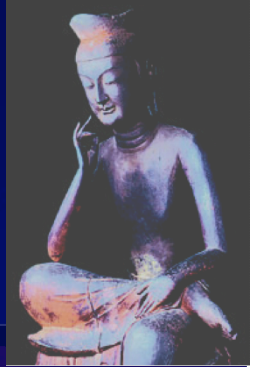


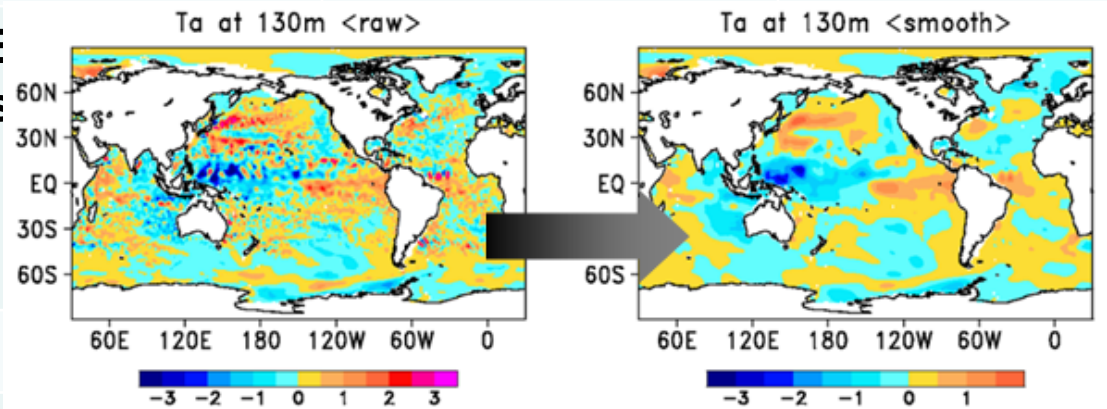
# Decadal prediction experiments using a Japanese AOGCM, MIROC



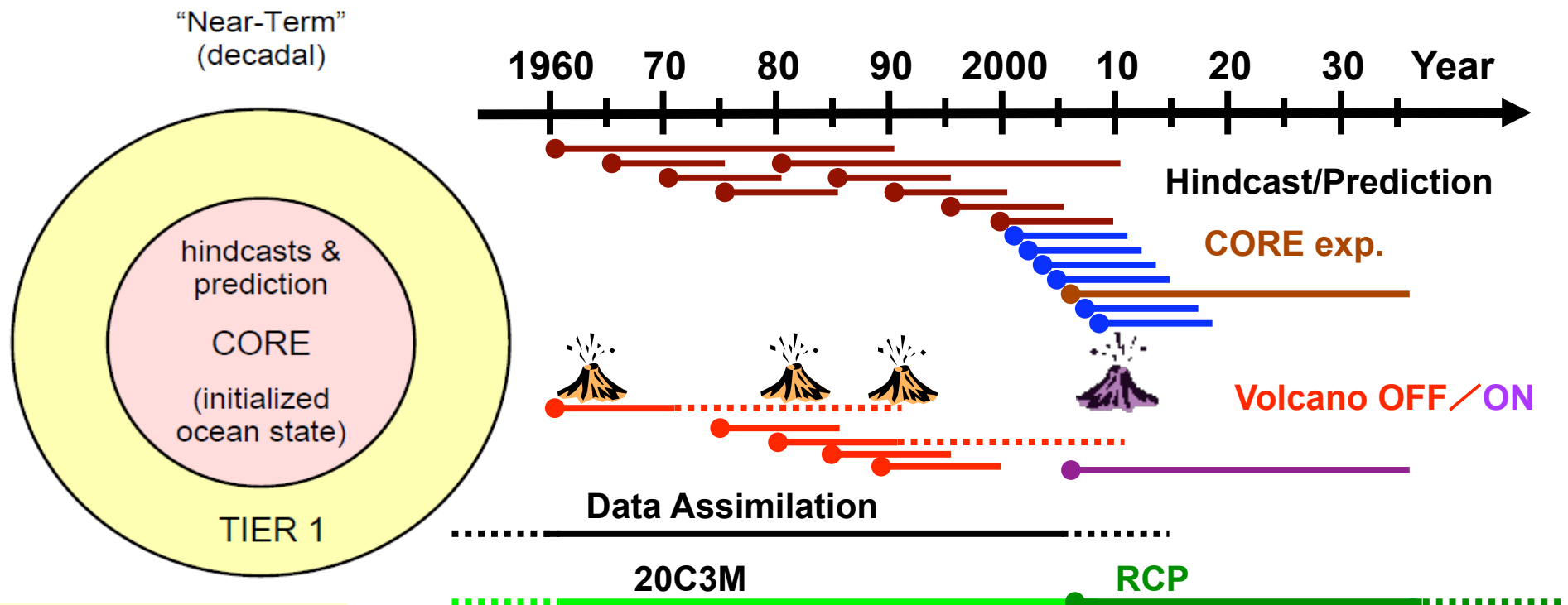
**Masahide Kimoto**  
Atmosphere and Ocean Research Institute  
The University of Tokyo  
and  
**Team SPAM**



# Decadal Prediction Experiments by MIROC

	MIROC3m	MIROC4h	MIROC5
Atmosphere	300km L20	60km L56	155 km L44
Ocean	1.4°x0.5-1.4° L44	0.28°x0.19° L48	1.4°x 0.5-1.4° L50
Forcing	CMIP3/SRESA1B	CMIP5/RCP4.5	CMIP5/RCP4.5
Initialization	Ocean T&S IAU (0 ~ 700m)	Ocean T&S IAU (0 ~ 3000m) Eddy Conserving	Ocean T&S IAU (0 ~ 3000m)
Ensemble generation			
Ensemble Size			
20C3m	10	3	3
Assimilation	10	1	3
Hindcasts	10	3	6

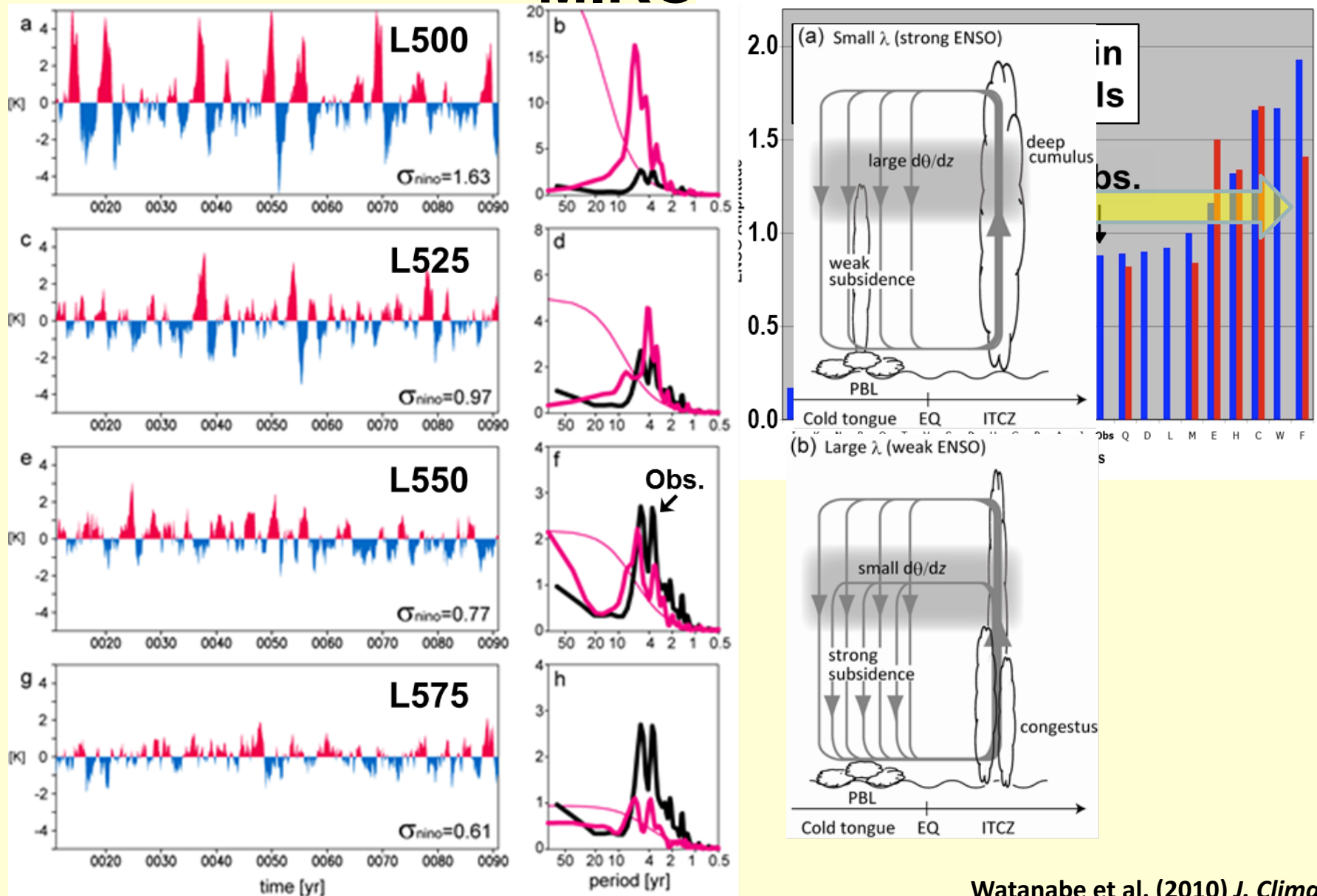
# CMIP5 Experimental Design



Taylor et al. (2008)

5000-Year Integration  
for 10 member ensemble,

# Convective Control of ENSO Amplitude in MIROC5



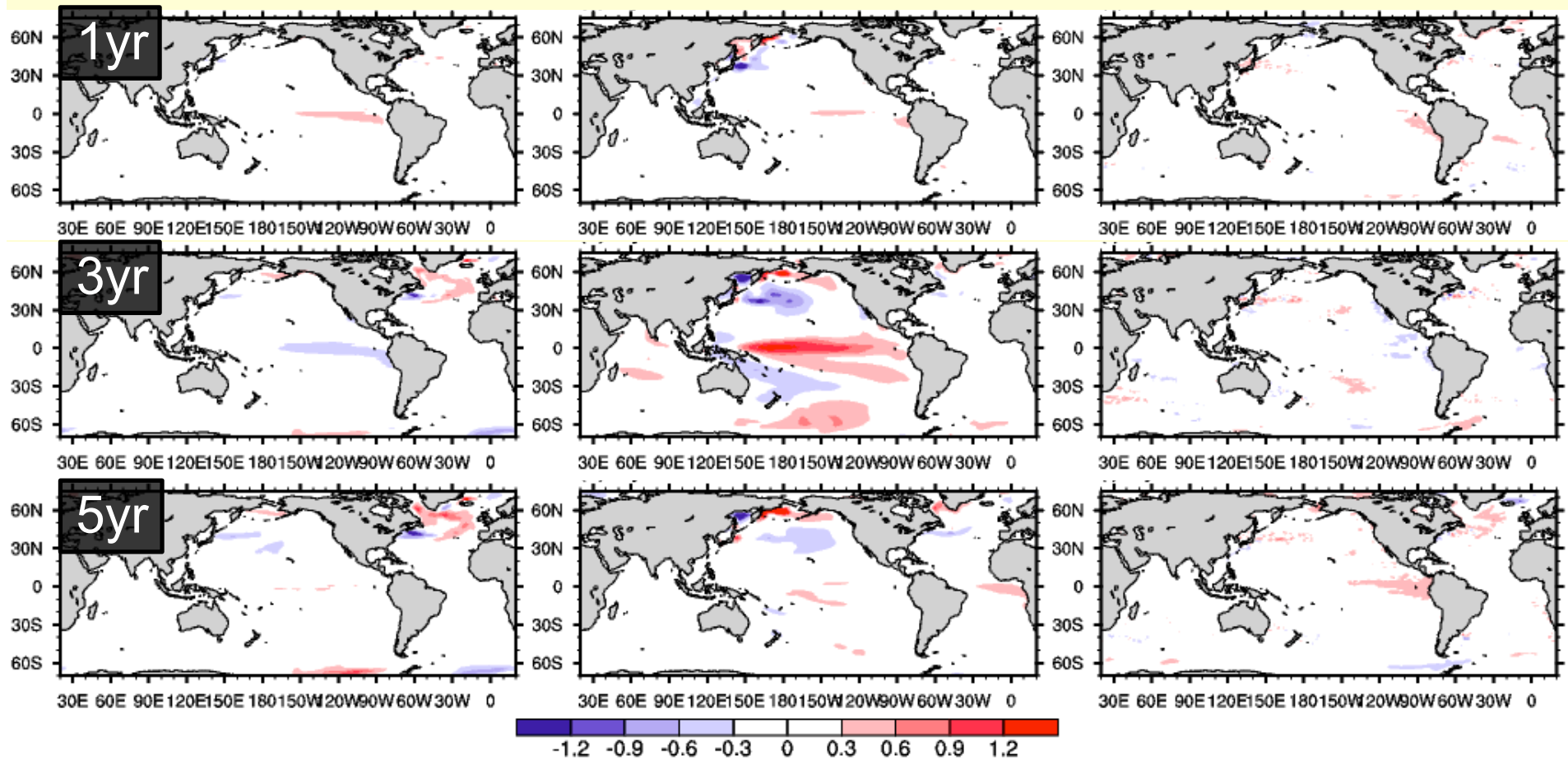


# Drift (SST)

LOW  
MIROC3

MID  
MIROC5

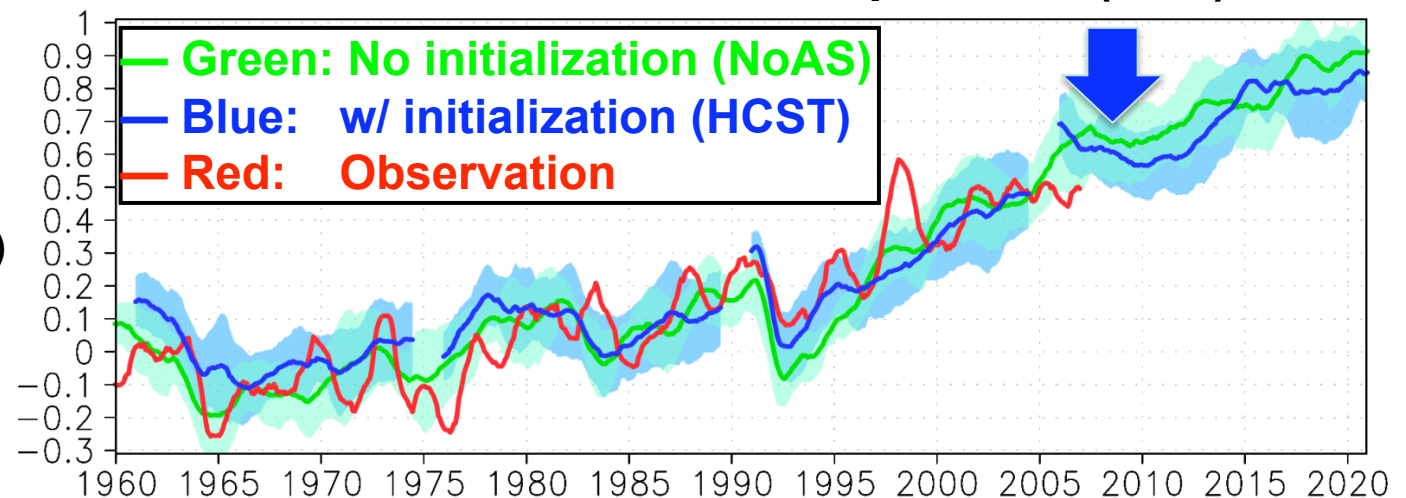
HI  
MIROC4



# Predictability of PDO

Mochizuki et al. (2010)

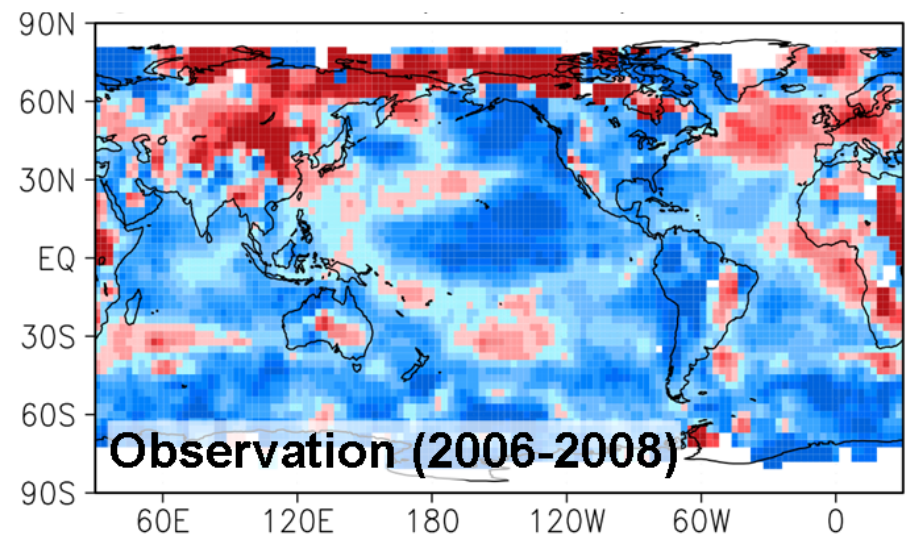
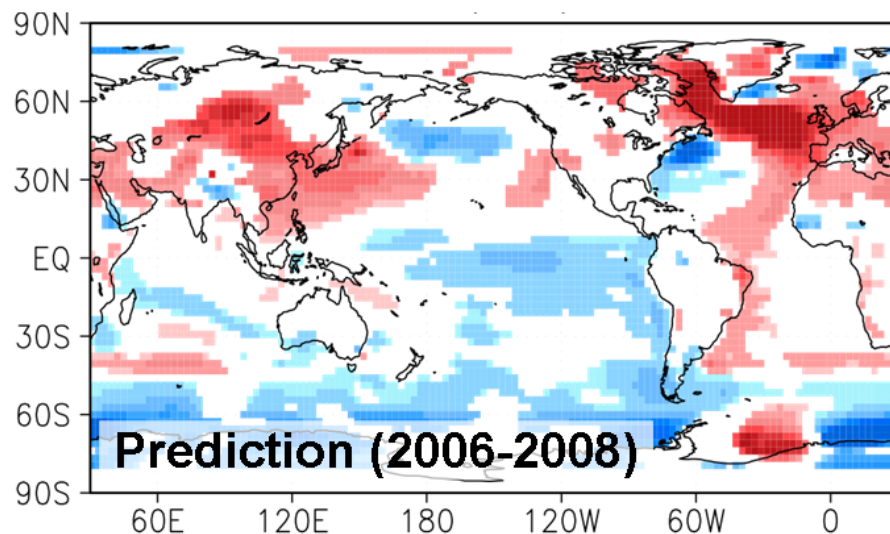
## Global mean surface air temperature (SAT)



Deviation from forced comp

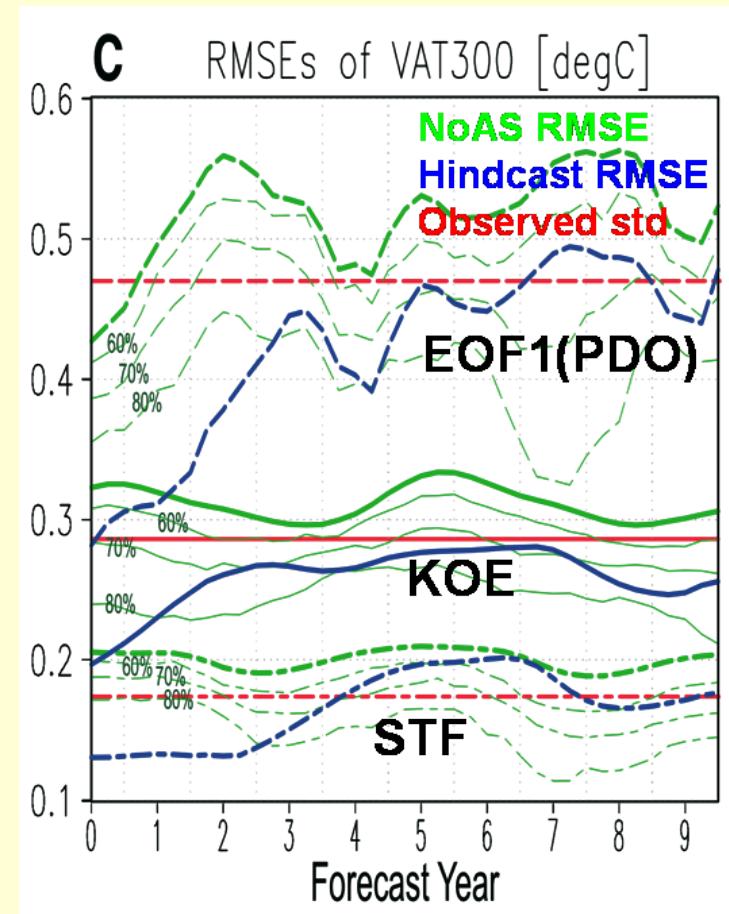
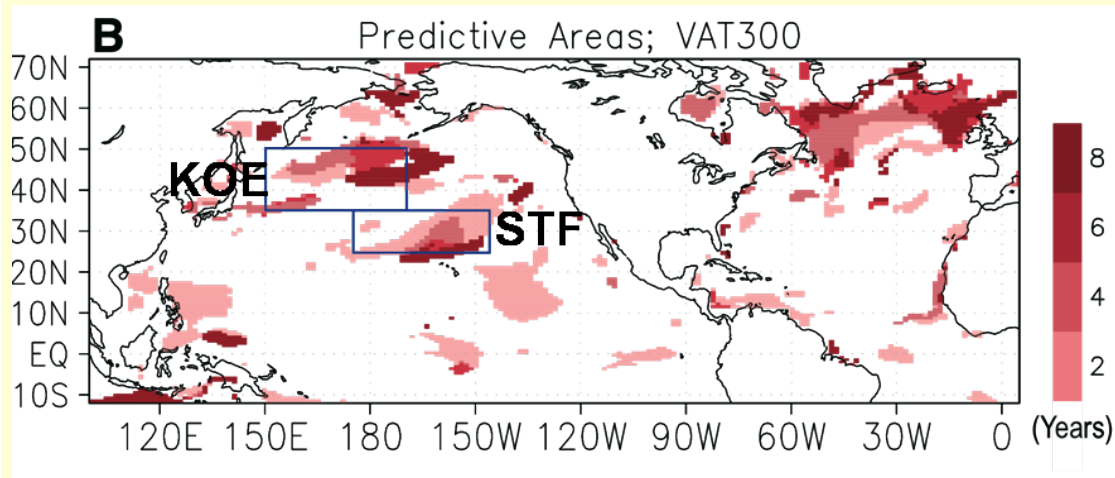
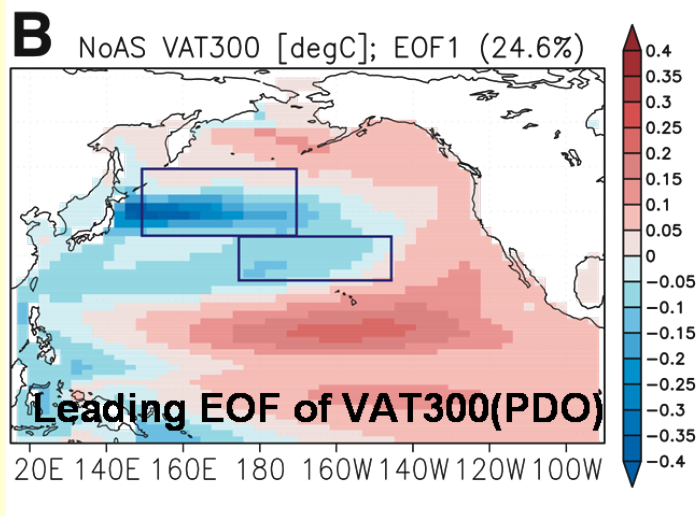
Prediction of PDO

## SAT deviation from NoAS

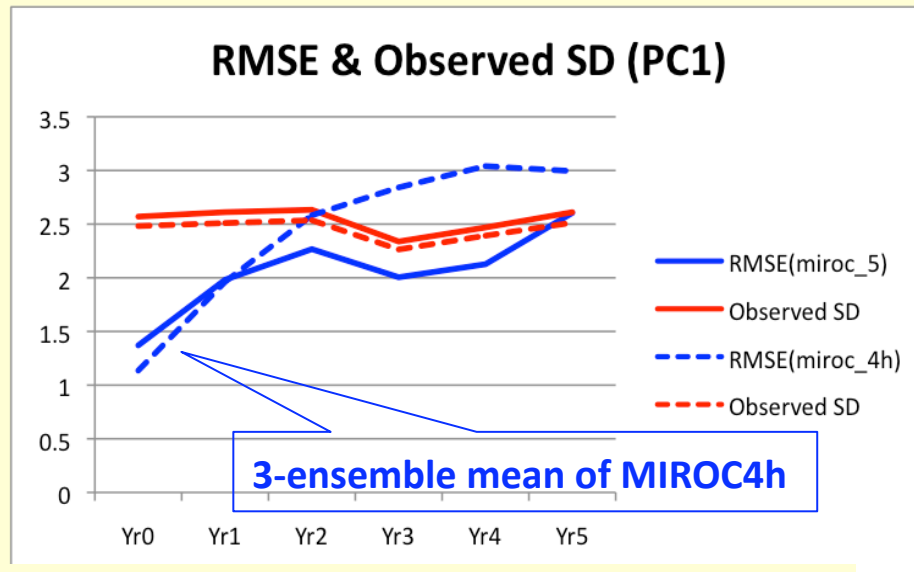


Lead time (yr)

# Subsurface memory

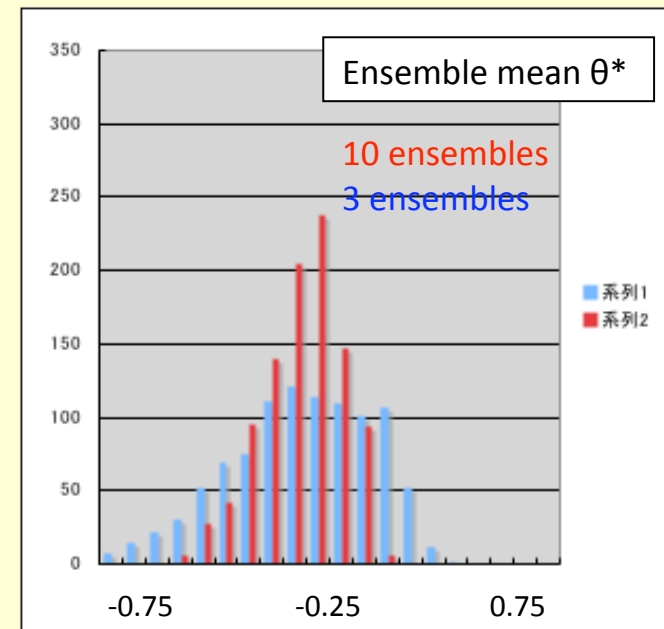
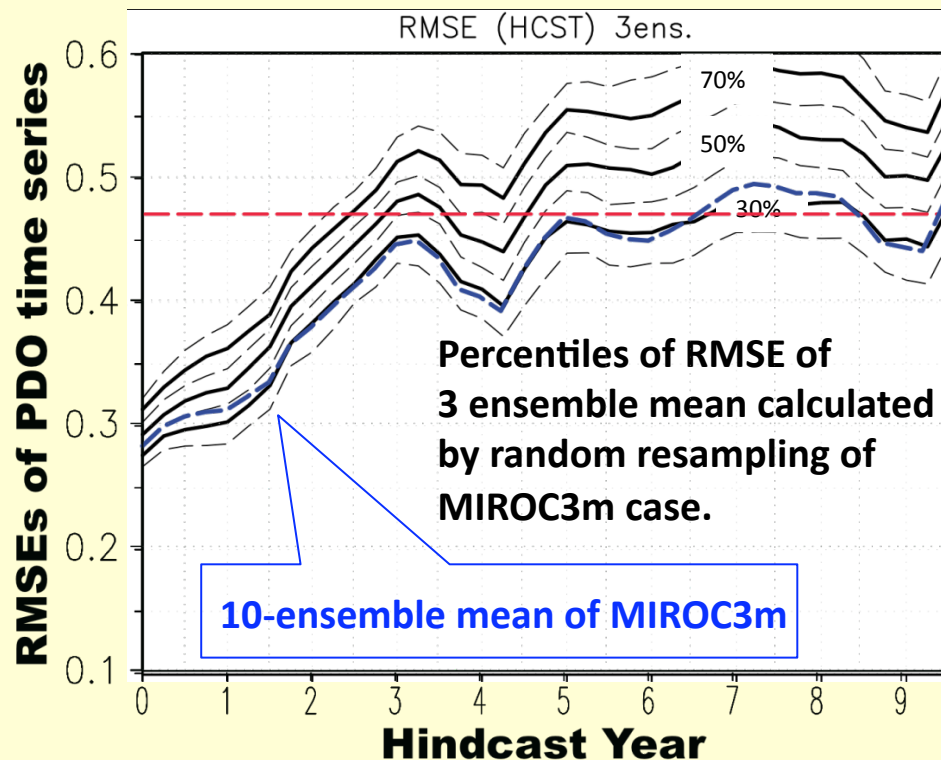


Mochizuki et al. (2010)



## Influence of number of ensembles on errors (e.g., RMSEs in ensemble means of the PDO index)

PDs of ensemble means of 10 members and randomly-resampled 3 members (e.g., PDO index during 2006-2010)

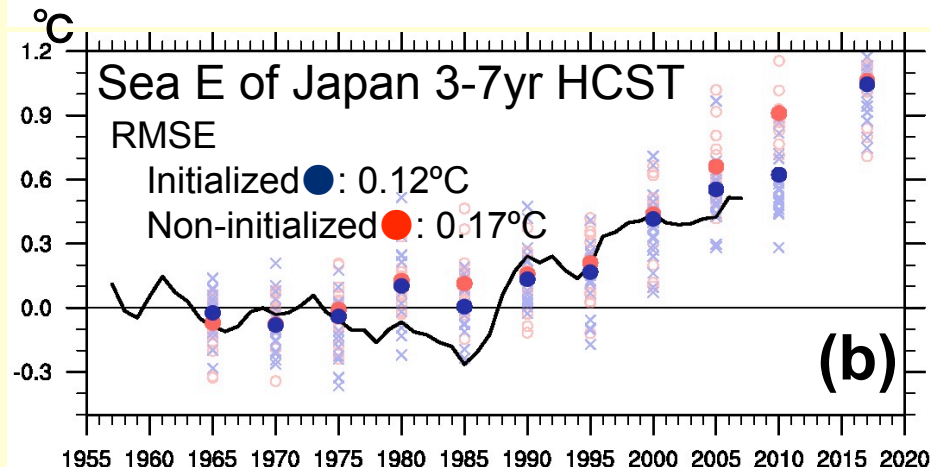
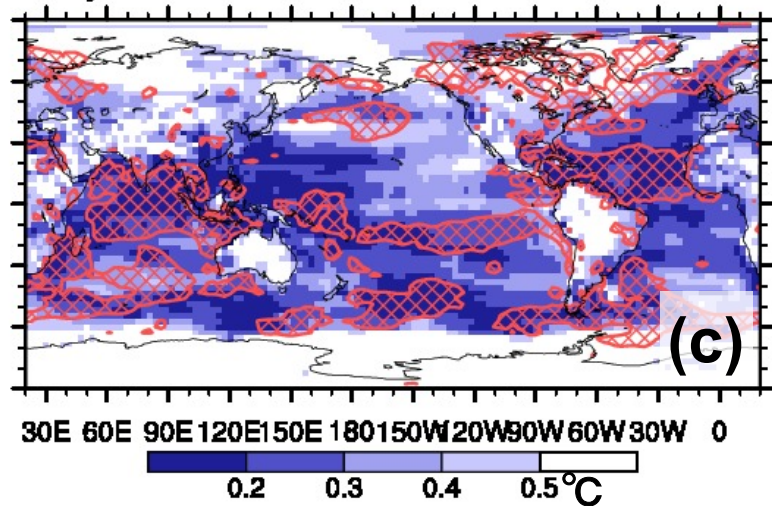
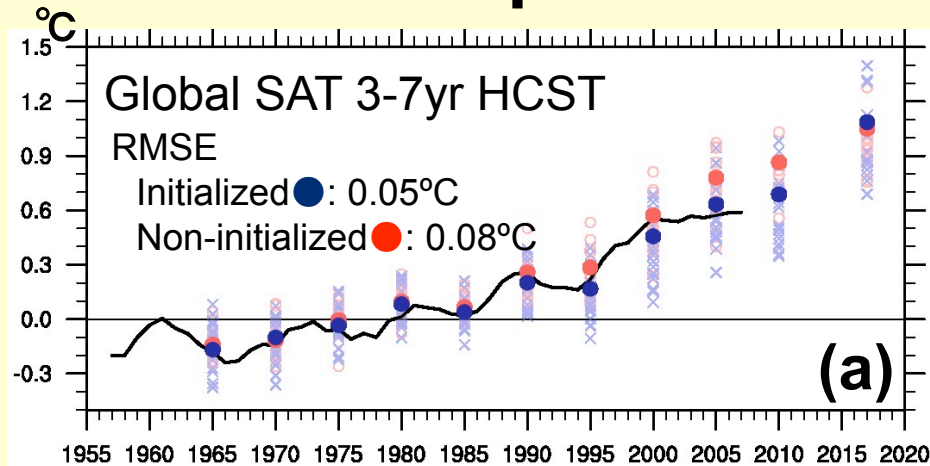






System for  
Prediction and  
Assimilation by  
MIROC

# Impact of initialization



(a) 5-yr mean global surface air temperature (SAT): Observation (black line) and 3-7 year hindcast (Blue: initialized, Red: non-initialized). Rightmost symbols are forecasts for 2015-2019 started from 2006.

(b) As in (a), but for SAT averaged over 130E-160W, 30N-60N (Japan and sea east of Japan).

(c) RMS skill of 3-7 year hindcasts(°C). Red shades indicate areas where initialized hindcasts are more than 10% better than non-initialized ones.

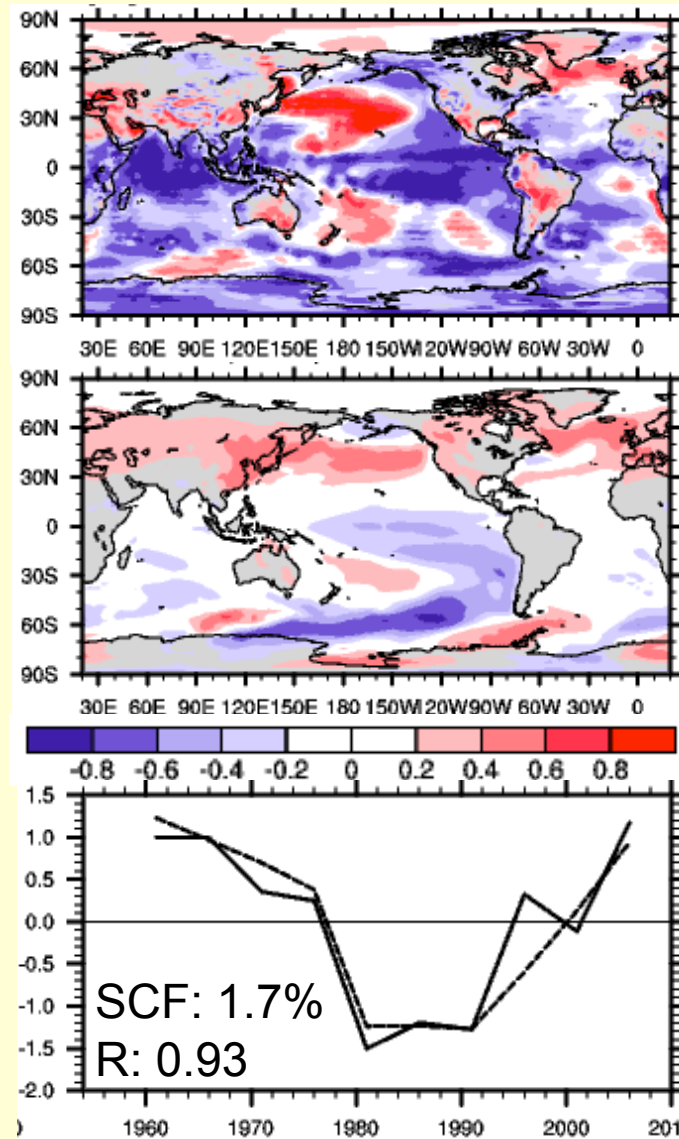
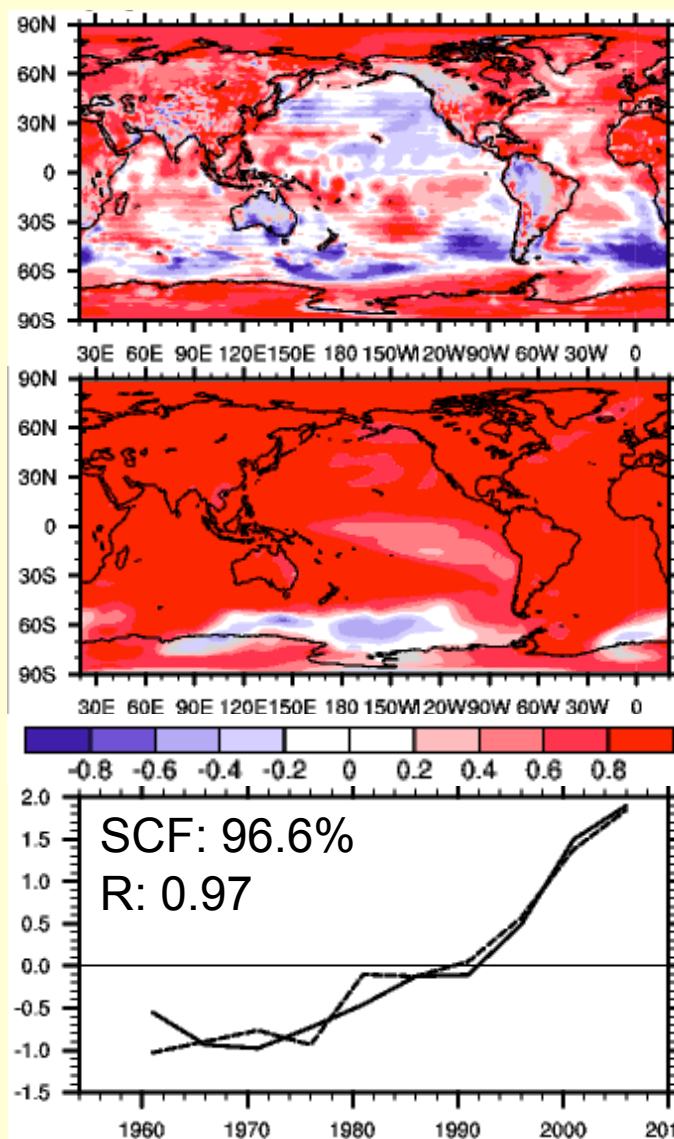
# Predictable Component

## SVD1

## SVD2

SVD between  
OBS SAT and  
1-3yr HCST  
**Obs**

**MIROC**

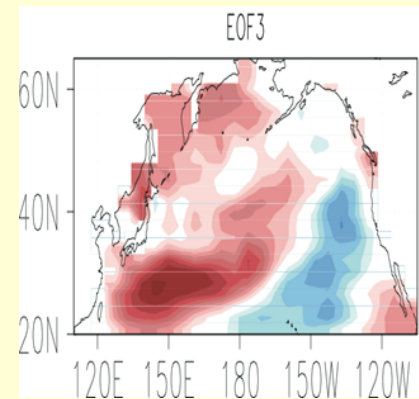
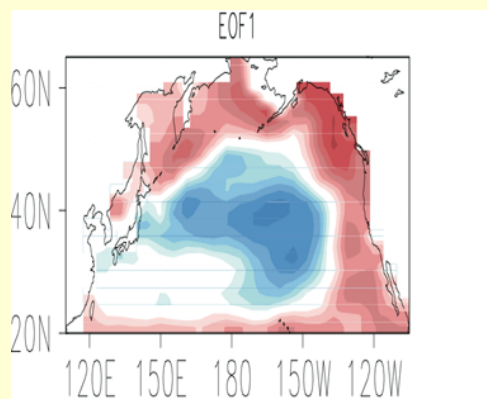
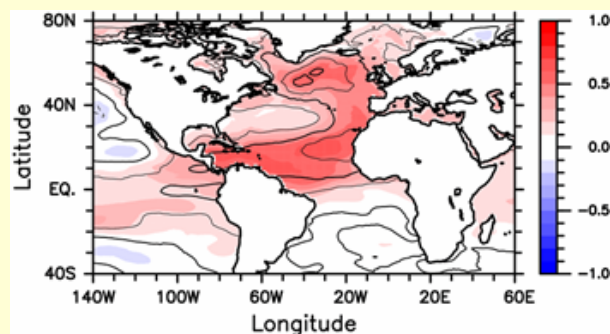
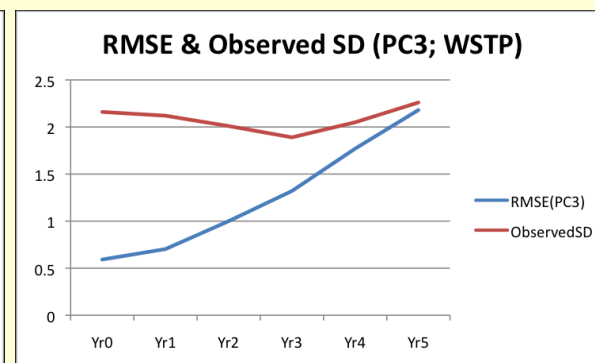
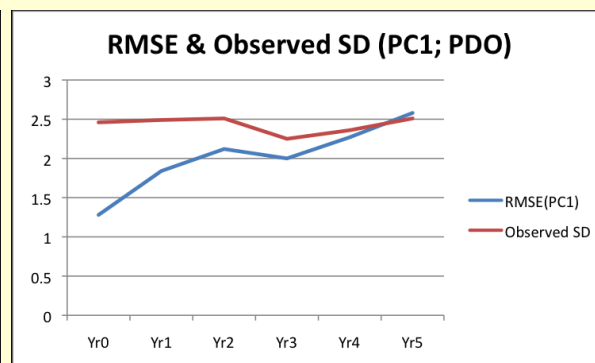
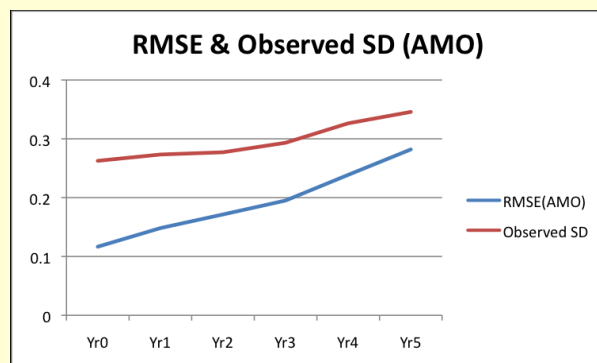
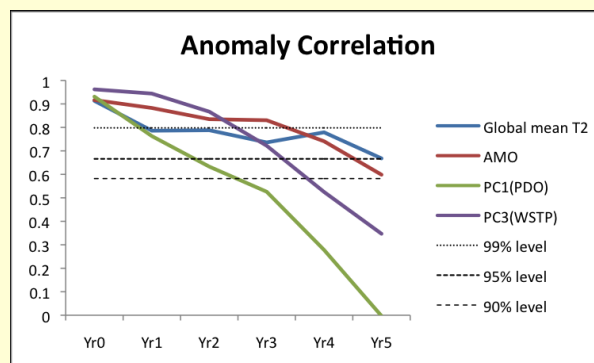


Based on a 3-model ensemble (MIROC3m, MIROC4h, MIROC5)

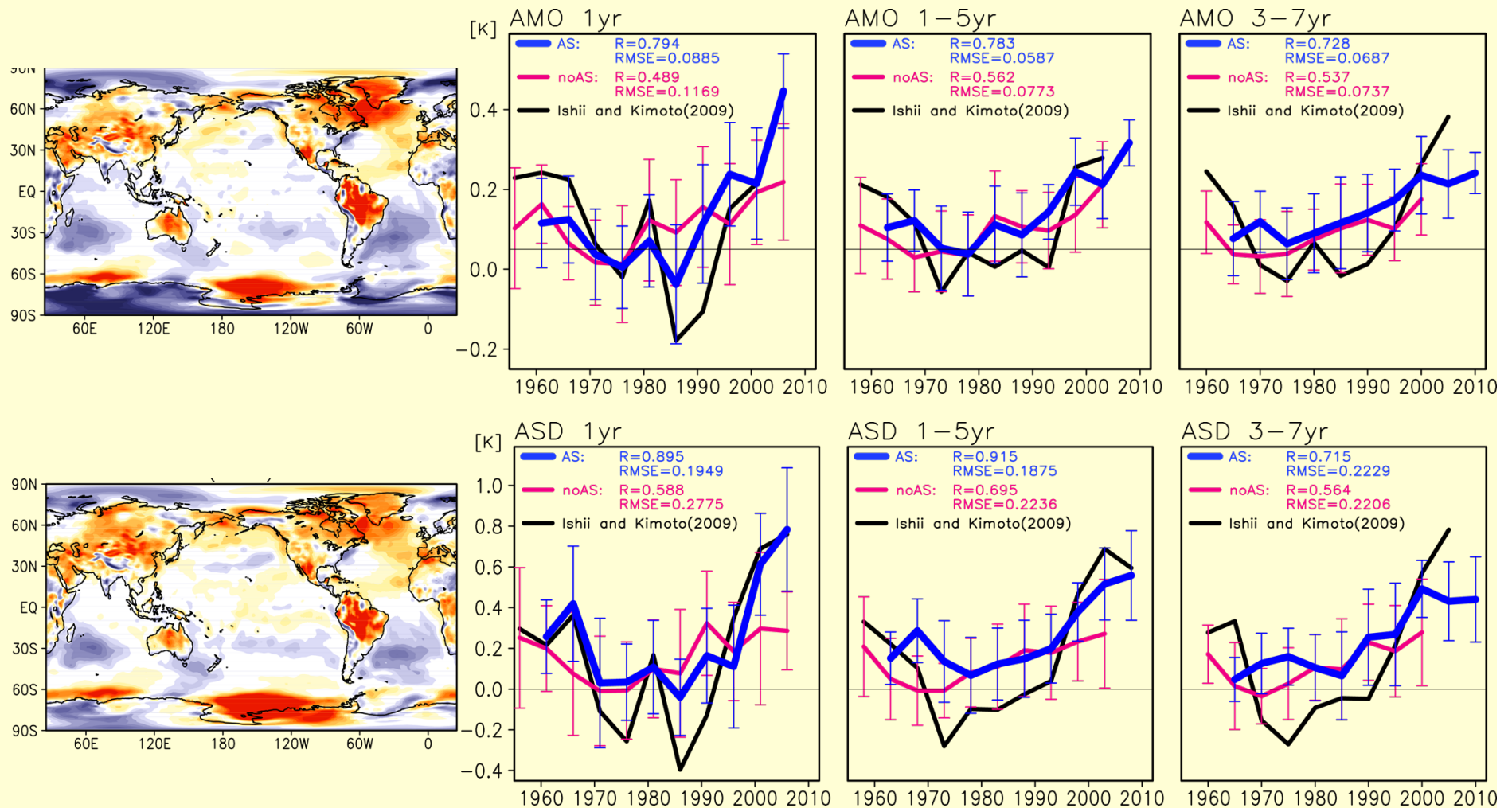




# Hindcast Skill

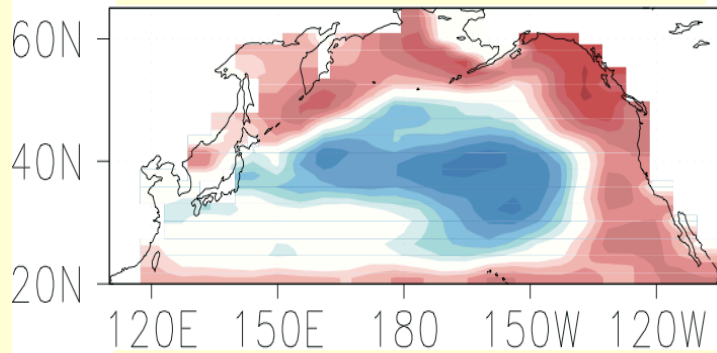


# Atlantic Multidecadal Oscillation (AMO)

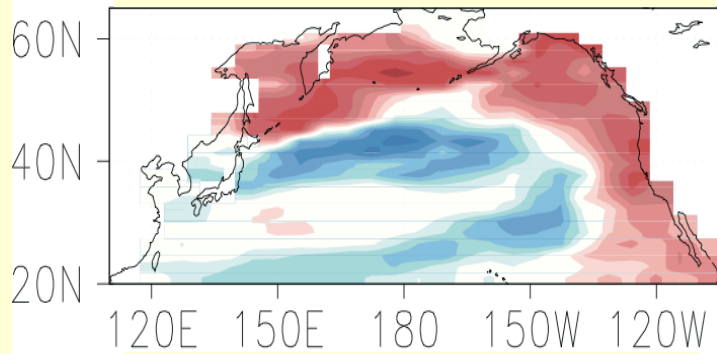


# Skills in PDO, AMO, ... (in terms of ACC and RMSE)

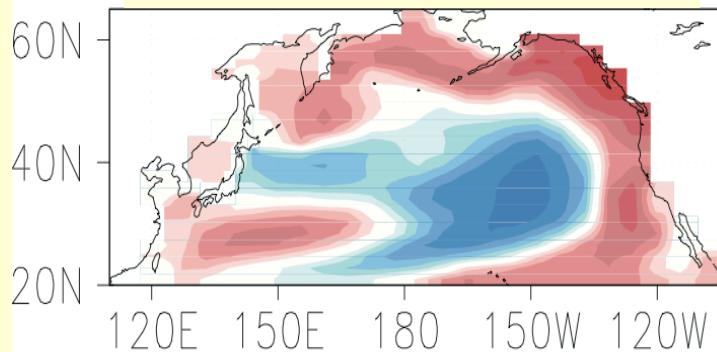
**Observed EOF1 (detrended)**



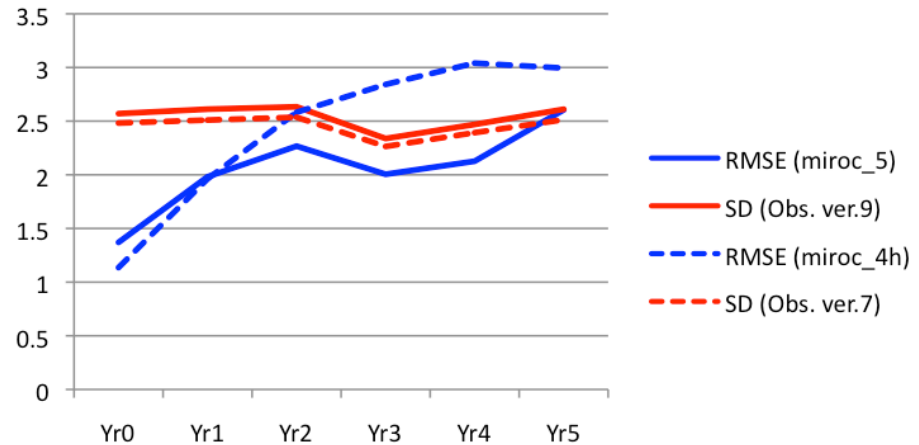
**MIROC4h EOF1 (control run)**



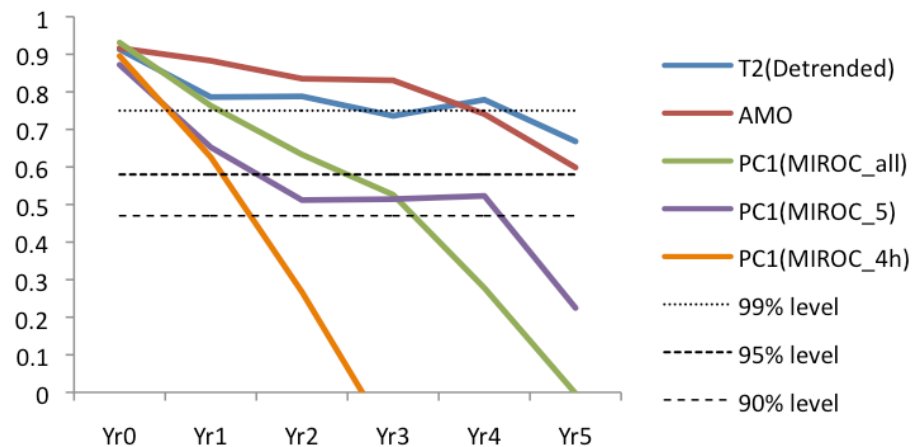
**MIROC5 EOF1 (control run)**



**RMSE & Observed SD (PC1)**



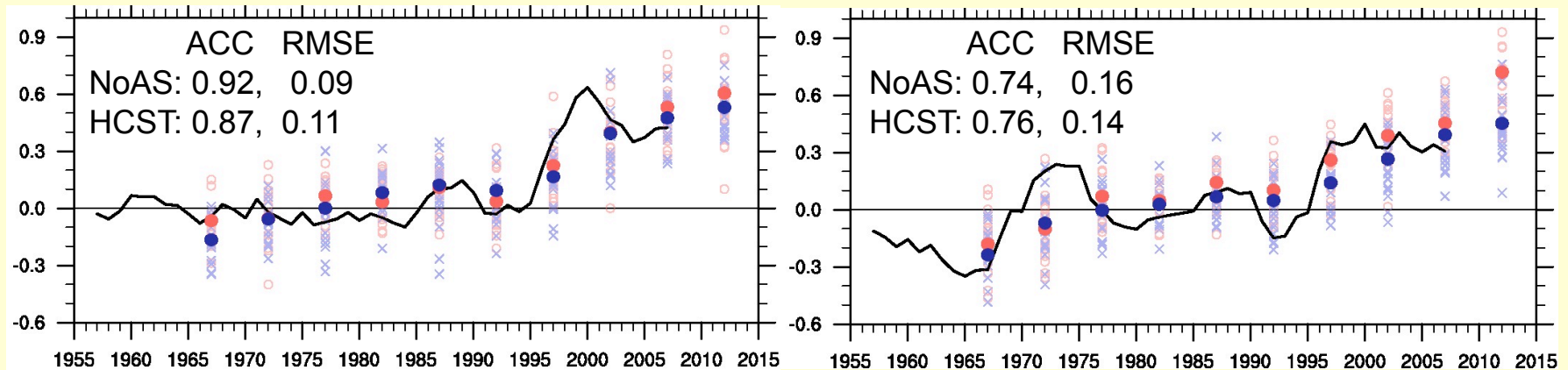
**Anomaly Correlation Coefficients**



# Climate shift in mid-1990s

## North Pacific

## South Pacific

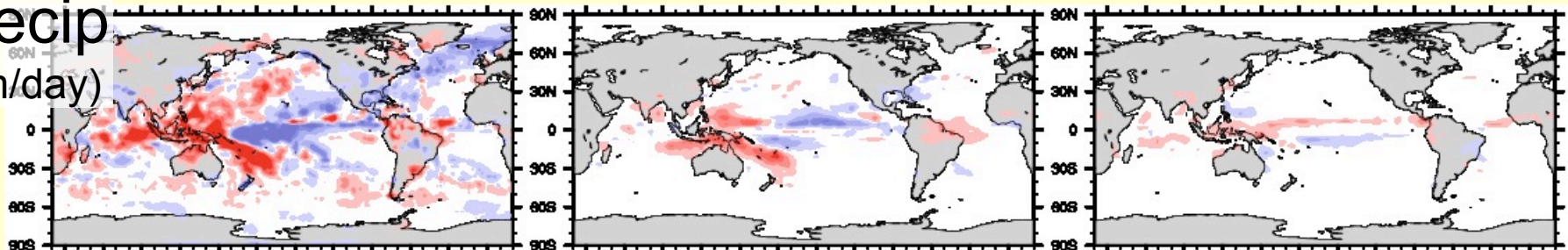


Obs

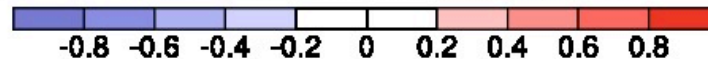
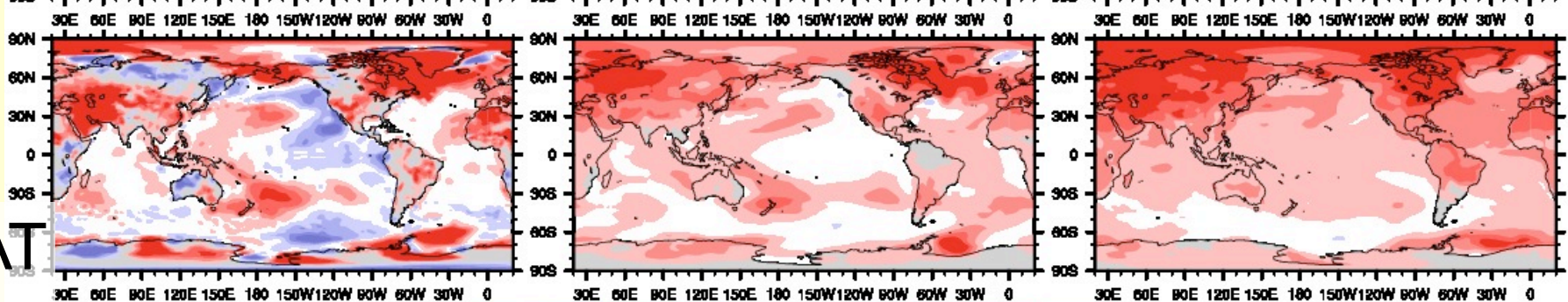
HCST

NoAS

Precip  
(mm/day)



SAT  
(°C)

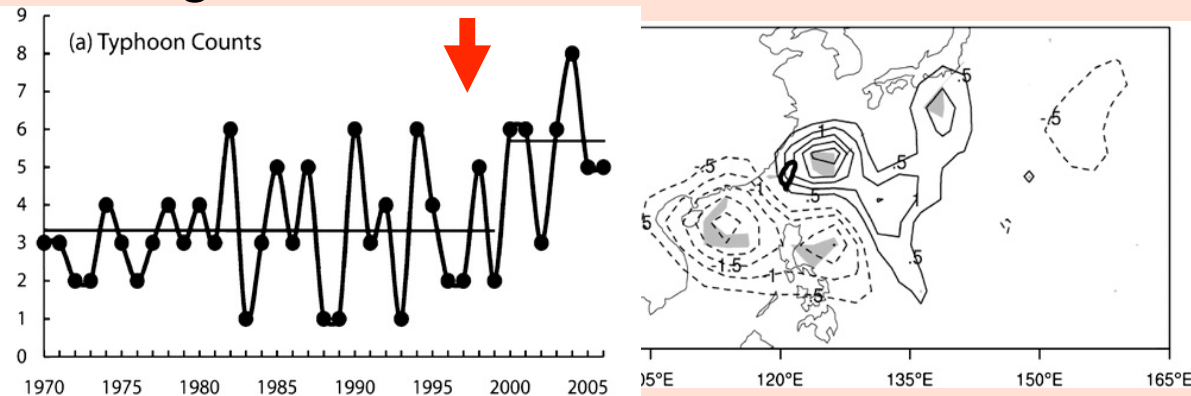




# What happened around 1995?

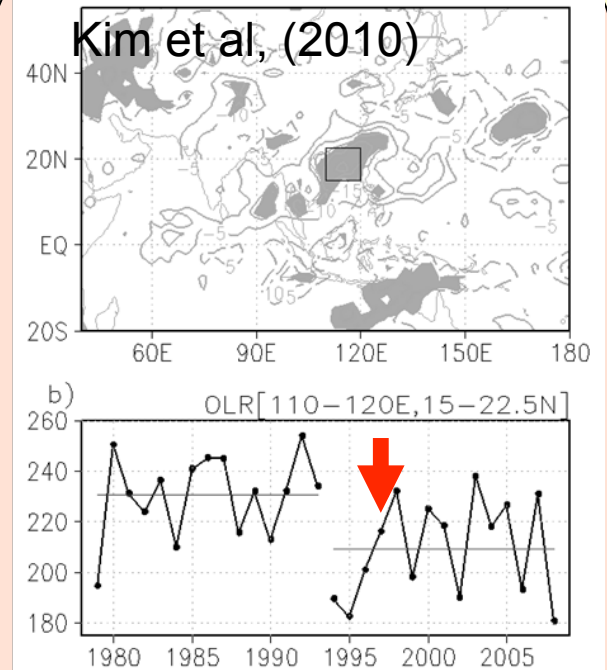
## TC regime shift

Tu et al. (2009)

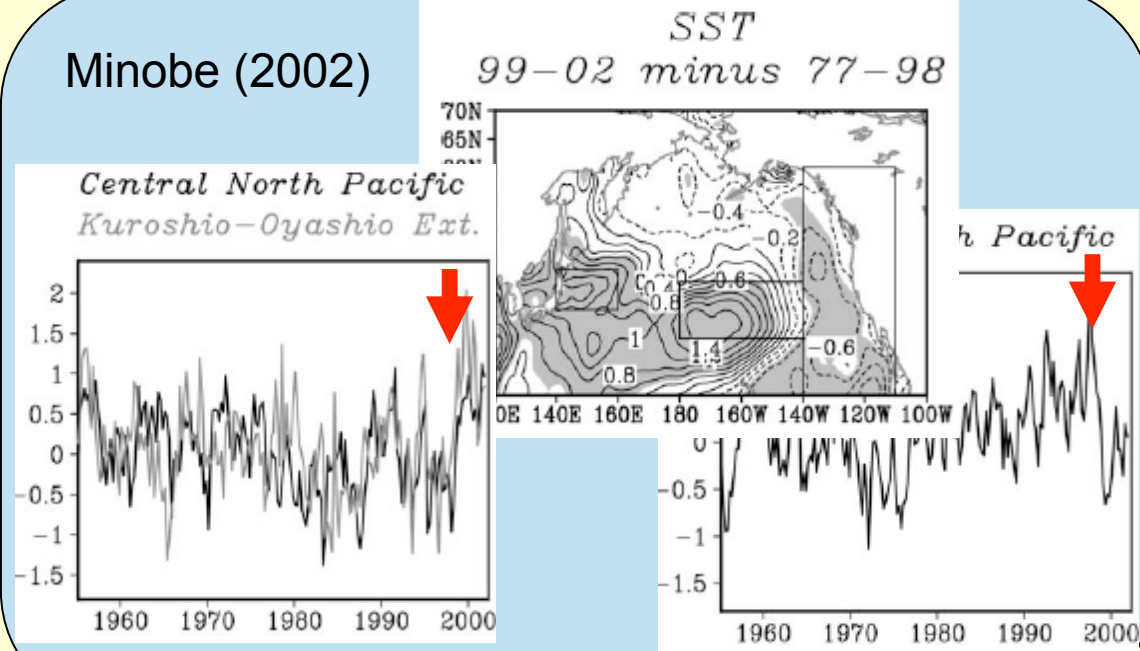


a) P42-44 OLR Difference

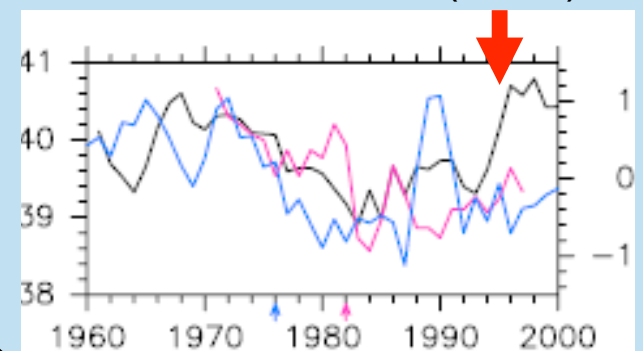
Kim et al, (2010)



Minobe (2002)

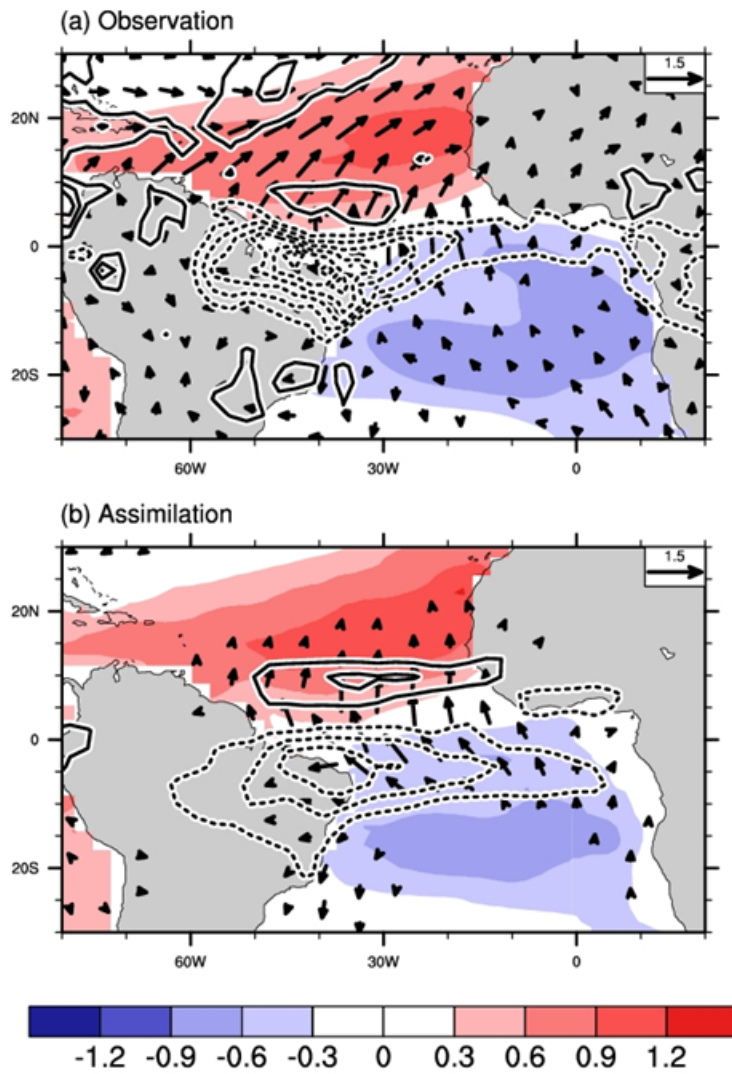


Tatebe and Yasuda (2005)

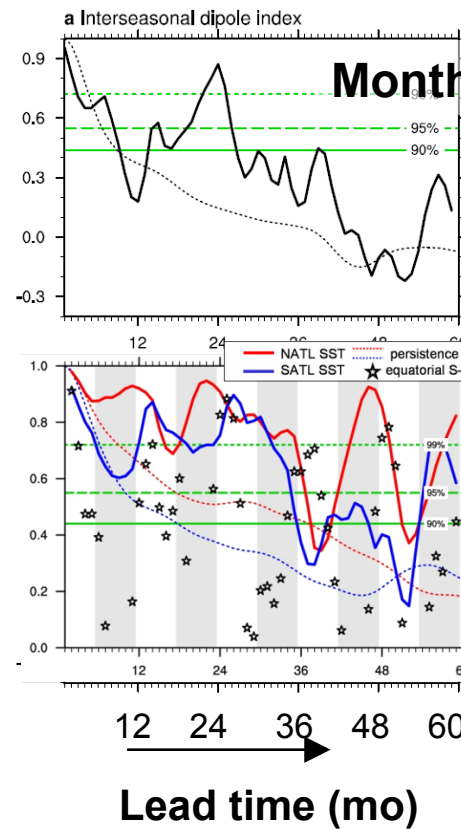


# Tropical Atlantic dipolar mode

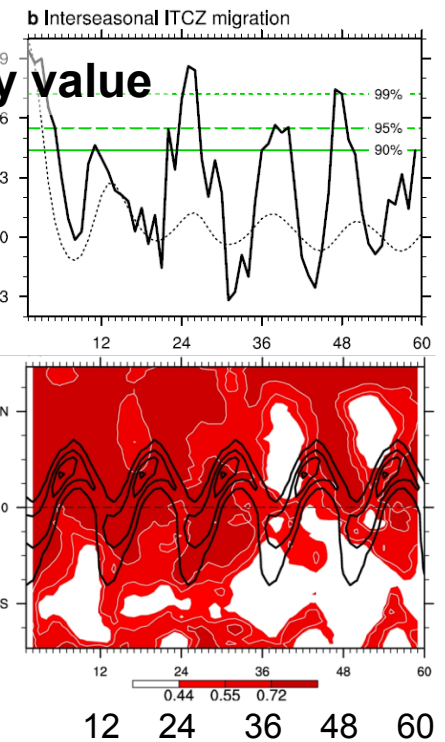
Regression map on the CESG index



SST index



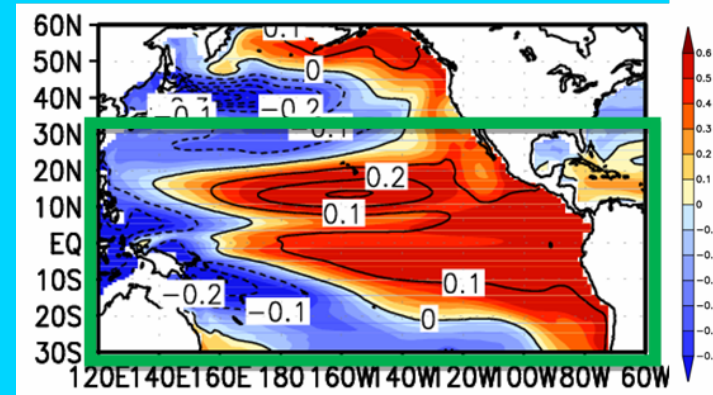
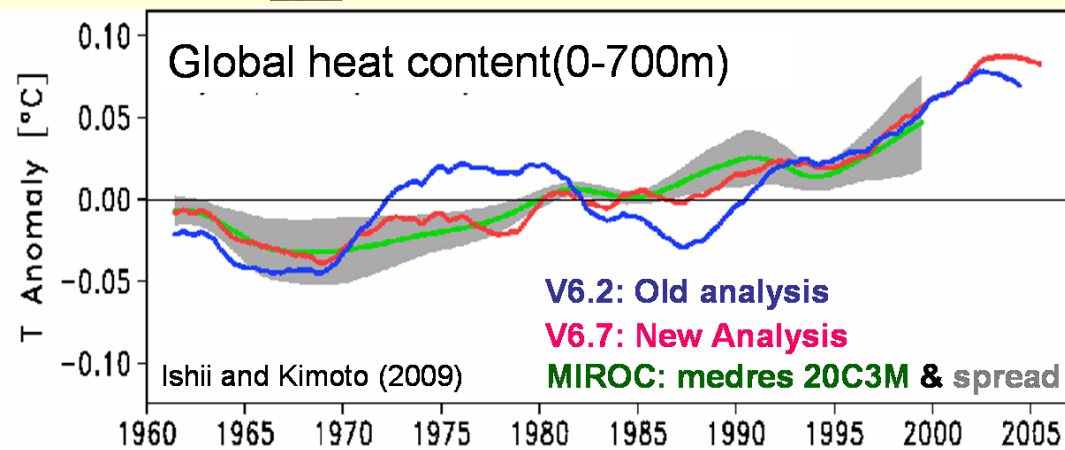
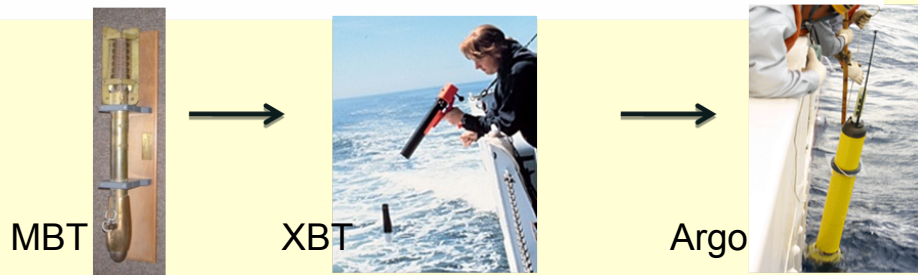
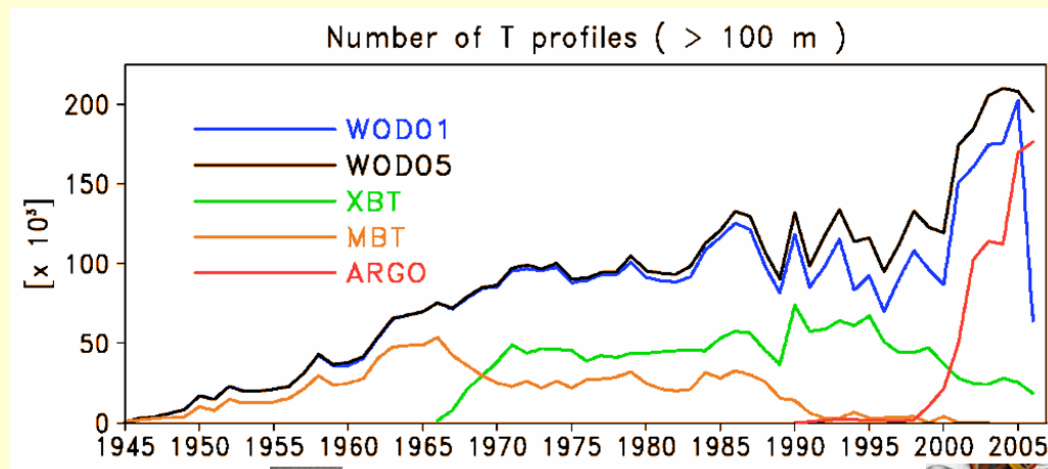
PRCP



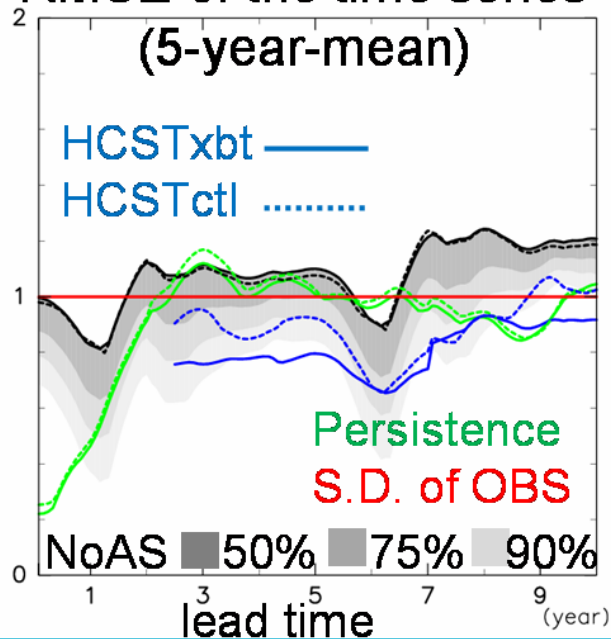


# Impact of historical XBT bias correction

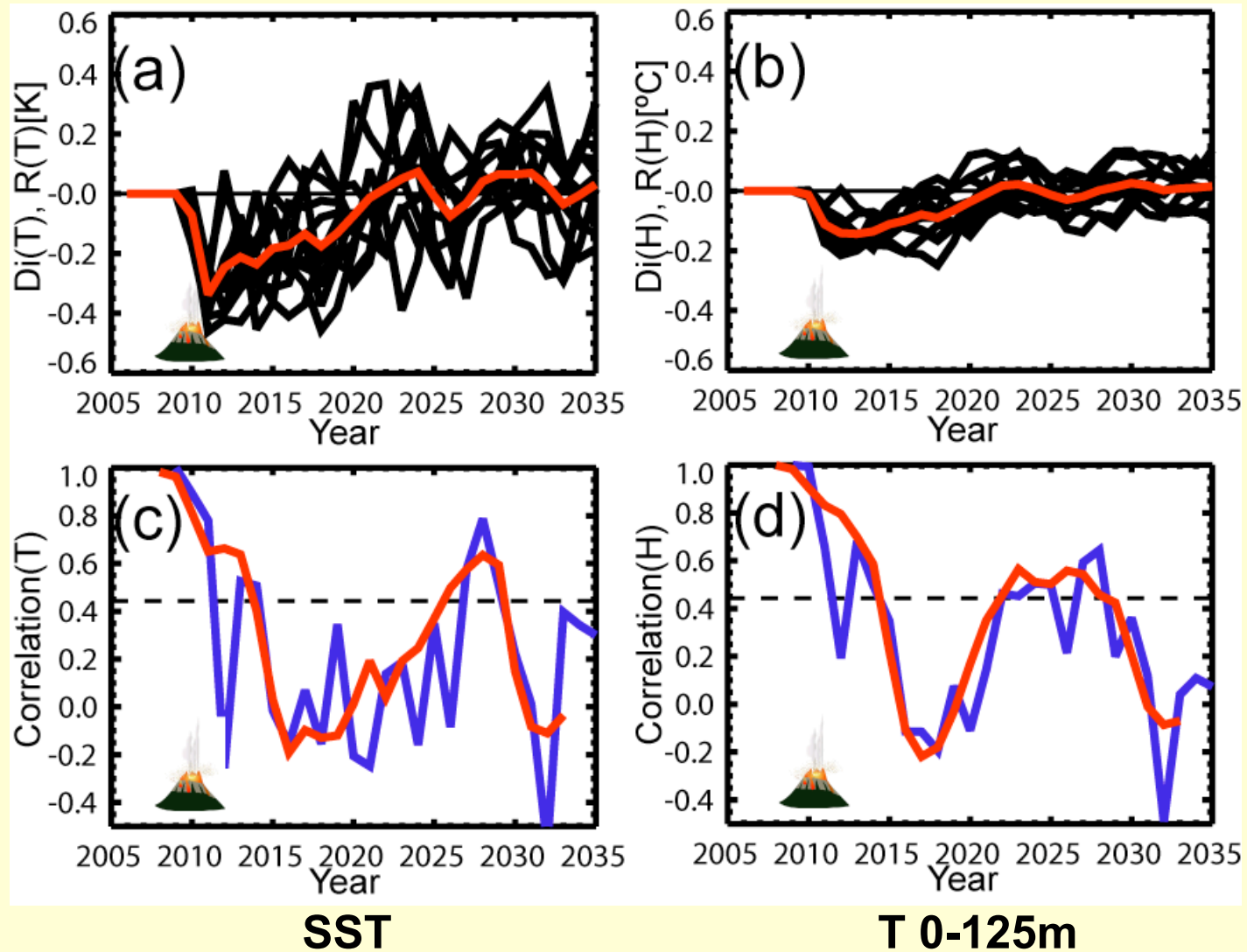
Yasunaka et al. JC, in press)



## RMSE of the time series (5-year-mean)



# Impact of 2010 “Pinatubo” eruption



Shiogama et al. (2010; Adv. Meteor.)

# Summary

## Impact of initialization

- Yes, but marginal for global mean

## What's predictable?

- AMO>PDO>??, mechanisms?

## Issues

- Ensemble size
- Initial condition sampling
- Predictability for extreme events (e.g., typhoon activities)?
- Anomaly vs. full-field assimilation
- Atmos/sea ice data assimilation
- ...

