Ocean Carbon Hot Spots Workshop

Mesoscale Eddy in the Kuroshio and its Extension

Xiaopei Lin, *Xiaohui Ma, Lixiao Xu,* Zhaohui Chen, Chun Zhou, *Zhao Jing,* Lixin Wu

Physical Oceanography Laboratory/CIMSST, Ocean University of China and Qingdao National Laboratory for Marine Science and Technology

> **Ping Chang** Texas A&M University Other co-authors from NCAR, GEOMAR and Kiel University



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SICAL OCE

Western Boundary Current (WBC)-Key Region for the ocean and climate

Mass and Heat transport

Air-sea Heat Flux



Hot Spot under Global Warming



CO₂ Sink







Outline

- Eddy-Air Interaction
- Eddy in the mode water formation

Kuroshio and its Extension (KE)-Rich Eddy Activities



White contours: mean SSH field of Niiler et al. (2003)

High resolution models are needed for simulating eddies But eddies are too energetic in high resolution models



Figure 7. The lifespan of eddies generated in the Comoros Basin as tracked (a) AVISO and (b) ROMS. Black (white) bars represent cyclonic (anticyclonic) eddies.

(Charine, 2014)

Forward and inverce cascade?



How could we kill eddies in the Kuroshio and its Extension? What's the impact on the ocean and climate?

High Resolution Regional Coupled Model



Atmosphere Force Ocean: Large and Quick Ocean Force Atmosphere: Small and Slow

2002-11-01 OLR (W/m2)



Ma et al., 2015, Sci. Rep

Eddy is strongly dissipated by eddy-air interaction

With eddy-air interaction

Without eddy-air interaction



1 degree SST anomaly causes about 50W/m2 heat flux anomaly





Observation in 2015 & 2016

KE Monitoring System

Observation in 2014



Eddy observations in April 2016













Observation shows similar results with model and reanalysis

```
OAflux
HF=109.55;LHF=86.195;SHF=23.355
X-Float
HF=161.3;LHF=116.83;SHF=45.48
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HF is increased by 47%
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SST AVHRR 12.6 SST WOA13 11.5

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1degree increase = 47 W/m<sup>2</sup>
Compared with OAflux
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25.5

40°N





OMEA Interaction Mechanism



These eddy-air interaction is confirmed by observation and reanalysis data



Eddy dissipation and its impact on air-sea interaction

Eddies control the local heat flux, wind speed and weather system



About ³/₄ eddy potential energy is dissipated by eddy-air interaction in the north of KE

LETTER





Enhanced Eddy-induced Ocean-to-Atmosphere Turbulent Heat Transfers in the Global Western Boundary Current Regio. Yanan Zhu (poster)



Meridional Shift of the Oyashio Extension Front in the Past 35 Years. Baolan Wu (poster)

Outline

• Eddy-Air Interaction

• Eddy in the mode water formation

Eddy could affect mode water in KE

Mode Water Path Way





Eddy transport is comparable with wind driven circulation and disappears at mid-latitude WBCs *Zhang, Wang and Qiu, 2014, Science*

A Zonal volumn transport per latitude (Sv/degree)





Sample every day, 2m vertical resolution Parking depth: 500 m

In the south of KE, eddy help to transfer the low potential vorticity water into the thermocline and advect westward



Comments and Suggestions

