CME/PNU CGCM Predictability of Winter Temperature over East Asia

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Motive

- Monsoon is a typical phenomena resulted from “atmosphere-ocean -snow/ice-land surface” coupling.

- Study of Monsoon system using Coupled General Circulation Model is necessary.

Purpose

- Investigation of East Asia winter temperature predictability of CME/PNU CGCM

Dynamical Long-term Prediction System

AGCM Initialization

Reproduction : Sep. 1 ~ Sep. 30
Initial Condition for CGCM:
Oct. 1 , 3, 5, 7, 9

OGCM/Sea ice Initialization

Spin-up : 100 - year
Reproduction : Jan. 1, 1979 ~ Feb. 28, 2005
Initial Condition for CGCM:
Oct. 1 , 3, 5, 7, 9

AGCM
EVP Sea Ice
OGCM

CME/PNU CGCM
(No Flux Adjustment)

CGCM Ensemble Hindcast

26-year (1979~2004) CGCM Climatology

5-Month Lead Hindcast (Oct ~ Feb)

Hindcast Experiment with CCM3 AGCM using Persistent and Observed SST Anomalies

1971-2004 Reproduction for LSM Initial Conditions

PSSTA AGCM Ensemble Hindcast

BC : SST anomaly observed October

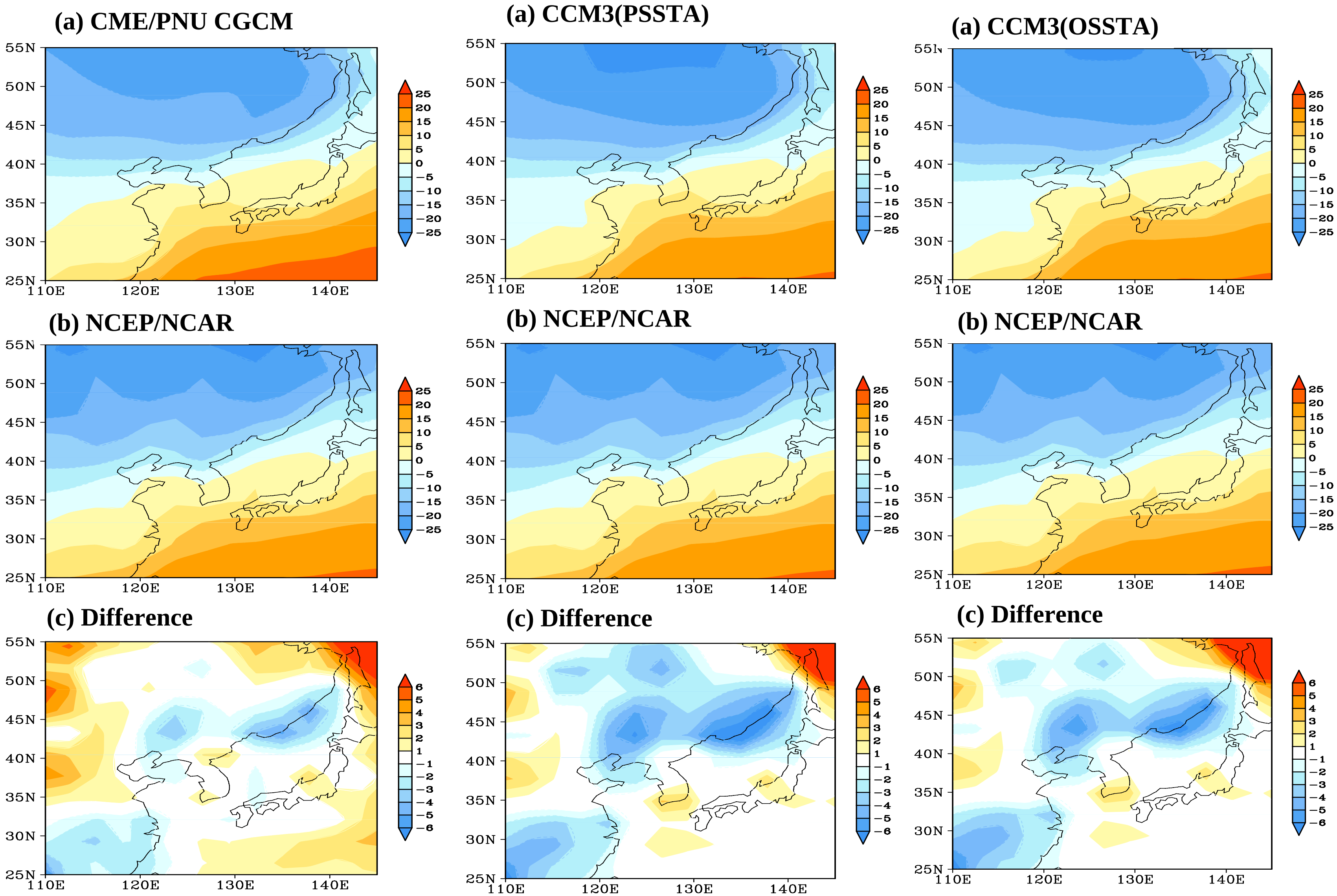
OSSTA AGCM Ensemble Reproduction

BC : Real SST anomaly

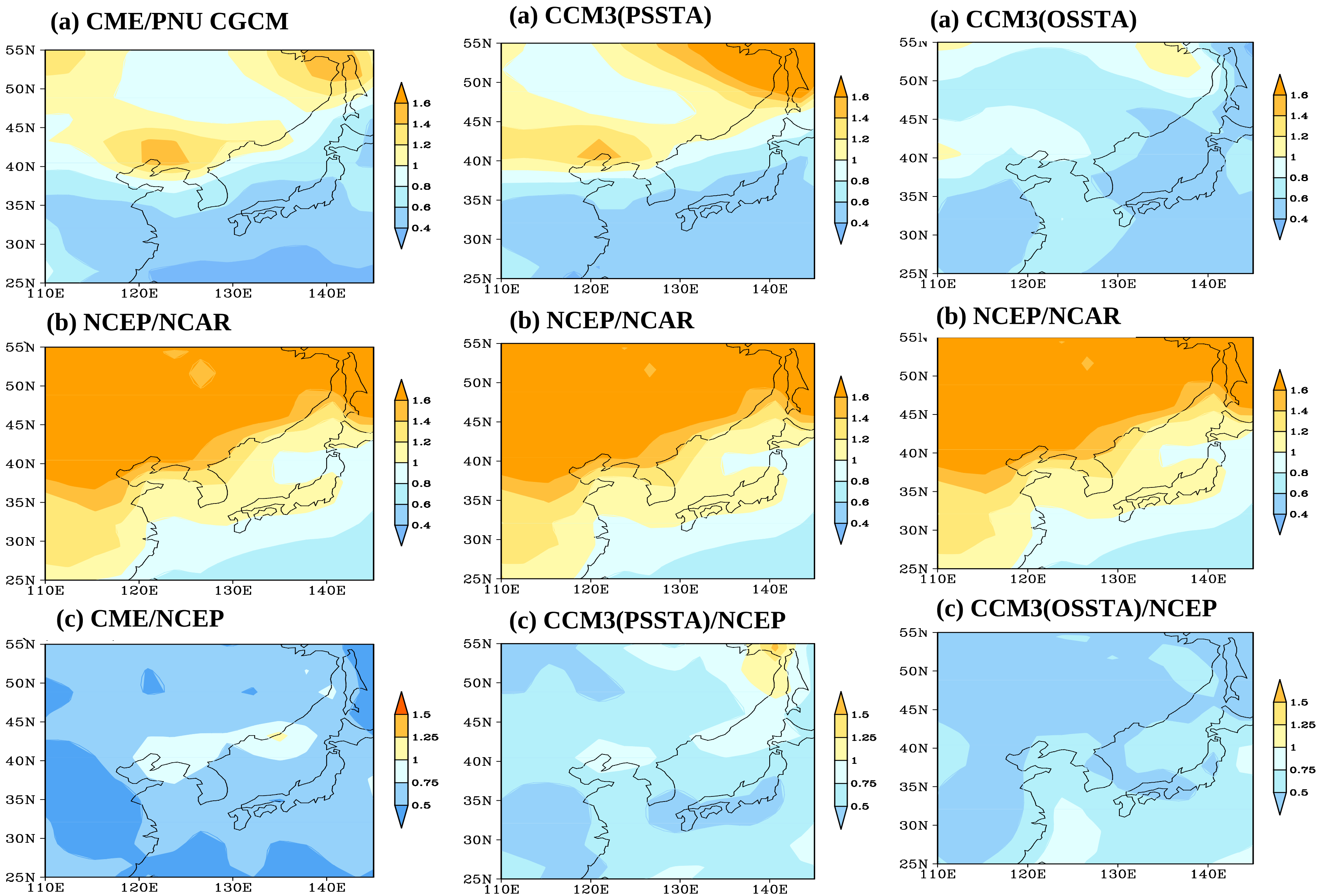
AGCM Stand-Alone Ensemble Experiment

- 26-year (1979~2004) AGCM Run
- 4-Month Lead Hindcasts (Nov-Feb)
- I.C.s for AGCM (10 ensemble members)
  : Oct. 27-30 (00Z, 12Z)

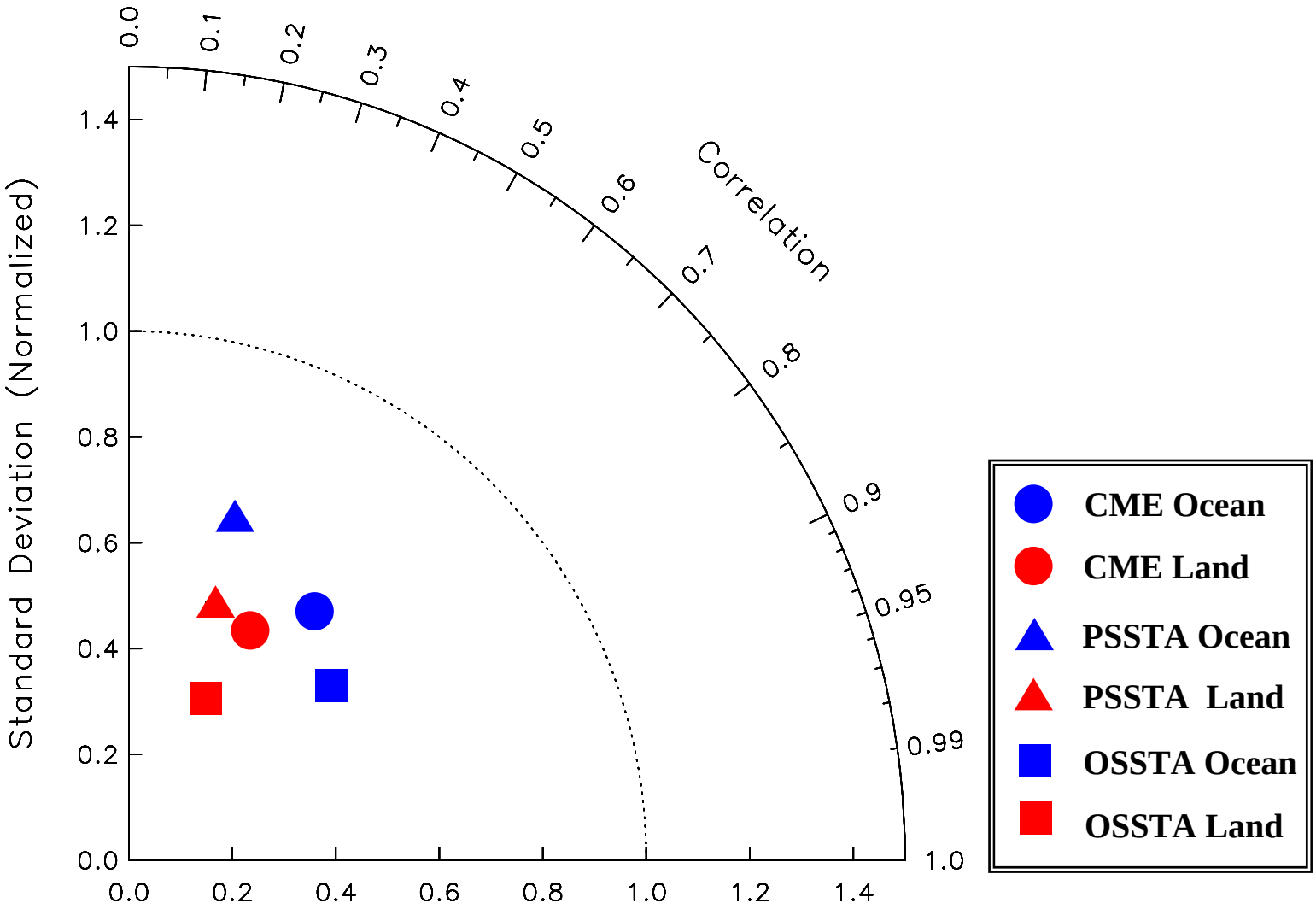
Winter Temperature Climatology



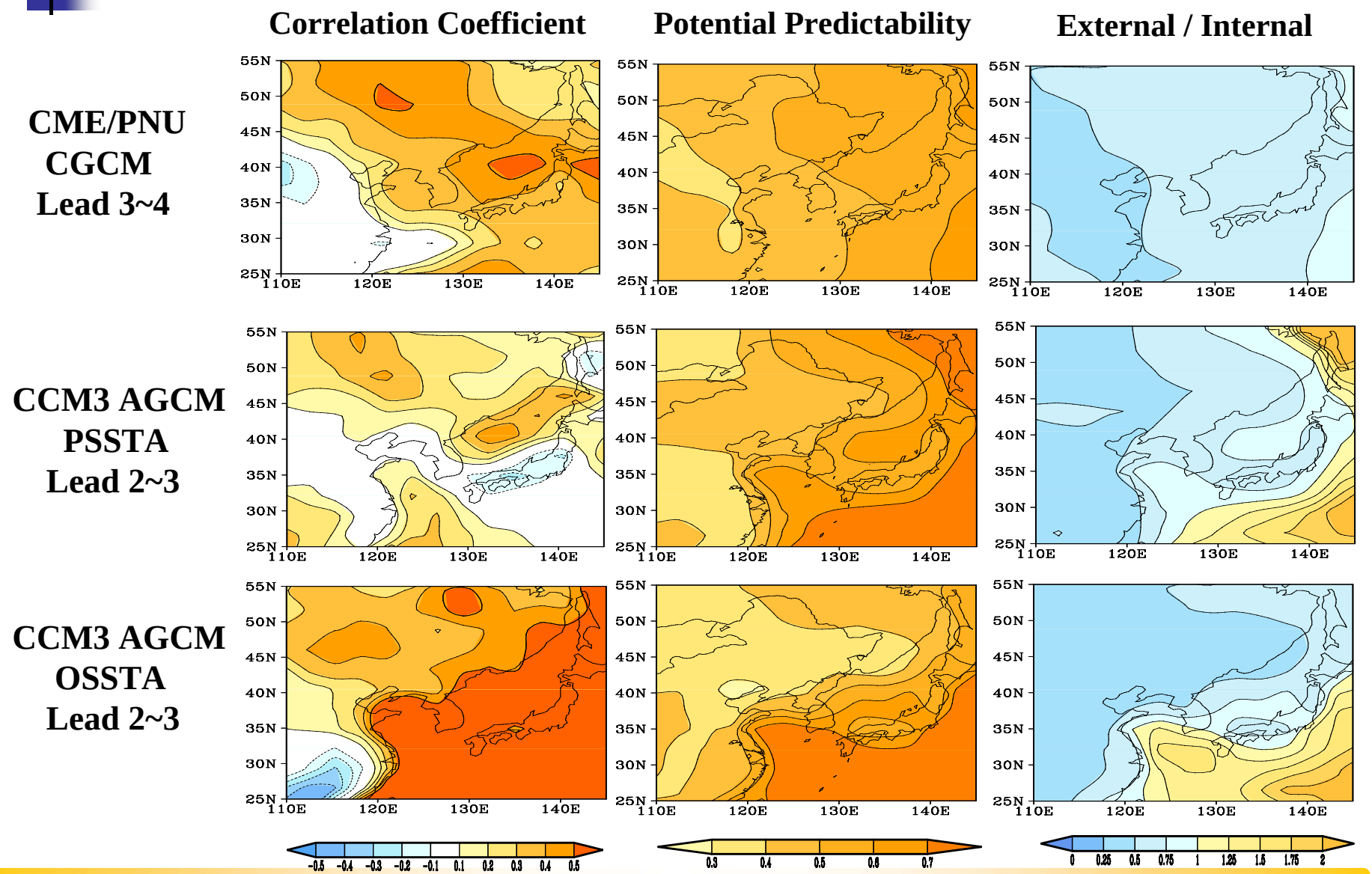
Standard Deviations of Winter Temperature



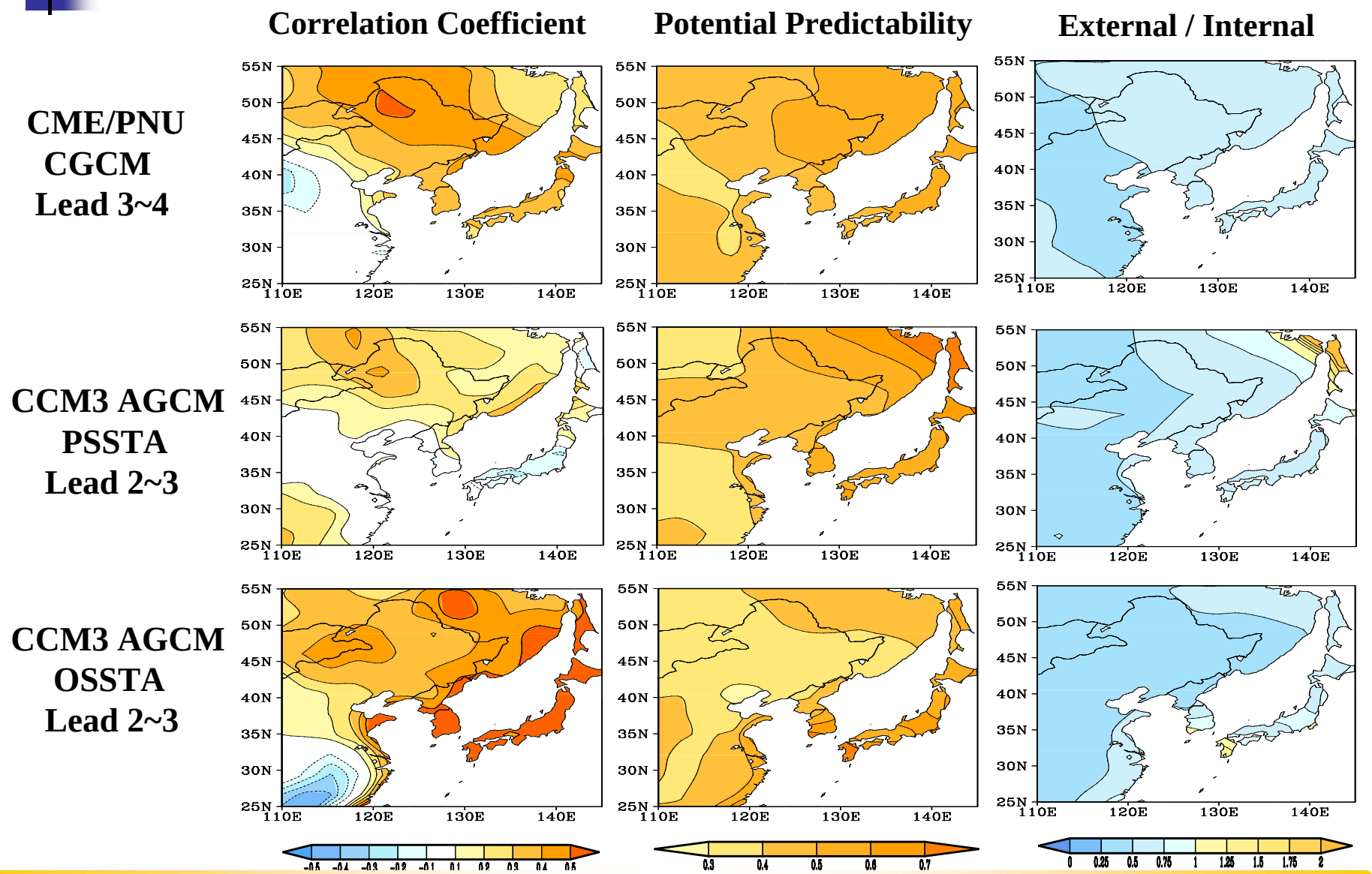
Taylor Diagram of EA Tsfc (Land and Ocean)



Winter Temperature Predictability over East Asia

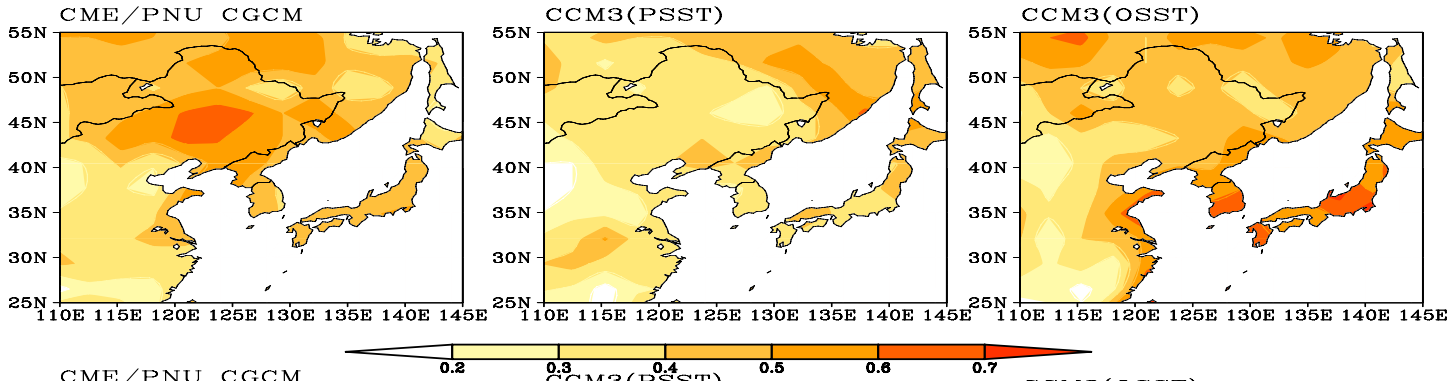


Winter Temperature Predictability over East Asia

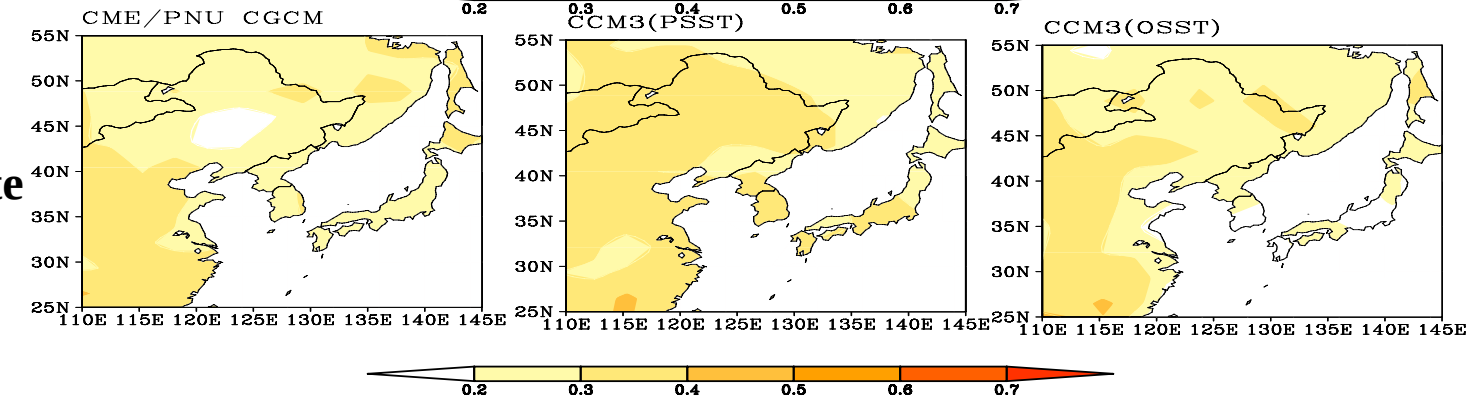


Skill Scores

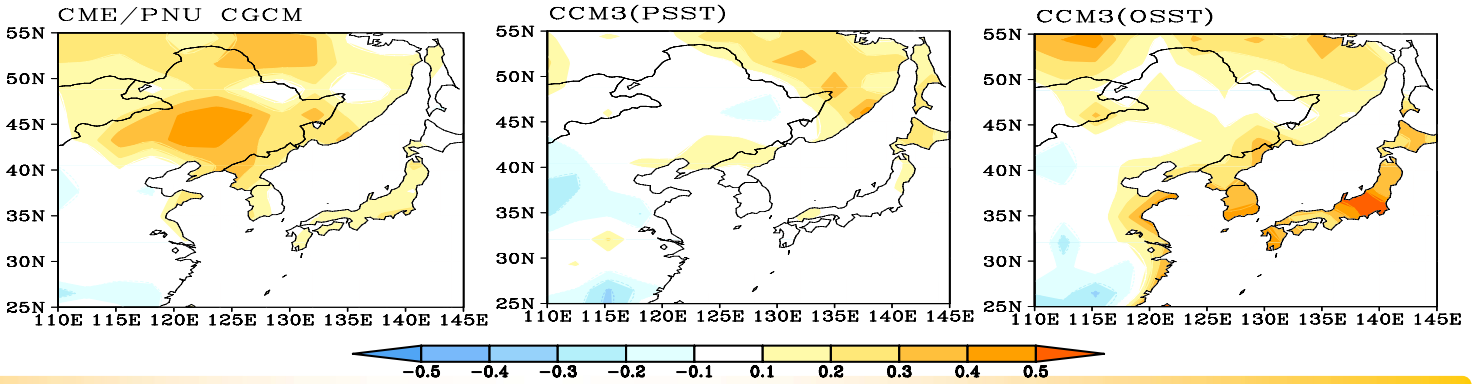
Hit rate



False Alarm rate

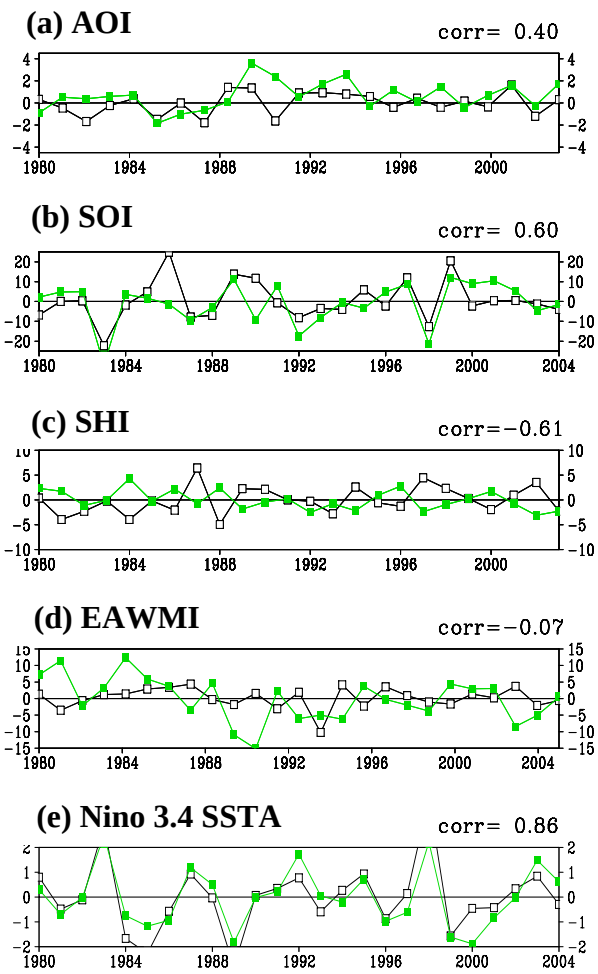


Heidke Score

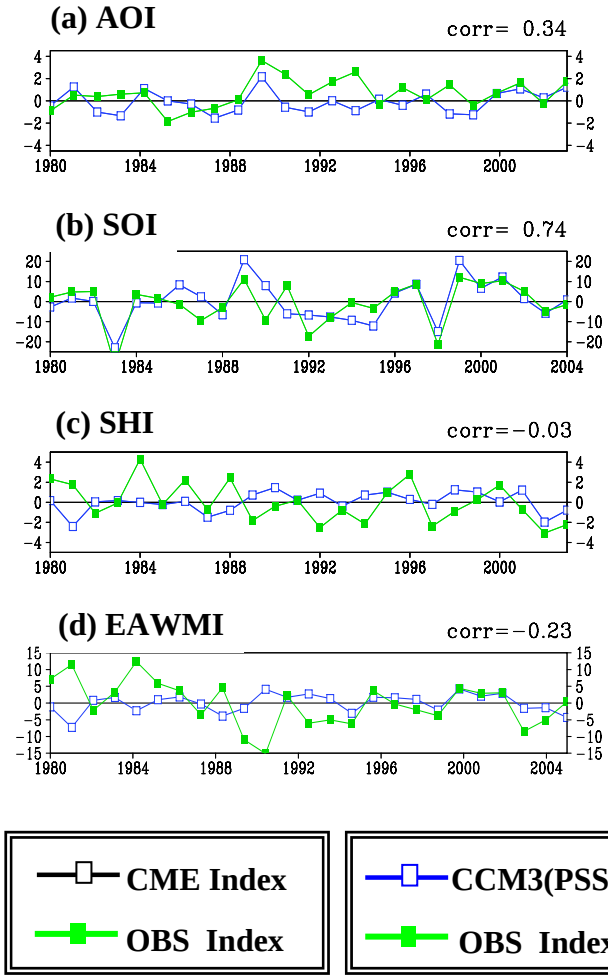


Timeseries of Model and Observed Indices

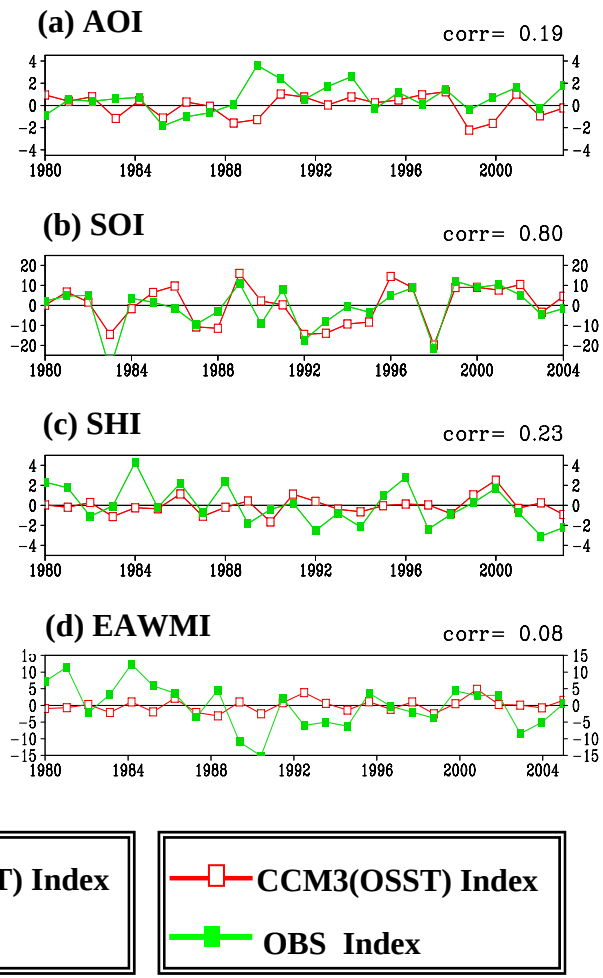
CME/PNU CGCM & OBS



CCM3 AGCM (PSSTA) & OBS



CCM3 AGCM (OSSTA) & OBS



Definitions of Indices

AOI : the leading principal component of monthly MSLP poleward of 20ºN in Northern Hemisphere (Thompson and Wallace 1998)

SOI : $10 \times \dfrac{\Delta p - \Delta p_{ave}}{SD(\Delta p)}$

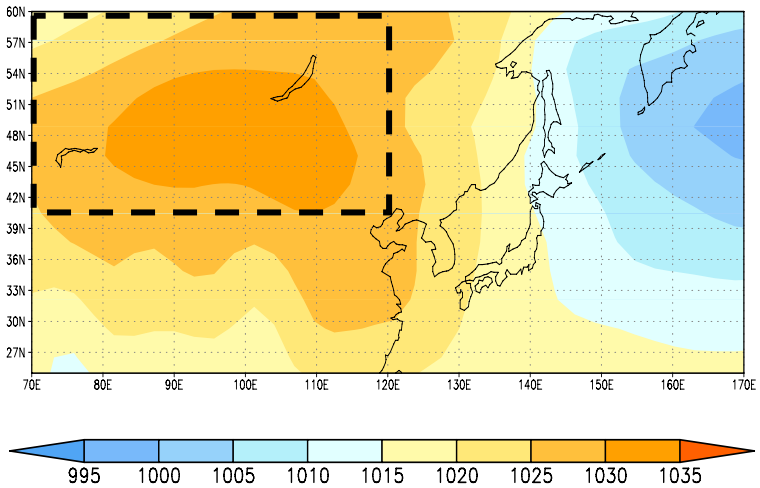
Δp : difference of Tahiti and Darwin MSLP

Δp_{ave} : average of Δp

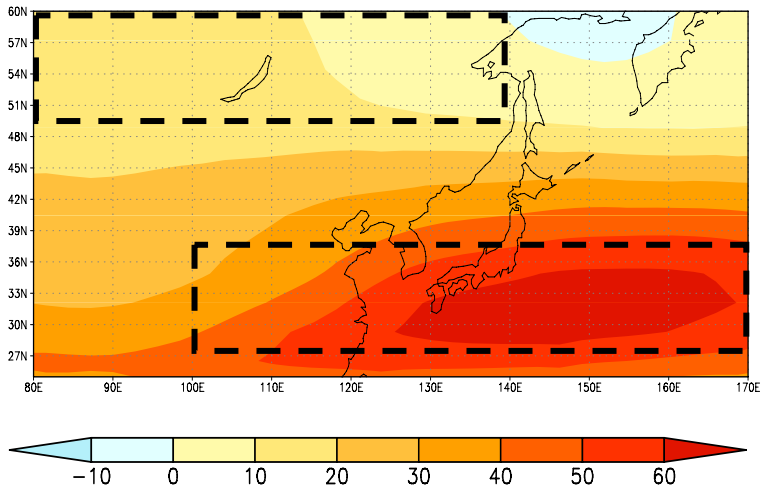
$SD(\Delta p)$: standard deviation of Δp

Nino3.4 SSTA : averaged SSTA (5˚S ~5˚N, 170˚W-140˚W)

SHI = SLP (40º ~ 60º N, 80º ~ 120º E) (Gong and Ho, 2002)

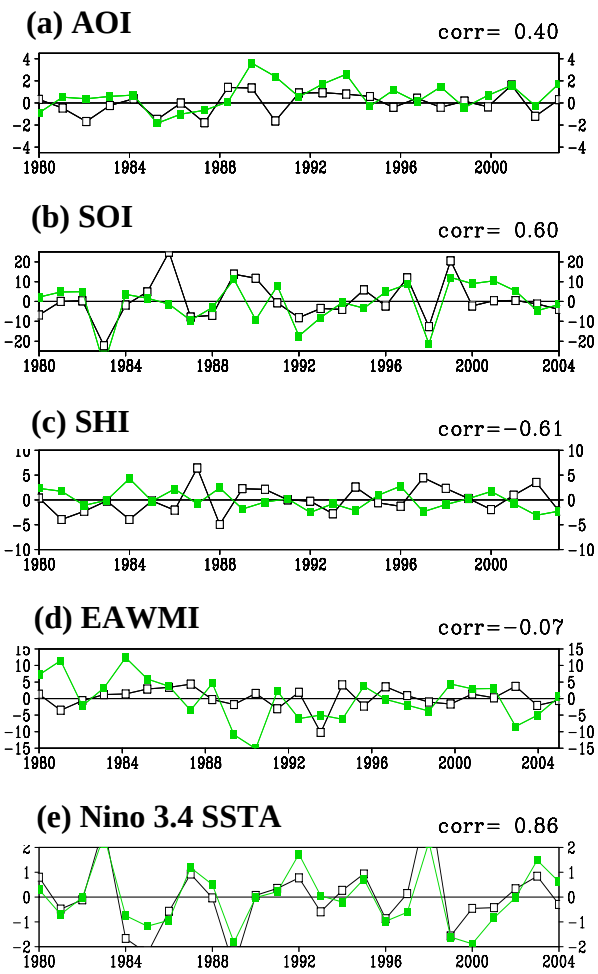


EAWMI = U300(27.5º ~ 37.5º N, 110º ~ 170º E) -U300(50º ~ 60º N, 80º ~ 140º E) (Jeon et al , 2002)

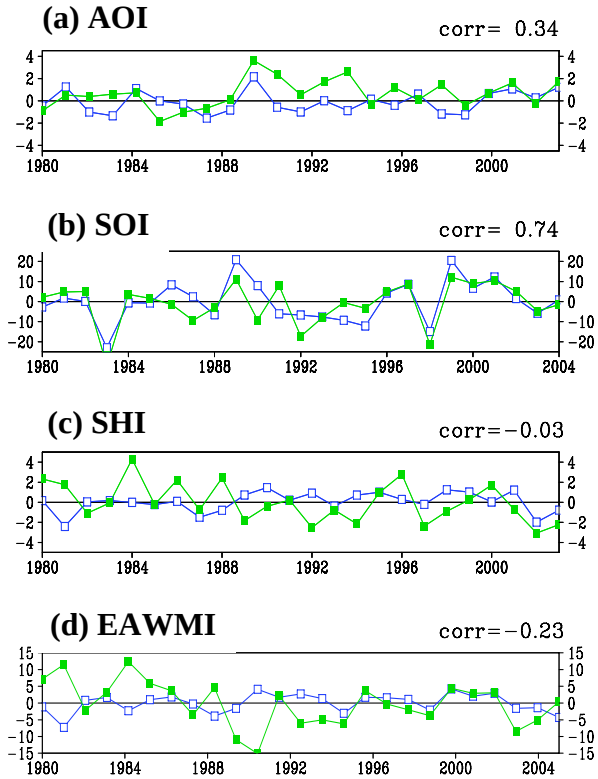


Timeseries of Model and Observed Indices

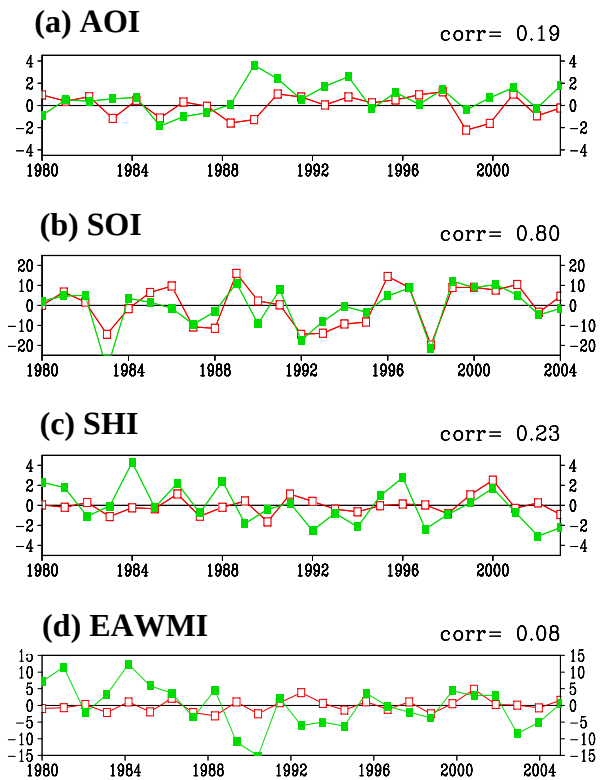
CME/PNU CGCM & OBS

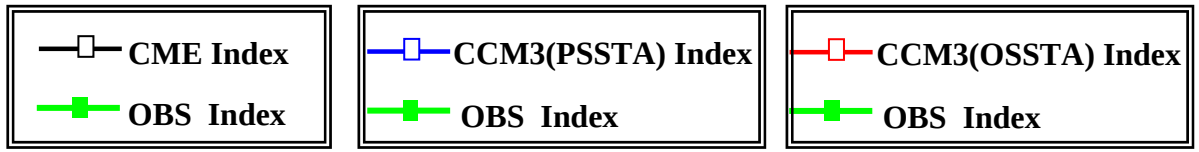


CCM3 AGCM (PSSTA) & OBS



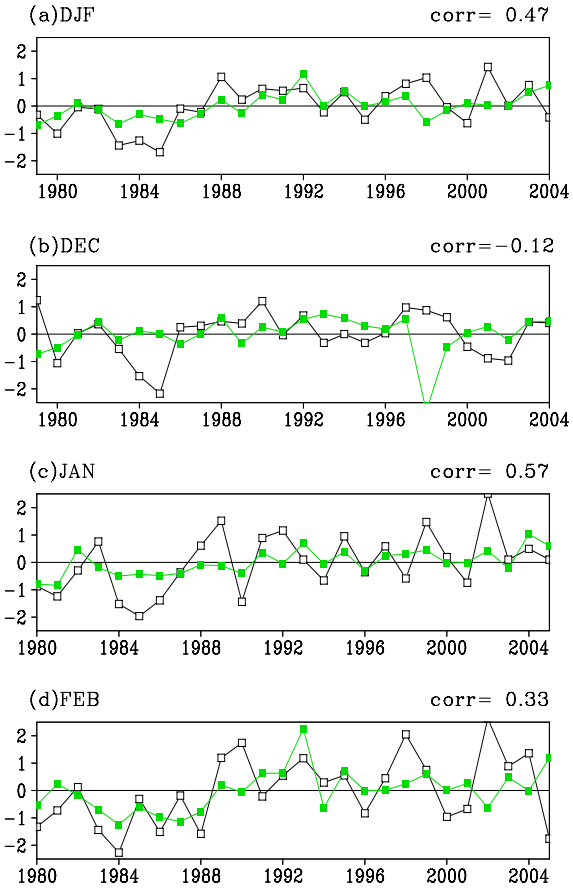
CCM3 AGCM (OSSTA) & OBS



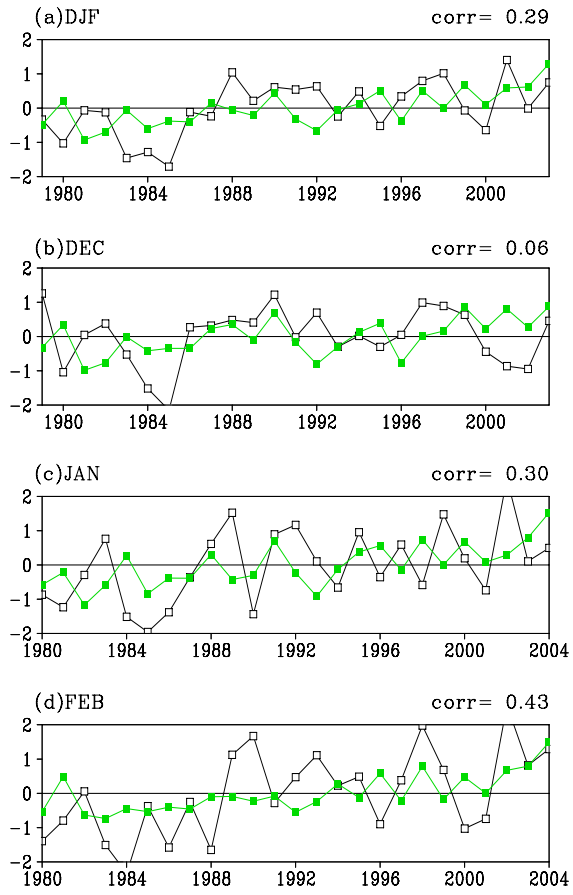


Observed and Model Hindcast EA Tsfc

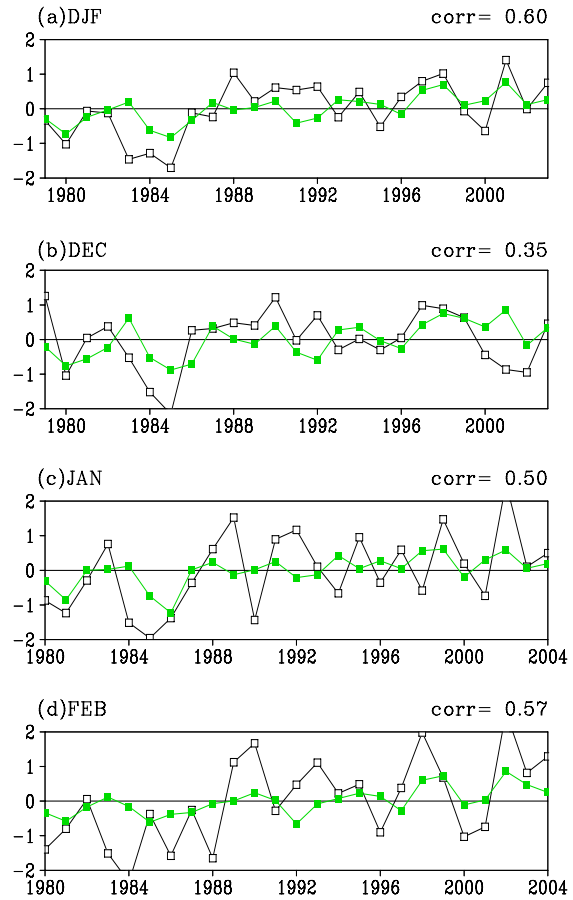
CME/PNU CGCM Lead 2~4



CCM3 AGCM (PSSTA) Lead 1~3



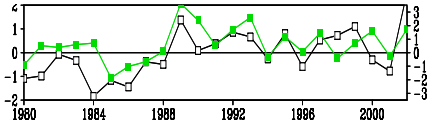
CCM3 AGCM (OSSTA) Lead 1~3



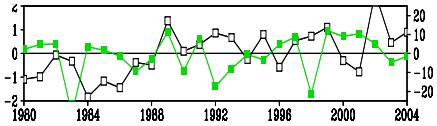
Timeseries of EA Winter Tsfc and Observed Indices

Observed Tsfc and observed Indices

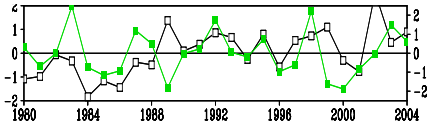
(a) AOI CORR=0.62



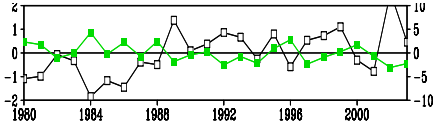
(b) SOI CORR=-0.02



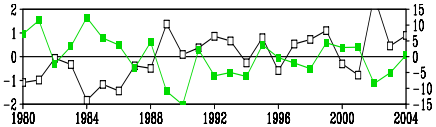
(c) Nino3.4 SSTA CORR=0.18



(d) SHI CORR=-0.71



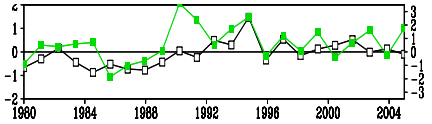
(e) EAWMI CORR=-0.64



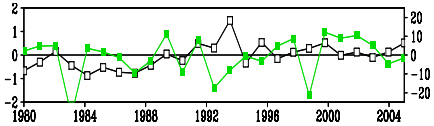
OBS Index — OBS Temp

CME/PNU CGCM Lead 2~4

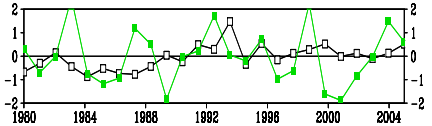
(a) AOI CORR=0.52



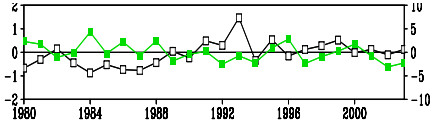
(b) SOI CORR=0.03



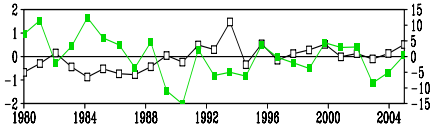
(c) Nino3.4 SSTA CORR=0.07



(d) SHI CORR=-0.39



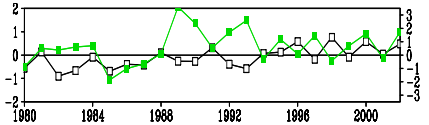
(e) EAWMI CORR=-0.24



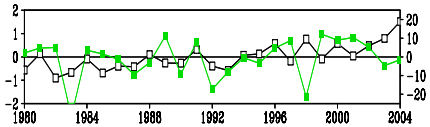
CME Temp

CCM3 AGCM (PSSTA) Lead 1~3

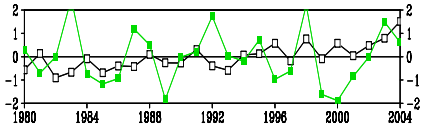
(a) AOI CORR=0. 07



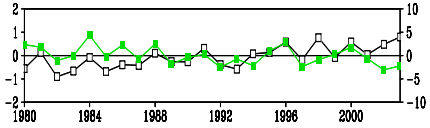
(b) SOI CORR=0.12



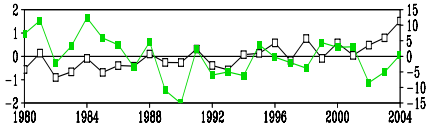
(c) Nino3.4 SSTA CORR=0.07



(d) SHI CORR=0.02



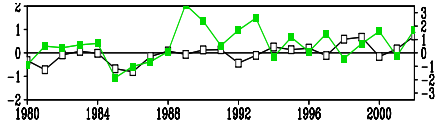
(e) EAWMI CORR=-0.03



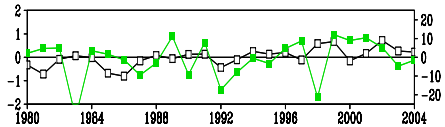
PSST Temp

CCM3 AGCM (OSSTA) Lead 1~3

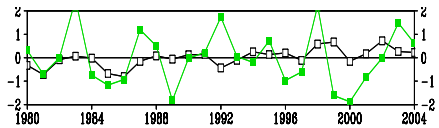
(a) AOI CORR=0.24



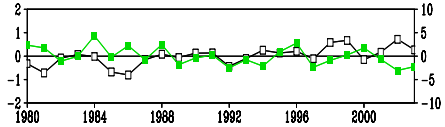
(b) SOI CORR=0.00



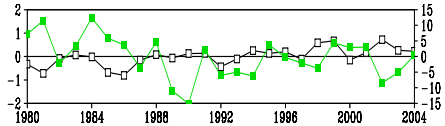
(c) Nino3.4 SSTA CORR=0.20



(d) SHI CORR=-0.29

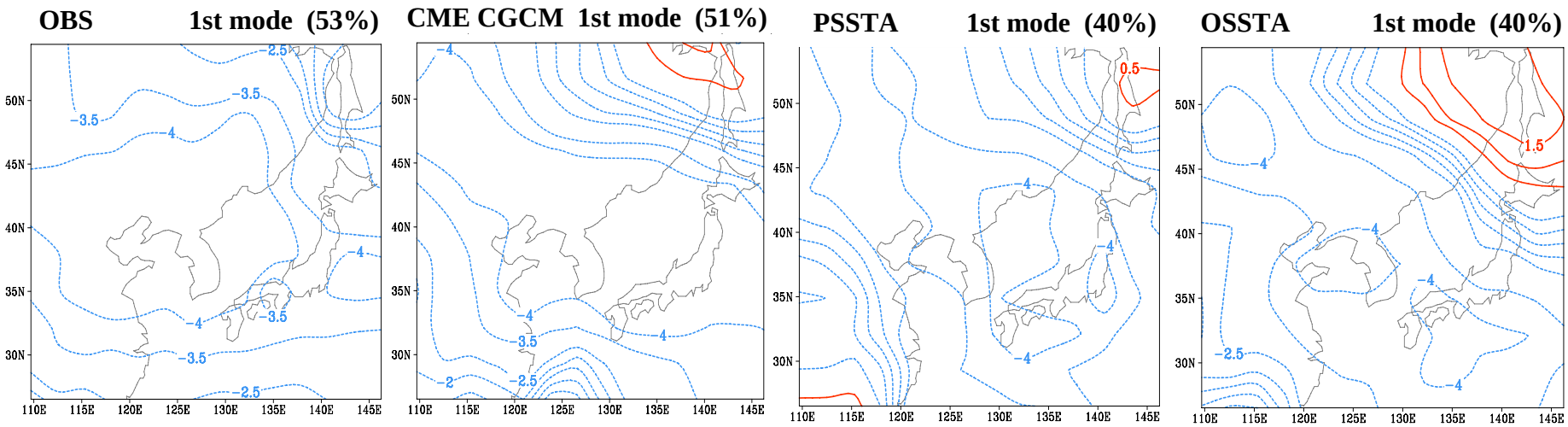


(e) EAWMI CORR=-0.35

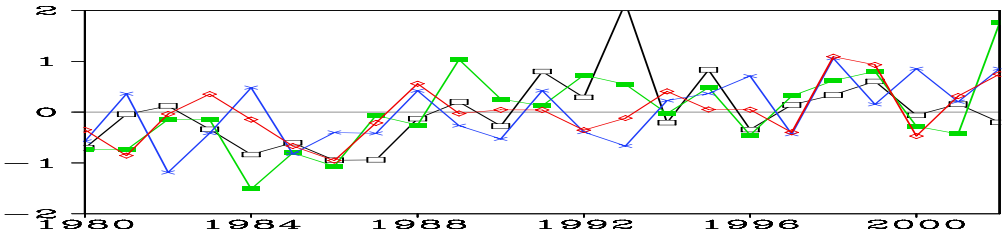


OSST Temp

EOF for EA Winter Temperature



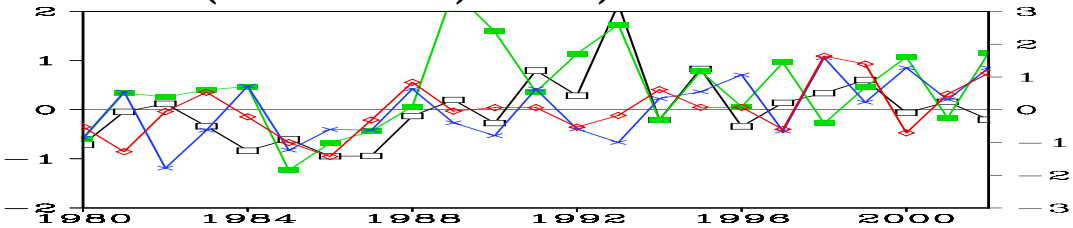
Model (1st modes of T) & OBS (1st mode of T)



Corr = 0.53 | Corr = 0.13 | Corr = 0.55

CGCM / OBS | PSST / OBS | OSST / OBS

Model (1st modes of T) & AOI)



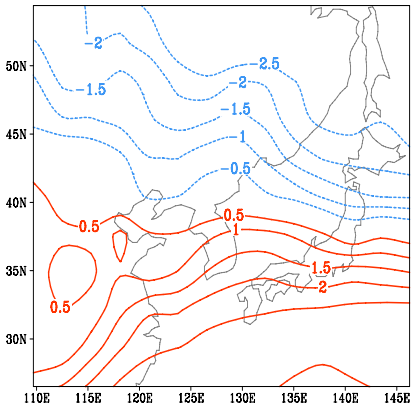
Corr = 0.52 | Corr = 0.03 | Corr = 0.10

CGCM / OBS AOI | PSST / OBS AOI | OSST / OBS AOI

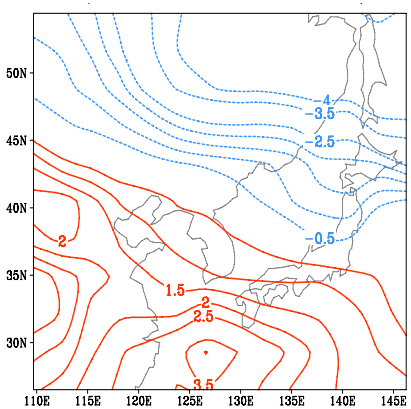
EOF for EA Winter Temperature

2nd mode

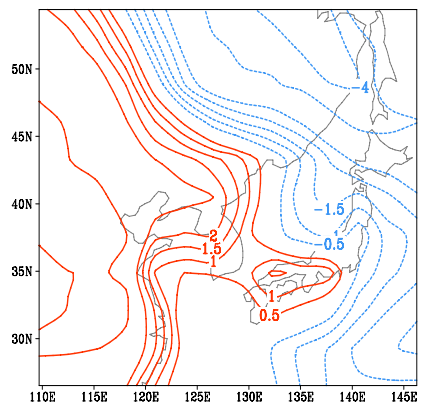
OBS (19 %)



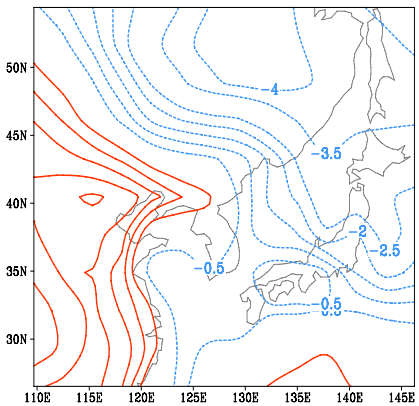
CME/PNU (25 %)



CCM3 (PSSTA) (37 %)

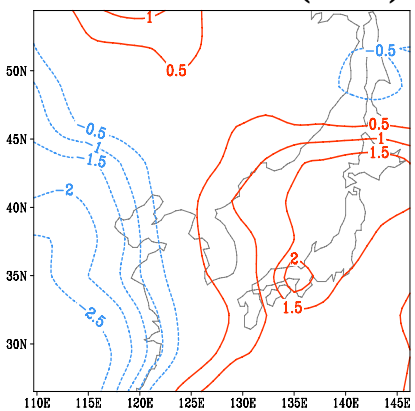


CCM3 (OSSTA) (22%)

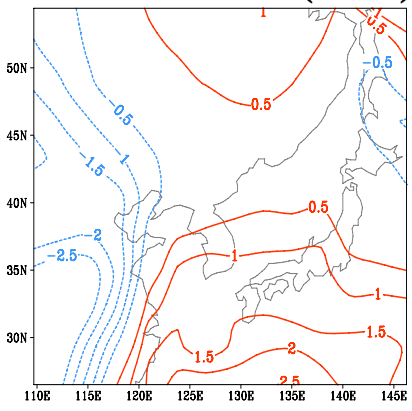


3rd mode

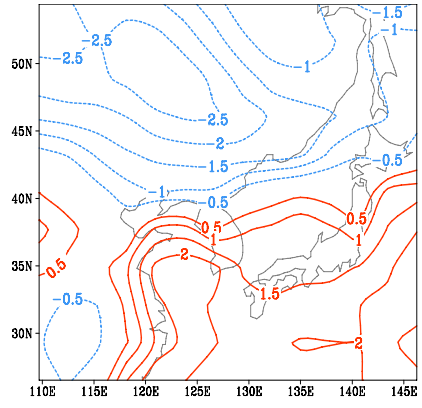
OBS (7 %)



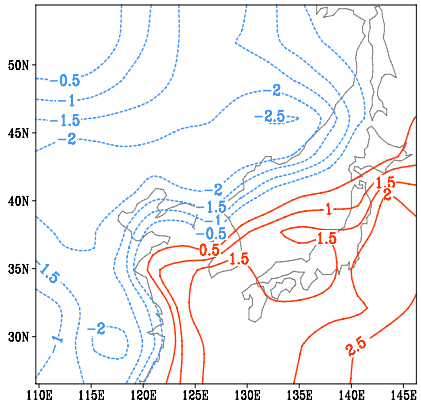
CME/PNU (12 %)



CCM3 (PSSTA) (29 %)



CCM3 (PSSTA) (11 %)



C.C.s between the First 2 Modes and Different Indices

OBS

	AOI	SOI	Nino 3.4 SSTA	SHI	WMI
1st mode	0.60	-0.08	0.19	-0.75	-0.70
2nd mode	0.27	0.26	-0.17	0.19	0.24

CME/PNU CGCM

	AOI	SOI	Nino 3.4 SSTA	SHI	WMI
1st mode	0.52	0.01	0.06	-0.31	-0.22
2nd mode	0.08	0.18	-0.19	-0.30	-0.32

CCM3 AGCM (PSSTA)

	AOI	SOI	Nino 3.4 SSTA	SHI	WMI
1st mode	0.03	0.14	-0.05	0.24	0.16
2nd mode	-0.20	-0.05	0.06	0.17	0.29

CCM3 AGCM (OSSTA)

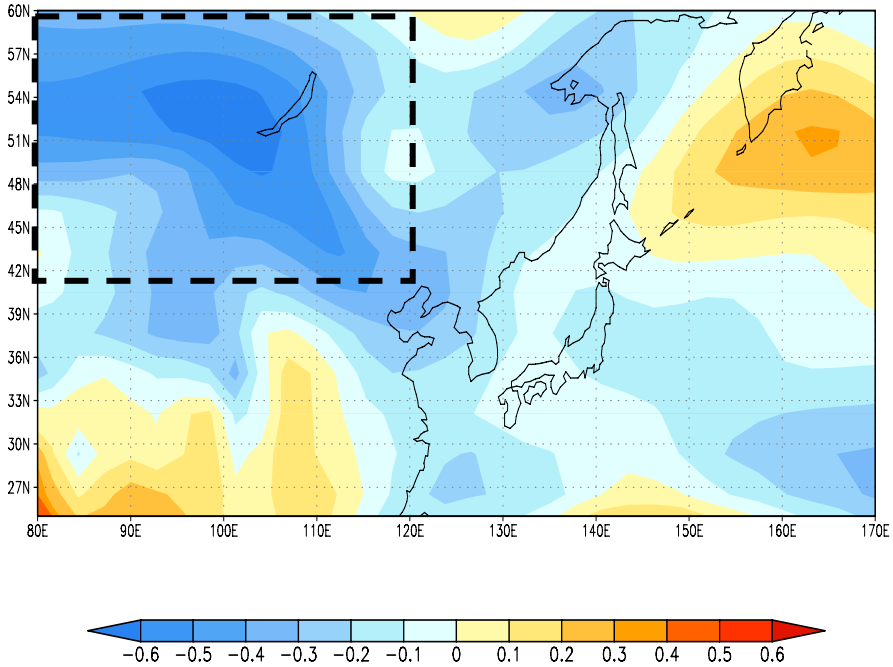
	AOI	SOI	Nino 3.4 SSTA	SHI	WMI
1st mode	0.1	-0.17	0.31	-0.27	-0.29
2nd mode	0.47	-0.41	-0.31	-0.17	-0.22

Summary for Temperature

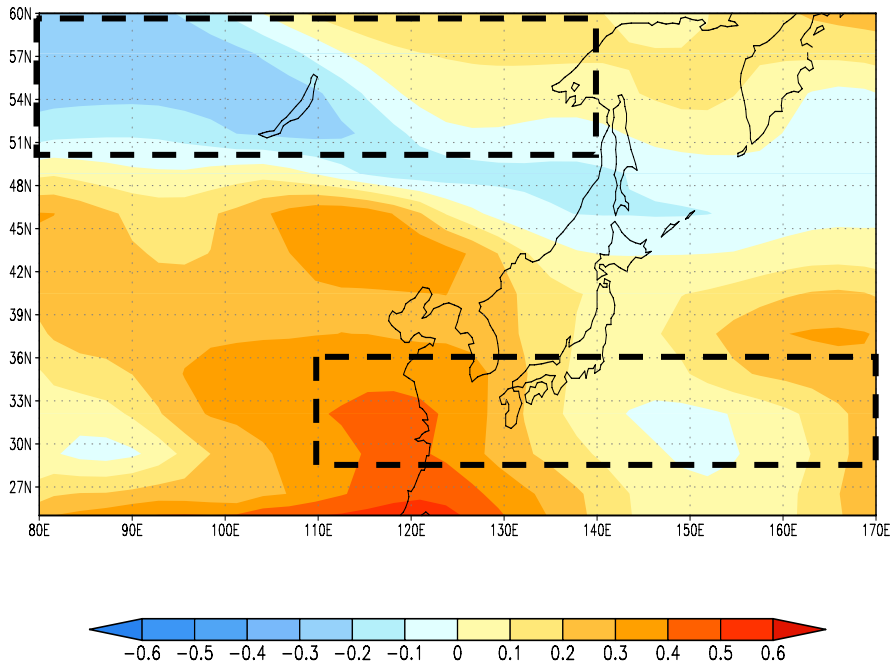
- The CME/PNU CGCM has a good capability of predicting winter temperature over East Asia.
- The predictability mainly comes from the CGCM's capability of depicting the first prominent mode of temperature in the region.
- The prominent mode of the East Asia winter temperature is closely linked with AO pattern and our CGCM has a good predictability in depicting the AO pattern.

Correlation coefficients of SLP and U300

SLP Correlation



U300 Correlation



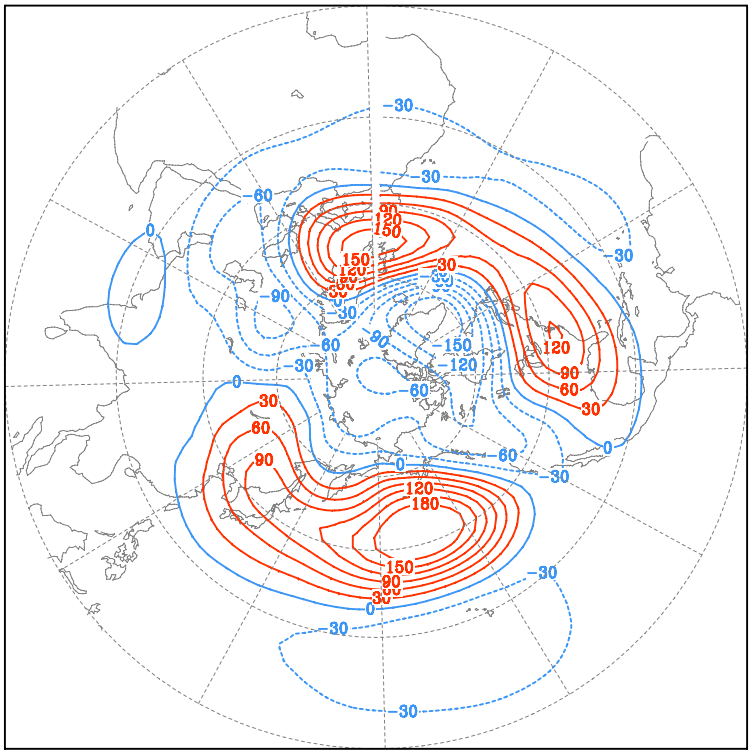
SHI = averaged SLP (40º ~ 60º N, 70º ~ 120º E)

(Gong and Ho, 2002)

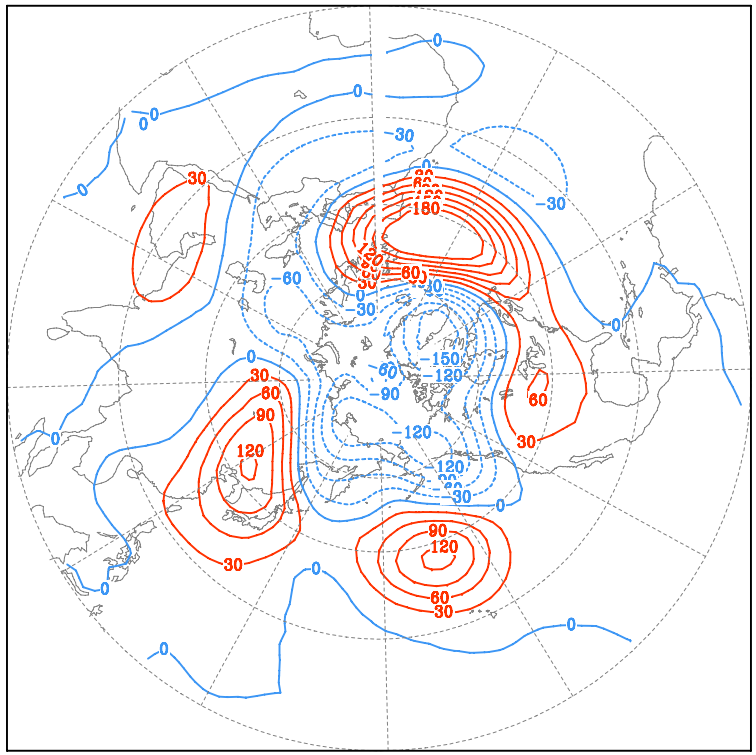
EAWMI = U300(27.5º ~ 37.5º N, 110º ~ 170º E)
-U300(50º ~ 60º N, 80º ~ 140º E)
(Jeon et al , 2002)

First mode of Z500 - DJF

OBS **1st mode (25%)**

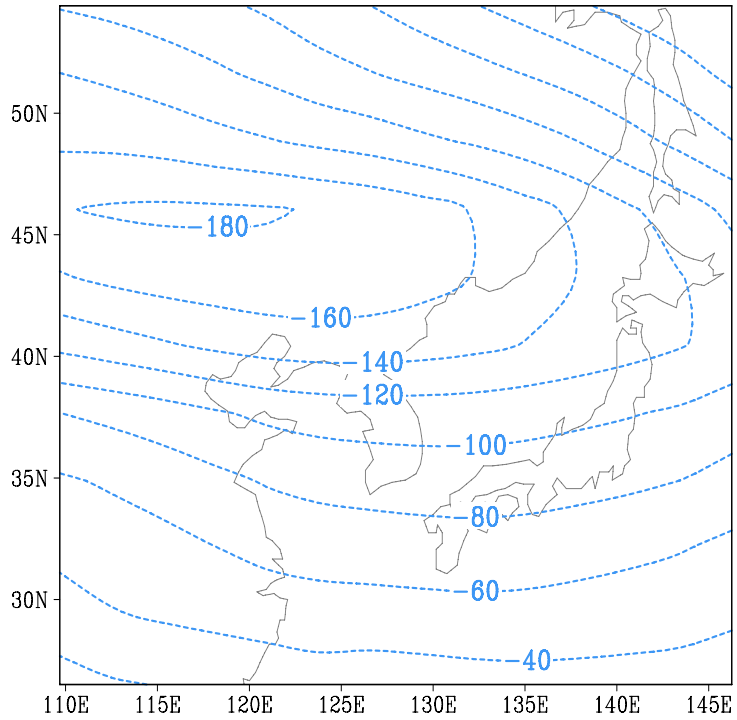


CME/PNU CGCM **1st mode (25%)**



EOF mode of 500-1000 hPa GPH

OBS **1st mode (62 %)**



CME/PNU CGCM **1st mode (74 %)**