

Seasonality of submesoscale (10-100 km⁻) dynamics in the Kuroshio Extension

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Transition from geostrophic flows to internal waves in

- The transition of the transition of the transition of the transition of the term of term of the term of term of
- Significant geographic variability.
- Drake Passage ADCP



This study: analysis of LLC outputs in the



- Spin-ups from EGEO2, forced by winds, surface fluxes,
- LLC 2160, 1/24: effective resolution ~20 km, hourly outp 2013.
- LLC 4320, 1/48: effective resolution ~8 km, hourly output

Upper-ocean stratification



Upper-ocean Ass**geasothatity**ual cycle of stratification.

- Shallow baroclinic instabilities energize submesoscale turbulence in winter (e.g., Sasaki et al. 2014; Callies et al. 2015).
- Seasonality of internal waves
 near the surface?

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- Shallow baroclinic instabilities energize submesoscale turbulence in winter.
- Strong nearsurface stratification in







Surface vorticity <u>and divergence</u>

- Vorticity peaks in winter.
- Divergence peaks in summer, with secondary peak in winter.
- Most of variance at Mar 2011 scales <100 km.



SSH variance



- Inertia-gravity waves are enhanced in summer/fall.
- Phase cancellation between turbulence and waves: weak seasonality in hourly 1D spectrum

Summary

- **Out-of-phase** seasonal cycle near the surface.
- Submesoscale **turbulence** peaks in **winter**/spring.
- Inertia-gravity waves peak in summer/fall.
- Implications for the accuracy of geostrophic velocity diagnosed from SWOT.
- Details in Rocha et al., GRL, in press, tinyurl.com/Rocha-GRL16.

Extras

A Haiku for this talk Submeso annual cycle Wintertime is turbulent Summertime is wavy

dynamics in the Kuroshio Extension

- Vigorous seasonality of KE and SSH variance at SWOT relevant scales (10-100 km).
- Submesoscale geostrophic turbulence peaks in late winter/early spring.
- Inertia-gravity waves peak in late summer/early fall.

Joint-PDFs



Depth-dependence



Surface KE spectrum



 Phase cancellation between turbulence and waves: weak seasonality in hourly 1D spectrum