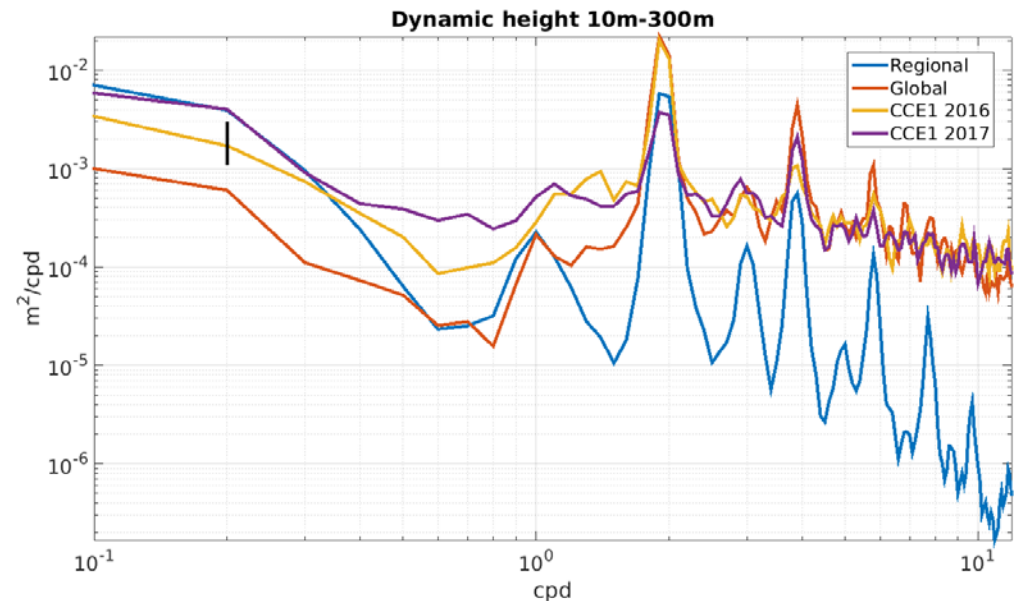
Can a regional model generate enough internal wave energy?

Regional tests

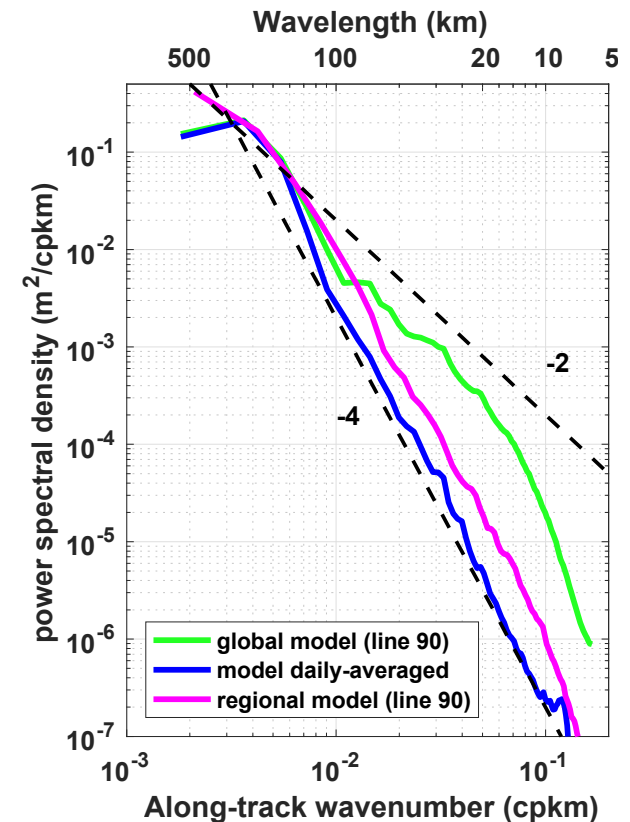
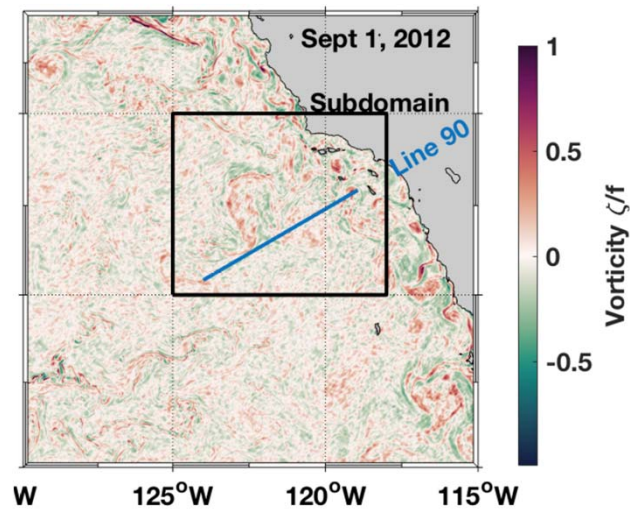
- Mooring has high-frequency energy in 2016 and 2017
- Global model (Ilc4320 MITgcm) replicates mooring energy
- Regional MITgcm missing energy at high frequency

Hypotheses:

- Mooring data noisy; global model too energetic
- ~~Interannual variability in observations~~
- Open boundaries don't let in enough energy



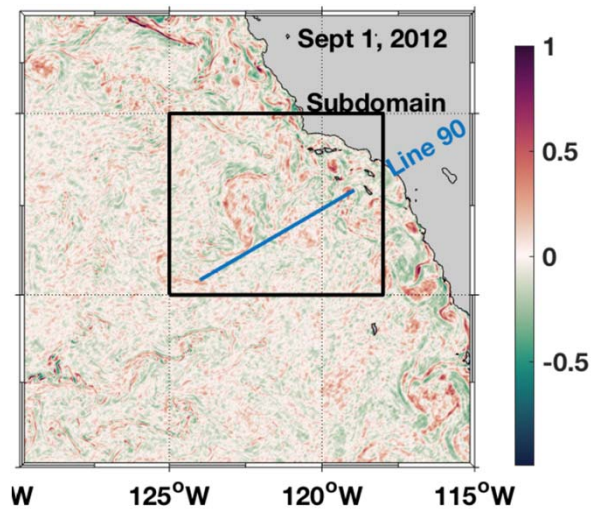
Sea surface height wavenumber spectra



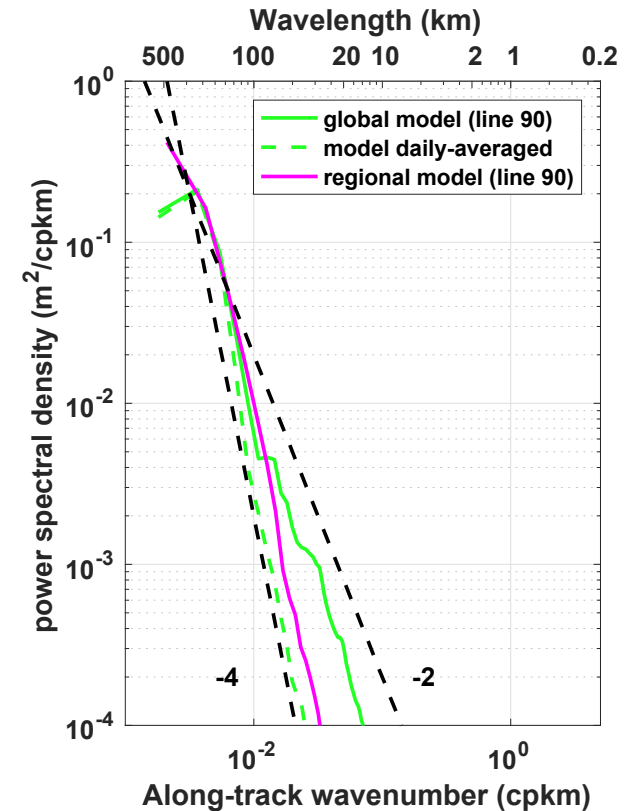
- Global model: spectra from **hourly output** vs **daily averages**
- **Regional model**: less energetic than global model at high wavenumbers--- more like daily averages

Adapted from Chereskin et al, submitted, JGR-Oceans, 2018

Sea surface height wavenumber spectra



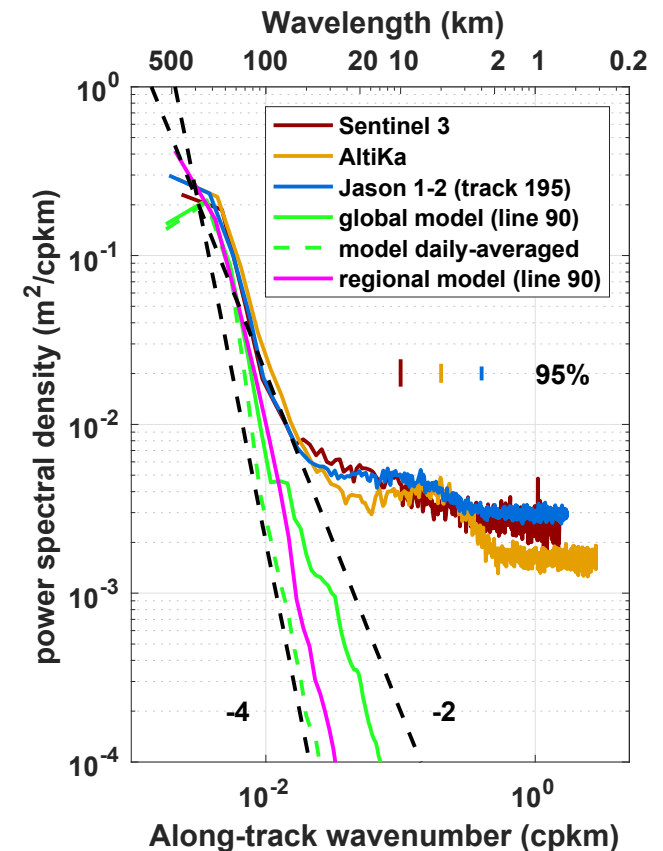
- Global model: spectra from **hourly output** vs **daily averages**
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Adapted from Chereskin et al, submitted, JGR-Oceans, 2018

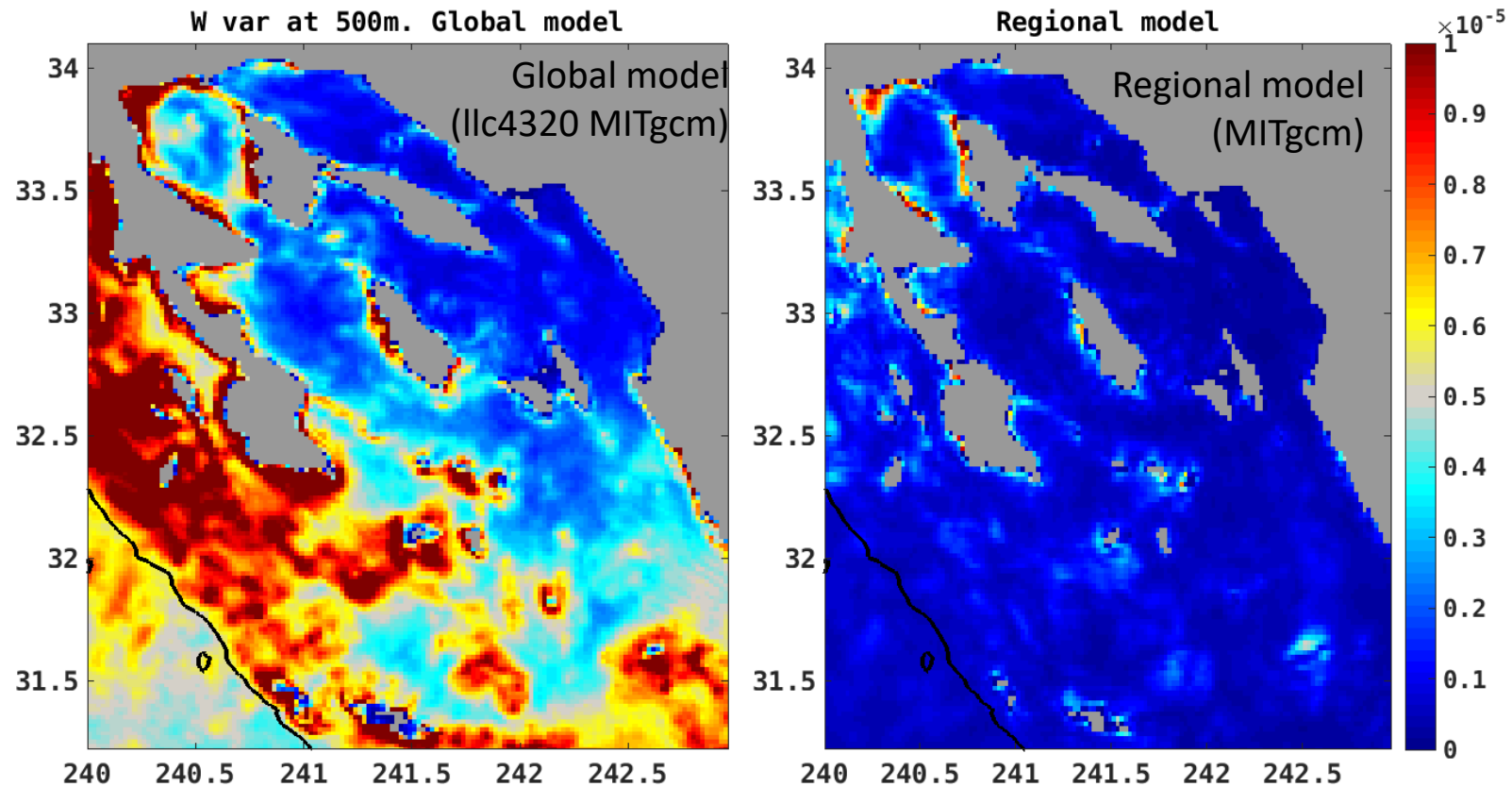
Sea surface height wavenumber spectra

- Global model: spectra from **hourly output** vs **daily averages**
- **Regional model**: less energetic than global model at high wavenumbers--- more like daily averages
- Altimeter spectra more energetic than models from 100-50 km and flatten out (implying “noise”) for scales smaller than ~50 km.



Adapted from Chereskin et al, submitted, JGR-Oceans, 2018

Vertical velocity comparable in SoCal Bight, in lee of islands



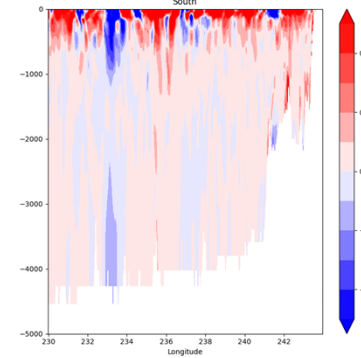
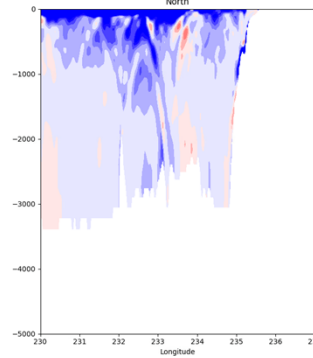
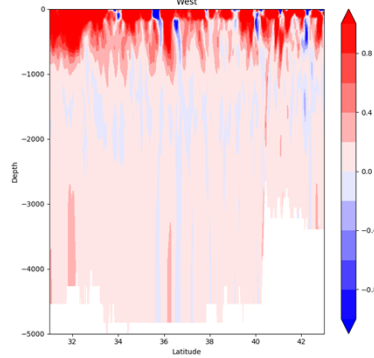
Wave energy flux ($u'p'$)

West

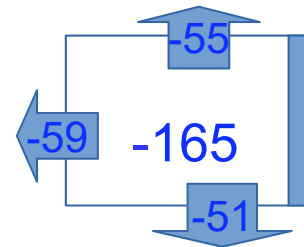
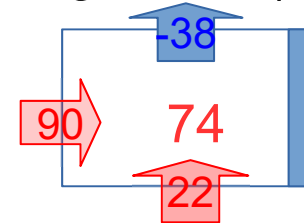
North

South

Global



Megawatts (MW)



Regional

Positive: energy into the domain. **Negative:** energy out of the domain.

Summary and Conclusions

- Small-scale and high-frequency processes occur in the California Current region in observations and global model, but not in regional model
- Energy originates outside of regional domain (e.g. Hawaii and western Pacific).
- Future work: Regional models that represent internal waves will need a new strategy to input energy at open boundaries.

