



National Agency for
Meteorology and
Environment Monitoring



Information and Research
Institute of Meteorology,
Hydrology and
Environment

SEASONAL OUTLOOK FOR WINTER 2016/2017 OVER MONGOLIA

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/ Weather, Environment Modeling and Research Division, IRIMHE/

8-9 November, 2016, Ulaanbaatar

Outline

1. Methods to issue seasonal outlook
2. PDO, Arctic Sea Ice, Snow cover
3. El-Nino/La-Nina
4. Sunspot number
5. Seasonal outlook over Mongolia

1. Methods to issue seasonal outlook

- ❑ Statistical methods
- ❑ Analogy method
- ❑ Prediction by NCEP/GFS
- ❑ Prediction by PNU CGCM
- ❑ Forecast (NCEP, Met Office etc.)

Statistical methods

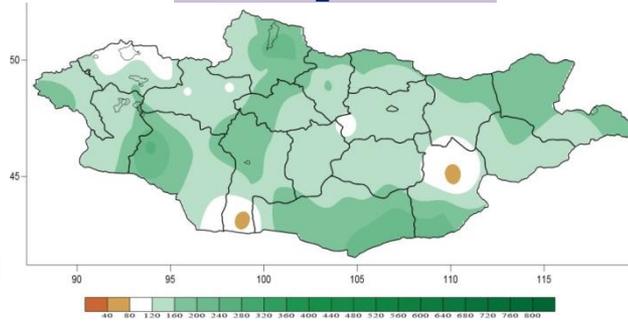
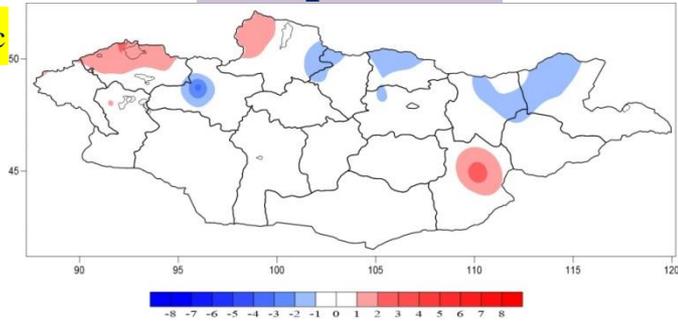
- Lagged –correlation method –lead time: 6 month
- “Extreme” statistical model - lead time: 6 month
- Statistical downscaling of APCC MME
lead time: 1-3 month

Lagged correlation method lead time: 6 months

Temperatur

Precipitation

Dec



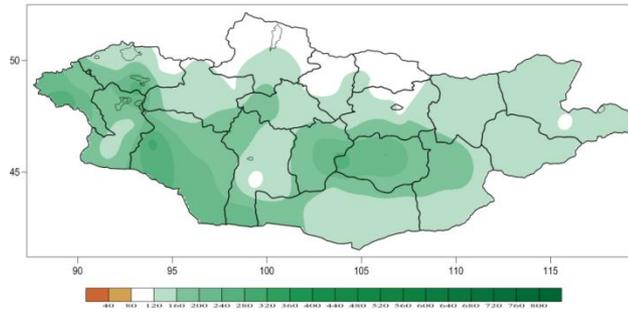
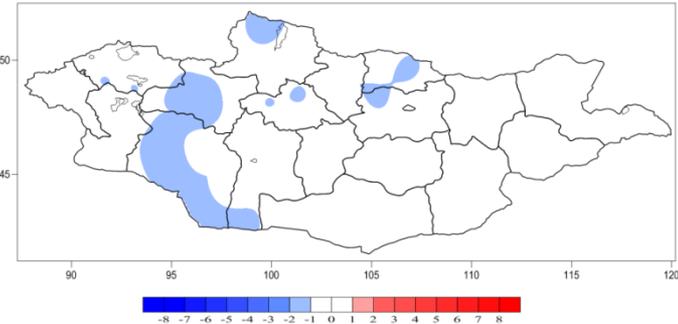
Temperature:

According to this map, we will be expected significantly warmer winter than normal in the eastern part, some cold winter in the west-southern part. In the some parts, temperature anomaly will be near normal in December.

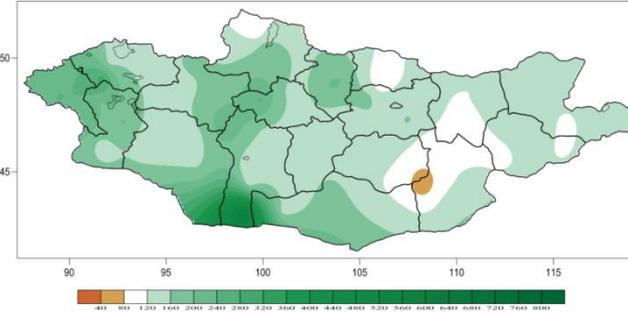
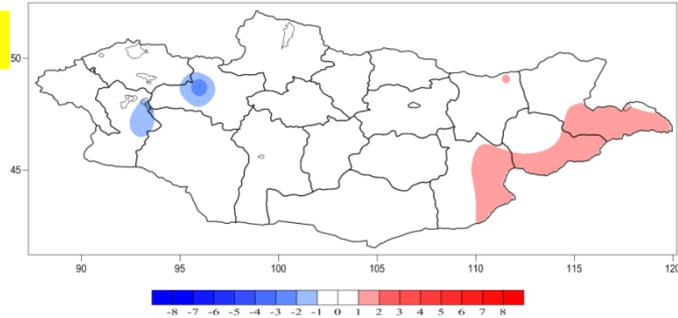
Precipitation:

According to this map, precipitation will be significantly above normal in the south-western and eastern parts, and below normal in more places of the western and central parts of country. In some places, precipitation will be expected near normal in December.

Jan



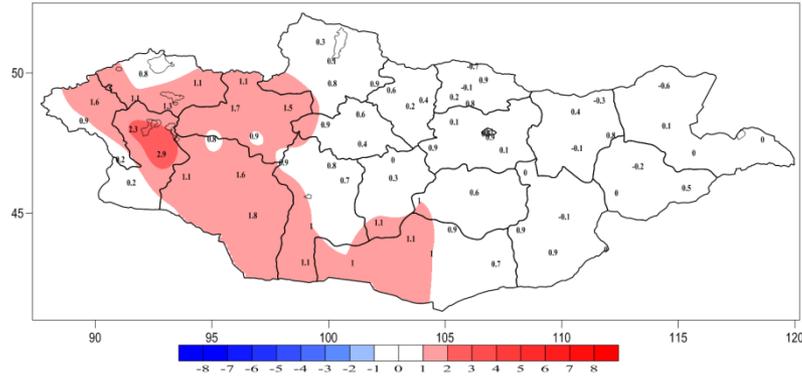
Feb



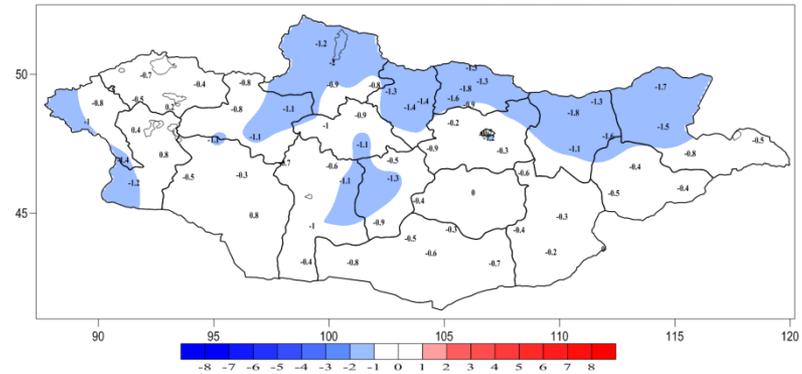
“Statistical downscaling of APCC MME lead time: 1-3 month

Temperature at 2m:

Temperature prediction of MRG_CPT_2016_nov_t2m_2

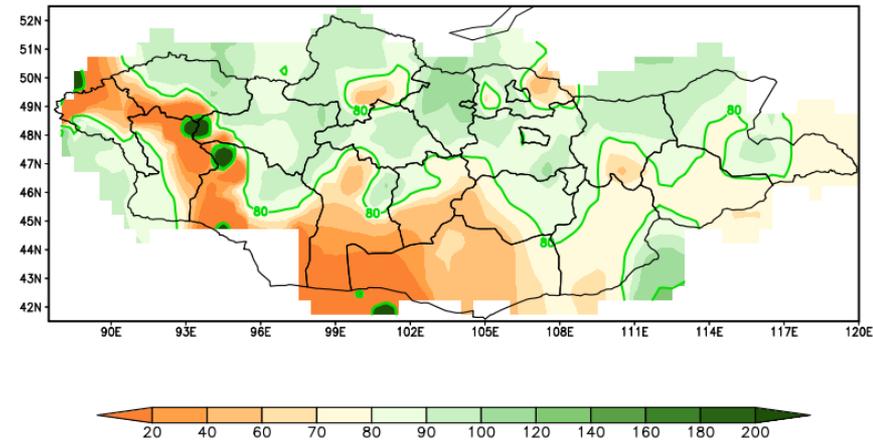


Temperature prediction of MRG_CPT_2016_nov_t2m_3

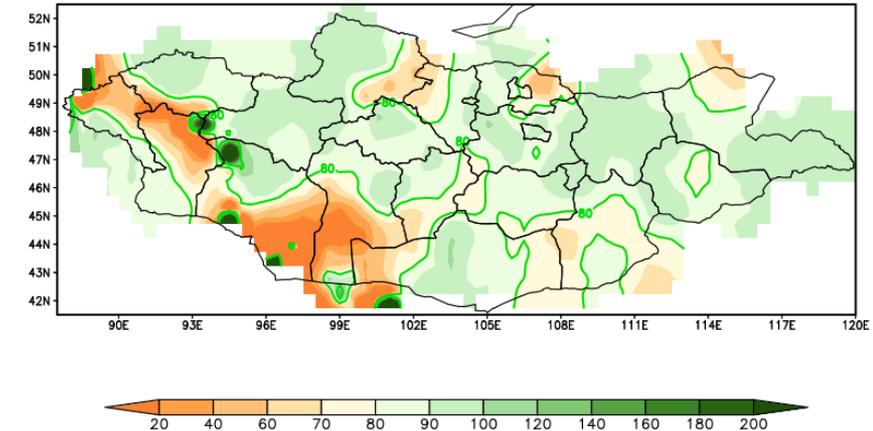


Dec

Precipitation:



Jan



Temperature:

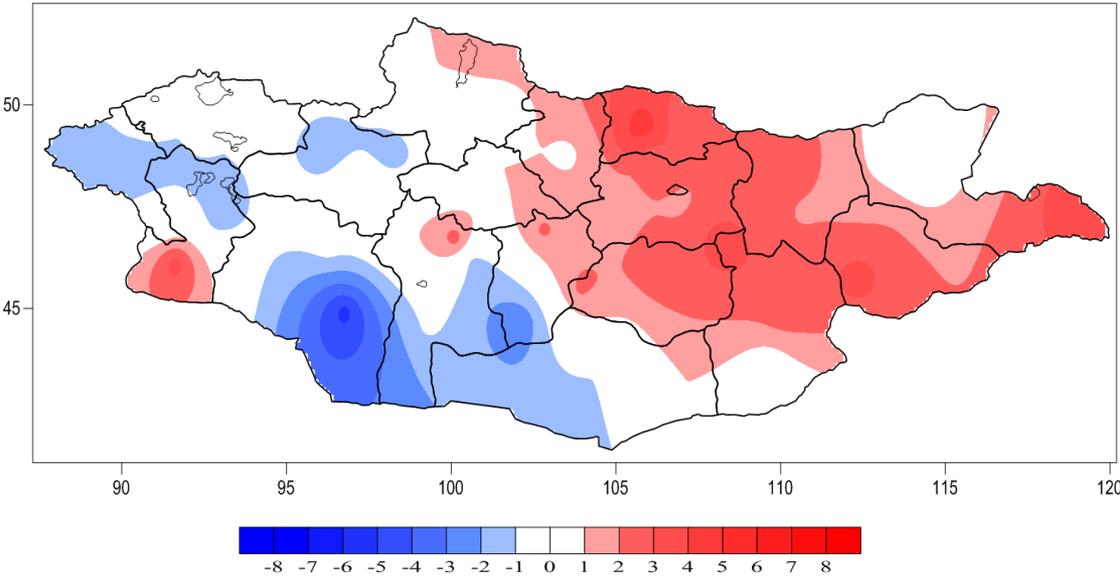
According to this method, temperature anomalies will be above normal in the south-western part of country in first month, and slightly cold in almost whole northern part in January. Furthermore, normal temperature will be in the some southern part country in February.

Precipitation:

Precipitation anomalies predicted above normal in almost whole parts country, but less precipitation will be in less territory in the south-western parts of country in both two months.

Analogy method (analogy month for December 2016: December-2007)

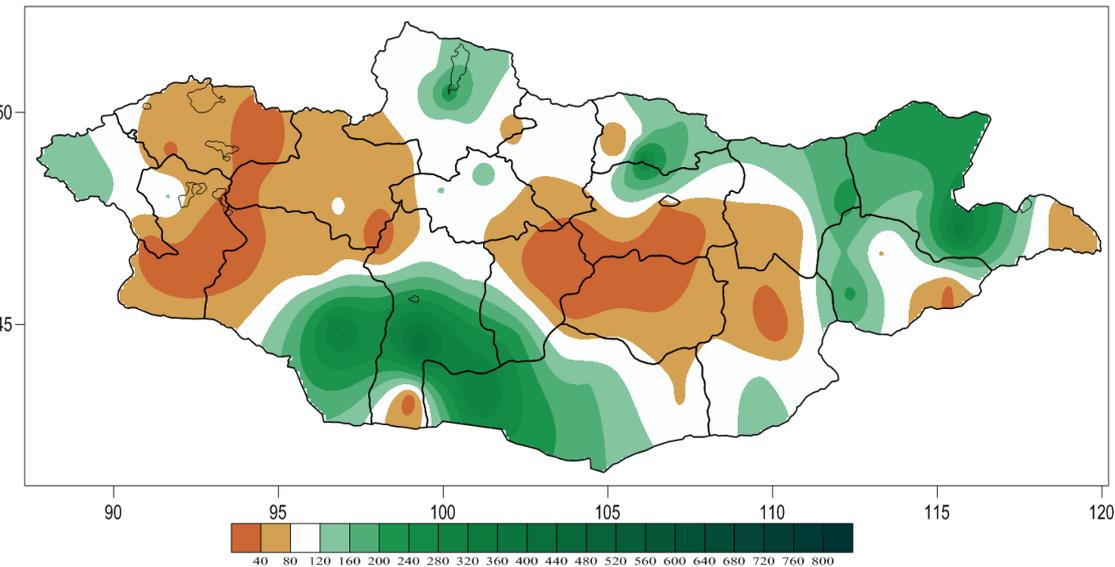
Temperature anomaly 2007-12



Temperature:

According to this map, we will be expected significantly warmer winter than normal in the eastern part, some cold winter in the west-southern part. In the some parts, temperature anomaly will be near normal in the December.

Precipitation anomaly 2007-12



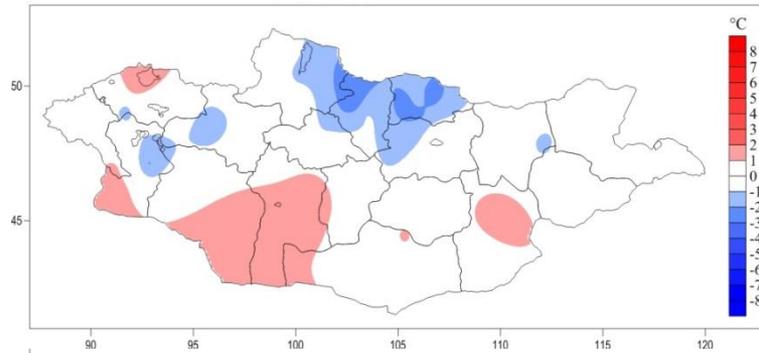
Precipitation:

According to this map, precipitation will be significantly above normal in the west-southern and eastern parts, and below normal in more places of the western and central parts of country. In some places, precipitation will be expected near normal in the December.

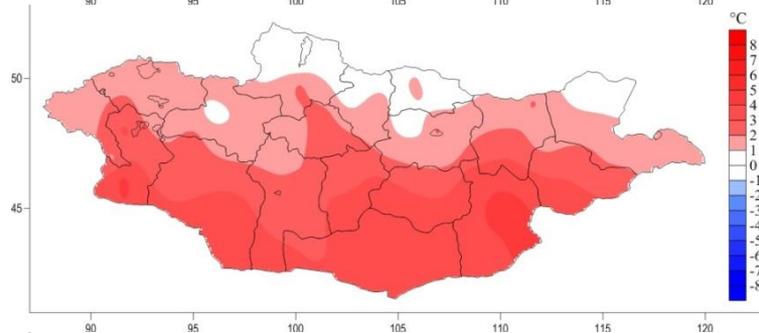
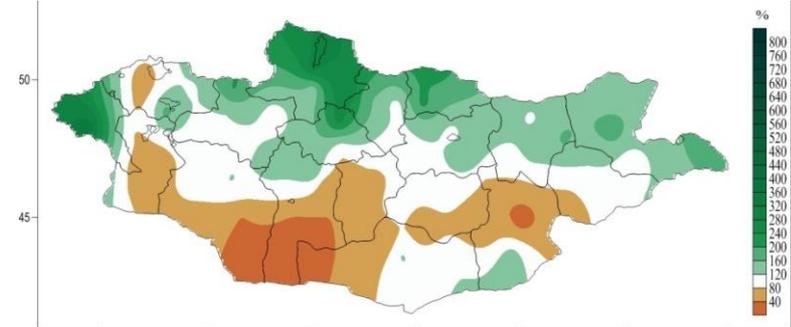
Prediction by NCEP/GFS lead time: 9 months

Temperature:

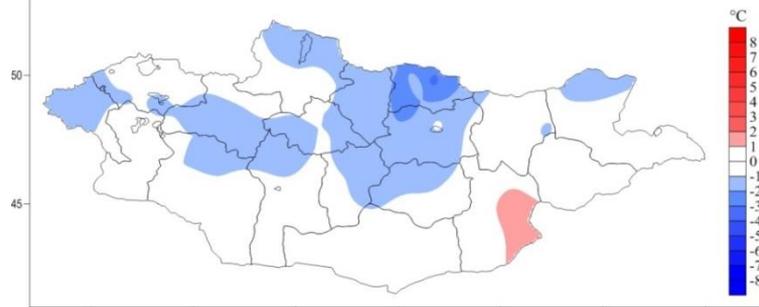
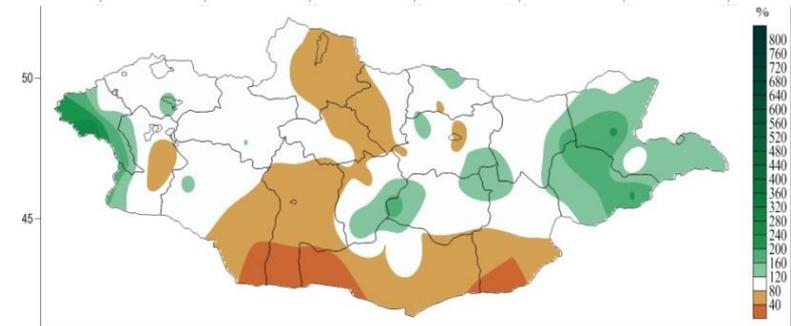
Precipitation:



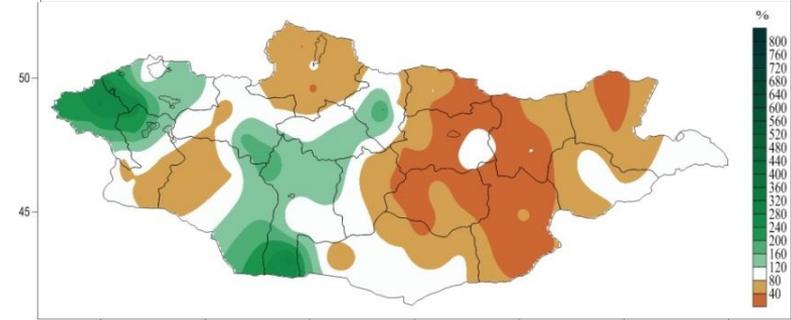
Dec



Jan



Feb



Temperature anomalies will be above normal in some less parts in the December and February. Particularly, that anomaly will be expected significantly warmer than normal in almost whole country in the January. However, cold winter predicted in some northern parts country in the January and February. Normal temperature predicted in some parts in the December and February, and in less northern part country in the January.

Precipitation anomalies predicted above normal in the northern part in the December, in less western and eastern parts in the January, and in some western and west southern parts in the February. Less precipitation predicted in the some southern parts in the December and January, and eastern part in the February. Normal precipitation will be expected in rest parts country in whole winter.

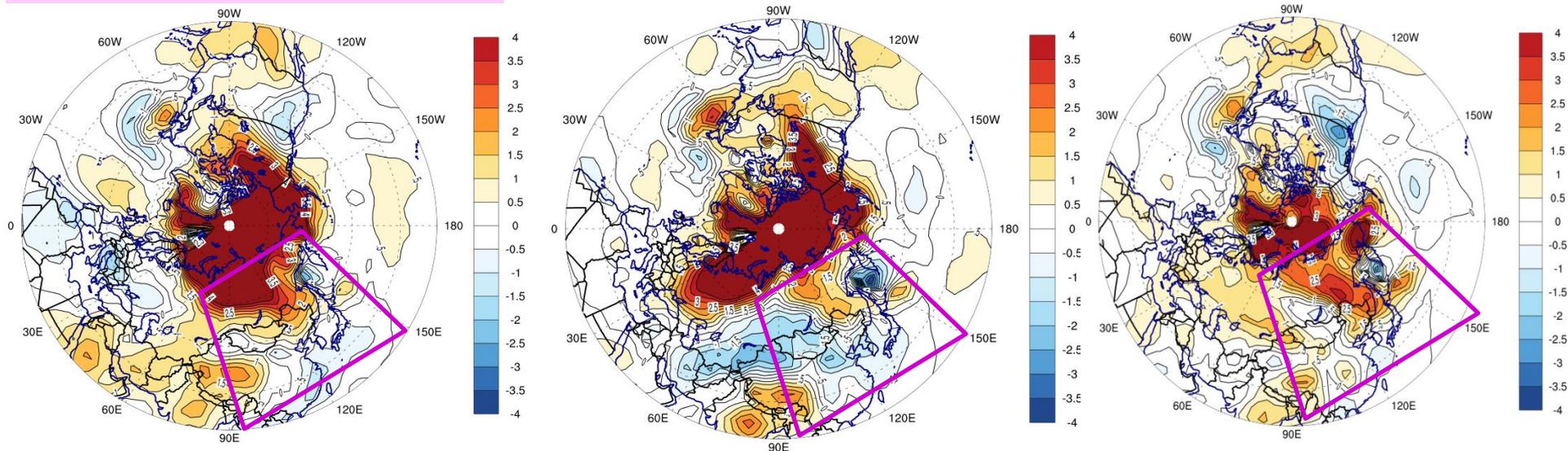
Prediction by PNU CGCM

Dec

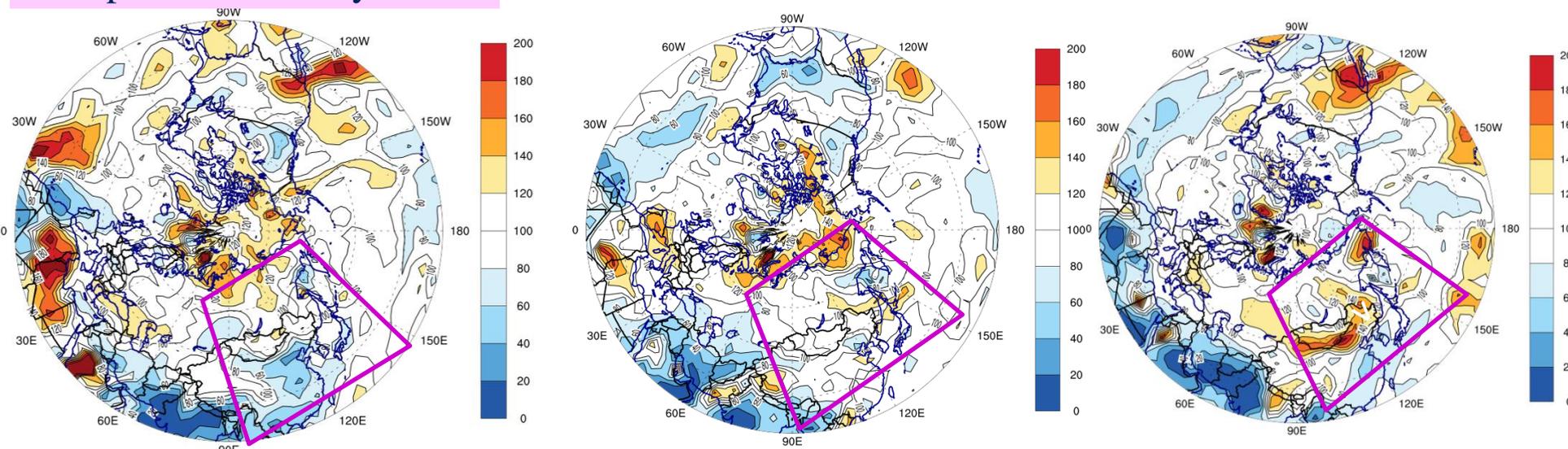
Jan

Feb

Temperature anomaly at 2 m:



Precipitation anomaly:



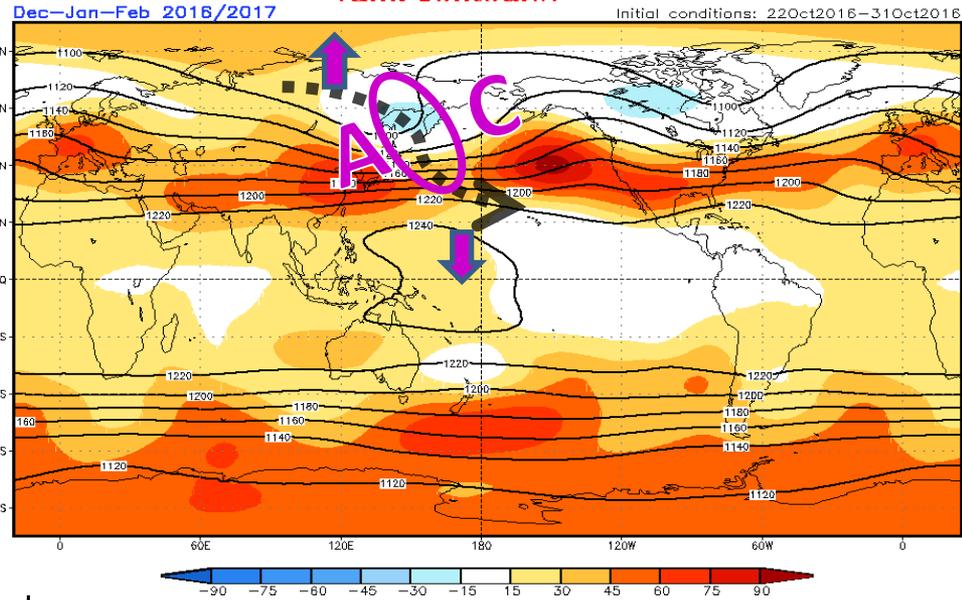
Forecast (NCEP, ECMWF, Met Office,
APCC, BCC, TCC, and IRI etc.)

In the 200hPa level

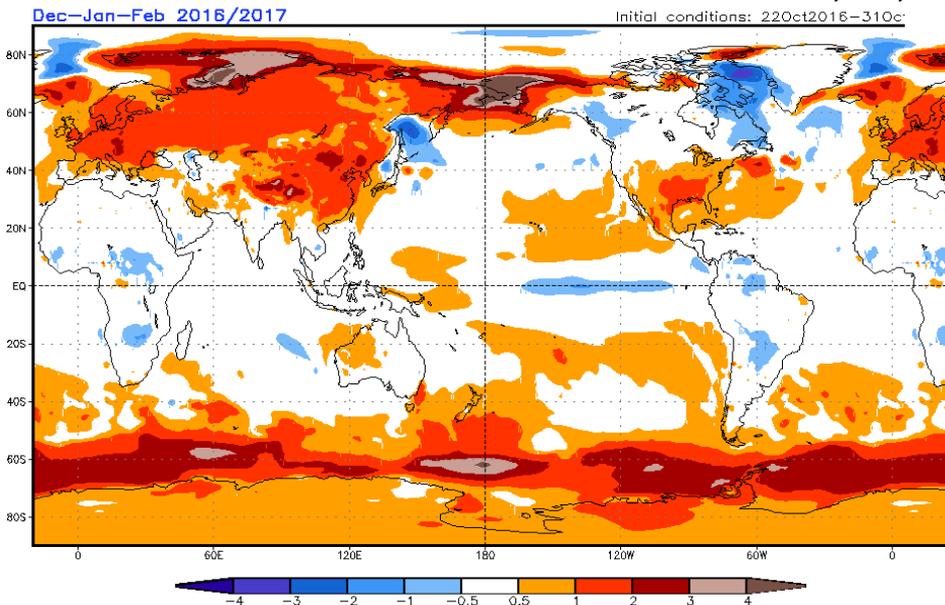
Anticyclonic circulation anomalies over the Eurasian continent **A** indicates that the subtropical jet is shifted northward near Mongolia.

Cyclonic circulation anomalies over the Kamchatka **C** indicates that the subtropical jet is shifted southward in the Kamchatka.

CFSv2 seasonal z200 anomalies (m; shaded) and total (dm: contours)



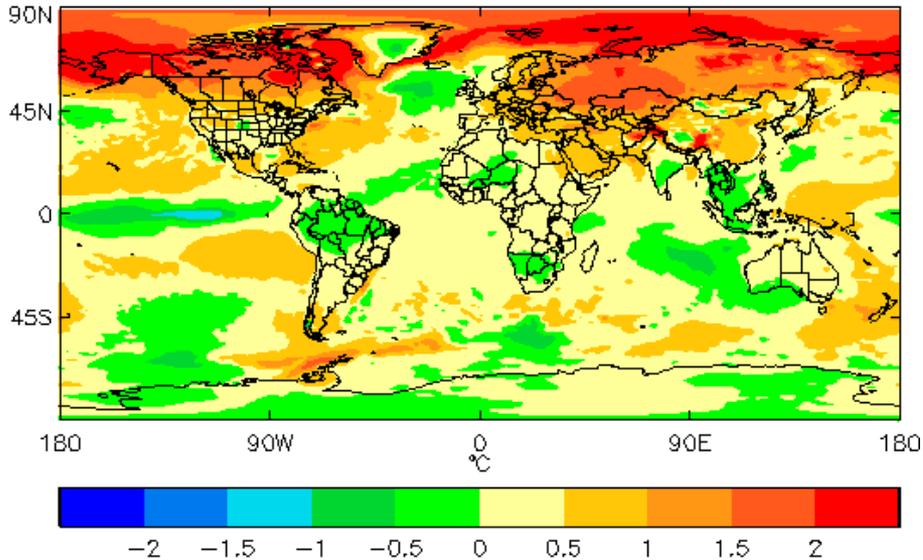
CFSv2 seasonal T2m anomalies (K)



Positive anomalies will be predicted in the Eurasian continent.

Negative anomalies will be expected near the Okhotsk sea and in the north of Japan.

Ensemble mean anomaly : 2m temperature : Dec/Jan/Feb
Issued October 2016

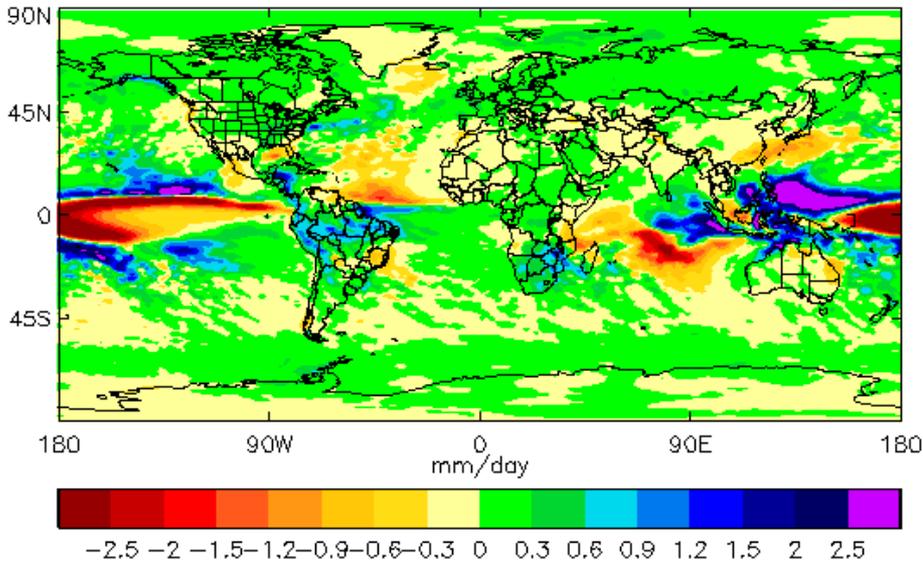


Temperature:

Positive anomalies will be predicted in almost whole the Eurasian continent. Particularly, that anomaly will be predicted significantly above normal in the northern regions.

A little bit negative anomalies will be expected in some south-western parts of Mongolia.

Ensemble mean anomaly : precipitation : Dec/Jan/Feb
Issued October 2016



Precipitation:

Positive anomalies will be predicted in north regions of the Eurasian continent.

Negative anomalies will be expected over China and the sea south of Japan.

2. PDO, Arctic Sea Ice, Snow cover

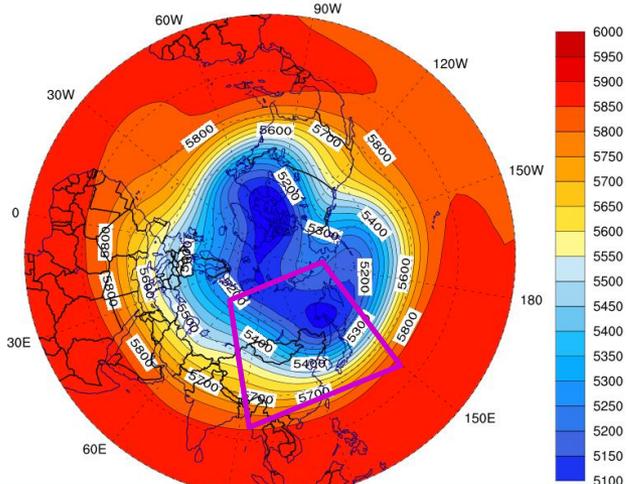
Impact of strong and weak PDO on winter climate

Com. H500 in Jan. during strong PDO

Com. H500 in Jan. during weak PDO

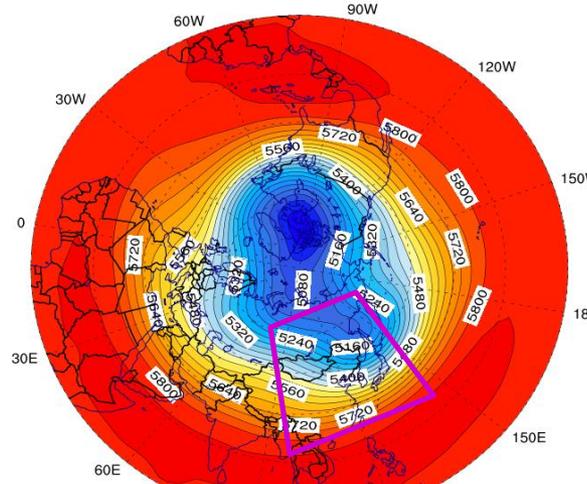
During strong PDO winters, warm and wet air masses shifted according northeast Pacific to Arctic. To clarify, it changes location of Arctic low to the northeast of America and the Eurasian continent with cold and wet air masses. In addition appears local cyclone center over the northeastern of Asia. H500 level anomaly lower than normal in almost whole East Asia.

H_500_PDO >+1_01_mean



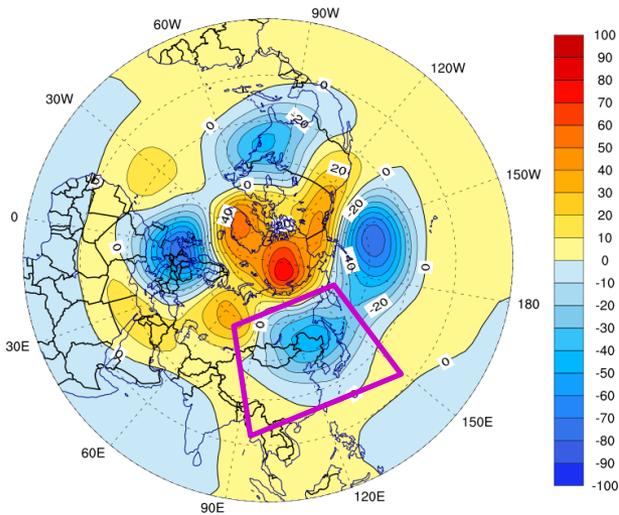
DJF: 1961,1977, 1984-1988, 1994, 2003, 2006, 2015, 2016

H_500_PDO <=-1_01_mean

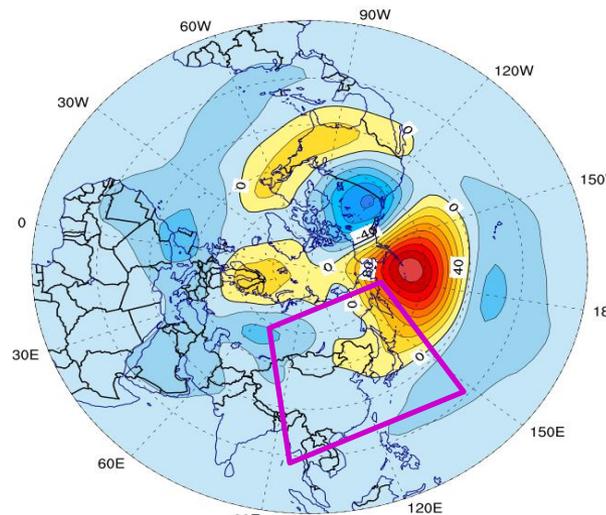


DJF: 1952, 1956, 1957, 1961, 1963, 1964, 1968, 1971, 1990, 1994, 1999, 2010, 1994, 1999, 2010, 2011

H_500_ano_PDO >+1_01_mean



H_500_ano_PDO <=-1_01_mean



During weak PDO winters, location of Arctic cyclone moved to the northern of America with cold and wet air masses. H500 level anomaly higher than normal in almost whole East Asia.

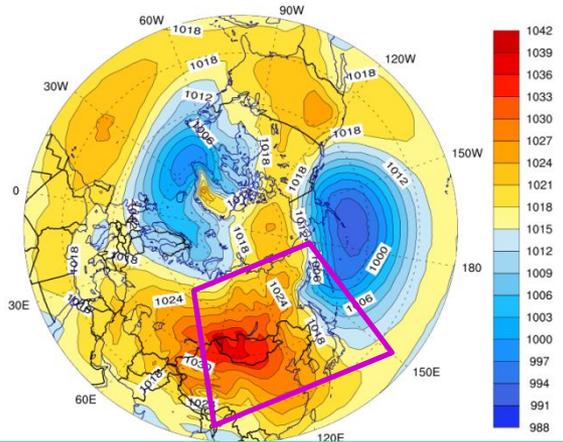
Impact of strong and weak PDO on Winter climate

Com. SLP in Jan. during strong PDO

Com. SLP in Jan. during weak PDO

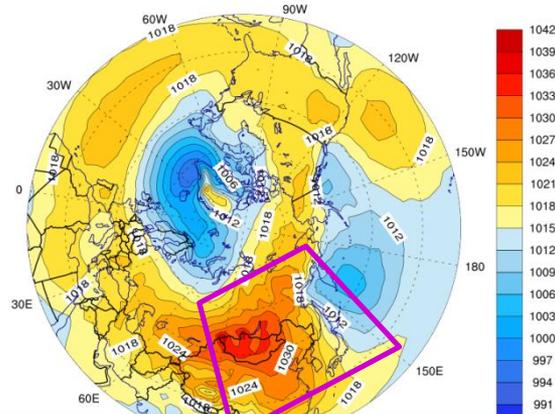
Com. SLP_an. in Winter. during strong PDO

SLP_01_mean_(PDO>+1)



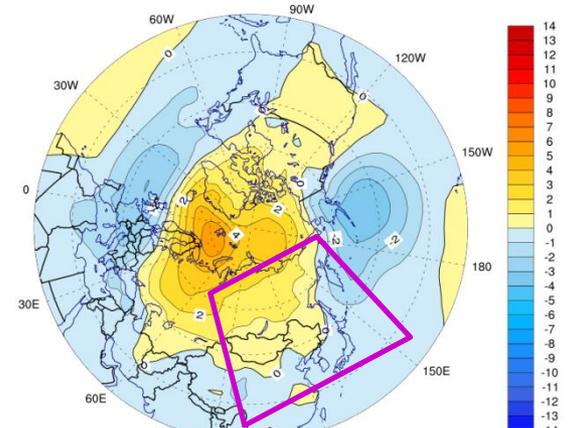
DJF: 1961, 1977, 1984-1988, 1994, 2003, 2006, 2015, 2016

SLP_01_mean_(PDO<=-1)



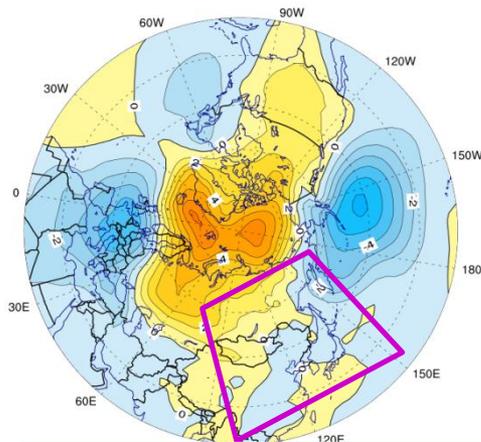
DJF: 1952, 1956, 1957, 1961, 1963, 1964, 1968, 1971, 1990, 1994, 1999, 2010, 1994, 1999, 2010, 2011

SLP_ano_Winter_(PDO>+1)

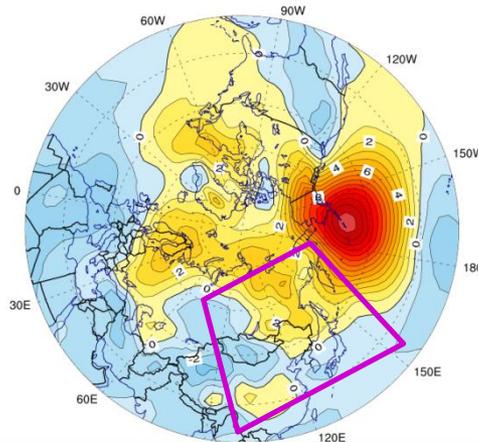


Com. SLP in Winter. during weak PDO

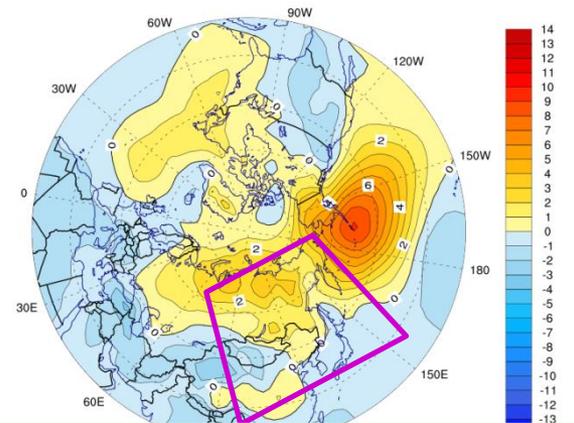
SLP_ano_mean_(PDO>+1)



SLP_ano_mean_(PDO<=-1)



SLP_ano_Winter_(PDO<=-1)



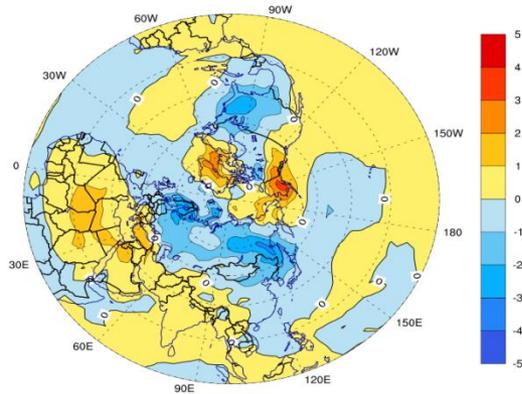
When the index is positive (negative), sea level pressures (SLPs) values in the high latitudes of the North Pacific are likely to be lower (higher) than their normals. This indicates that the Aleutian Low is stronger (weaker) than its normal in winter and spring. During strong PDO winters, The Siberian high was extended and stronger than normal. The Aleutian Low was stronger than normal. During weak PDO winters, the Siberian high was weakened. The Aleutian was weakened.

Impact of strong and weak PDO on Winter climate

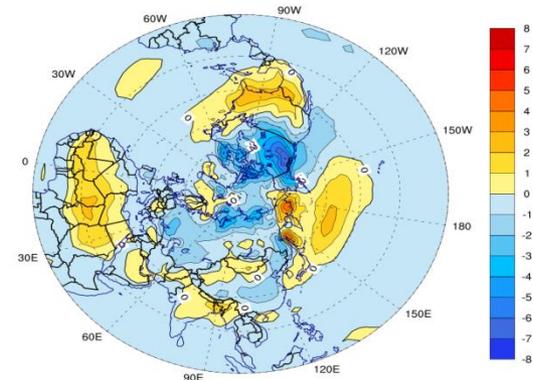
Com. STA in Jan. during strong PDO

Com. STA in Jan. during weak PDO

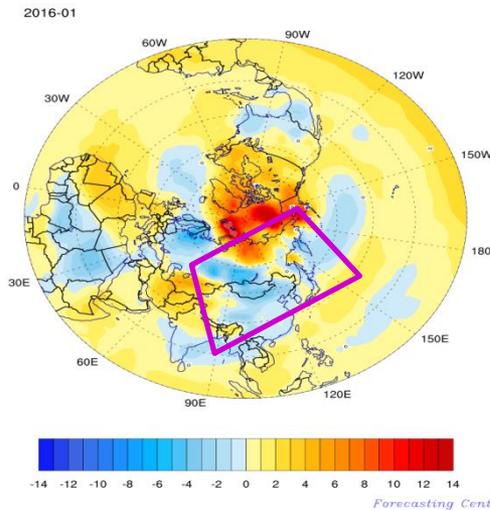
Surfate Temperature anomaly_01_mean_(PDO>+1)



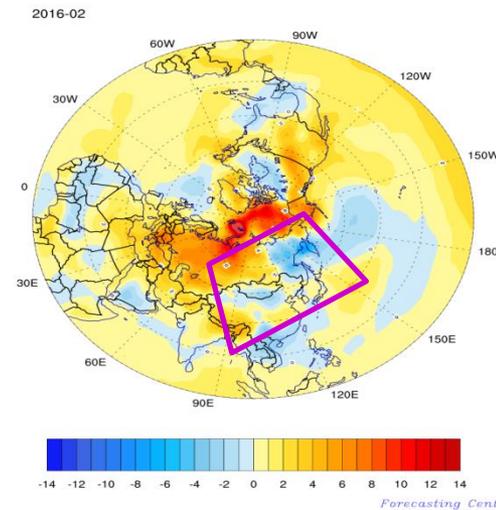
Surfate Temperature anomaly_01_mean_(PDO<-1)



Monthly Mean Temperature Anomaly at surface



Monthly Mean Temperature Anomaly at surface



January 2016

February 2016

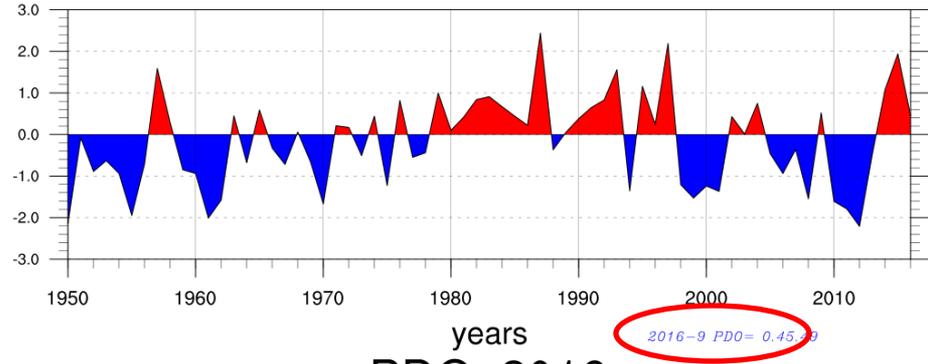
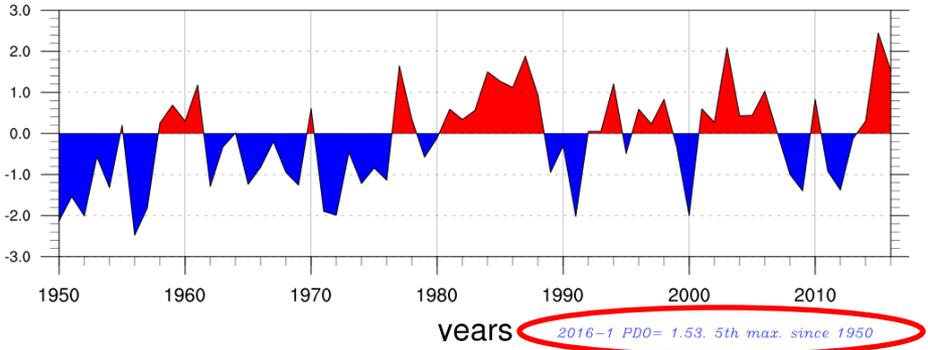
When the PDO index is positive (negative), SSTs in the central part of the North Pacific are likely to be lower (higher) than their normal. During strong PDO winters, observed below normal temperature anomaly in almost whole East Asia. In the Arctic, observed above normal temperature than normal. During weak PDO winters, observed opposite situation.

Impact of strong and weak PDO on Winter climate

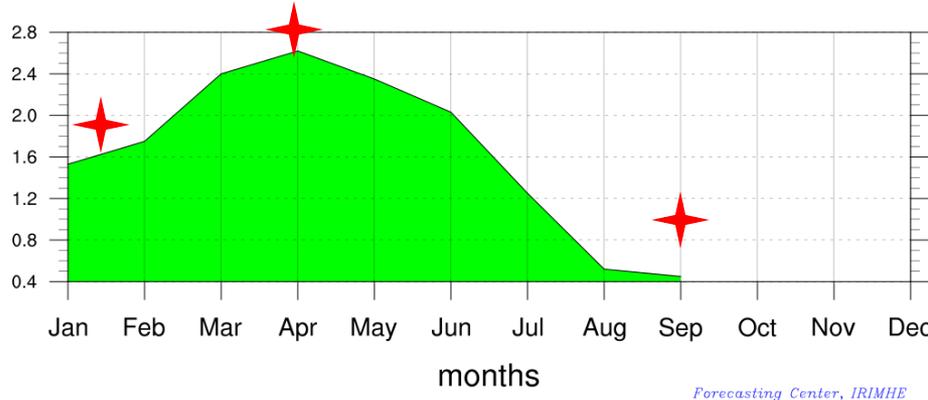
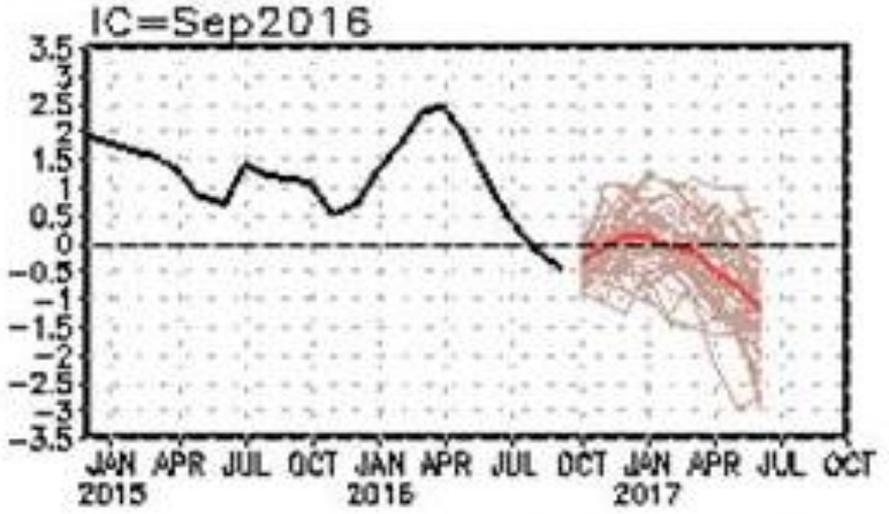
PDO_Jan

PDO conditions

PDO_Sep



PDO outlook:



Forecasting Center, IRIMHE

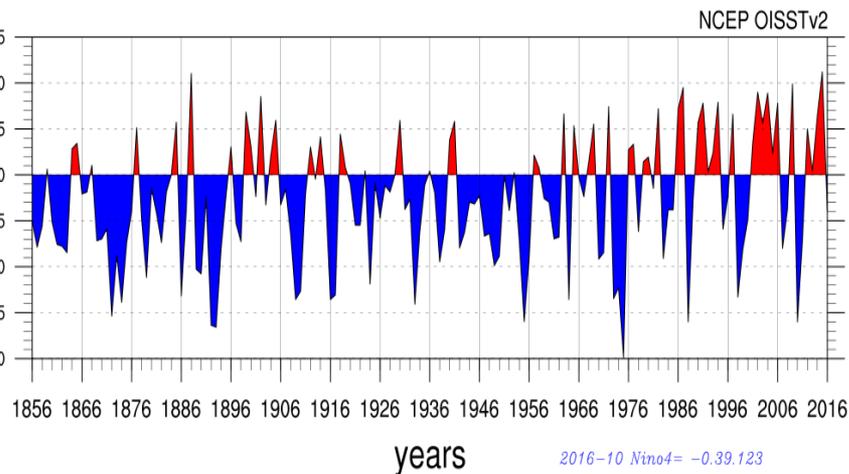
Perhaps, PDO index might be slightly positive, so the Siberian high and the Aleutian low will be stronger than their normal.

ensemble mean — Observations

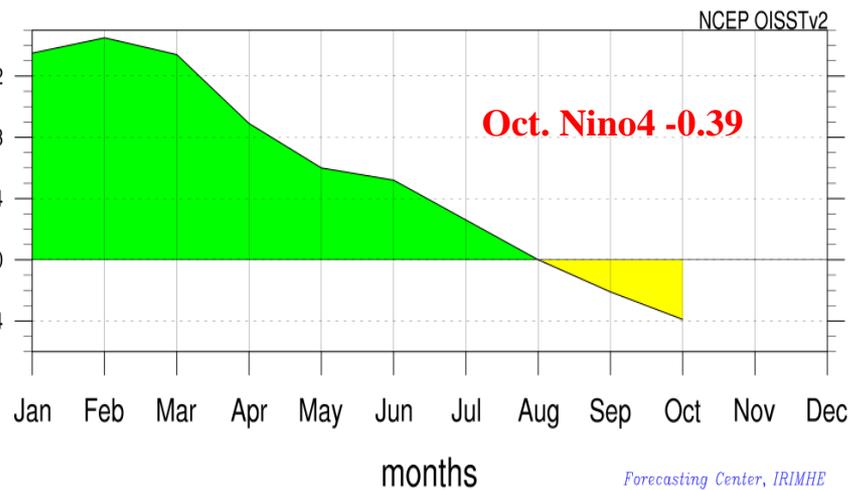
ENSO last condition

ENSO outlook

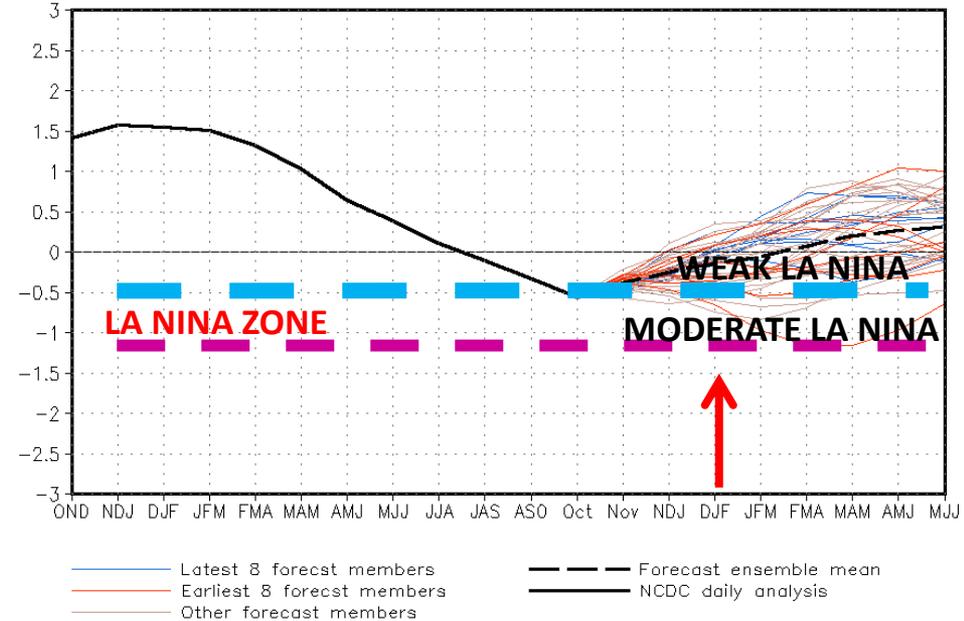
Nino4_Oct



Nino4_2016



CFSv2 forecast Nino4 SST anomalies (K)



<http://origin.cpc.ncep.noaa.gov/products/people/wwang/cfsv2fct/>

We will be expected weak La Nina in coming winter 2016/2017.

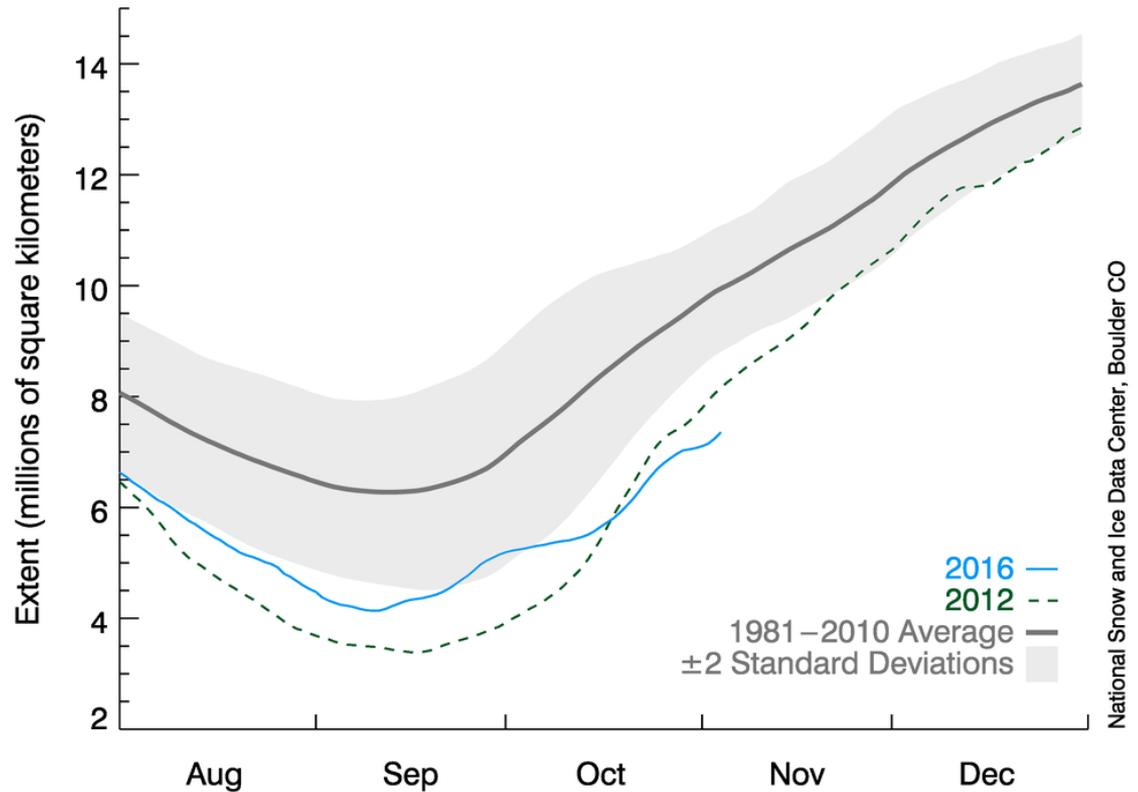
Sea Ice Concentration

SIC, October 2016



median 1981-2010

Arctic Sea Ice Extent
(Area of ocean with at least 15% sea ice)



National Snow and Ice Data Center, Boulder CO

04 Nov 2016

Sea Ice Concentration Winter Outlook in 2016/2017



NWS/NCEP/CPC

Initial conditions: 22Oct2016–31Oct2016

Last update: Wed Nov 2 2016

Dec

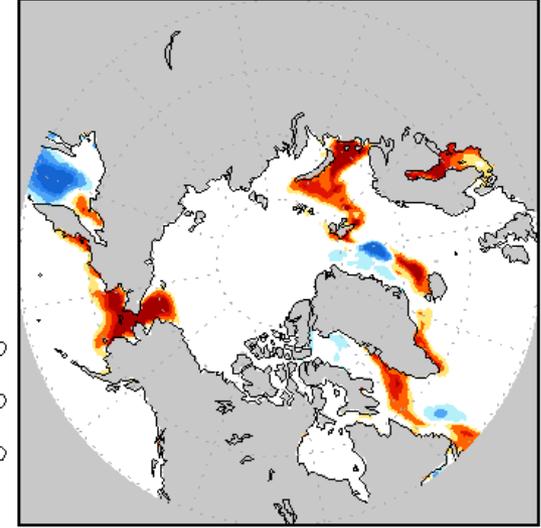
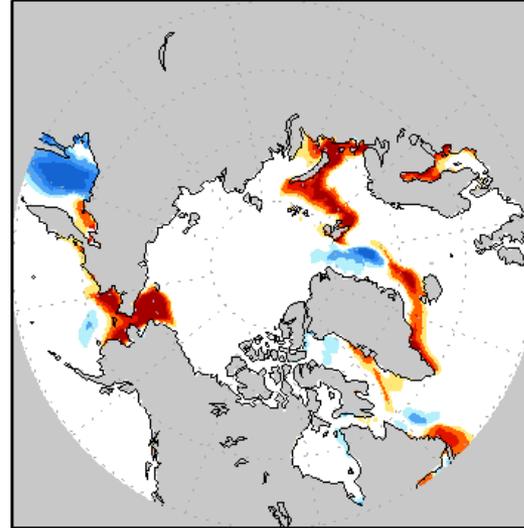
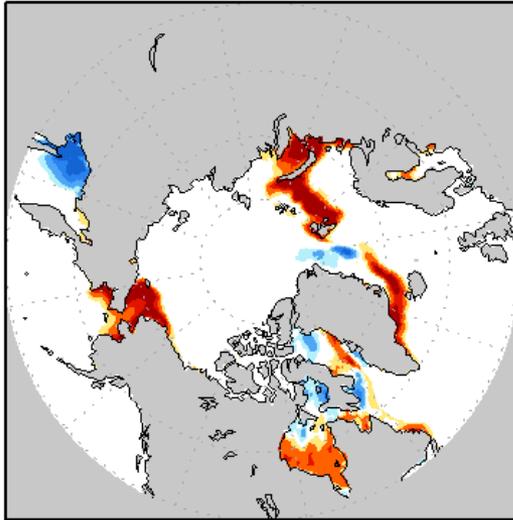
Jan

Feb

Anomalies

Anomalies

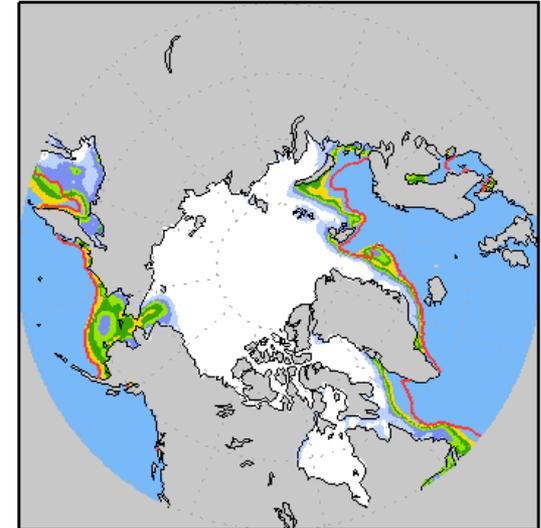
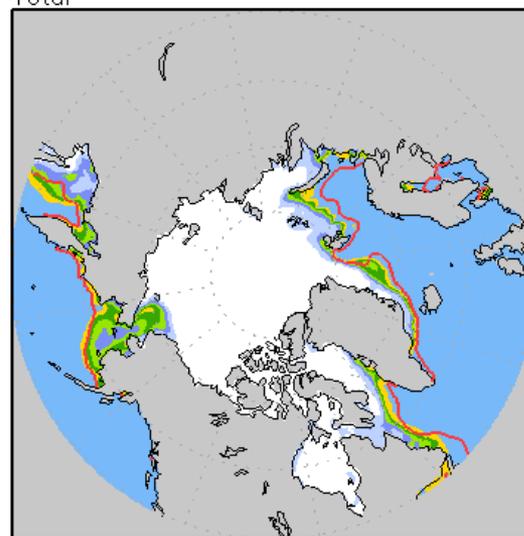
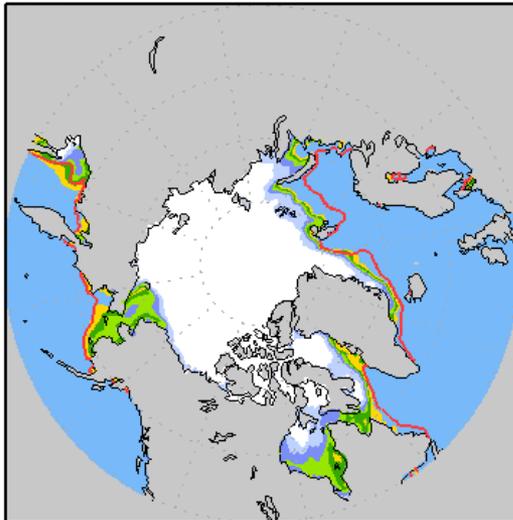
Anomalies



Total

Total

Total



Red curves are 15% concentration contours of NSIDC 1982–2010 climatology.

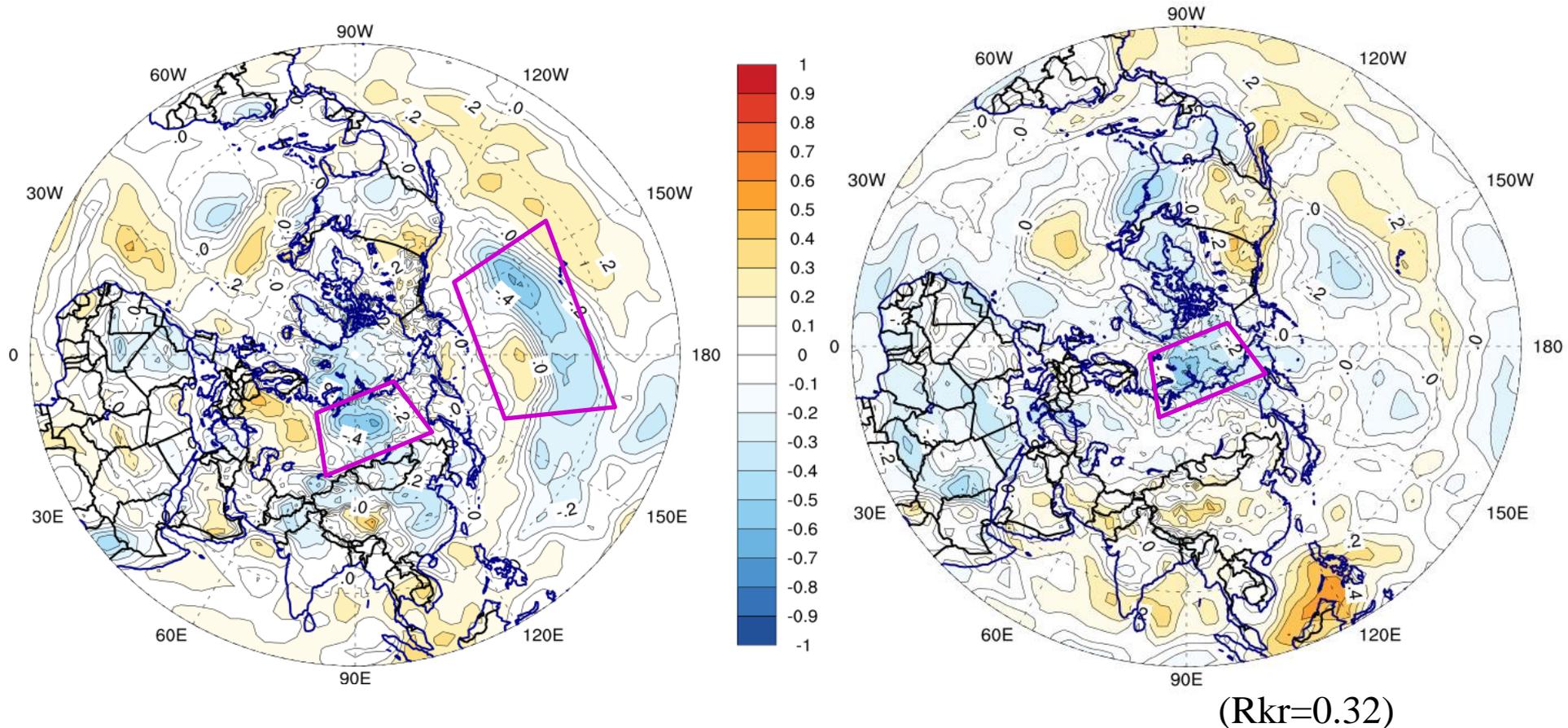
Red curves are 15% concentration contours of NSIDC 1982–2010 climatology.

Red curves are 15% concentration contours of NSIDC 1982–2010 climatology.

Correlation between ST and average Temperature over Mongolia

XII.mn.: VI

XII.mn.: X

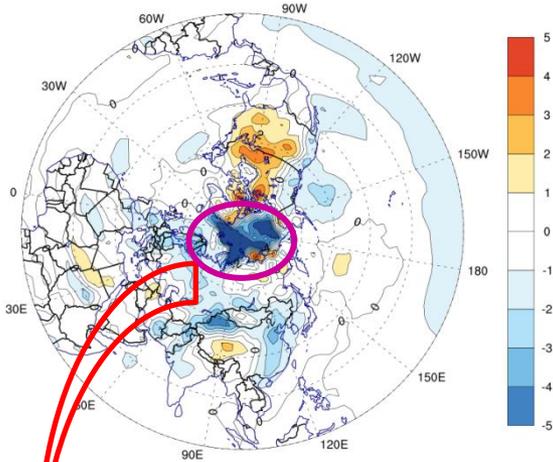


In results, we get some area which have significantly high correlation. For example, Central Siberia with -0.6..-0.7 correlation between June ST and December T, and Central Pacific ST with -0.6..-0.7 between June ST December T.

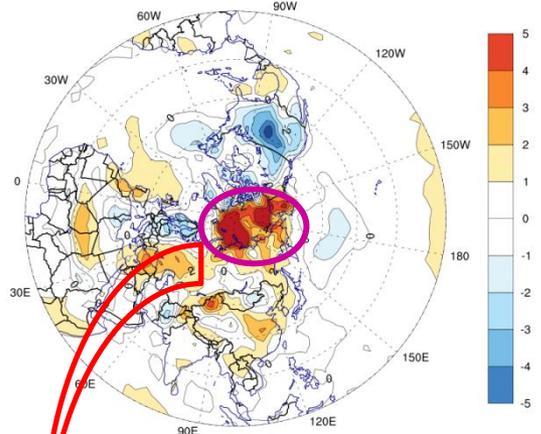
In additionally, we get area which have significantly high correlation. For example, Red sea and North land with -0.6..-0.7 for December.

October Arctic Warming

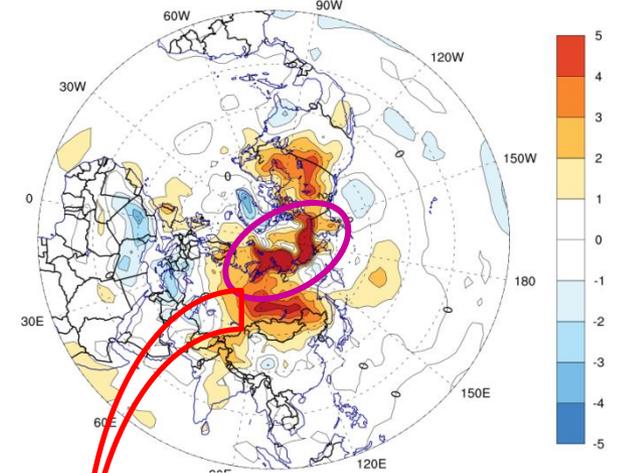
tem_t2m_anomaly 1973 10



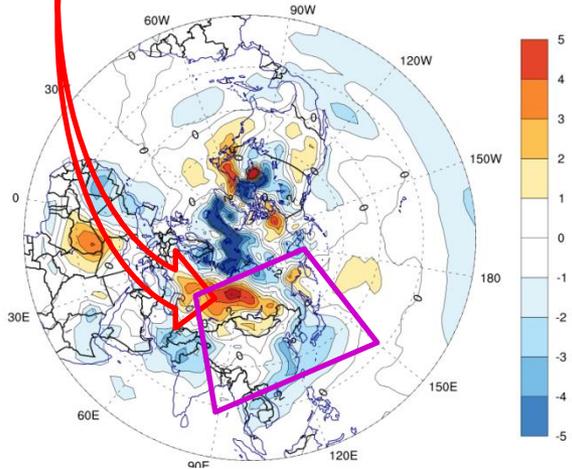
tem_t2m_anomaly 2009 10



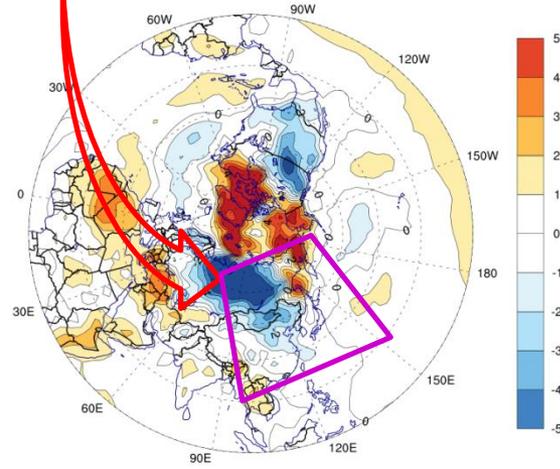
tem_t2m_anomaly 2011 10



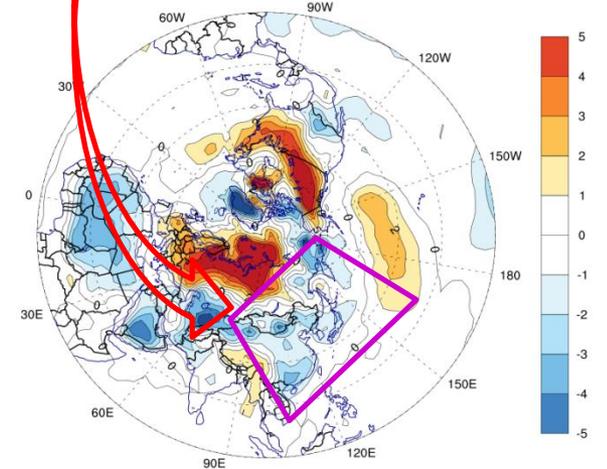
tem_t2m_anomaly 1973 12



tem_t2m_anomaly 2009 12

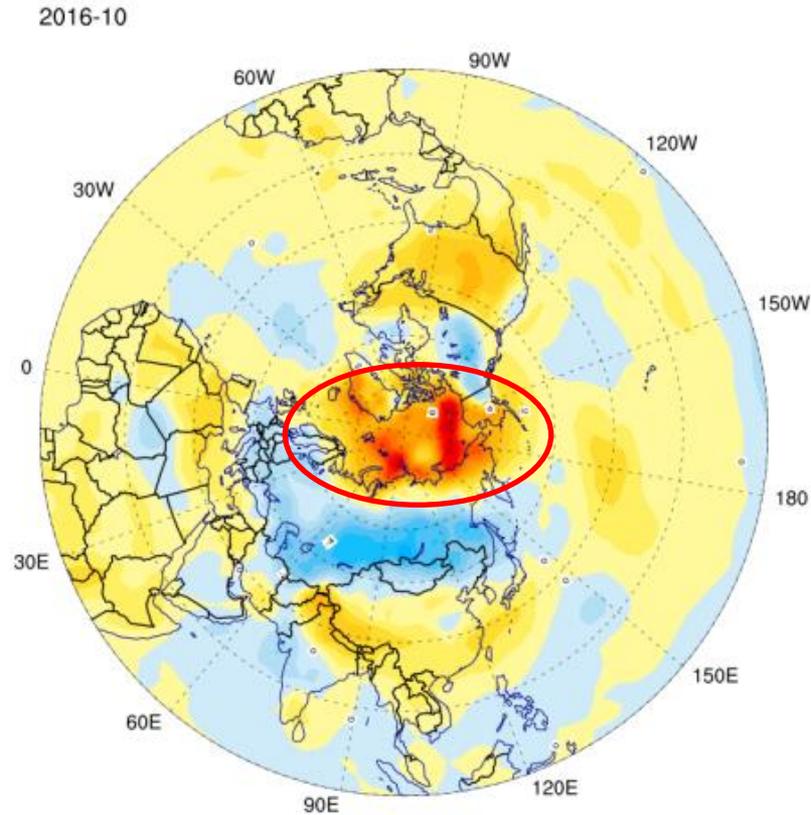


tem_t2m_anomaly 2011 12

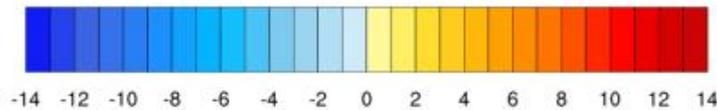


Current surface temperature anomaly conditions

Monthly Mean Temperature Anomaly at surface



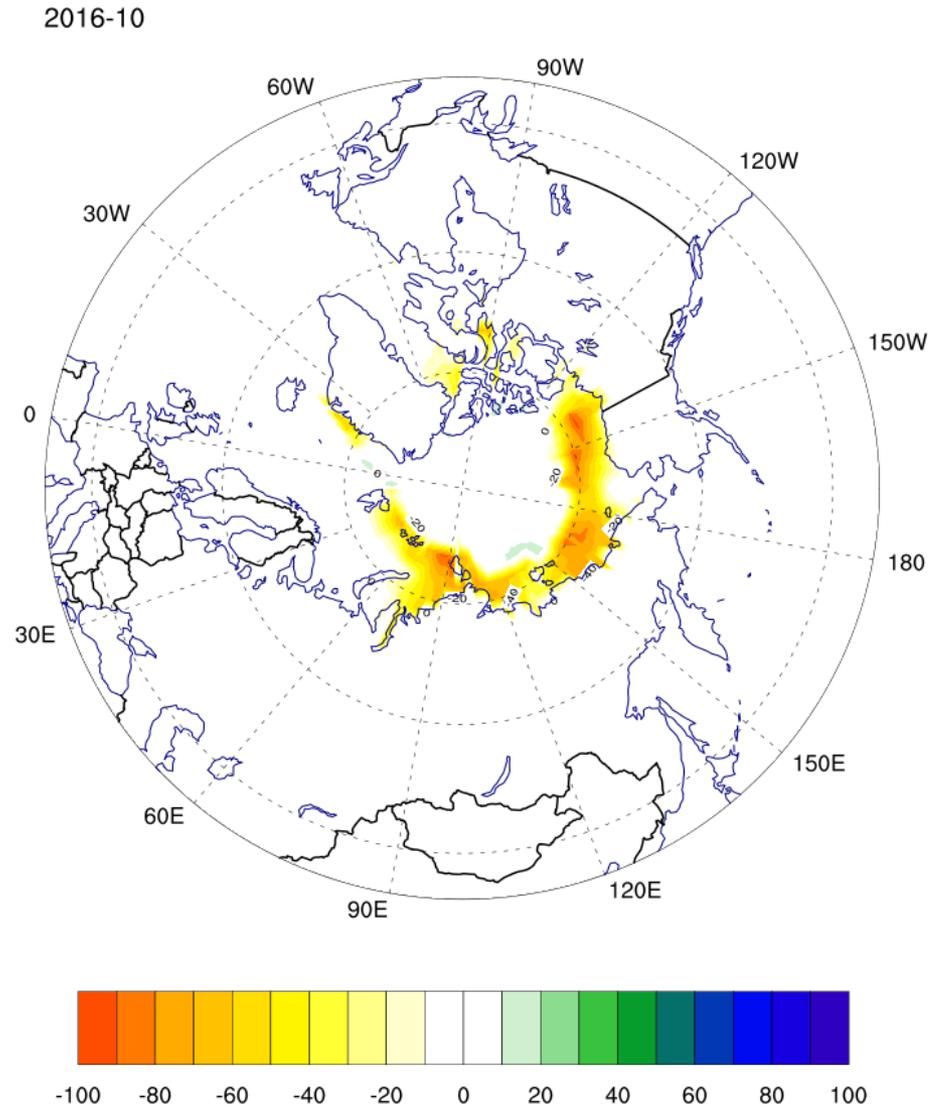
... ?



Forecasting Center, IRIMHE

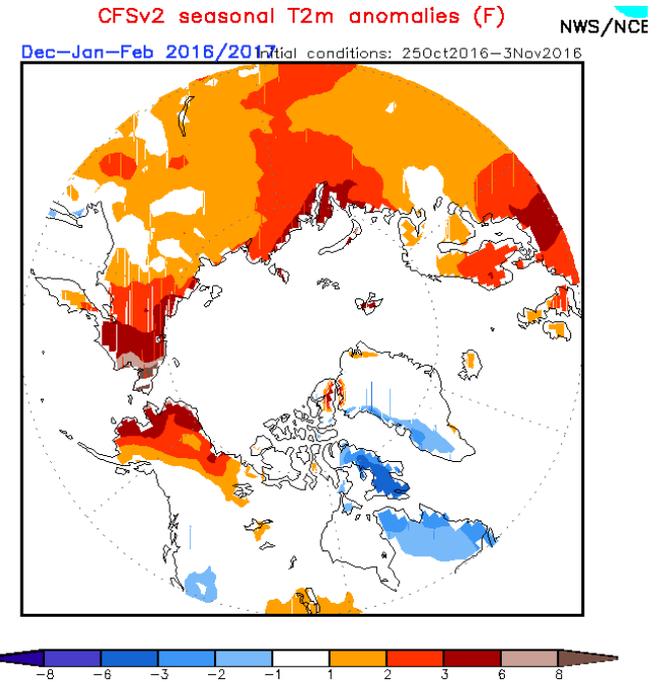
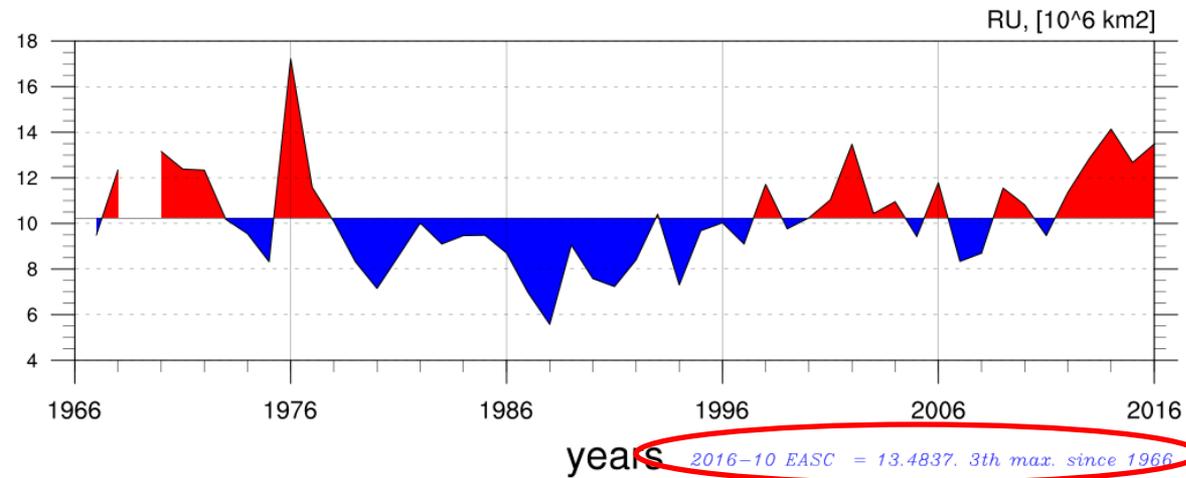
Latest SIC anomaly conditions

Monthly Mean Ice Concentration anomaly (%)



Eurasian Snow Cover

EA snow cover_Oct

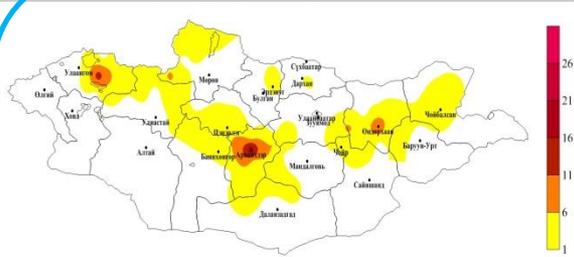


<http://origin.cpc.ncep.noaa.gov/products/people/wwang/cfsv2fcst/>

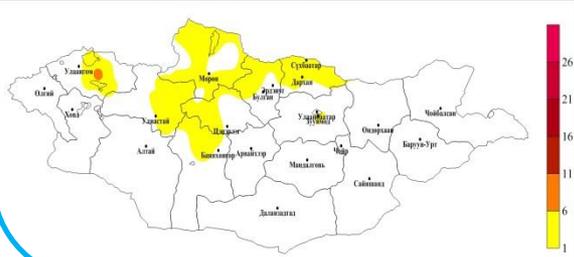
Winters with below normal temperature and above normal precipitation anomalies

October Snow Cover over Mongolia

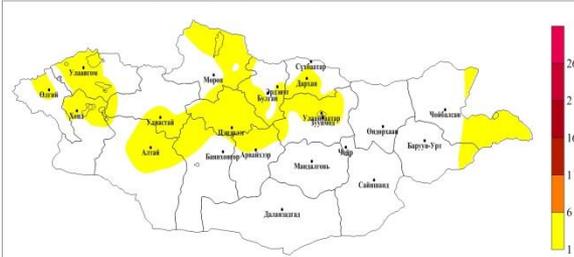
Цасны зузаан (2009/10/31)



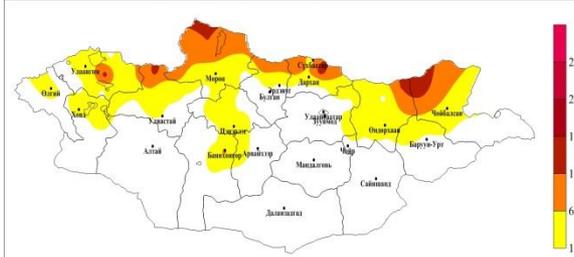
Цасны зузаан (2011/10/31)



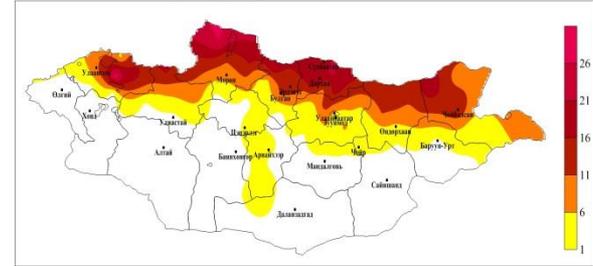
Цасны зузаан (2015/10/31)



Цасны зузаан (2016/10/31)



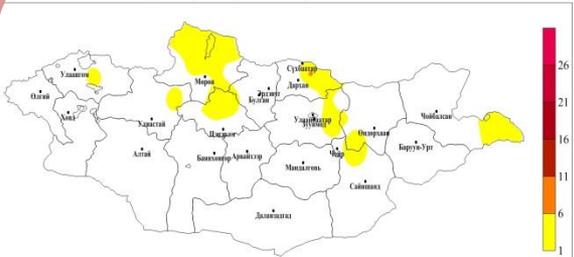
Цасны зузаан (2016/11/07)



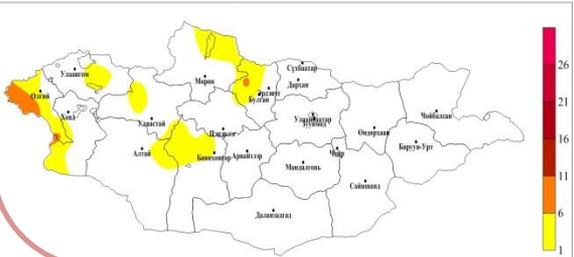
Winters with below normal temperature and above normal precipitation anomalies
2009/2010, 2011/2012, 2015/2016,
2016/2017 ?

Winters with above and normal temperature

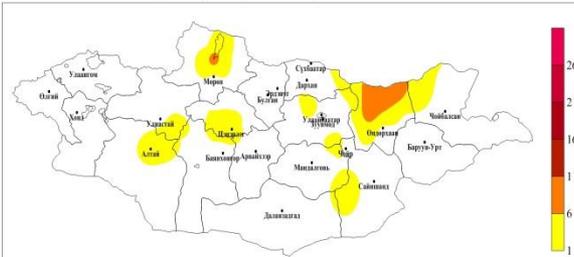
Цасны зузаан (2008/10/31)



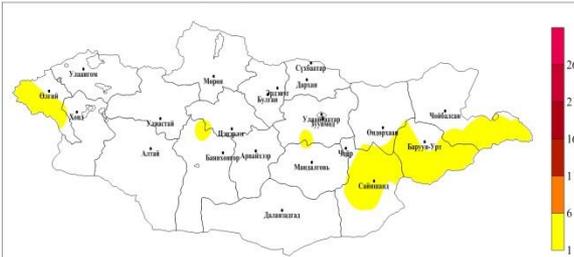
Цасны зузаан (2012/10/31)



Цасны зузаан (2013/10/31)

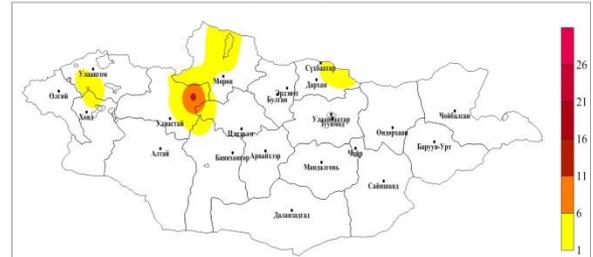


Цасны зузаан (2014/10/31)



Winters with above and normal Temperature
2008/2009, 2010/2011, 2012/2013,
2013/2014, 2014/2015,

Цасны зузаан (2010/10/31)



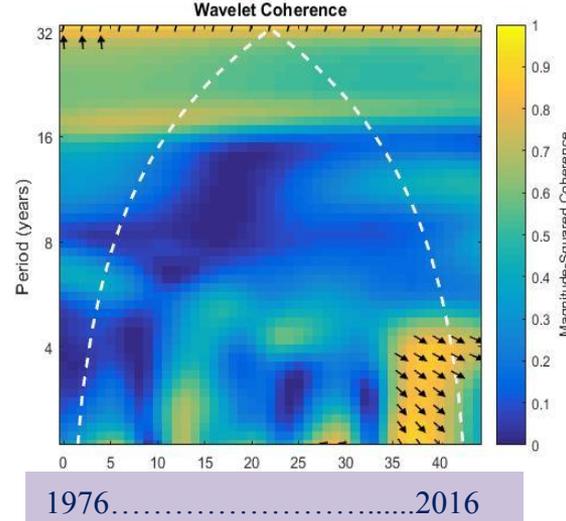
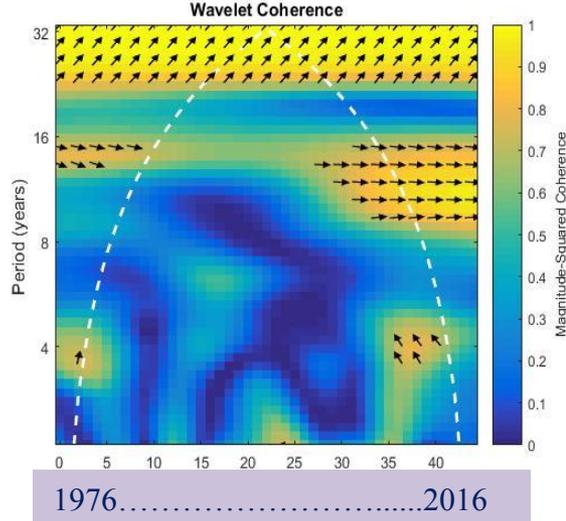
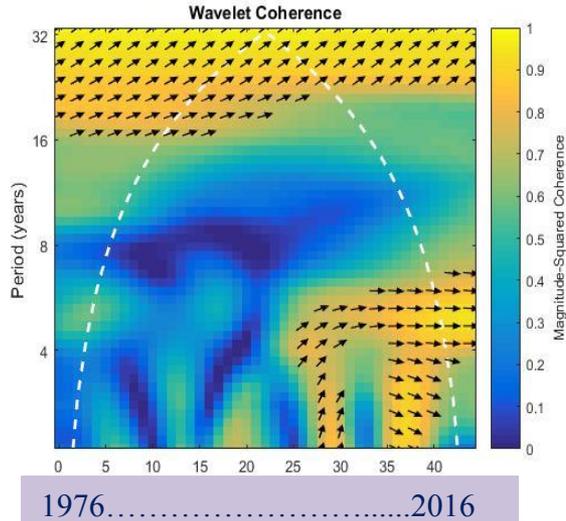
Wavelet Coherence between teleconnection indexes and temperature, and precipitation over Mongolia in January

EA

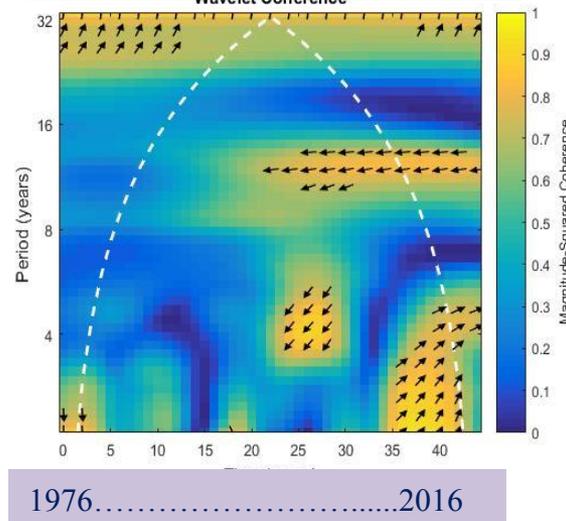
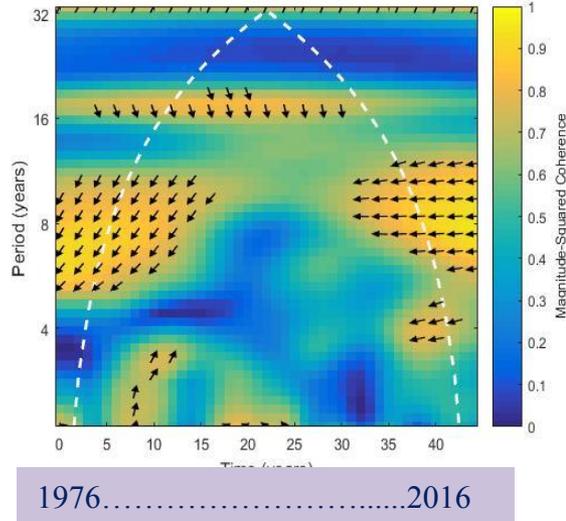
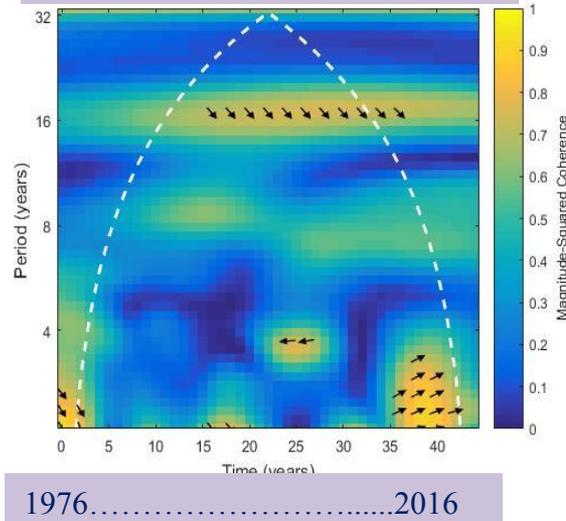
NAO

Nino3

T

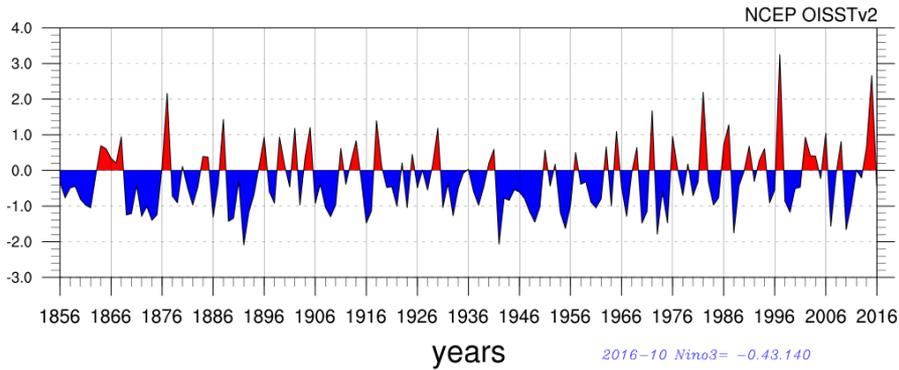


R

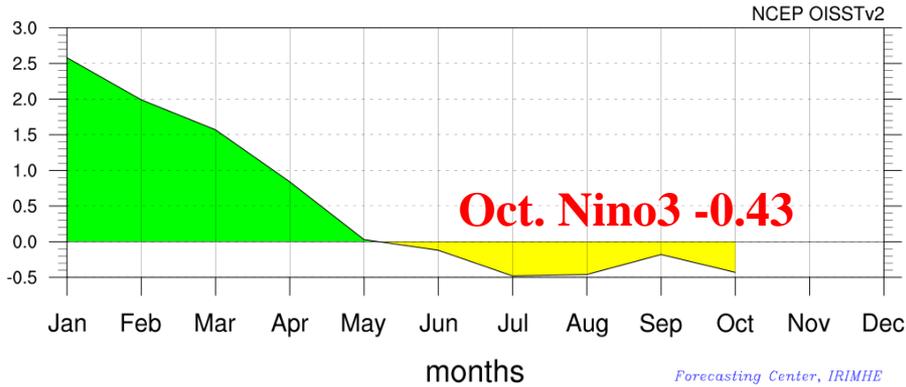


ENSO last condition and outlook

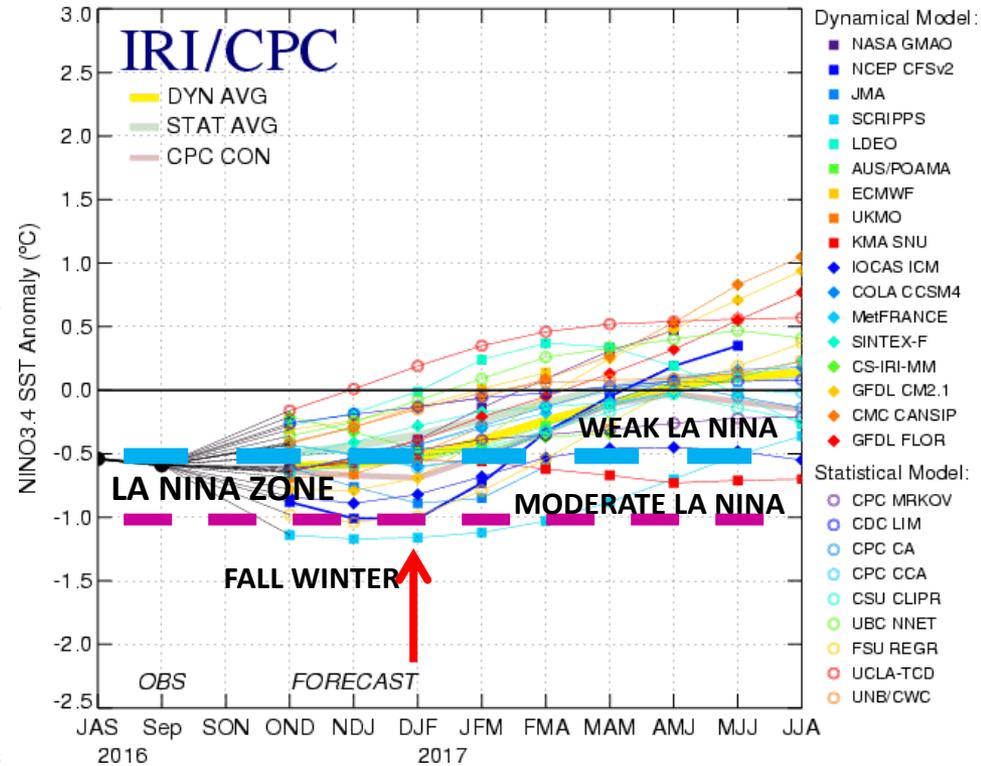
Nino3_Oct



Nino3_2016



Mid-Oct 2016 Plume of Model ENSO Predictions

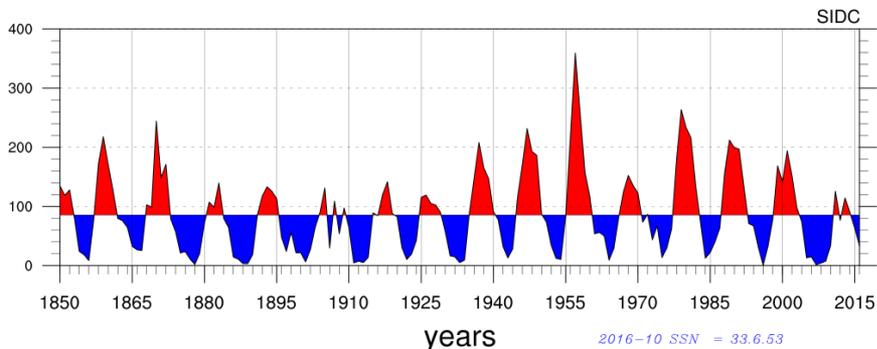


<http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/>

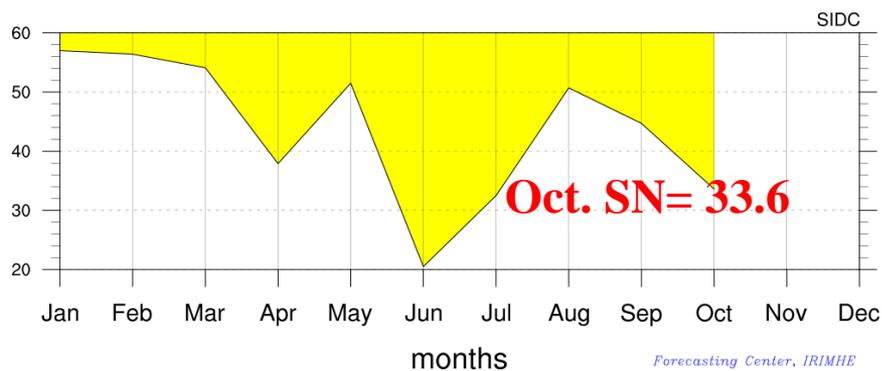
Sunspot number, SN

SN latest condition

monthly mean sunspot number_Oct



monthly mean sunspot number_2016



Predicted Sunspot Number

| Yr | Mo | Predicted | High | Low |
|------|----|-----------|------|------|
| 2016 | 5 | 27.9 | 28.9 | 26.9 |
| 2016 | 6 | 27.8 | 29.8 | 25.8 |
| 2016 | 7 | 27.7 | 30.7 | 24.7 |
| 2016 | 8 | 27.6 | 32.6 | 22.6 |
| 2016 | 9 | 27.4 | 32.4 | 22.4 |
| 2016 | 10 | 27.5 | 33.5 | 21.5 |
| 2016 | 11 | 27.6 | 34.6 | 20.6 |
| 2016 | 12 | 28 | 35 | 21 |
| 2017 | 1 | 28.8 | 36.8 | 20.8 |
| 2017 | 2 | 28.8 | 37.8 | 19.8 |
| 2017 | 3 | 28.3 | 37.3 | 19.3 |
| 2017 | 4 | 28.2 | 38.2 | 18.2 |
| 2017 | 5 | 27.6 | 37.6 | 17.6 |
| 2017 | 6 | 26.1 | 36.1 | 16.1 |
| 2017 | 7 | 24.9 | 34.9 | 14.9 |
| 2017 | 8 | 23.7 | 33.7 | 13.7 |
| 2017 | 9 | 22.5 | 32.5 | 12.5 |
| 2017 | 10 | 21.4 | 31.4 | 11.4 |
| 2017 | 11 | 20.3 | 30.3 | 10.3 |
| 2017 | 12 | 19.2 | 29.2 | 9.2 |

<http://www.swpc.noaa.gov/products/predicted-sunspot-number-and-radio-flux>

5. Seasonal outlook over Mongolia

DJF outlook Temperature



Precipitation



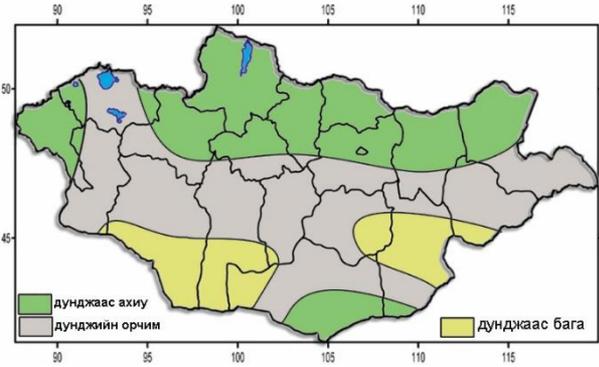
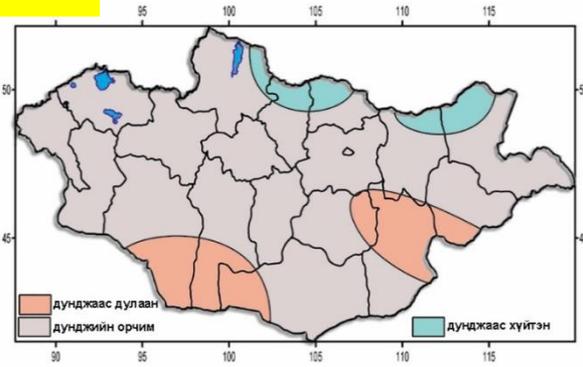
Summary

- ❖ All in all, temperature anomaly will be **normal** and **below normal**.
- ❖ Precipitation will be **normal** and **above normal**.

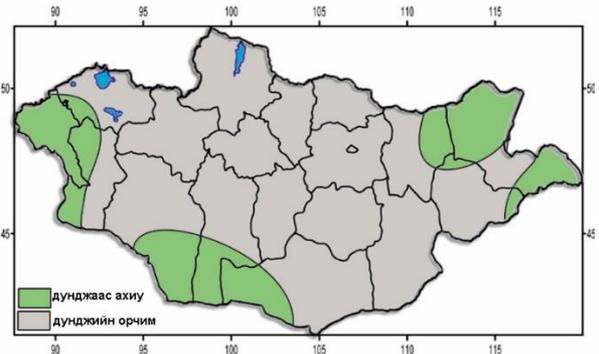
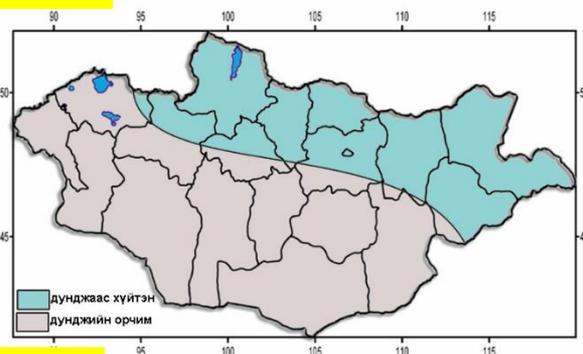
Temperature

Precipitation

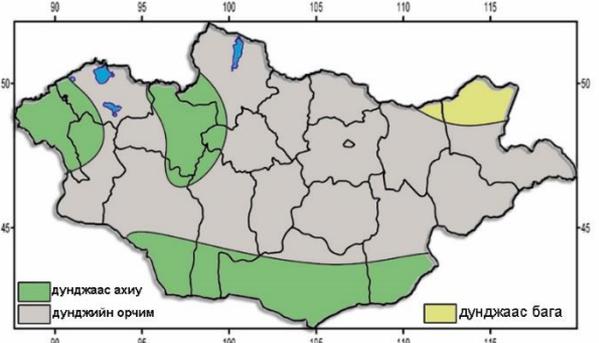
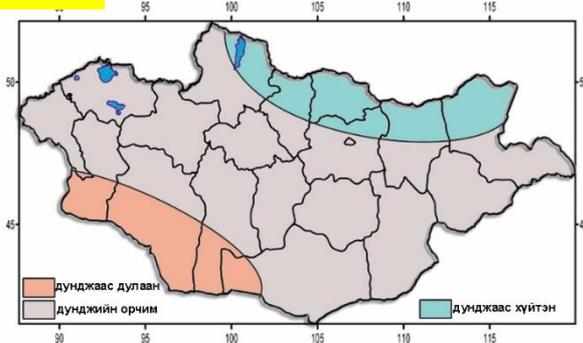
Dec



Jan



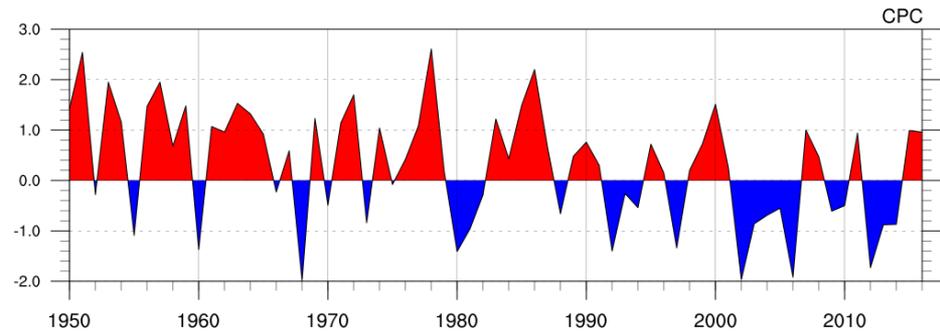
Feb



THANK YOU FOR YOUR
ATTENTION !



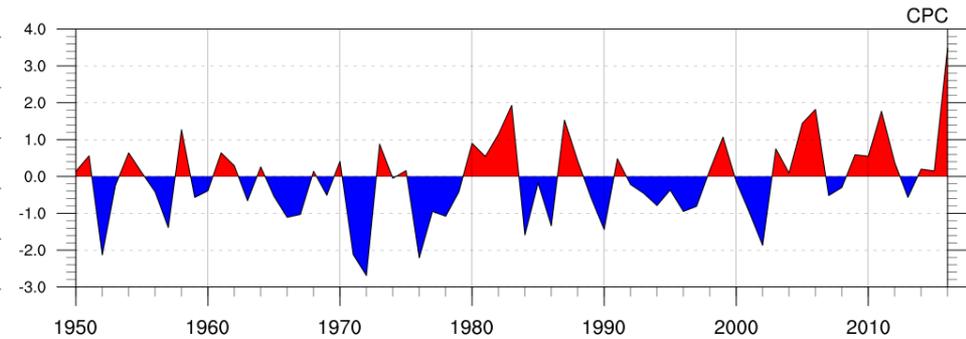
NAO_Oct



years
NAO_2016

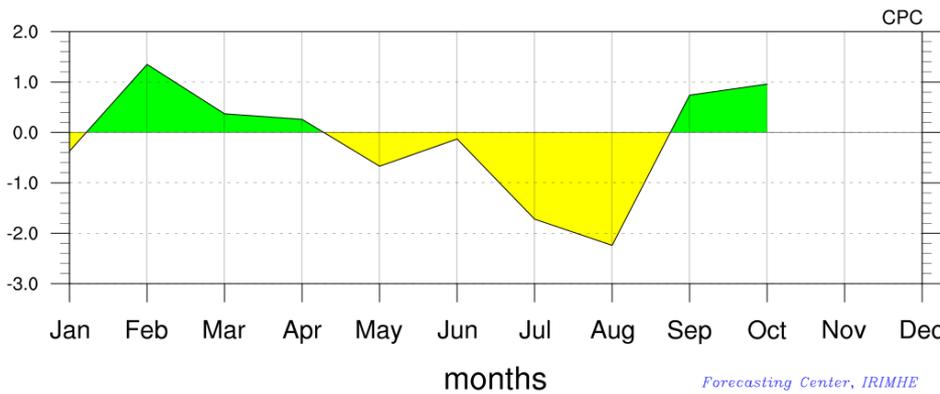
2016-10 NAO = 0.9644

EA_Sep



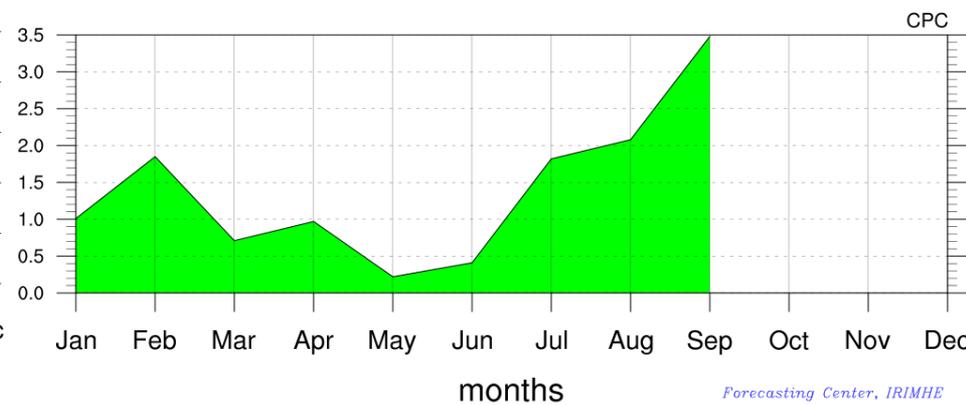
years
EA_2016

2016-9 EA = 3.48. 1th max. since 1950



months

Forecasting Center, IRIMHE



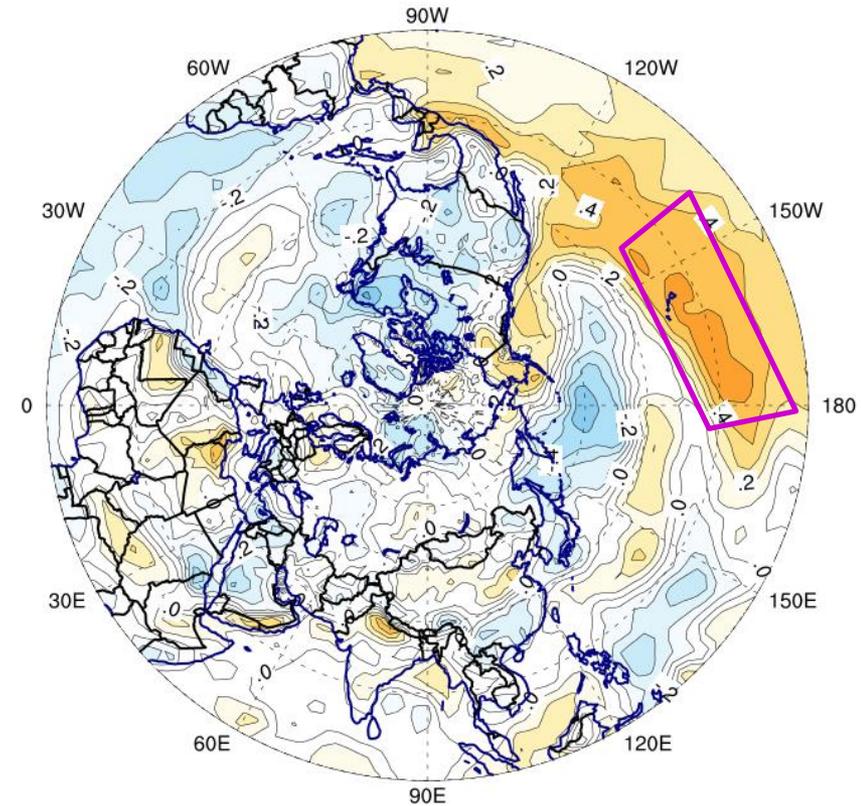
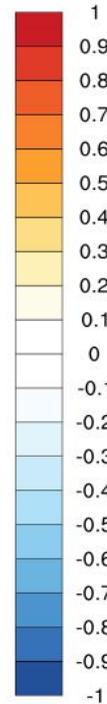
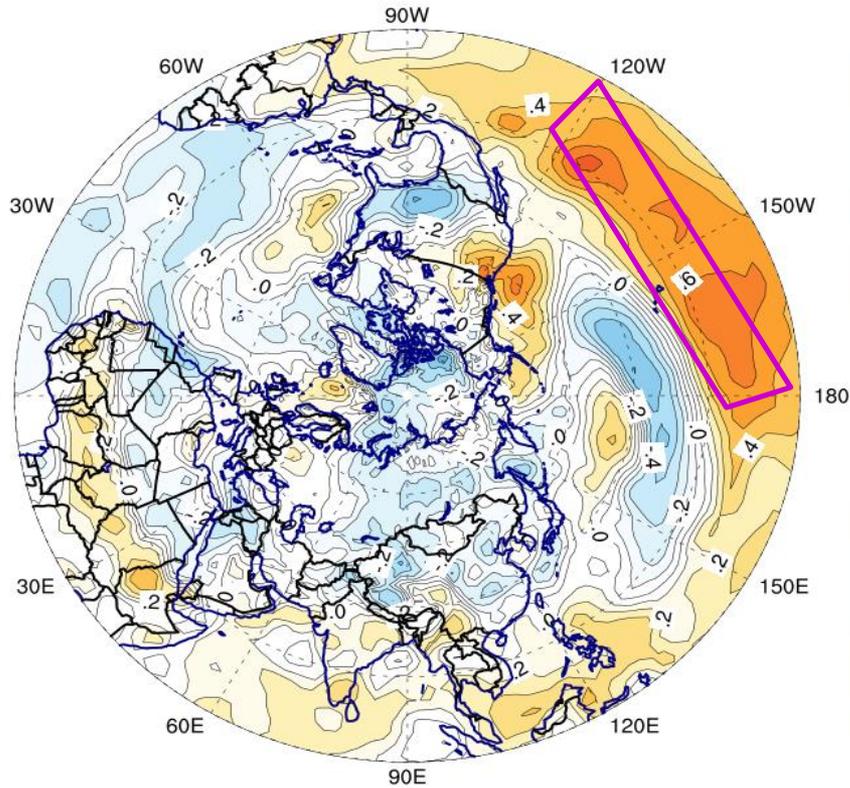
months

Forecasting Center, IRIMHE

Correlation between ST and average Temperature over Mongolia

I.mn.: VI

I.mn.: VIII



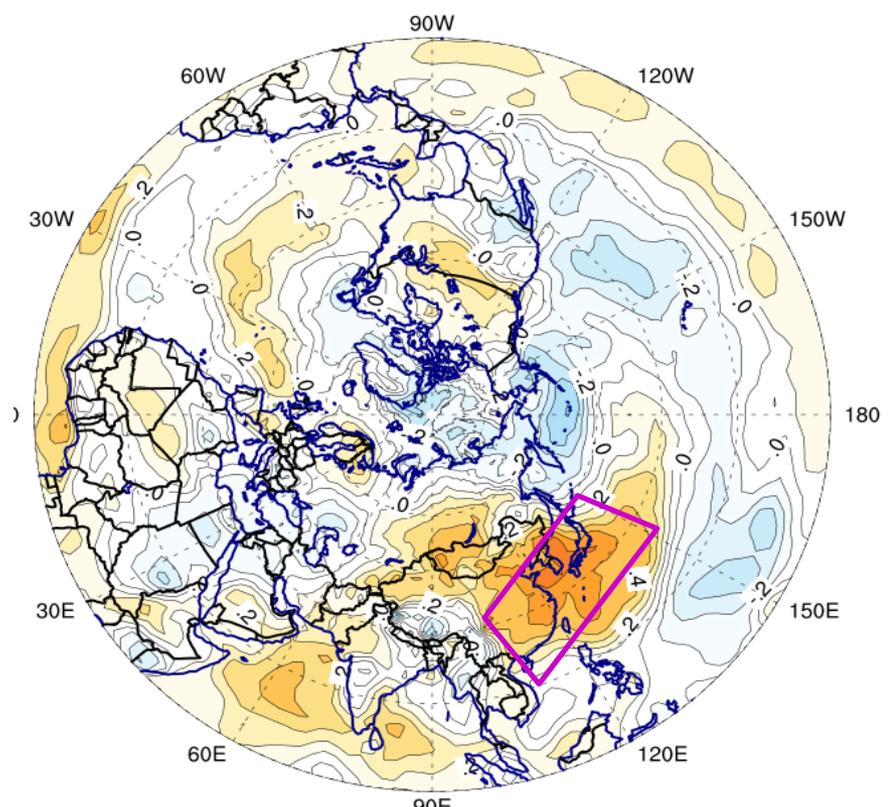
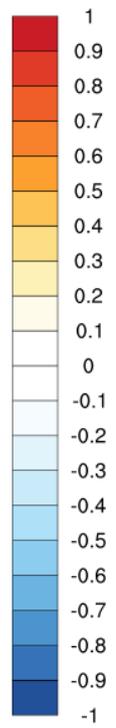
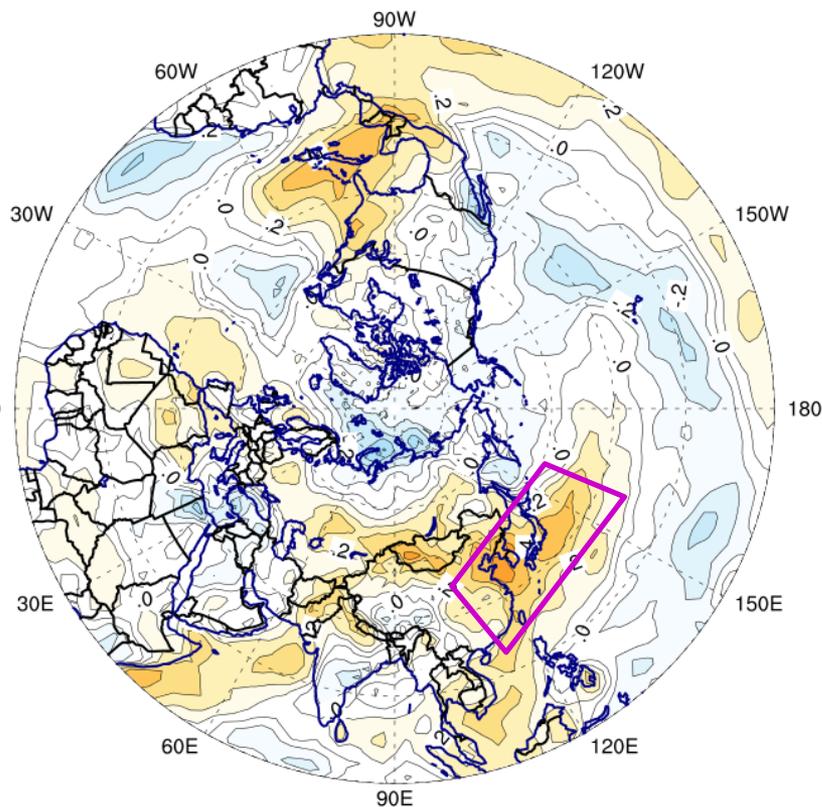
($R_{kr}=0.32$)

In results, we get area which have significantly high correlation. This is ENSO region with -06..-0.7 correlation for .

Correaltion between ST and average Temperature over Mongolia

II.mn.: I

II.mn.: XII



II-р сарын температур ба гридийн цэг бүр дээрх T2m хоорондын корреляцын хамаарал (Rkr=0.32)

| Өвлийн сар | Хамааралтай сарууд | R | Район | Статистик үнэмшил (R>Rkr) |
|------------|--------------------|----------|---|---------------------------|
| II | XII | 0.6-0.7 | 120-130E, 35-40N Солонгосын хойг, Японы өмнөд хэсэг | + |
| | | | | + |
| | I | 0.5-0.6 | 120-130E, 35-40N Солонгосын хойг, Японы өмнөд хэсэг | + |
| | | -0.4-0.5 | 60-78E, 65-75N Шинэ газрын арал | + |

4. Influence Solar activation (sunspot number, SN)

Spectral Analysis and Complex Demodulation between SN and monthly mean temperature anomaly in January over Mongolia

Spectral Analysis and Complex Demodulation between SN and monthly mean precipitation anomaly in January over Mongolia

