INTRODUCTION

Mesoscale geostrophic eddies (O(100-300km)) are the largest reservoir of the kinetic energy (KE) in the oceans (Ferrari and Wunsch, 2009).

→ The mechanisms that distribute and control the KE have not yet been well understood.

→ The distribution of the sea surface height (SSH) and KE over a range of spatial scales

→ Underlying processes of oceanic mesoscale turbulence such as those from quasi-

    -geostrophic (QG; Hua and Haidvogel, 1986) and surface quasi-geostrophic (SQG; Held et al., 1995) turbulence theories.

→ Satellite sea surface height (SSH) data are useful to observe KE distribution in the global region (e.g., Le Traon et al., 2008, Xu and Fu, 2011).

Question: If a shallow SSH spectral slope persists for smaller scale, this would suggest very high EKE at small scales.

→ SSH wavenumber spectrum at wavelengths shorter than 100km are examined in a realistic high-resolution simulation.

High-resolution simulation

Model Description

Model: OFES (Masumoto et al., 2004, Komori et al., 2005)

Domain: North Pacific (20S-68N, 100E-70W)

Resolutions: 1/30° Number of vertical level: 100 (60 layers in the upper 500m)

Horizontal mixing: Bi-harmonic


Forcing: 6 hourly reanalysis data of JRA-25 (Onogi et al., 2007)

Initial condition: Outputs from 0.1° hindcast simulation on JAN/01/2000

JAN/01/2000

JUN/01 DECE/31 in 2001

EKE averaged in Jun-Dec/2001

High EKE: East of 170W, 20-50N, East of 160E, 40-50N.

Low EKE: Other regions

Comparable to satellite observations (e.g. Chelton et al. 2001).

Summary and Discussion

• In all, high and low, EKE regions, the SSH spectral slopes almost follow a K^-4 or slightly steeper law, observed in particular for scales smaller than 100km.

• Such slope close to SQG theory and the associated inverse KE cascade highlight the dynamical impact of small-scale process on the larger-scale ones.

• Spectral slope of satellite observation removing measurement noise became much closer to that in this simulation. (see a below figure)

• Further space mission (SWOT), high-resolution in-situ observations such as radar observations (e.g. Kim et al., 2011) and realistic simulation with even higher resolution with internal tides (e.g. Richman, submitted) should be useful.

Modified spectral slope of satellite observed SSH removing measurement noise (Personal comm. by Dr. Fu)

QG like regime at 250m depth and SQG-like regime at surface are consistent with previous studies (Lapeyre and Klein, 2006; Klein et al., 2008).