Seasonal Climate Outlook for Winter 2019/2020 over China

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Outline
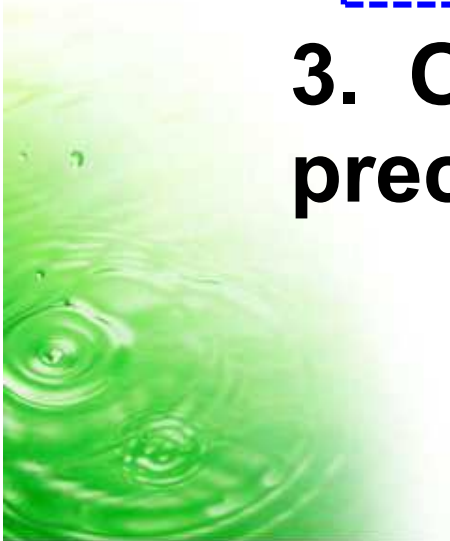
1. **EAWM System and Signals**

2. **Outlook for EAWM**

   2.1 Prediction by BCC_CSM 1.1m, BCC/CMA

   2.2 Statistic Analysis with SSTA and Arctic Sea Ice

3. **Outlook for temperature and precipitation over China**

1. EAWM system and potential boundary forcing

Major circulation systems affecting winter climate in China

- East Asia Winter Monsoon (EAWM), including :
  Arctic Oscillation,
  Ural blocking,
  Siberian high,
  East Asian trough，
  Western Pacific subtropical
   high (WPSH),
   India-Burma trough.

- potential boundary forcing
  SSTA (ENSO, IOD)
 Arctic Sea Ice Extent (ASIE)

During winter, the Siberian high (SH) and EAWM play more important roles in regulating winter temperature. And their potential boundary forcing signals contains SSTA and Arctic sea ice extent, SSTA main contains ENSO and IOD.
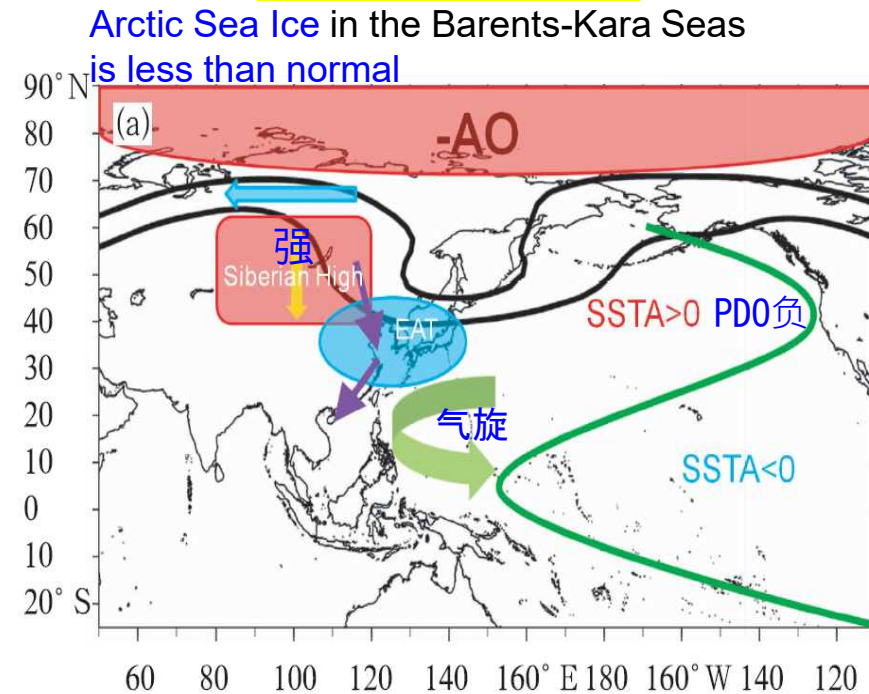
● **Schematic diagrams depicting the characteristics and circulation patterns during (a) warm and (b) cold winter over China.**

(a) warm winter

Arctic Sea Ice is above normal

(b) cold winter

Arctic Sea Ice in the Barents-Kara Seas is less than normal
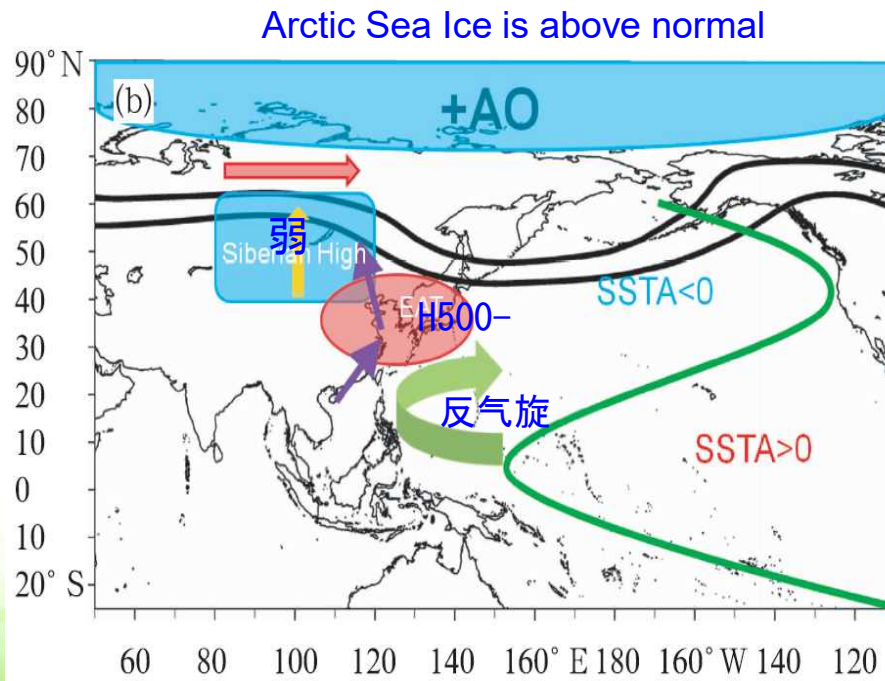
In warm winter: there is a warm SST in Pacific, and the Arctic Sea Ice in the Barents-Kara Seas is above the normal. The Arctic Oscillation is in positive phase, Siberian high, the East Asian trough, and EAWM are weak, these patterns lead to warmer temperatures in China. In cold winter: the circulation patterns show a opposite feature.
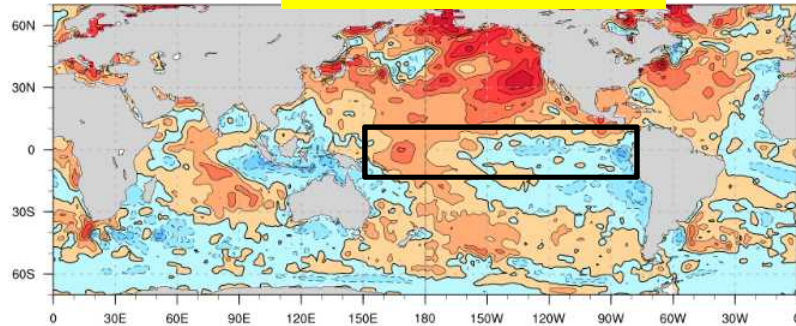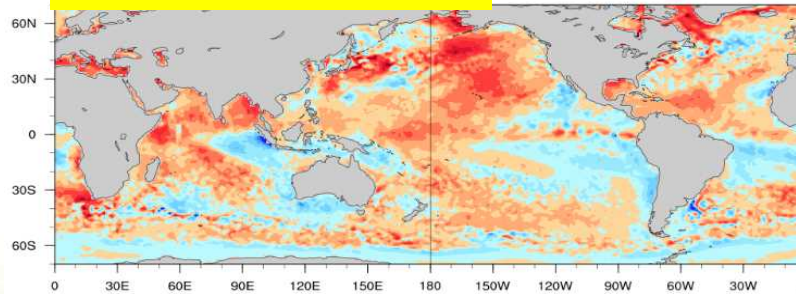
Liang et al,2014；Ding et al. 2014
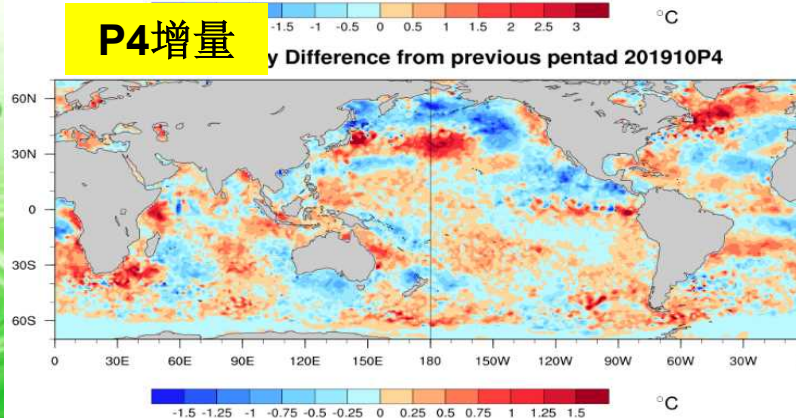
● Recent global SST monitoring

SSTA-2019Sep

SSTA-2019Oct_P4

P4增量

DATE	Nino3.4	Nino3	Nino4
7月5候	0.3	-0.04	0.98
7月6候	0.2	-0.28	0.86
8月1候	0.23	-0.41	0.79
8月2候	0.09	-0.4	0.78
8月3候	-0.11	-0.51	0.61
8月4候	-0.16	-0.47	0.65
8月5候	-0.38	-0.4	0.49
8月6候	-0.38	-0.43	0.37
9月1候	-0.34	-0.34	0.42
9月2候	-0.25	-0.32	0.38
9月3候	-0.48	-0.79	0.20
9月4候	-0.09	-0.58	0.38
9月5候	-0.09	-0.51	0.65
9月6候	-0.03	-0.31	0.67
10月1候	0.11	-0.15	0.73
10月2候	0.08	-0.42	0.78
10月3候	0.29	0.01	0.79
10月4候	0.30	0.06	0.81

◆ **In July 2019, the weak El Niño Modoki event ended, the eastern Pacific Ocean became colder in August and September. In end of September to early October 2019, the Nino3.4 index was close to 0°C. But the SST in mid-eastern Pacific increased somewhat in October.**

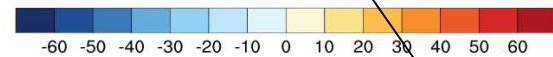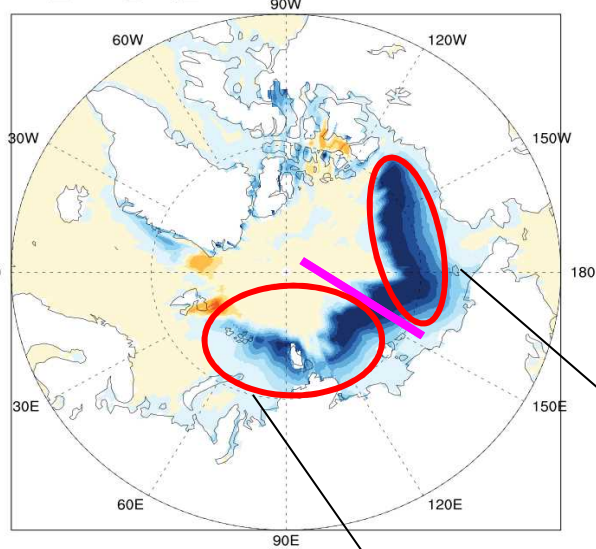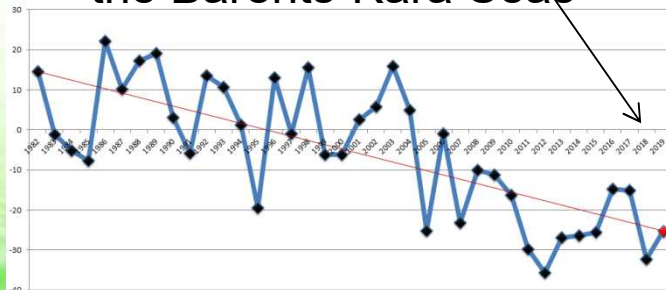◆ **The Indian Ocean Dipole (IOD) is in positive phase.**

Arctic sea ice monitoring in September 2019

Credit: National Snow and Ice Data Center： https://nsidc.org/arcticseaicenews/

icec_anom_Sep_2019

September Monthly Mean Extent and Trends

41-year trend:
1979-2019
82,400 km² / yr

flattest 13-year trend:
2007-2019
1,200 km² / yr

steepest 13-year trend:
1999-2012
203,000 km² / yr

Monthly September ice extent for 1979 to 2019
shows a decline of 12.9 percent per decade.

the Barents-Kara Seas
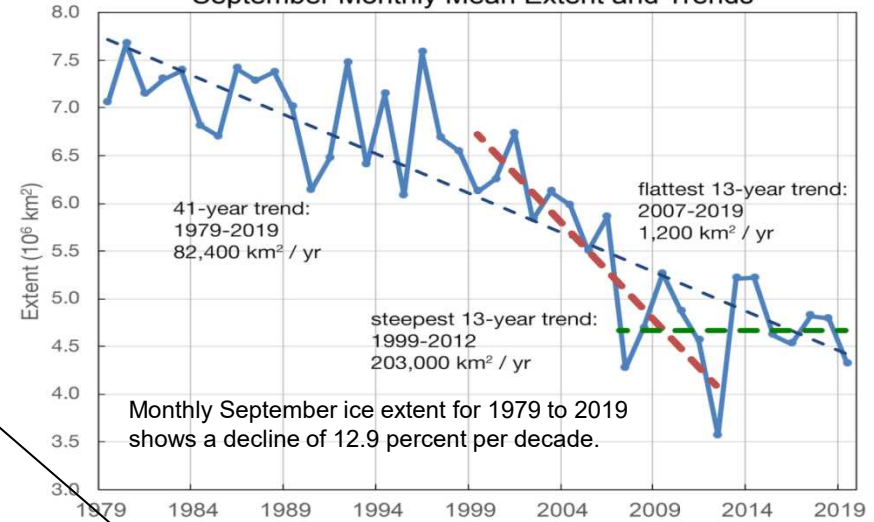
East Siberian sea - Chukchi sea
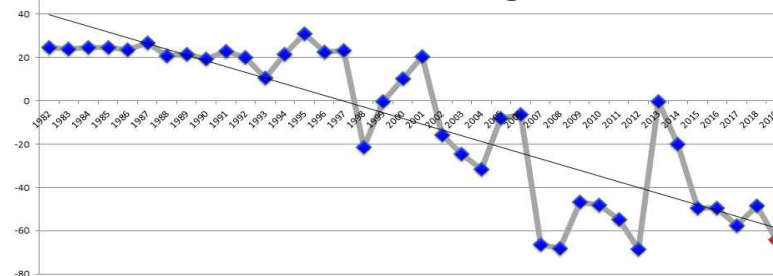
Arctic sea ice extent is 3rd lowest in September 2019. But the sea ice in the Barents-Kara Seas is close to normal after detrended. And the sea ice in the East Siberian sea - Chukchi sea is below the normal after detrended.

Outline

ENSO

BCC Three-Month Forecast — Started 20191001 — Valid 201912 - 202002
Sea Surface Temperature (line) and its Anomaly (shading) — Units: C
BCC_CSM1.1(m) — Member Size = 24
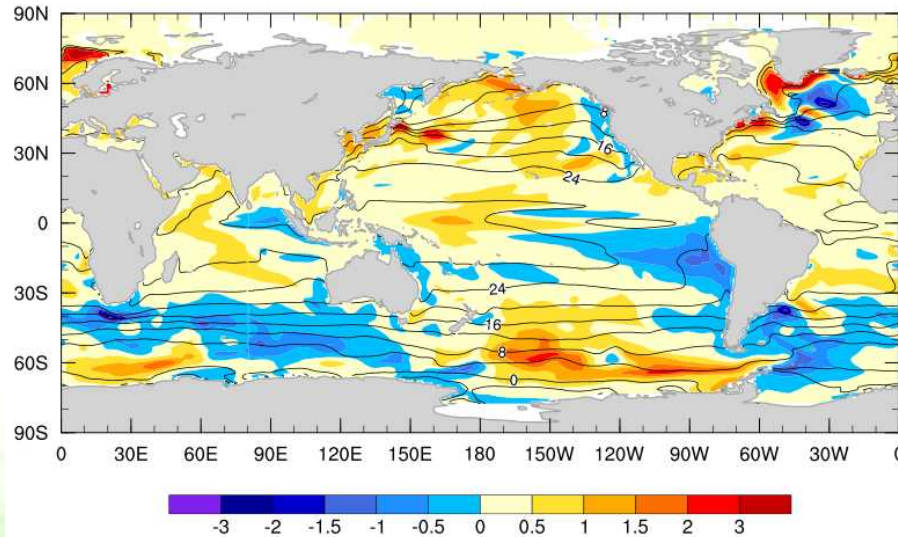
ENSO SST Indices (K): CMME 20190920 forecast
Monitor (OISST): 201810-201909; Forecast: 201910-202003
Nino3.4
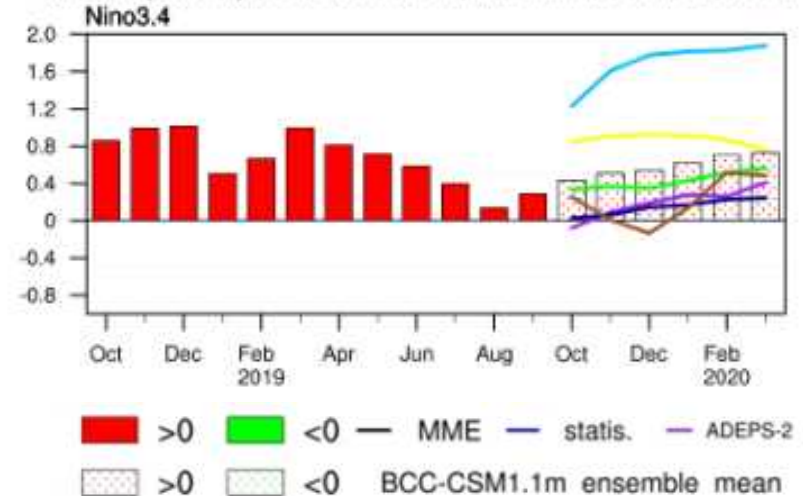
> ➤ BCC model and other dynamical and statistical models predict there's about an <u>85% chance</u> the tropical Pacific will remain ENSO-neutral through the winter, **and warm SSTA will maintained in central Pacific, and negative SSTA in the eastern Pacific.**
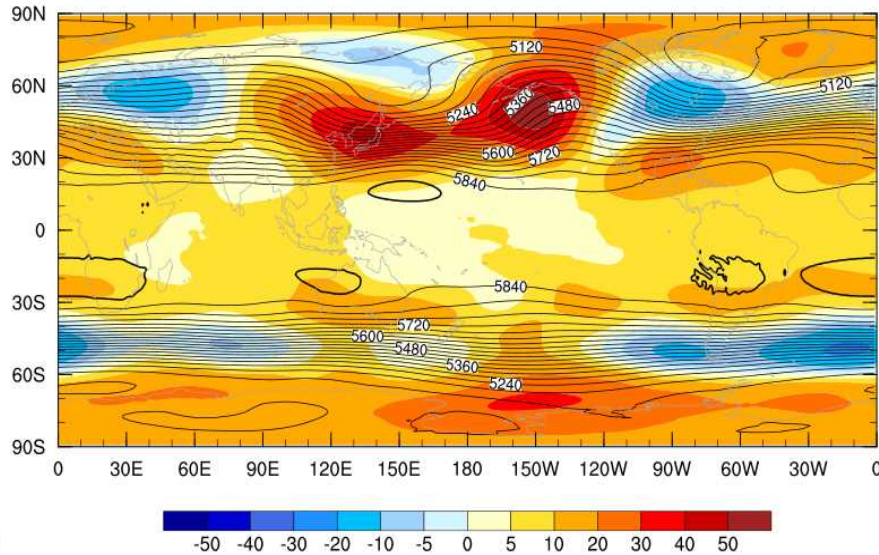
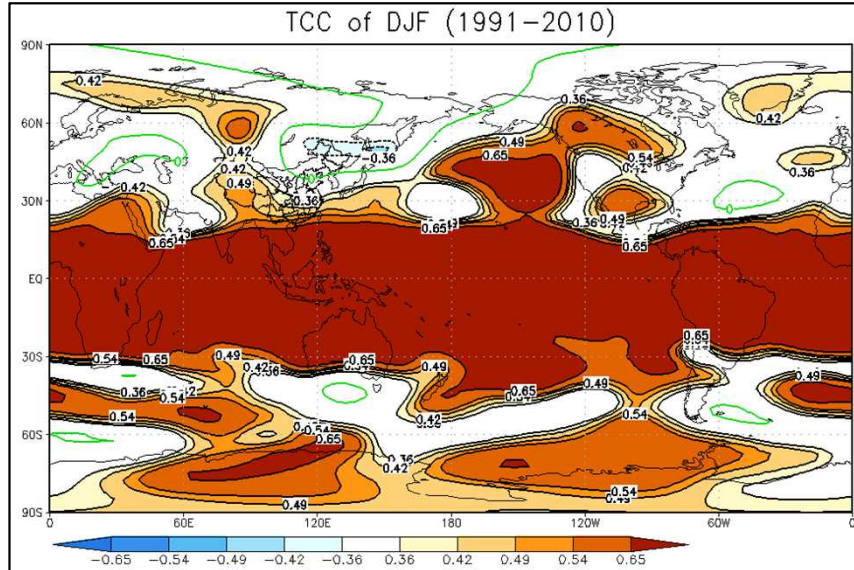# 500 hPa geopotential height (GH) anomaly

Prediction

Hindcast

- ➢ **Zonal circulation over East Asia**
- ➢ **Positive AO**
- ➢ **Weak East Asia trough**
- ➢ **Positive Tibetan Plateau height anomaly**
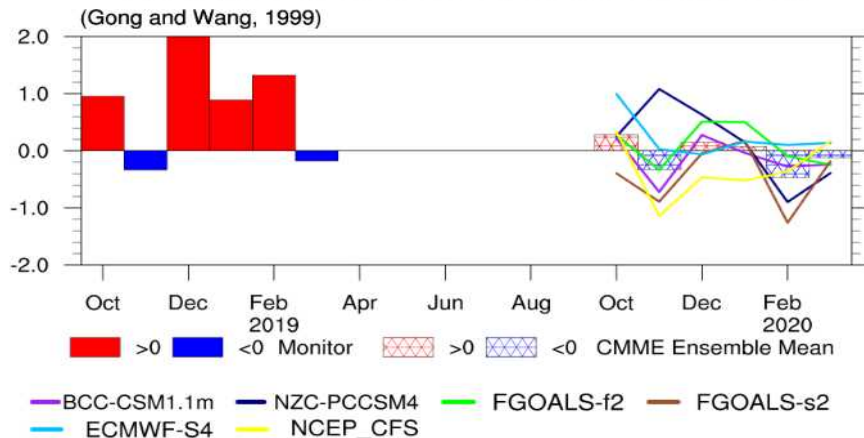- ➢ **Strong western Pacific subtropical high**
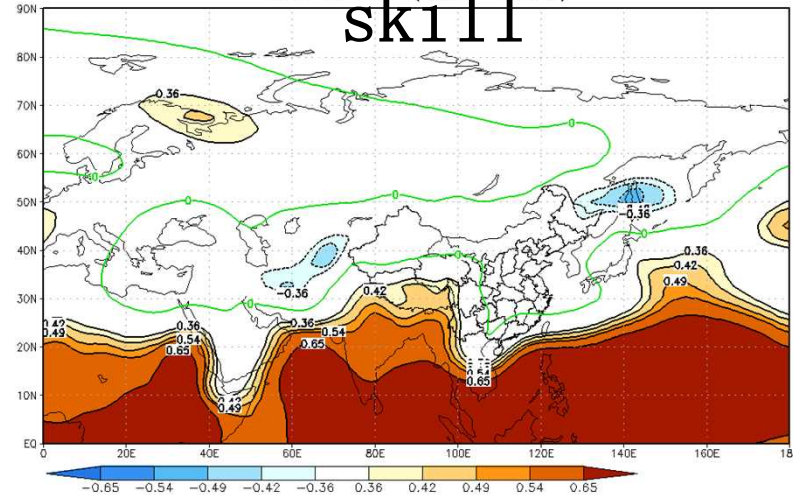
SLP (Siberian High)

Prediction
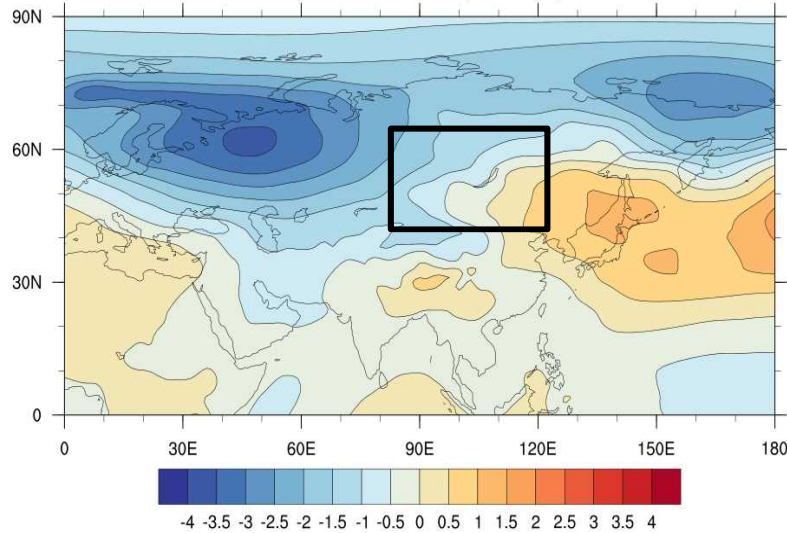
Hindcast skill

SibH Intensity Index: CMME 20190920 Forecast
Monitor (NCEP I): 201810-201909; Forecast: 201910-202003

(Gong and Wang, 1999)

intraseasonal variation of SH
**Stronger in December,
Stronger-Normal in January,
Weak in February**

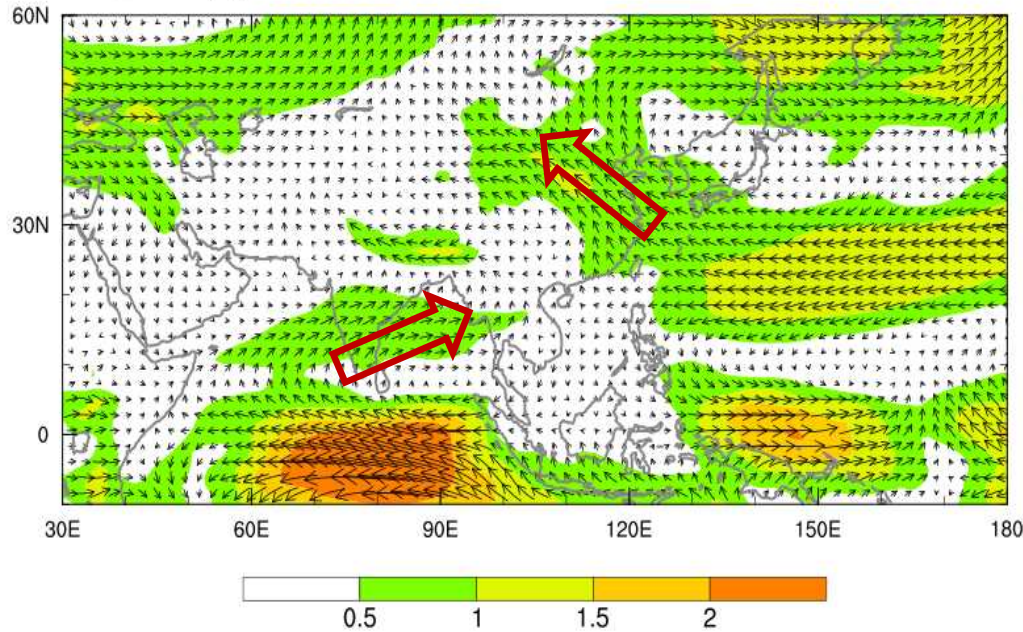SH is defined by standardized SLP averaged from 40-60N, 80-120E.
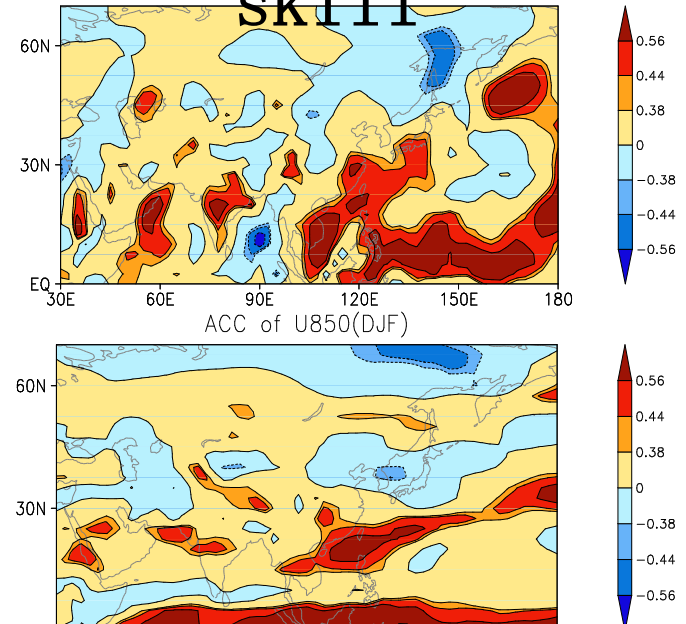
850hPa wind anomaly

Prediction

BCC Three-Month Forecast
850 hPa Wind Anomaly
BCC_CSM1.1(m)

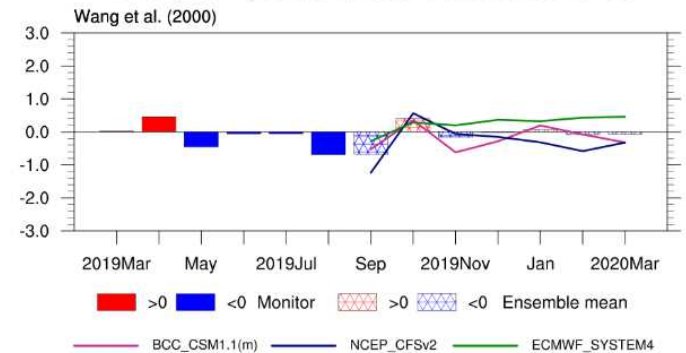Started 20191001   Valid 201912 - 202002
Units: m/s
Member Size = 24

Hindcast skill

ACC of V850(DJF)

ACC of U850(DJF)

Philippine Sea AntiCyclone (PSAC) index: MODES forecast
Monitor (NCEP I): 201903-201908; Forecast: 201909-202003

Wang et al. (2000)

>0 <0 Monitor   >0 <0 Ensemble mean

BCC_CSM1.1(m)   NCEP_CFSv2   ECMWF_SYSTEM4

- Southeast wind anomaly will dominate East Asia
- Philippine anticyclone near normal
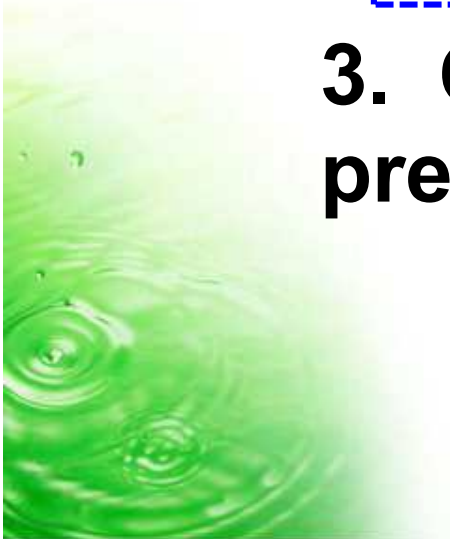- **Strong India-Burma trough**

Outline

1. EAWM System and Signals

2. Outlook for EAWM

2.1 Prediction by BCC_CSM 1.1m, BCC/CMA

2.2 Statistic Analysis with El Niño and Arctic Sea Ice

3. Outlook for temperature and precipitation over China

2.2 Statistic Analysis the EAWM with El Niño and Arctic Sea Ice

● **The characteristics of EAWM and WPSH in the SSTA similar years**
(**El Niño Modoki**)

SSTA similar years	Siberian High index	EAWM index	Intensity	Ridge Position
1990/1991	-0.5	-0.2	weak	-0.4
2002/2003	-0.4	-1.1	strong	-0.5
2003/2004	-0.4	-0.2	strong	-0.2
2004/2005	0.9	1.7	strong	-0.8
2006/2007	-1.3	-1.1	strong	-0.1
2009/2010	-1.1	0.6	strong	-1.3
2013/2014	-0.6	-0.5	A little weak	-1.2
2014/2015	-0.5	-0.3	strong	-0.6
2016/2017	-0.8	-1.3	strong	0.7
2018/2019	2.0	1.0	strong	2
	Weak	Weak	strong	southerly

The intensity is strong and the Ridge Position of WPSH is southerly in the most similar years.

Indian Ocean Tsunami [tsuːˈnɑːmi]

BCC

● Possible impact of SIC in Arctic

SIC anomaly in Sep 2019

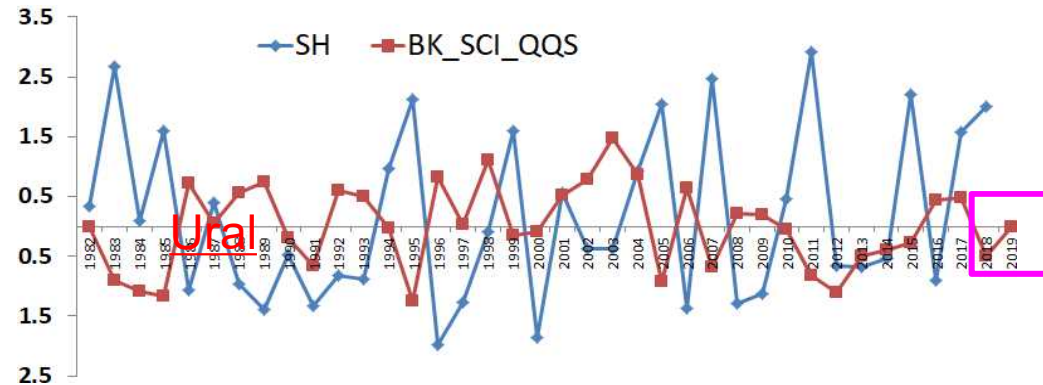icec_anom_Sep_2019
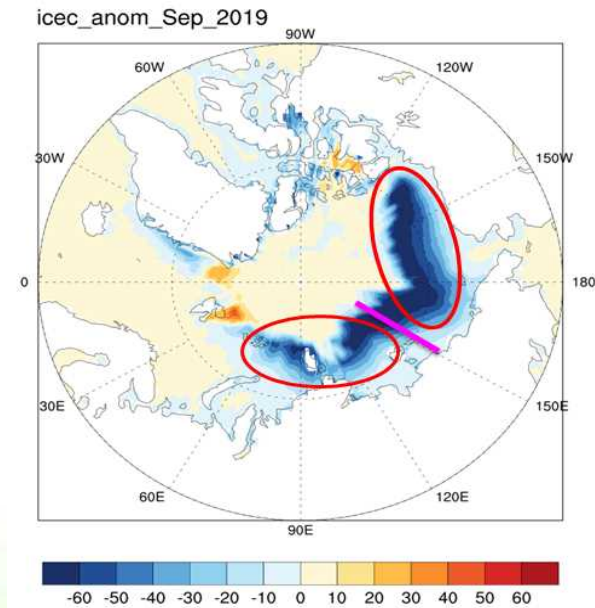
Arctic Sea Ice in the Barents-Kara
Seas：67.5-80.5N，20.5-80.5E

SH in DJF and SIC in Sep (detrend)

- ☐ Studies have shown that Arctic sea ice extent provides a potential signals for winter Siberian High.(Wu et al., 2011) . There is a significant negative correlation between sea ice anomalies over Barents-Kara Sea in Sep and the SH in winter.
- ☐ The sea ice anomalies over BK Sea in Sep 2019 is normal after removing trend.
- ☐ ACIE is not favorable to a stronger Siberian high in the coming winter.

India-Burma trough: strong

UV&hgt ltm at 700hPa
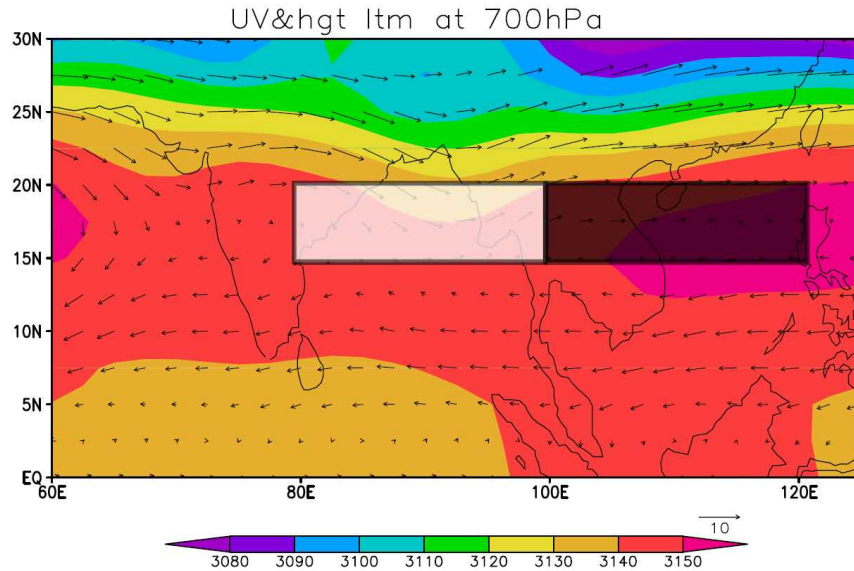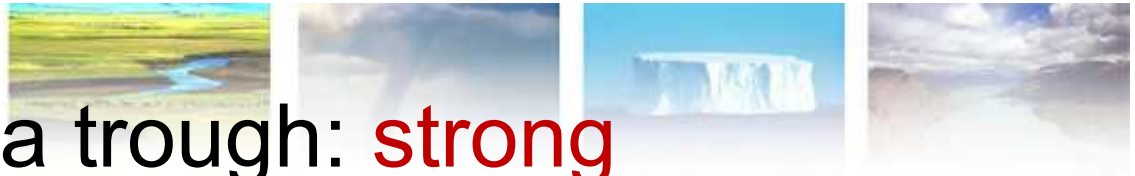
- ☐ A positive India-Burma trough index indicates it is strong.
- ☐ There is a significant positive correlation between the India-Burma trough index in winter and IOD index in Sep.
- ☐ The positive IOD in Sep 2019 is very favorable to a strong India-Burma trough in the coming winter.

Corr=0.51
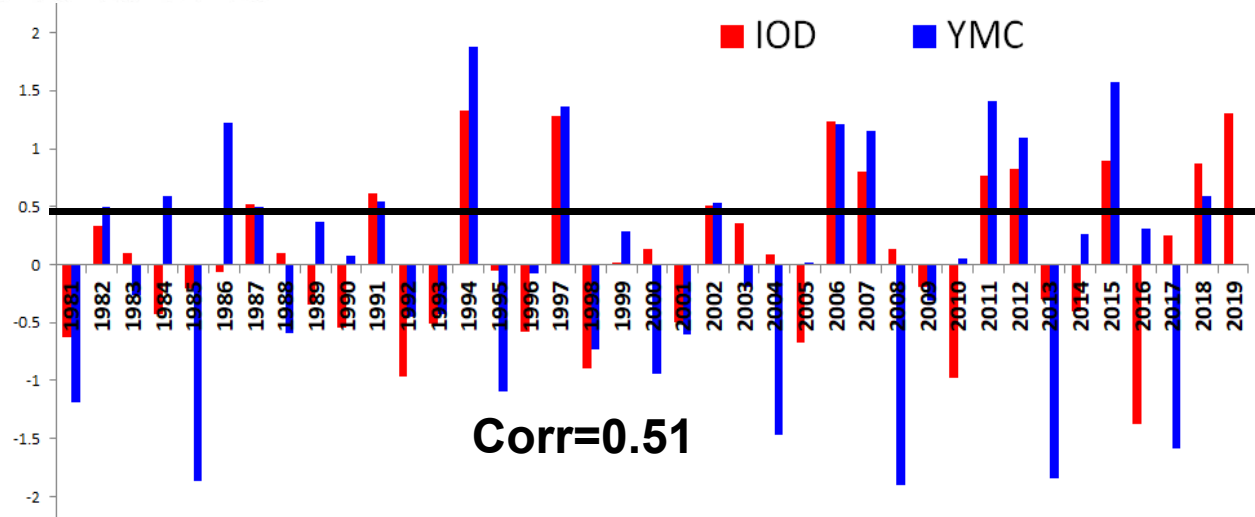
Summary of Outlook for Winter Circulation in 2019/2020

- **EAWM: weak**

- **Siberian High: weak**

- **East Asian Trough: weak** → **warm temperature over most of China**

- **AO: positive**

- **Western Pacific Subtropical High: strong**

- **India-Burma Trough: strong**

- **Low level: anomalous southerly winds over East Asia** → **More precipitation over most of China**

Outline

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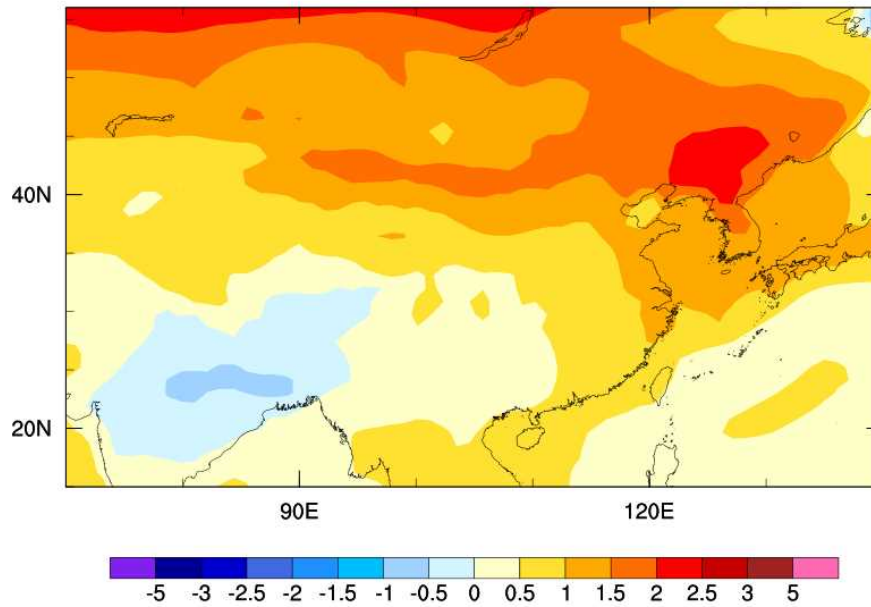
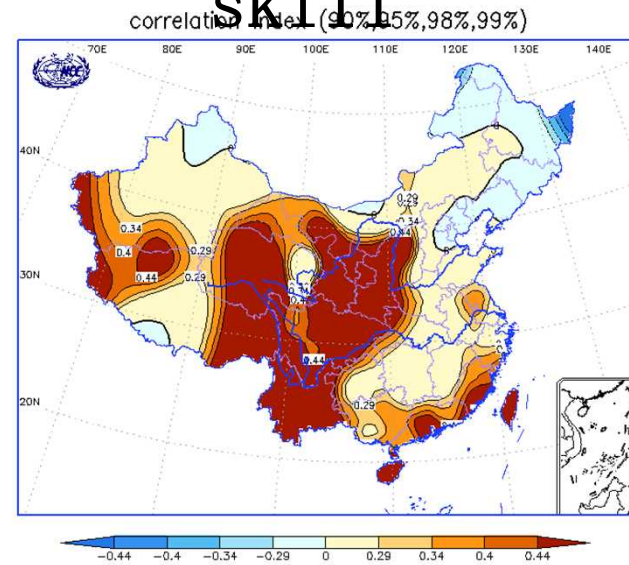3. **Outlook for temperature and precipitation over China**

● Temperature – BCC_CSM1.1m

Prediction of
Anomalies of T2m (℃)

Hindcast
skill

BCC Three-Month Forecast   Started 20191001   Valid 201912 - 202002
2-m Air Temperature Anomaly   Units: degC
BCC_CSM1.1(m)   Member Size = 24
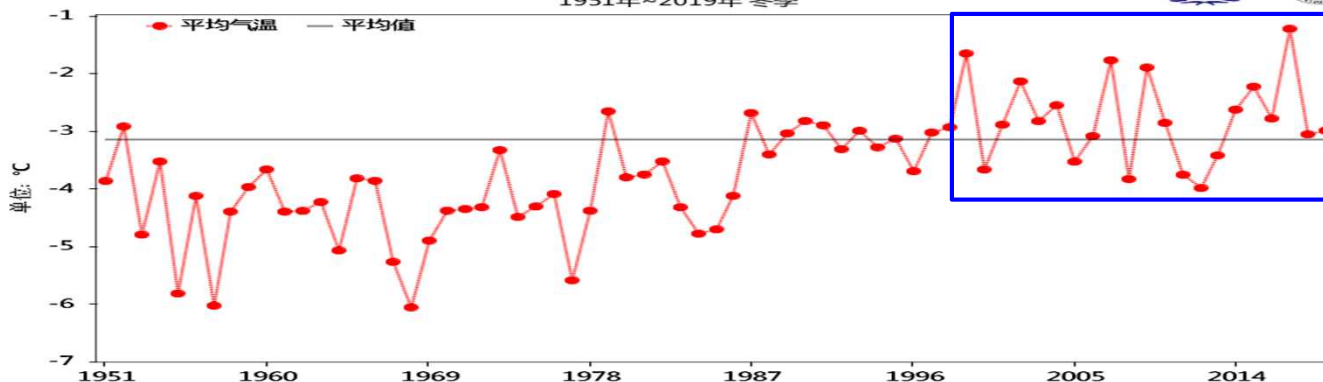
correlation index (90%,95%,98%,99%)

This is the prediction of temperature from BCC_CSM1.1.
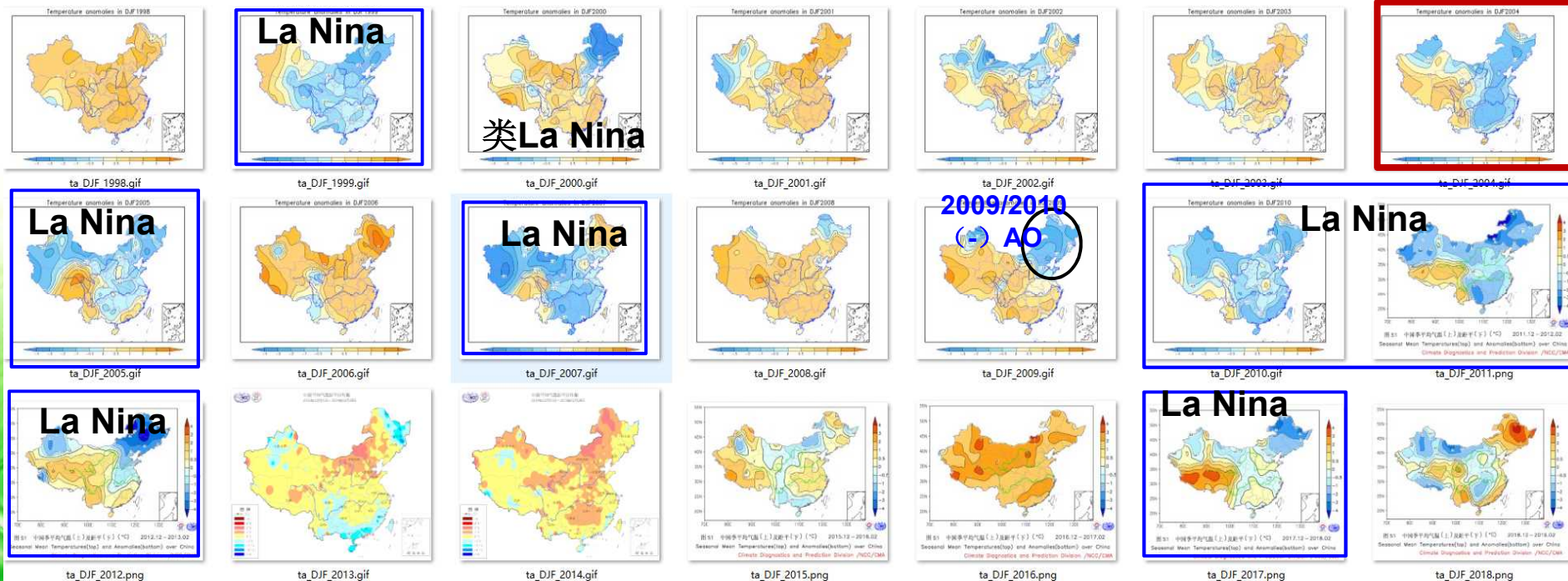The prediction indicates that temperature over most of China will be above
normal.

Interdecadal background of temperature

中国任意时段日平均气温历年序列
1951年~2019年 冬季

2004/2005

La Nina

类La Nina

La Nina

La Nina

2009/2010
（﹣）AO

La Nina

La Nina

La Nina

ta_DJF_1998.gif
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ta_DJF_2013.gif
ta_DJF_2014.gif
ta_DJF_2015.png
ta_DJF_2016.png
ta_DJF_2017.png
ta_DJF_2018.png

Temperature Anomaly in winter in the SSTA similar years

SSTA similar years
1990/1991
2002/2003
2003/2004
2004/2005
2006/2007
2009/2010
2013/2014
2014/2015
2016/2017
2018/2019

Temperature anomalies in DJF1990

Temperature anomalies in DJF2002

Temperature anomalies in DJF2003

2004/2005

Indian Ocean Tsunami [tsuːˈnɑːmi]

Temperature anomalies in DJF2006

Temperature anomalies in DJF2009
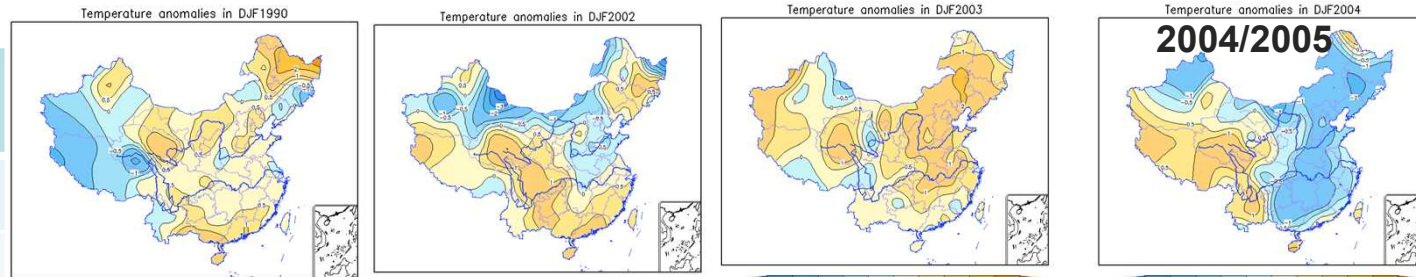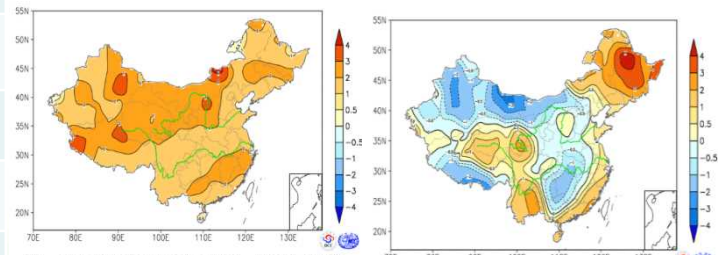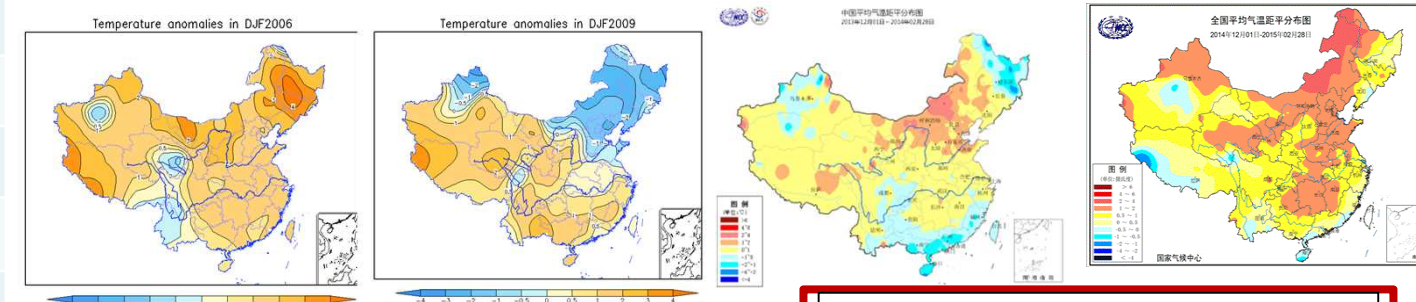
图S1 中国季平均气温（上）及距平（下）（°C） 2016.12–2017.02
Seasonal Mean Temperatures(top) and Anomalies(bottom) over China
Climate Diagnostics and Prediction Division /NCC/CMA
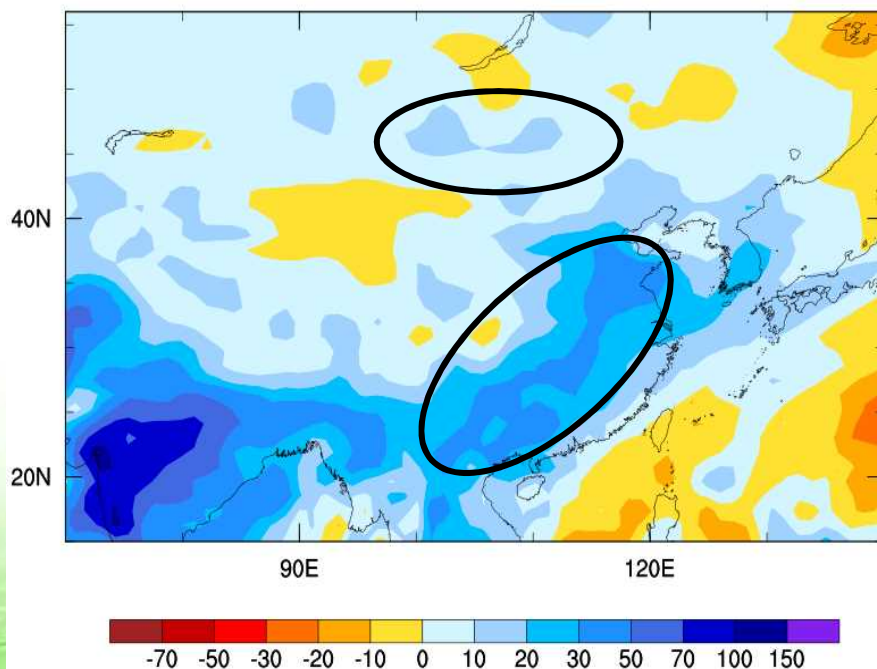
图S1 中国季平均气温（上）及距平（下）（°C） 2018.12–2019.02

composite of temperature positive anomaly frequency

2400站气温正距平频次合成分析图
1991,2003,2004,2005,2007,2010,2014,2015,2017,2019年冬季
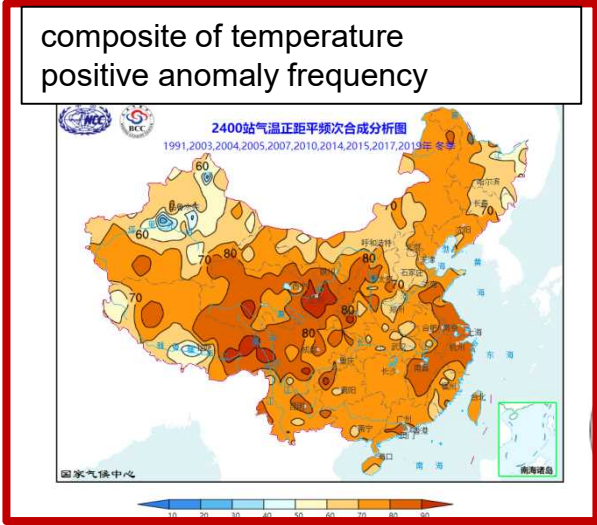
● Precipitation – BCC_CSM1.1m

Prediction Anomaly
Percentage of Precipitation (%)

Hindcast skill

This is the prediction of precipitation from BCC_CSM1.1. The prediction indicates that precipitation over most of China will above normal.
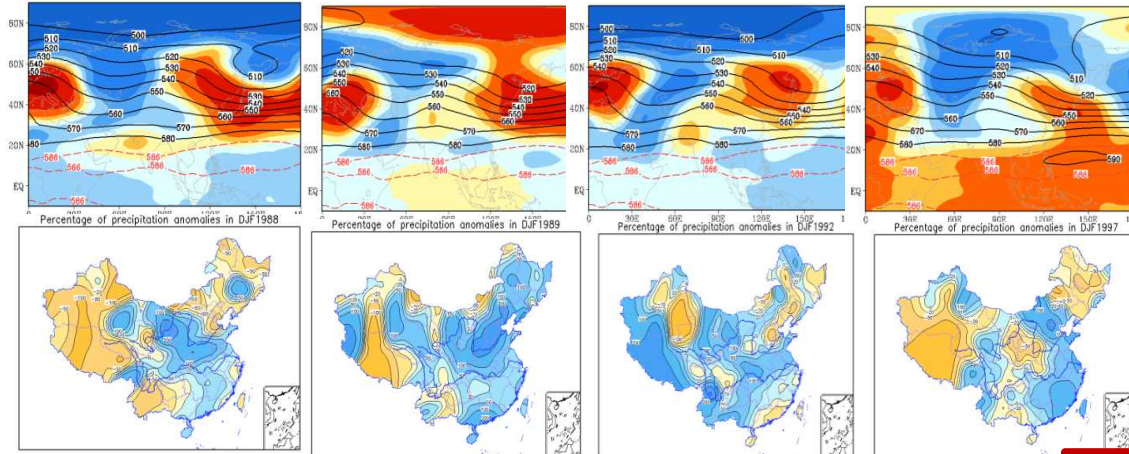
The "west-lower and east-higher" circulation is favorable for more precipitation over China
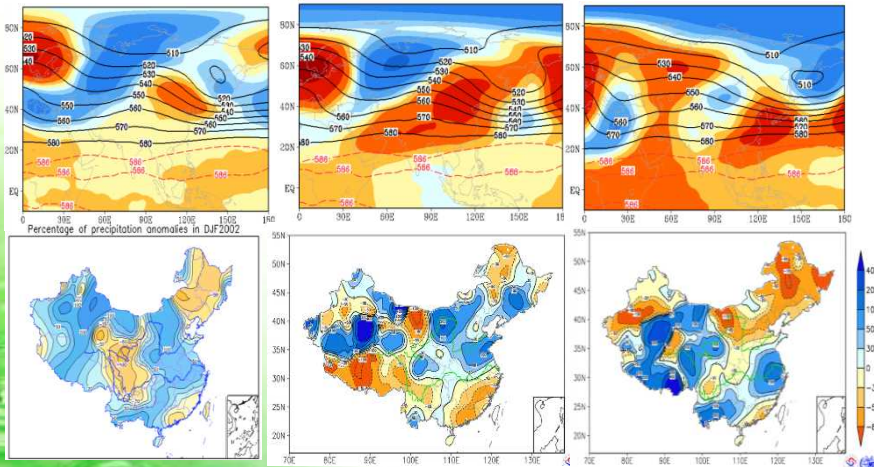
1988/89 **1989/90** **1992/93** **1997/98**

The 500-hPa height anomaly field are "**west-lower and east-higher**" in the mid-high latitudes in Eurasia；
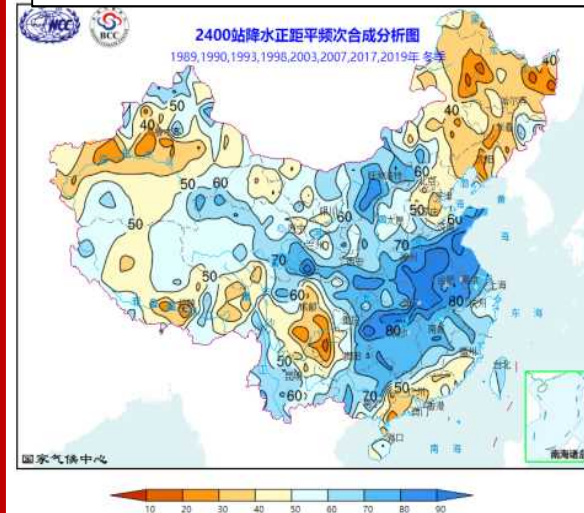**Strong WPSH**
Strong IOT

2002/03 **2016/17** **2018/19**

composite of Precip. positive nomaly frequency
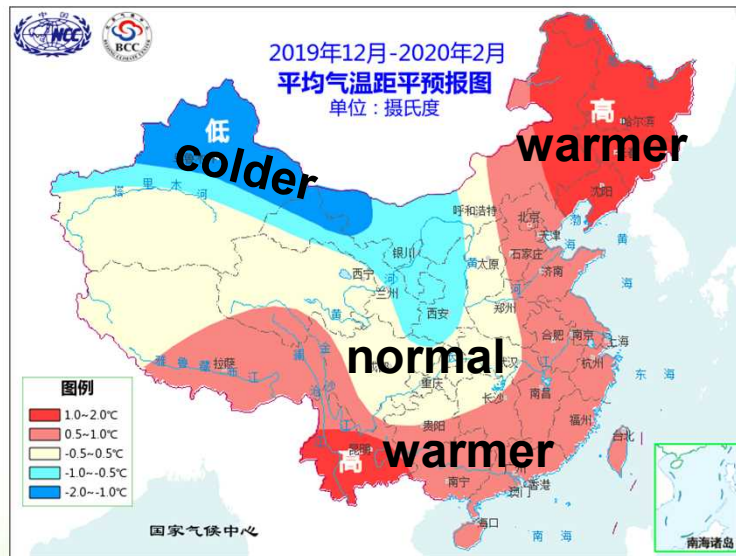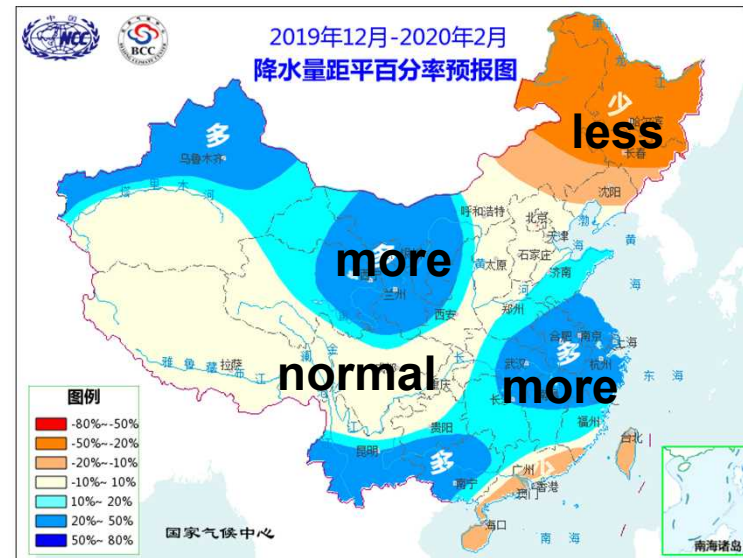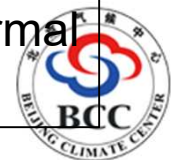
Outlook for 2019/2020 winter

EAWM : normal-weak

| Temperature | Precipitation |

> The temperature of most parts of China will be warmer than normal, especially northeast China and southwest China. Northwest China will be colder than normal.

> The precipitation will be above-normal in most part of China, below normal in northeast China.

Thank you !