



Outlook of East Asia Winter Monsoon for 2015/2016

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Outline

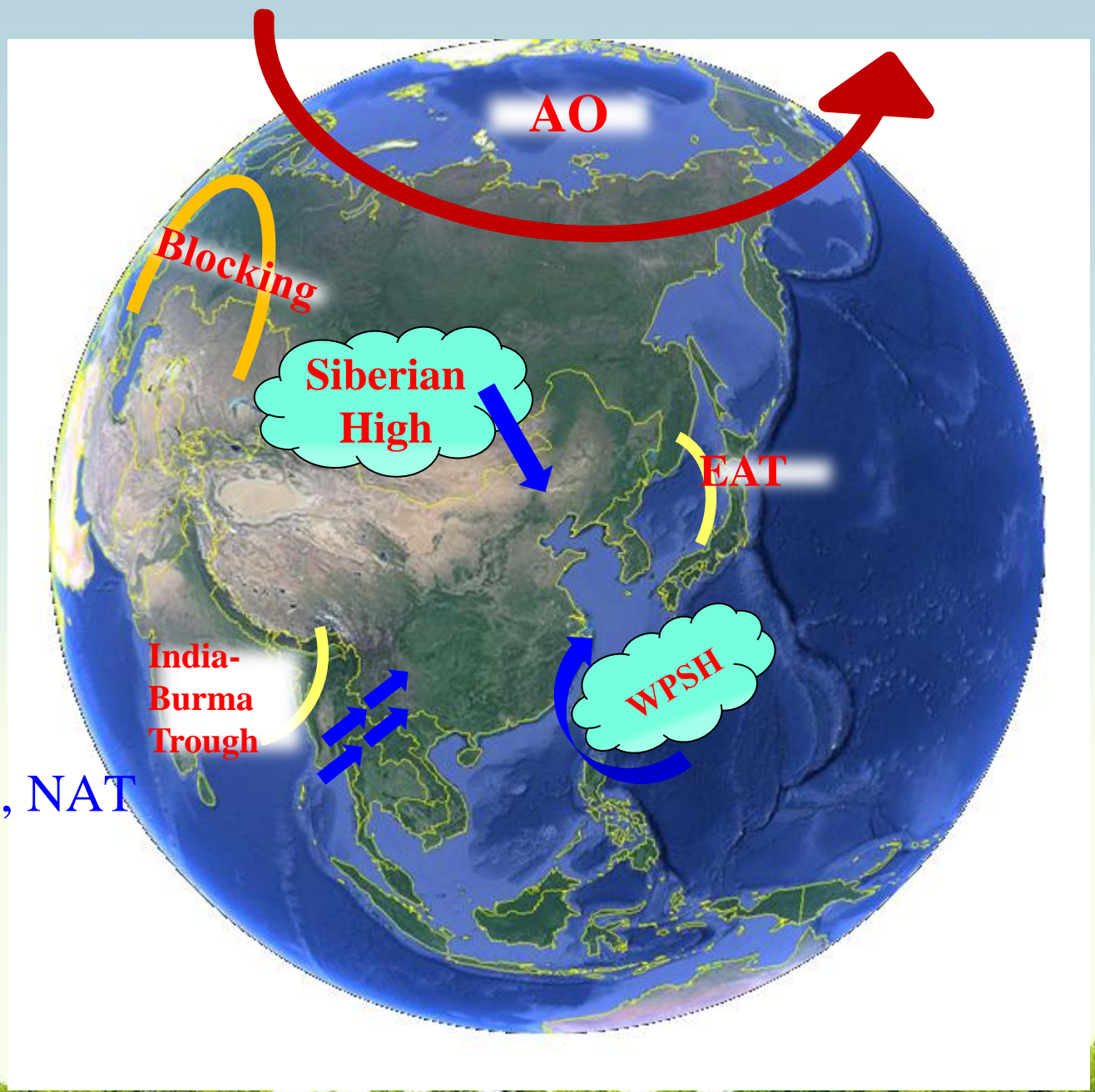
- EAWM System and Signals
- Prediction by BCC_CSM 1.1m, BCC/CMA
- Prediction by NZC-PCCSM4, IAP/CAS
- Statistic Analysis
- Outlook for EAWM





(I)EAWM system and potential boundary forcing

SSTA (ENSO, IO, NAT)
Sea Ice
Snow Cover



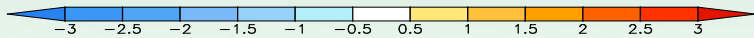
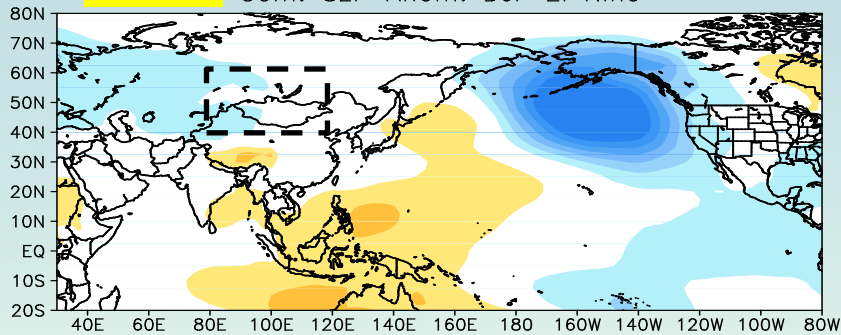


Impact of El Nino -- Circulation

(1982,1986,1987,1991,1994,1997,2002,2004,2006,2009,2014)

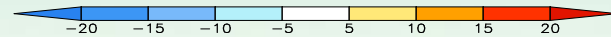
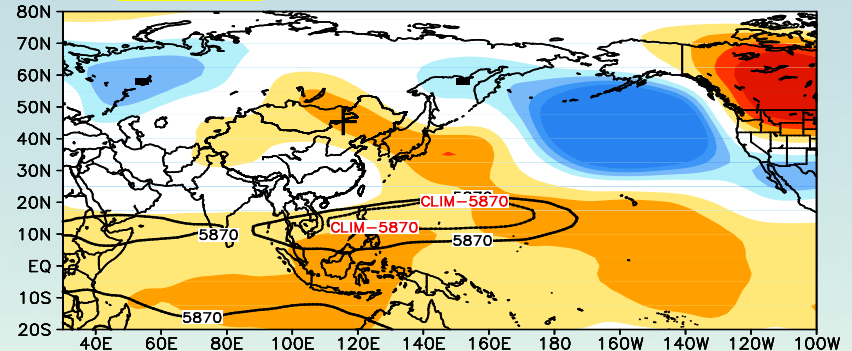
SLP

Com. SLP Anom. DJF El Nino



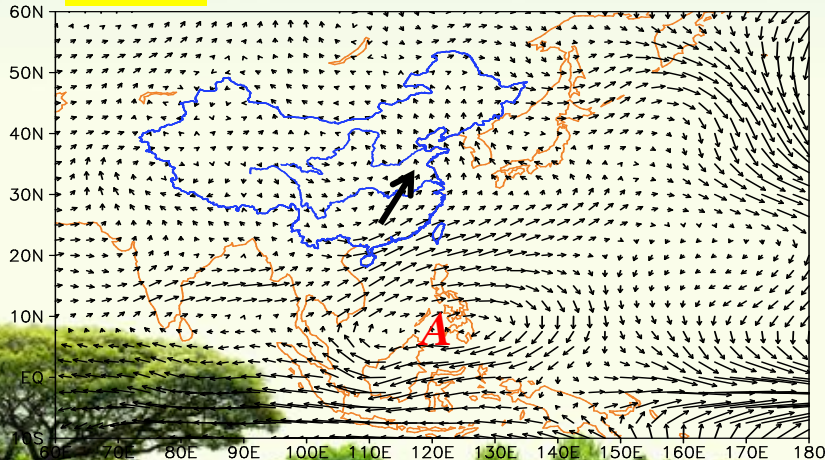
H500

Com. H500 DJF El Nino



V850

Com. V850 DJF El Nino

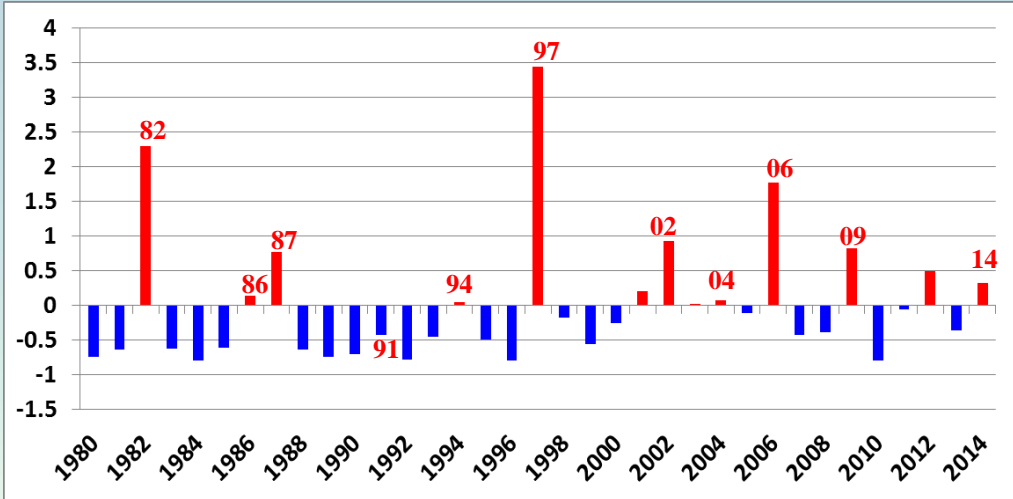


1. Anomalous **anticyclone** around the Philippines;
2. Low-level anomalous **southerlies** over East Asia;
3. **Strong WPSH**, extending more westward and southward;
4. **Weakened and shallower East Asian trough**.



WPSH

Normalized index of WPSH intensity in DJF



Most El Nino years

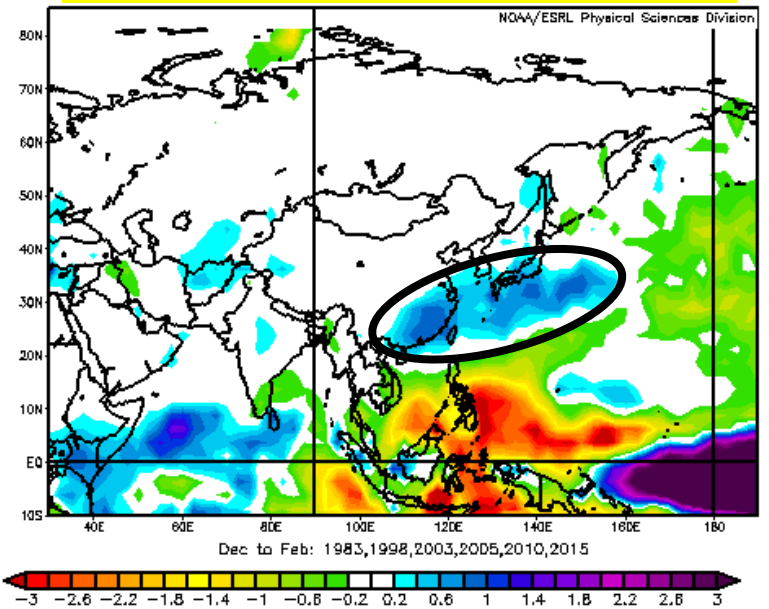
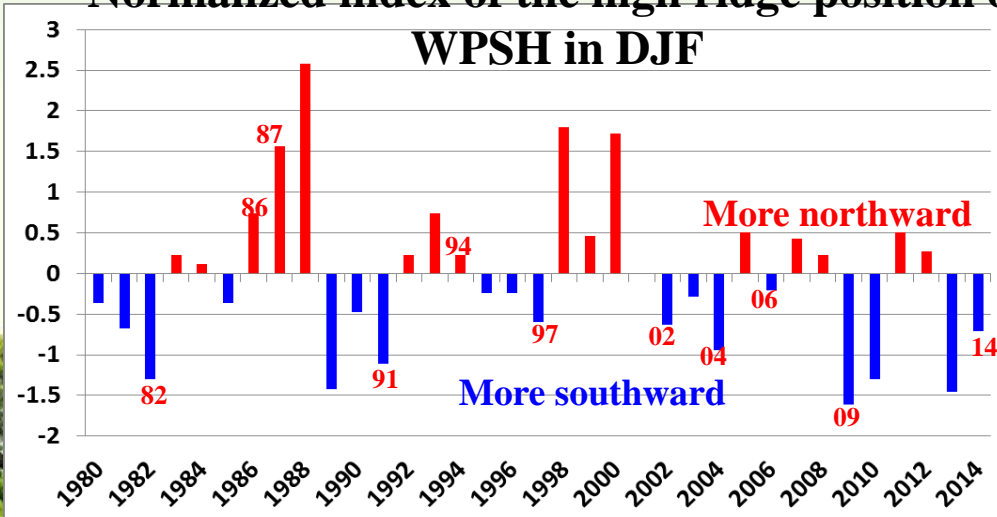


WPSH: strong, westward, southward



Composite CMAP anomaly in DJF

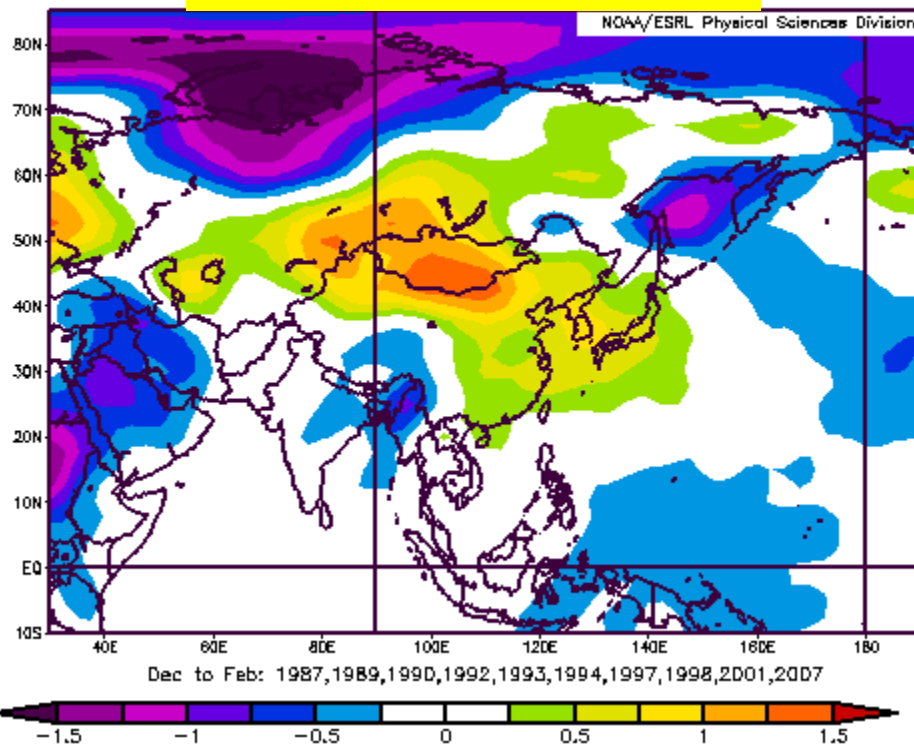
Normalized index of the high ridge position of WPSH in DJF



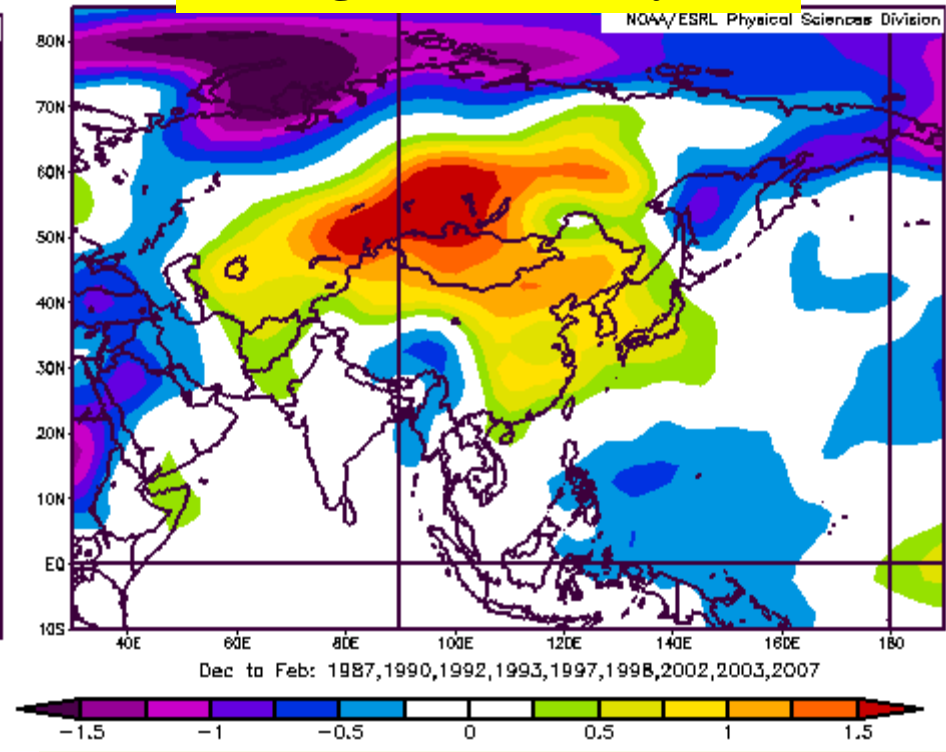


Impact of weak winter monsoon on temperature

Com. AirTem in DJF during weak SHI years



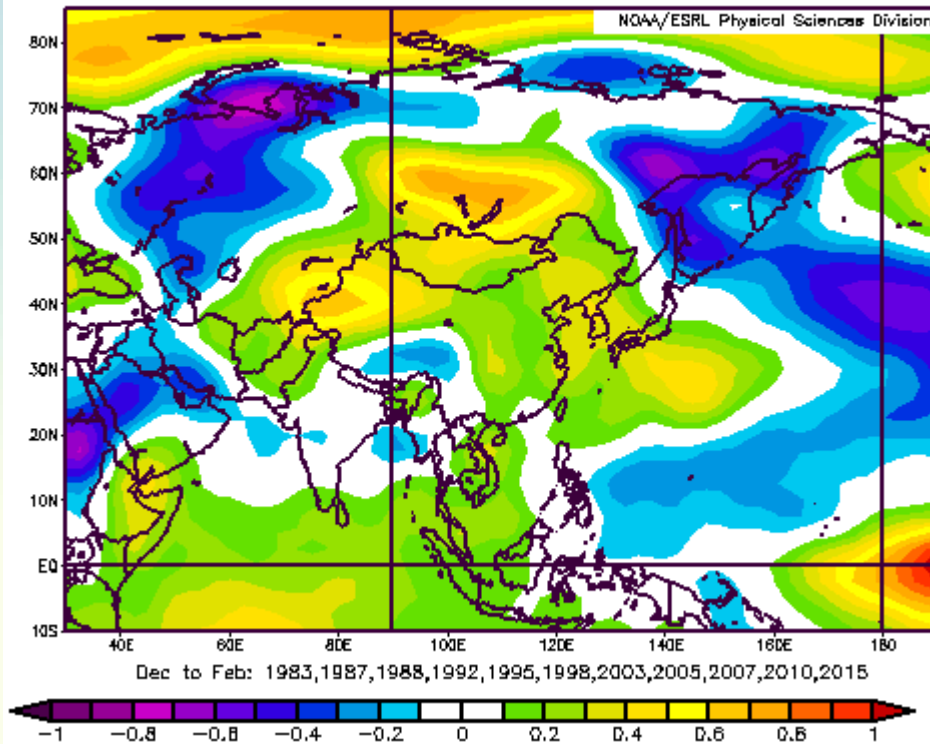
Com. AirTem in DJF during weak EAWM years



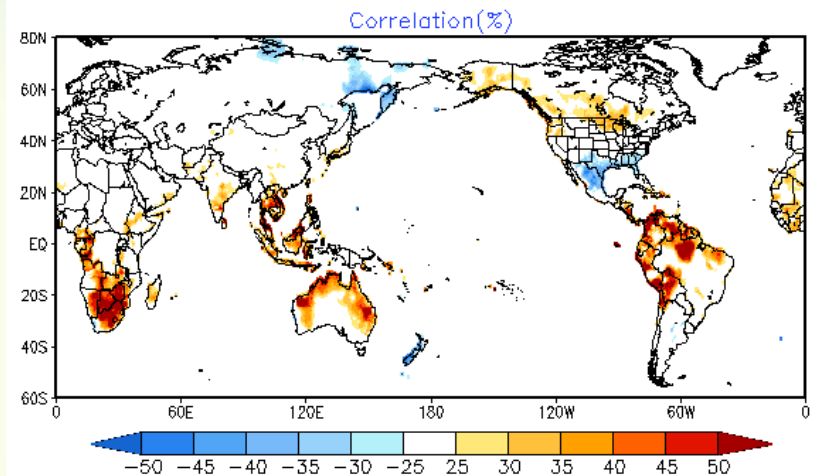
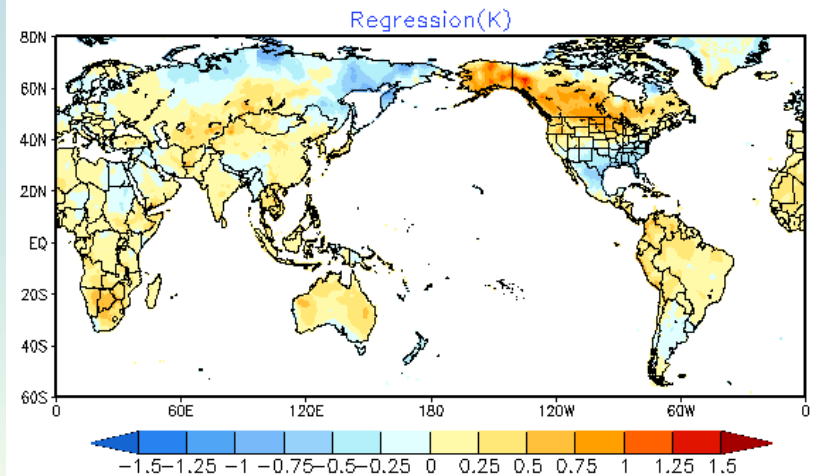


Impact of El Nino -- Temperature

Composite AirTem DJF



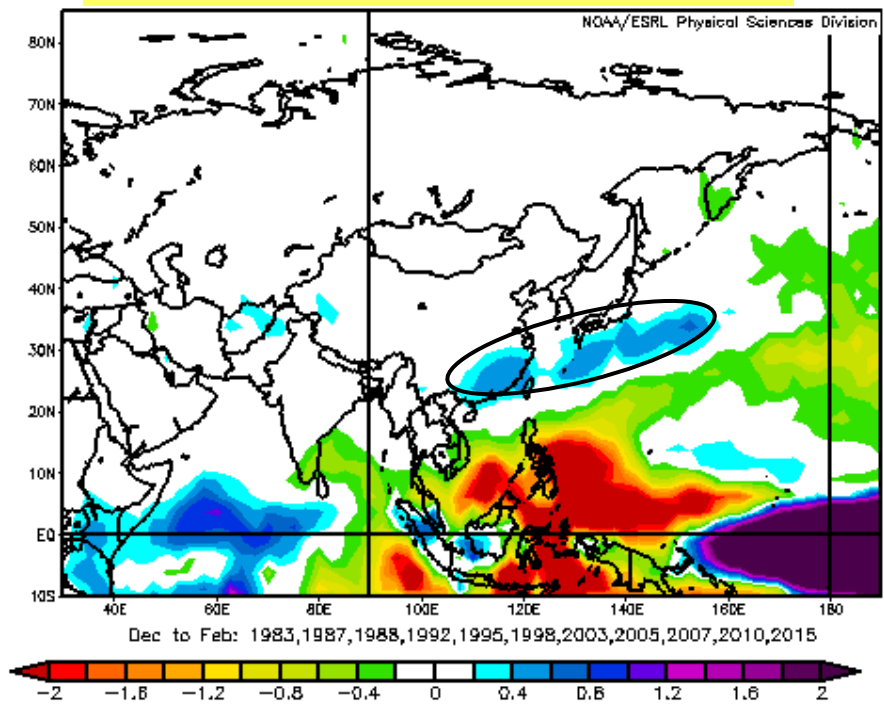
ENSO Teleconnection: DJF Temp



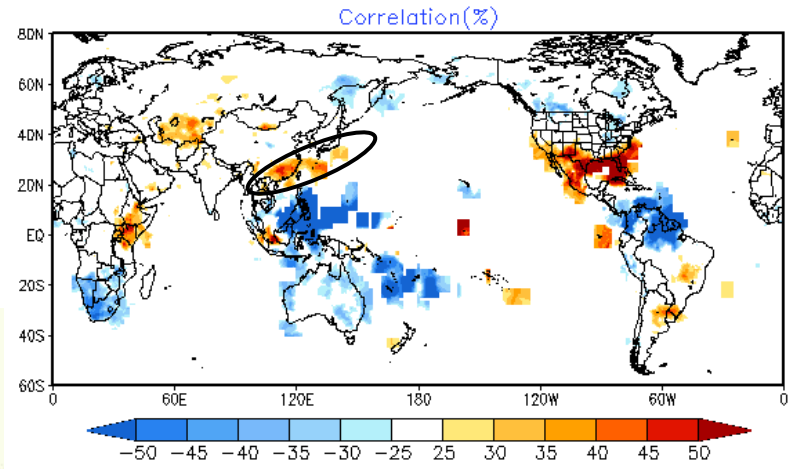
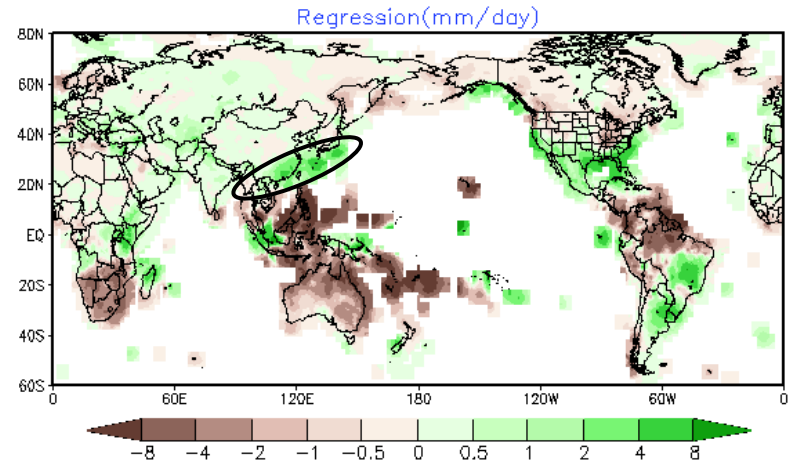


Impact of El Nino -- Precipitation

Composite CMAP DJF



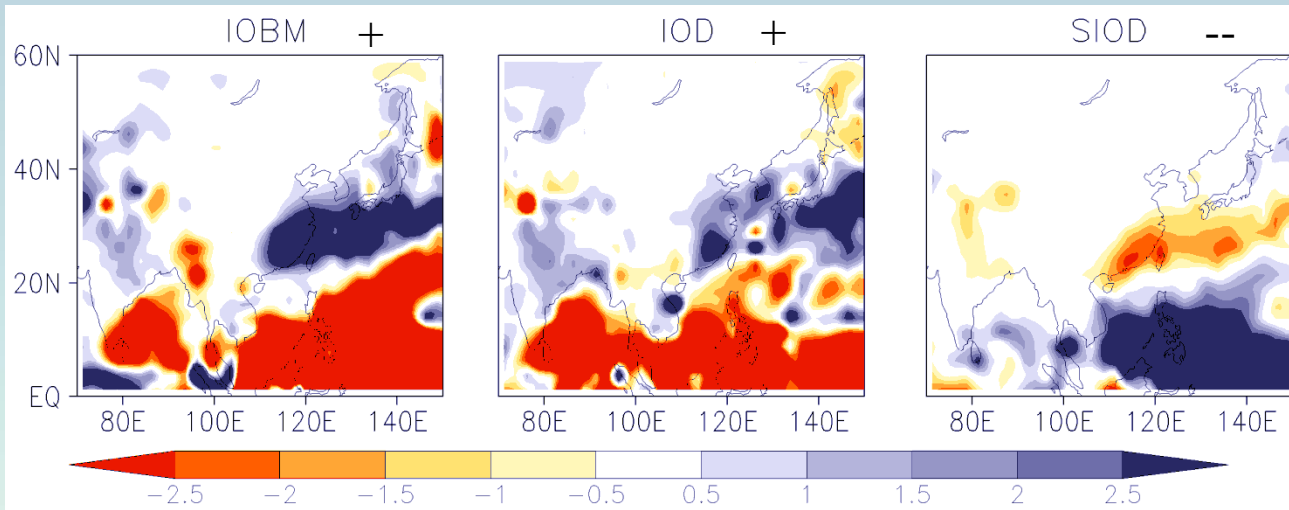
ENSO Teleconnection: DJF Precip



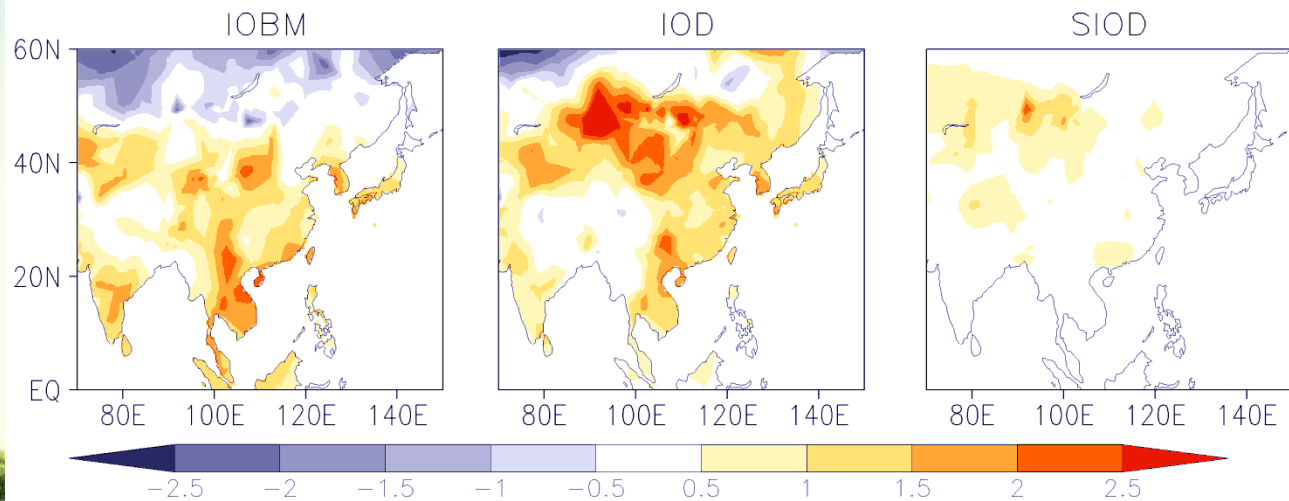


Correlation between IO indices and Precip/Temp.

Precip.



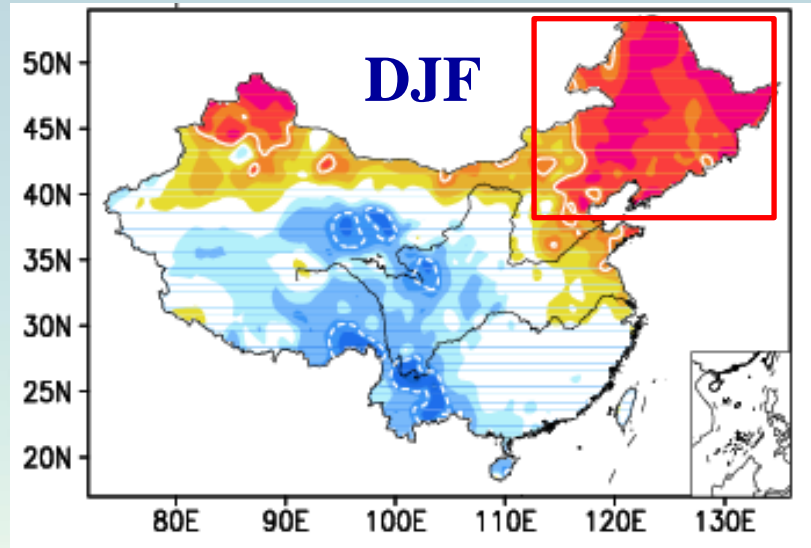
Temp.



IO indices is in favor of more rainfall over South China, more warm in most of EA



The correlation between AO and Temp.

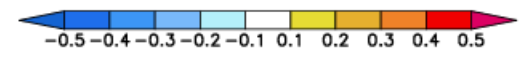
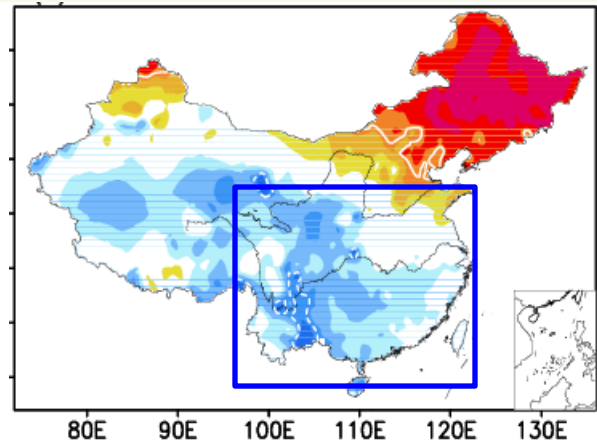
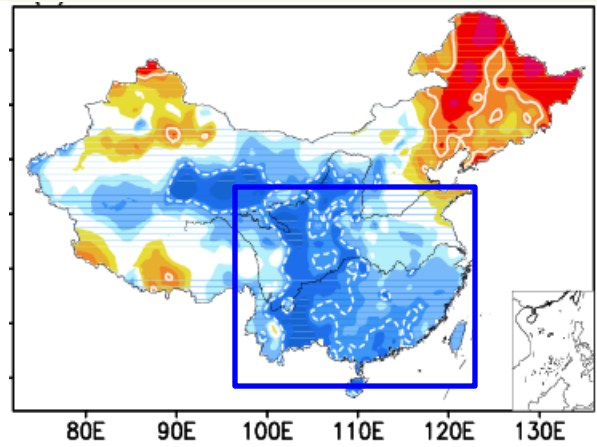
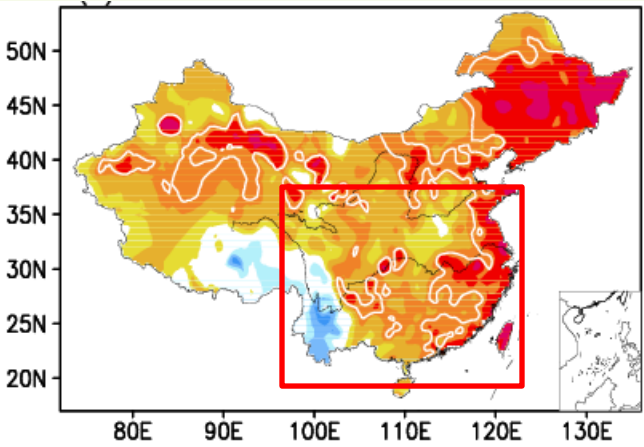


Zuo, Ren, Li 2015

DEC

JAN

FEB





(II) Prediction by BCC_CSM1.1m

Model prediction Scheme

Model : Climate System model (BCC_CSM1.1m)

Resolution of Atm. : T106 (~110 km) ; Tropical ocean : 30 km.

Initial data :

Atm. : NCEP daily reanalysis (Air Temp., winds, SLP, etc)

Ocean : NCEP_GODAS monthly, Pentad reanalysis

Ensemble members : 24 (15 LAF+9 SV)

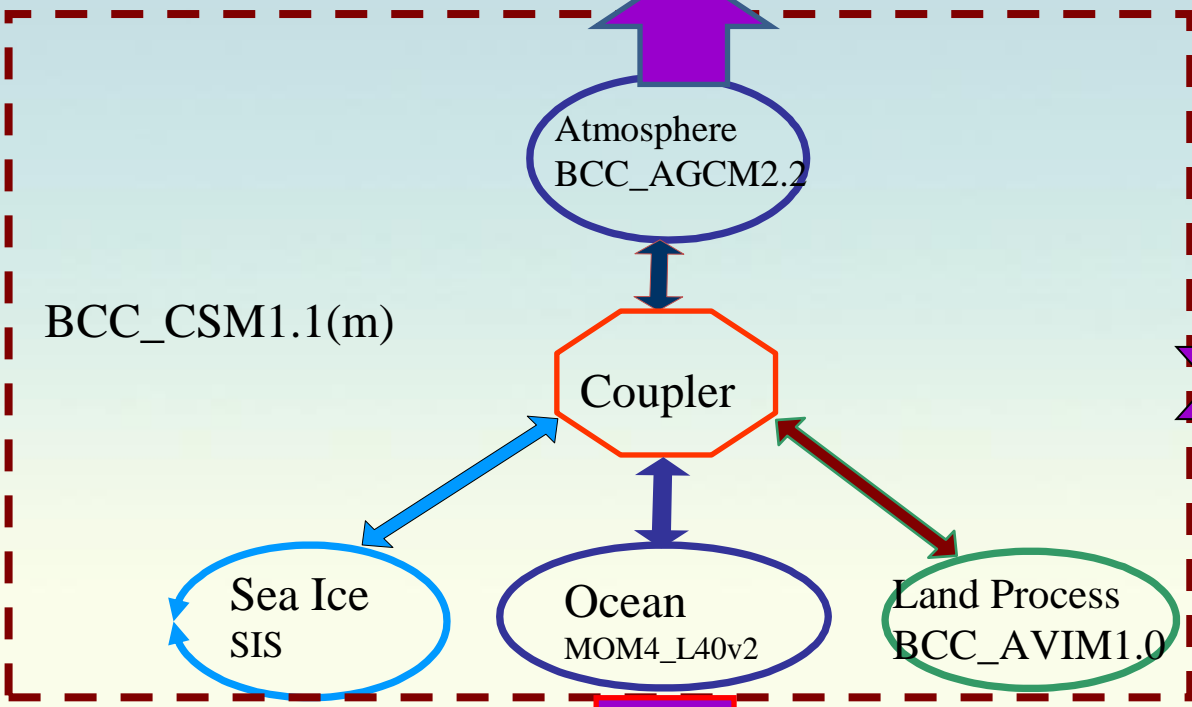
Prediction range : 13 months (from 2015.10.1~2016. 10.31)

Hindcast time period : 1991~2010

Operational starting date of the model : Dec., 2014



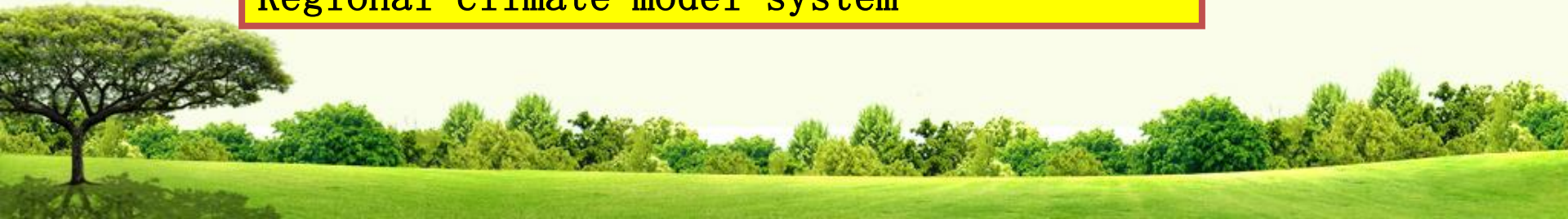
The second generation dynamical extended range forecast (DERF2.0)



BCC_CSM1.1(m)

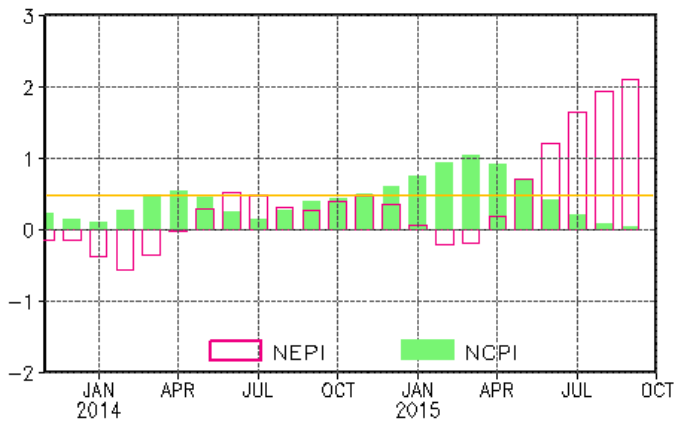
The second generation seasonal prediction model

Regional climate model system

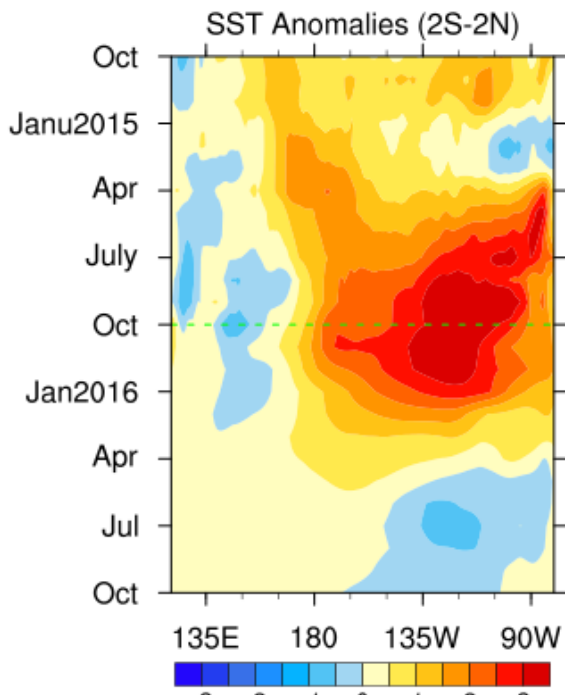


ENSO outlook in spring, 2015

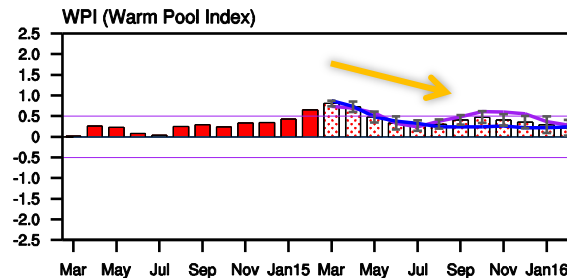
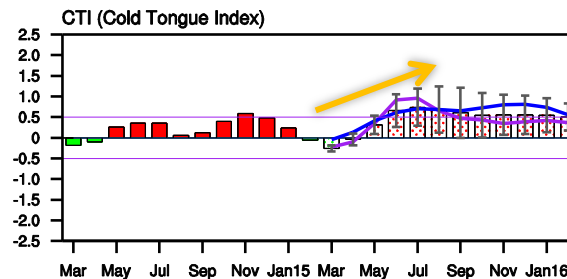
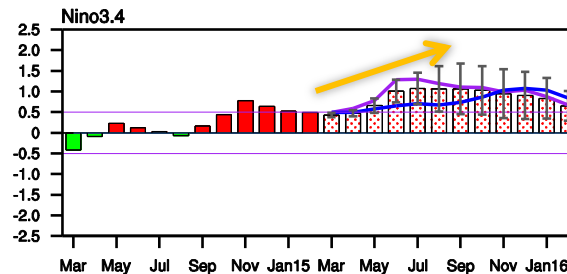
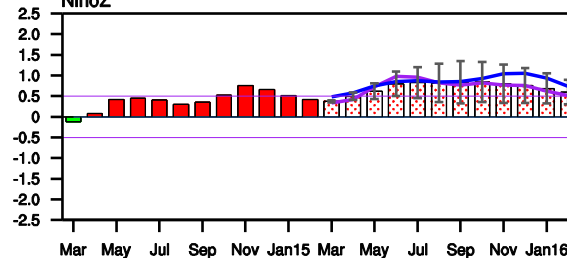
Red: traditional El Niño;
green: El Niño-modoki



Evolution at Equator: BCC_CSM1
201410-201509; Forecast: 201510



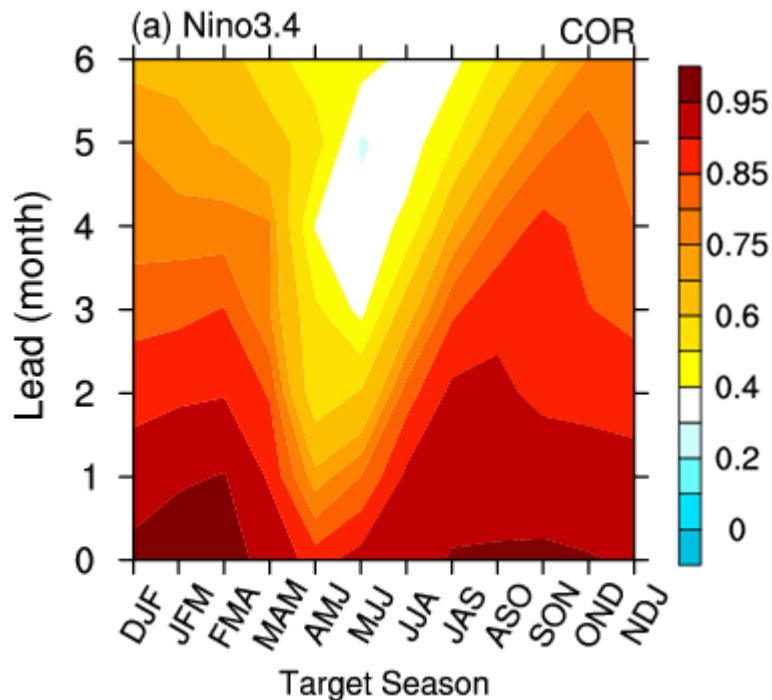
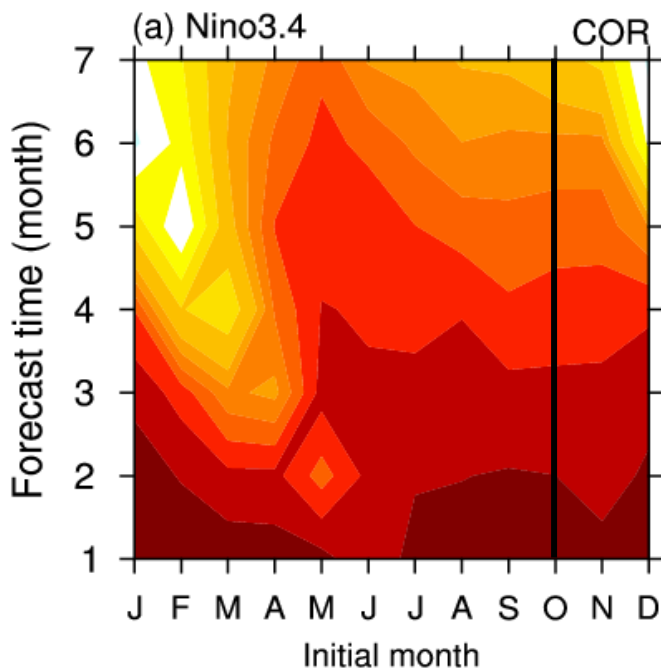
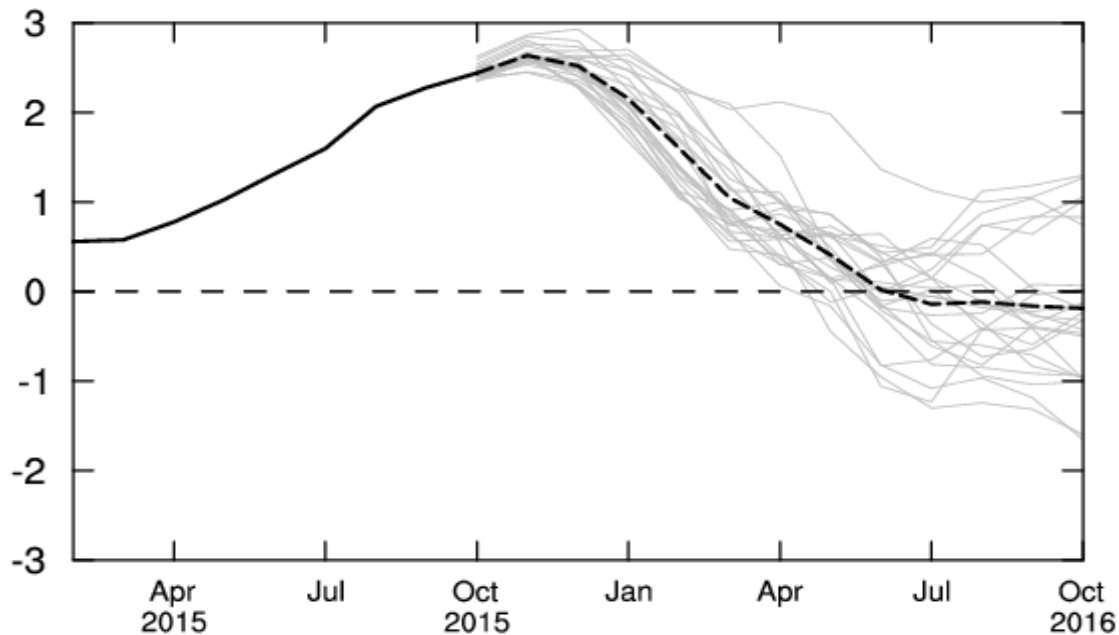
ENSO SST Indices (K): BCC_CSM1.1 m forecast
Monitor (ERSST): 201403-201502; Forecast: 201503-201602



■ >0 ■ <0 Obs. — stat. — ADEPS-2
 >0 <0 BCC_CSM1.1m ensemble mean

Nino 3.4

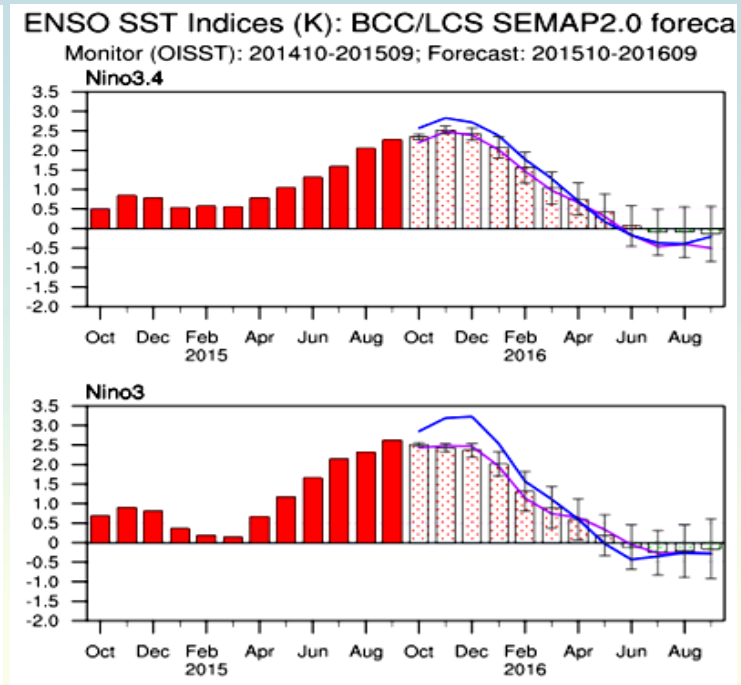
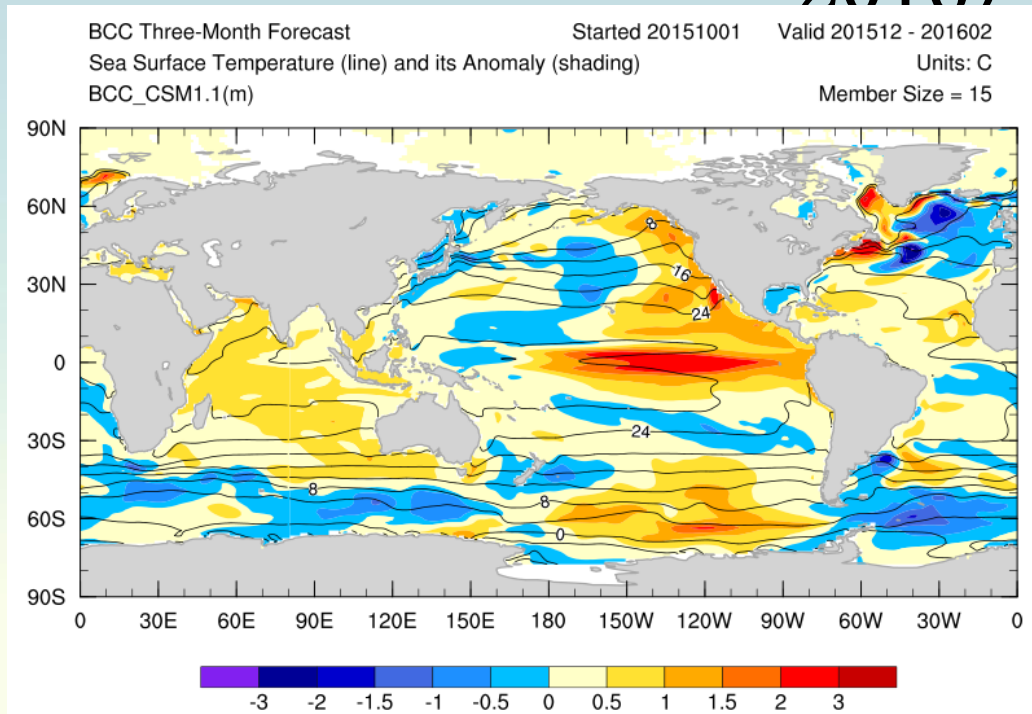
BCC_CSM forecast Nino3.4 SST anomalies (K)



Hindcast
Skill
depend on
each
month



ENSO outlook (Dec. 2015 - Feb. 2016)

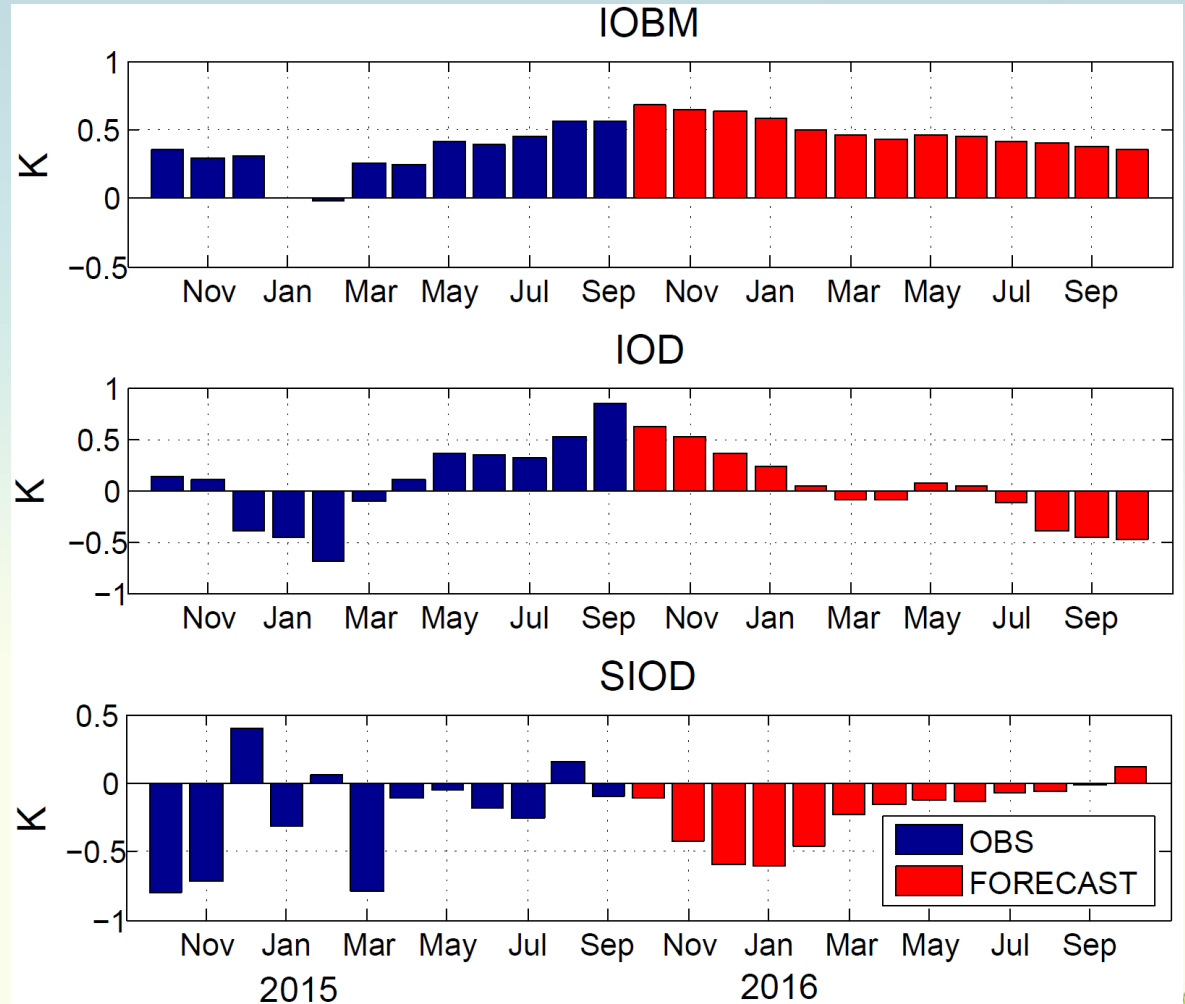
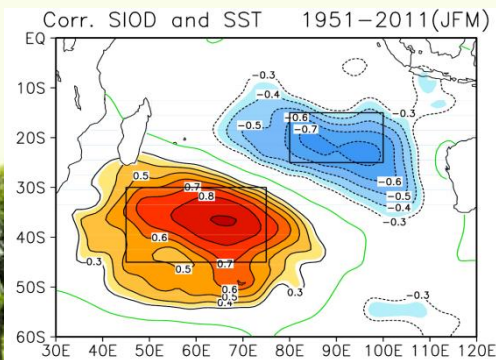
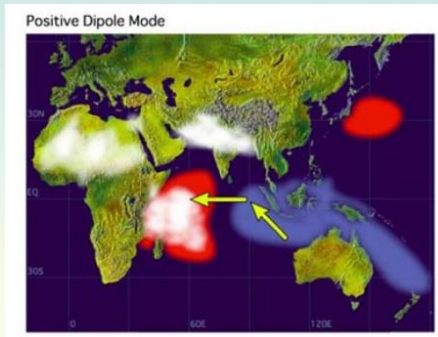
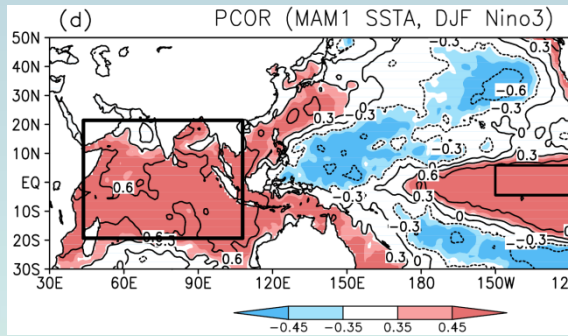


El Nino mature phase in the Middle & East tropical Pacific Ocean

SSTA Nino index
(Provided by BCC opening research Lab., Oct. 2015)

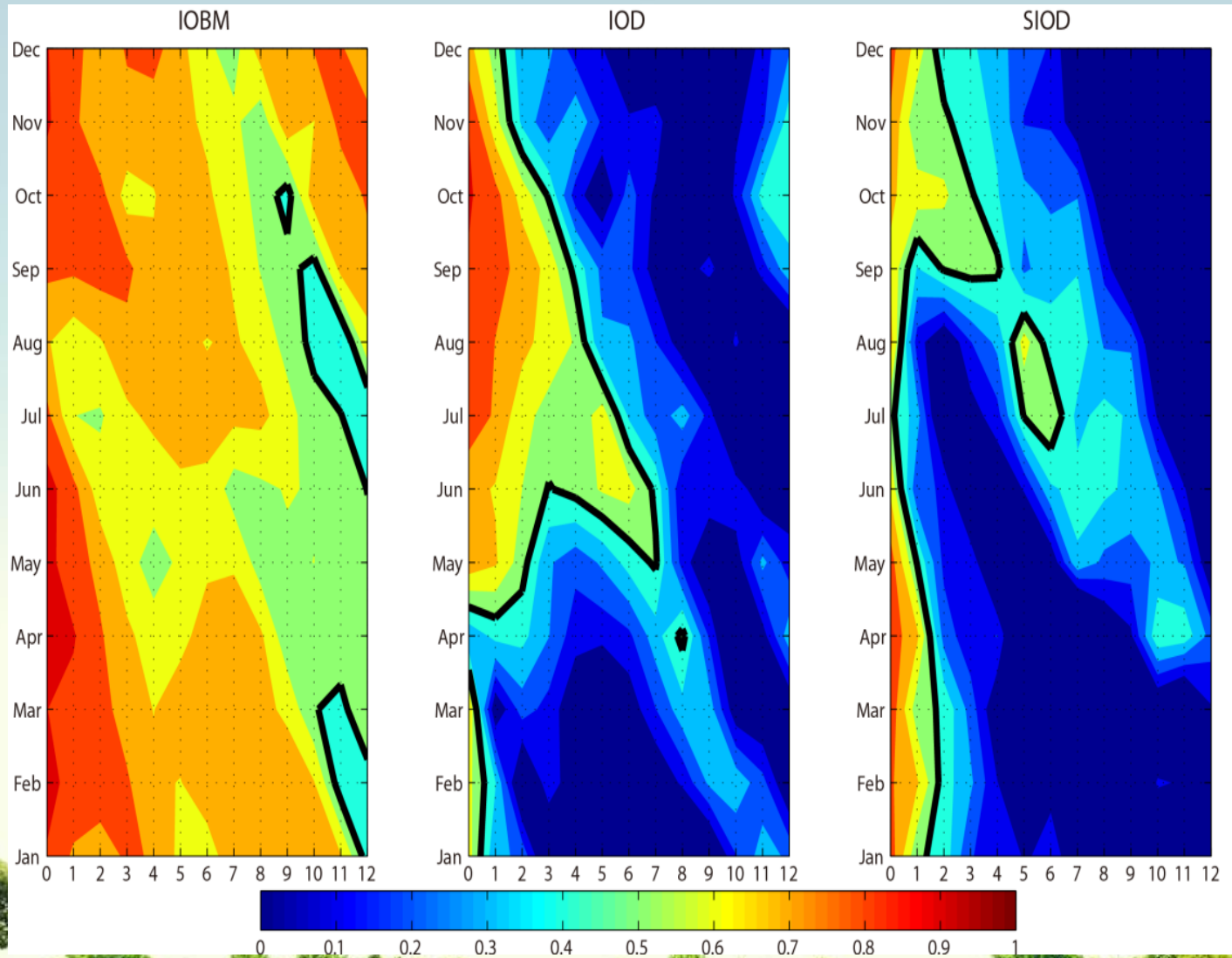


Indian Ocean Index outlook



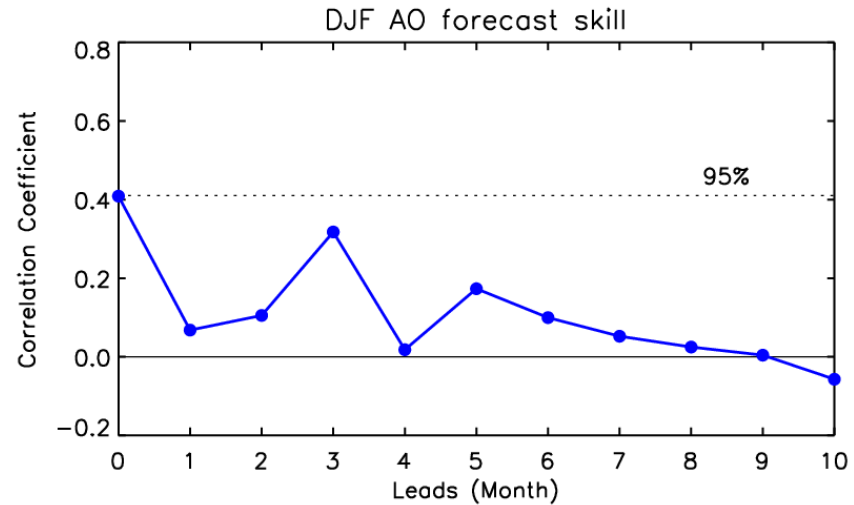
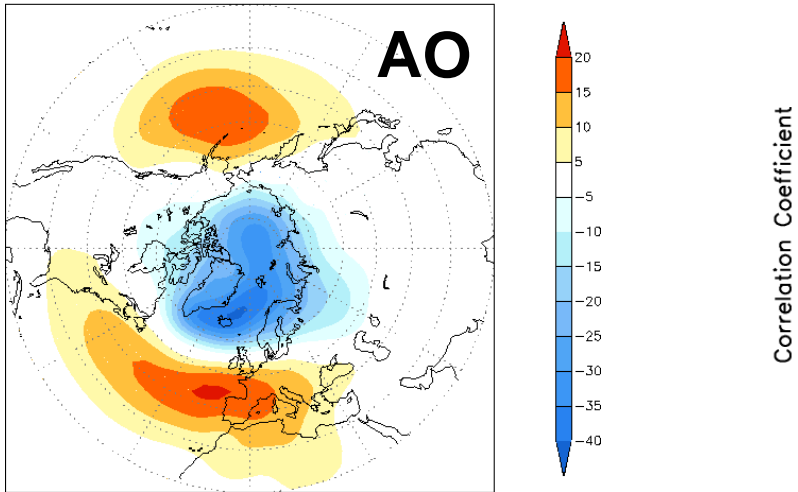


IO index forecast skill



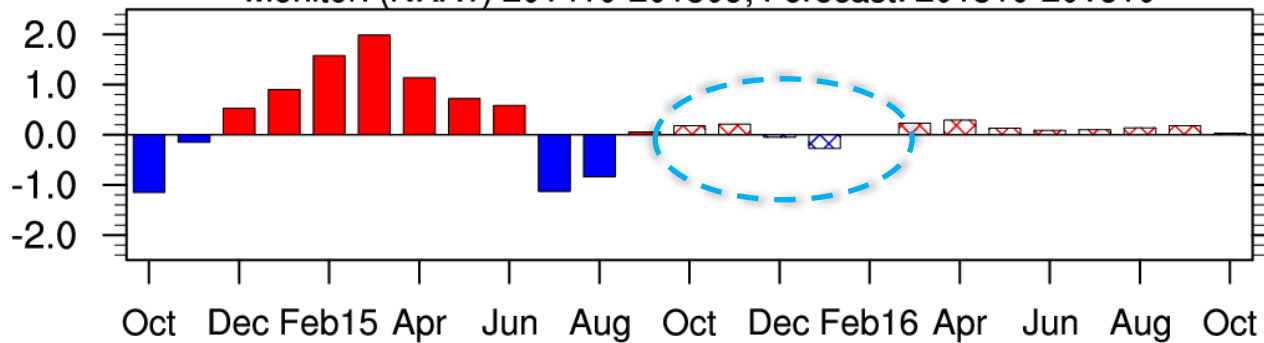
AO skill and outlook

Leading EOF (19%) shown as regression map of 1000mb height (m)



AO Index: BCC_CSM1.1m Forecast

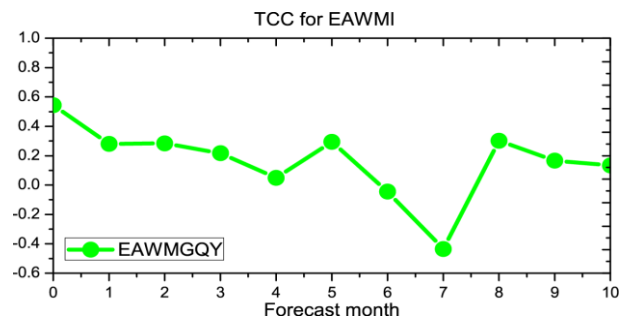
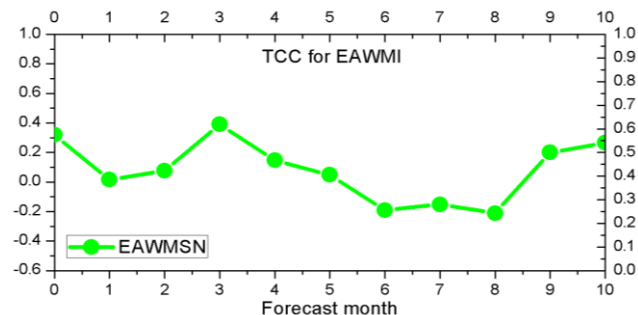
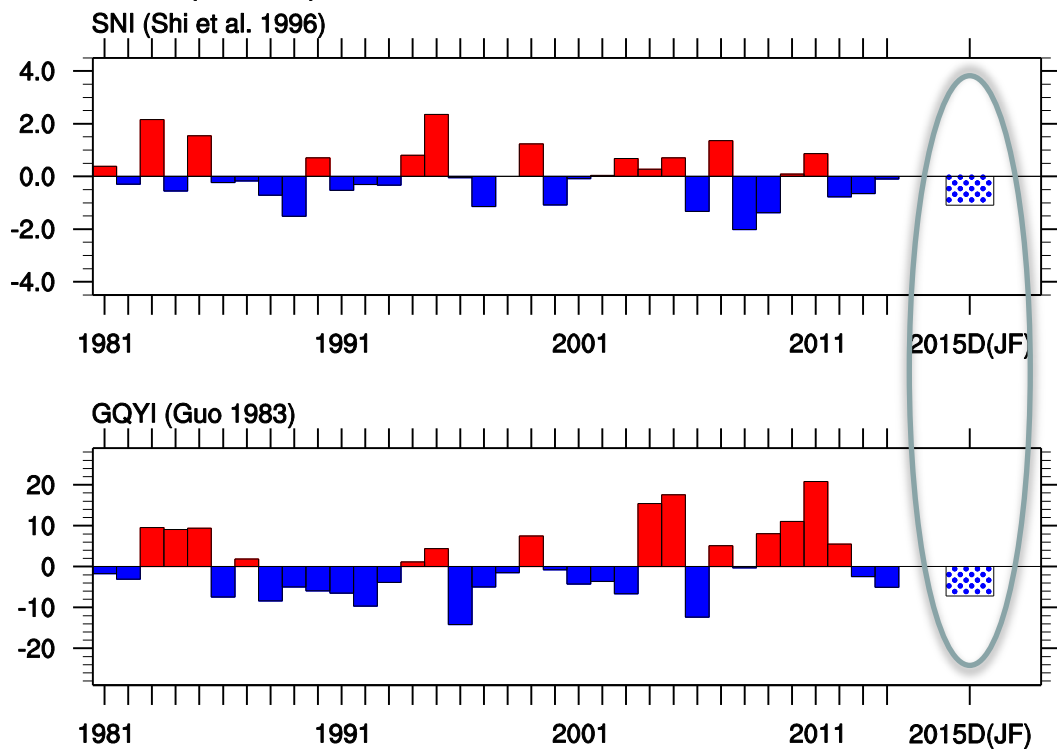
Monitor: (NRA1) 201410-201509; Forecast: 201510-201610



■ >0 ■ <0 Monitor ■ >0 ■ <0 Forecast

EAWM index outlook

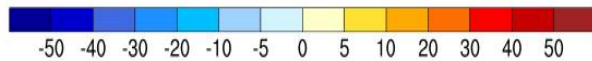
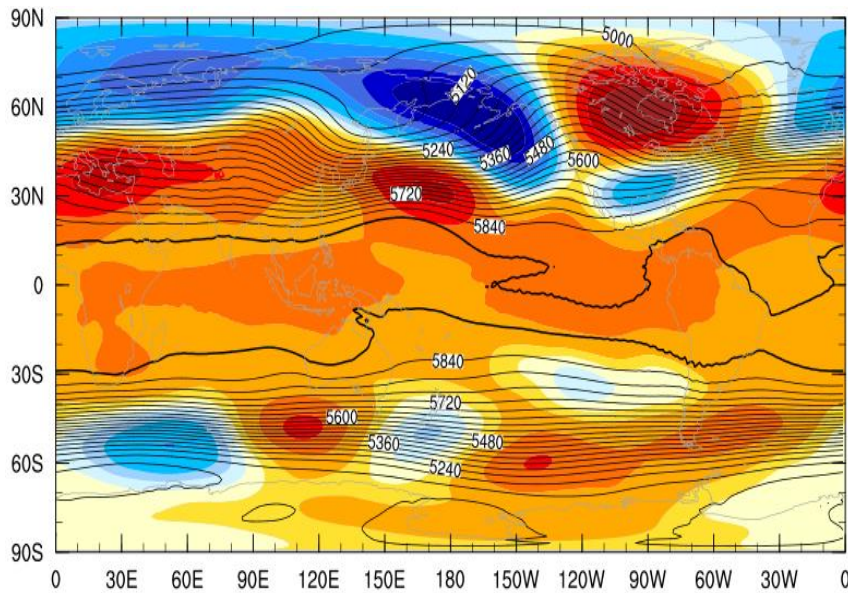
Monitor (NRA1): 1981-2014; Forecast: 201512-201512



Weak EASM in the coming winter

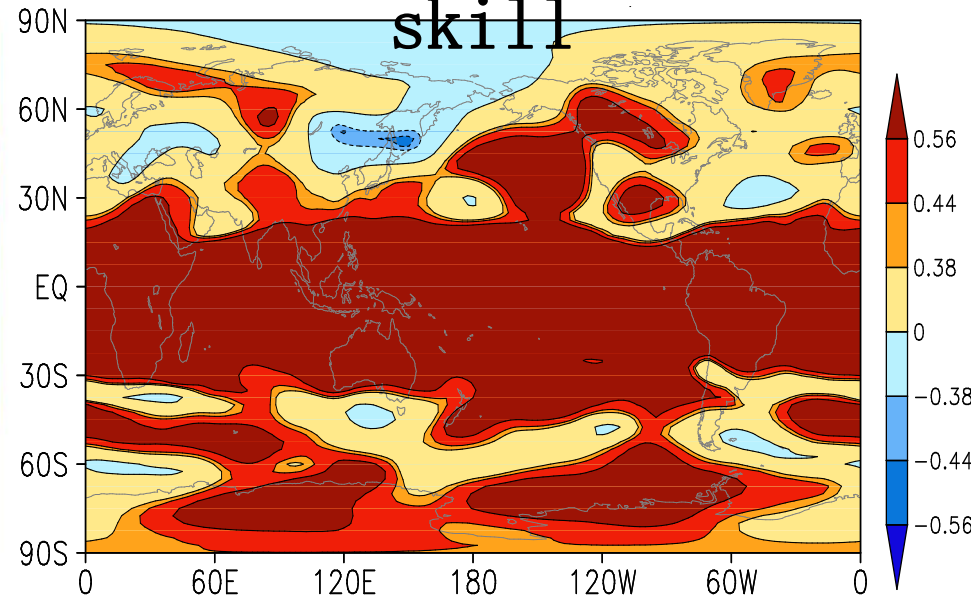
500 hPa GH

Prediction



**Zonal wind will dominate
Europe and Asia mid-high
latitudes**

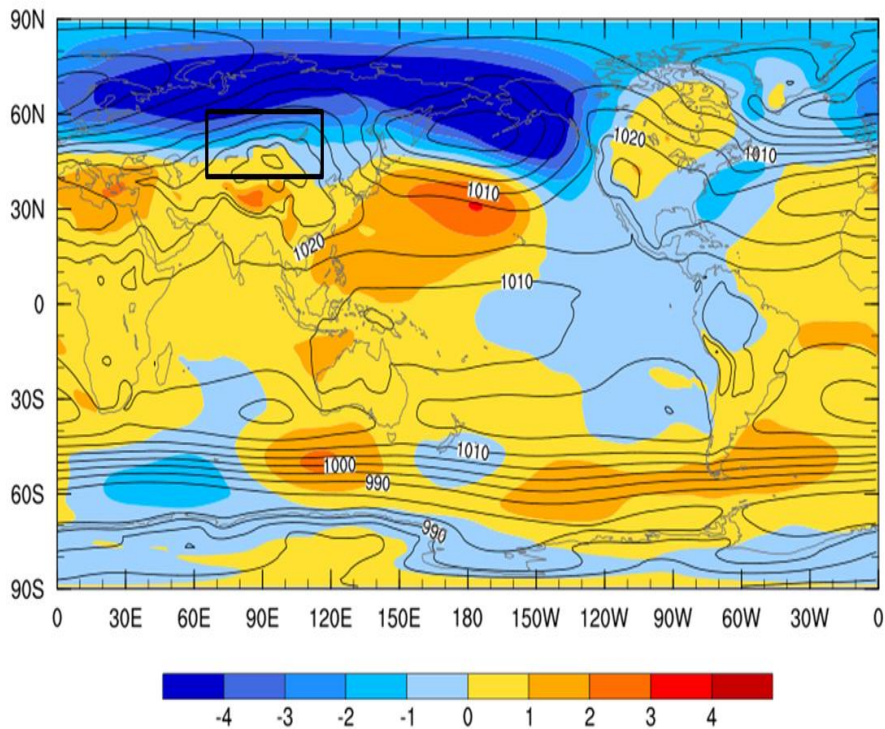
Hindcast skill



20yrs, from
1991 to 2010

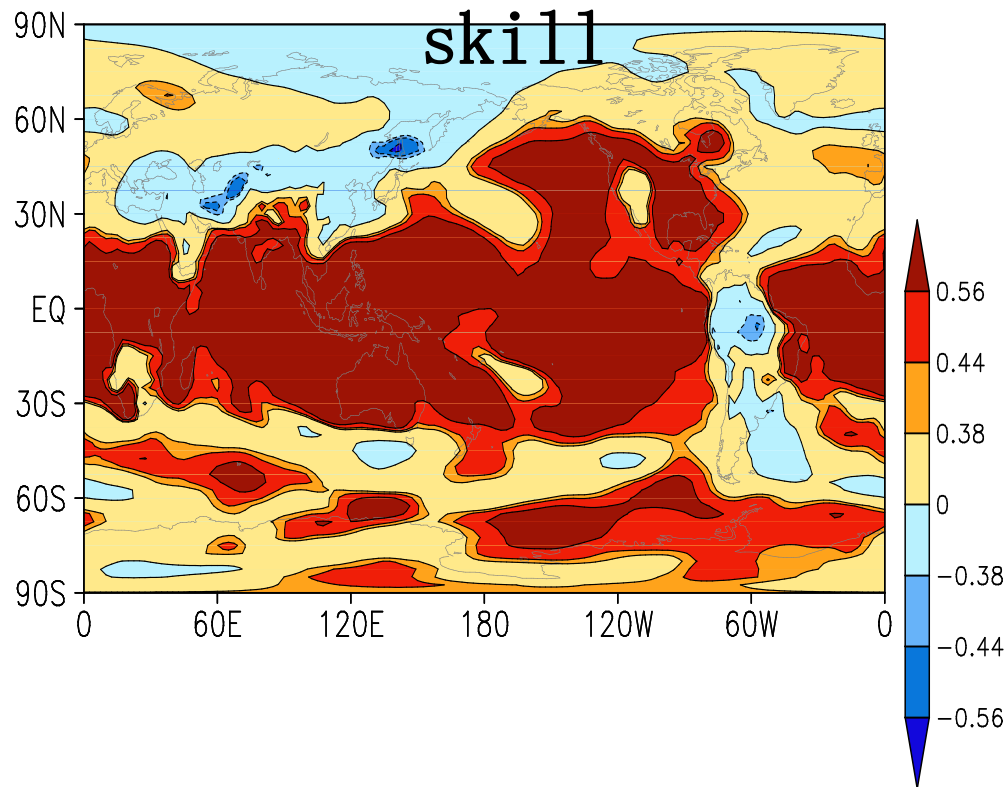
SLP

Prediction



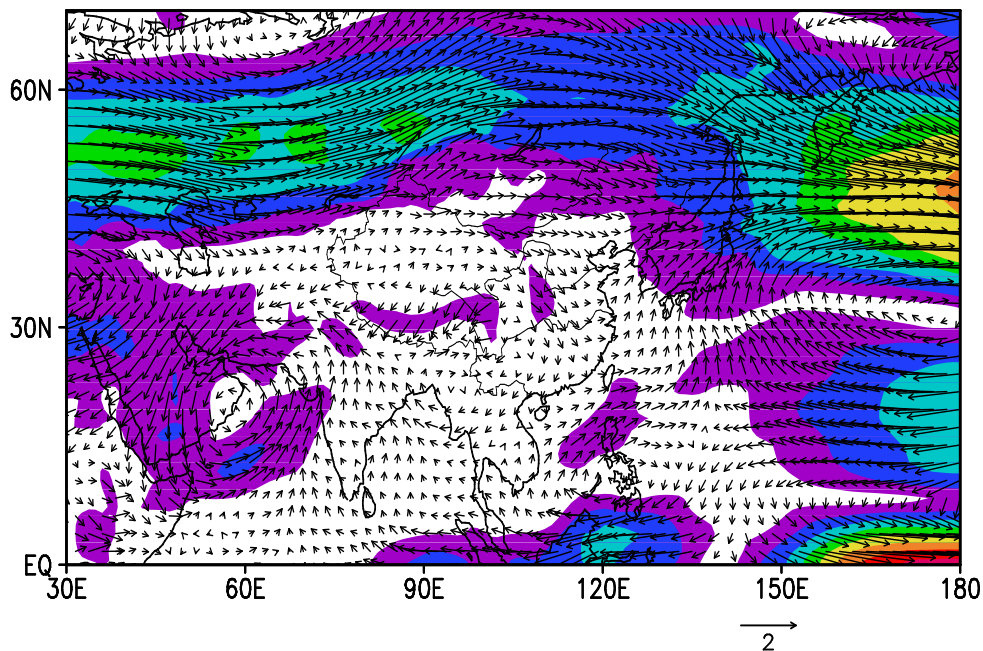
Weaken Siberia High

Hindcast



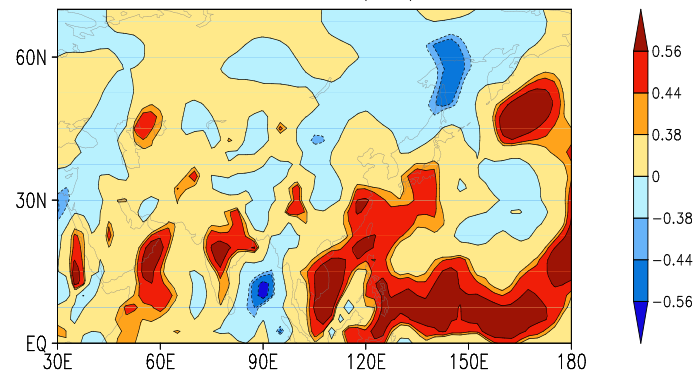
850hPa wind

Prediction

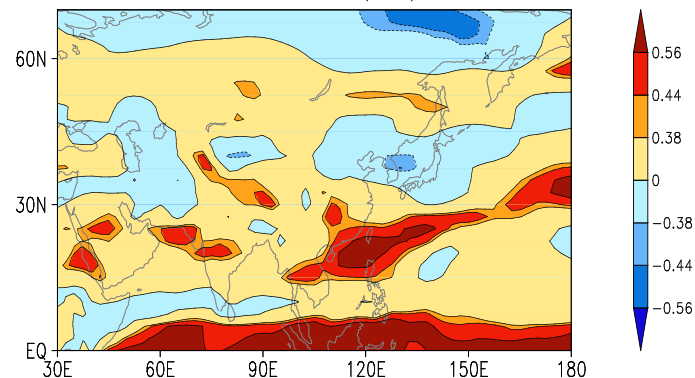


Anti-cyclone around Phillipines

ACC of V850(DJF)

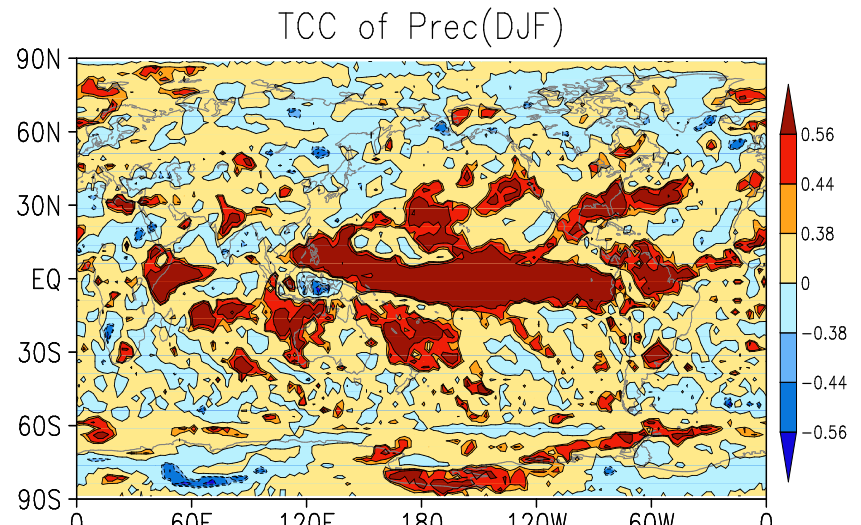
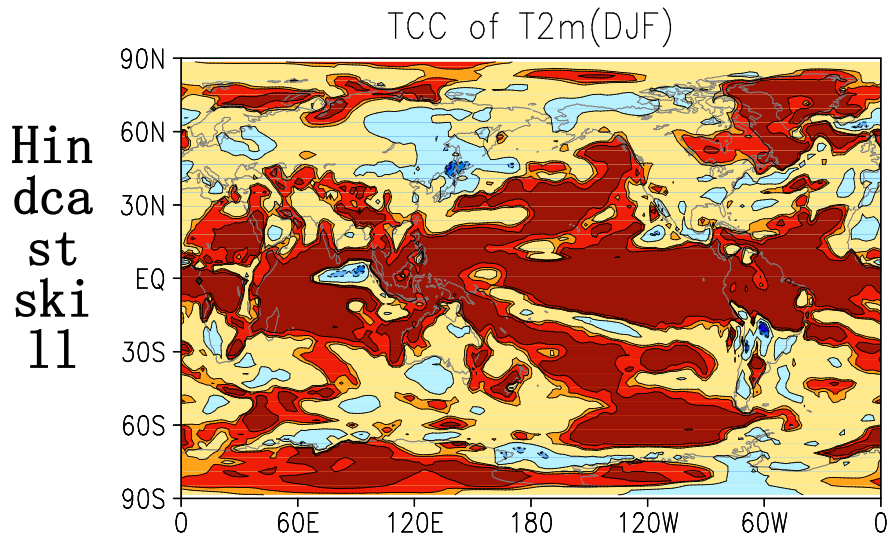
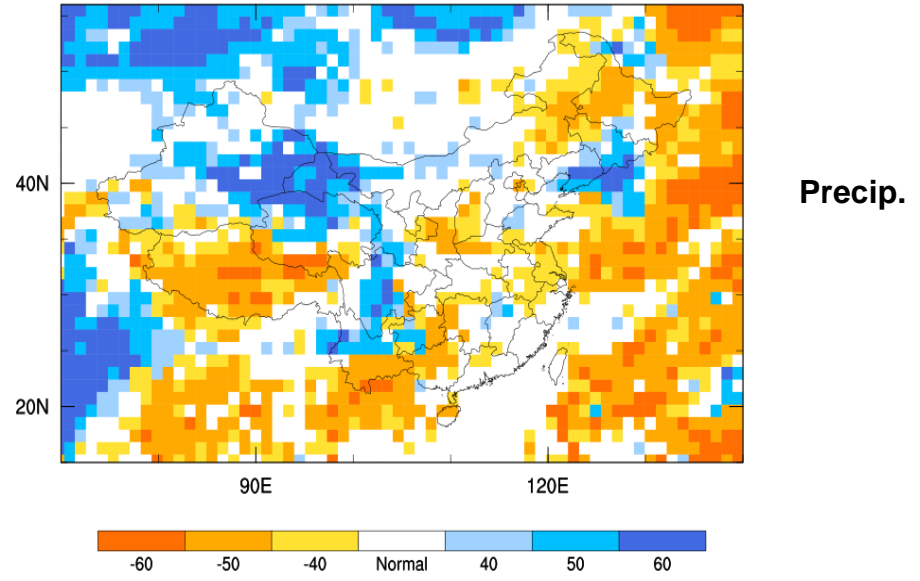
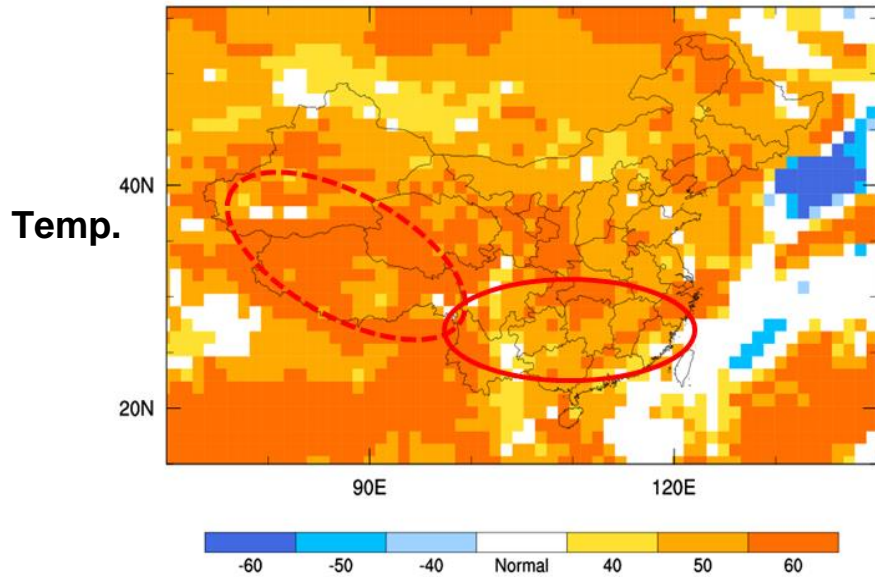


ACC of U850(DJF)



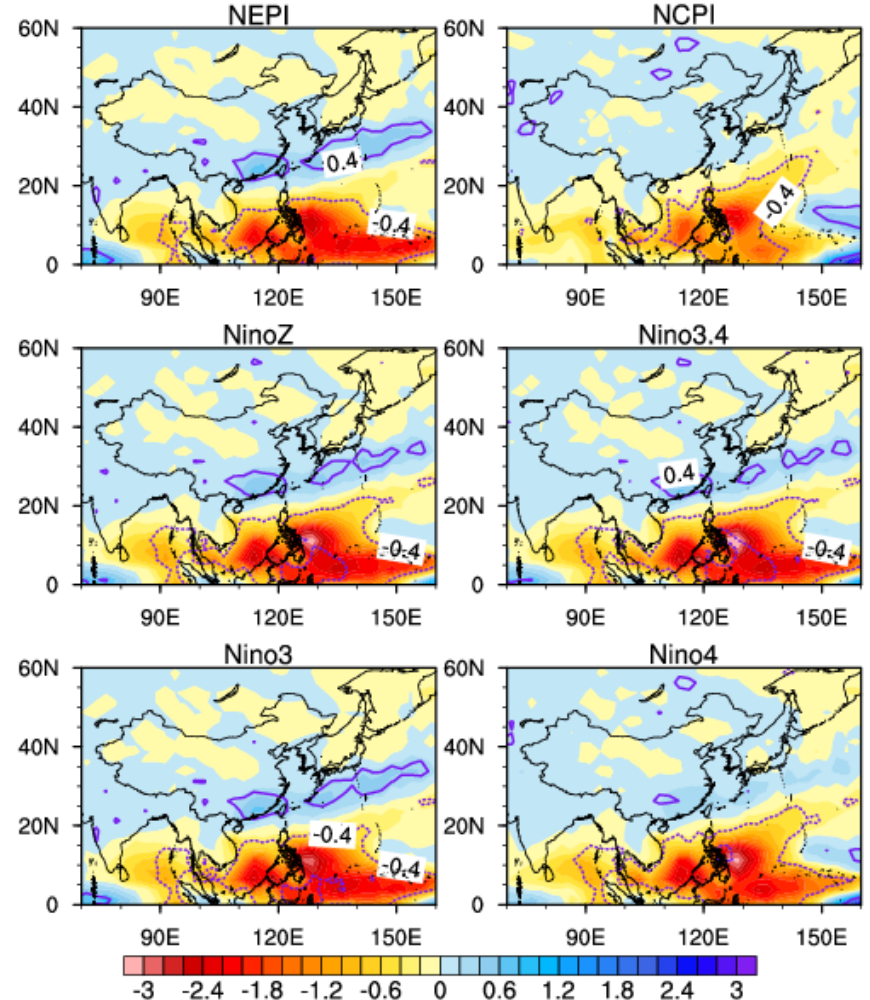
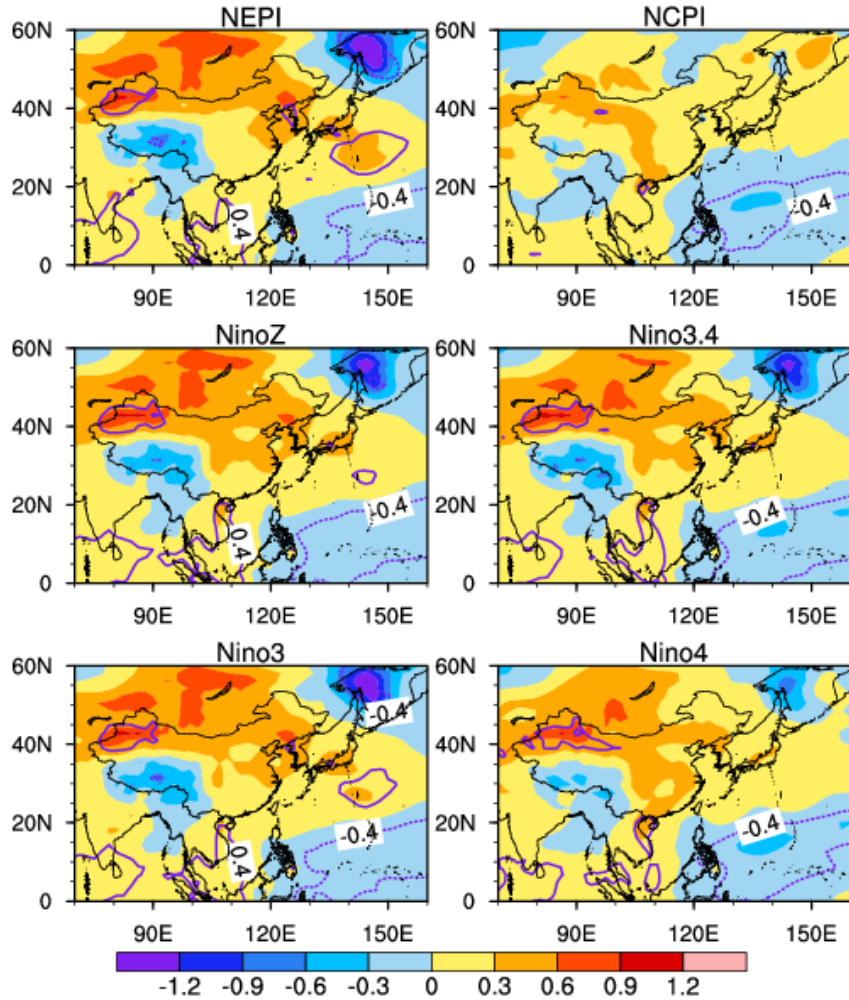
Hindcast skill

Air temperature and precipitation



Regressed Temperature at 2m of Nino Indices in DJF (K)

Regressed Precipitation of Nino Indices in DJF (mm/day)



Regression analysis:

Strong ENSO ---- anti-cyclone over the Philippines, more rainfall over South China
 weak EAWM ---- warm over most Asia,

From BCC_CSM1.1m

Relative higher skill information:

**Strong ENSO ----anti-cyclone over the Philippines--
-- more rainfall over South China**

**IO indices (IOBW+, IOD+,SIOD-) -----more rainfall
over South China**

**weak EAWM (weak SH, weak EAT) ----warm over
most of the Asia**

Uncertainties:

NAST: low skill

AO: near normal



(III) Prediction by NZC-PCCSM4

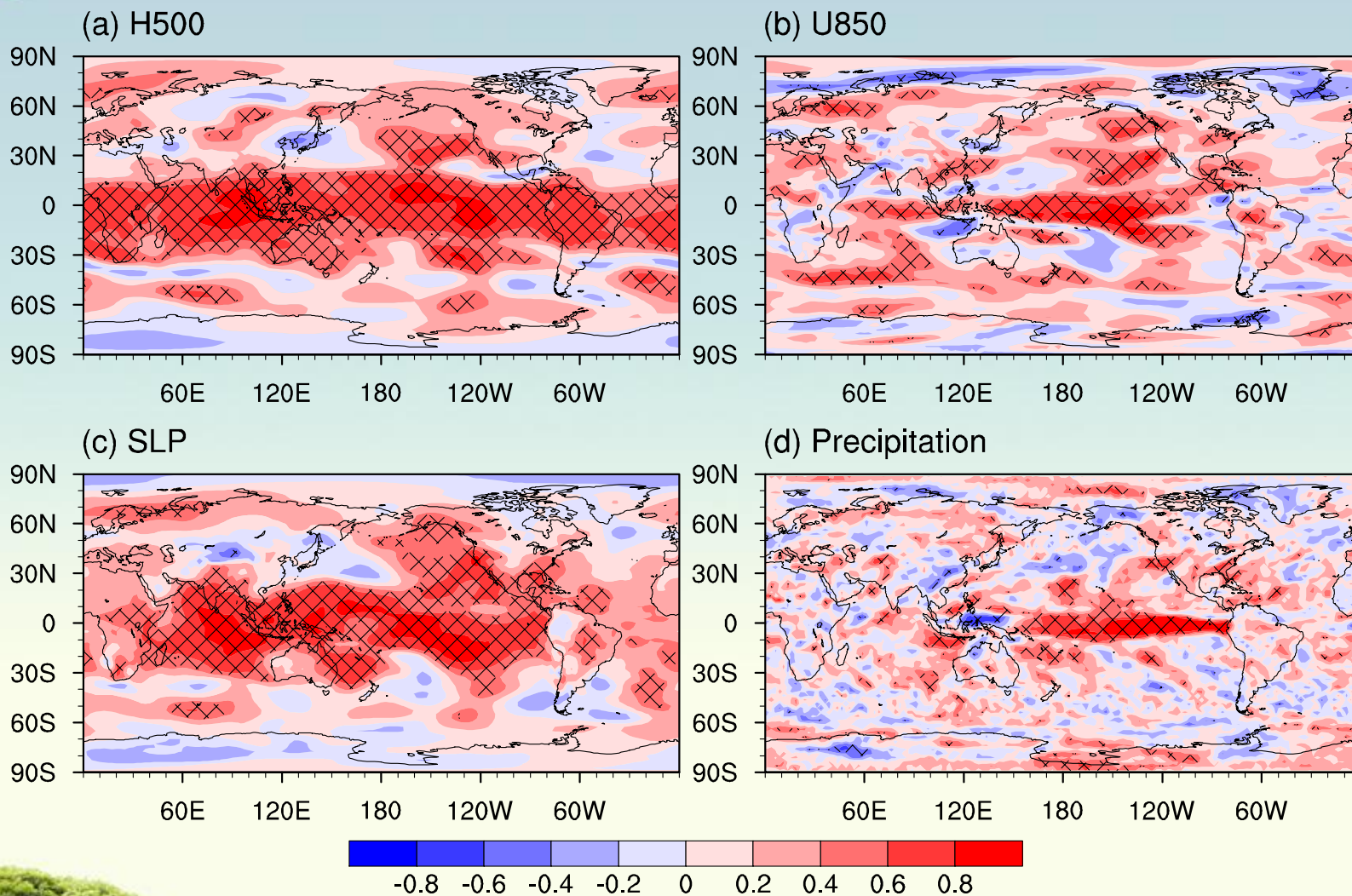
Ensemble experiment design

- NZC-PCCSM4 T1 Prediction System (Ma and Wang, 2014) : Tier one prediction system based on Community Climate System Model version 4.0
- Ensemble prediction:
 - 7 members
 - Ensemble method: Lagged average forecast
- Integration time: 2015.10.01-2016.06.01 (2 month leading)





NZC-PCCSM4: Temporal ACC for DJF

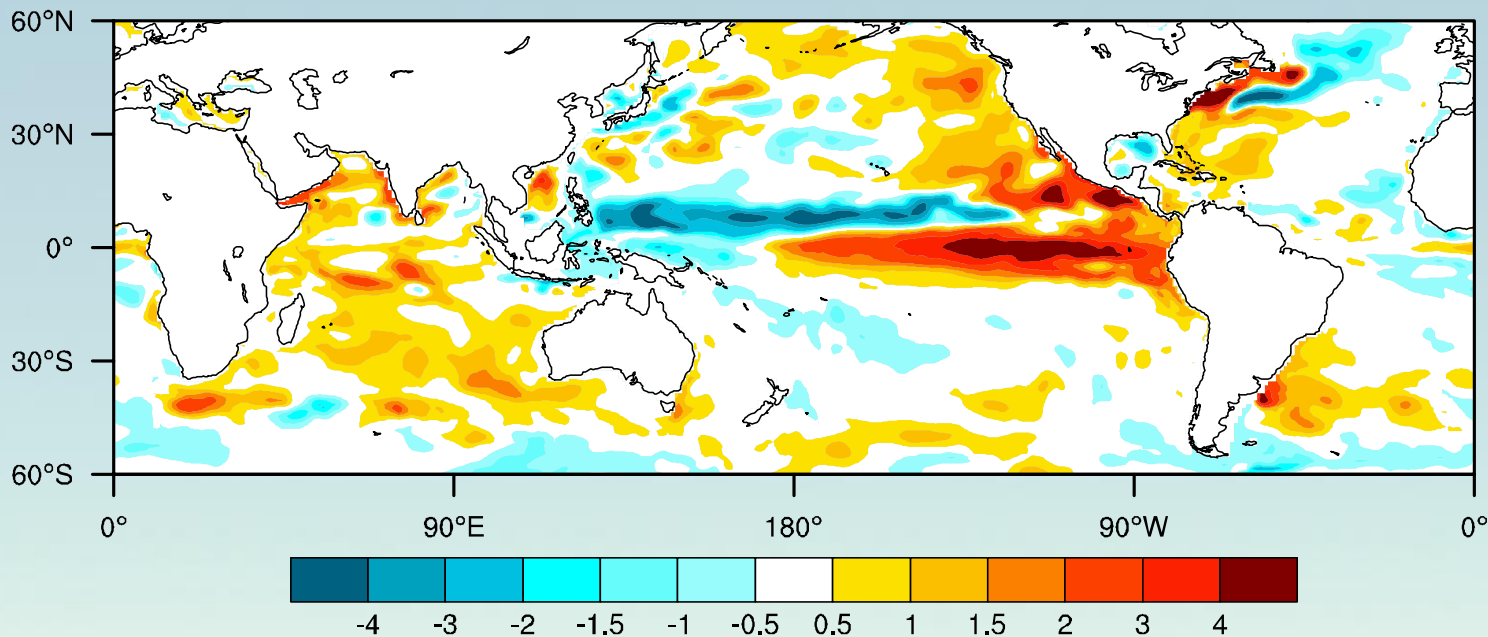


Red: positive skill Blue: negative skill Cross line: 95% significance



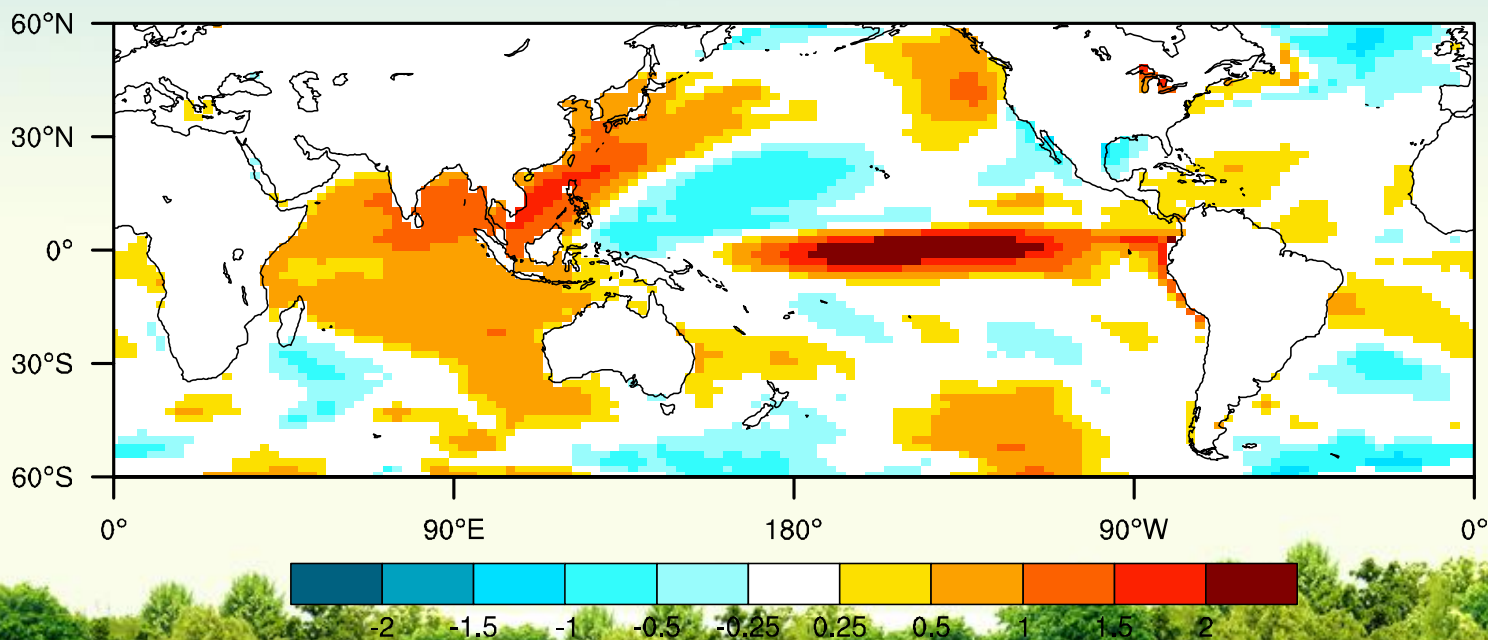
Initial SSTA

Nino3.4 index: 2.34



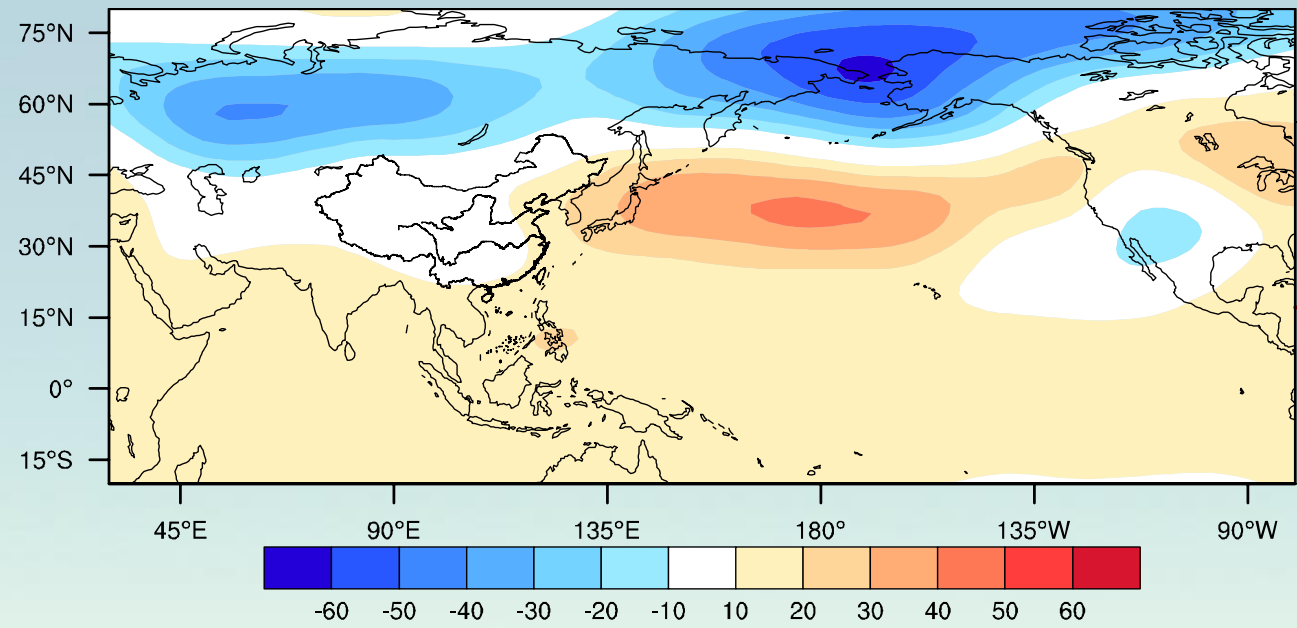
DJF SSTA

Nino3.4 index: 1.96

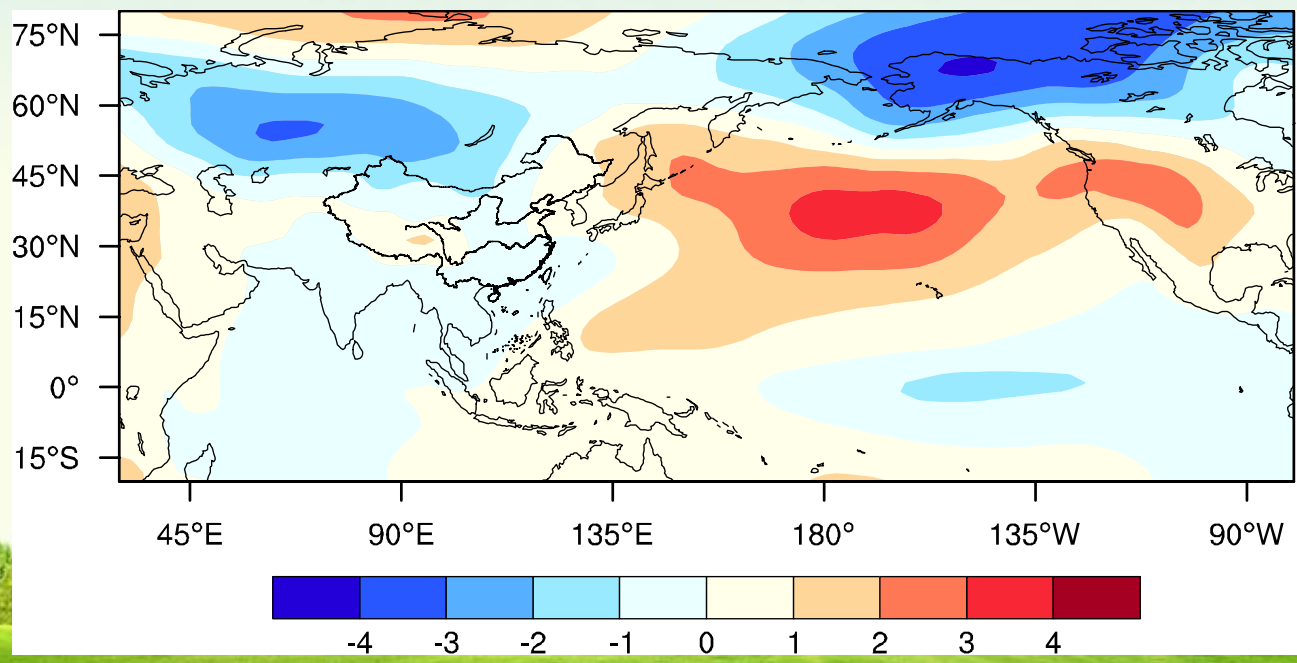




Predicted Anomalies of H500 (gpm)

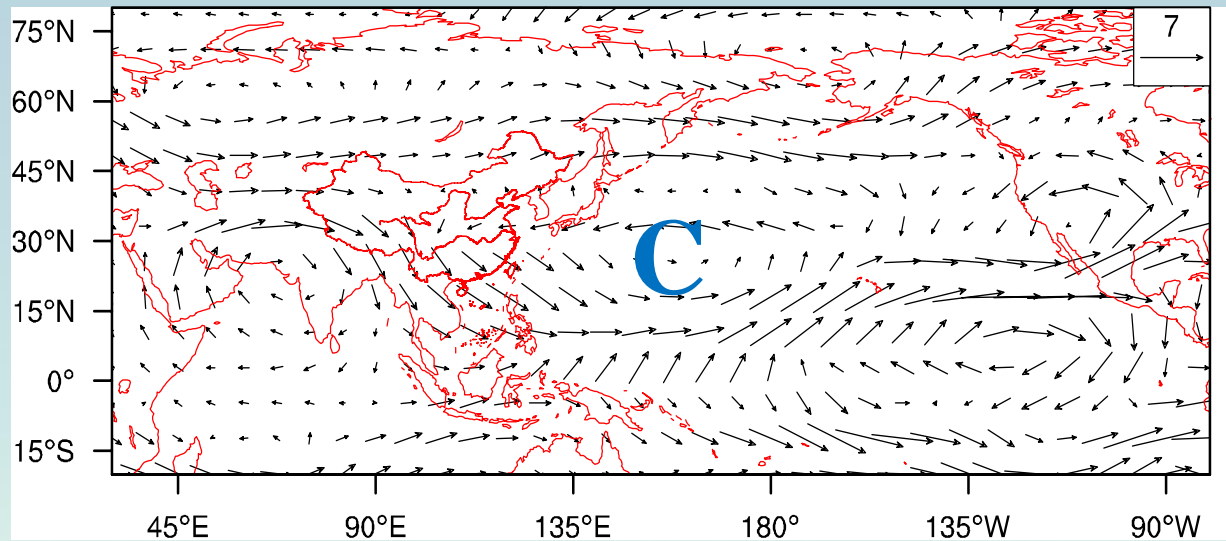


Predicted Anomalies of SLP (Pa)

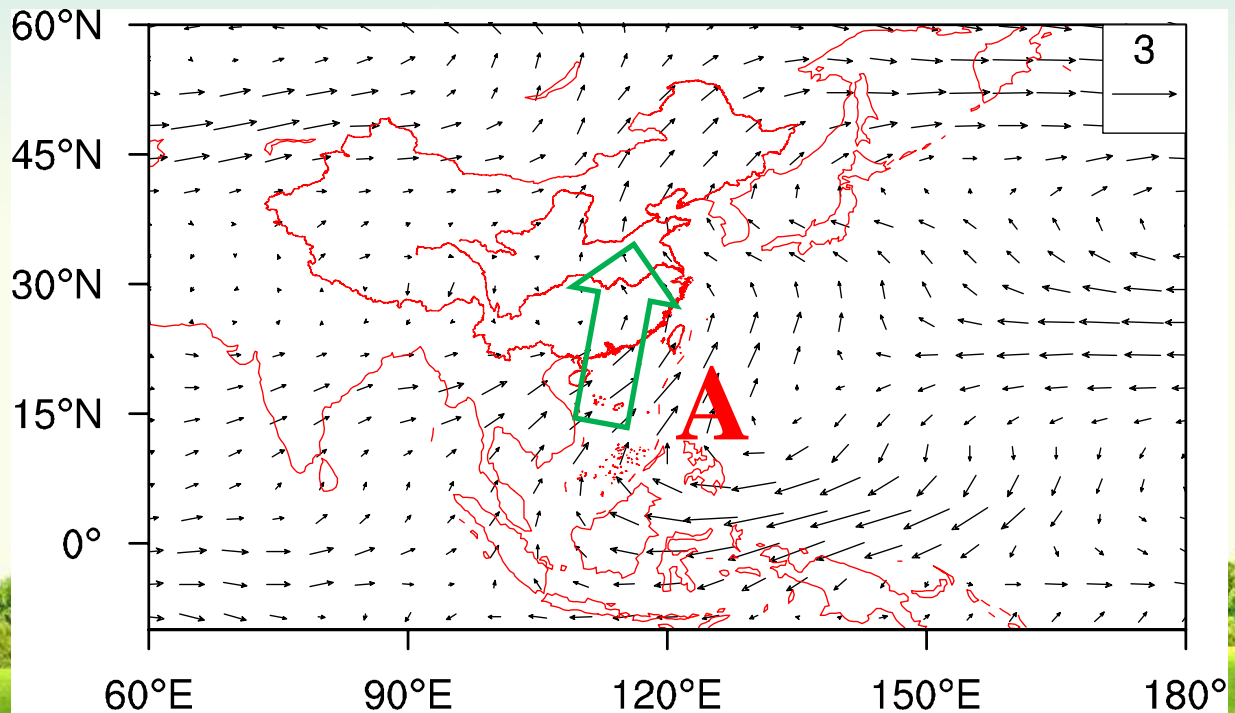




Predicted Anomalies of UV200 (m/s)

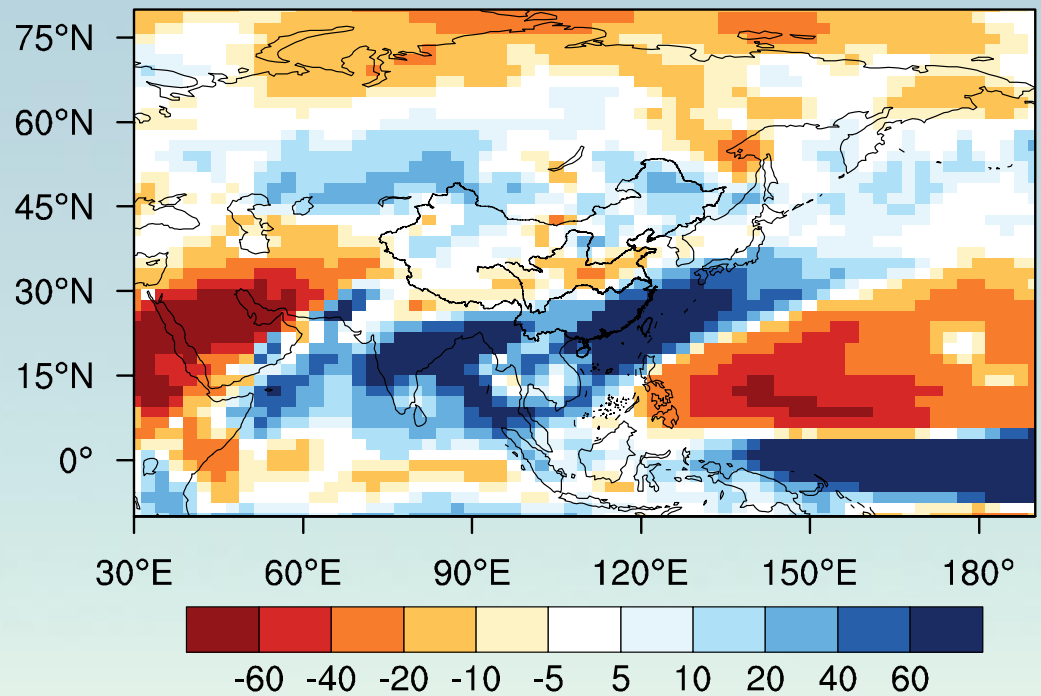


Predicted Anomalies of UV850 (m/s)

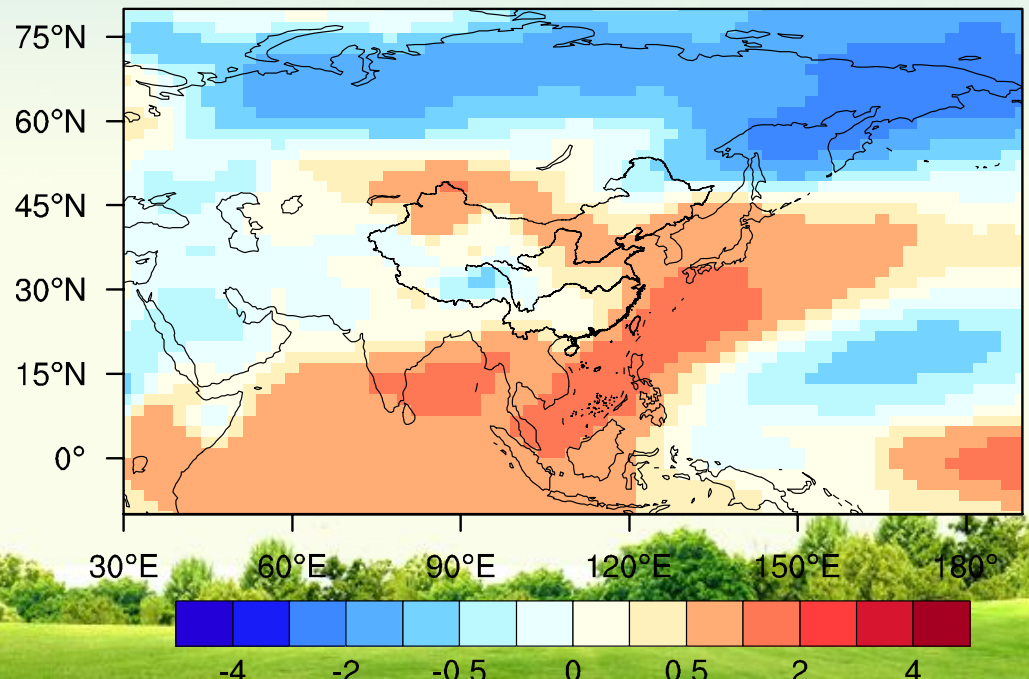




Anomaly Percentage of Precipitation (%)



Anomalies of T2m (K)





From NZC-PCCSM4

Relative higher skill information:

Strong ENSO ----anti-cyclone over the Philippines---- more rainfall over South China

weak EAWM (weak SH, weak EAT) ----warm over most of the Asia

Precip. ----more rainfall over South China, South Asia, south part of Japan

Temp.----warm in most of region except part of northeast China and north part of Japan





(IV) Statistic Analysis

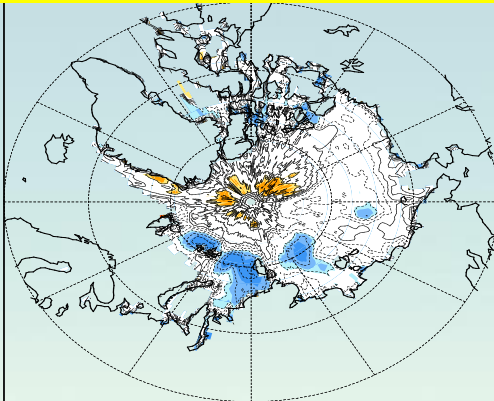
- Strong signal and higher skill output from model: ENSO, more active moist condition
- Uncertainties: cold wave activity (AO, blocking high, SH)



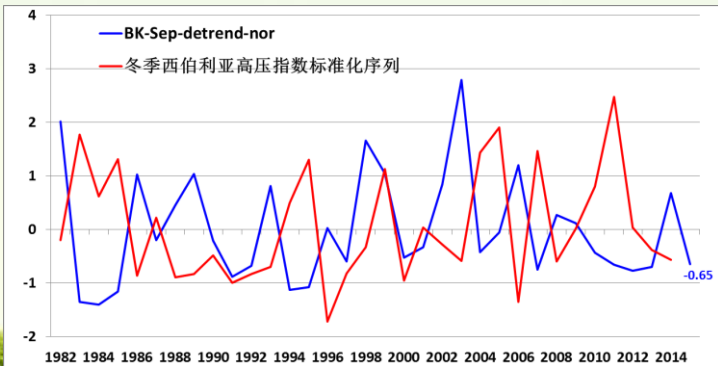


Possible impact of SIC in BK Sea

Corr(SHI-DJF, SIC-Sep)



Cor (BK,SHI) = -0.42 (>95%)



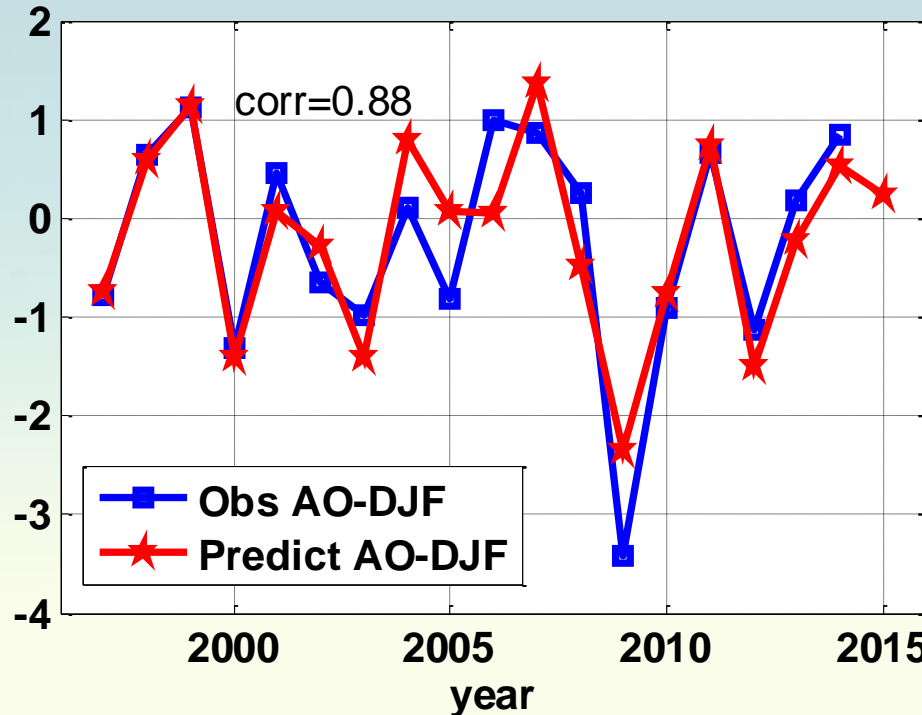
**Barents-Kara Sea:
67.5-80.5N, 20.5-80.5E**

	Sea ice anomaly in BK sea in Sept. (detrend linear tendency)	standard SH index in DJF
1984	-1.41	0.62
1983	-1.35	1.78
1985	-1.16	1.31
1994	-1.13	0.50
1995	-1.08	1.31
1991	-0.88	-1.00
2012	-0.77	0.03
2007	-0.76	1.47
2013	-0.70	-0.39
1992	-0.68	-0.83
2011	-0.66	2.48
2015	-0.65	?
1997	-0.59	-0.82
2000	-0.53	-0.95
2010	-0.43	0.80



Statistic model: AO outlook

AO-DJF prediction by SAI-Oct and MCA-SIC(Aug)

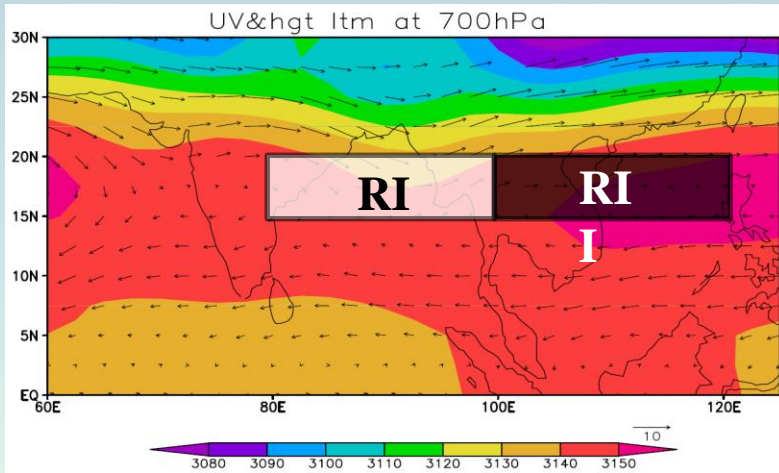


predictors: sea ice in Aug. and snow cover over Eurasian in Oct.

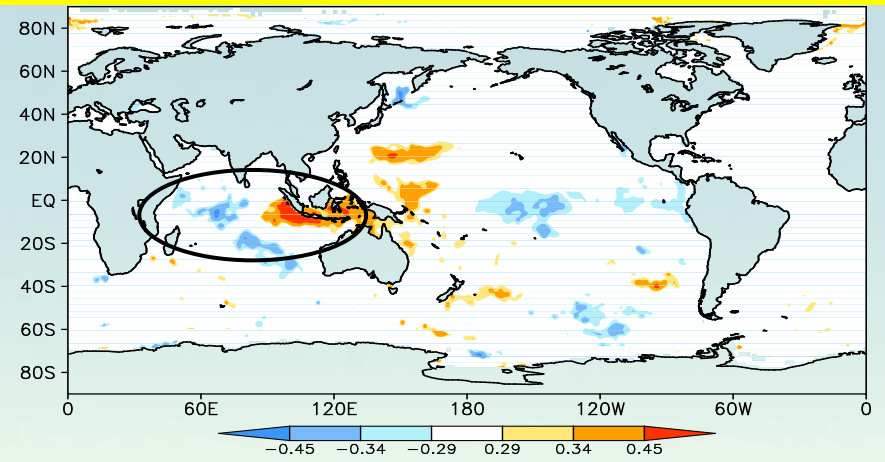
AO outlook: near normal (weak positive phase, even weak than that in 2014)



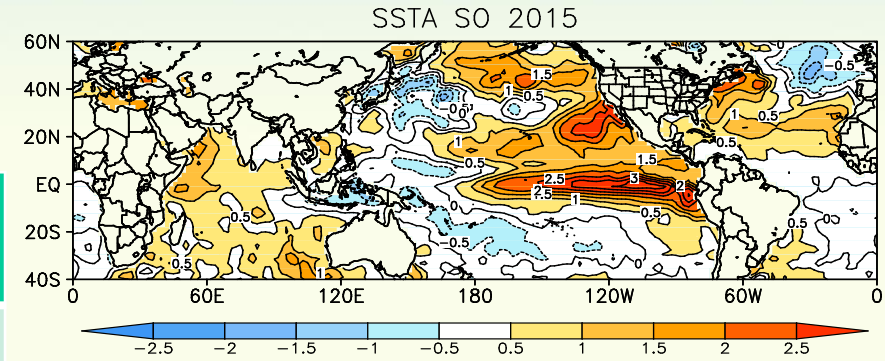
India-Burma Trough (H700-Diff)



Corr. between IBT in DJF and SSTA in previous SON



IBT index is defined as the H700 differences between RI and RII
 Negative index: **strong** IBT
 Positive index: **weak** IBT

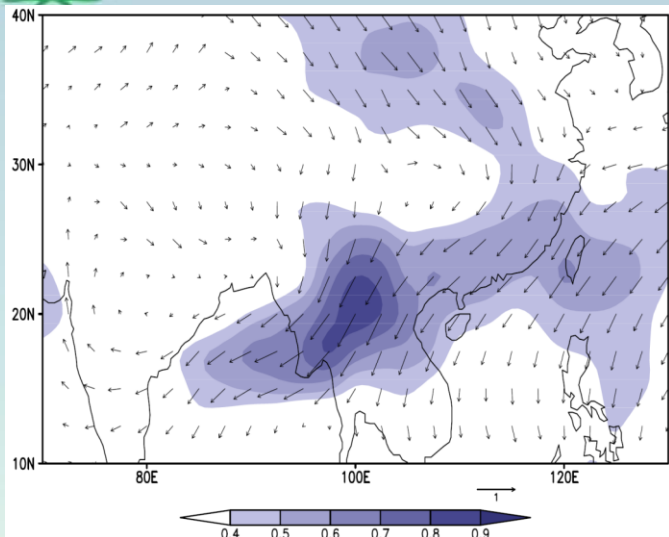


Corr	IBT-Nino3.4(DJF)	IBT-IOBW(DJF)	IBT-IOD(SON)
1980-2013	-0.32 (>90%)	-0.35 (>95%)	-0.54 (>99.9%)

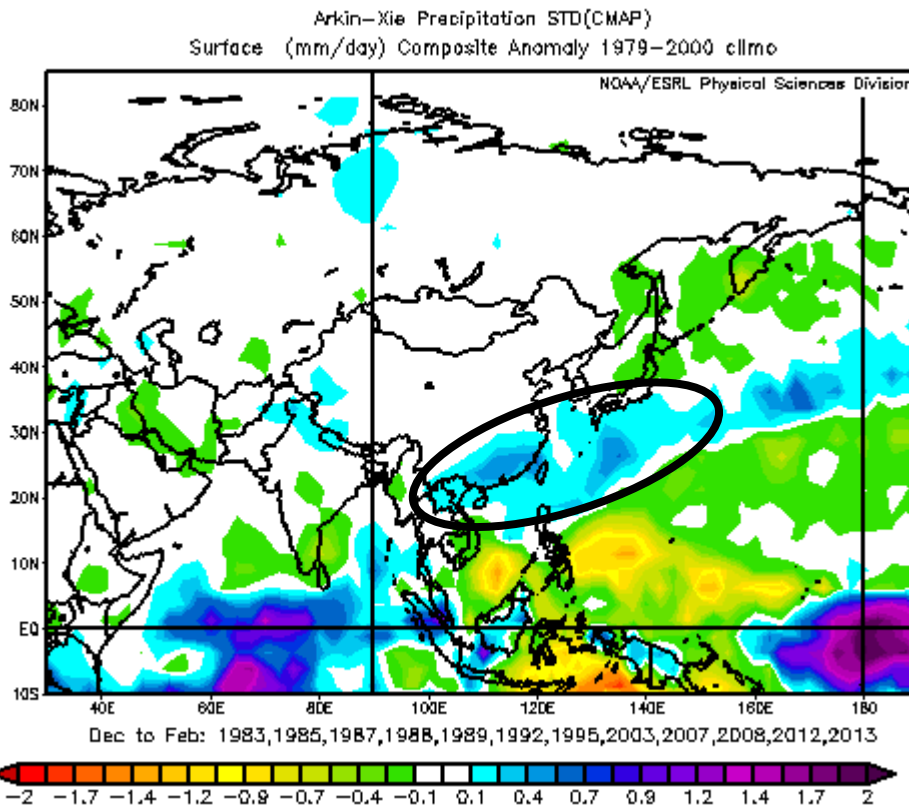




Corr. (IBT, MoistFlux)

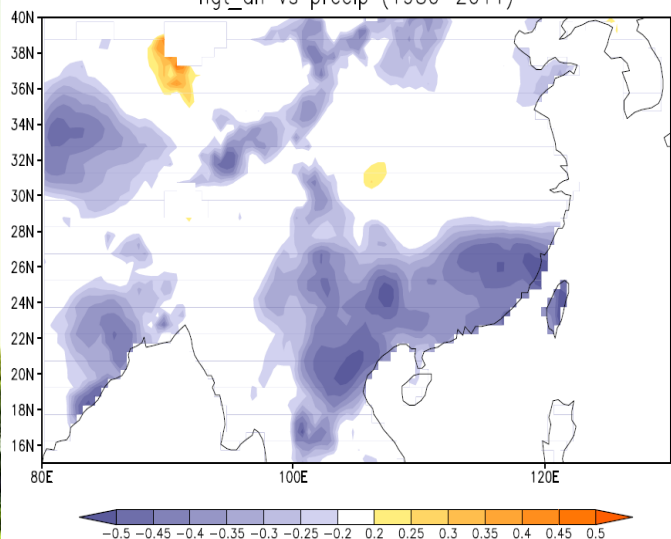


Composite CMAP in DJF during strong IBT years



Corr. (IBT, precip in DJF)

hgt_dif vs precip (1980~2011)





Outlook for Winter Circulation in DJF 2015/2016

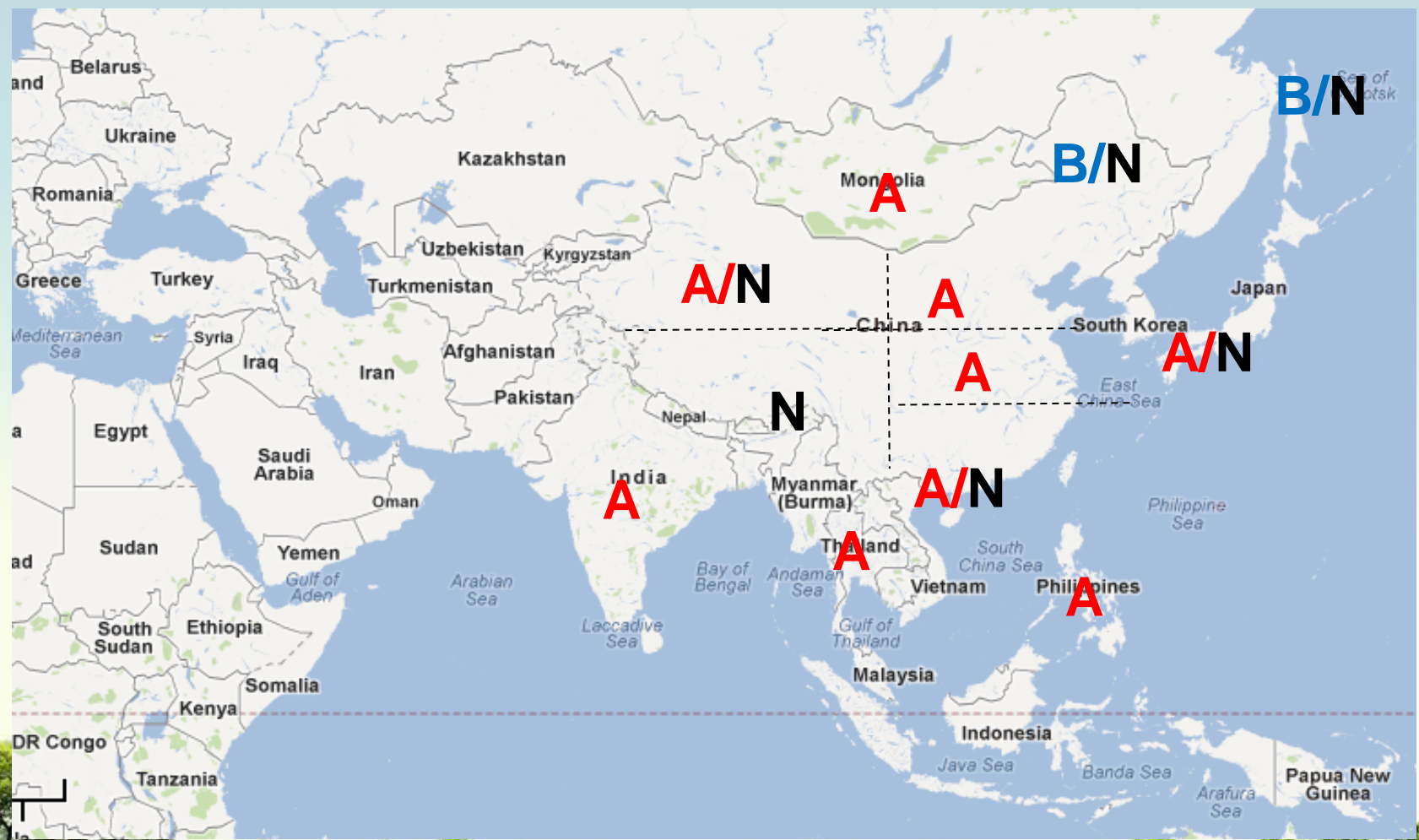
- AO: **near normal**
- EAWM: **weak**
- Siberian High: **weak**
- East Asian Trough: **weak**
- India-Burma Trough: **strong**
- Low level: anomalous **anticyclone** around the Philippines, anomalous **southerly** winds over East Asia





Outlook for Temp. in DJF 2015/2016

N





Outlook for Precip. in DJF 2015/2016

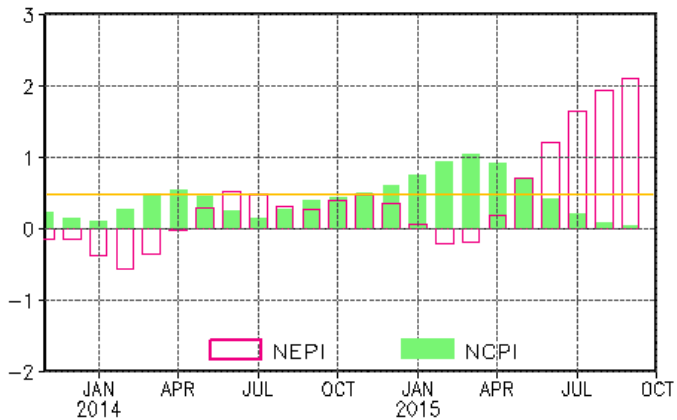




Thanks for
your
attention

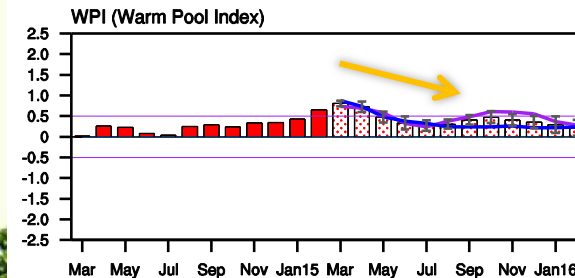
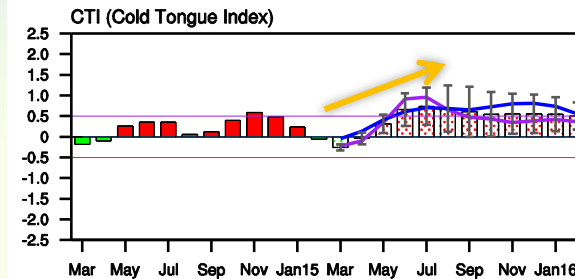
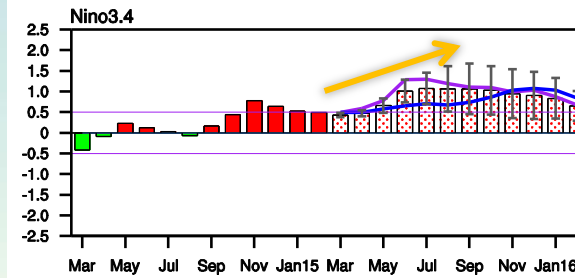
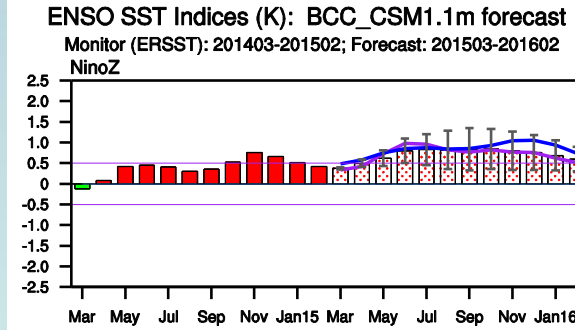
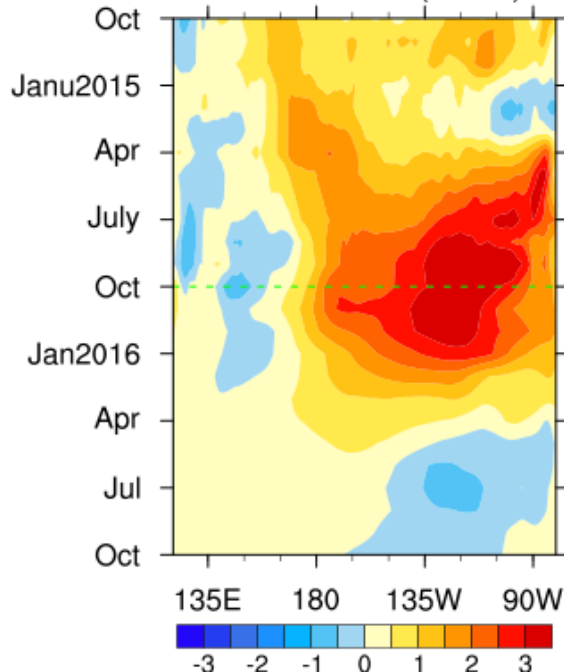


ENSO review and outlook

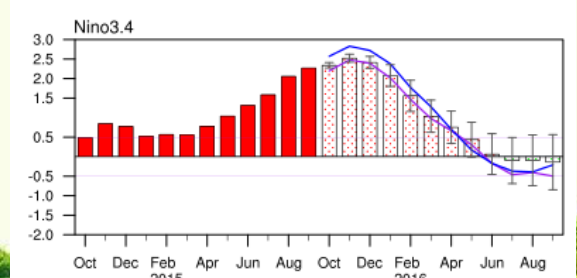
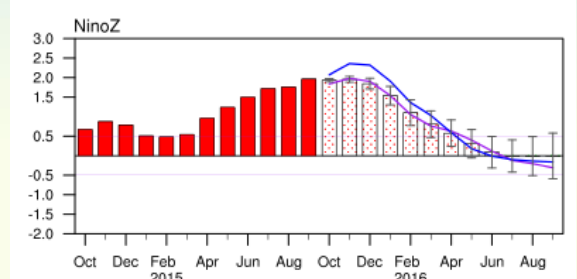
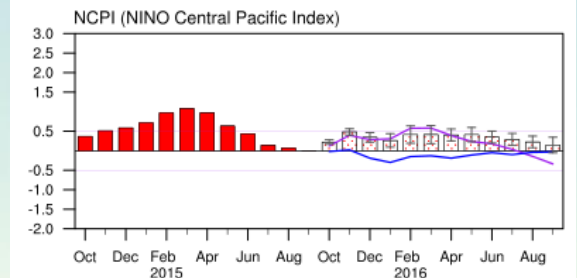
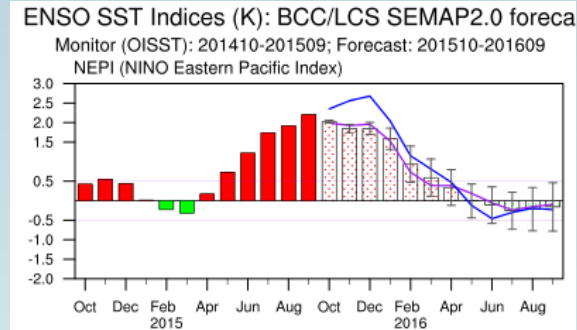


SST Anomalies at Equator: BCC_CSM1.1m forecast
 Monitor (ERSST): 201410-201509; Forecast: 201510-201609

SST Anomalies (2S-2N)

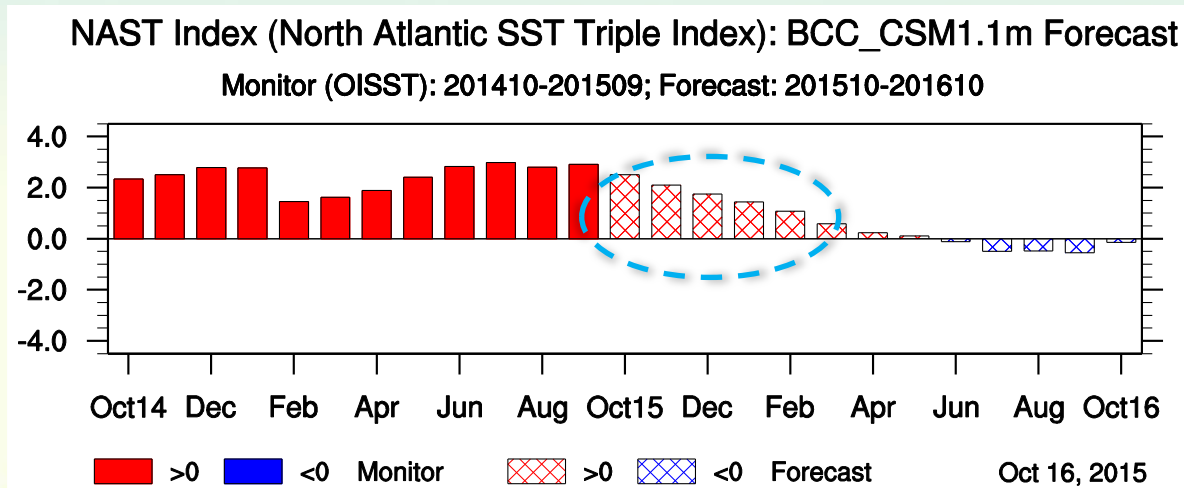
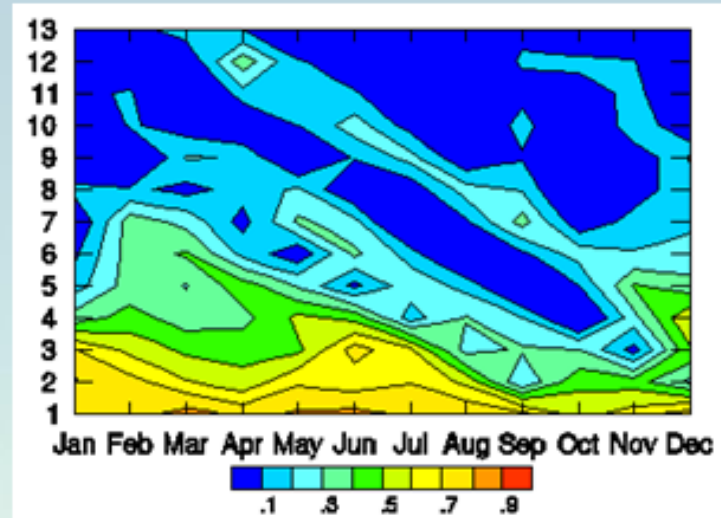
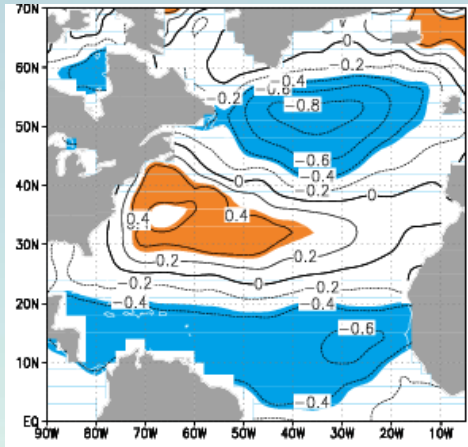


■ >0 ■ <0 Obs. — statis. — ADEPS-2
 >0 <0 BCC-CSM1.1m ensemble mean



■ >0 ■ <0 Obs. — statis. — ADEPS-2
 >0 <0 BCC-CSM1.1m ensemble mean

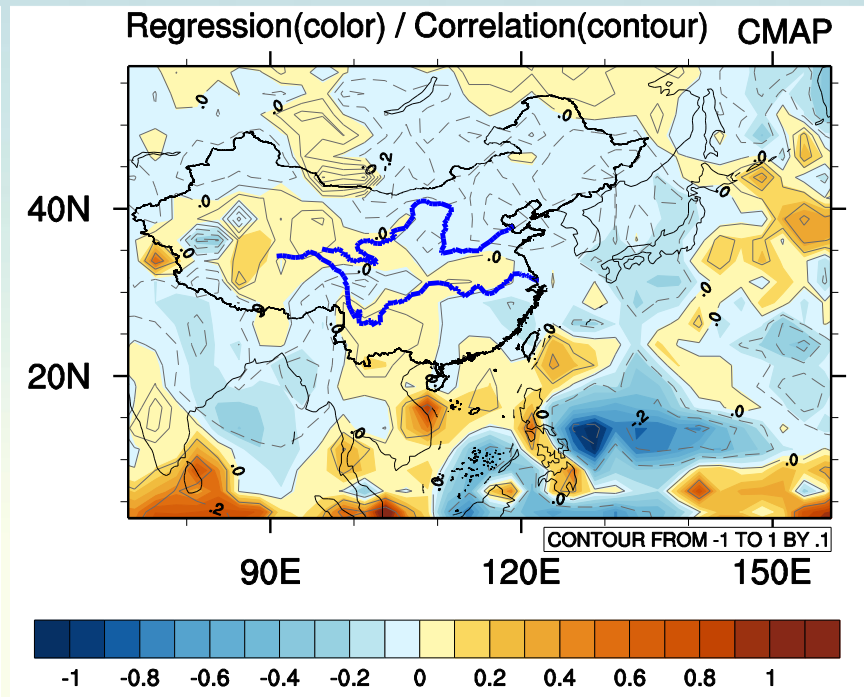
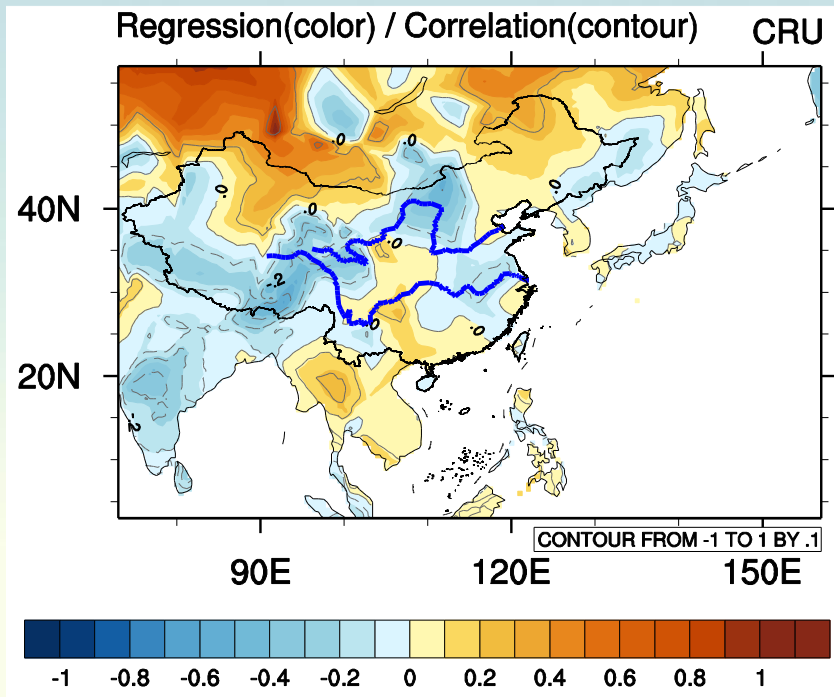
NAST skill and outlook



The skill of NAST is not very high.



NAST index and Temp./Precip.



High NAST in winter---warm in Northeast China,
Less rainfall in most of China



BCC_AGCM versions

Version	Description
BCC_AGCM2.0 (T42L26)	<p>Originated from CAM3</p> <p>Model Dynamics: Wu et al.(2008, <i>J.Atmos.Sci.</i>)</p> <p>Model Physics: Wu et al. (2010, <i>Climate Dynamics</i>)</p> <ul style="list-style-type: none">➤ Deep convection: modified Zhang and Mu (2005) scheme .➤ Dry Adiabatic➤ Snow cover fraction parameterization (Wu T. and Wu G., 2004)➤ Sensible and latent flux parameterization on the ocean-Atmosphere interface are modified.
BCC_AGCM2.1 (T42L26) BCC_AGCM2.2 (T106L26)	<ul style="list-style-type: none">➤ A new cumulus convective parameterization scheme suggested by Wu (2012: <i>Climate Dynamics</i>)
BCC_AGCM3.0 (T266) Developing	<ul style="list-style-type: none">➤ Model Dynamics (Divergence Damping; FFSL;...)➤ Moisture process, Cloud parameterizations, Land surface process
BCC_AGCM_Chem0 BCC_AGCM_Chem1 (T42L26, T106L26) BCC_AGCM_CUACE Developing	<ul style="list-style-type: none">➤ To couple with the atmospheric chemistry model (MOZART2)➤ To couple with MOZART2, and to include 17 prognostic aerosol tracers