Preparing for CMIP6 of FIO-ESM

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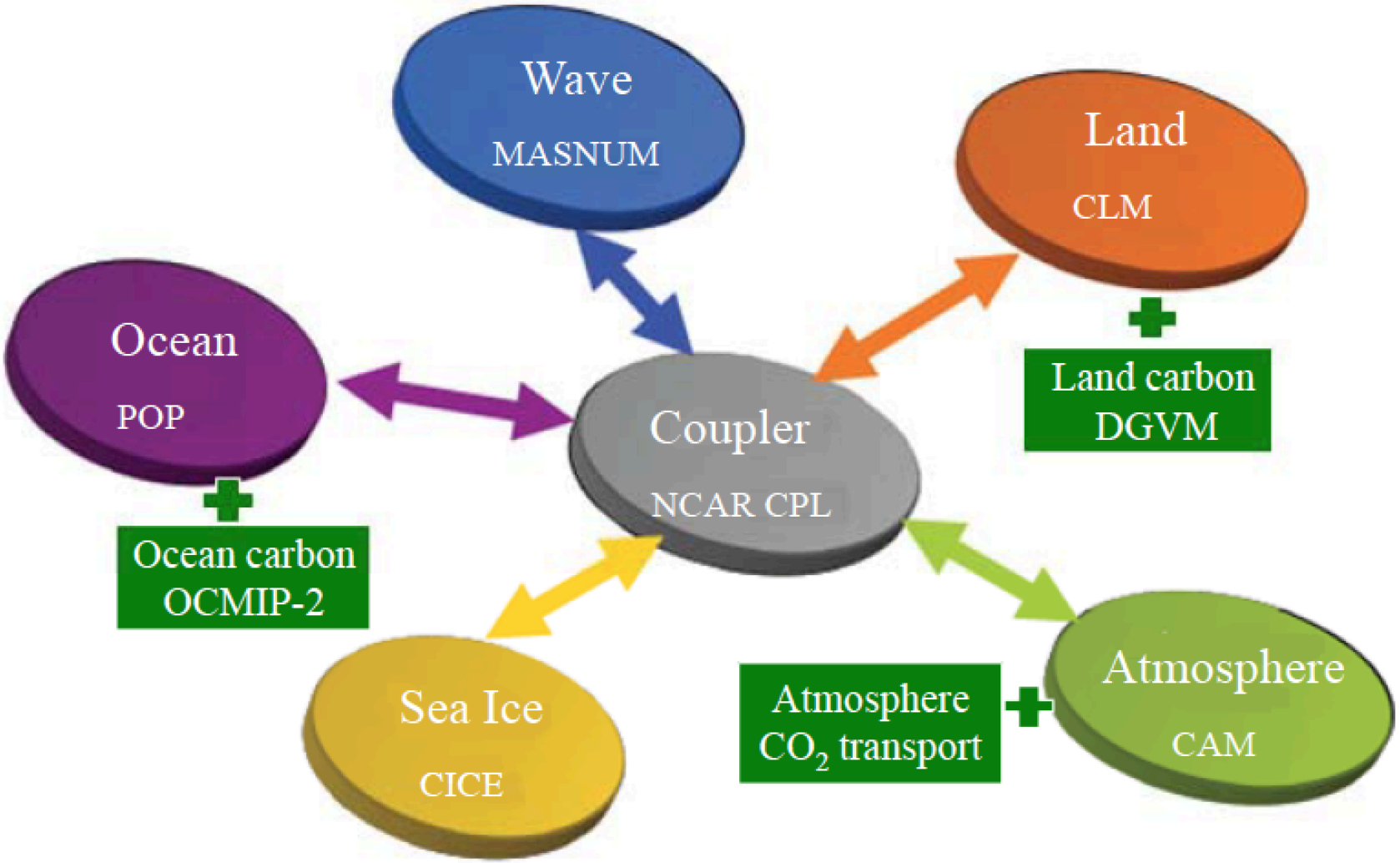
Outline

- Development of FIO-ESM
- Experiments to be run
- Suggestions

Development of FIO-ESM

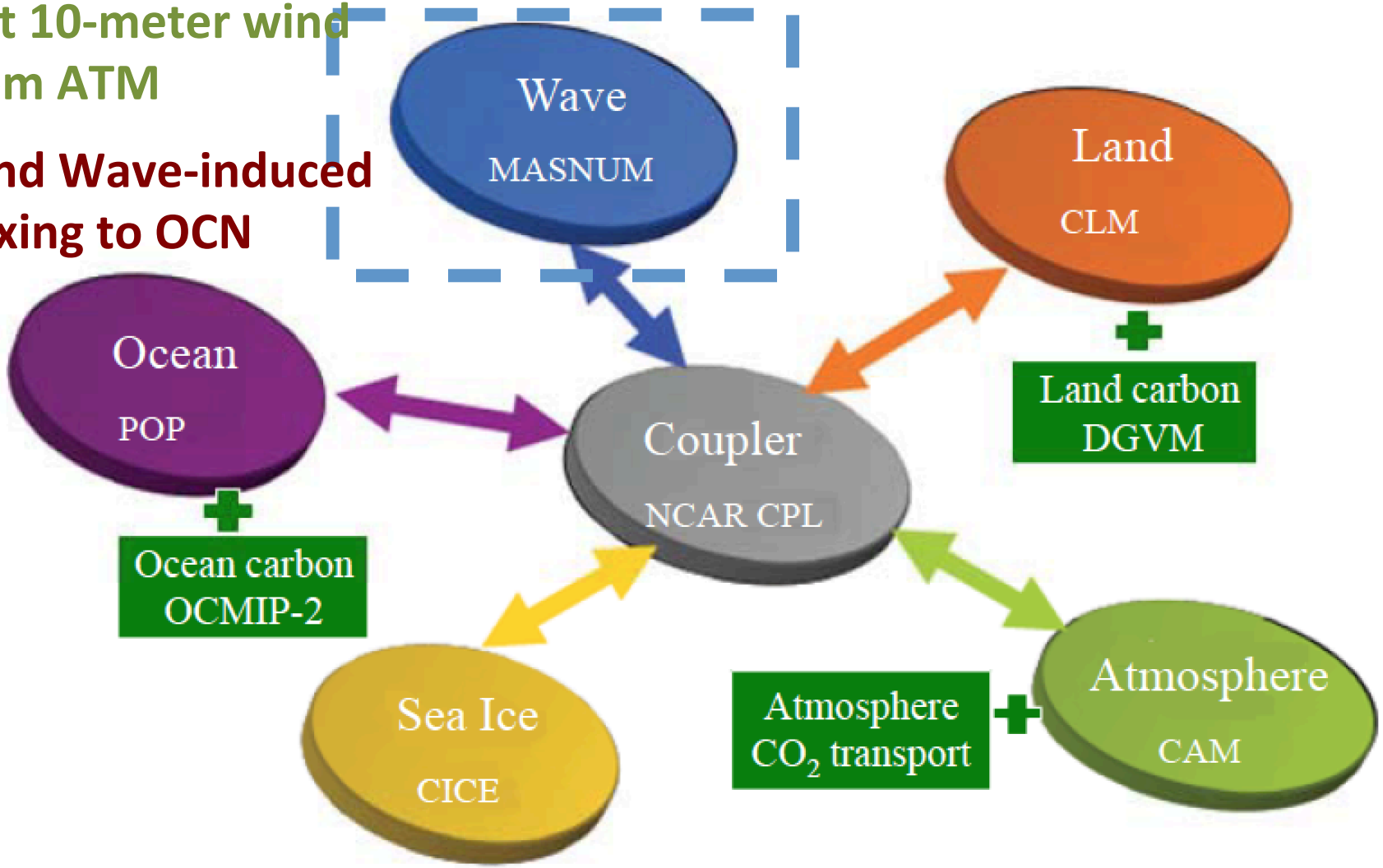
Framework of FIO-ESM version1.0



Framework of FIO-ESM version1.0

Get 10-meter wind from ATM

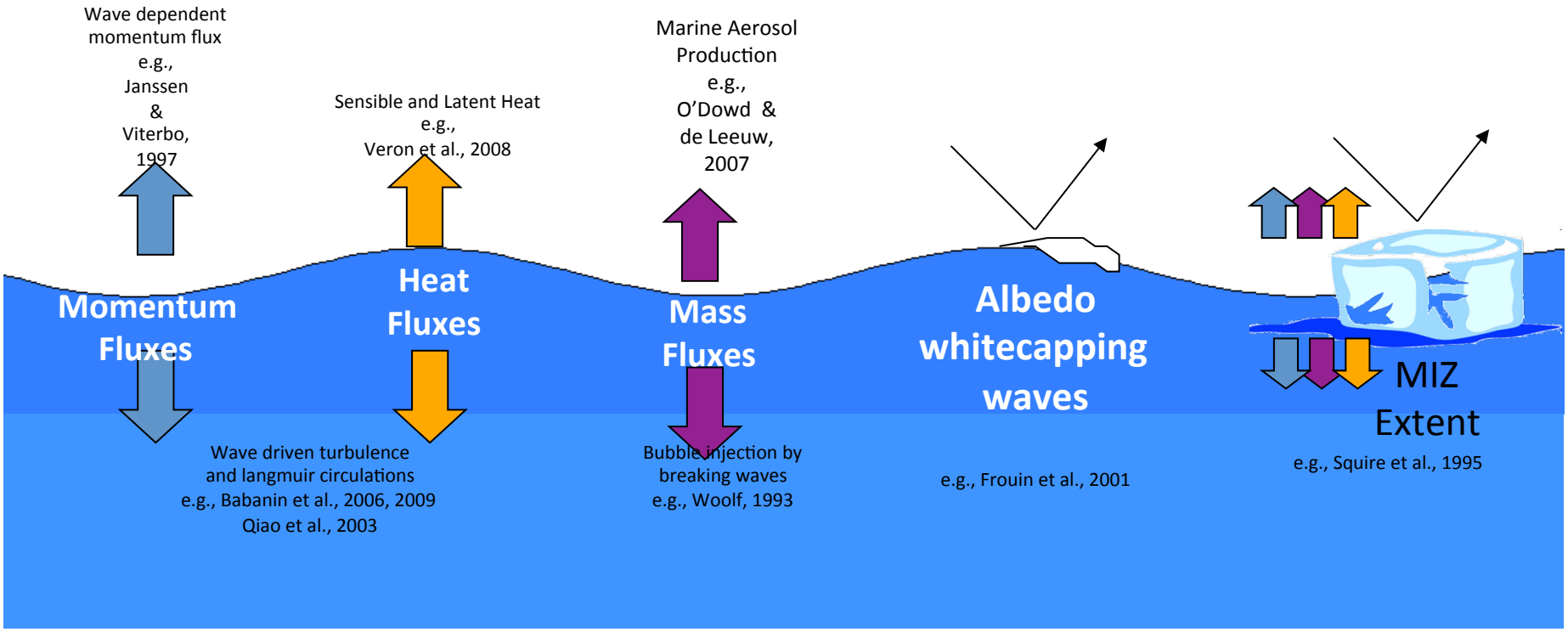
Send Wave-induced mixing to OCN



The expected changes for FIO-ESM

Component		FIO-ESM v1	FIO-ESM v2
ATM	Model	CAM3	CAM5, or BCC-AGCM3
	Resolution	H: 300km; V: 26 level	H: 200, 100 and 50 km; V: 50 level
LND	Model	CLM3.5	CLM4
	Resolution	300km	200, 100, and 50 km
OCN	Model	POP 2	POP2, or MOM5, or NEMO3
	Resolution	H: 100km; V: 40 level	H: 100, 50, and 25 km; V: 60 level
ICE	Model	CICE4	CICE4
	Resolution	100km	100, 50, and 25 km
WAV	Model	MASNUM Wave model	MASNUM Wave model
	Resolution	200km	200, 100, and 50 km
COUPLER		CPL6	CPL7 or C-Coupler 1.0

Surface wave effects in the coupled climate system



The expected changes for FIO-ESM

Physical Processes

Component	FIO-ESM v1	FIO-ESM v2
WAV	(1) Non-Breaking Wave-induced mixing	(1) Non-Breaking Wave-induced mixing (2) Breaking Wave mixing (3) Langmuir Circulation
		(1) Drag Coefficient (2) Air-sea heat flux
OCN		(1) Tidal mixing
Carbon	(1) CASA (Land)	(1) DGVM (Land)

Experiments to be run

MIPs to be simulated

	Short name of MIP	Long name of MIP	FIO China
1	AerChemMIP	Aerosols and Chemistry Model Intercomparison Project	0
2	C4MIP	Coupled Climate Carbon Cycle Model Intercomparison Project	1
3	CFMIP	Cloud Feedback Model Intercomparison Project	0
4	DAMIP	Detection and Attribution Model Intercomparison Project	2
5	DCPP	Decadal Climate Prediction Project	1
6	FAFMIP	Flux-Anomaly-Forced Model Intercomparison Project	2
7	GDDEX	Global Dynamical Downscaling Experiment	2
8	GeoMIP	Geoengineering Model Intercomparison Project	2
9	GMMIP	Global Monsoons Model Intercomparison Project	1
10	HighResMIP	High Resolution Model Intercomparison Project	2
11	ISMIP6	Ice Sheet Model Intercomparison Project for CMIP6	0
12	JCOMM*	Coordinated Ocean Wave Climate Project	1
13	LS3MIP	Land Surface, Snow and Soil Moisture	0
14	LUMIP	Land-Use Model Intercomparison Project	0
15	nonlinMIP	Non-linear Model Intercomparison Project	2
16	OCMIP6	Ocean Carbon Cycle Model Intercomparison Project, Phase 6	1
17	PDRIP	Precipitation Driver and Response Model Intercomparison Project	2
18	PMIP	Palaeoclimate Modelling Intercomparison Project	2
19	RFMIP	Radiative Forcing Model Intercomparison Project	0
20	ScenarioMIP**	Scenario Model Intercomparison Project	2
21	SensMIP	Sensitivity Model Intercomparison Project	2
22	VolMIP	Volcanic Forcings Model Intercomparison Project	2

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6	FAFMIP	Flux-Anomaly-Forced Model Intercomparison Project	2
7	GDI		2
8	Geo		2
9	GMI		1
10	HighR		2
11	ISM		0
12	JCOMM*	Coordinated Ocean Wave Climate Project	1
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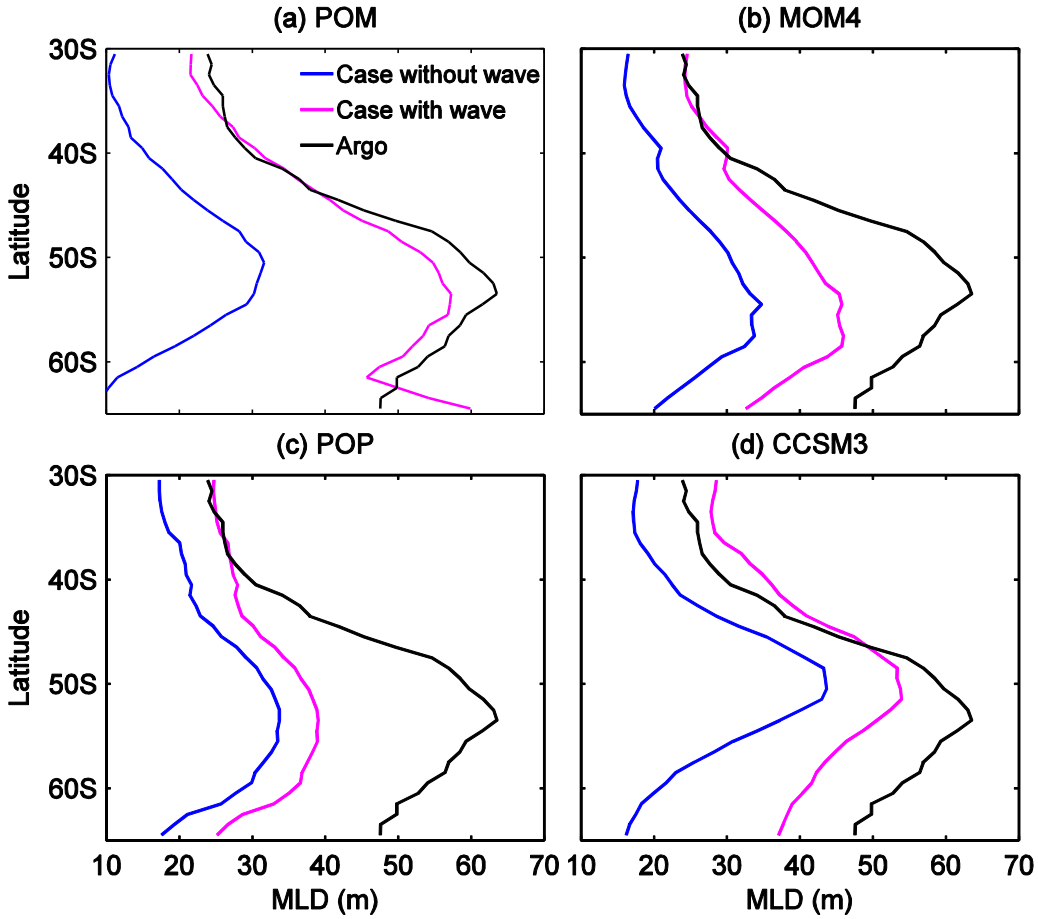
Total around 10,000 model years include DECK and MIPs

Suggestions

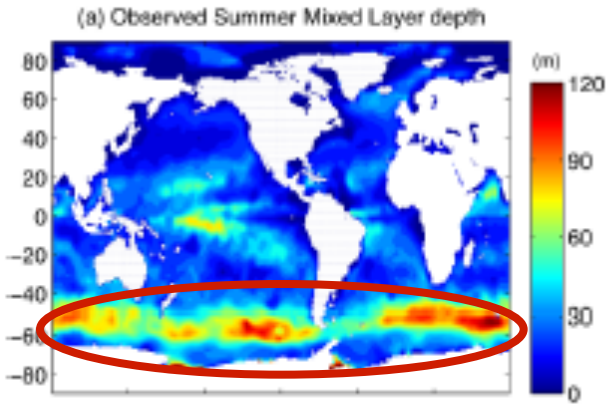
Suggestions

(1)The experiments on Forcing ocean/ocean-sea ice models, like CORE2, should be included in DECK, which can provide the information to diagnose ocean model biases and its contribution to coupled models biases.

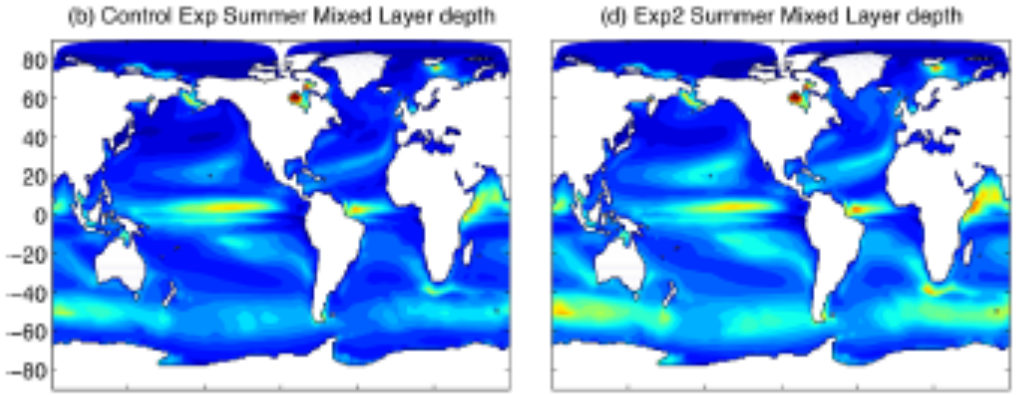
Non-breaking surface wave-induced vertical mixing (Bv) can much improve the MLD simulation in the Southern Ocean

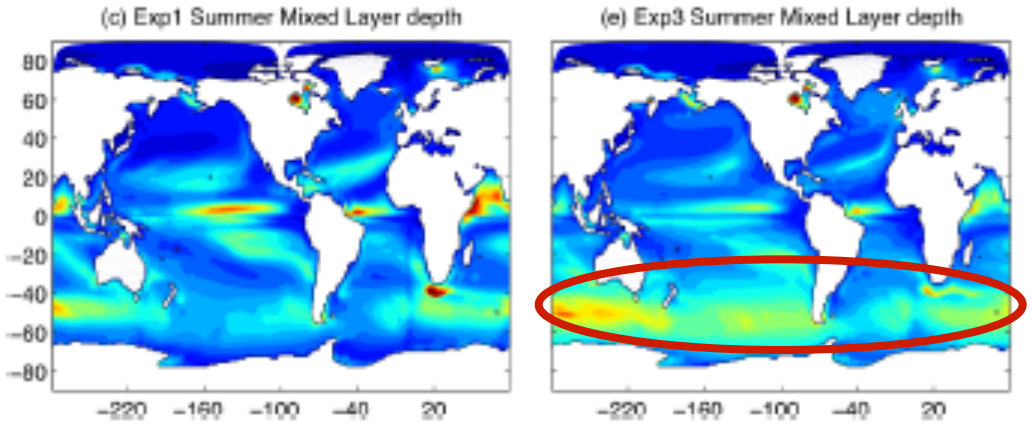


Huang Chuangjiang, ***Fangli Qiao***, Qi Shu, Zhenya Song, 2012, Evaluating austral summer mixed-layer response to surface wave–induced mixing in the Southern Ocean. ***J. Geophys. Res.***, 117, C00J18, doi:10.1029/2012JC007892



Data





Add Bv

FanYalin , and Stephen M. Griffies, 2014, Impacts of Parameterized Langmuir Turbulence and Nonbreaking Wave Mixing in Global Climate Simulations, J Climate, DOI: 10.1175/JCLI-D-13-00583.1

Suggestions

(1)The experiments on Forcing ocean/ocean-sea ice models, like CORE2, should be included, which can provide the information to diagnose ocean model biases and its contribution to coupled models biases.

(2) Surface wave is important for improving climate models, our institute would like to provide help if any research group would like to include surface wave.

Thank you

for your attention

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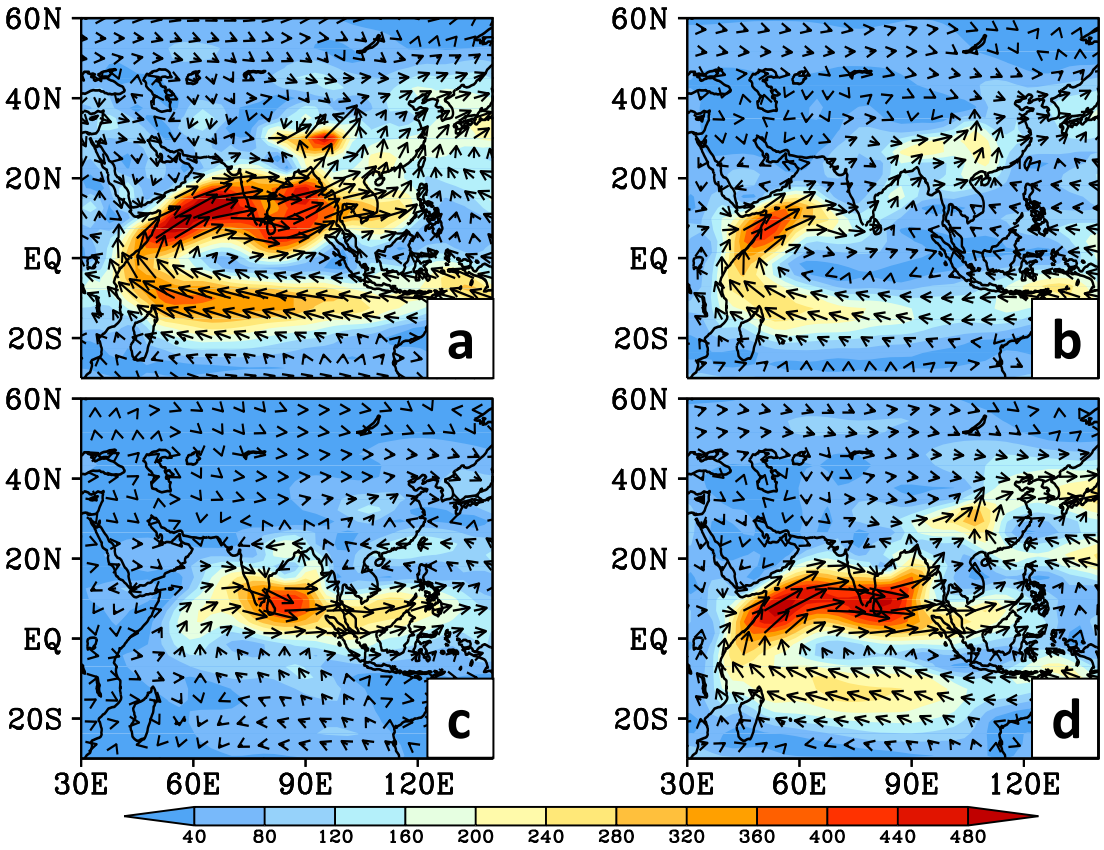
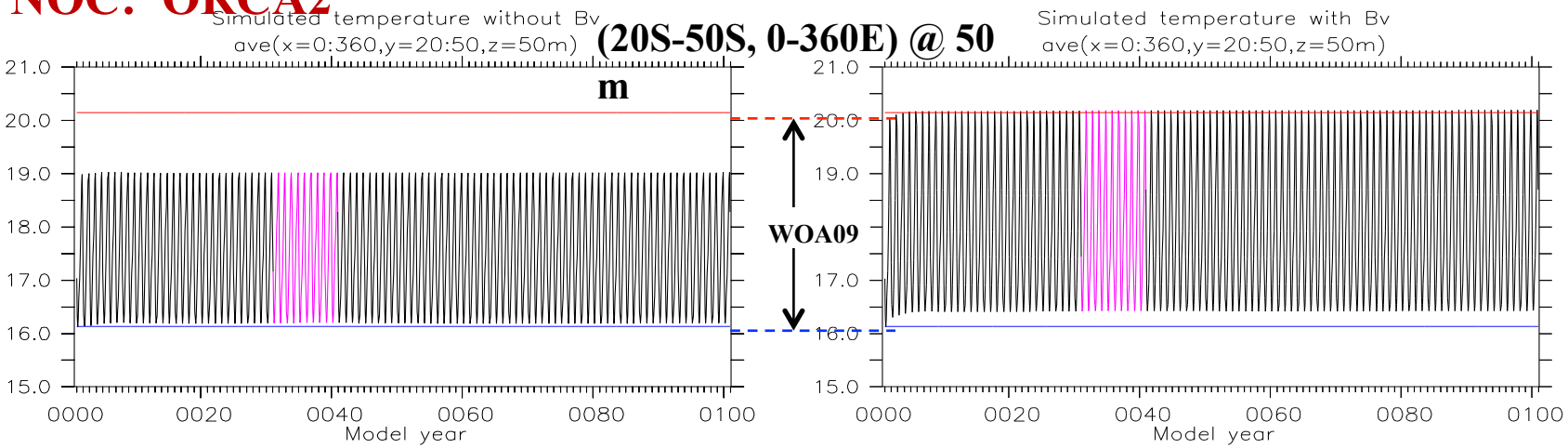
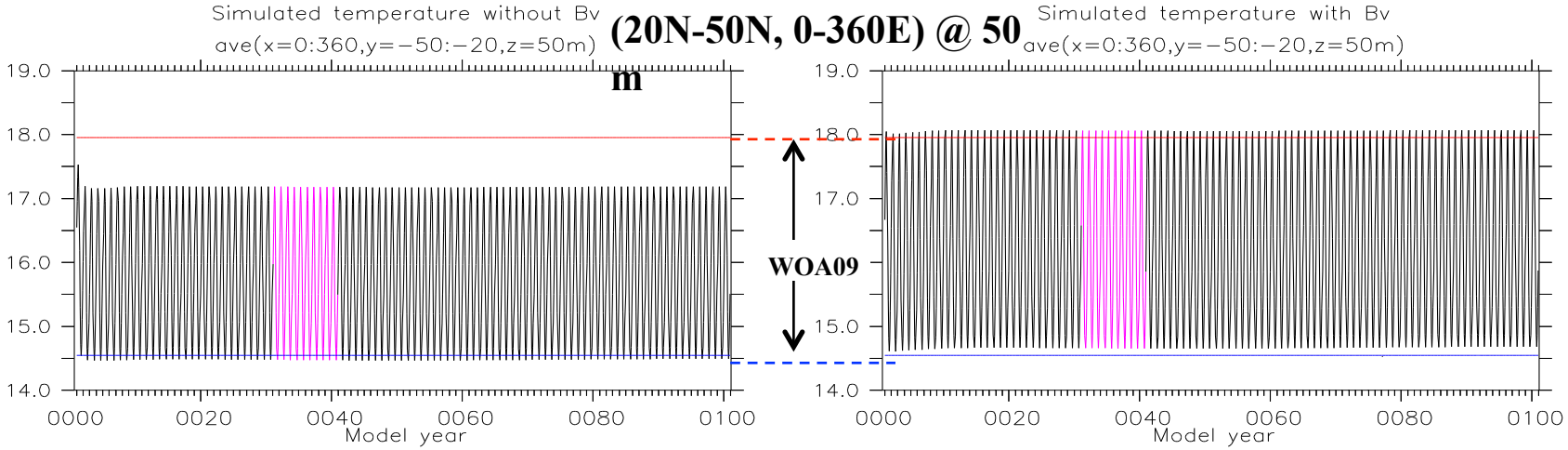
Water vapor transport in Asia-Australia monsoon area



Song Yajuan, Fangli Qiao, Zhenya Song, 2012, Improved Simulation of the South Asian Summer Monsoon in a Coupled GCM with a More Realistic Ocean Mixed Layer. *J. Atmos. Sci.*, 69, 1681-1690, doi: http://dx.doi.org/10.1175/JAS-D-11-0235.1

NOC: ORCA2


Simulated temperature without Bv
ave(x=0:360,y=20:50,z=50m)
(20S-50S, 0-360E) @ 50
Simulated temperature with Bv
ave(x=0:360,y=20:50,z=50m)
m
WOA09
21.0
20.0
19.0
18.0
17.0
16.0
15.0
0000
0020
0040
0060
0080
0100
Model year


Simulated temperature without Bv
ave(x=0:360,y=−50:−20,z=50m)
(20N-50N, 0-360E) @ 50
Simulated temperature with Bv
ave(x=0:360,y=−50:−20,z=50m)
m
WOA09
19.0
18.0
17.0
16.0
15.0
14.0
0000
0020
0040
0060
0080
0100
Model year

One-dimensional experiments from OWS

➢**Observational data: the ocean weather station Papa located in the eastern North Pacific at (145°W, 50°N) from June 9, 2007 to January 16, 2008.**

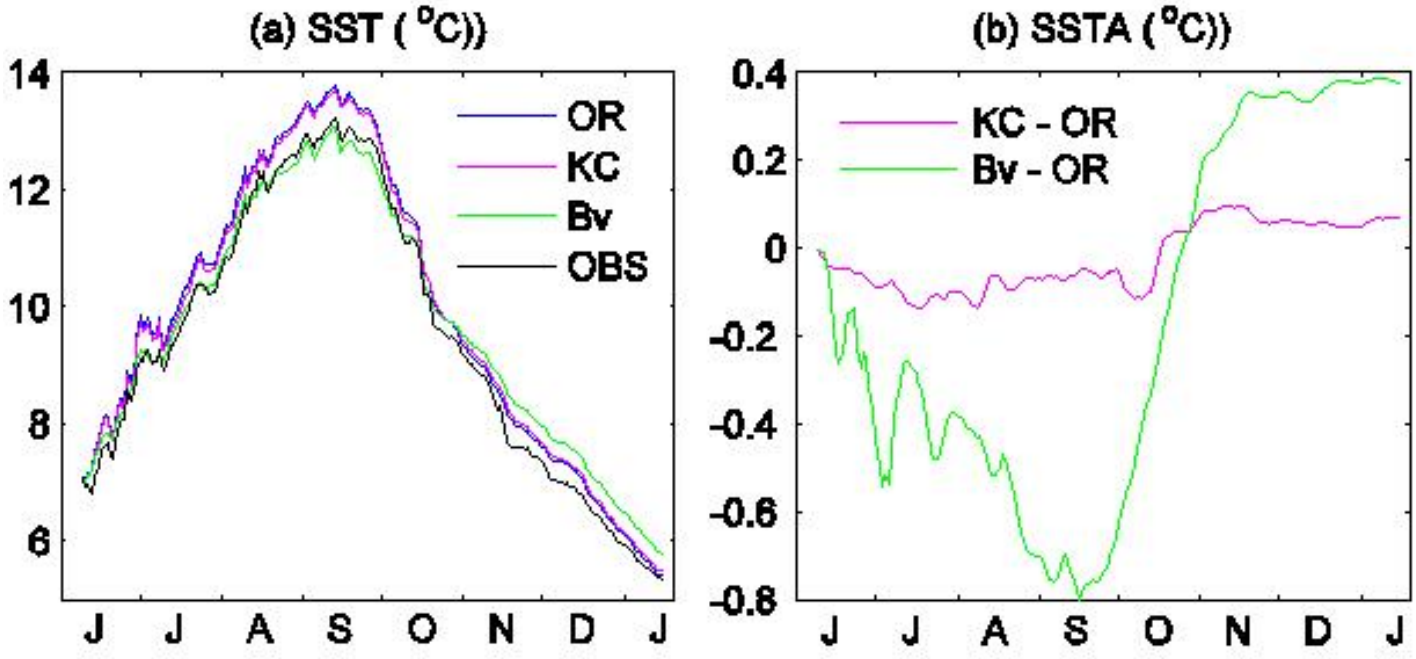
- ✓ **Initial temperature and salinity: June 9, 2007**
- ✓ **Initial velocity: Zero.**
- ✓ **Forcing fields: Hourly surface data**
- ✓ **Seawater optical type: Type II**

Experiments:

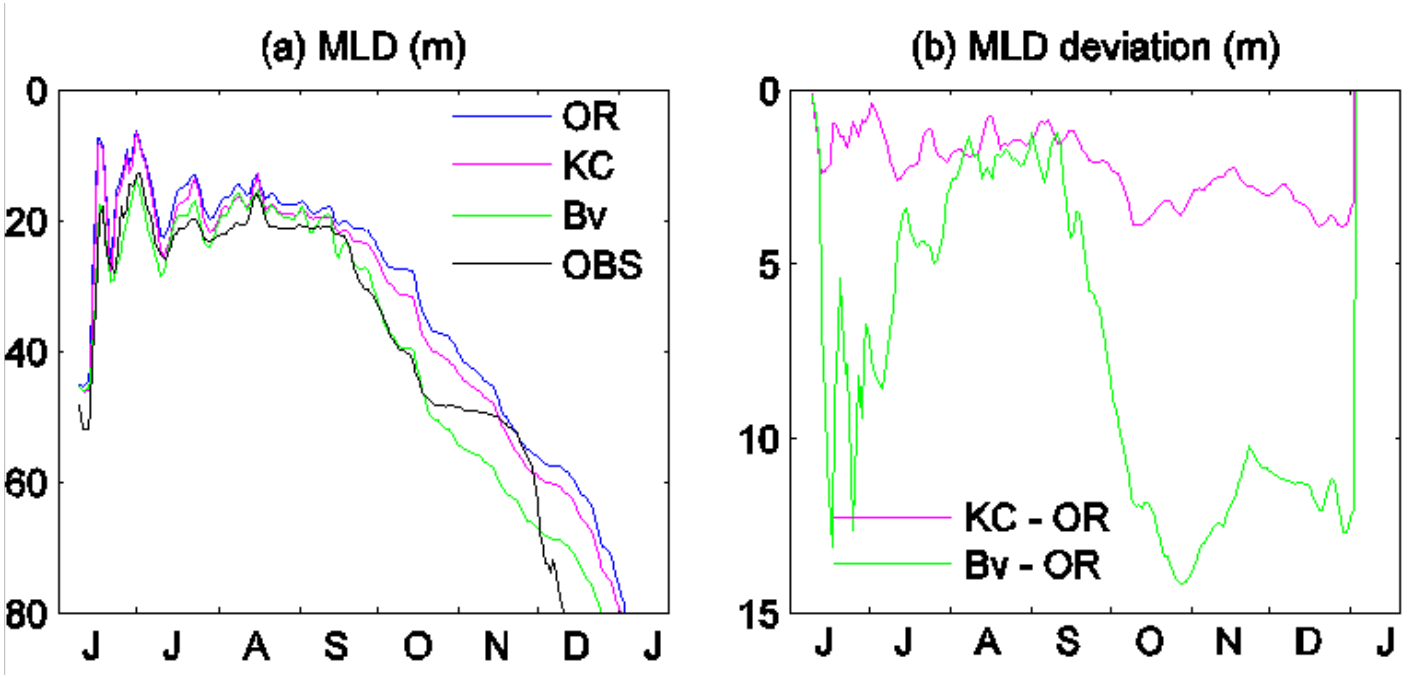
OR: control experiment with the classical M-Y scheme

KC: experiment including effects of Langmuir circulation

Bv: experiment including effects of wave-induced mixing with α=0.3.

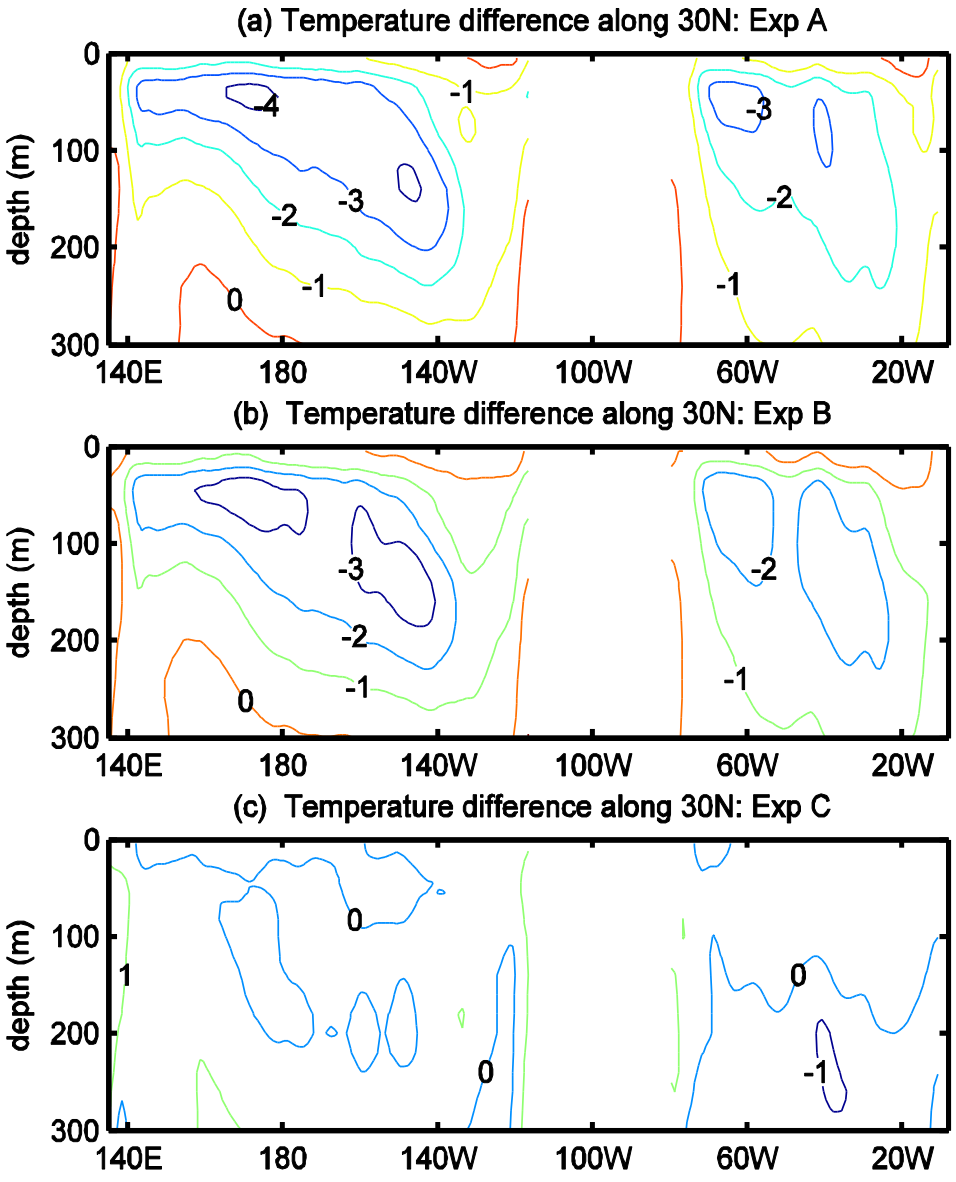


(a) Simulated and observed daily-mean SST, and (b) their deviations from June 9, 2007 to January 16, 2008



(a) Simulated and observed daily-mean mixed layer depth (MLD), and (b) their deviations from June 9, 2007 to January 16, 2008. The MLD is defined as the depth at which the temperature drops by 0.5°C from the surface.

Simulated ocean temperature biases



Upper: Exp A (M-Y scheme);

Middle: Exp B (M-Y scheme + wave breaking)

Lower: Exp C (M-Y scheme + Bv).