

EASCOF-6
Nov 8, 2018

Wintertime Surface Air Temperature Modes

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Part 1

**Understand
the leading interannual variability modes of
surface air temperature during boreal winter**

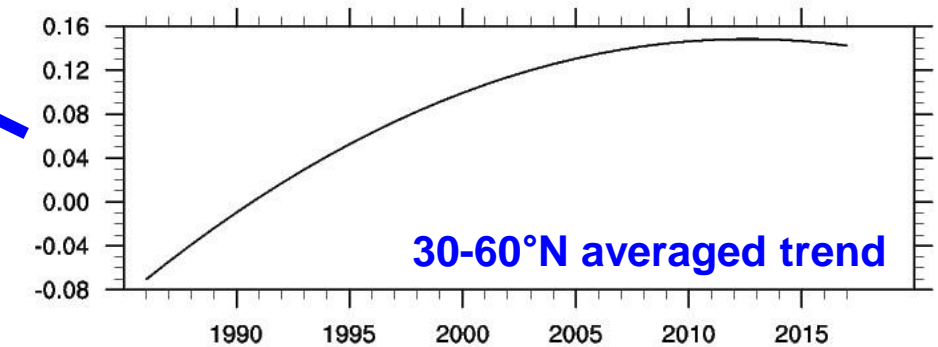
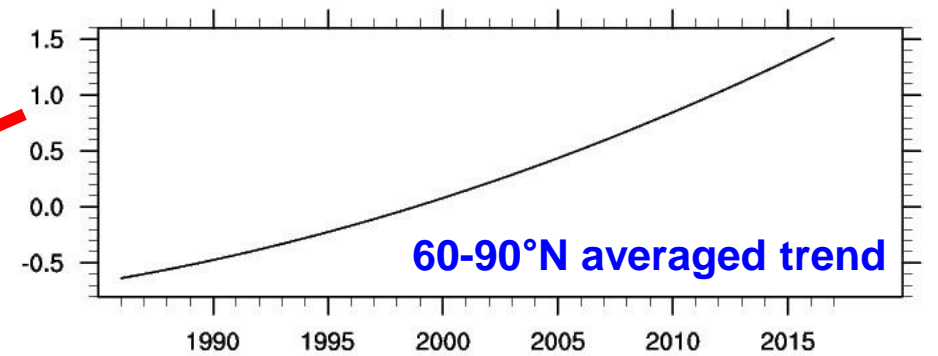
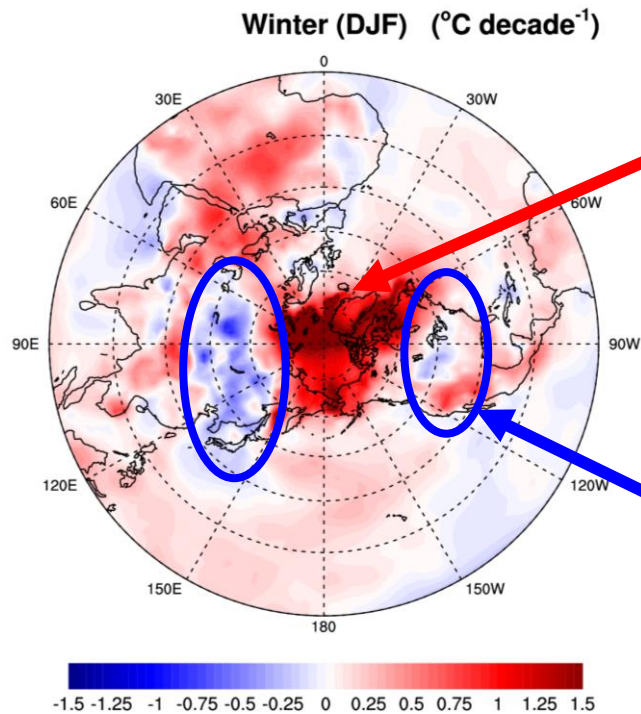
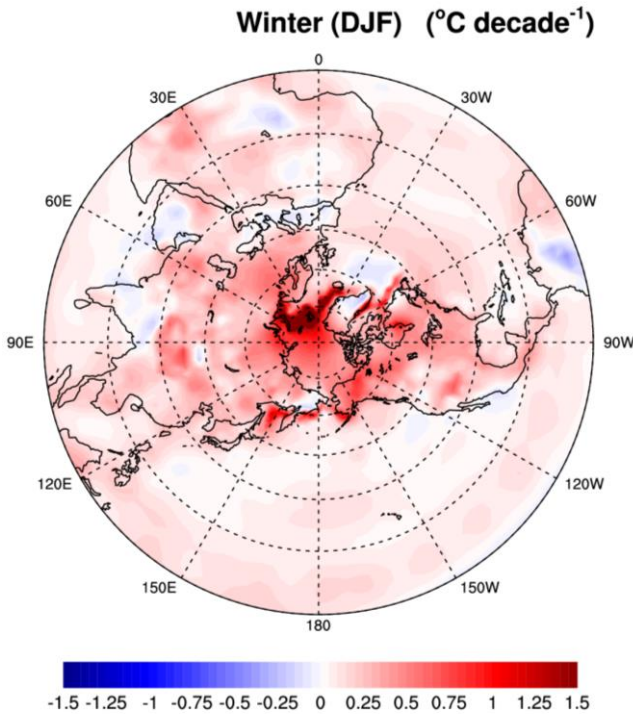
NH surface(T2m) warming trend in winter

1958-2017 (60yrs)

1986-2017 (32yrs)

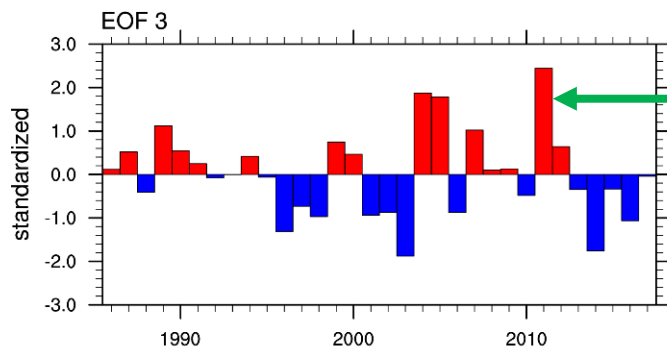
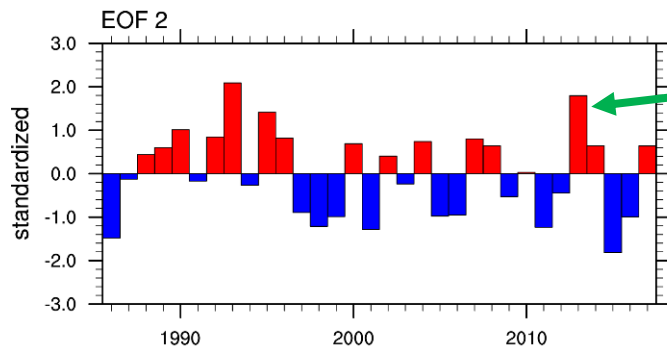
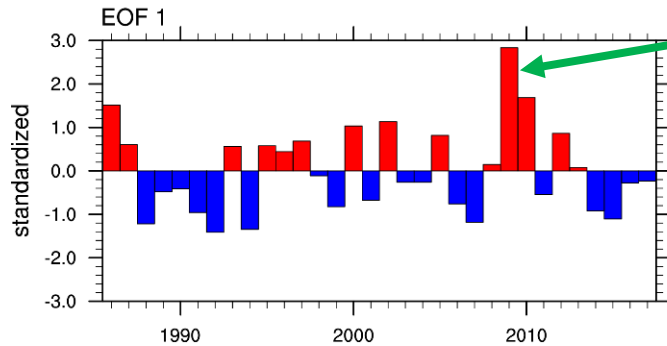
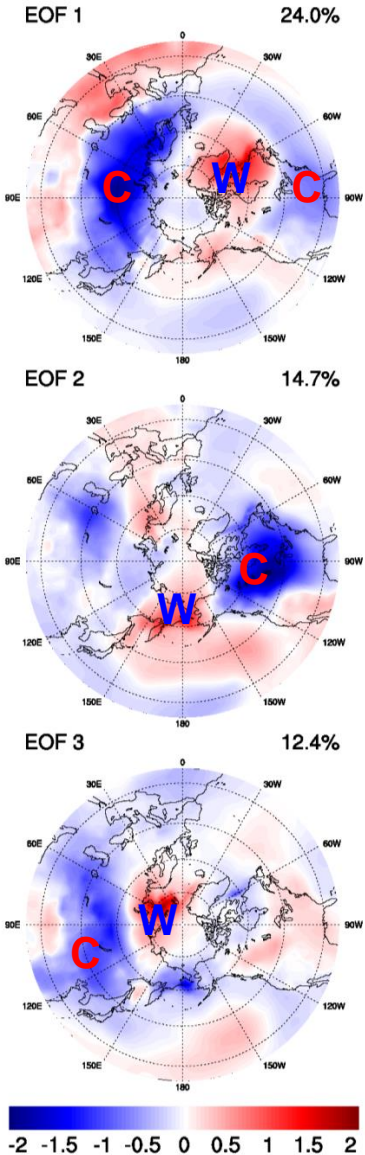
Detrended warming trend
Using Ensemble Empirical Mode
Decomposition (EEMD)

T2m
[DJF]

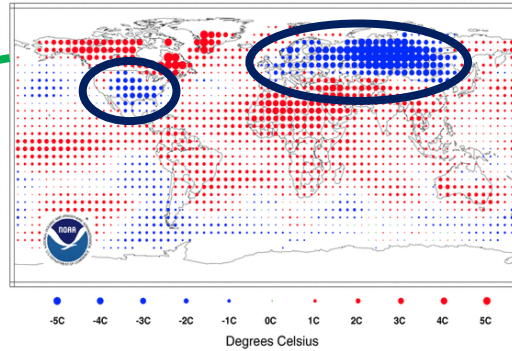


Wintertime surface air temperature modes

T2m EOF [DJF] 1986-2017

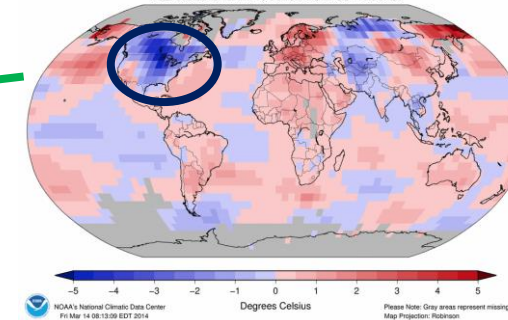


Temperature Anomalies Dec-Feb 2010
(with respect to a 1971-2000 base period)
National Climatic Data Center/NESDIS/NOAA



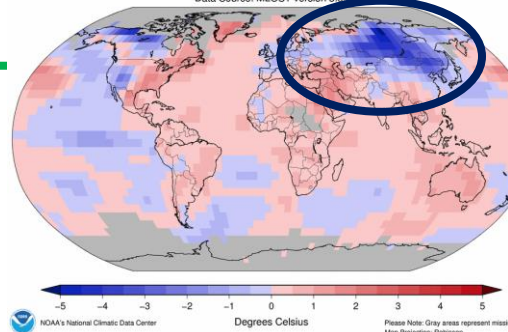
Warm Arctic (near Greenland)
Cold North Eurasia & South Eastern North America

Land & Ocean Temperature Departure from Average Dec 2013-Feb 2014
(with respect to a 1981-2010 base period)
Data Source: GHCN-M version 3.2.2 & ERSST version 3b



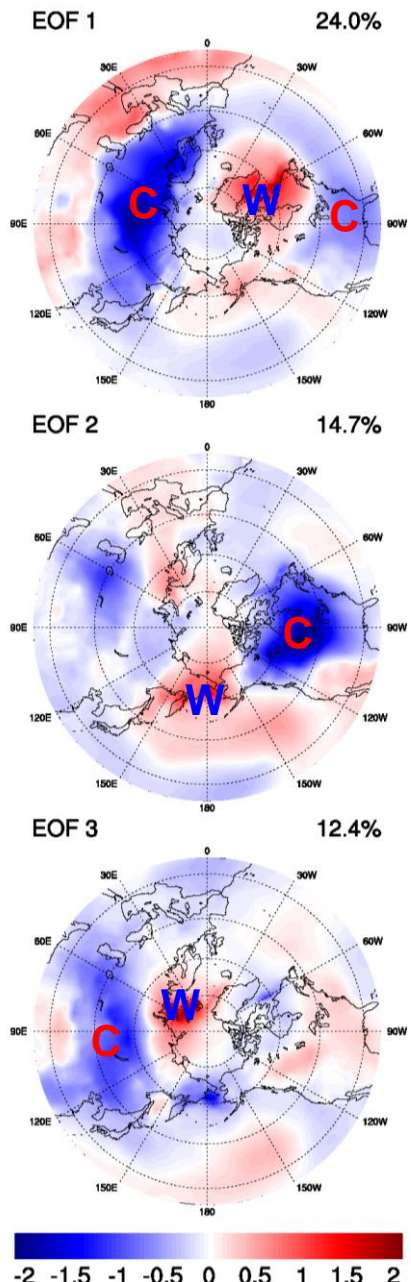
Warm Arctic (near Bering Sea)
Cold Canada & Northern US

Land & Ocean Temperature Anomalies Dec 2012-Feb 2013
(with respect to a 1981-2010 base period)
Data Source: MLOST version 3.5.3



Warm Arctic (near B-K Sea)
Cold Europe & Asia

Simultaneous correlation with climate indices



EOF1 [DJF]

Climate indices [DJF]	Correlation with PC1
EA (East Asia)	-0.33*
SK (South Korea)	-0.38**
AO	-0.87**
B-K sea	-0.26
C-B sea	0.02
NAO	-0.80**
SCAND	0.63**
EA/WR	-0.38**
PNA	0.13
PDO	-0.28
NINO1+2	0.03
NINO3.4	0.09
QBO	-0.18

EOF2 [DJF]

Climate indices [DJF]	Correlation with PC2
EA (East Asia)	-0.19
SK (South Korea)	-0.18
AO	0.05
B-K sea	-0.13
C-B sea	0.41**
NAO	0.09
SCAND	0.21
EA/WR	-0.23
PNA	-0.49**
PDO	-0.28
NINO1+2	-0.42**
NINO3.4	-0.24
QBO	-0.06

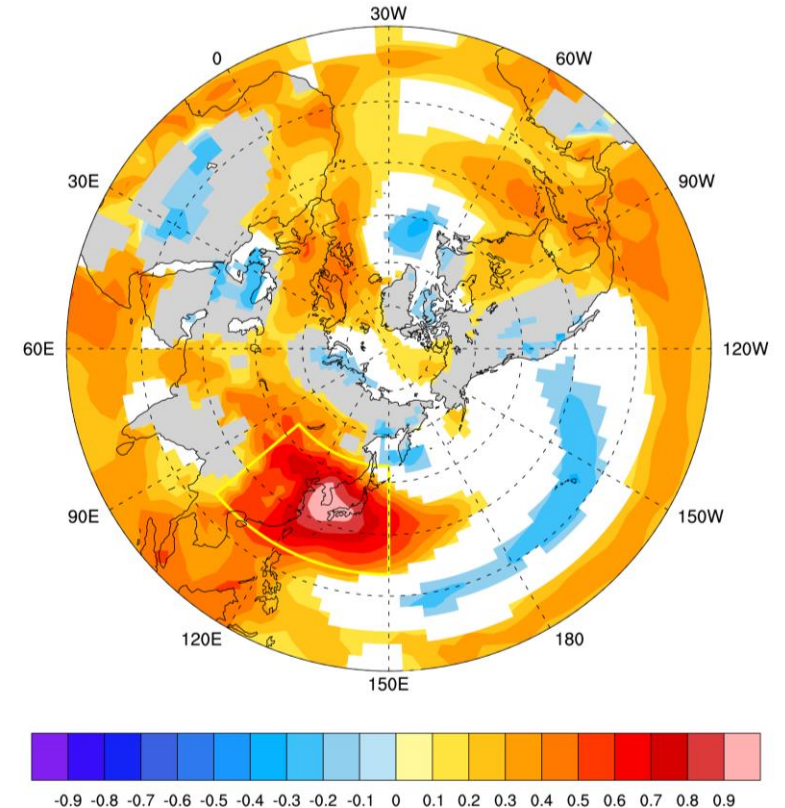
EOF3 [DJF]

Climate indices [DJF]	Correlation with PC3
EA (East Asia)	-0.67**
SK (South Korea)	-0.44**
AO	-0.00
B-K sea	0.53**
C-B sea	-0.28
NAO	0.13
SCAND	0.35*
EA/WR	-0.20
PNA	-0.08
PDO	-0.28
NINO1+2	-0.20
NINO3.4	-0.15
QBO	-0.2

Relationship with winter temperature over EA and South Korea

Climate indices	PC1	PC2	PC3
EA [DJF] (East Asia)	-0.33*	-0.19	-0.67**
EA [DJ] (East Asia)	-0.43**	-0.08	-0.46**
EA [F] (East Asia)	-0.09	-0.24	-0.64**
SK [DJF] (South Korea)	-0.38**	-0.18	-0.44**
SK [DJ] (South Korea)	-0.51**	-0.16	-0.20
SK [F] (South Korea)	-0.04	-0.13	-0.58**

Correlation map associated with SK index [DJF]



Yellow Domain: EA (East Asia)

Part 2

**Understand the major teleconnection patterns
that contribute to recent severe winter
temperature in the NH
(source of seasonal predictability)**

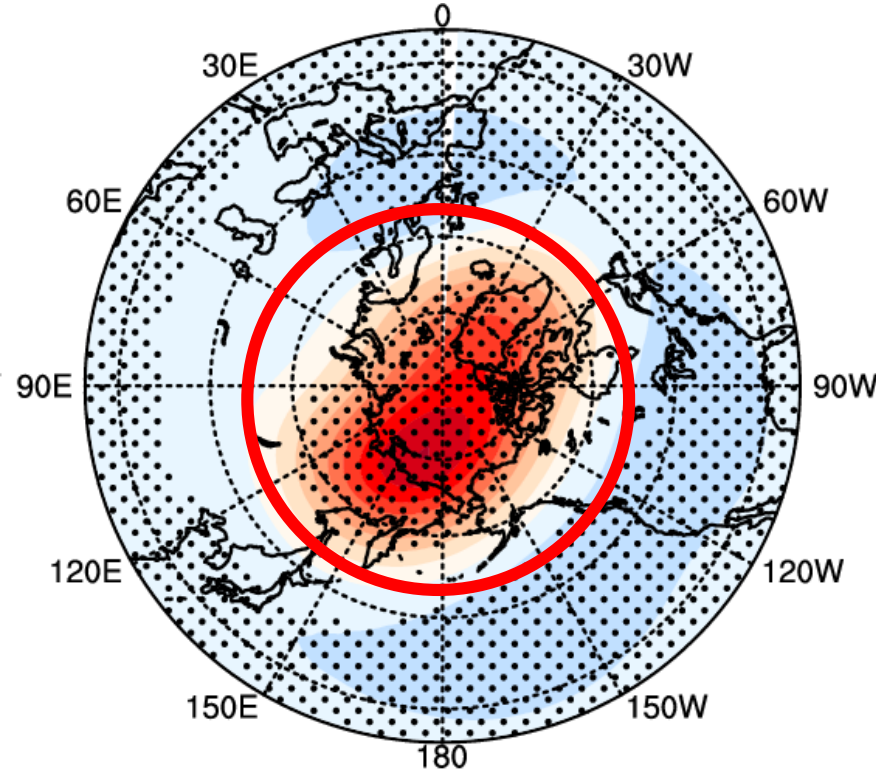
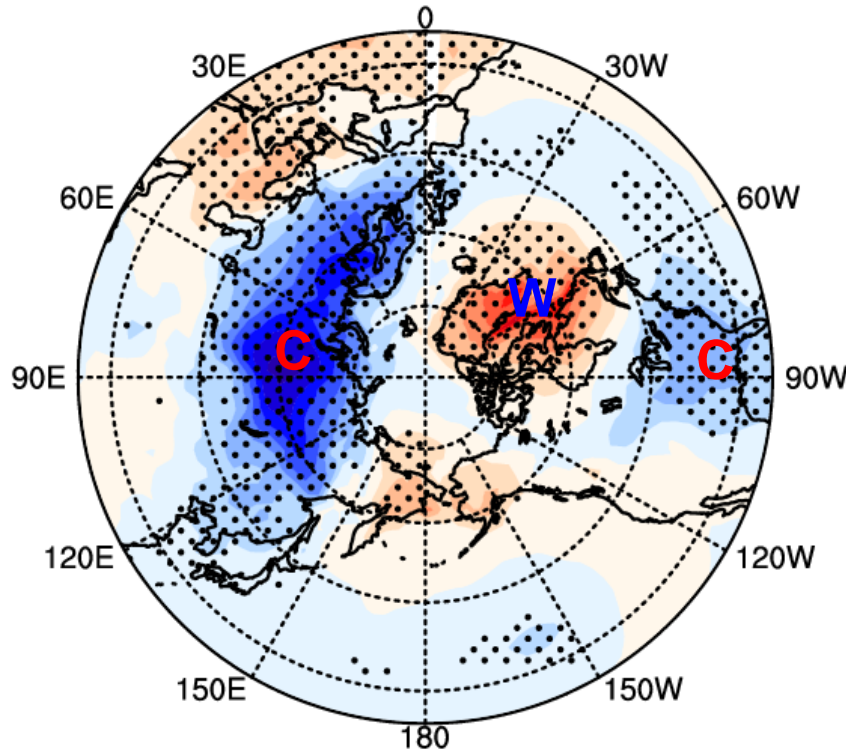
Seasonal predictability of PC1 mode

Regression Map

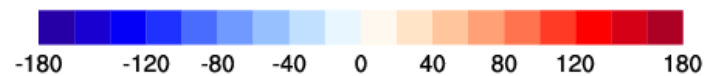
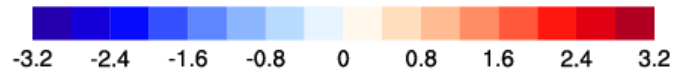
T2m

Z50

DJF



Weaken
Stratospheric
Polar Vortex



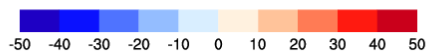
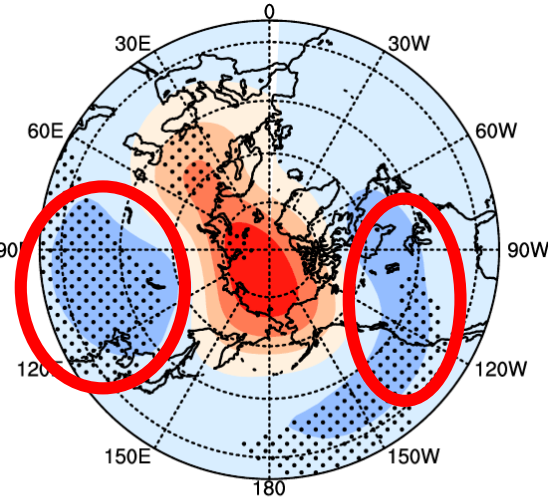
Dots: 95% significance

Seasonal predictability of PC1 mode

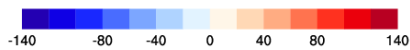
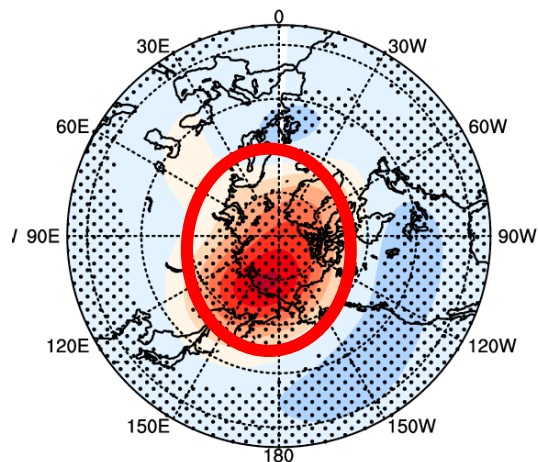
Z50

Regression Map

ON

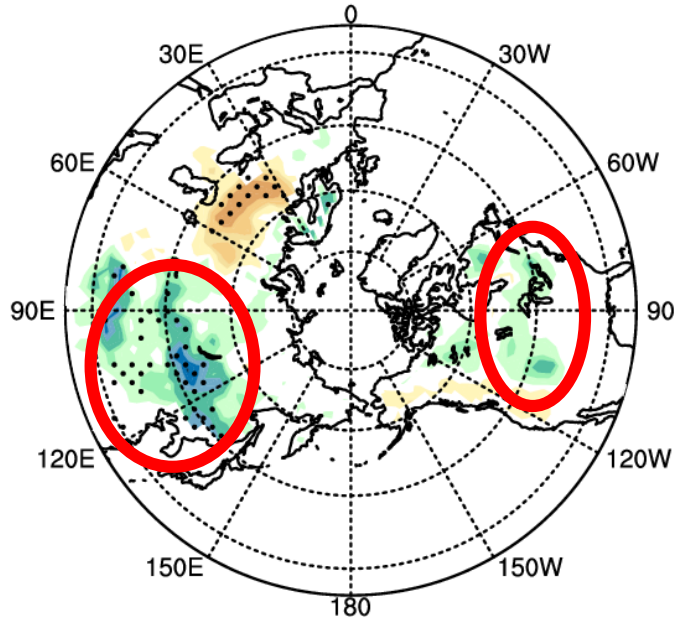


ND

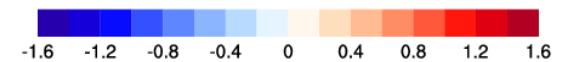
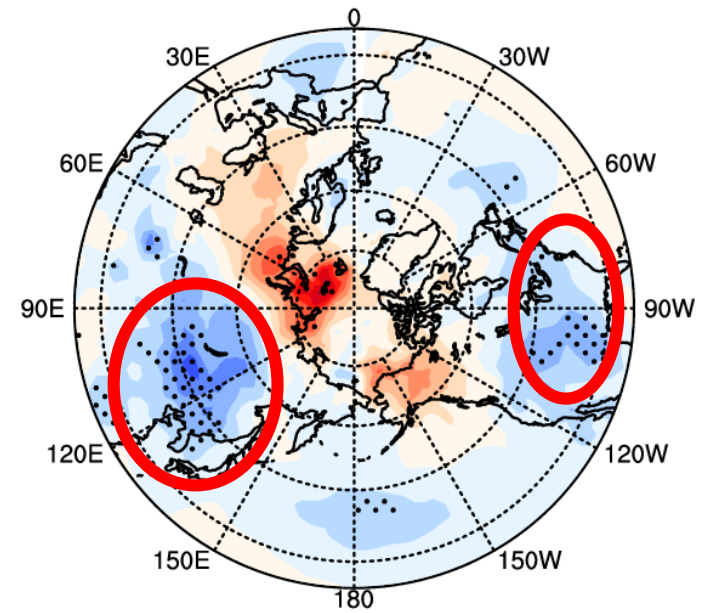


Snow cover

ON



T2m



Dots: 95% significance

Seasonal predictability of PC1 mode

750

Regression Map

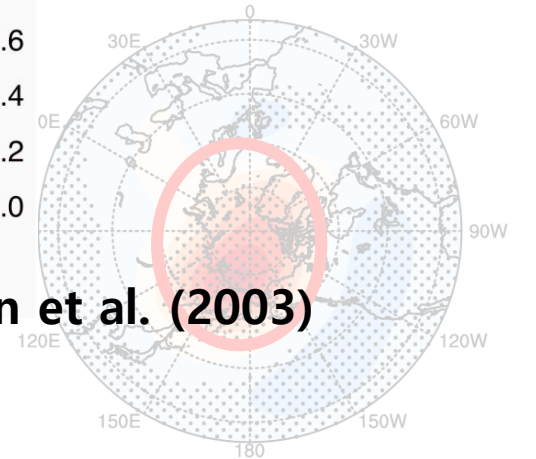
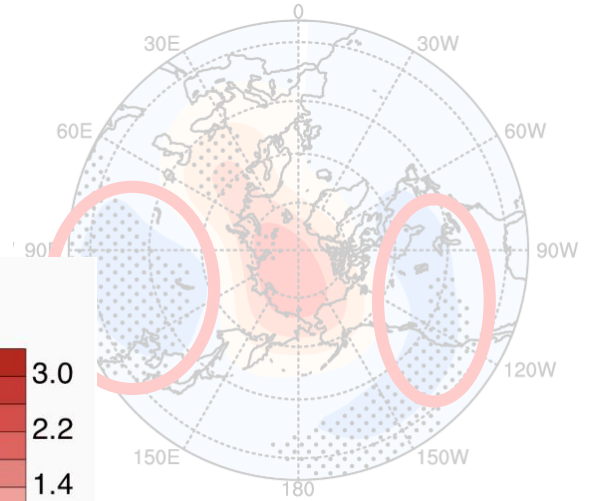
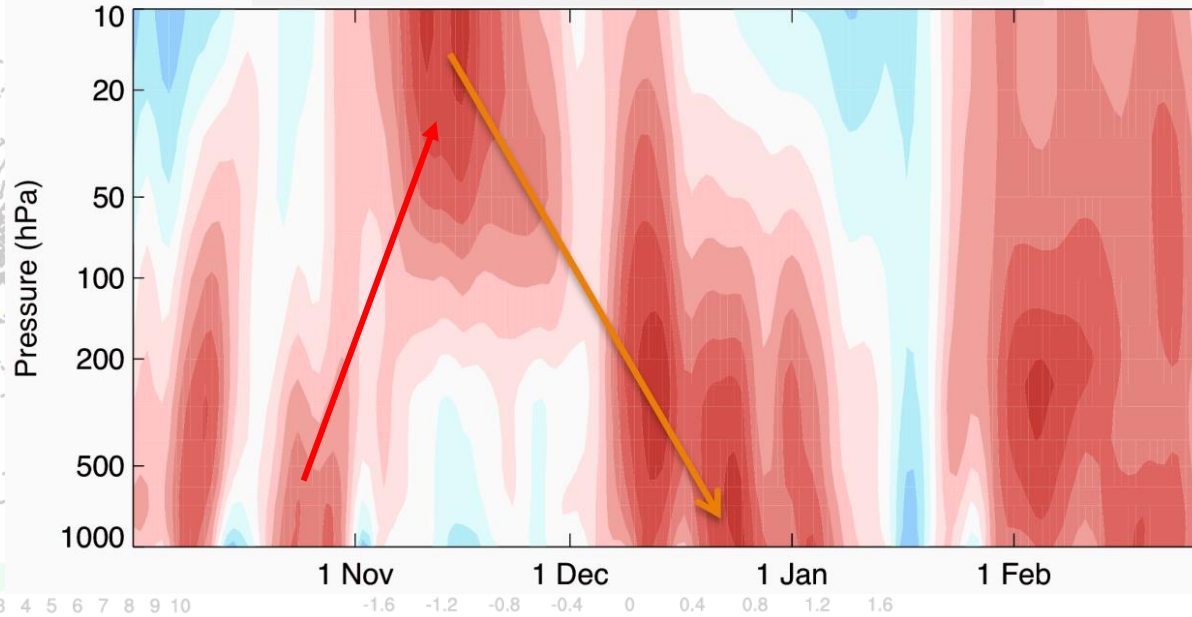
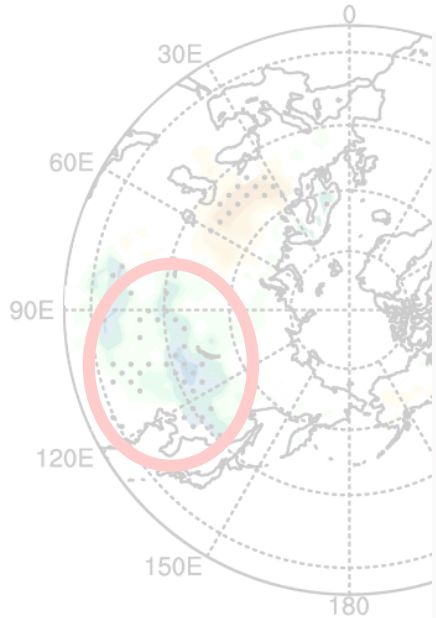
Snow cover

T2m

ON

ON

Polar-Cap Heights Composite Map



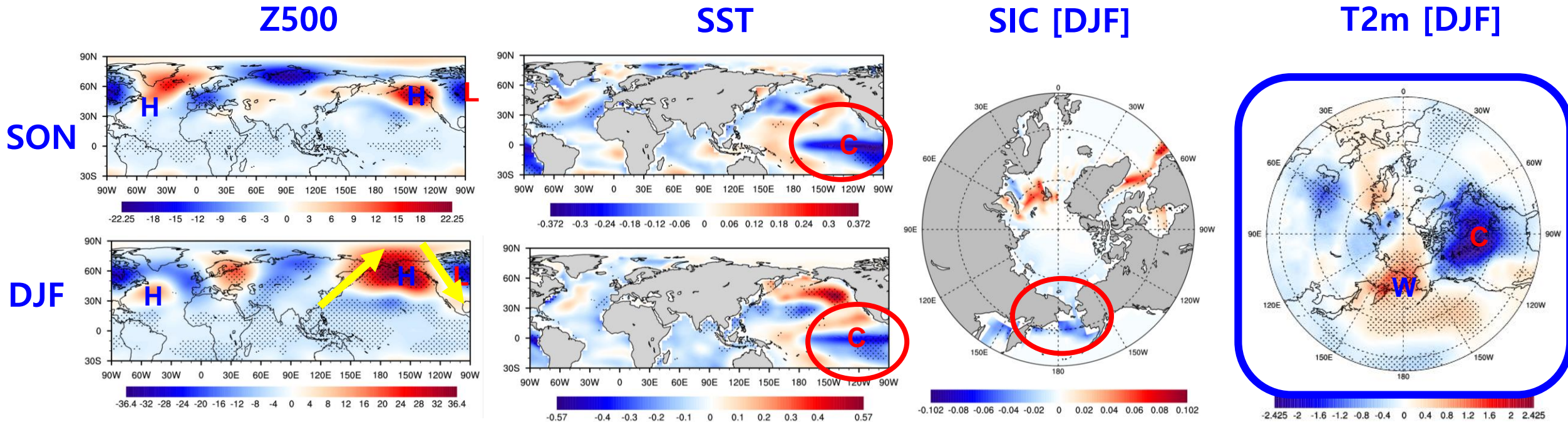
Cohen et al. (2003)

High snow cover(late fall) in Eurasia
→ Cold in early winter

Dots: 95% significance

Seasonal predictability of PC2 mode

Regression Map



Dots: 95% significance

Eastern Pacific La Nina with Negative PNA pattern and Sea ice reduction in Bering sea can induce cold winter in Canada and North US.

Seasonal predictability of PC2 mode

Regression Map

SON

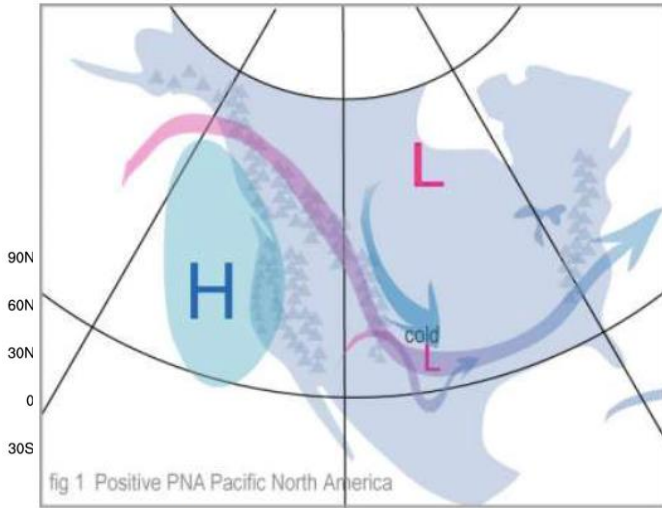
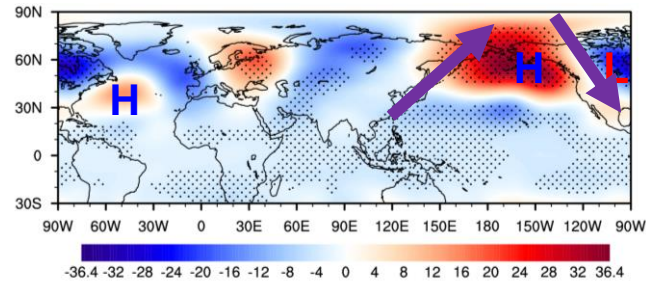
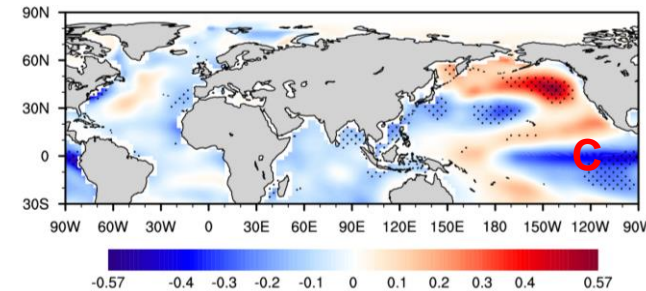
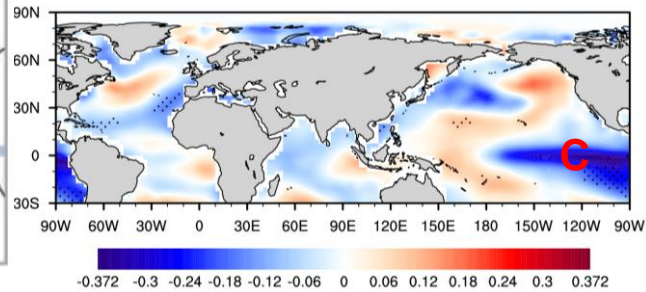


Figure A. Positive PNA Pattern. (Image from www.docweather.com).

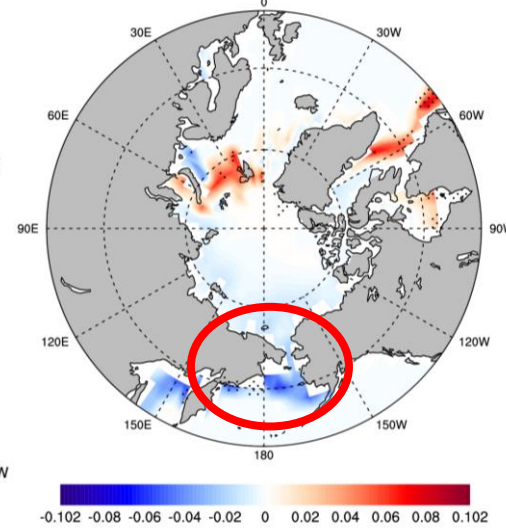
DJF



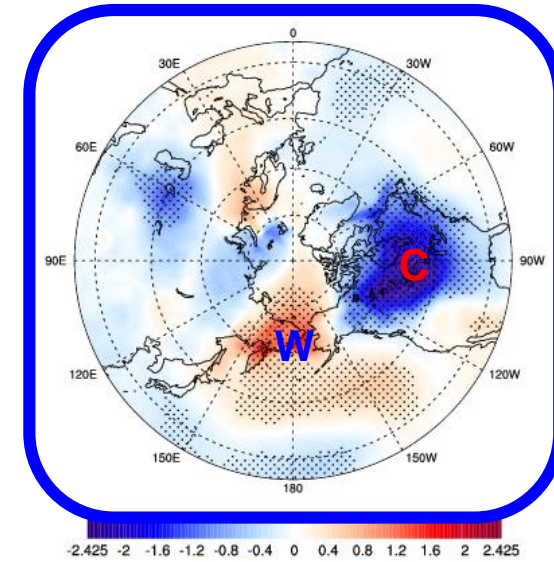
SST



SIC [DJF]



T2m [DJF]

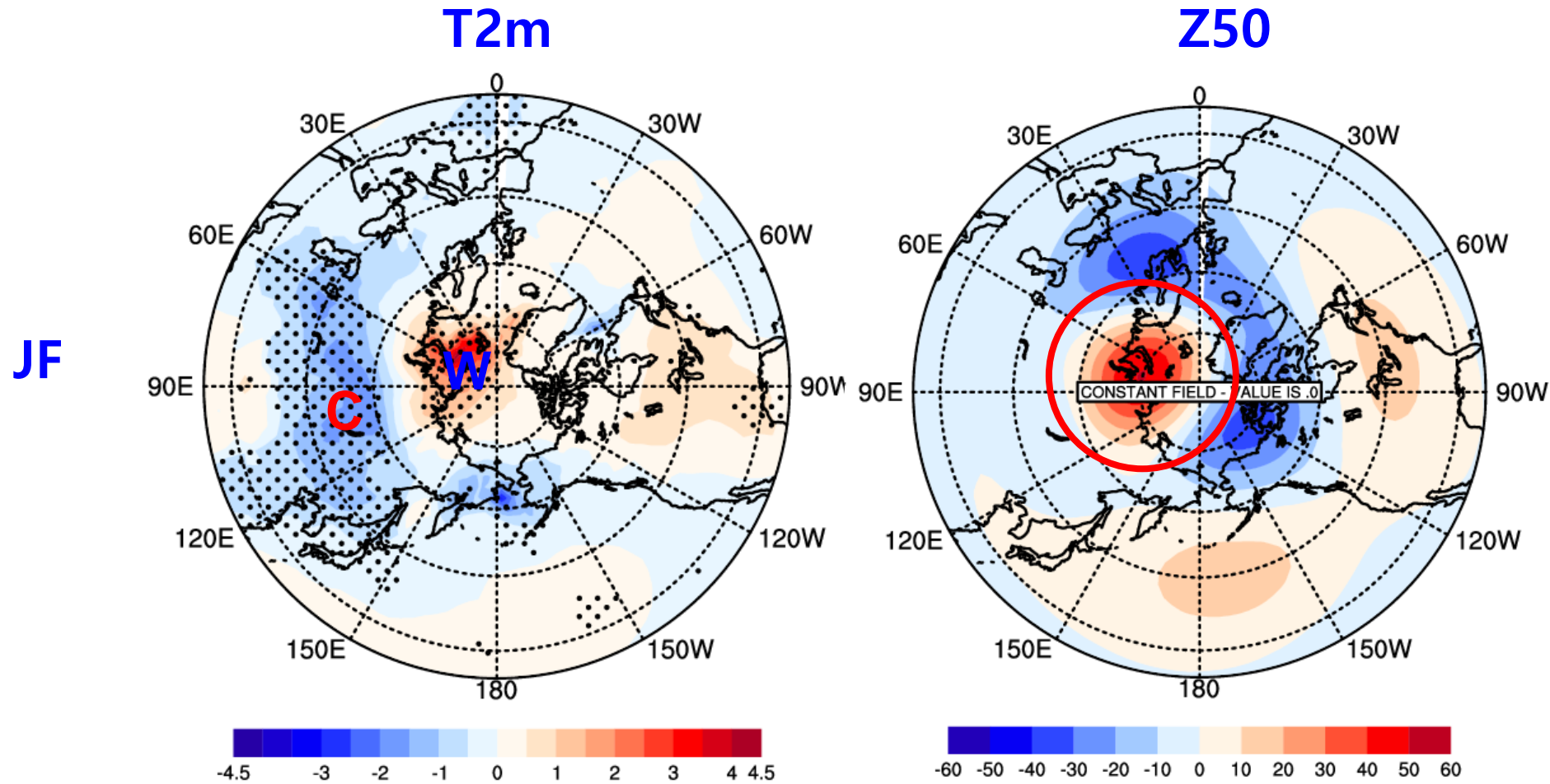


Dots: 95% significance

Eastern Pacific La Nina with Negative PNA pattern and Sea ice reduction in Bering sea can induce cold winter in Canada and North US.

Seasonal predictability of PC3 mode

Regression Map

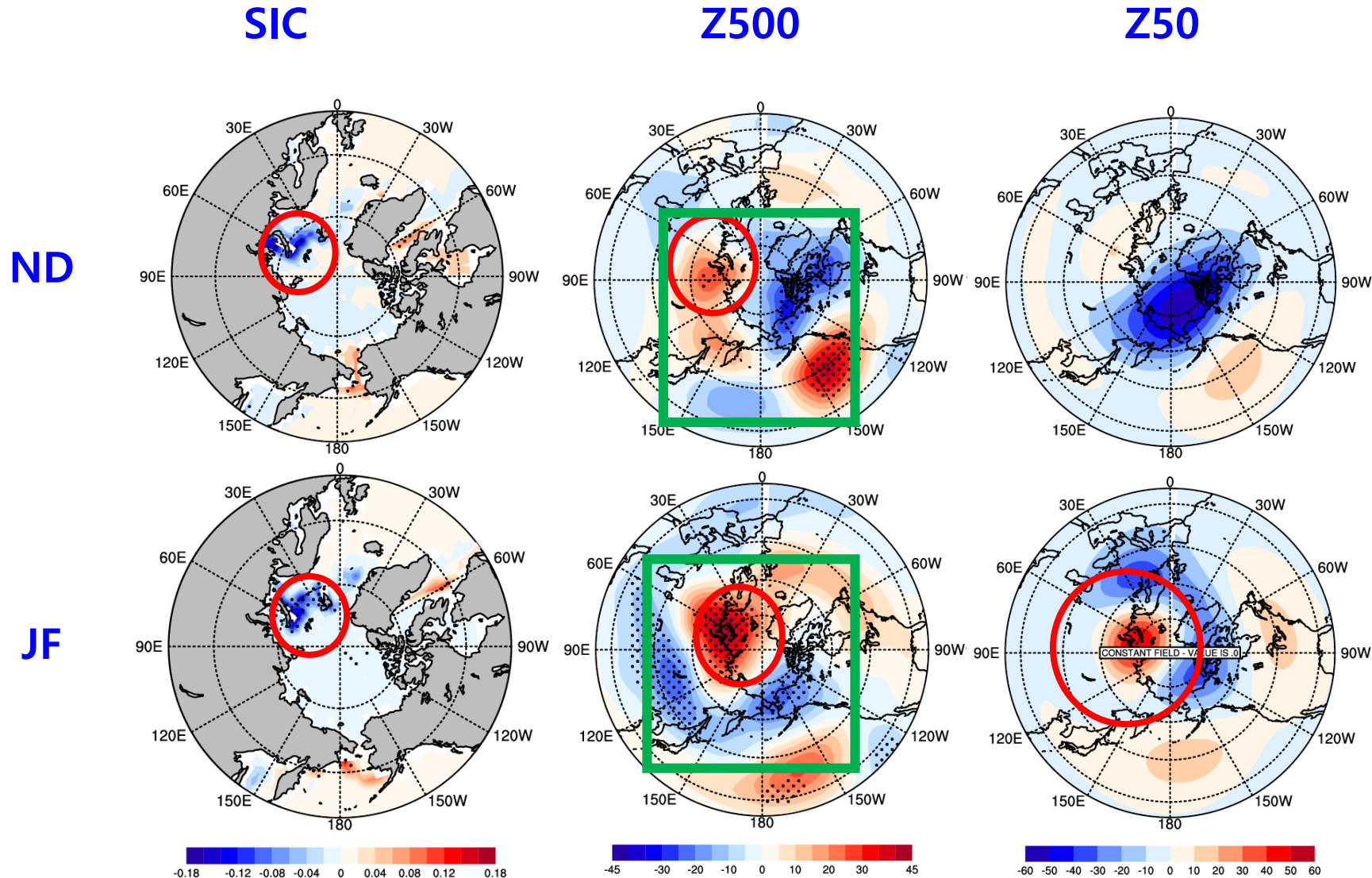


Split/displacement
of Stratospheric
Polar Vortex

Dots: 95% significance

Seasonal predictability of PC3 mode

Regression Map



Ural blocking circulation intensify sea ice reduction in B-K sea

Sea ice loss over B-K sea enhances tropospheric wavenumber-1 and -2 field, thus increasing upward wave propagation

Polar Vortex weakens (displacement) and cold Asia occurs in late winter

Dots: 95% significance

Outlook of 2018/19 winter

Statistical Prediction Model

$$\text{EA T2m [DJF]} = 0.44 \times (\text{K-B sea ice [ON]}) + 0.33 \times (\text{Eurasian snow cover [SON]})$$

EA T2m [DJF] [105E-135E, 25N-60N]
K-B sea ice [ON] [45E-130E, 70N-85N]
Eurasian snow cover [SON] [30E-70E, 50N-60N]

Model Performance

CORR = 0.46
GMSS = 0.37

Correlation between index and predictors

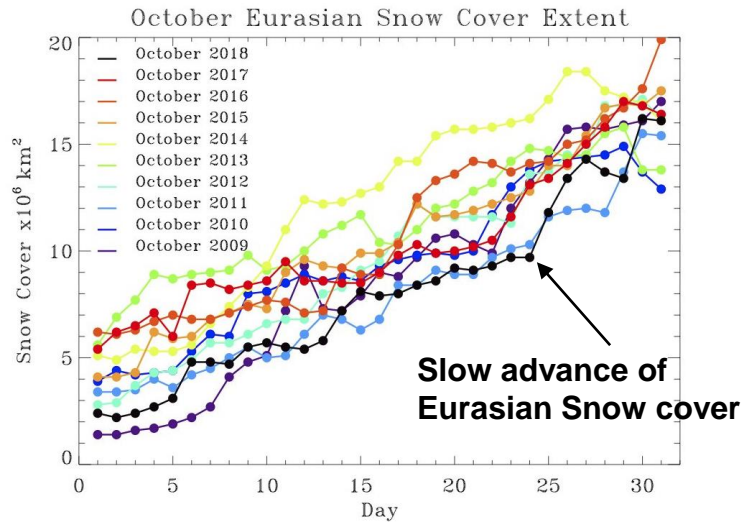
Corr(K-B sic, Eura snow) = -0.02
Corr(K-B sic, EA T2m) = 0.44
Corr(Eura snow, EA T2m) = 0.32

Intensity	2018 Prediction
-1.48	Below Normal

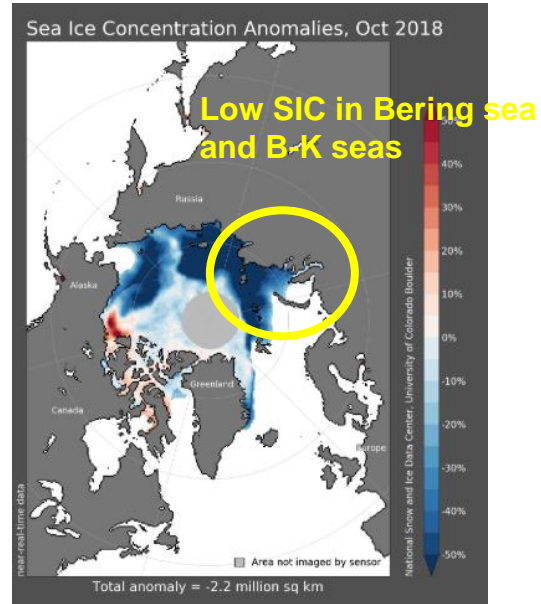
Thank You
for your attention

Winter 2018 Outlook

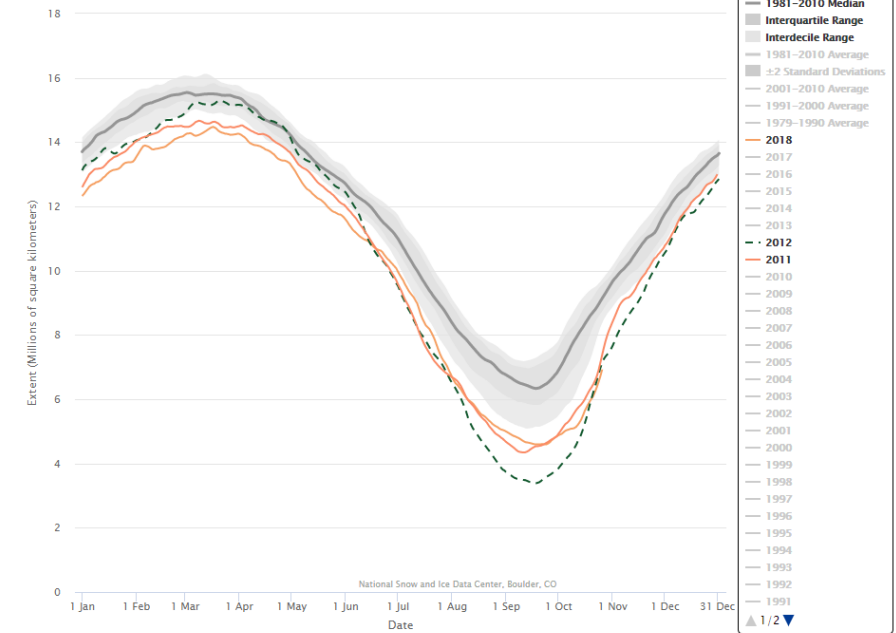
Snow Cover Oct



SIC Oct



Arctic Sea ice Extent



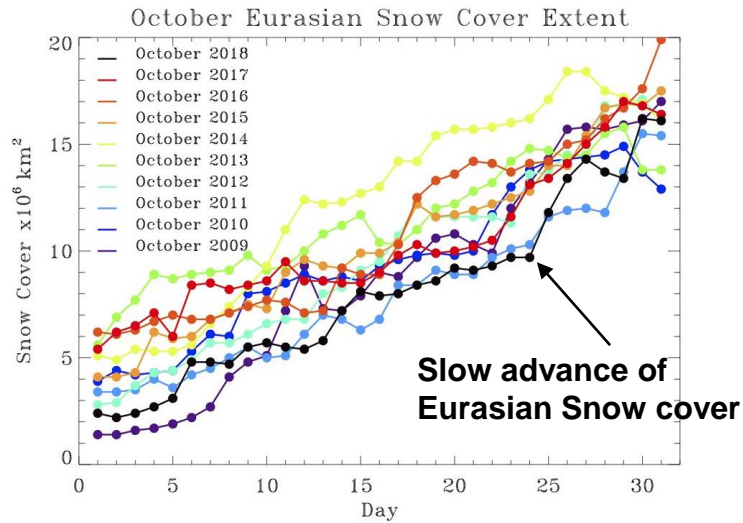
Low sea ice in Kara-Barents Seas → **chance of** very **cold** periods of weather **across Asia** will be increased

Most of the month of October, the Eurasian snow cover extent slowly advanced but strongly advanced at the end of October → Will likely **favor** a neutral to weak PV and **relatively cold** winter temperature in Northern Eurasia

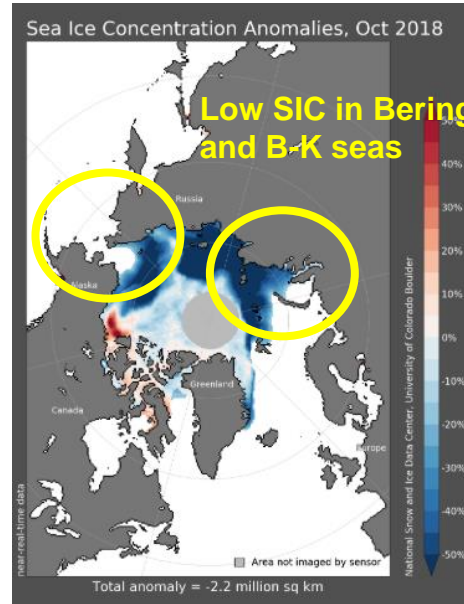
Monitoring closely the evolution of Eurasian snow cover extent and Arctic sea ice anomalies later this fall and winter will be important!

Winter 2018 Outlook

Snow Cover Oct



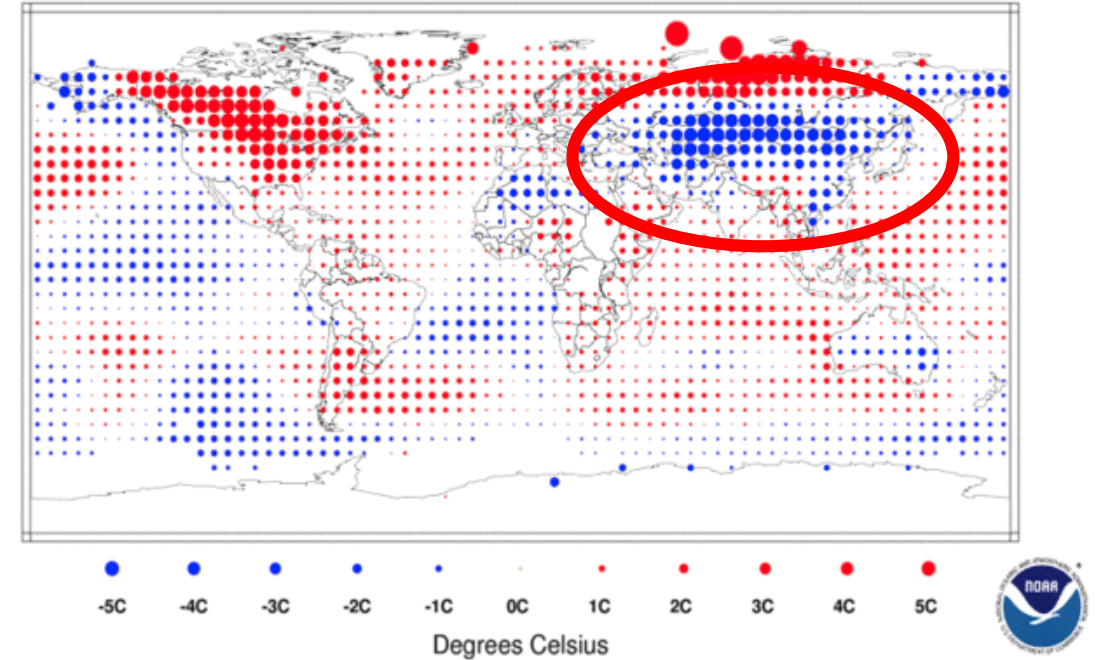
SIC Oct



Temperature Anomalies Dec-Feb 2012

(with respect to a 1971-2000 base period)

National Climatic Data Center/NESDIS/NOAA



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