Development and application of BCC high resolution model prediction system

All members of BCC model group

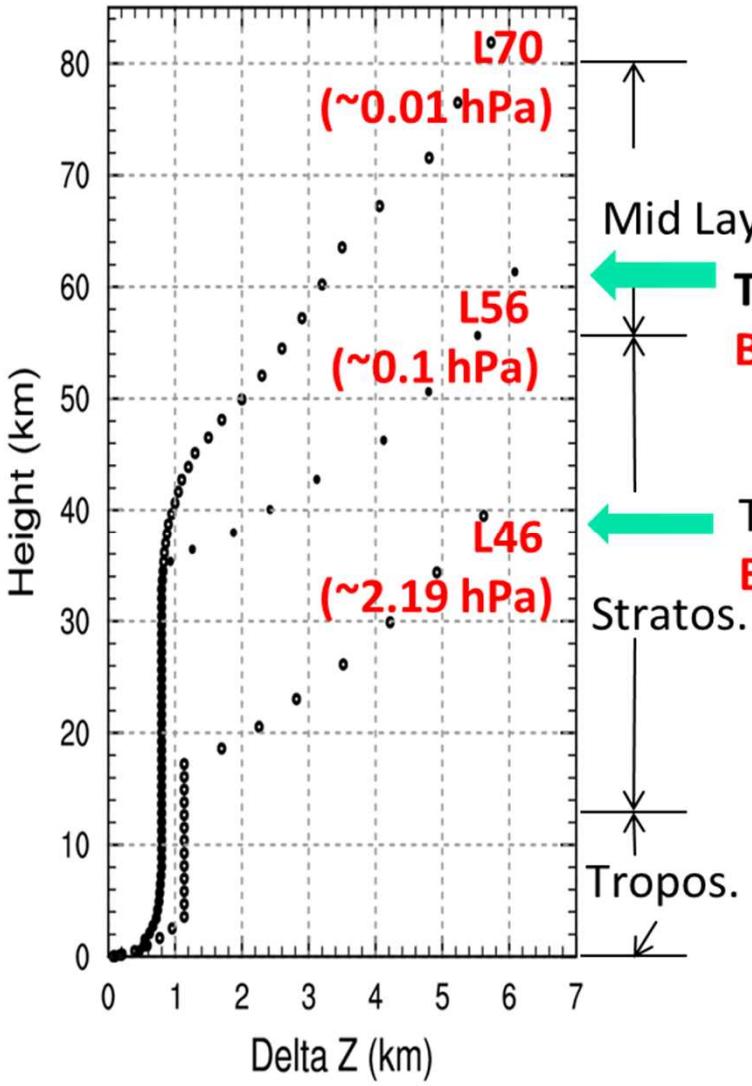
The 7th EASCOF

November 2019, Ulaanbaatar, Mongolia

Contents

- **Introduction of BCC models**
- **The simulation ability of BCC high resolution model**
- **Application of BCC high resolution model**

Introduction of BCC models



Mid Layer

T266L56, model top

BCC-CSM2-HRv1

Global ~ 45km, model top over 60km

Ocean: 1/4x1/4°, Vertical 40 levels

T106L46, model top

BCC-CSM2-MR

Stratos.

Global ~ 100km, model top over 60km

Ocean: MOM4_L40, Vertical 40 levels

Tropos.

Contents

- Introduction of BCC models
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The simulation ability of BCC-CSM2-HR (T266L56)

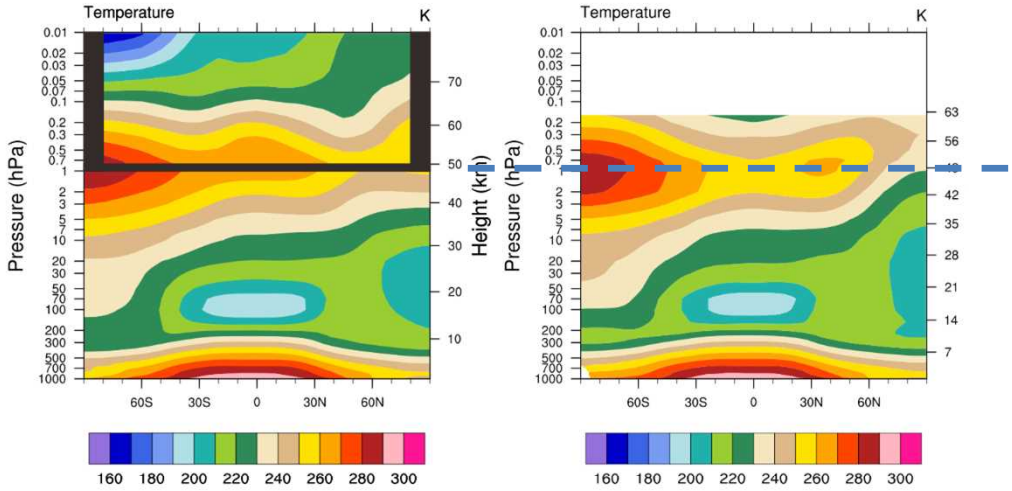
1. **The simulation ability for the temperature and the vertical structure of wind in the stratosphere and the middle atmosphere and their seasonal changes**

The vertical structure of temperature

BCC-CSM2-HR

JRA55/CIRA-86 | T266L56

JAN



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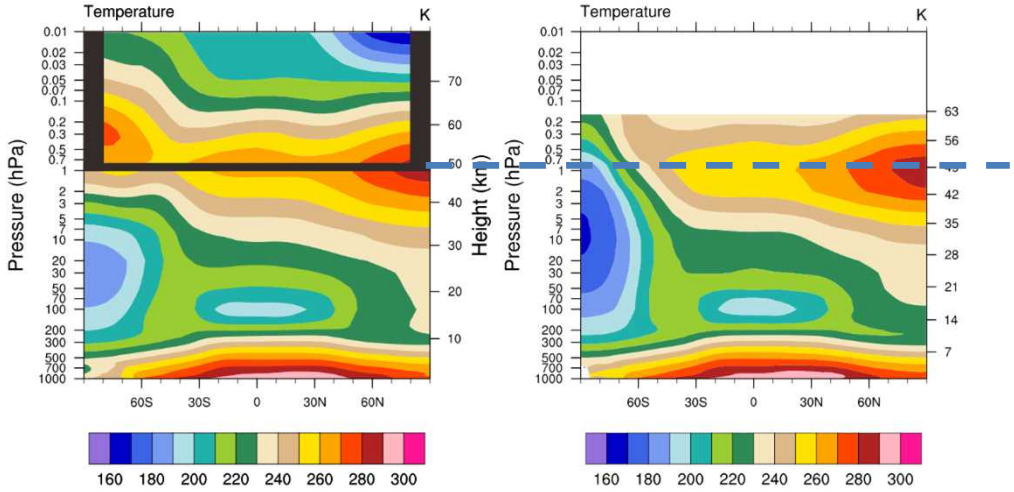
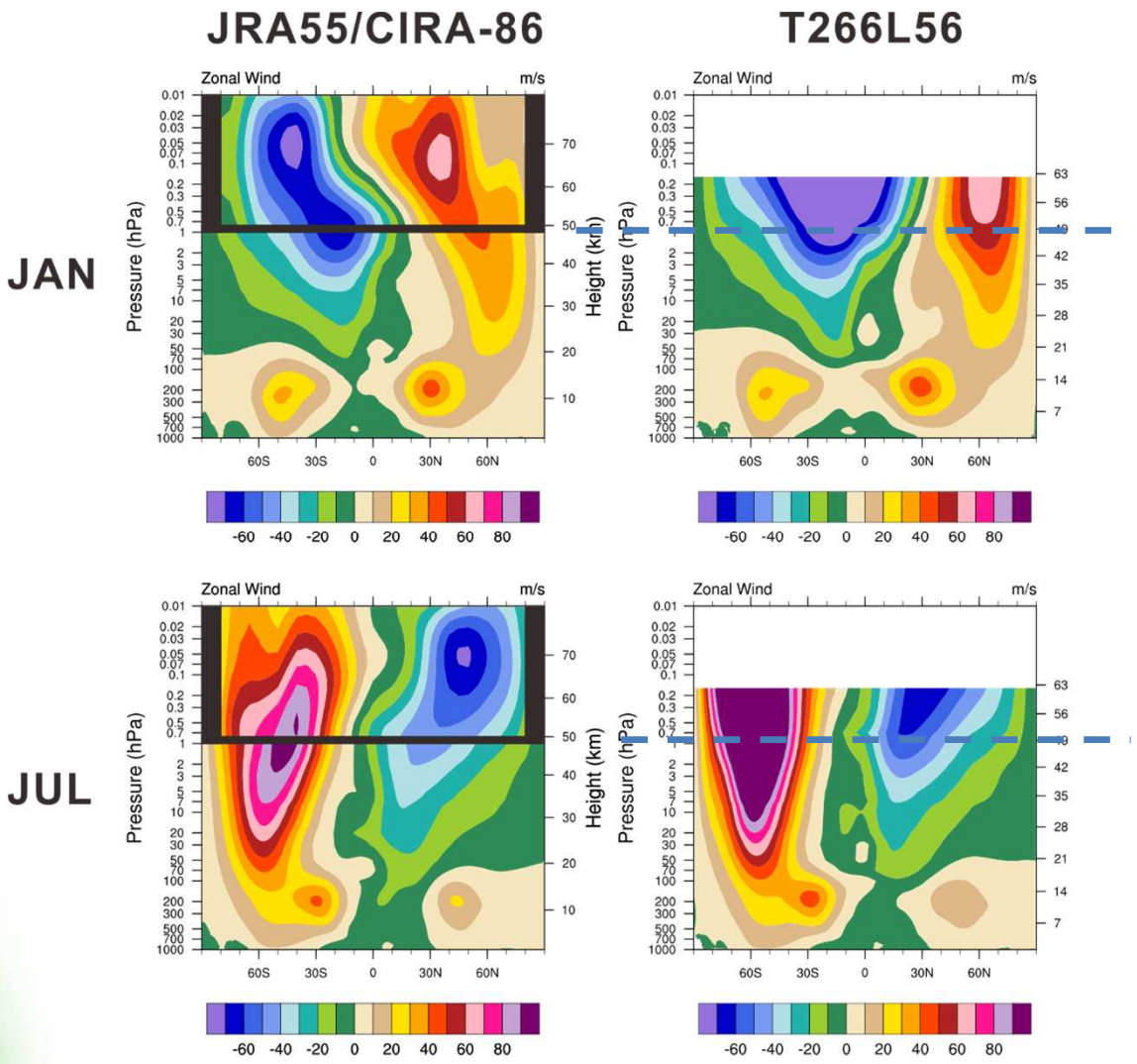


2019/11/21

The vertical structure of wind

BCC-CSM2-HR

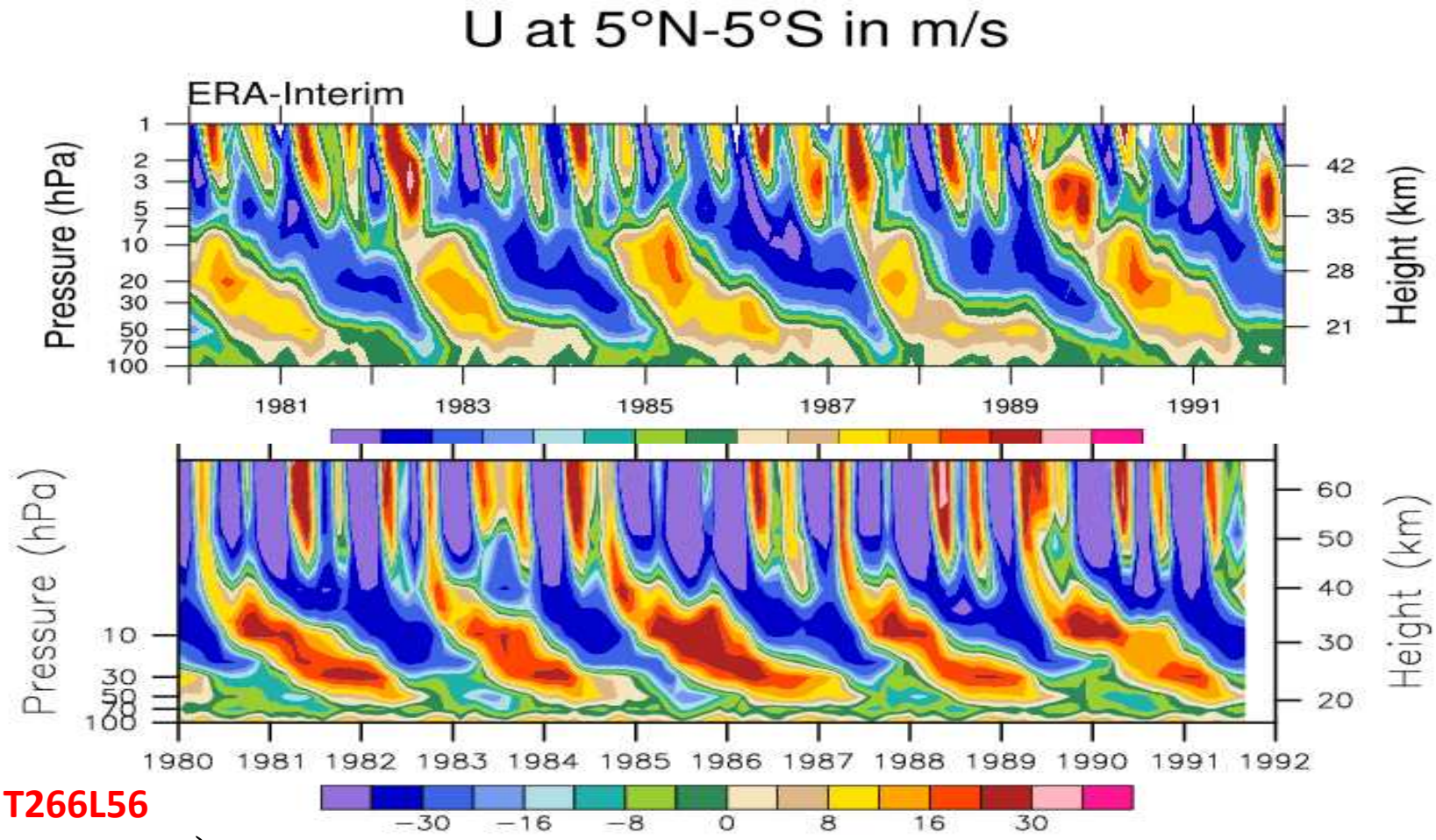


The simulation ability of BCC-CSM2-HR (T266L56)

1. The simulation ability for the temperature and the vertical structure of wind in the stratosphere and the middle atmosphere and their seasonal changes

2. Climate variations at different timescales, such as the stratospheric quasi-biennial oscillation (QBO), the Madden–Julian Oscillation (MJO)

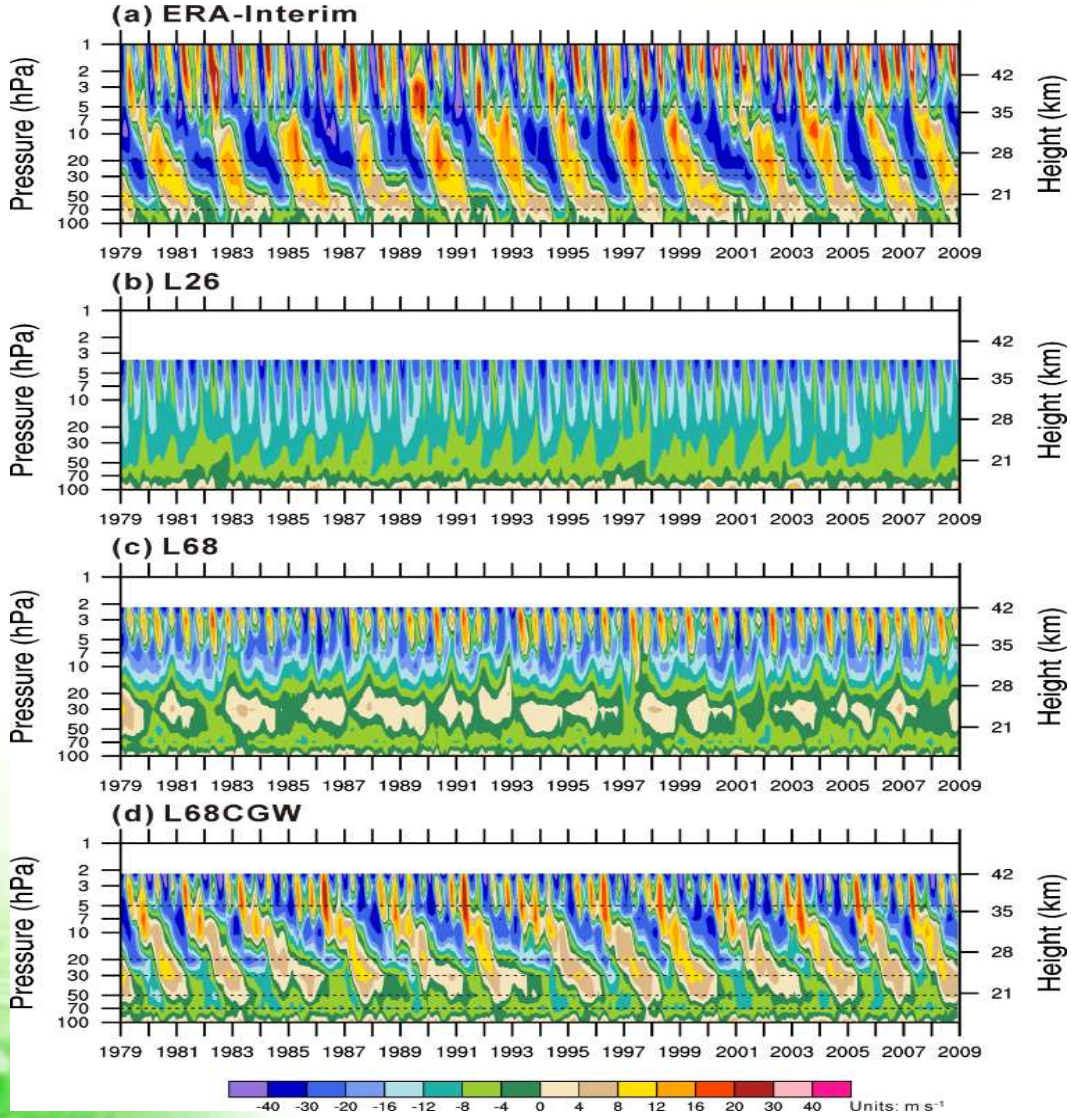
Quasi-Biennial Oscillation (QBO) in BCC-CSM2-HR



T266L56

（BCC-CSM2-HR）

Quasi-Biennial Oscillation (QBO) in BCC-AGCM



Monthly tropical zonal winds between 5°N and 5°S in the lower stratosphere from 1979 to 2008

Increase of vertical resolution is better to represent large-scale waves. But a mesoscale GW parameterization is more important to provide unresolved wave forcing of the QBO.

BCC-AGCM can spontaneously generate the QBO with realistic periods, amplitudes, and asymmetric features between westerly and easterly phases.

Reference:

- **Lu, Y., T. Wu, W. Jie, A. A. Scaife, M. B. Andrew, and J. H. Richter, 2019: Variability of the stratospheric quasi-biennial oscillation (QBO) and its wave forcing simulated in the Beijing Climate Center atmospheric general circulation model (BCC-AGCM), J.Atmos.Sci. in press.**

The simulation ability of BCC-CSM2-HR (T266L56)

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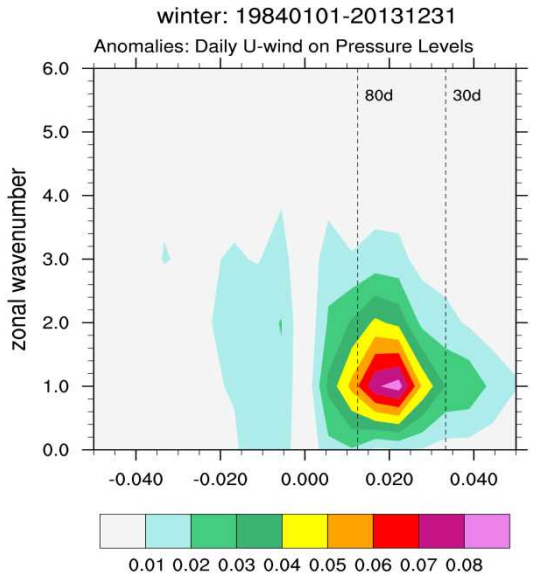
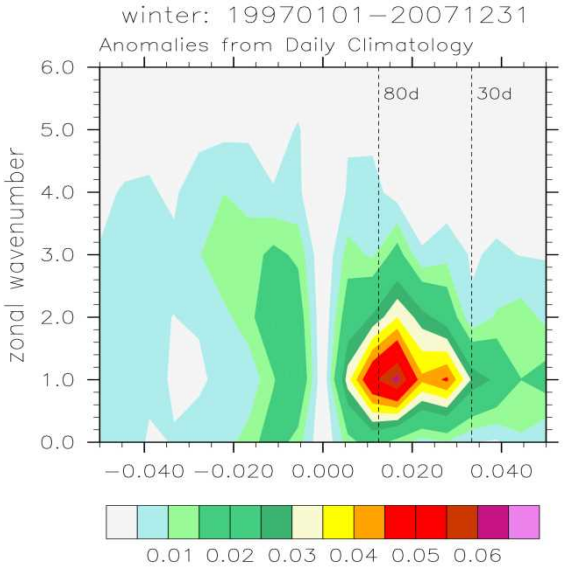
OBS

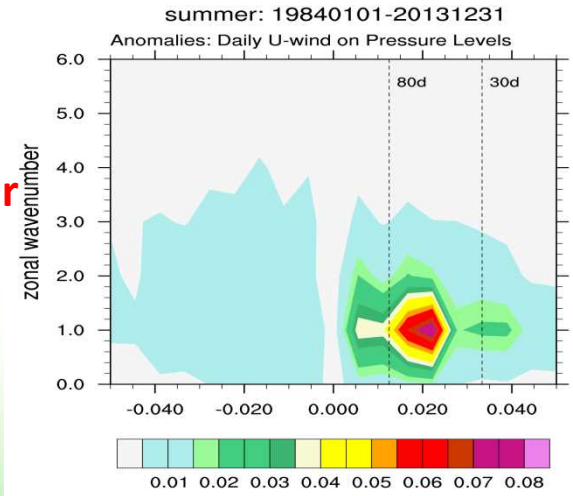
BCC-CSM2-HR
(T266L56)

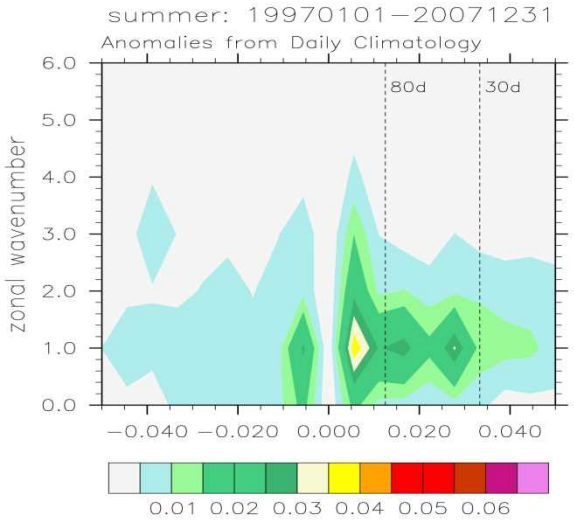
winter



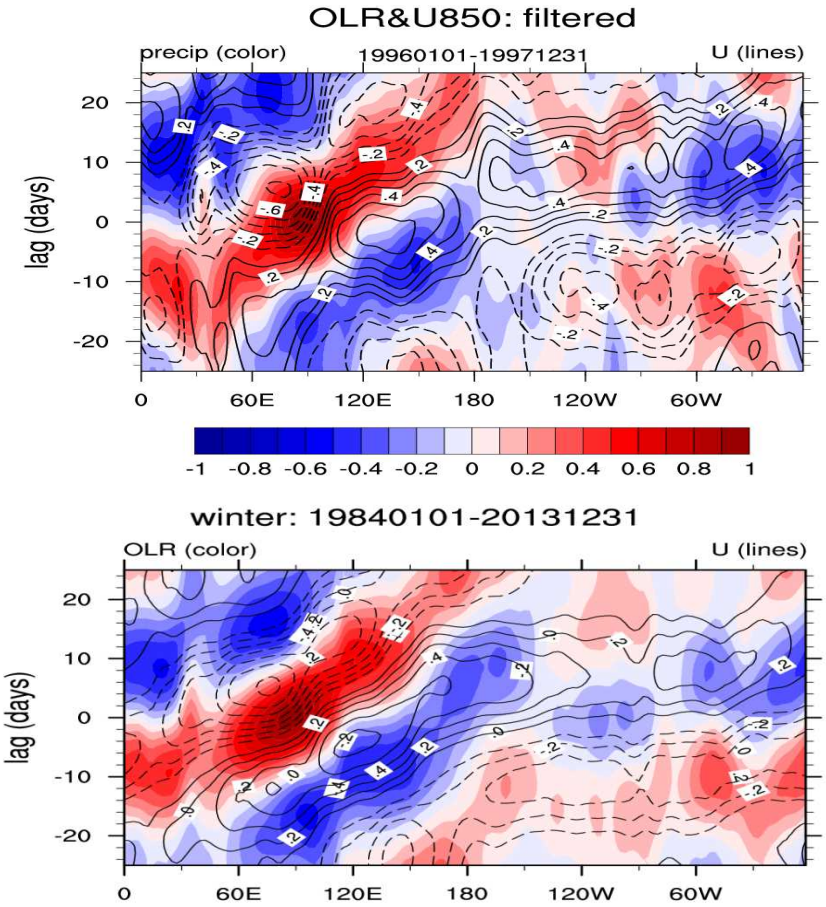


Summer

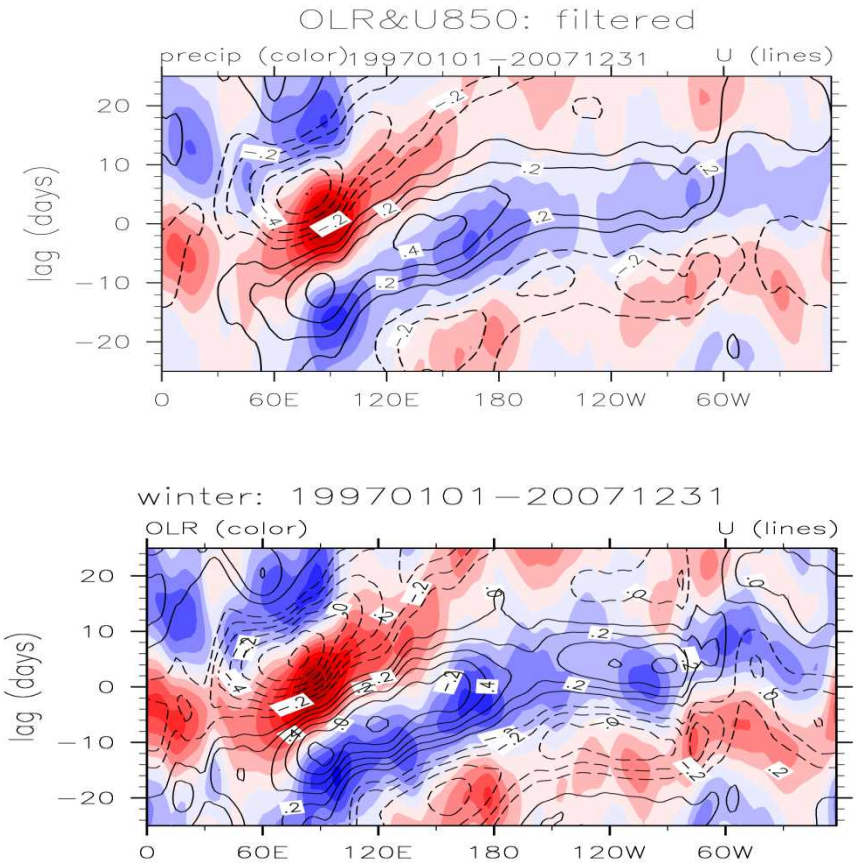




OBS

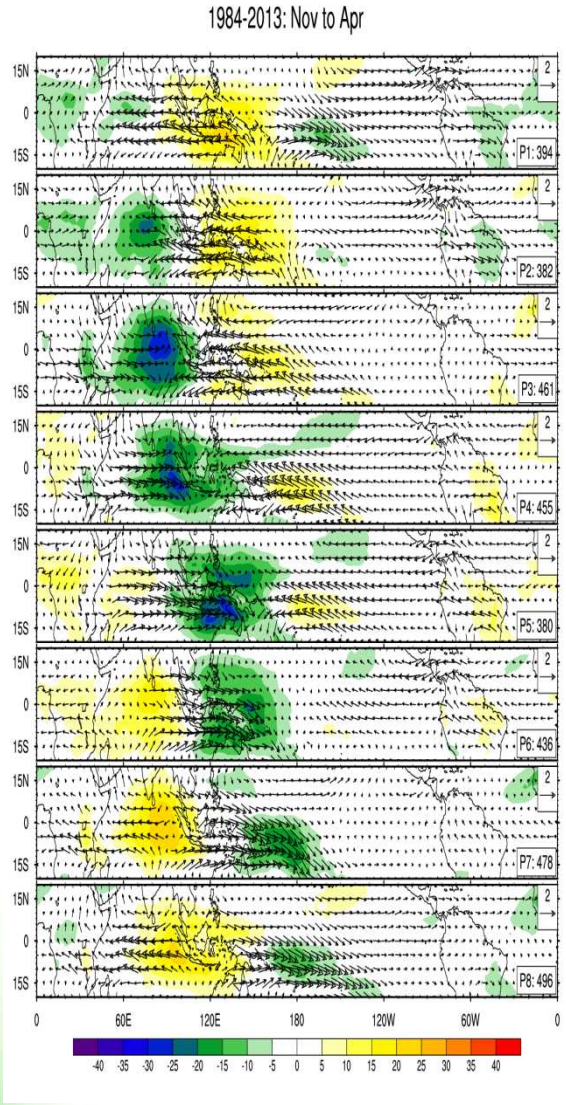


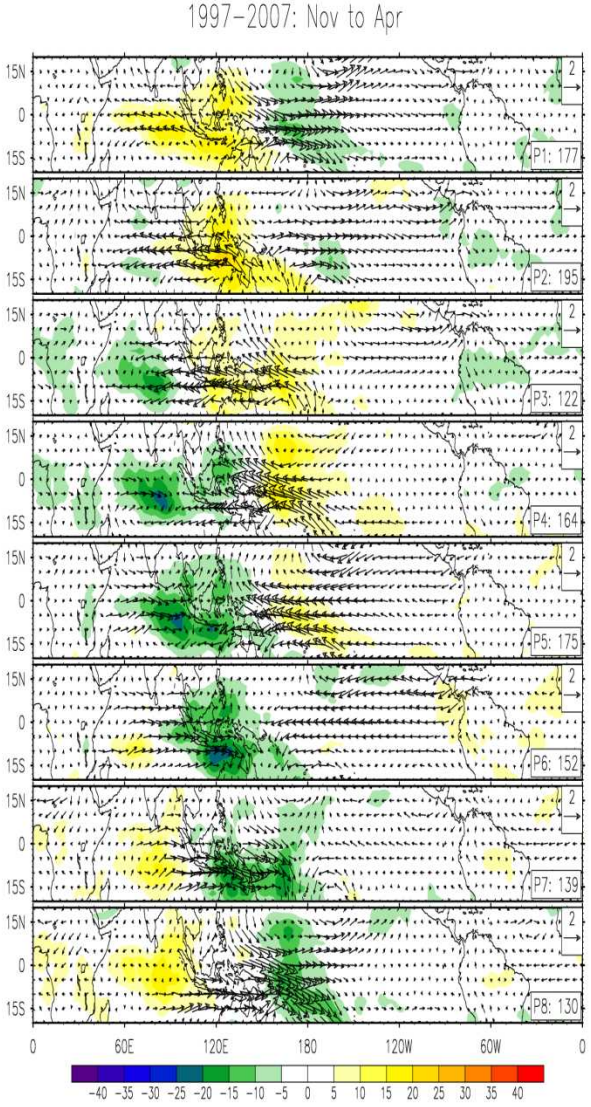
BCC-CSM2-HR (T266L56)

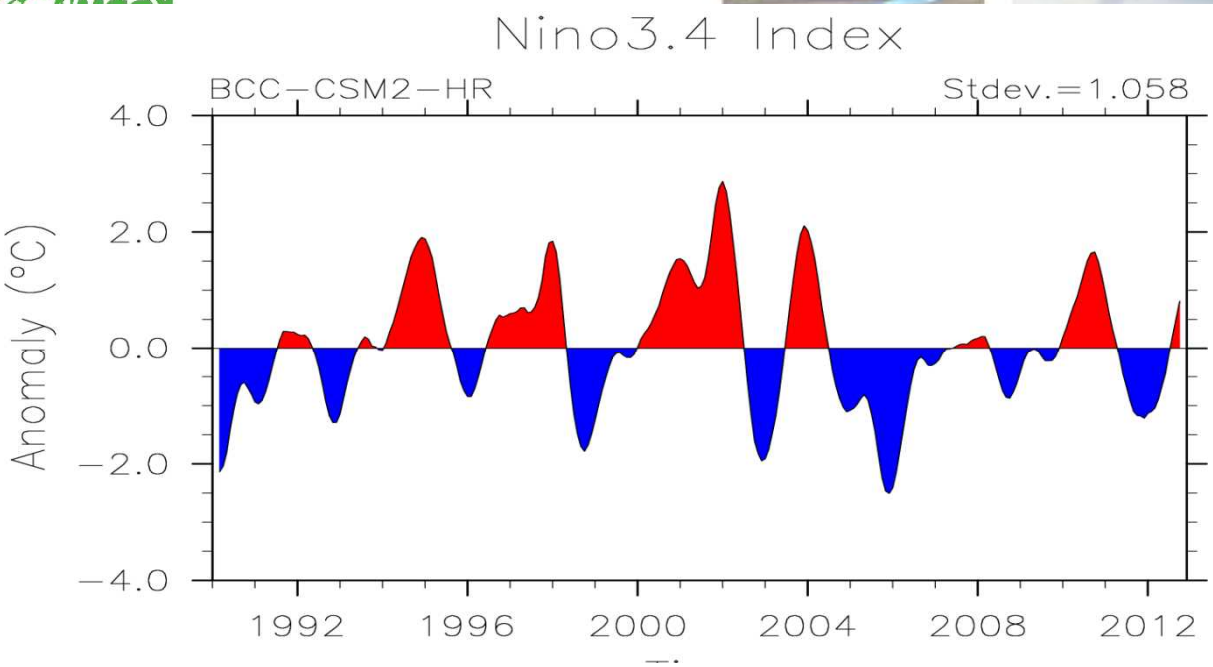


OBS

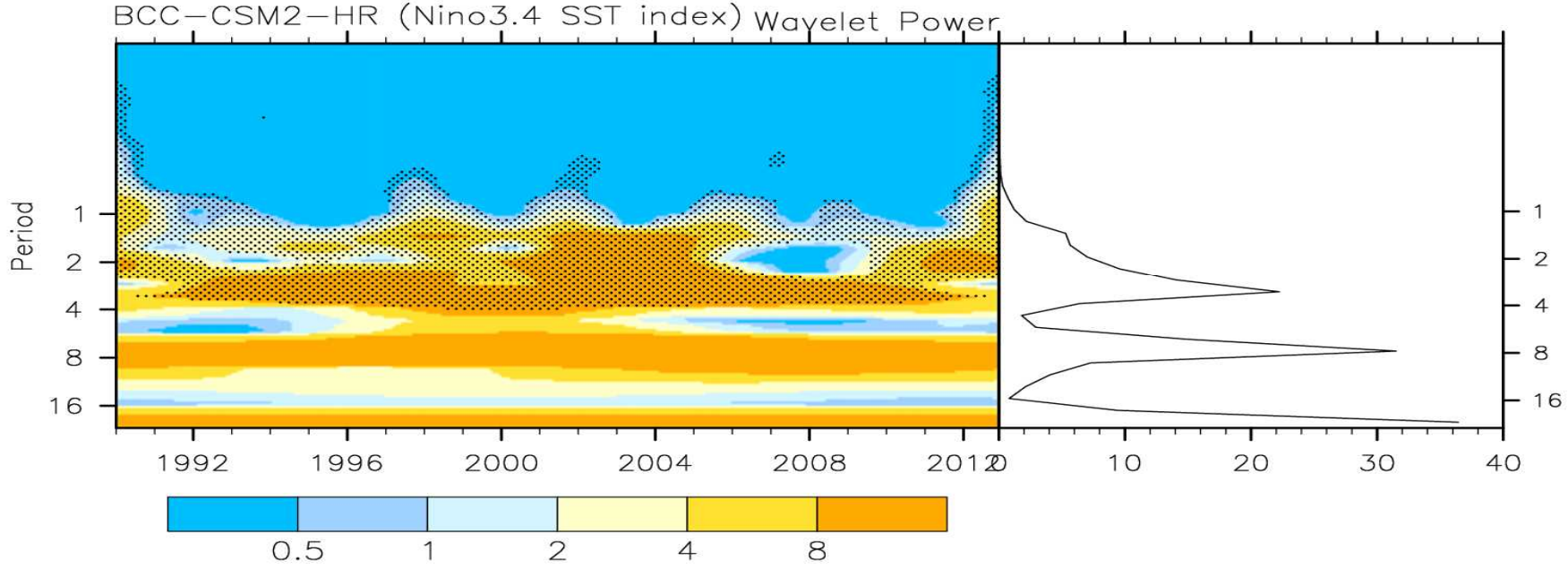
BCC-CSM2-HR (T266L56)





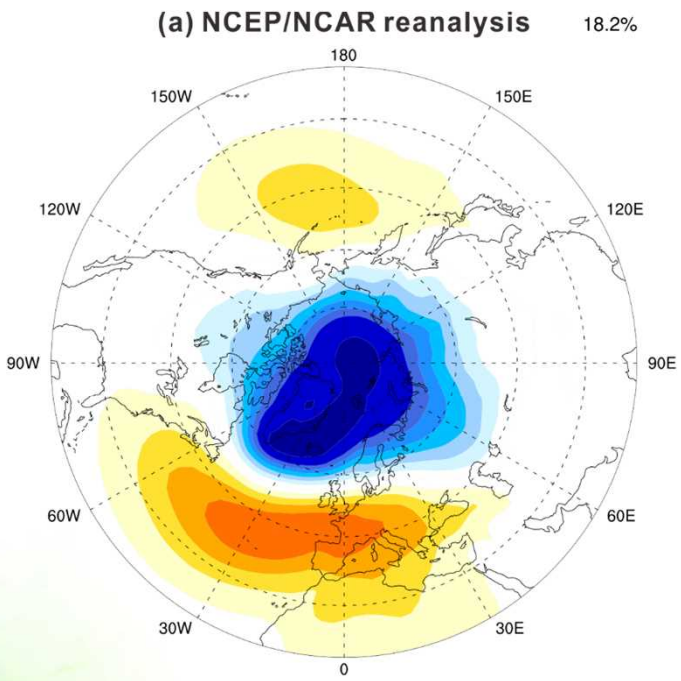


BCC-CSM2-HR
(T266L56)

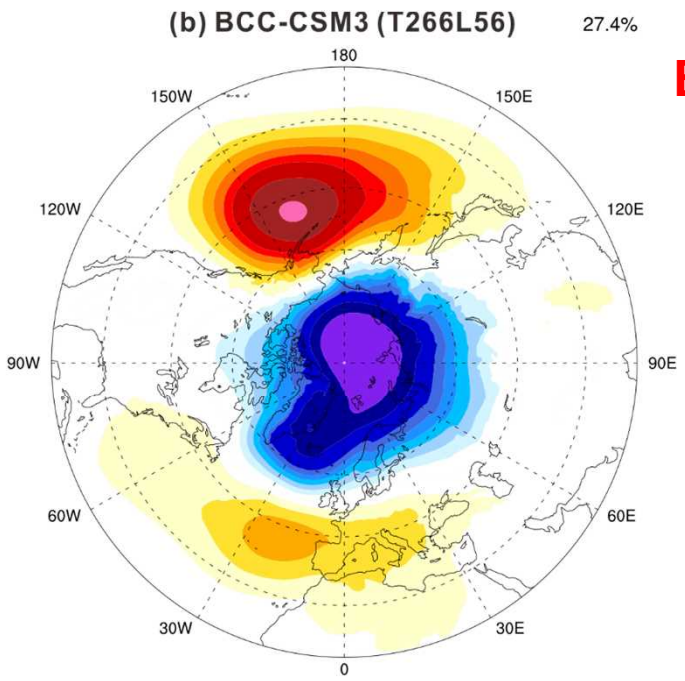


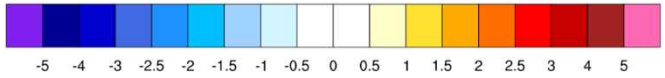
Representation of the Arctic Oscillation (AO)

(1950–2000)



(1990–2006)





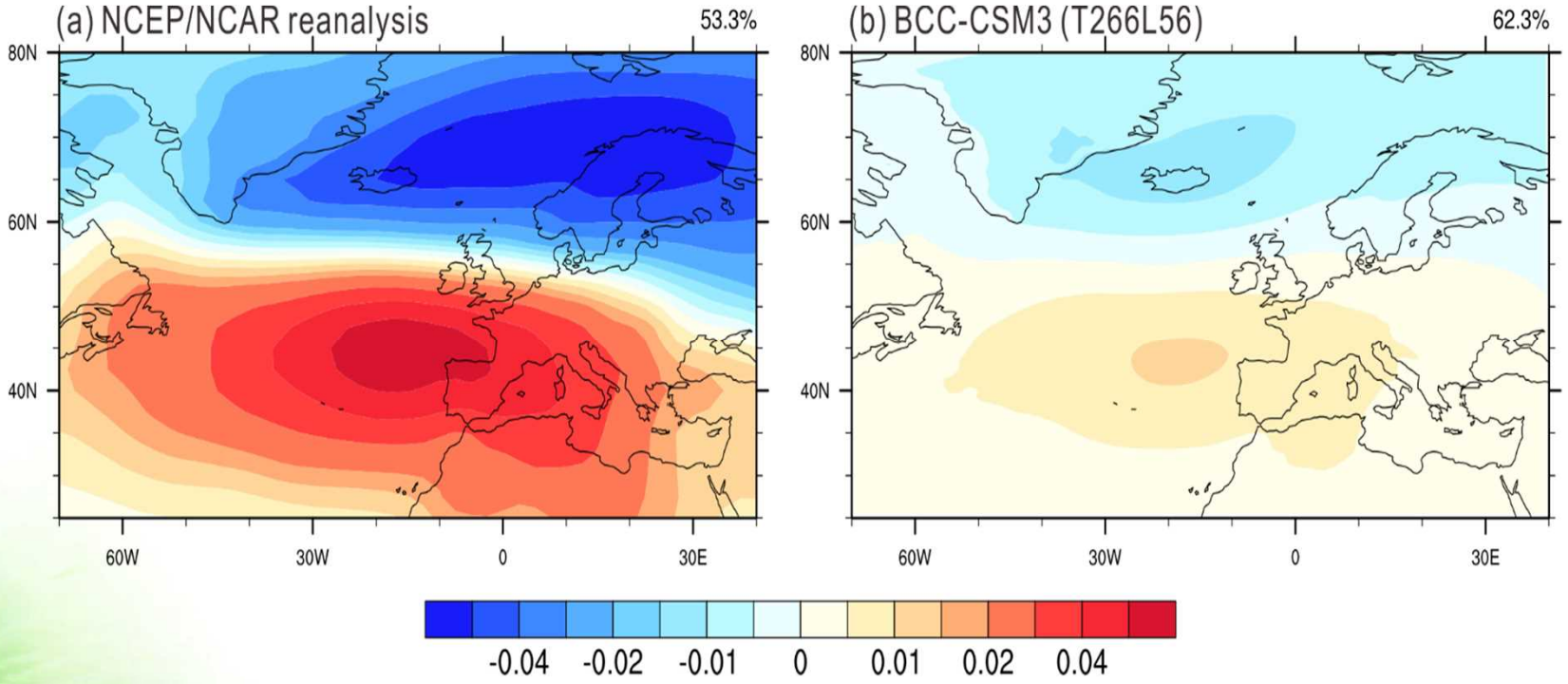
BCC-CSM2-HR
(T266L56)

Regressions of SLP anomalies in winter on the AO index derived from (a) the NCEP/NCAR reanalysis and (b) the BCC-CSM3 model simulations. The percentage of variance explained by the winter AO pattern is given at the top right-hand corner of each panel.

Representation of the North Atlantic Oscillation (NAO)

(1979–2003)

(1990–2006)



The leading EOF mode of winter SLP derived from (a) the NCEP/NCAR reanalysis and (b) the BCC-CSM3 model simulations. The percentage of variance explained by the winter NAO pattern is given at the top right-hand corner of each panel.

The simulation ability of BCC-CSM2-HR (T266L56)

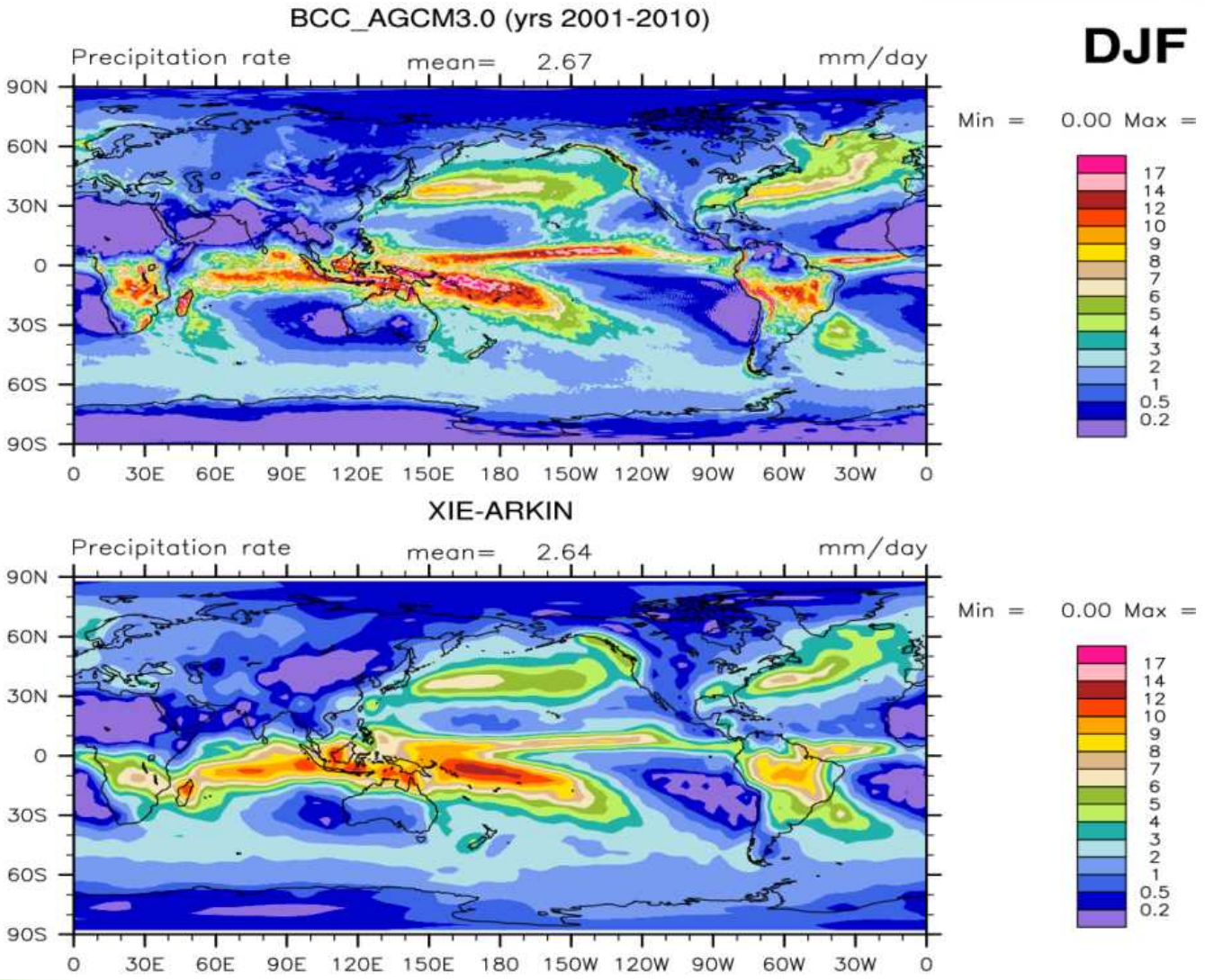
1. The simulation ability for the temperature and the vertical structure of wind in the stratosphere and the middle atmosphere and their seasonal changes

2. Climate variations at different timescales, such as the stratospheric quasi-biennial oscillation (QBO), the Madden–Julian Oscillation (MJO)

3. Improve the simulation of Intertropical Convergence Zone (ITCZ)

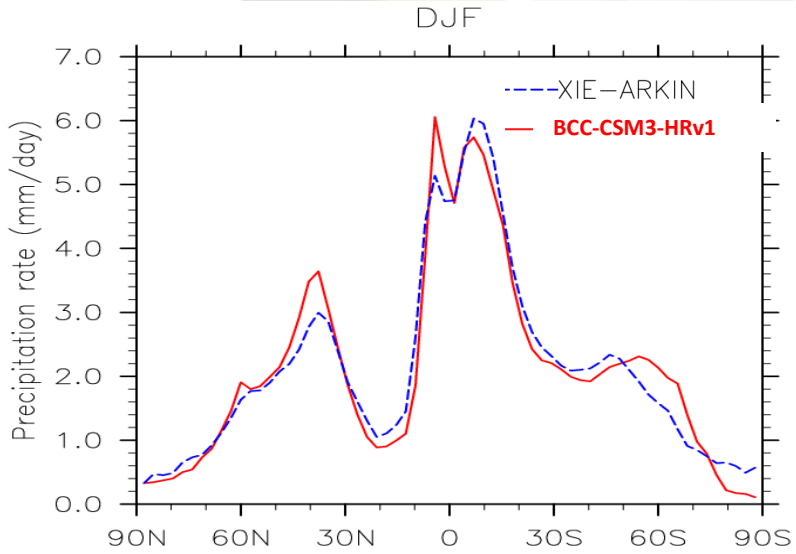
Precipitation climate mean from BCC-CSM2-HR

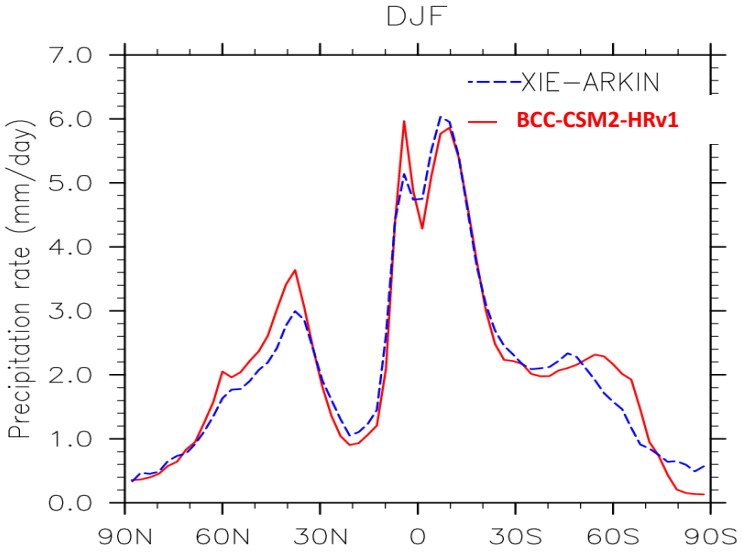
BCC-CSM2-HR
（T266L56）



OBS

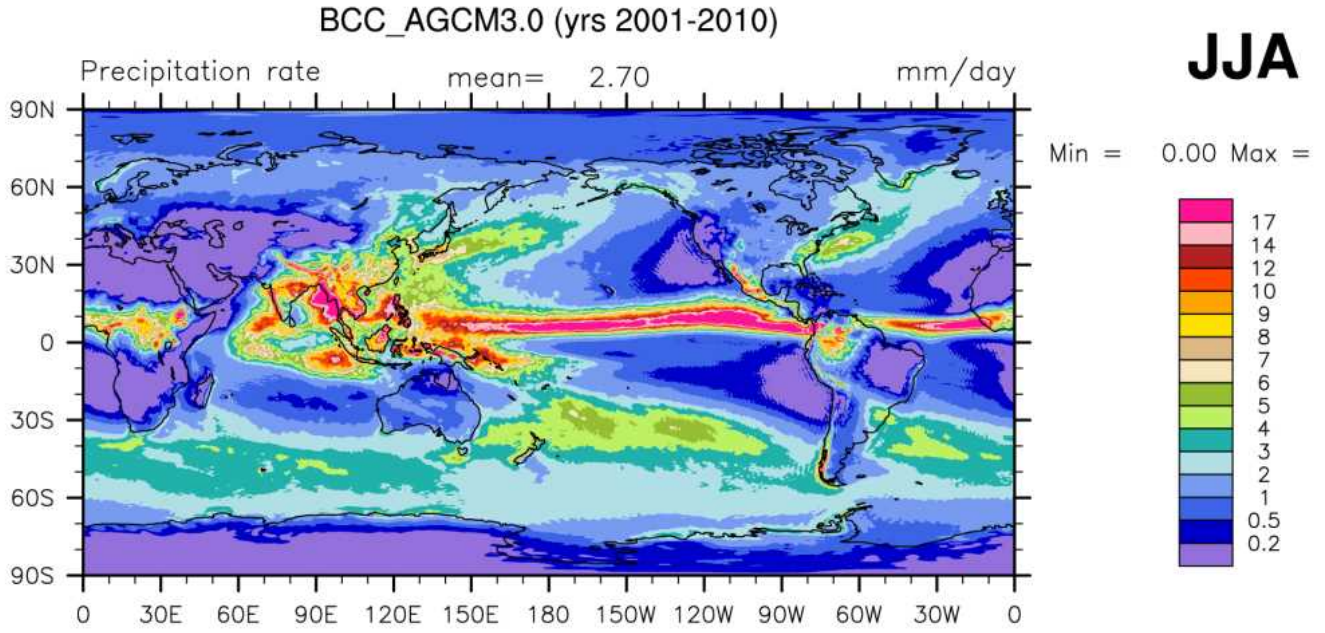
Precipitation climate mean from BCC-CSM2-HR



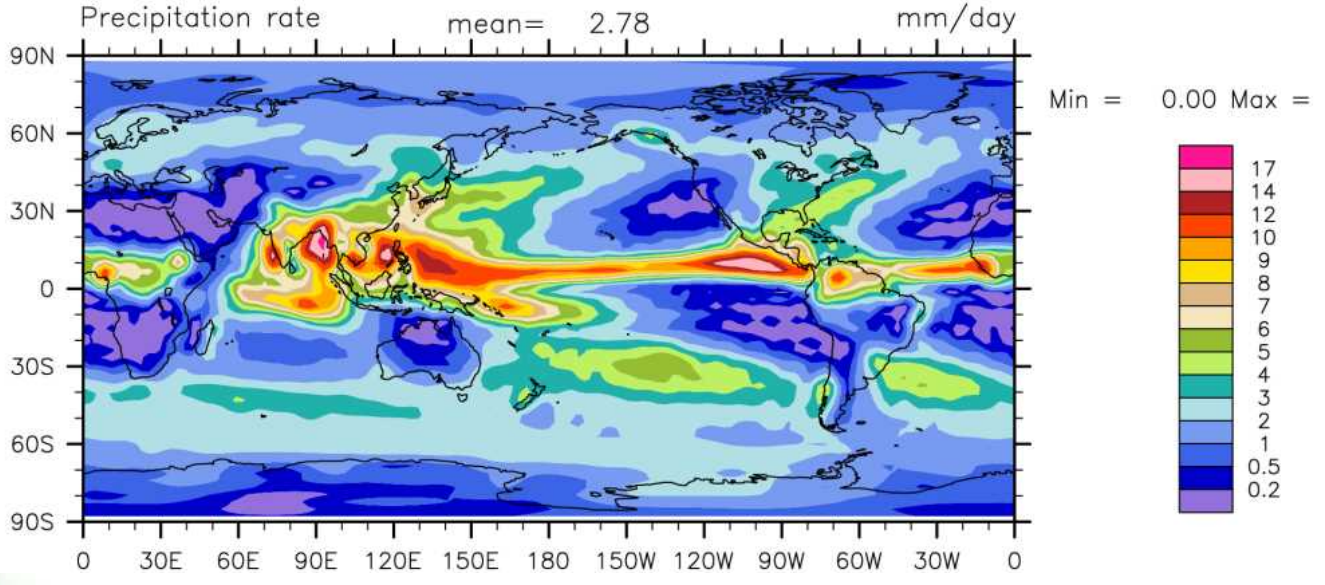


Precipitation climate mean from BCC-CSM2-HR

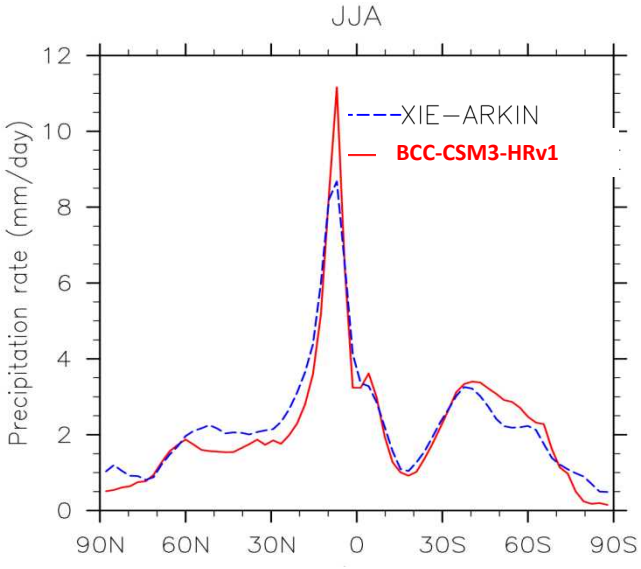
BCC-CSM2-HRv1
（T266L56）

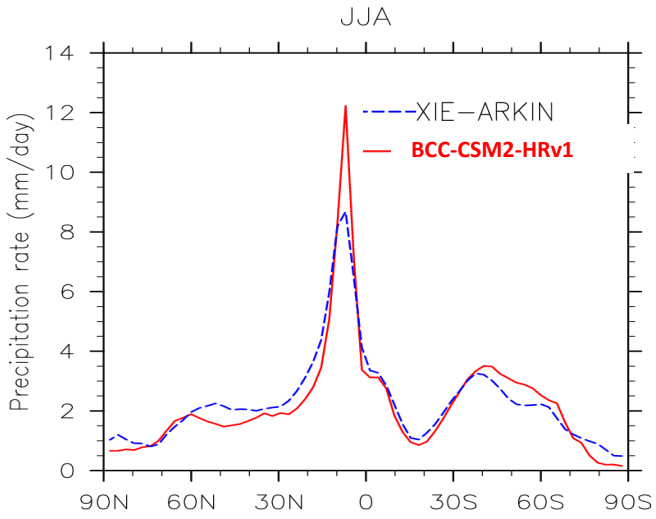


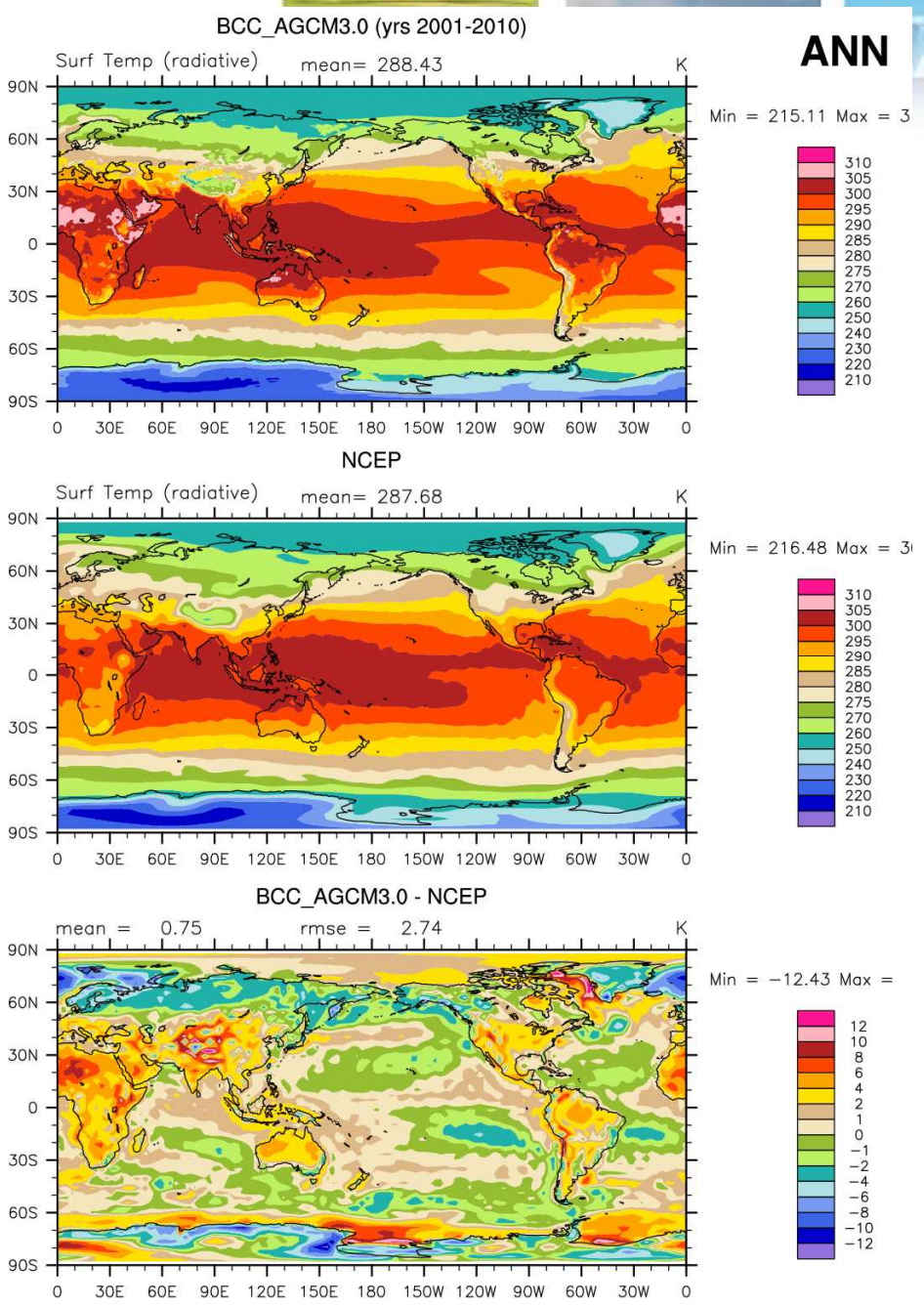
OBS



Precipitation climate mean from BCC-CSM2-HR






BCC_AGCM3.0 (yrs 2001-2010)
ANN
Surf Temp (radiative)
mean= 288.43
K
Min = 215.11 Max = 3
310
305
300
295
290
285
280
275
270
260
250
240
230
220
210
90N
60N
30N
0
30S
60S
90S
0 30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W 0
NCEP
Surf Temp (radiative)
mean= 287.68
K
Min = 216.48 Max = 3
BCC_AGCM3.0 - NCEP
mean = 0.75
rmse = 2.74
K
Min = −12.43 Max =
12
10
8
6
4
2
1
0
−1
−2
−4
−6
−8
−10
−12

The simulation ability of BCC-CSM2-HR (T266L56)

1. The simulation ability for the temperature and the vertical structure of wind in the stratosphere and the middle atmosphere and their seasonal changes

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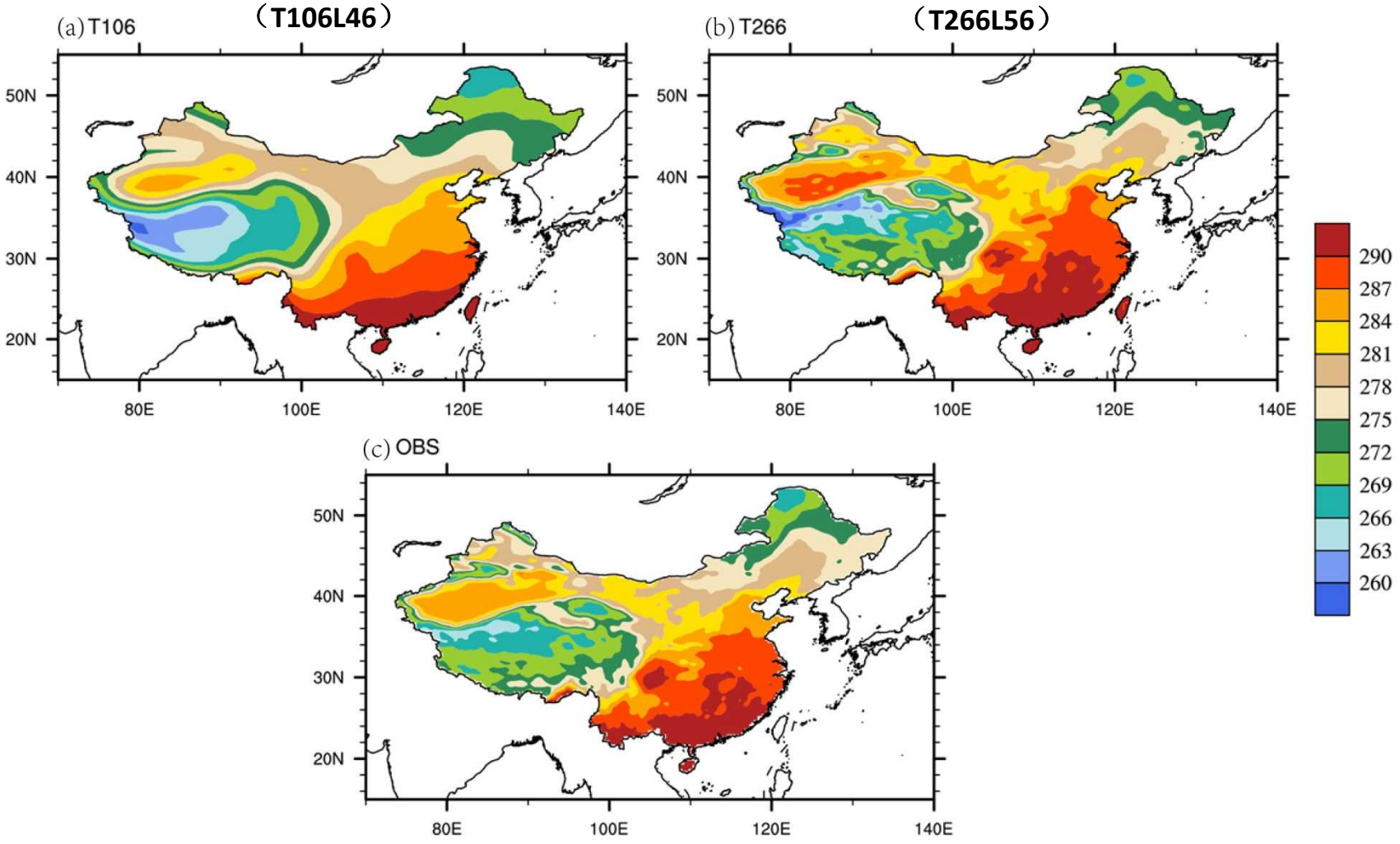
3. Improve the simulation of Intertropical Convergence Zone (ITCZ)

4. Improve the simulation of surface air temperature, precipitation, and atmospheric circulation for China and East Asia regions

Annual mean surface temperature (K)

BCC-CSM2-MR
（T106L46）

BCC-CSM2-HRv1
（T266L56）

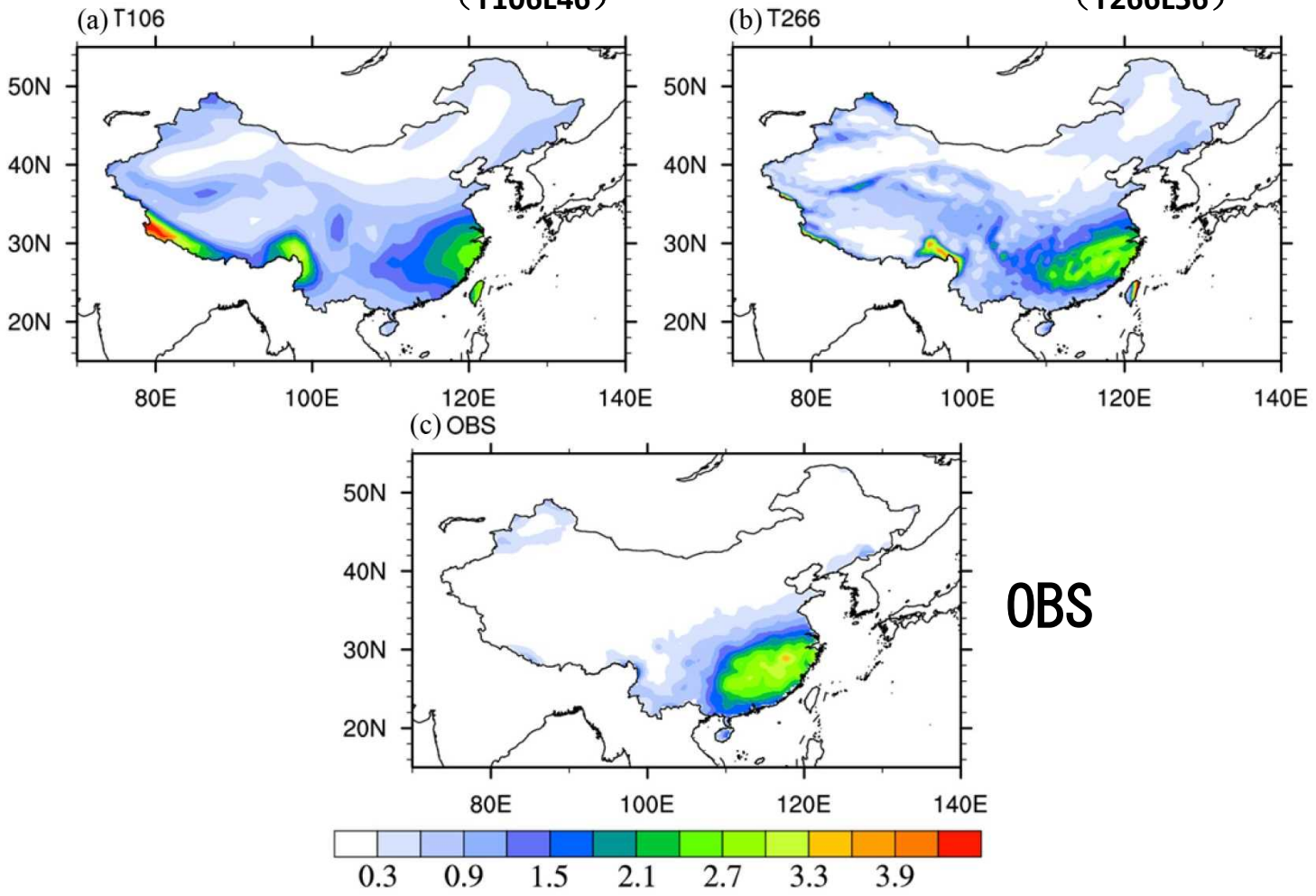


OBS

Mean precipitation in Winter(DJF)(mm/day)

BCC-CSM2-MR
（T106L46）

BCC-CSM2-HRv1
（T266L56）

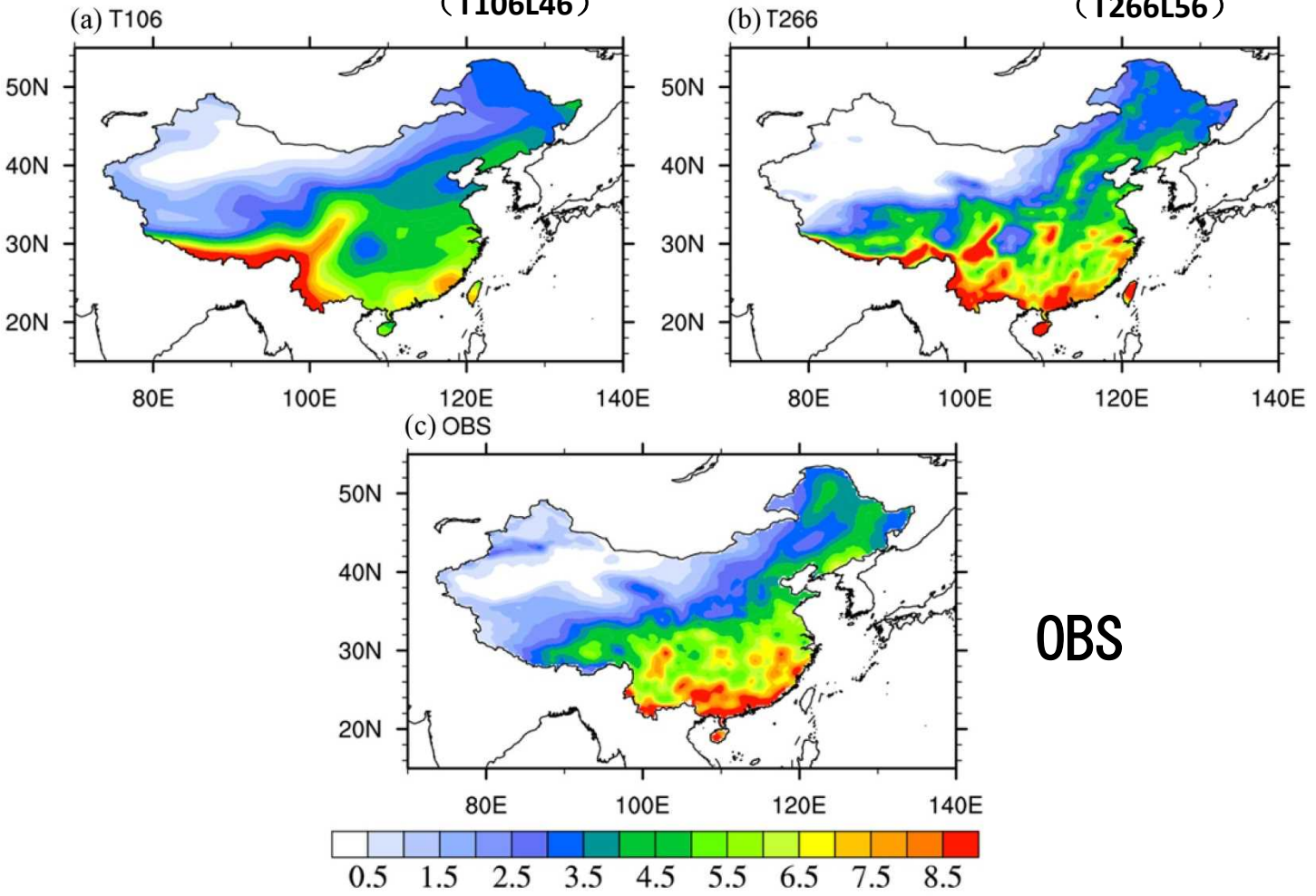


OBS

Mean precipitation in Summer(JJA)(mm/day)

BCC-CSM2-MR
（T106L46）

BCC-CSM2-HRv1
（T266L56）



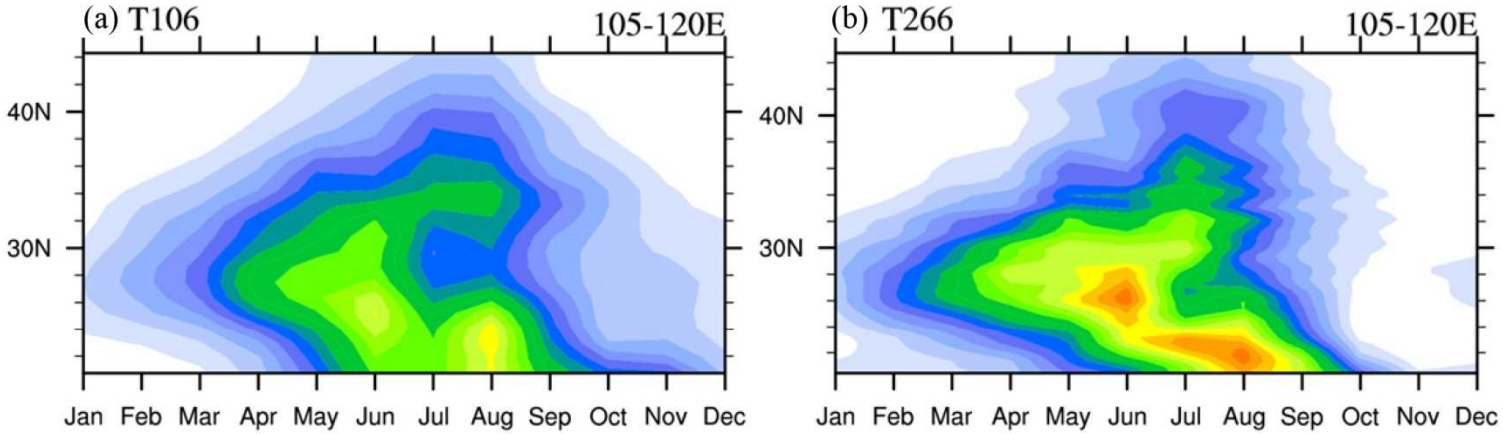
OBS

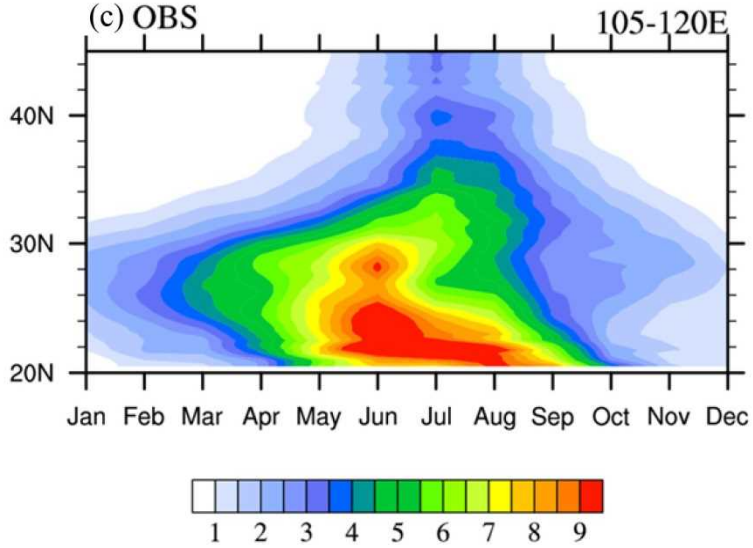
Seasonal movement of the precipitaiton in Eastern China

(mean between 105-120E)

BCC-CSM2-MR
（T106L46）

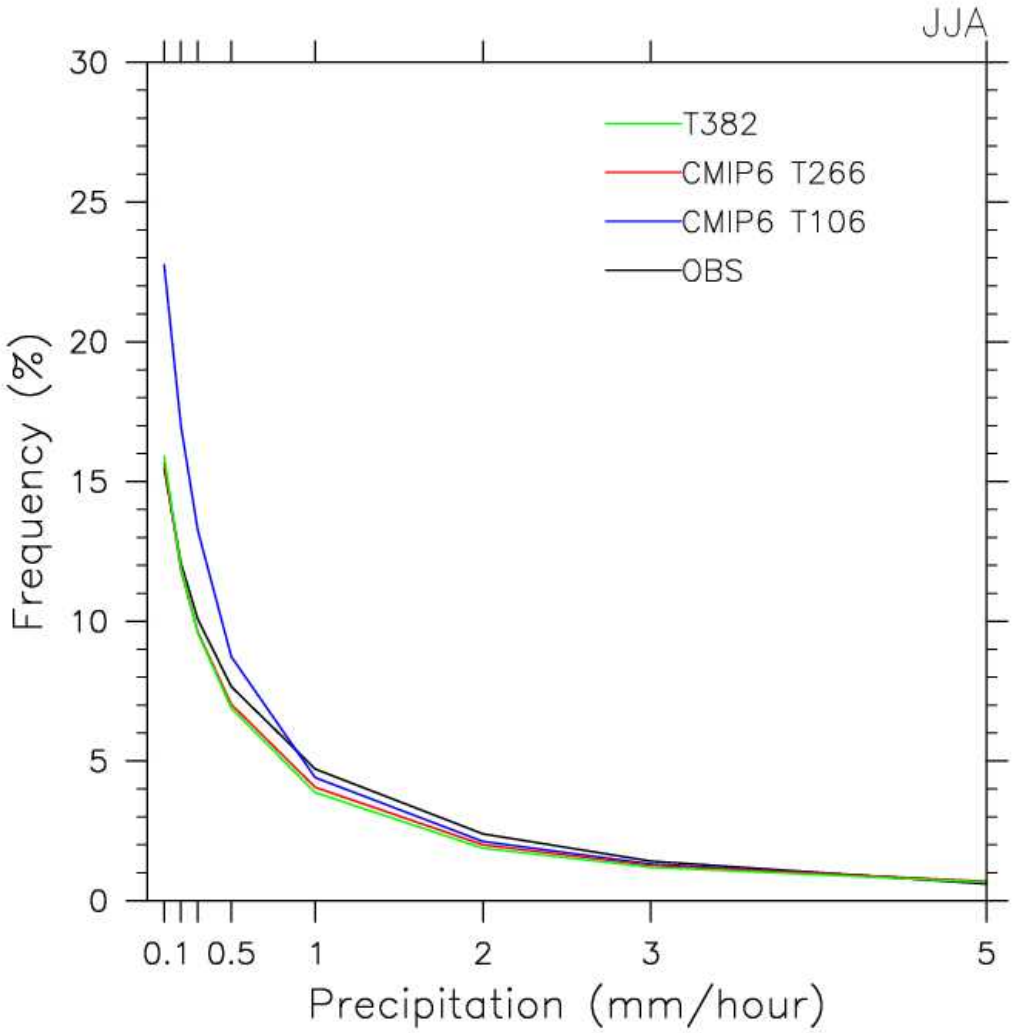
BCC-CSM2-HRv1
（T266L56）

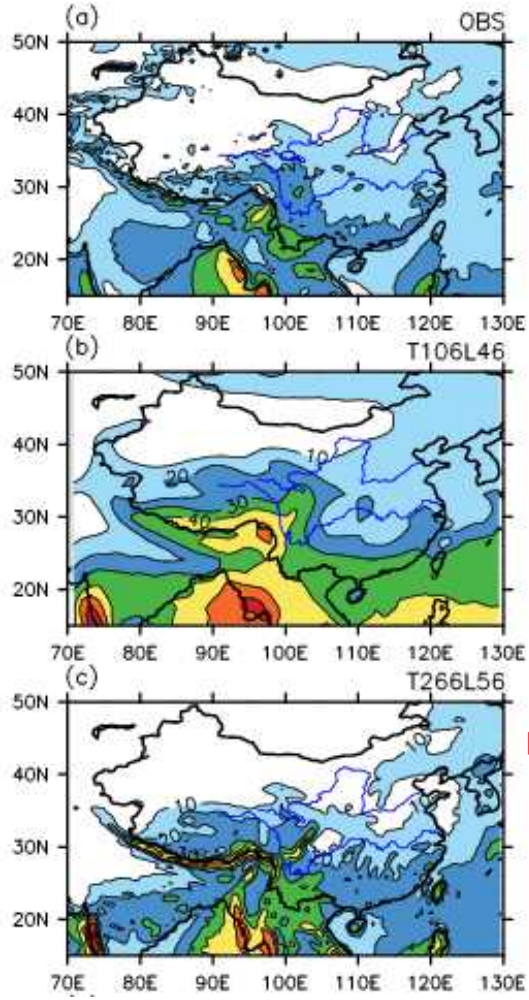




OBS

Summer precipitation frequency of East Asia





OBS

BCC-CSM2-MR
（T106L46）

BCC-CSM2-HRv1
（T266L56）

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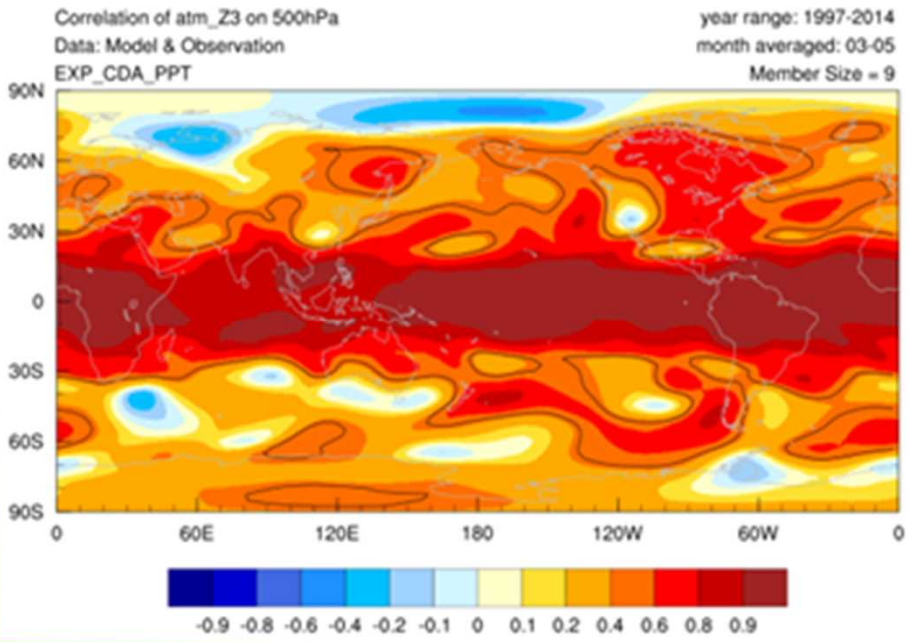
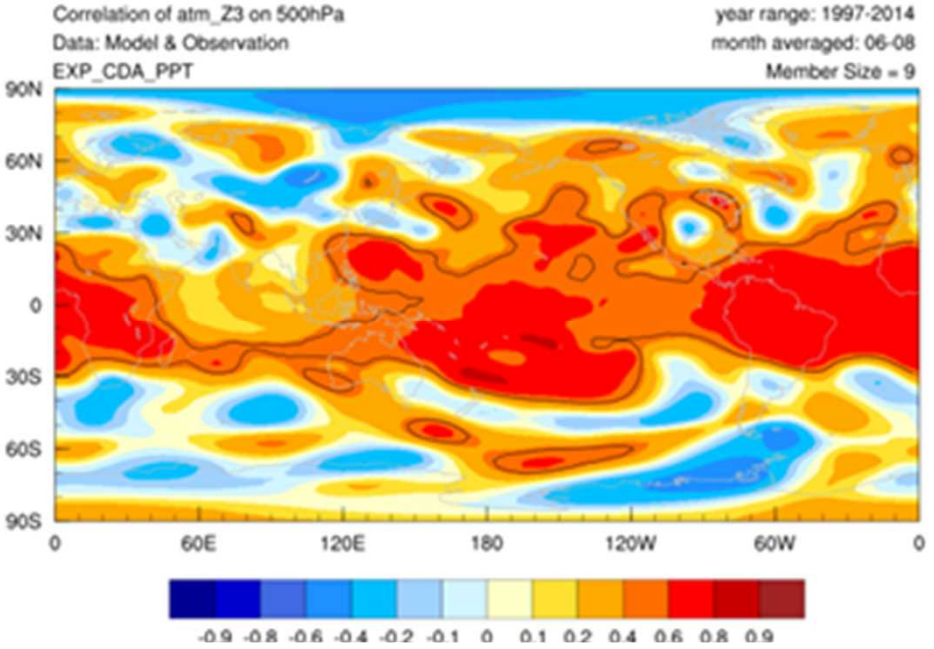
TCC Skill

MAM



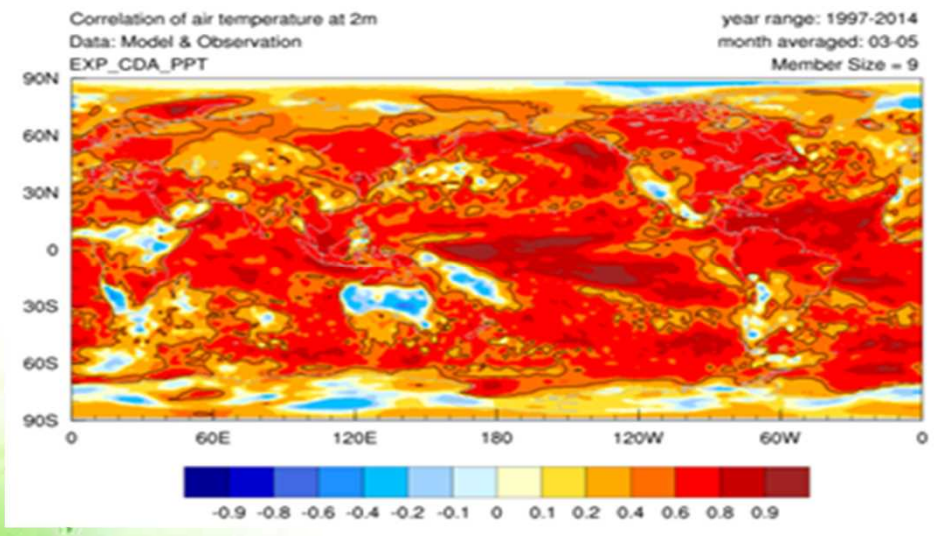
JJA

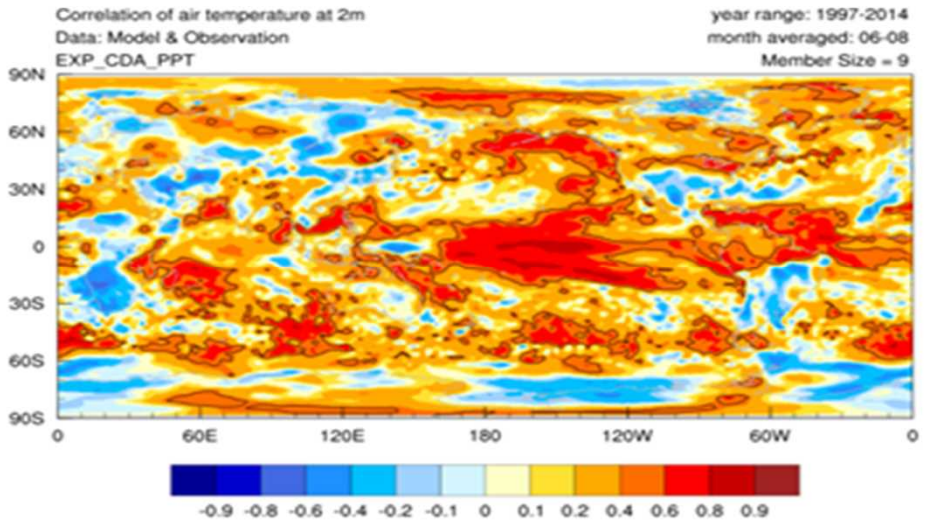


H500

TCC Skill

MAM **JJA**

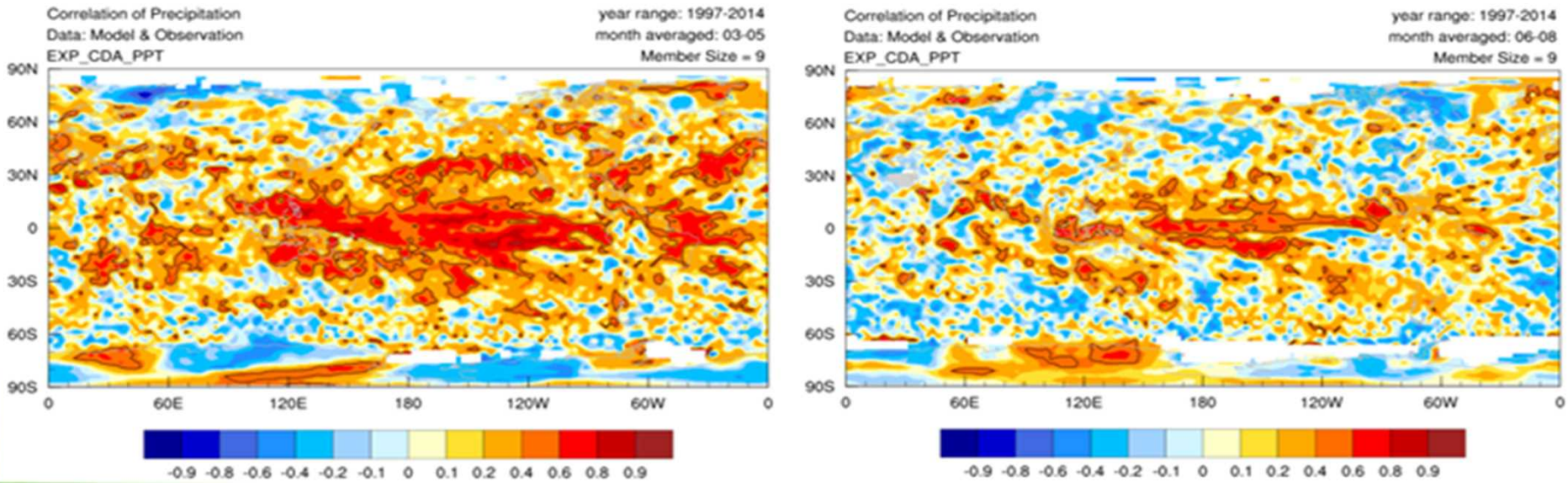




T2m

TCC Skill

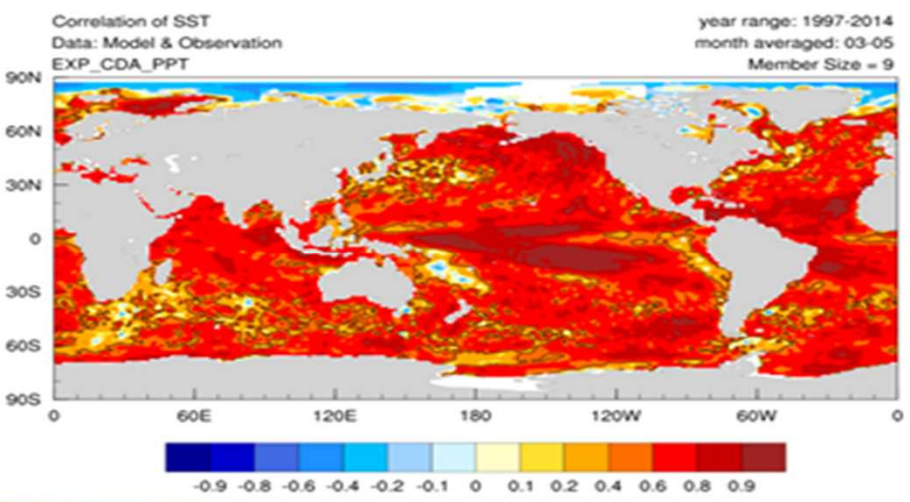
MAM **JJA**

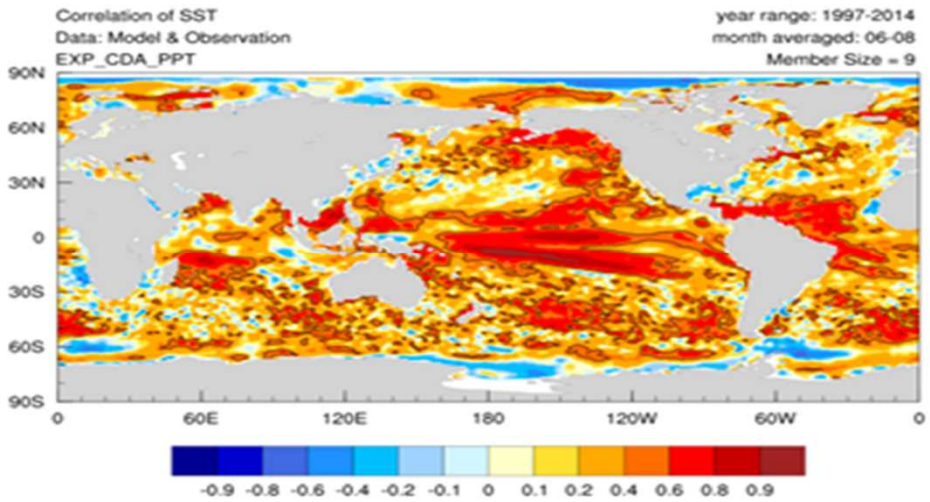


precipitation

TCC Skill

MAM **JJA**

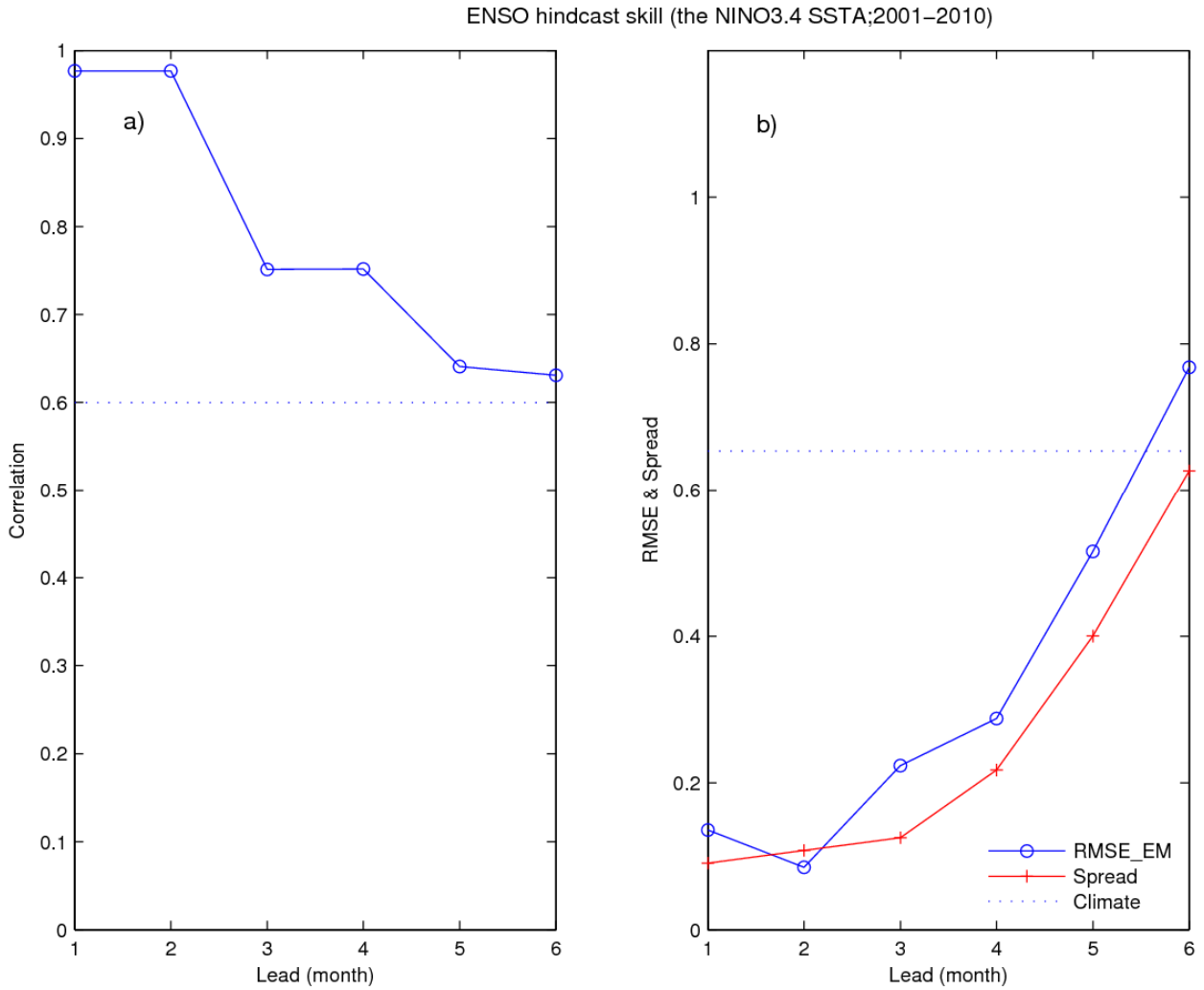




SST

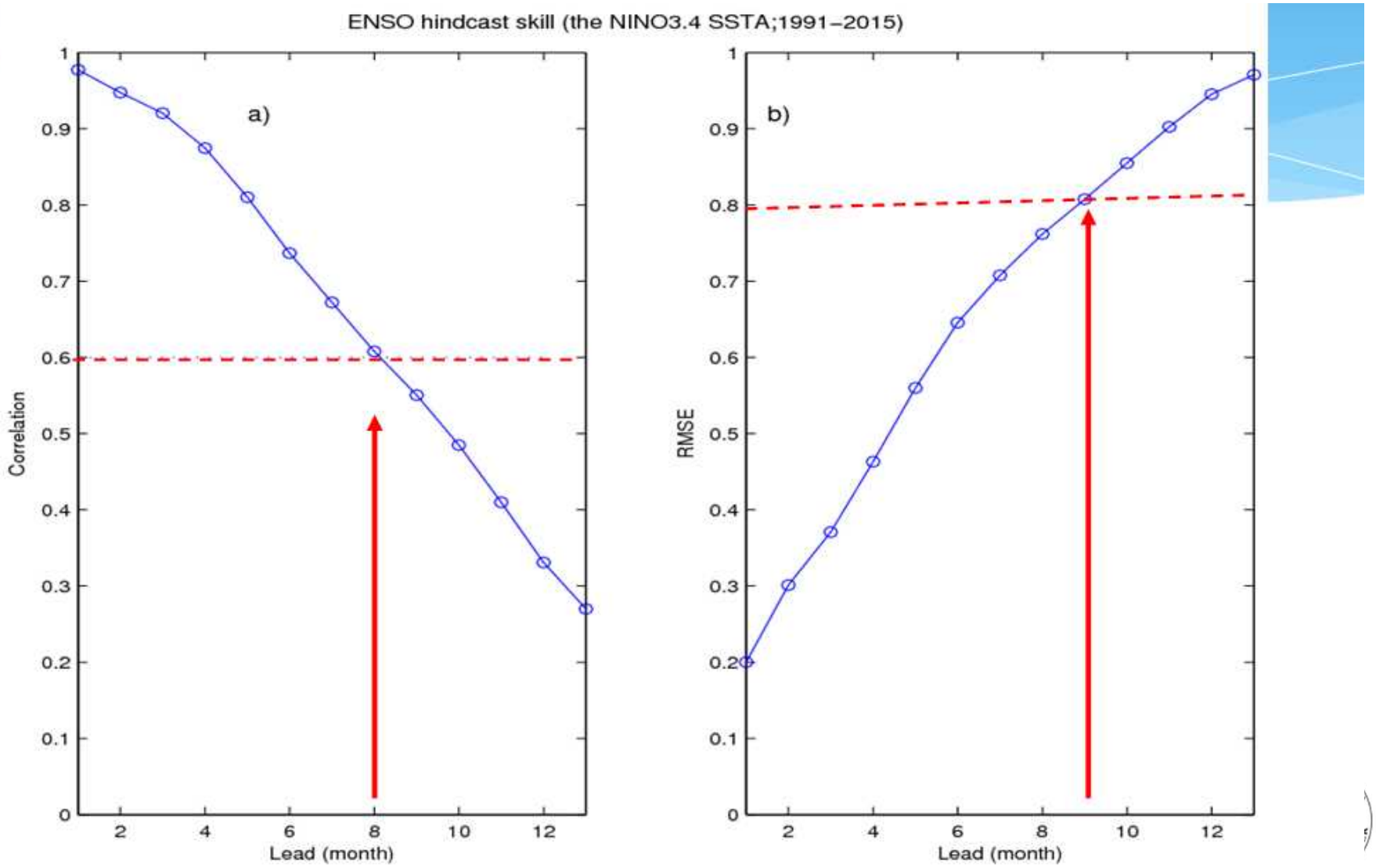
ENSO forecast skill of 2001-2010 from March

BCC-CSM2-HR(T266L56)



9 samples
(LAF 5 samples +PPT 3 samples +FLUX_HIGH 1 samples)

ENSO forecast skill of BCC-CSM2-MR(T106L46)



Thanks !