

Perspectives on waves, balanced motions & their interactions in high-resolution OGCMs (a summary of the Portland workshop)

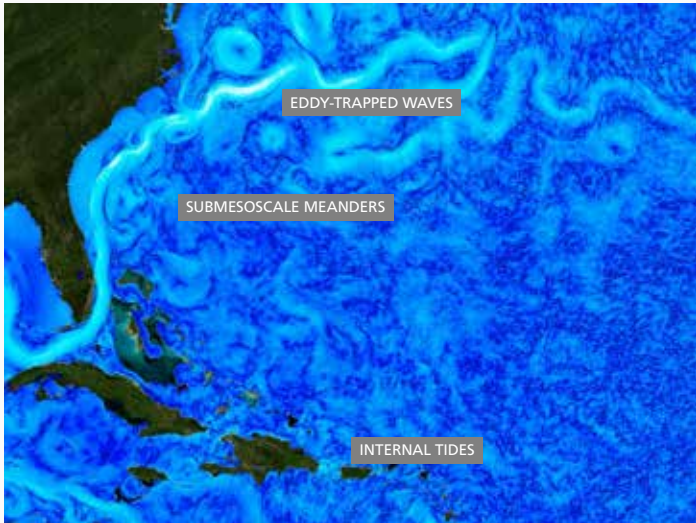
Edward D. Zaron, Portland State University
(thanks to Cesar Rocha, Scripps/UCSD)

June 26–29, 2018
SWOT Science Team Meeting
Montreal, Quebec

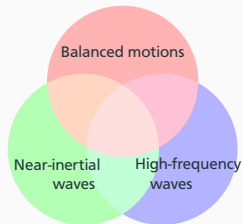
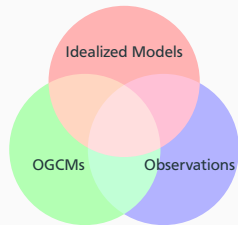
Pre-Ocean Sciences Meeting workshop:

“Interactions between internal gravity waves and meso/submesoscale currents in the ocean”

- Goals: “review what is known about internal wave–balanced interactions, identify questions that still need to be addressed, and consider how to meet these new challenges in the context of both fieldwork and numerical modeling.”
- 48 attendees – 22 talks – February 10–11, 2018.
- Meeting report under review at *BAMS*.
- Conference web site: <http://web.cecs.pdx.edu/~zaron/pub/SWOT.html>



Perspectives



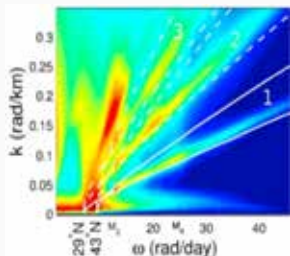
Themes of the Workshop

- Descriptions of internal waves & balanced motions in the ocean and in high-resolution ocean models.
- Mechanisms of energy exchange between internal waves & balanced motions.
- Synergy of observations and models for SWOT planning.

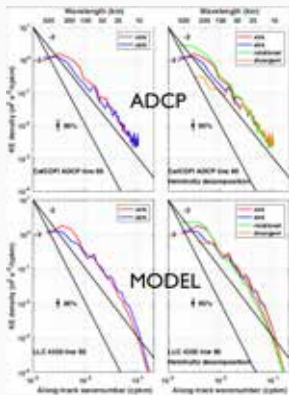
Identifying key questions for current and future research.

Descriptions of internal waves & balanced motions in the ocean and in high-resolution ocean models.

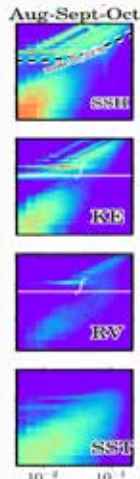
- Keynote talk by Brian Arbic – Global modeling of internal tides and the internal gravity wave continuum
- Kurt Polzin – Internal wave continuum, observations and theories
- Maarten Buijsman & Jay Shriver – Effect of resolution and assimilation on internal tides in HYCOM
- Sung Yong Kim – HFR observations
- Jörn Callies – Frequency dependence of SSH spectra vs. surface current spectra
- Teri Chereskin & Sarah Gille – ADCP observations
- Ed Zaron – Internal tides from altimetry



Arbic, $KE(k, \omega)$



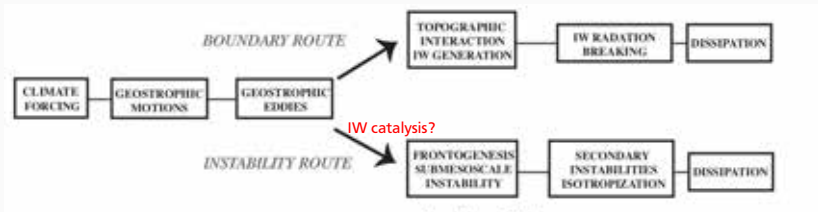
Chereskin, 1D decomp.



Klein

Mechanisms of energy exchange between internal waves & balanced motions.

- Sam Kelly – Low-modes interacting with realistic mean flows
- Michael Dunphy – Scattering and refraction of internal tide
- Cesar Rocha – Energy exchange from balanced flow to near-inertial waves
- Lief Thomas – Near-inertial waves interacting with a front
- David Straub – Near-inertial damping of geostrophic flows
- Roy Barkan – Forced IW's and eddy KE dissipation
- Patrice Klein – Diagnostics of waves, mesoscale, and submesoscale processes



Hamiltonian approach of Xie and Vanneste (2015):

Geostrophic advection and refraction decrease wave length-scales, thereby generating (P) at the expense of (K).



Rocha

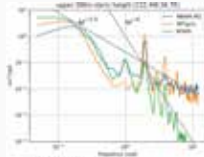
Synergy of observations and models for SWOT planning.

- Lee-Lueng Fu – The challenge of SWOT
- Jinbo Wang – Using models to define a SWOT cal/val campaign
- Jonathan Gula – Internal tides and eddies at the MAR
- Sarah Gille – Field experiment and synergies with SWOT
- Kyla Drushka/Luc Rainville – Glider observations in the Phillipine Sea
- Nicholas Raschle – New observational techniques for observing upper-ocean strain field
- Bruce Cornuelle – Ocean forecasting internal tides and surface waves

A “straw plan” for SWOT science campaign(s)

Campaign #1: A wavenumber-frequency view of submesoscale variability
Campaign to resolve 4D spectrum of ocean variability in pressure and velocity at scales of 10-200km. This campaign would capitalize on the existence of the SWOT fast-repeat orbit and the existence of an in situ cal/val array designed to resolve 20-200km

Campaign #2: A time-space view of submesoscale variability near a front
Frontal/submesoscale campaign with intensive measurements of submesoscale eddies and fronts. Scientific focus on dynamical processes and vertical transport in the upper ocean.



ROMS 1km, 60 levels
LLC4320, 1/48th, 90 levels

What makes the LLC4320 stand out in the performance of the high frequency simulation? Why is the spectra slope too steep in ROMS? The horizontal or vertical resolution is not the main culprit .

Gille

Wang

Ensuing questions/loose ends

1. Incremental progress and intercomparison of realistic OGCM outputs is leading to new questions.
2. Some unexplained differences among ocean models were noted by Jinbo Wang.
3. Jörn Callies' conclusion that the IGW continuum will not be observable with SWOT needs clarification. It appears to disagree with some other estimates of IGW SSH spectra.
4. Vertical velocity may be a key diagnostic of different dynamics. What are prospects for its measurement?
5. It may be useful (or not) to revise SWOT White Papers in light of new understanding about the interactions of internal gravity waves and meso/submesoscale flows.