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MIROC4 – a high-resolution climate model for the near-term prediction

← D2-6377 poster

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Innovative Program of Climate Change Projection for the 21st Century

objective

- Global warming will continue for at least several coming decades even if anthropogenic GHGs emission will be restricted in future.
- It is necessary to predict the climate change during coming decades more precisely with quantitative prediction errors caused by the model uncertainties, and to investigate environmental impacts by the climate change.

MIROC4

Model for Interdisciplinary Research on Climate

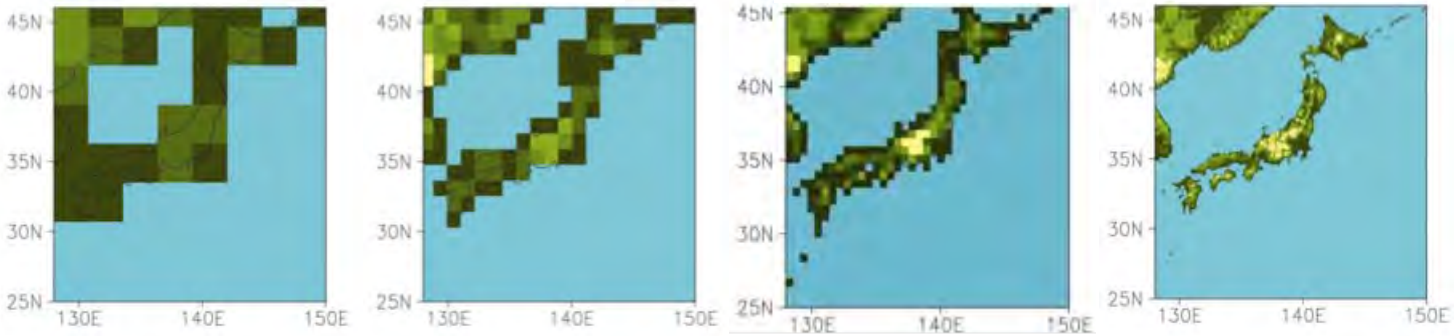
Updated version of MIROC3.2_hires (hereafter MIROC3h; K-1 model developers, 2004)

- Atm.: CCSR/NIES/JAMSTEC AGCM, T213 (~ 60km mesh, 640×320) L56
  - MIROC3h: T106 (~ 110km mesh, 320×160) L56
- Ocn.: COCO3.4, eddy-permitting (20~30km mesh, 1280×912)+ 0-layer thermodyn. EVP rheology sea ice, L47+BBL, rotated (NP is on the Greenland)
  - Ocn & sea ice models are the same as MIROC3h
- Land: MATSIRO (1280×960)
  - MIROC3h: 640×320
- River: TRIP (same as MIROC3h)
- 11~12 hrs/yr on the Earth Simulator 2 (20 nodes)

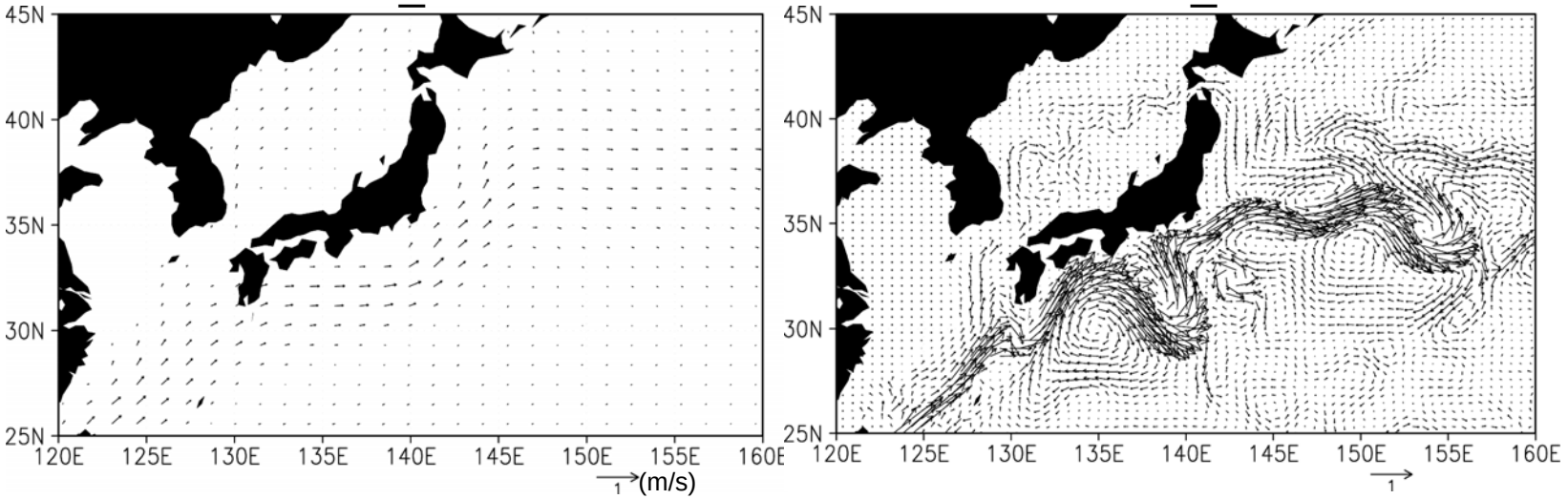
	Atmosphere	Ocean
AR4	MIROC3.2_medres (MIROC3m)	T42 (128 × 64, ~2.8°), L20	1.4° × (0.5°–1.4°), L43+BBL 0-layer EVP sea ice
AR4	MIROC3.2_hires (MIROC3h)	T106 (320 × 160, ~1.2°), L56	0.28125° × 0.1875°, L47+BBL 0-layer EVP sea ice
AR5 (near-term prediction)	MIROC4	T213 (640 × 320, ~0.6°), L56	0.28125° × 0.1875°, L47+BBL 0-layer EVP sea ice
AR5 (near-term prediction)	MIROC5	T85 (256 × 192, ~1.4°), L40, new physics	1.4° × (0.5°–1.4°), L49+BBL, multi-category sea ice

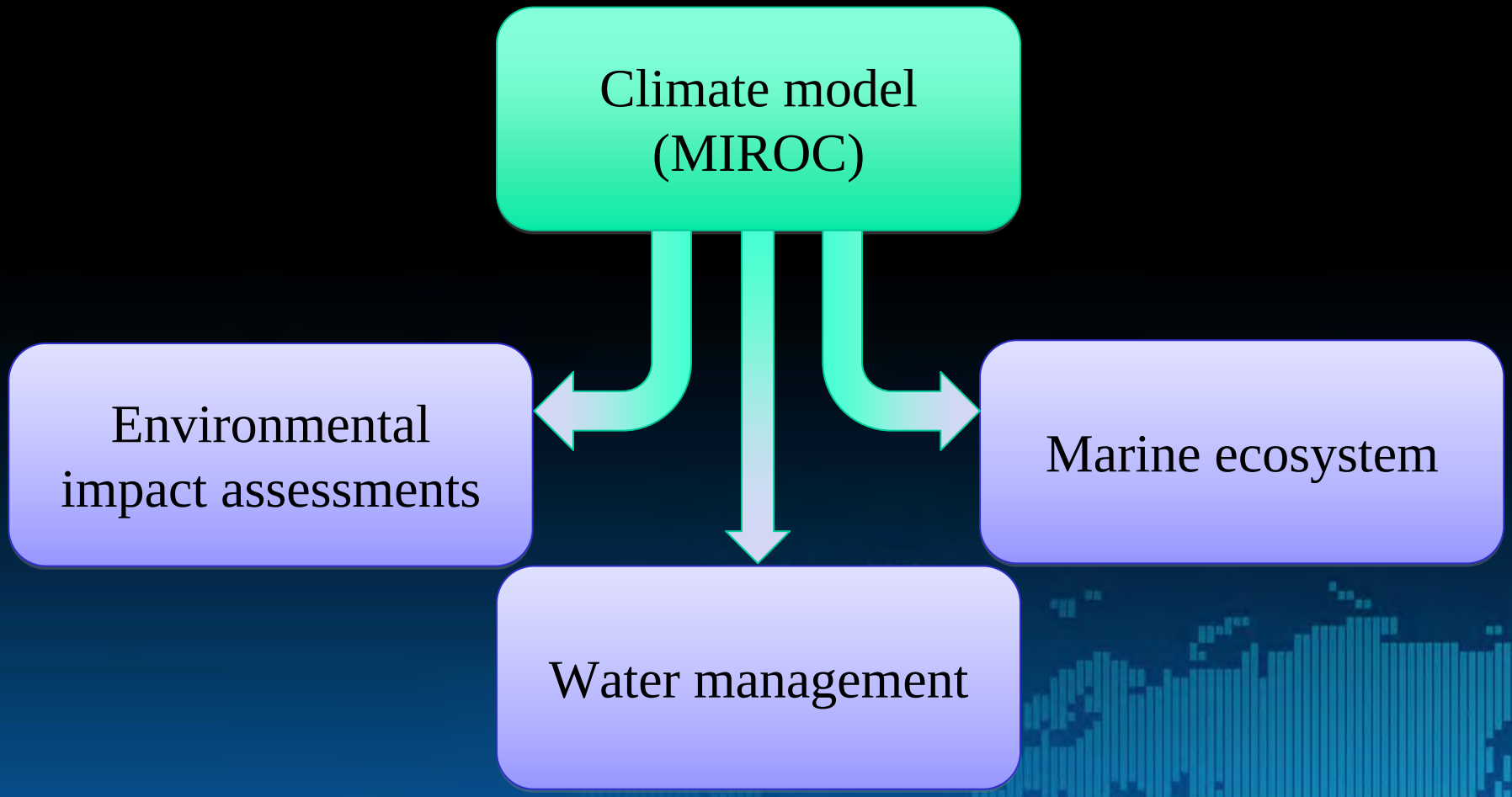
MIROC3m MIROC3h MIROC4

T42 T106 T213 ETOPO5



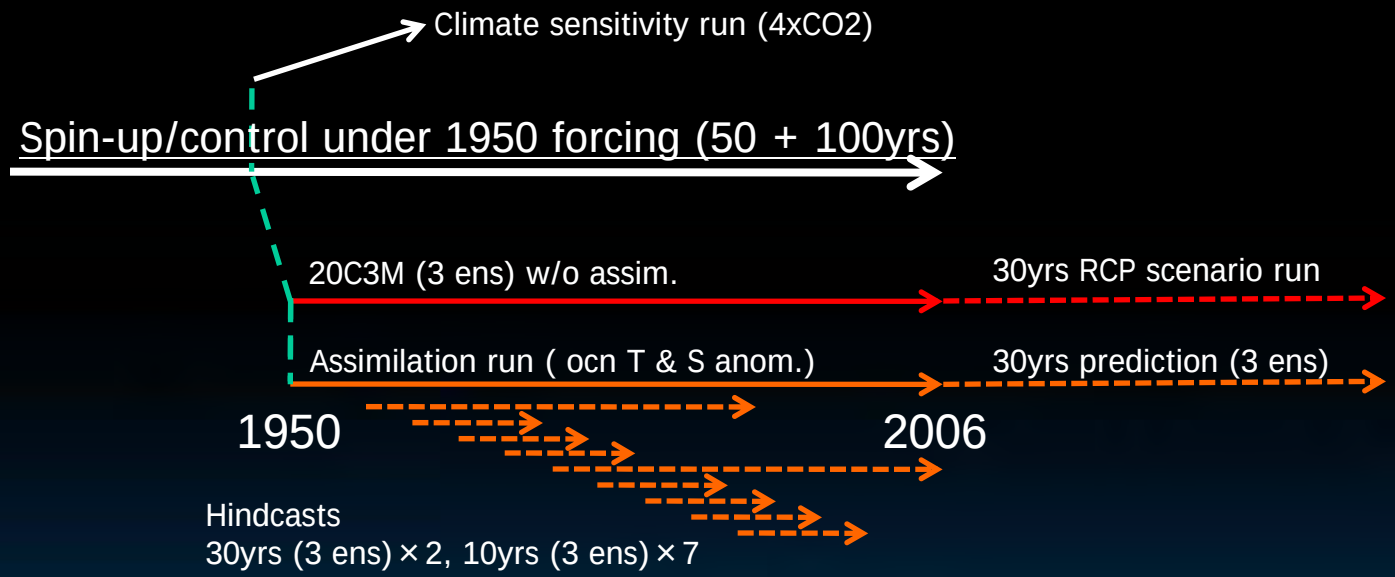
medres_ocn. hires_ocn.





High-resolution is useful for the information of these applications.

Plan (FY2009–2010)



- 50yrs spin-up and 70yrs control run were finished.
  - The period of the control run will be 100yrs (+30yrs).
  - Climate sensitivity experiments were done from y0071 of the spin-up (15yrs)
- 20C3M and an assimilation runs are finished.

Results

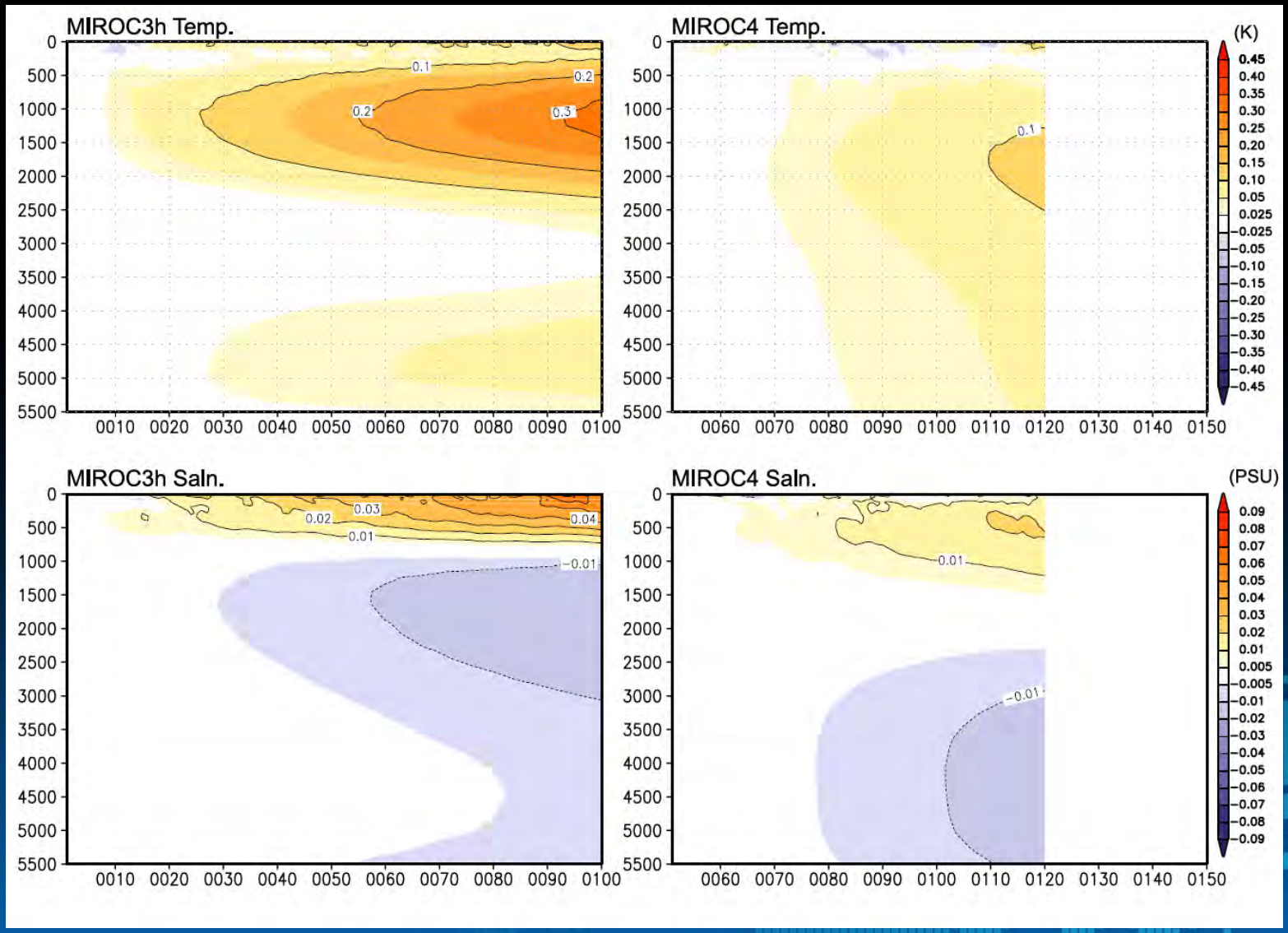
- Drifts of the ocn T & S
- SST & SSS errors
- Sea ice
- Ocn T & S of the surface layer in the N. Pacific
- Effects of orographic winds to the ocean
- Coastal upwelling
- ENSO

Ocn. Temp. & Saln. drifts

MIROC3h MIROC4

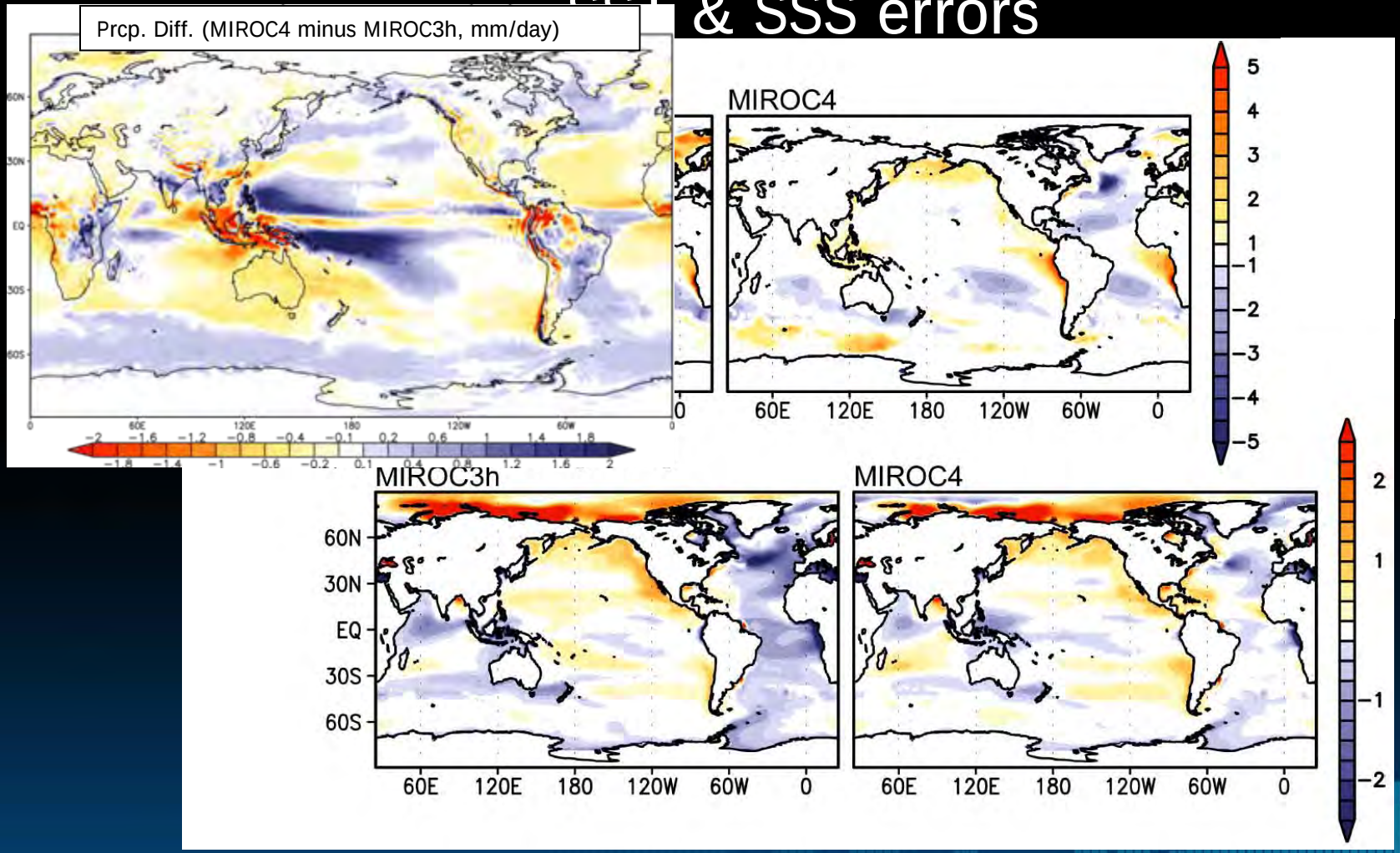
Ocn. Temp.

Ocn. Saln.



（differences from the first 5yrs avr.）

SST & SSS errors

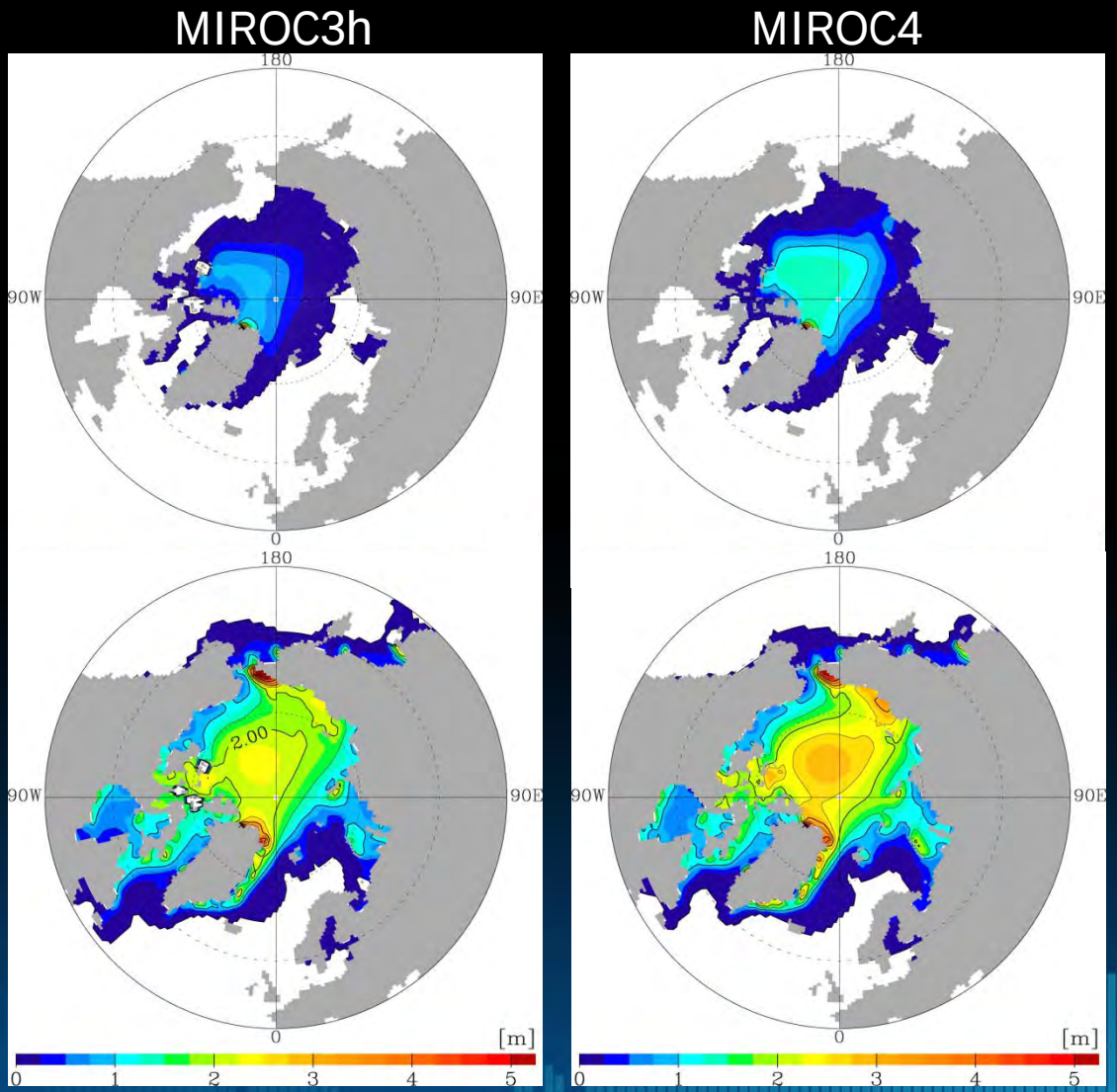


- SST bias is improved
  - cold bias in the low- & mid-latitudes, warm bias in the high-latitudes
- SSS bias
  - low salinity bias in the Atlantic is improved: reduction of the precip.
  - low salinity bias over the western tropical Pacific: increase of the precip.

Sea ice thickness NH.

NH., Sep.

NH., Mar.

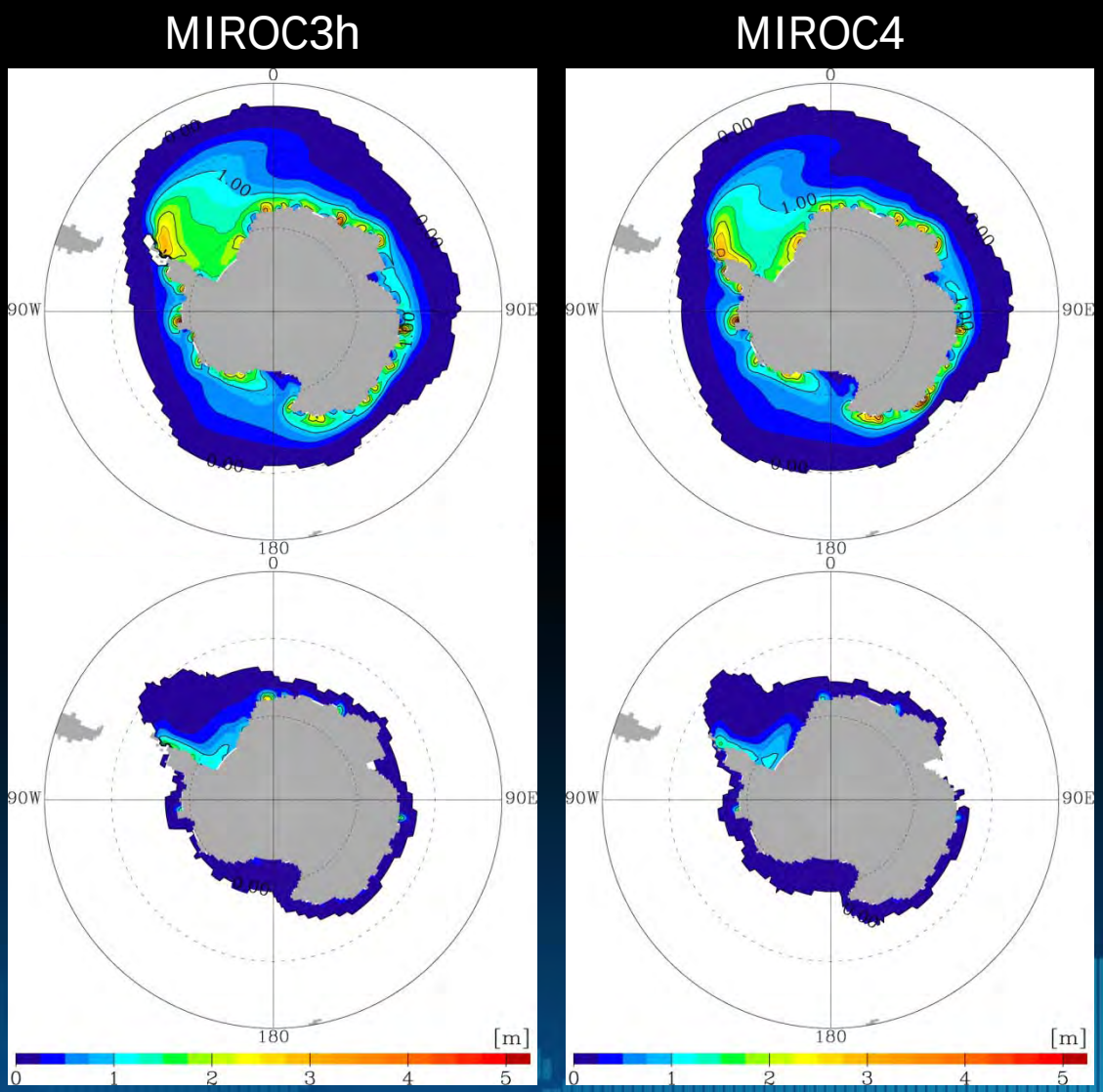


- Sea ice become thicker in the both summer and winter, (may be caused by the improvement of the warm bias in the high-lat.) but still thinner than obs.

Sea ice thickness SH.

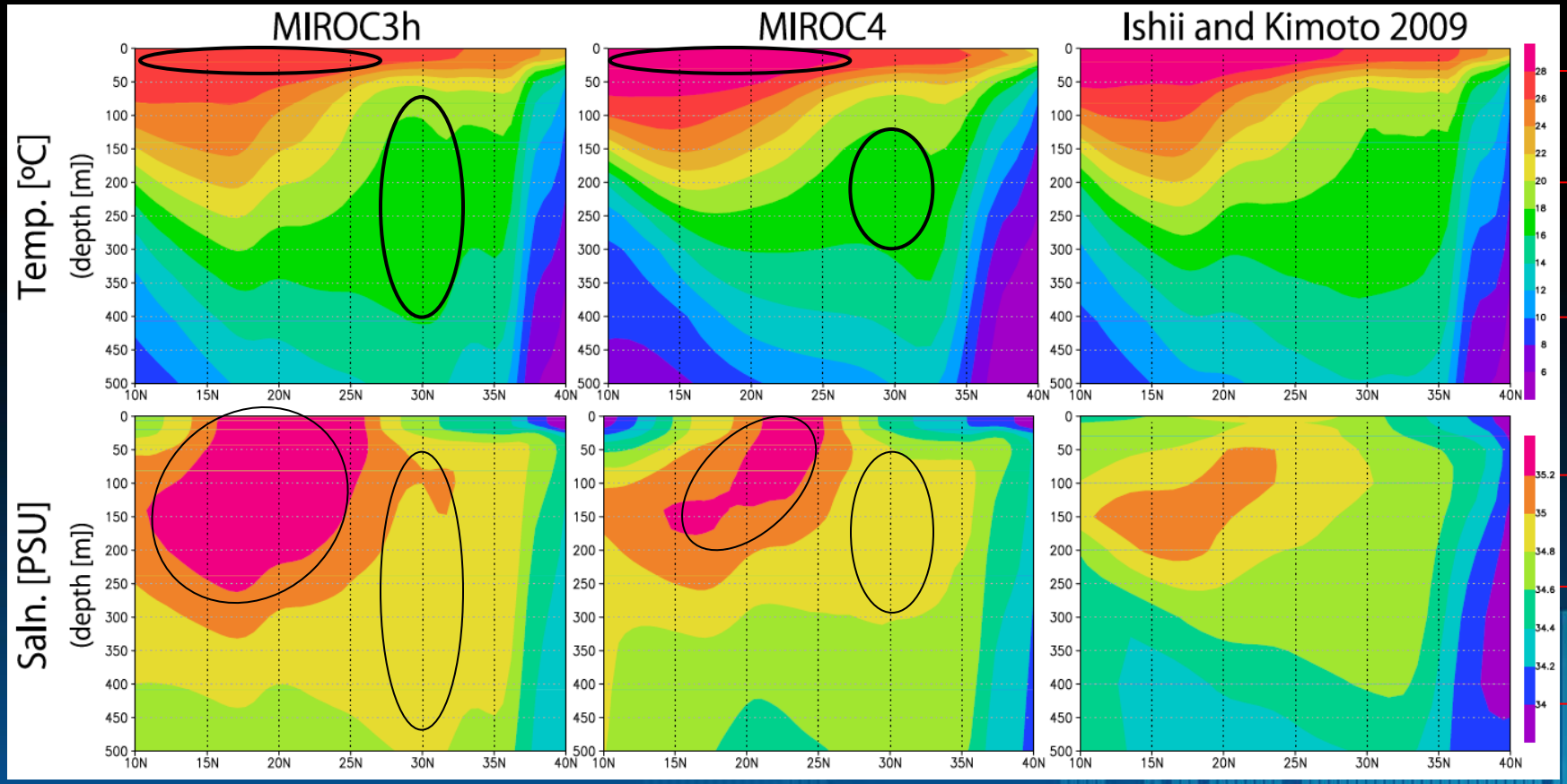
SH., Sep.

SH., Mar.



- There is little change from MIROC3h.

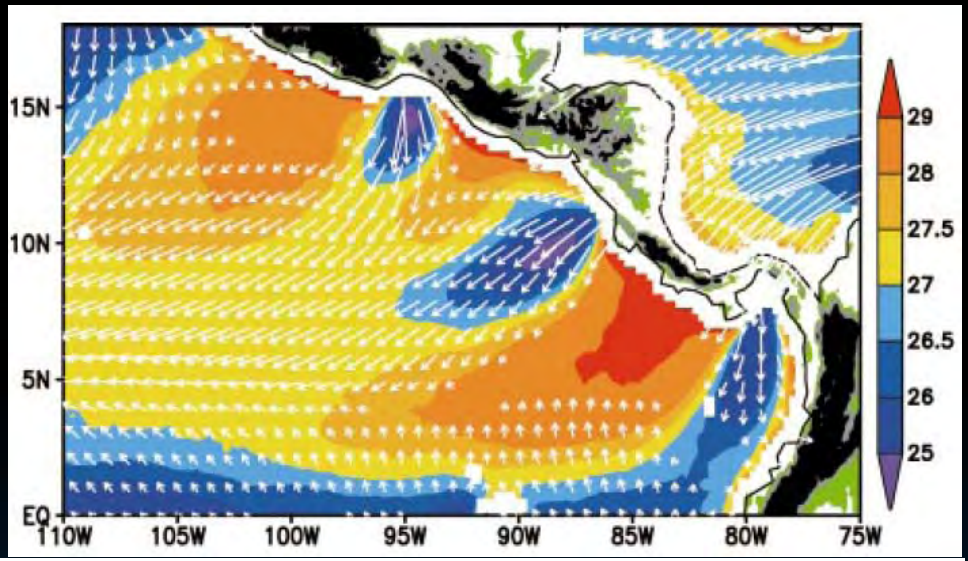
T & S of Aug. @ 150°E in N. Pacific



Orographic wind

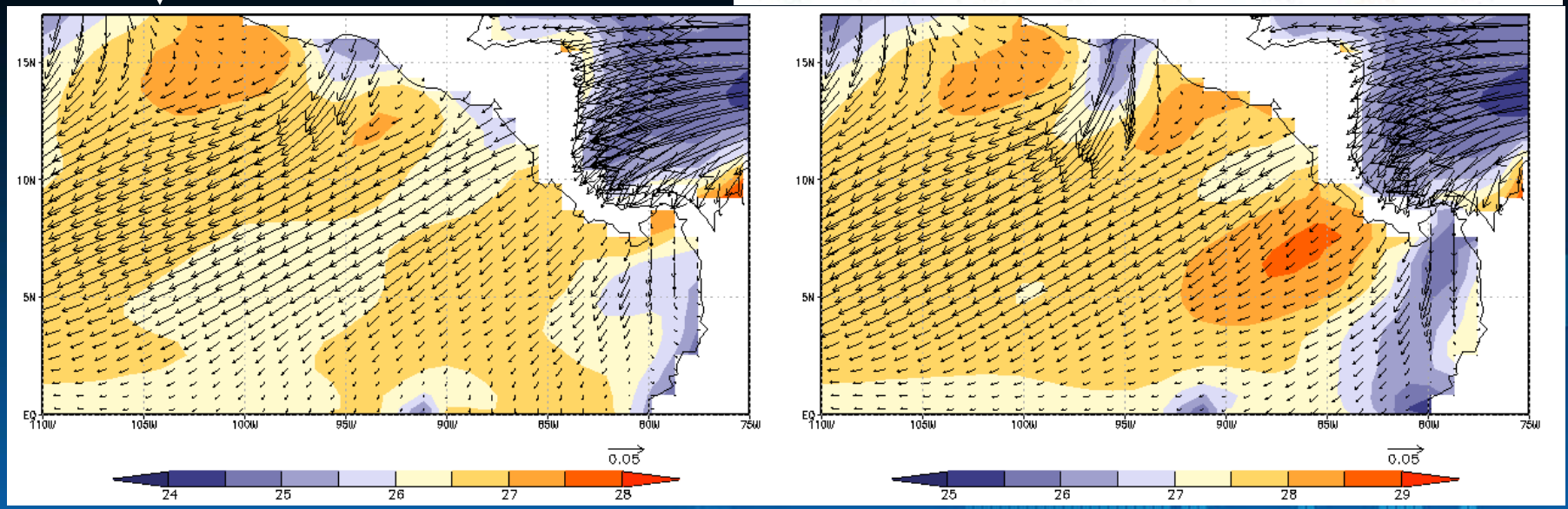
Jan-Mar SST and wind stress

Xie et al. (2005)



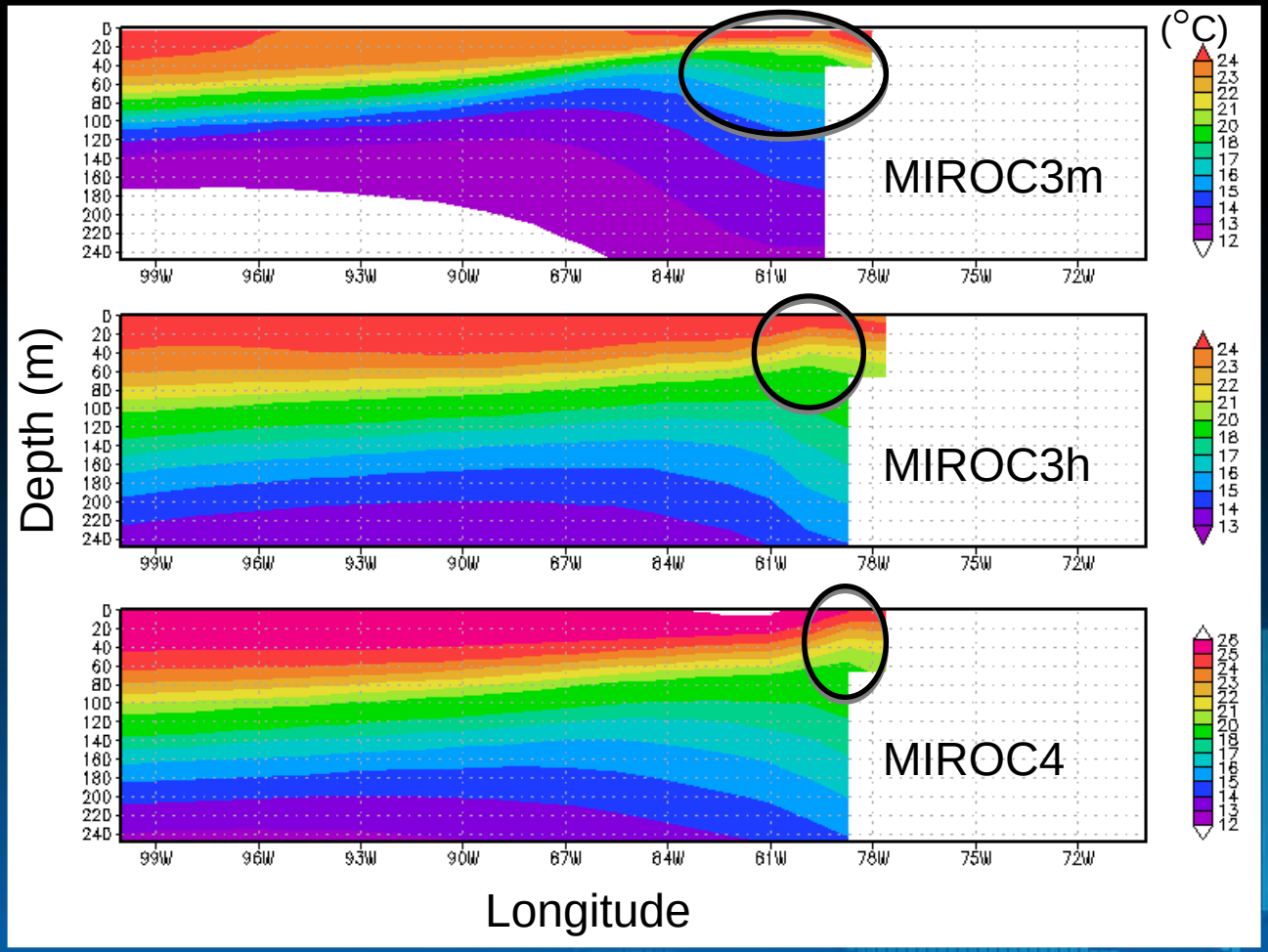
MIROC3h

MIROC4



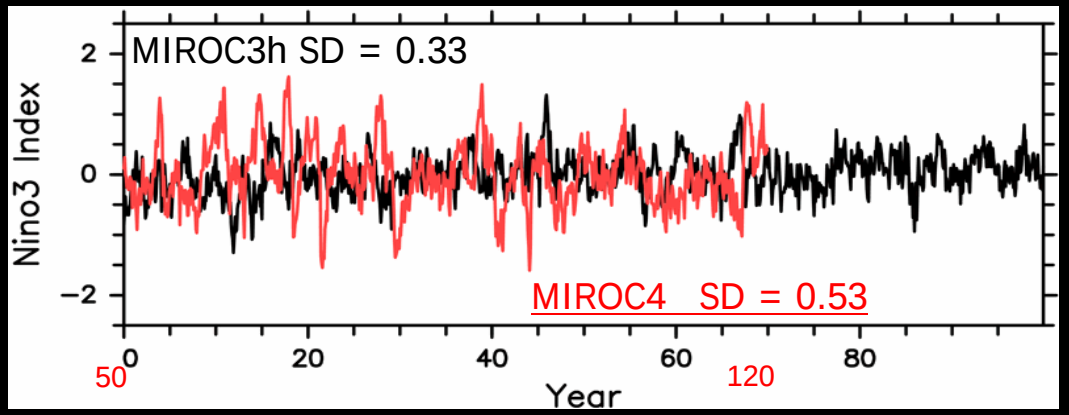
Coastal upwelling

Mean temperature along 10°S



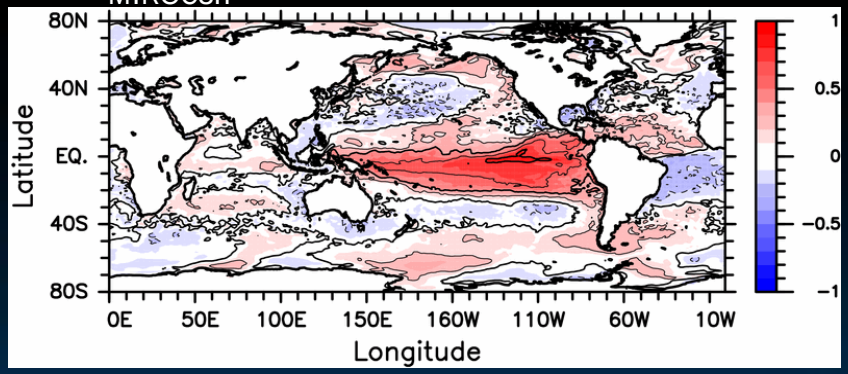
ENSO

Nino-3 Index

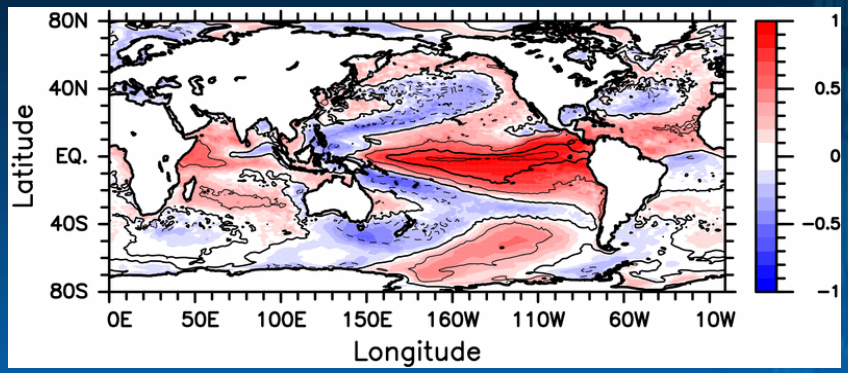


Nino-3 vs SST corr.- regress. map

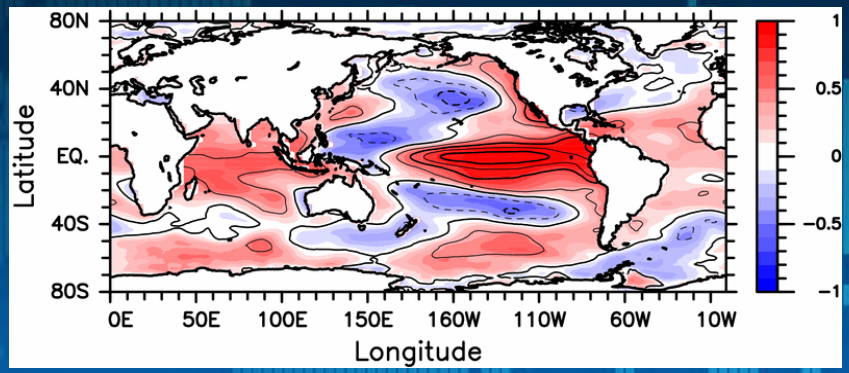
MIROC3h



MIROC4

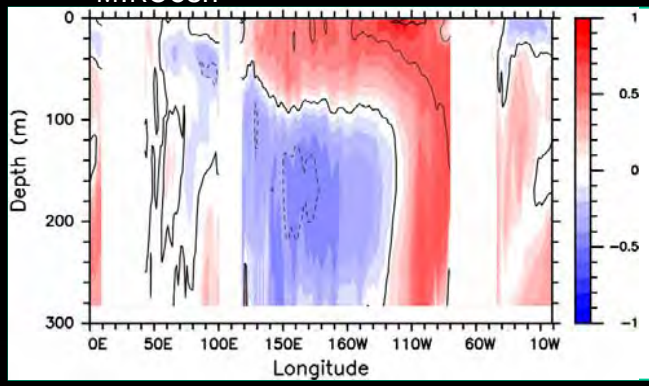


Obs.



Nino-3 vs T on the Eq. corr.-regress. map

MIROC3h



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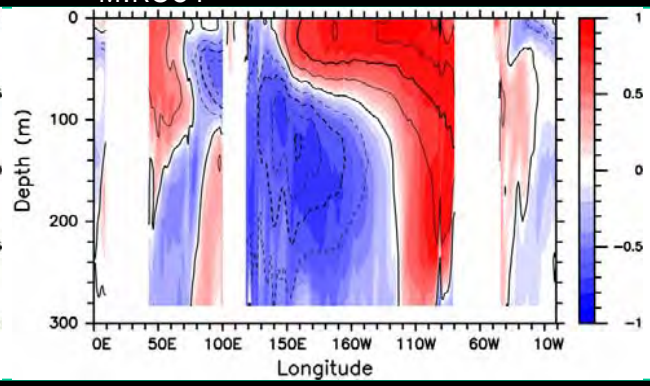
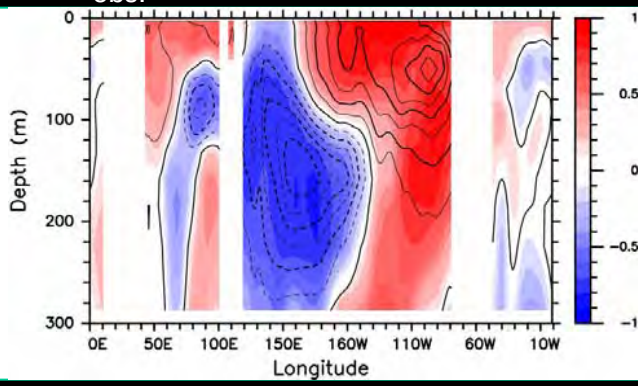
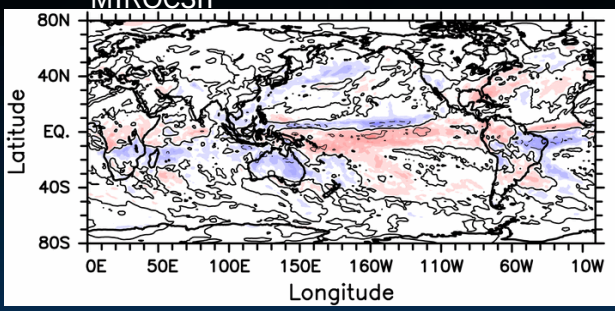


obs.

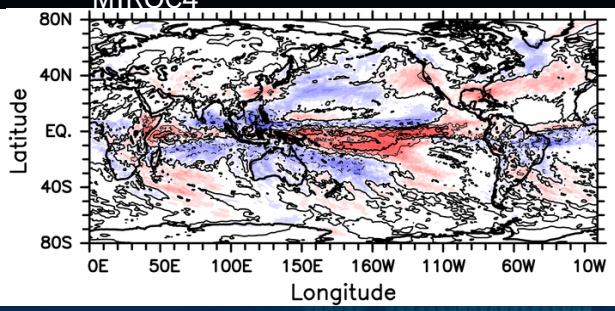


Nino-3 vs Prcp corr.-regress. map

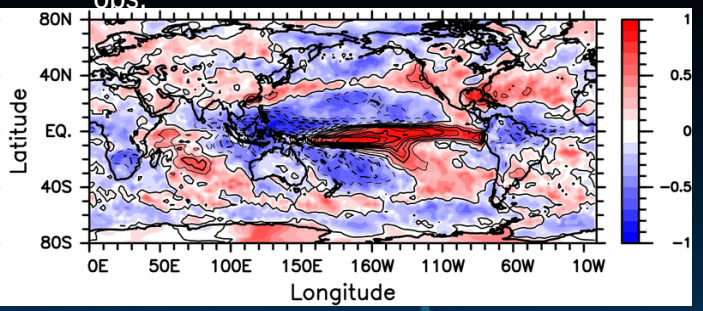
MIROC3h



MIROC4

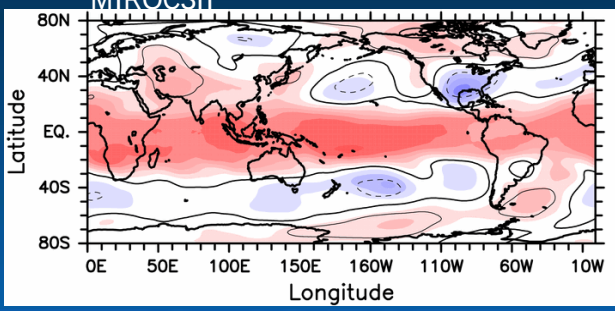


obs.

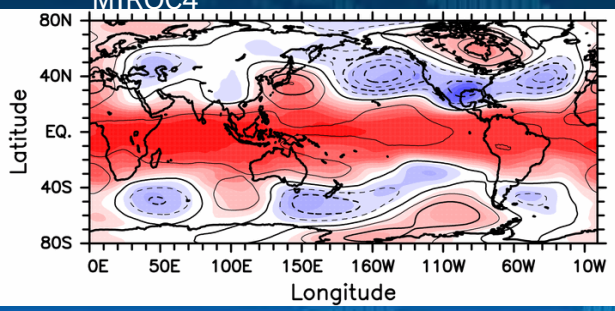


Nino-3 vs Z500 corr.-regress. map

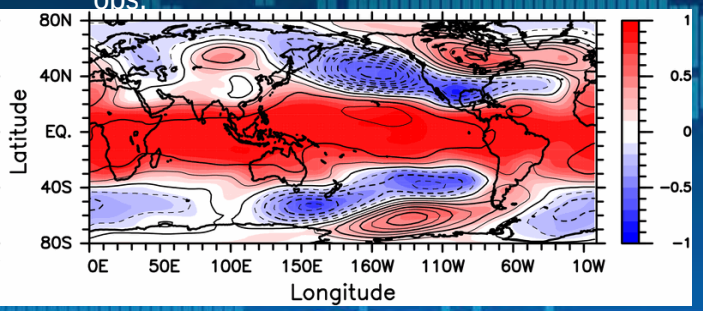
MIROC3h



MIROC4



obs.



Summary

- Generally, “not good points” in MIROC3h are improved in MIROC4.
  - SST errors are improved.
  - Drifts in ocean T & S are reduced, except for the deep ocean S.
  - Sea ice in the N. H. becomes thicker. (but still not enough…)
  - Effects of orographic winds to the ocean become clear.
  - ENSO amplitude is increased, and ENSO related teleconnection pattern is improved.
- An assimilation experiment for the initialization are finished.
  - We just started the hindcast experiments.
- Most of the experiments required by CMIP5 “CORE” will be finished by early 2012 using MIROC4.