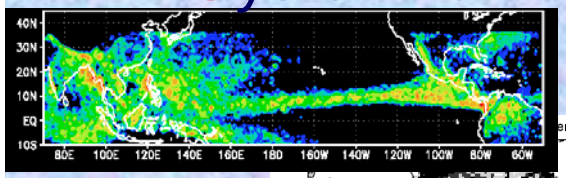
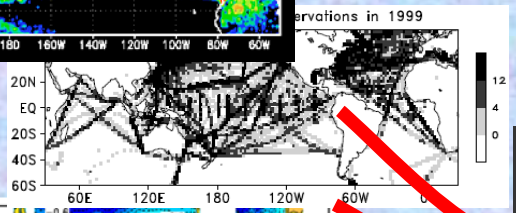
SPAM

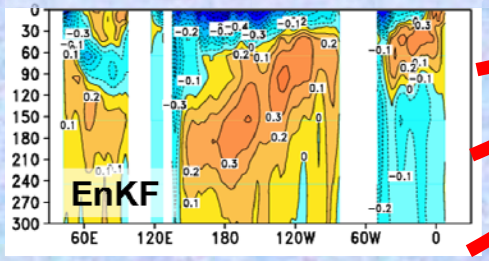
System for Prediction and Assimilation by MIROC



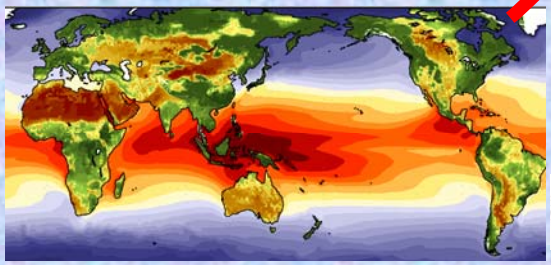


Data

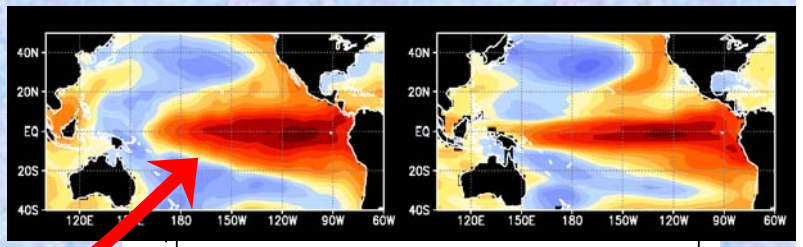
Assimilation/ Initialization

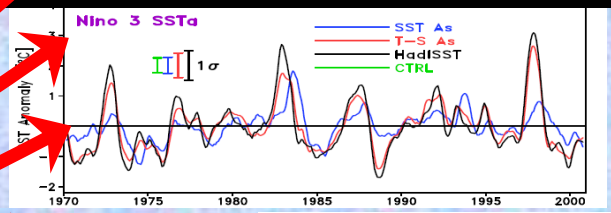


Data Assimilation

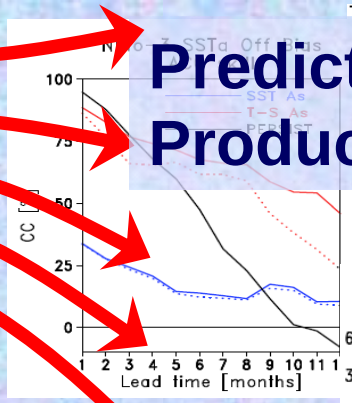


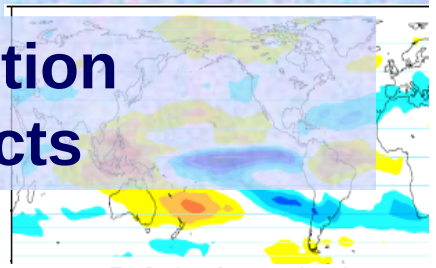
Coupled climate model MIROC



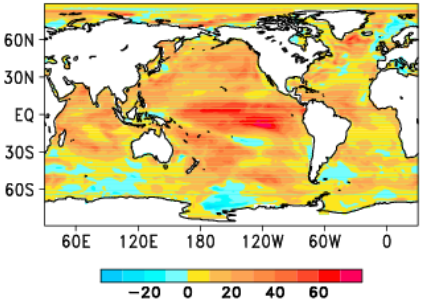


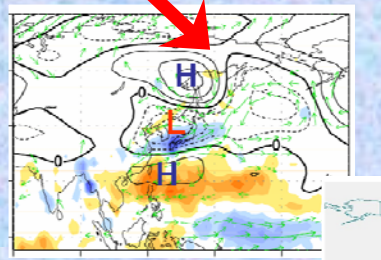
Prediction Products

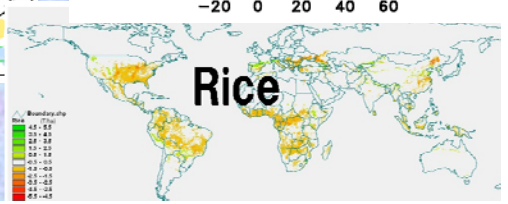




T−S As 6−mo lead

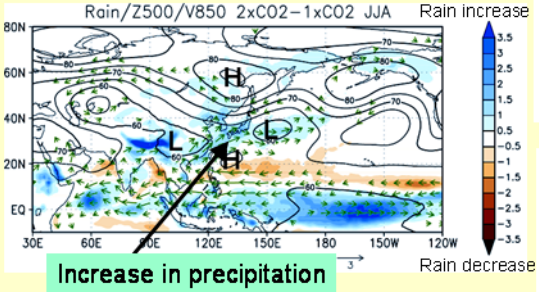






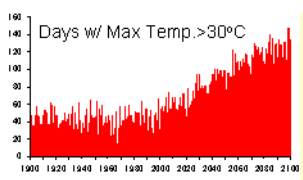
East Asian Summer Climate under the Global Warming

Changes in pressure and precipitation (70yrs from now)

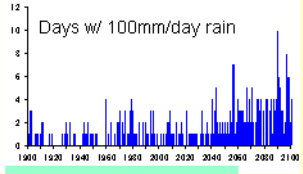


Increase in precipitation

Average temperature increase ~ 2.5°C



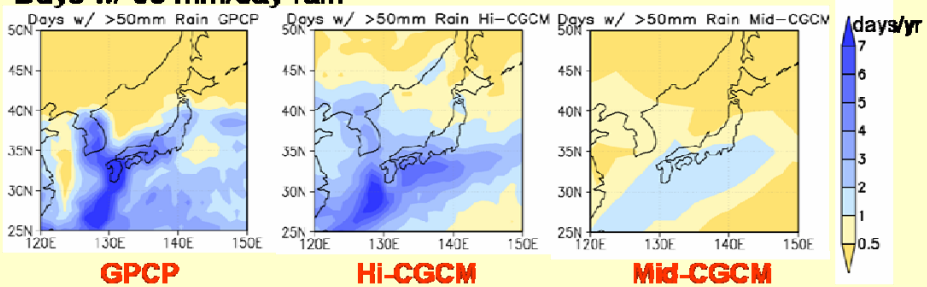
Hot summer days increase

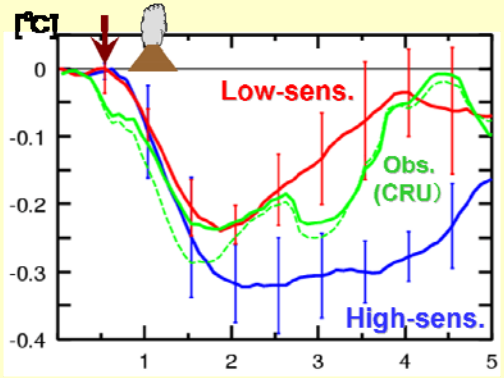


Heavy rain increases

CCSR/NIES/FRCGC

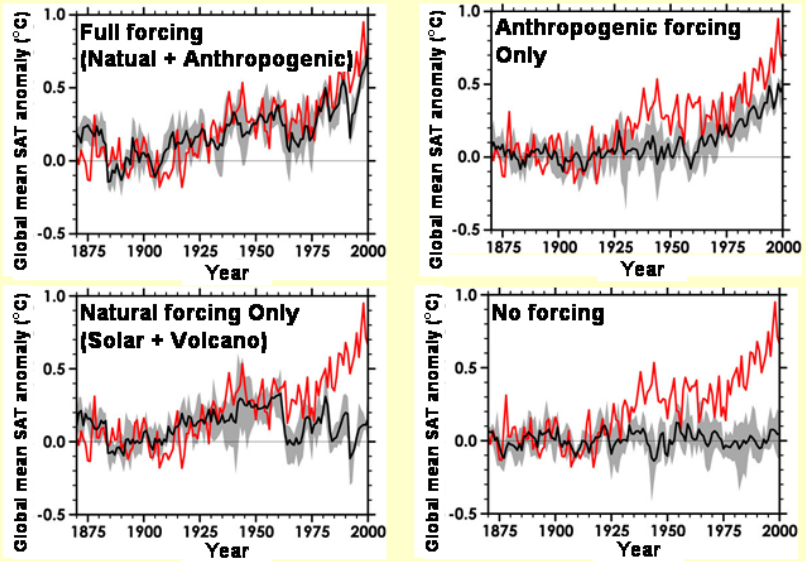
Days w/ 50 mm/day rain

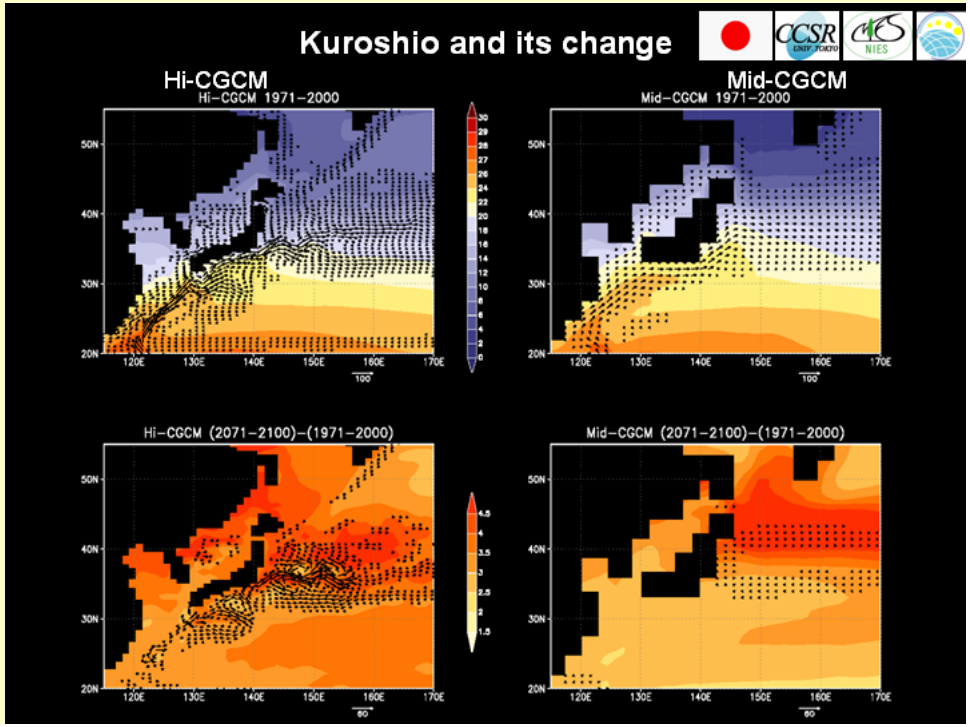


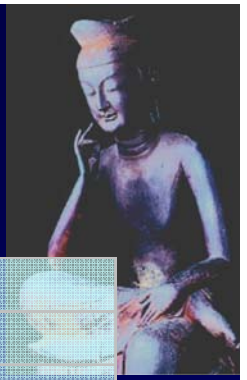


20th century climate reproduction experiment

Global mean SAT – change from the end of 18th century





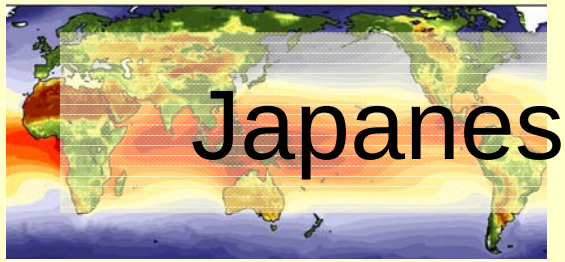


MIROC

(Model for Interdisciplinary Research On Climate)

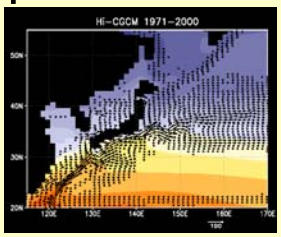
version 3.2 → 4.1

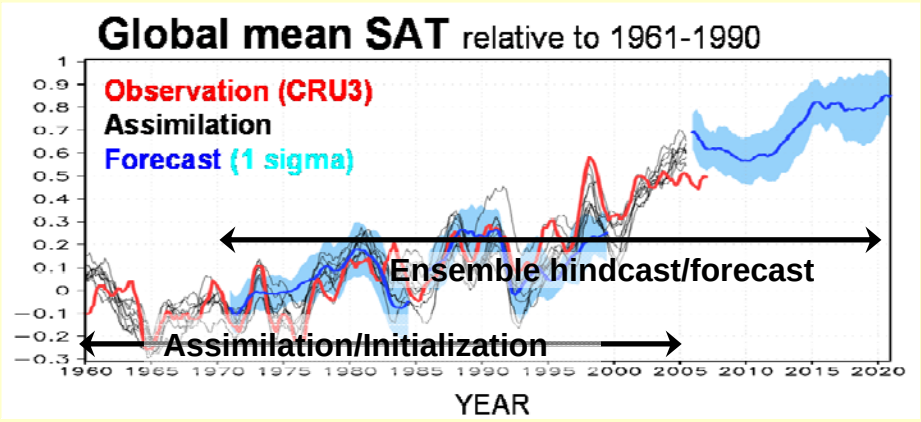
		MIROC3.2	MIROC4.1
Atmosphere			
	Resolution	T106L56 (hires) T42L20 (medres)	T213L56 (hires) T85L56 (medres)
	Radiation	MSTRN-8 (37ch)	MSTRN-X (111ch)
	Aerosol	simplified SPRINTARS	full SPRINTERS w/ Nitrate
	Chemistry	Off-line CHASER	Off-line CHASER
	LS condensati	Diagnostic (LeTreut-Li) + Simple water/ice partition	Prognostic PDF + Ice microphysics
	PBL	Mellor-Yamada lvl 2.0	Mellor-Yamada-Nakanishi-Niino lvl 2.5
	Cumulus	Prognostic A-S + critical RH	Prognostic A-S + critical RH with water/ice partition
	Land	MATSIRO	mosaic MATSIRO + prognostic LAI
Carbon Cycle		Off	Off
Ocean			
	Coordinate	lat-lon (rotated in hires)	Tripolar (in medres)
	resolution	20x30km (hirss) 100x140km (medres)	20x30km (hirss) 100x140km (medres)
	sea ice	EVP single thickness category + 0D thermodynamics	EVP multiple thickness categories + 1D thermodynamics

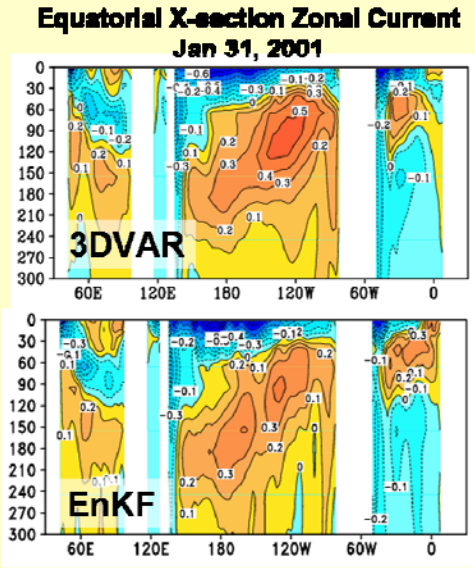


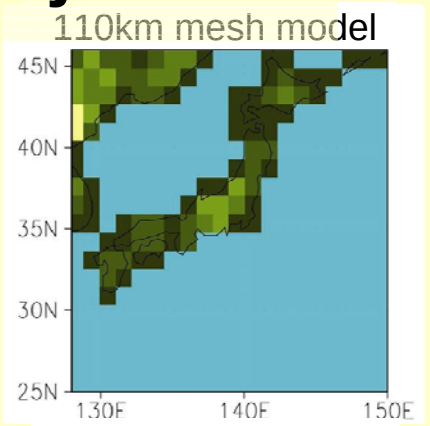
Japanese CLIMATE 2030 Project

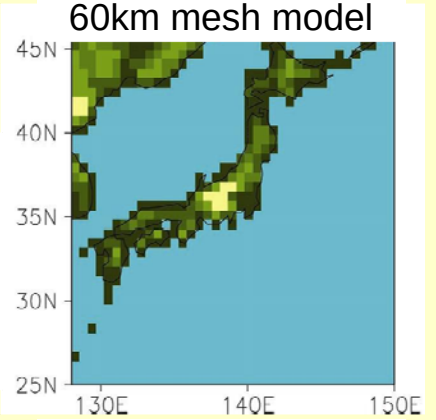
- A near-term prediction up to 2030 with a high-resolution coupled AOGCM
  - 60km Atmos + 20x30km Ocean
  - w/ updated cloud PDF scheme, PBL, etc
  - advanced aerosol/chemistry
- Estimate of uncertainty due to initial conditions
  - 10(?)-member ensemble
  - For impact applications
    - water risk assessment system
    - impacts on marine ecosystems
    - etc.
- Test run w/ 20km AOGCM (in 2011)

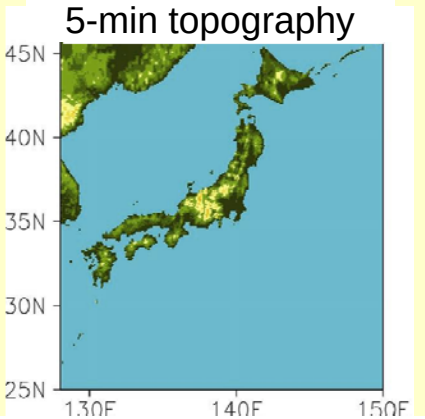












Near-Term Projection: Issues

- Models good enough?
- Resolution? Ensembles?
- Initialization? How?
- Drift?
- Decadal predictability?
- Chemistry? Aerosols?
- Volcanoes?

Analysis and Ensemble Options

Data	Assimilation Methods	Ensemble Generation
• Gridded subsfc T/S • Profiles of T/S • Sea Ice? • Atmospheric Data?	• Nudging • Incremental Analysis Update (IAU) • Anomaly assimilation? • 3DVAR • Ensemble Kalman Filter (EnKF)	• Lagged Average Forecasts (LAF) •Ensemble Assimilation • Breeding

SPAM: **S**ystem for **P**rediction and **A**ssimilation by **M**IROC

Observations used

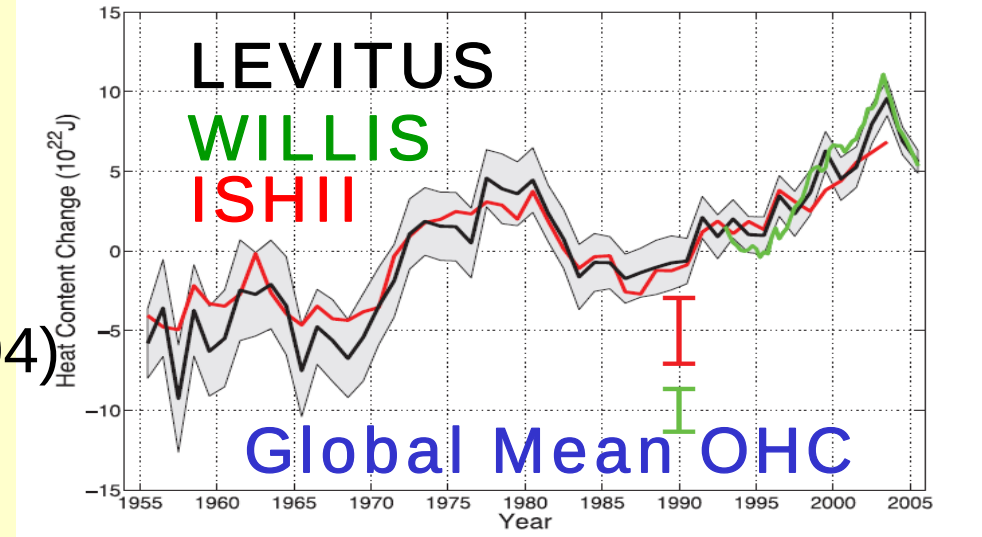
- **Gridded Observations**

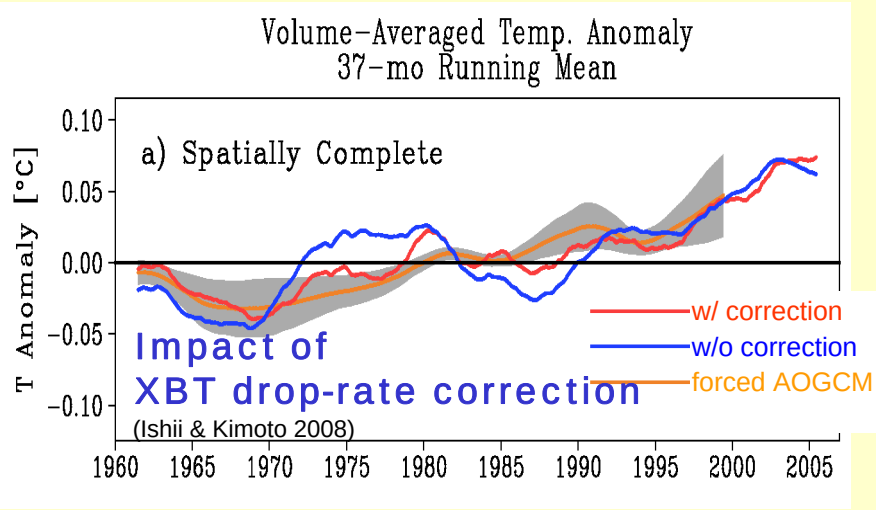
  Statistically optimized

  Analysis error

  - **COBE-SST** (Ishii et al. 2004)
    - 1850-present, monthly
    - 1°x 1°
  - **Historical Subsurface T & S analysis** (Ishii et al. 2006)
    - 1945-2005, monthly
    - 1°x 1°, 16L: 0-700 m

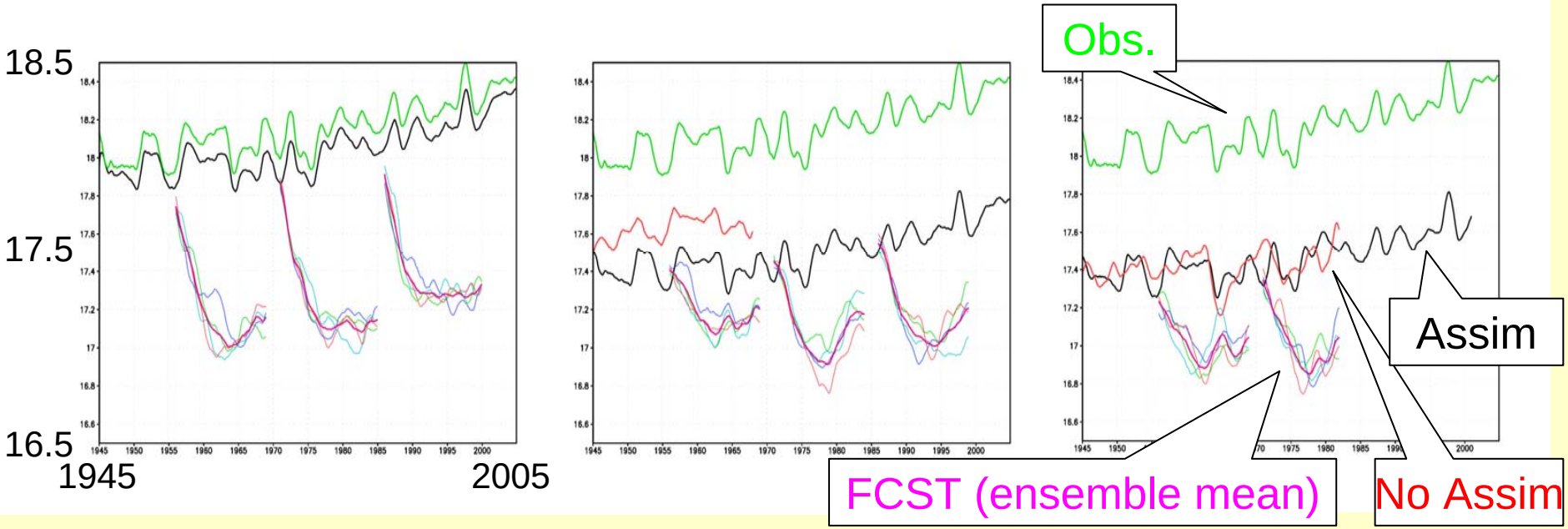
- **Observed T & S profiles by NODC (WOD05 & GTSPP)**





First Trial: Total & Anomaly Nudging

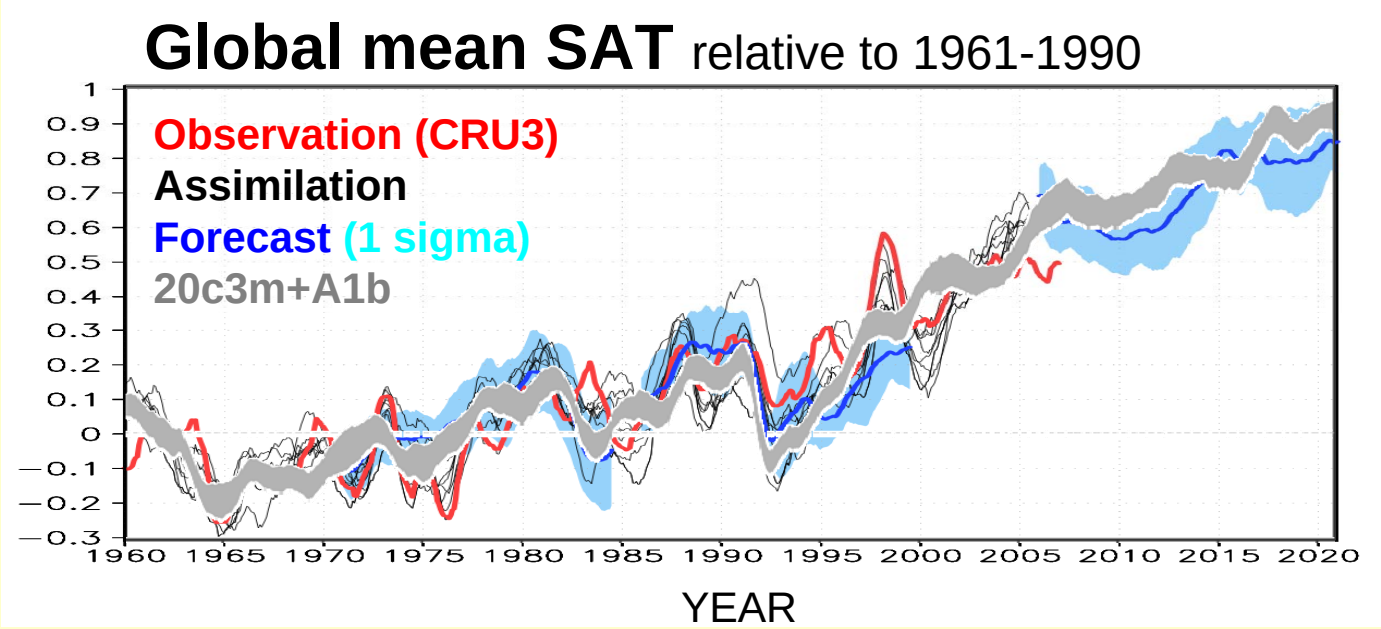
Ver0.0	Ver0.2n	Ver0.3n
MIROC3.2 bug-fix ver. Assimilating absolute values	MIROC3.2 bug-fix ver. Anomaly assimilation	MIROC3.2 AR4 official ver. Anomaly assimilation



Global Mean SST

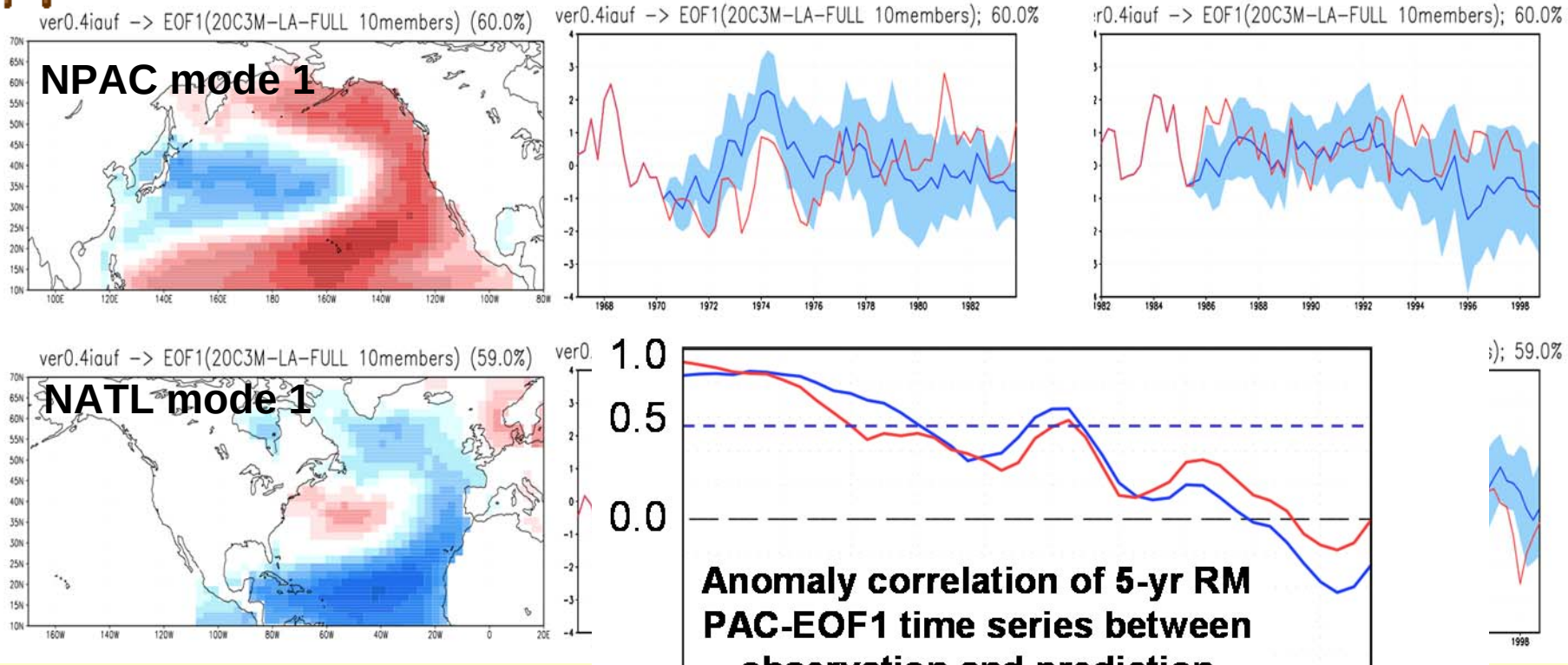
Latest choice:

- Assimilation of monthly anomalies
- IAU w/ data density consideration (←3DVAR)
- Heat and salinity conservation
- LAF / ensemble IAU / breeding ensemble generation

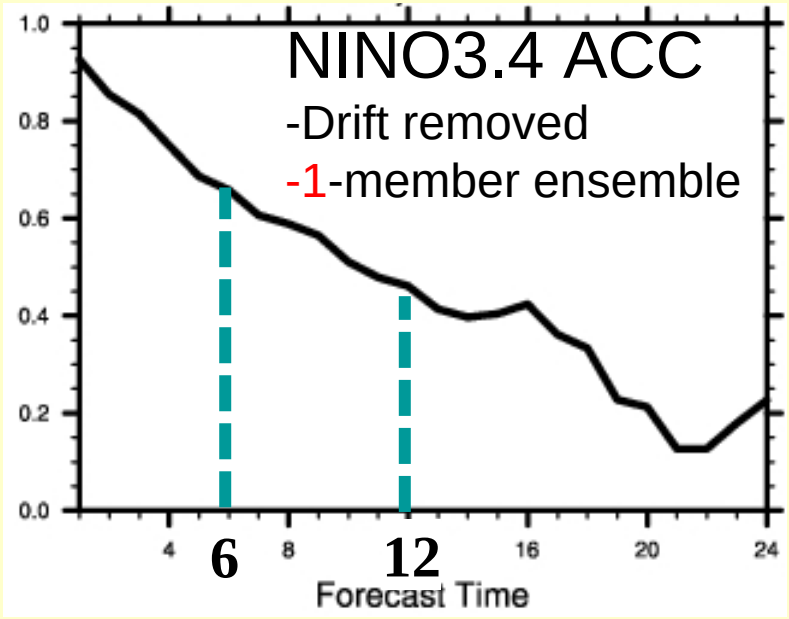


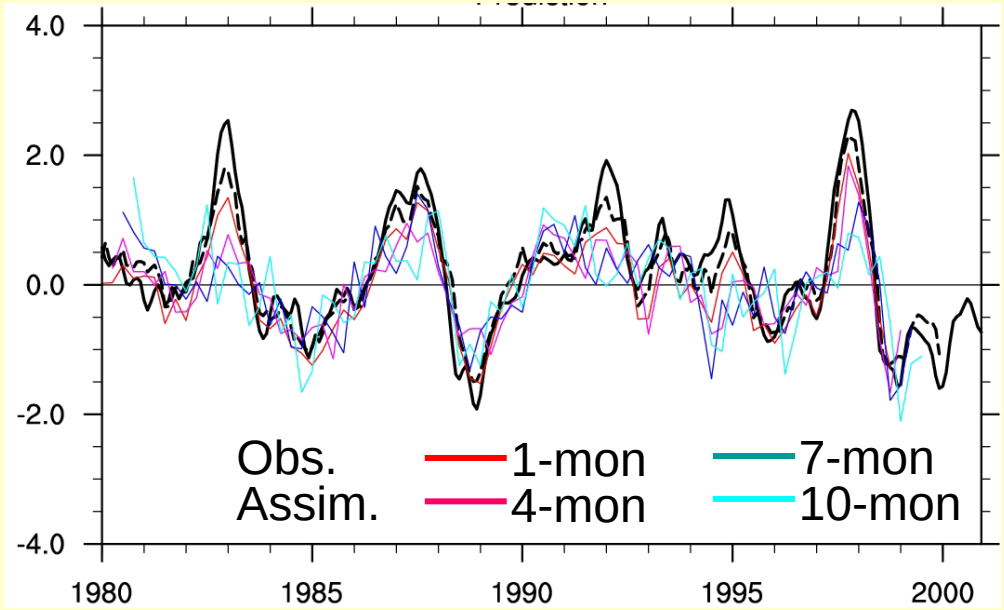
Decadal Predictability?

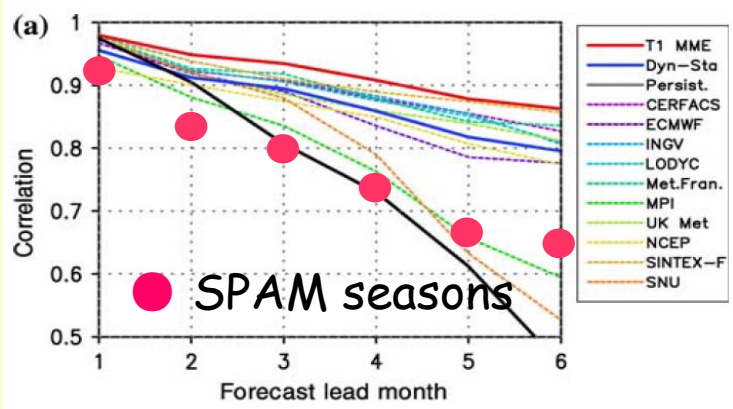
Assimilation vs. Hindcast for natural variability



SPAM seasons



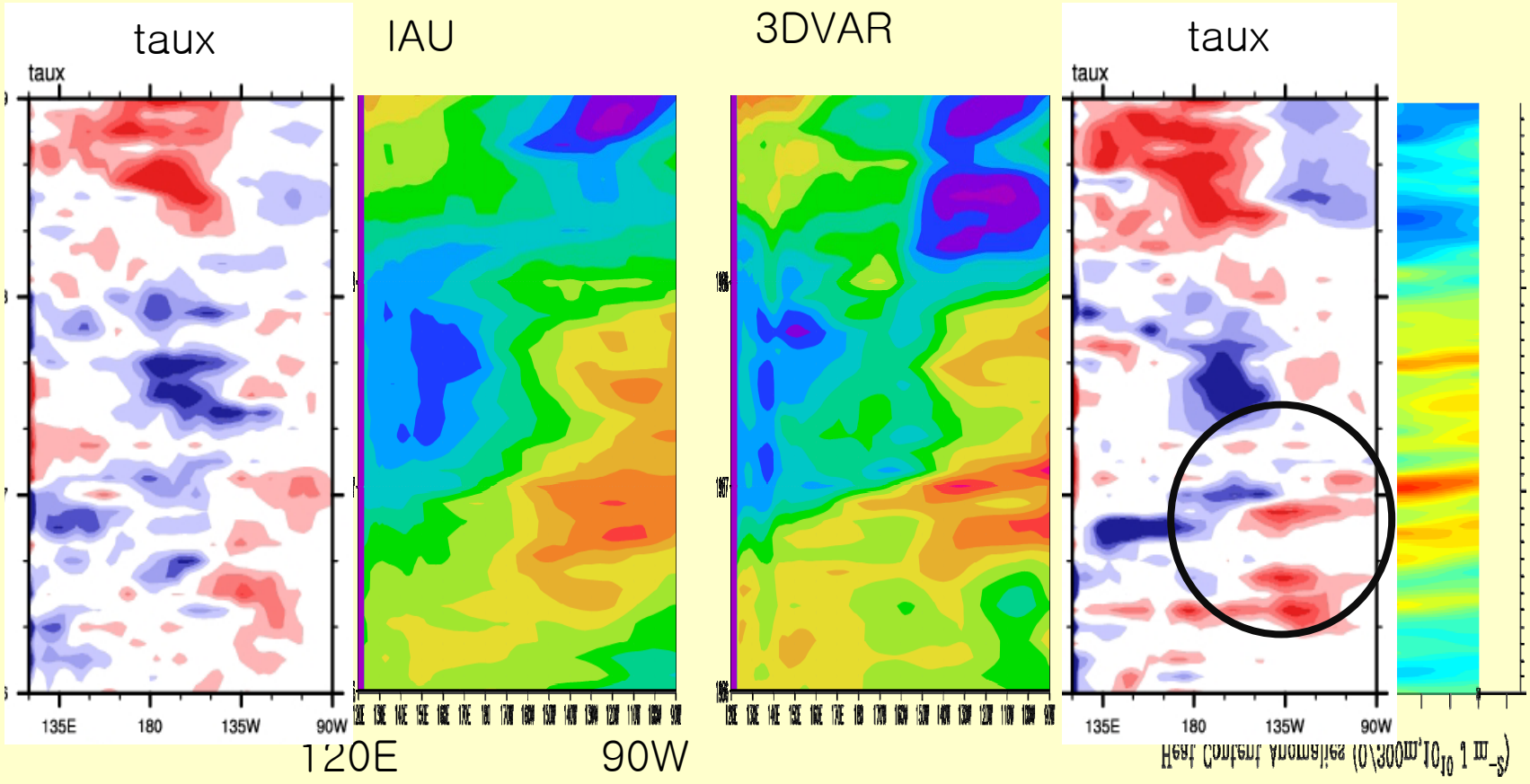




(Jin et al. 2008)

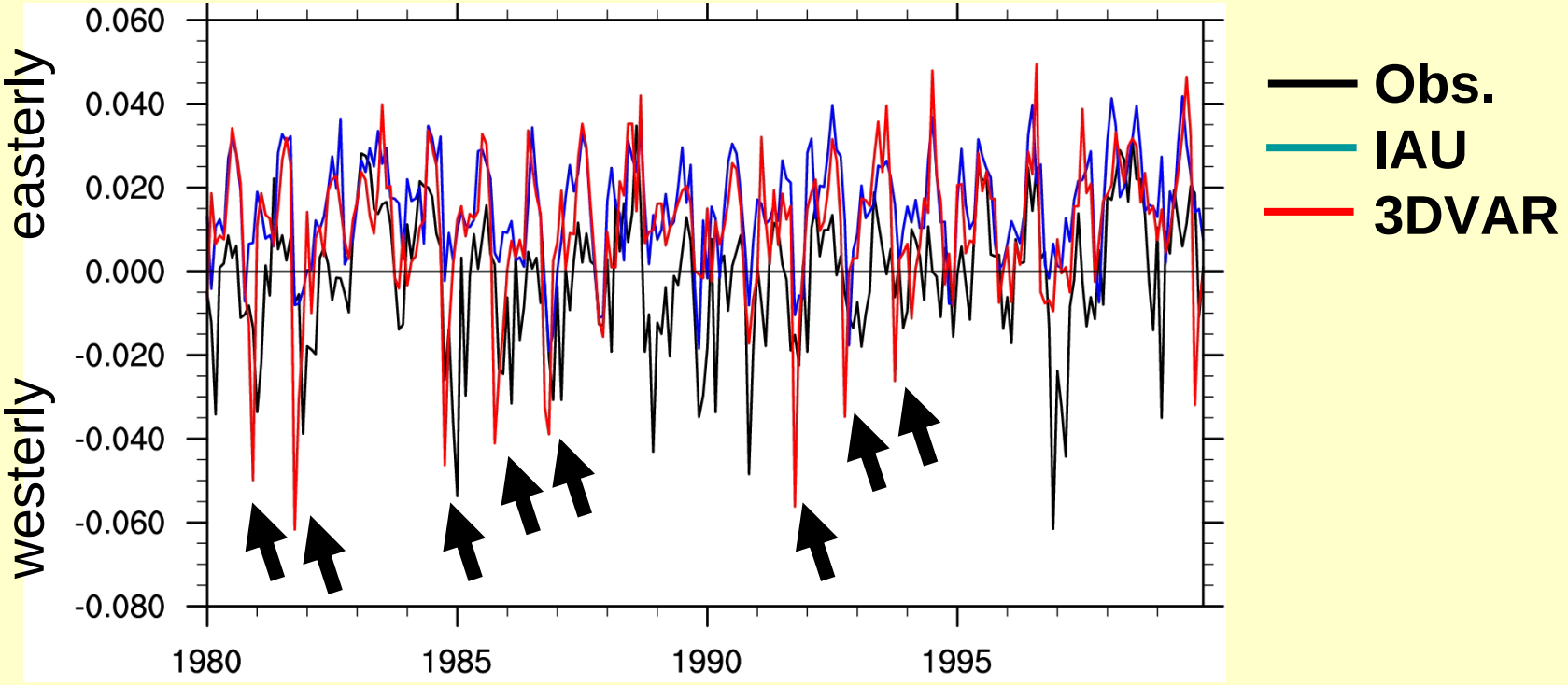
Assimilation technique : IAU ⇒ 3DVAR

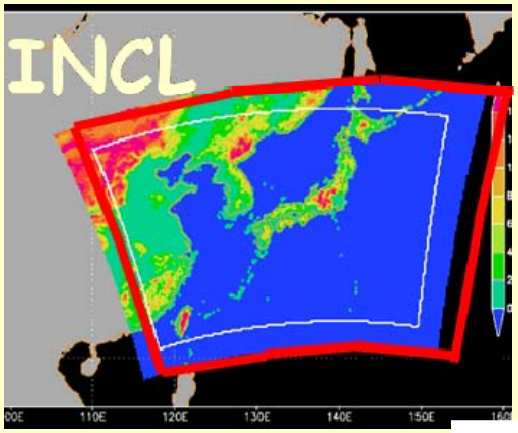
OHC (2S-2N)



High frequency variability is also appeared in zonal wind-stress field.

Equatorial zonal wind stress in the western Pacific (5S-5N, 130W-140W)

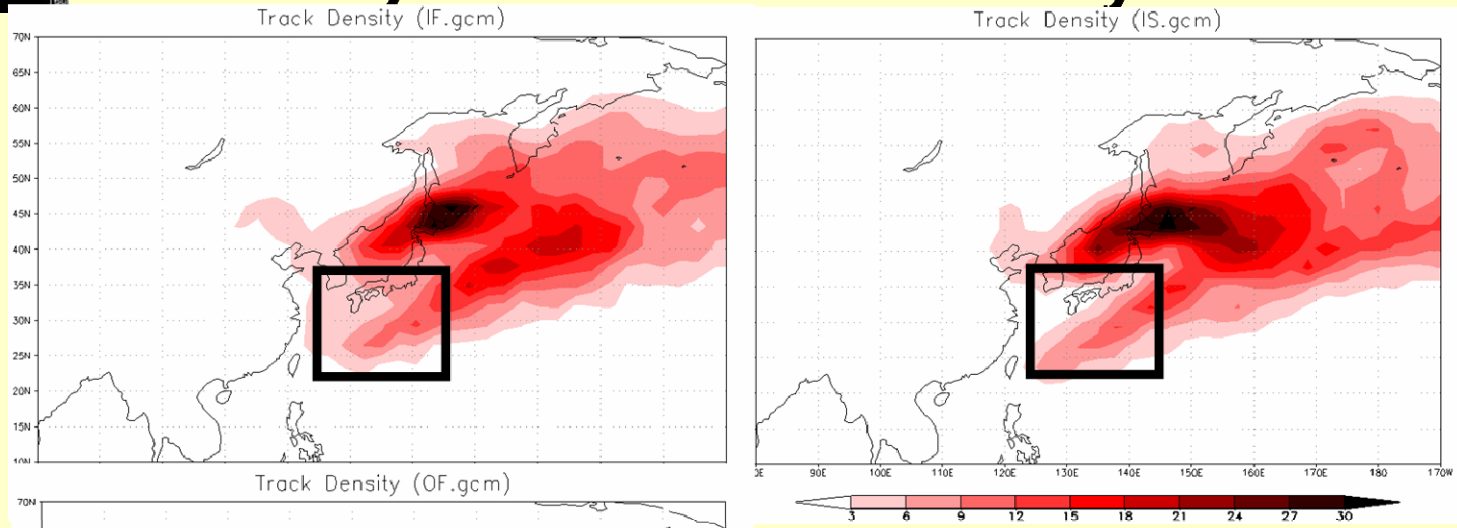




An Interactively Nested Climate Model

Inatsu & Kimoto (2008)

Cyclone Track Density

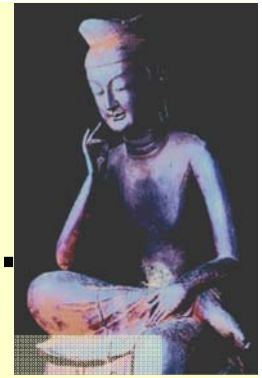


IF.gcm

IS.gcm

OF.gcm

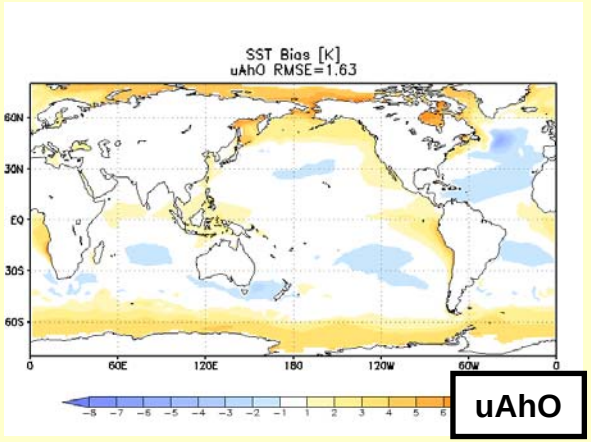
Thanks to SPAM & MIROC fellows…



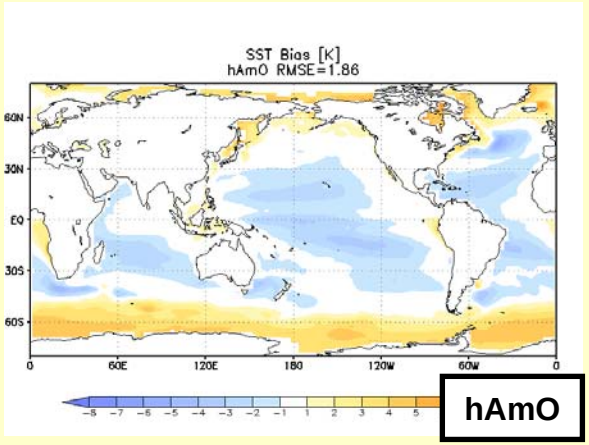
Especially,

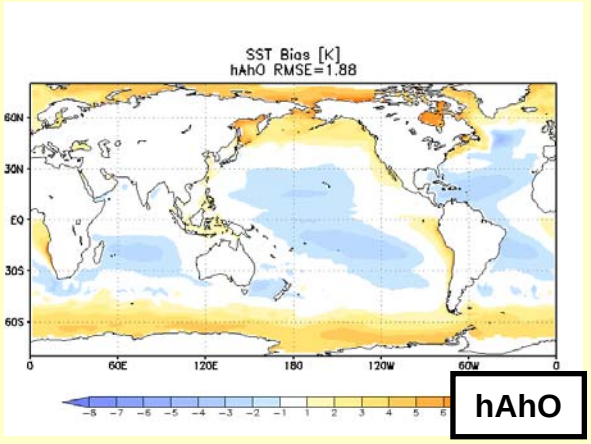
- Masayoshi Ishii (FRCGC/JMA)
- Yoshimitsu Chikamoto (CCSR)
- Hiroaki Tatebe (CCSR)
- Takashi Mochizuki (FRCGC)
- Masato Mori (CCSR)
- Sayaka Yasunaka (CCSR)
- Masahiro Watanabe (CCSR)
- Hideo Shiogama (NIES)
- Takashi Sakamoto (FRCGC)

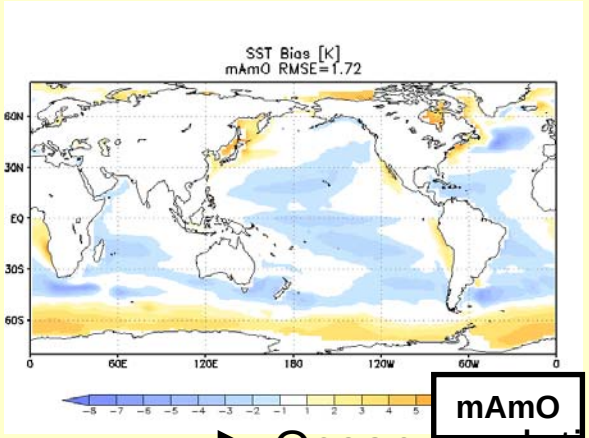
SST Bias

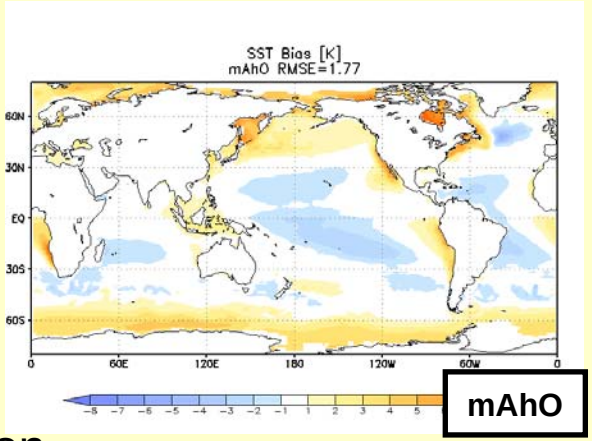


ATMOS resolution







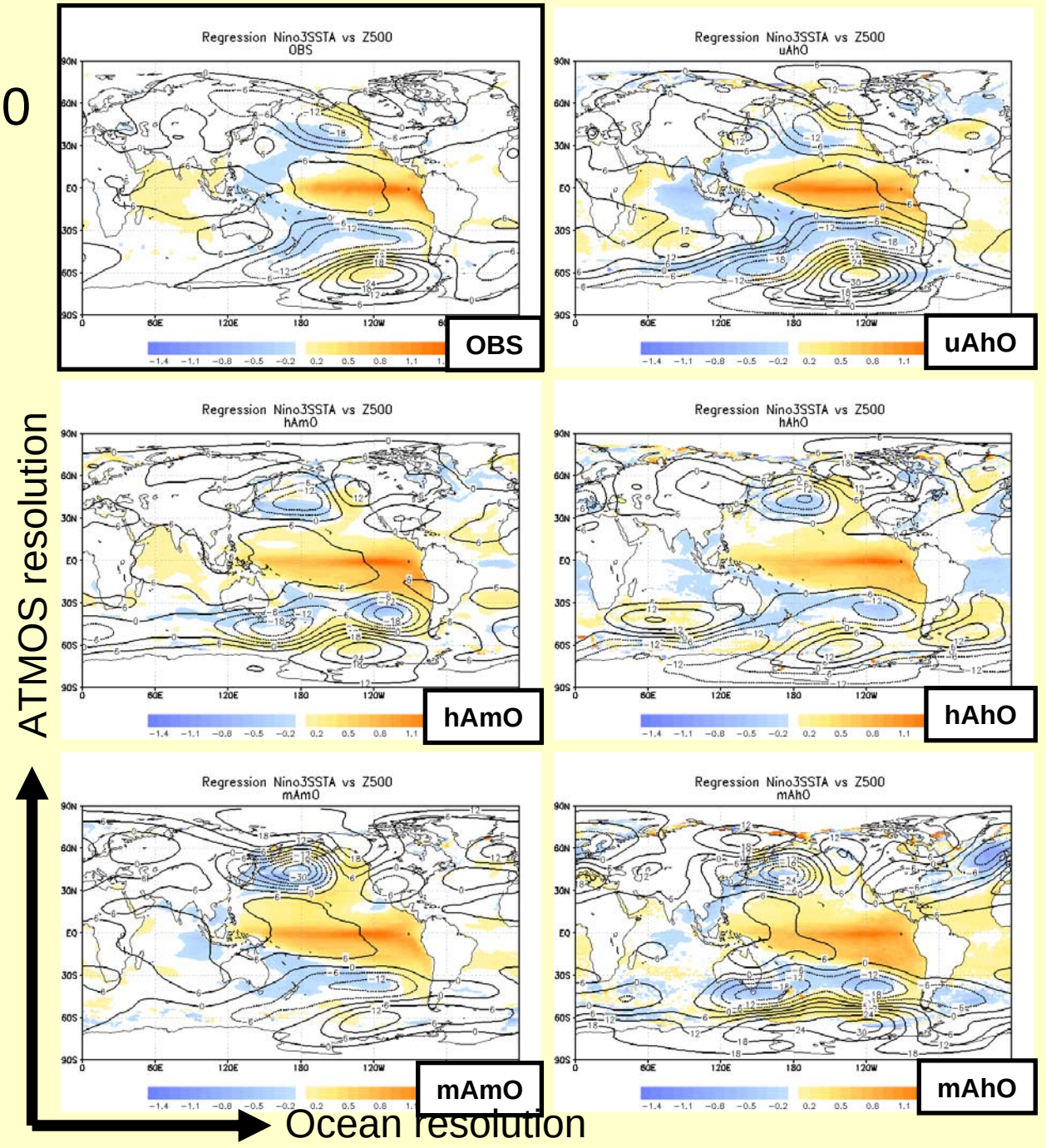


Ocean resolution

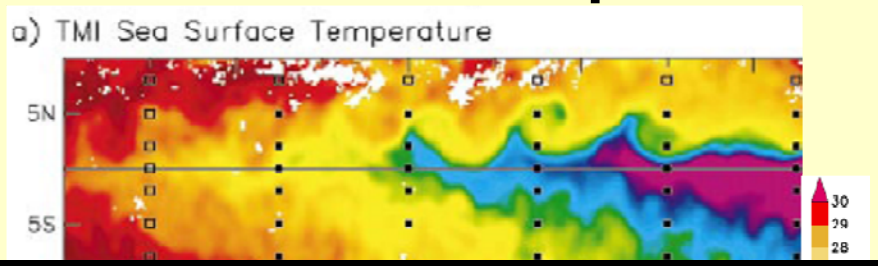
Regression
Nino3 index vs Z500

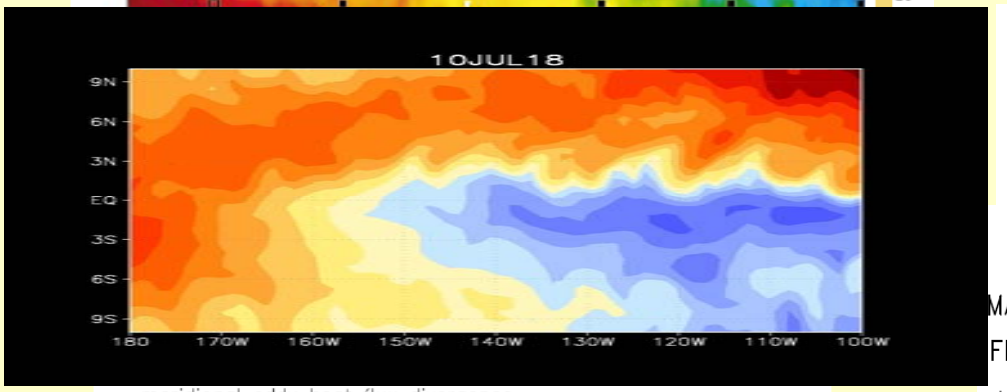
NINO3 std

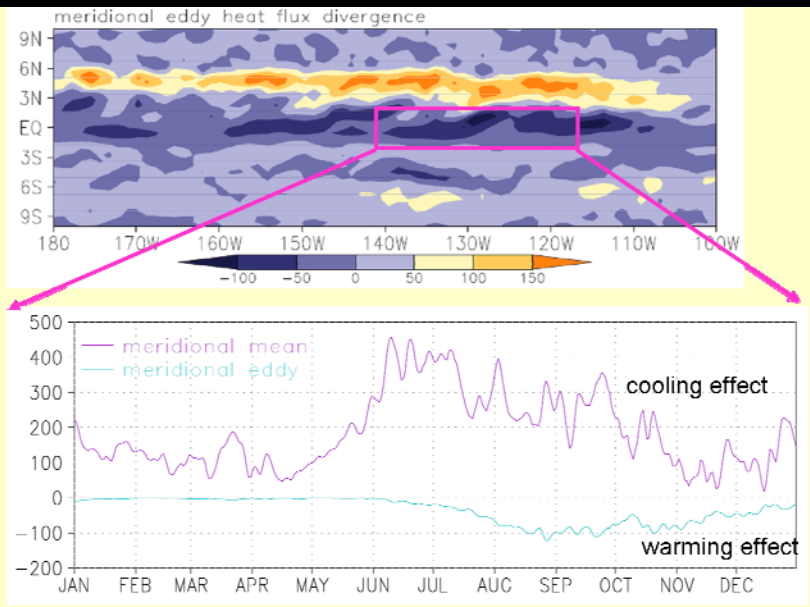
0.79	0.56
0.44	0.33
0.46	0.37

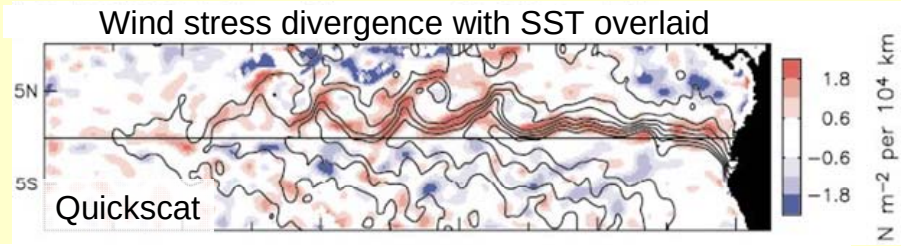


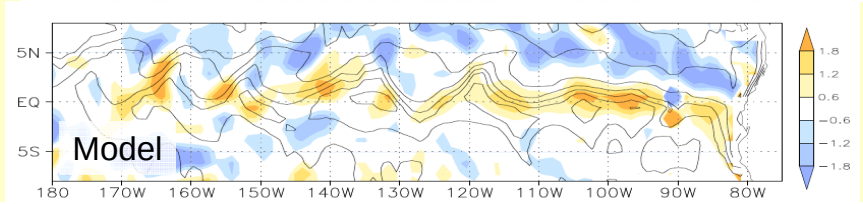
Tropical Instability Waves

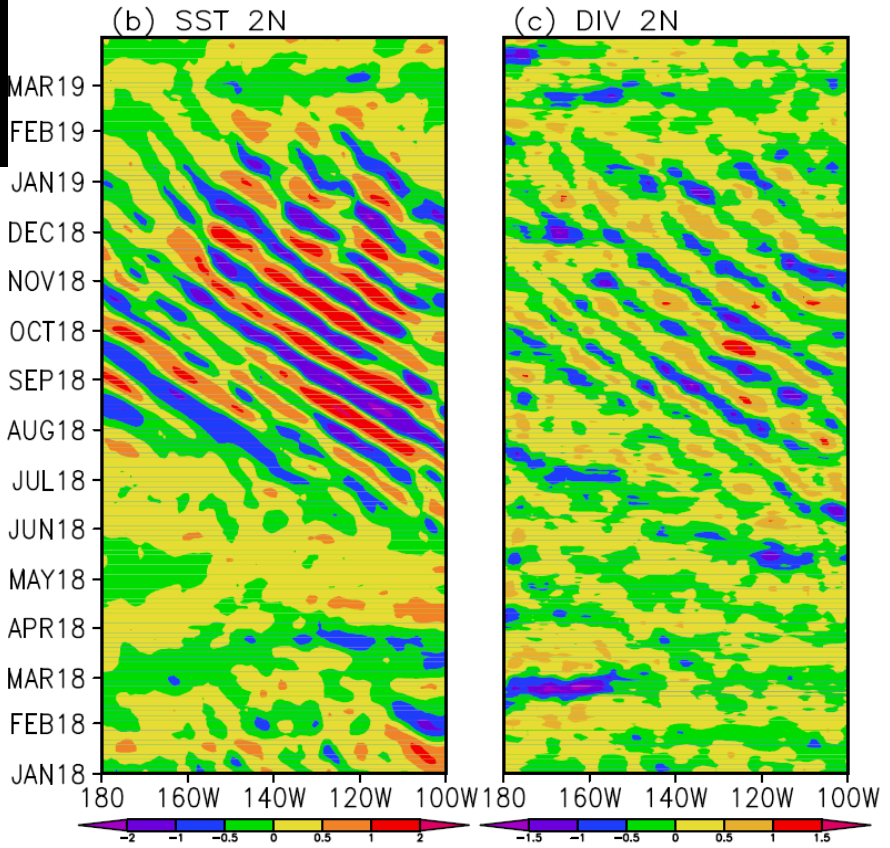




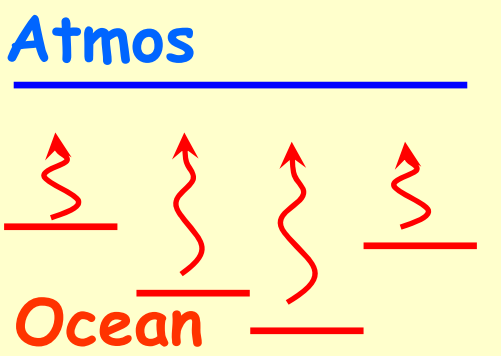


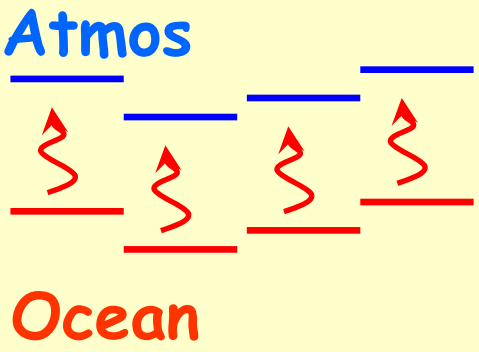


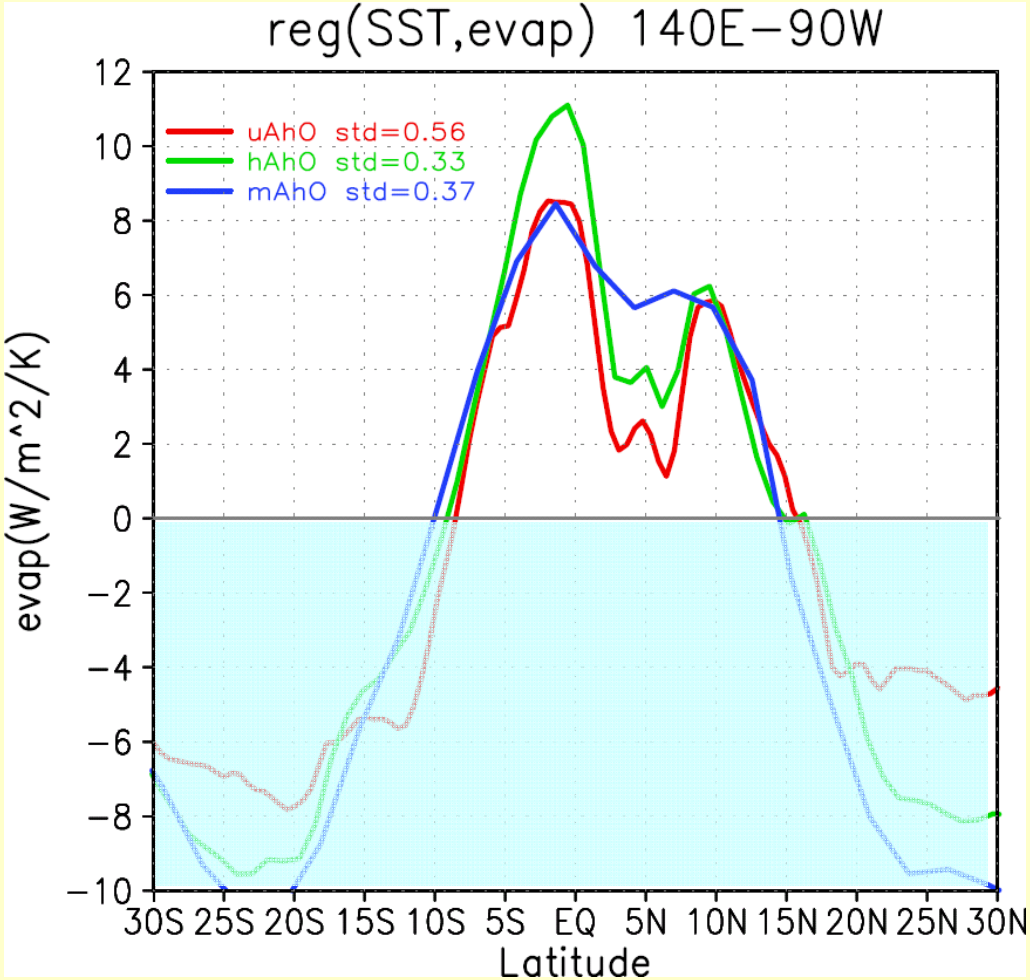




Chen & Kimoto (2008; JC sub judice)


Atmos
Ocean


Atmos
Ocean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uAhO std=0.56
hAhO std=0.33
mAhO std=0.37
evap(W/m^2/K)
12
10
8
6
4
2
0
−2
−4
−6
−8
−10
30S 25S 20S 15S 10S 5S EQ 5N 10N 15N 20N 25N 30N
Latitude