

# Climate Outlook in Korea for Winter 2023/24

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# Outlines

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- **Dynamic Models**

GloSes6, WMO-LC LRFMME

- **Climate Predictors Affecting Winter Season**

ENSO, Arctic sea ice, snow cover, etc.

- **2023/24 Winter Outlook**

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# Dynamic Models

- GloSea6, WMO-LC LRFMME -

# S2S Operational Model at KMA

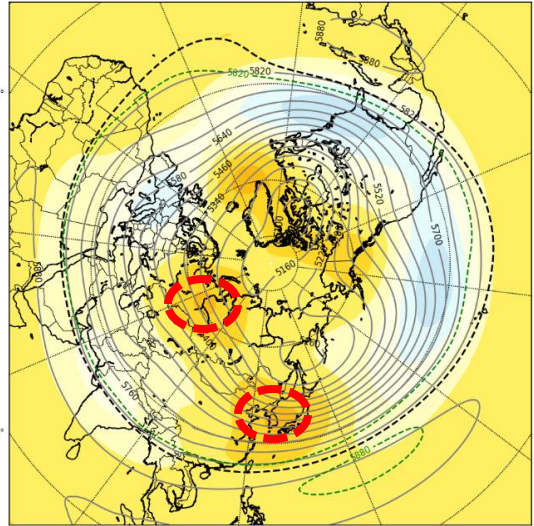
## KMA Global Seasonal Forecasting System **version 6 (GloSea6)**

		Hindcast	Forecast
<b>Period</b>		1993~2016 (24years)	2021~
<b>Initial Field</b>	<b>Atmosphere</b>	ECMWF ERA-interim	KMA NWP analysis
	<b>Land</b>	KMA JULES-ERA5	KMA JULES-ERA5
	<b>Ocean/Sea Ice</b>	UKMO NEMOVAR	KMA NEMOVAR
<b>Model</b>	<b>Running Time</b>	00UTC on 1st, 9th, 17th, 25th	00UTC everyday
	<b>Forecast Period</b>	252days	4mem (75days) 4mem (240days)
<b>Ensemble</b>	<b>Member</b>	7mem×24years = <b>168mem</b>	4mem (75days) 4mem (240days)

# (GloSea6) 500hPa GPH Anomaly (issued on Oct. 16, 2023)

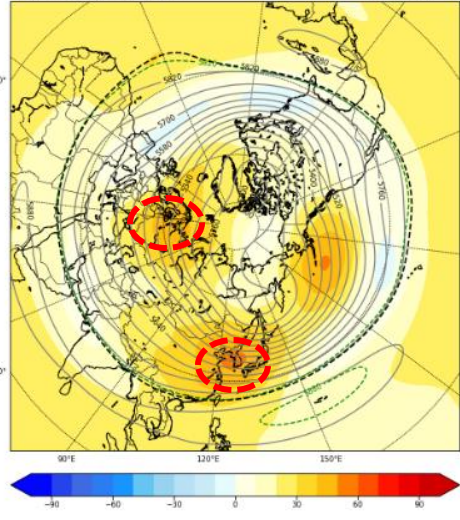
DJF

500hPa GPH Mean anomaly by GS6-KMA with HCST(1993-2016)  
[2023.12.01-2024.02.29] F 2seas | Date:2023.10.16



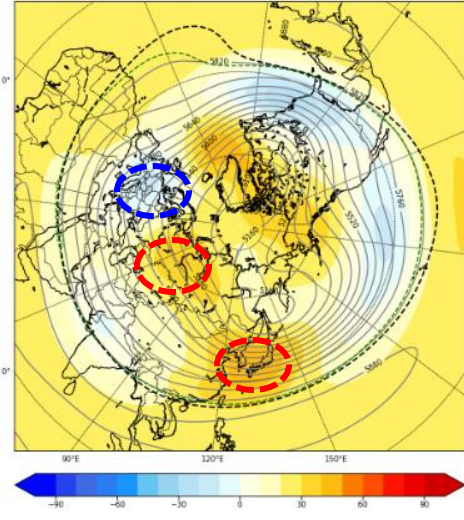
Dec

500hPa GPH Mean anomaly by GS6-KMA with HCST(1993-2016)  
[2023.12.01-2023.12.31] F 2mon | Date:2023.10.16



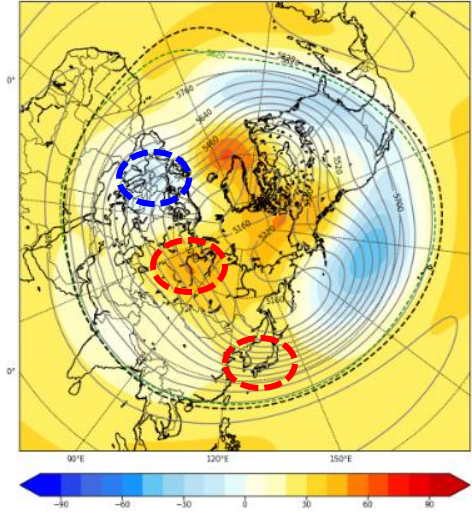
Jan

500hPa GPH Mean anomaly by GS6-KMA with HCST(1993-2016)  
[2024.01.01-2024.01.31] F 3mon | Date:2023.10.16



Feb

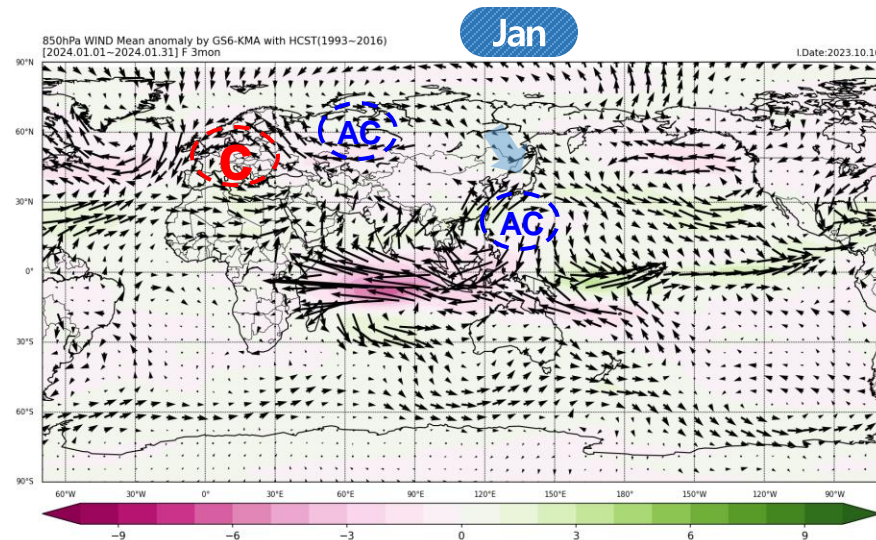
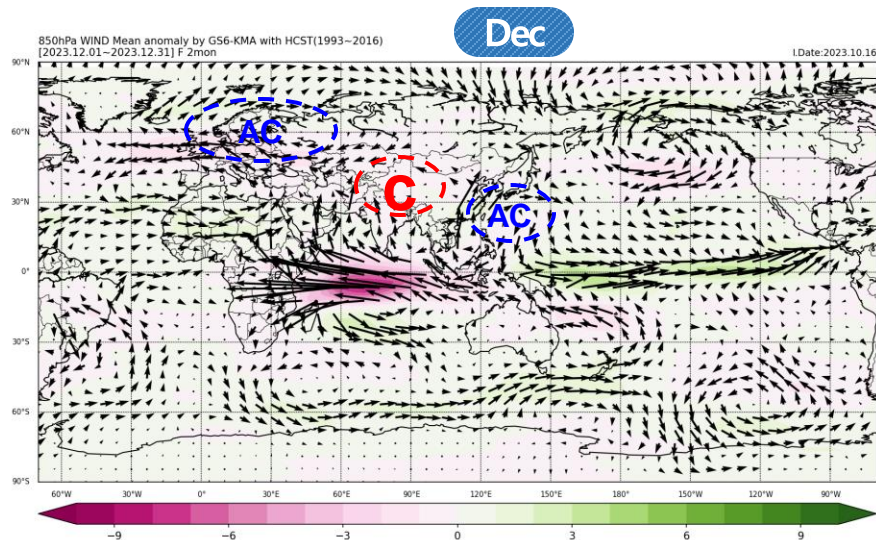
500hPa GPH Mean anomaly by GS6-KMA with HCST(1993-2016)  
[2024.02.01-2024.02.29] F 4mon | Date:2023.10.16



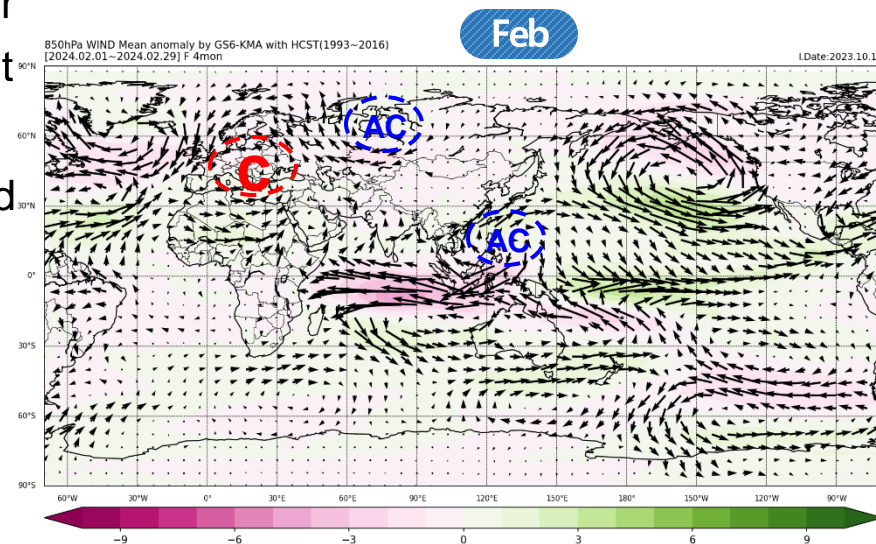
- ▶ In winter, **Positive anomalies** are shown over the Ural Mountains and East Asia
- ▶ **(Dec.)** Positive anomalies are over **Europe and East Asia** including Korea.
- ▶ **(Jan., Feb.)** Positive anomalies are over the **Ural Mountains** and East Asia.
- ▶ Positive anomalies are over the Ural Mountain in January and February, there is a possibility of cold air expanding to Korea



# (GloSea6) 850hPa Wind Anomaly (issued on Oct. 16, 2023)



- ▶ (Dec.) Anti-Cyclonic anomalies are predicted over Europe and over east of Korea. Warm and moist southwesterly winds flow into Korea
- ▶ (Jan, Feb.) Anti-Cyclonic anomalies are predicted over the **Ural Mountains** and **East Asia**.
  - Korea is expected to be influence by northwesterly winds due to anti-cyclonic circulation over the Ural Mountain

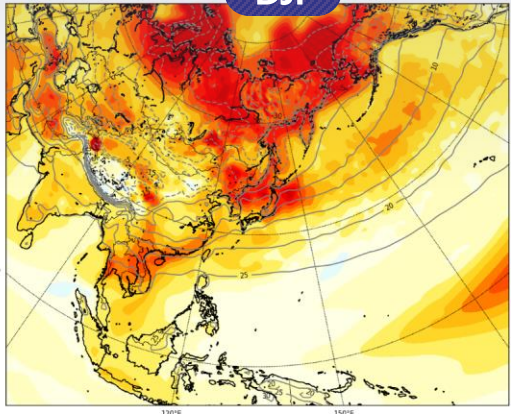




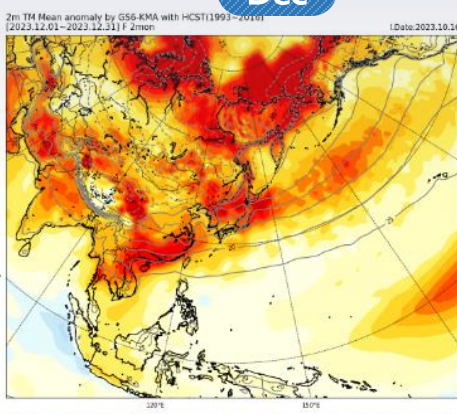
# (GloSea6) Temperature and Precipitation (issued on Oct 16, 2023)

## < Temperature (2m) >

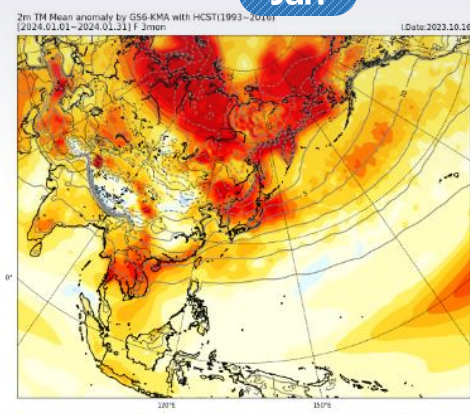
2m TM Mean anomaly by G56-KMA with HCST(1993-2016)  
[2023.12.01-2024.02.29] F 2 seas | DJF | IDate:2023.10.16



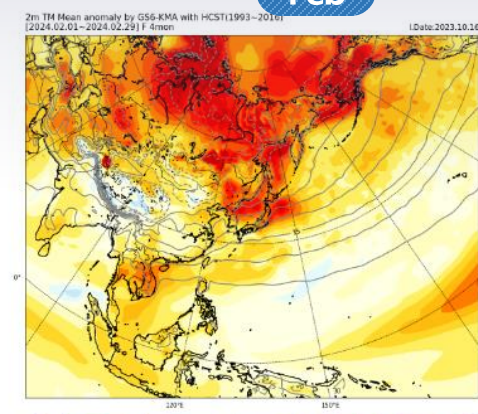
Dec



Jan



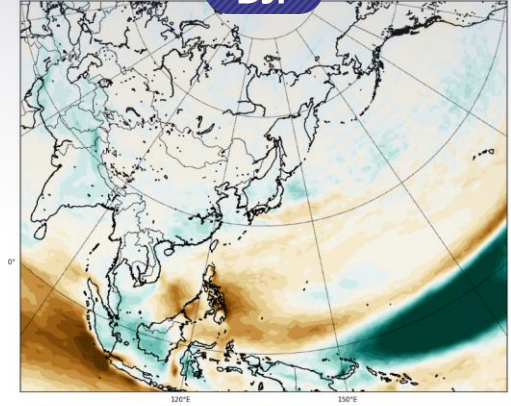
Feb



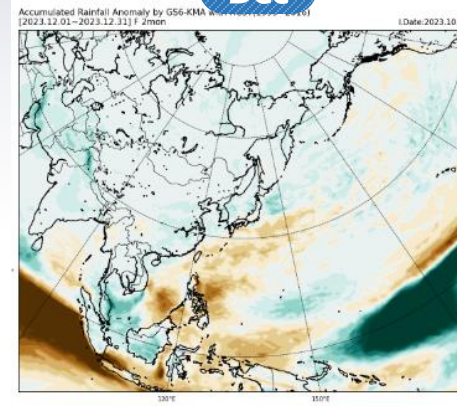
► Above-normal temperature is predicted over a wide area East Asia

## < Precipitation >

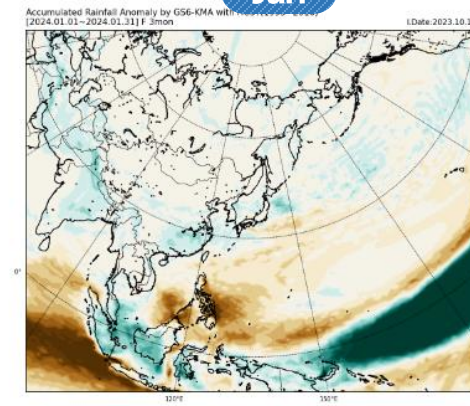
Accumulated Rainfall Anomaly by G56-KMA with HCST(1993-2016)  
[2023.12.01-2024.02.29] F 2 seas | DJF | IDate:2023.10.16



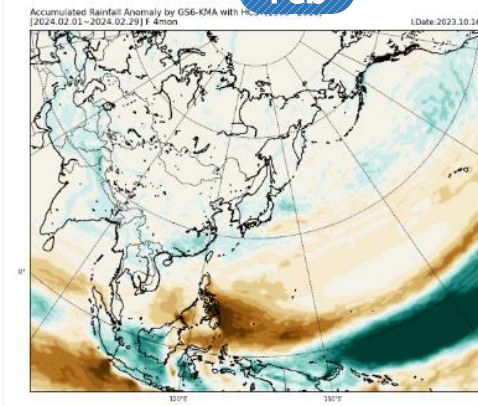
Dec



Jan



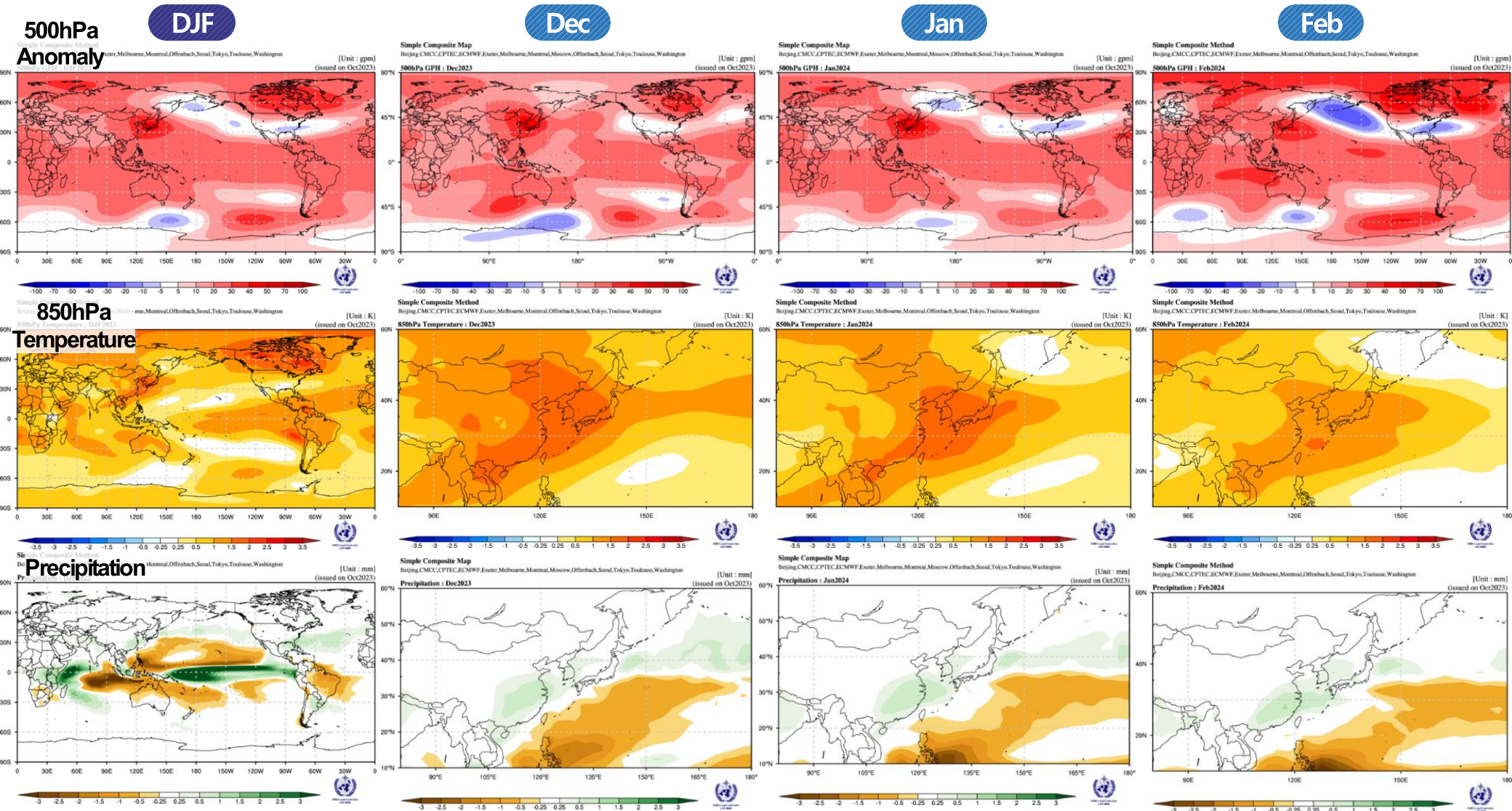
Feb



► Above-normal precipitation is predicted over East Asia and central equatorial Pacific, and below-normal precipitation is predicted over the eastern equatorial Indian Ocean



# (WMO-LC LRFMME) Issued on Oct, 2023

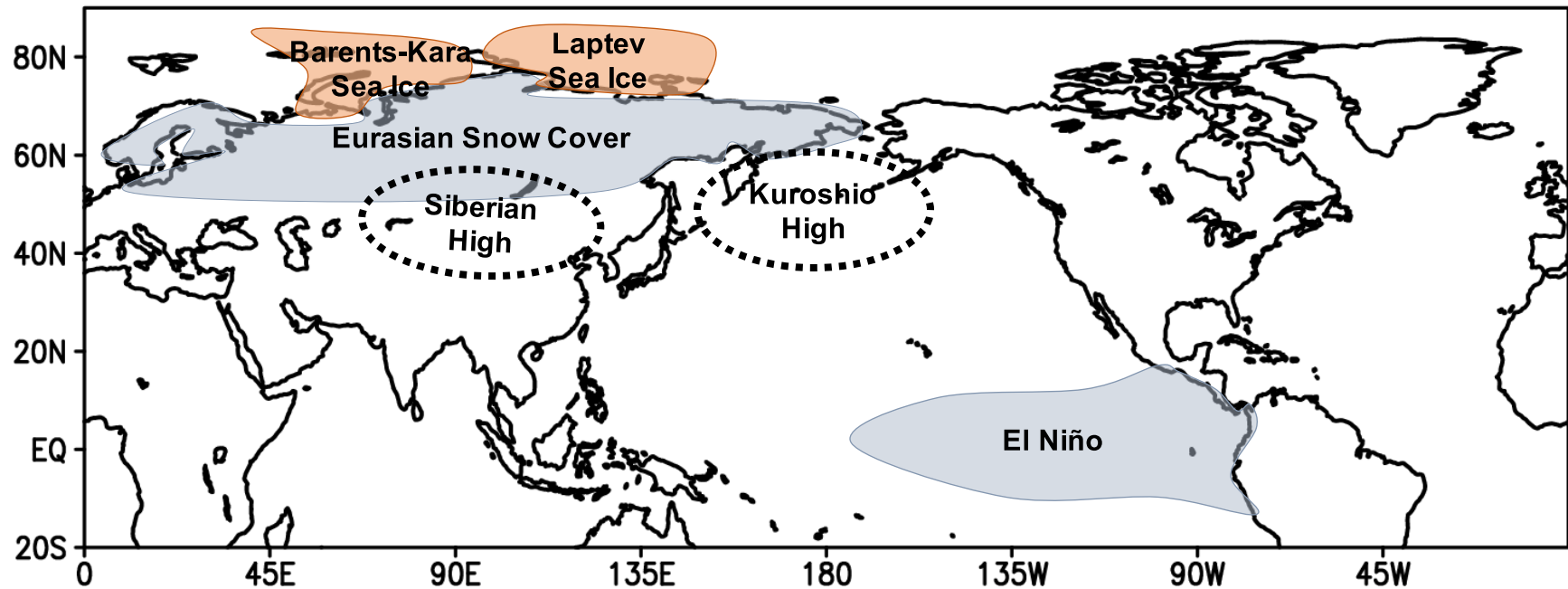


- ▶ In 500hPa height field, positive anomalies are predicted over East Asia.
- ▶ The temperature is predicted to be above normal over East Asia.
- ▶ The precipitation is predicted to be above normal and normal over South Korea.



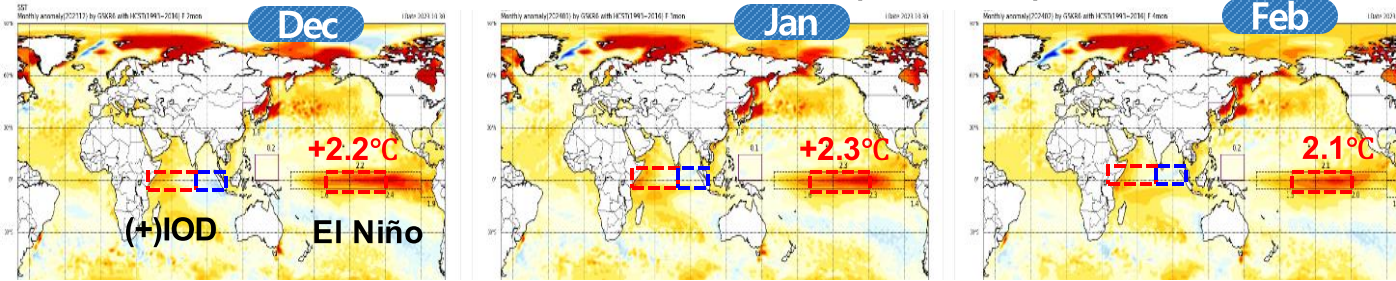
# Climate Predictors Affecting Winter Seasons

- ENSO, Arctic sea ice, snow cover, etc. -

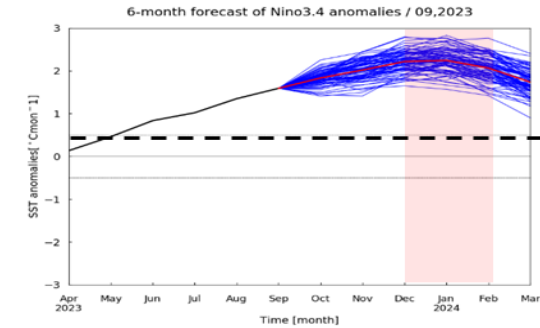


# ① ENSO / IOD Condition and Prediction

## < SST Anomalies Forecasts (GloSea6) >



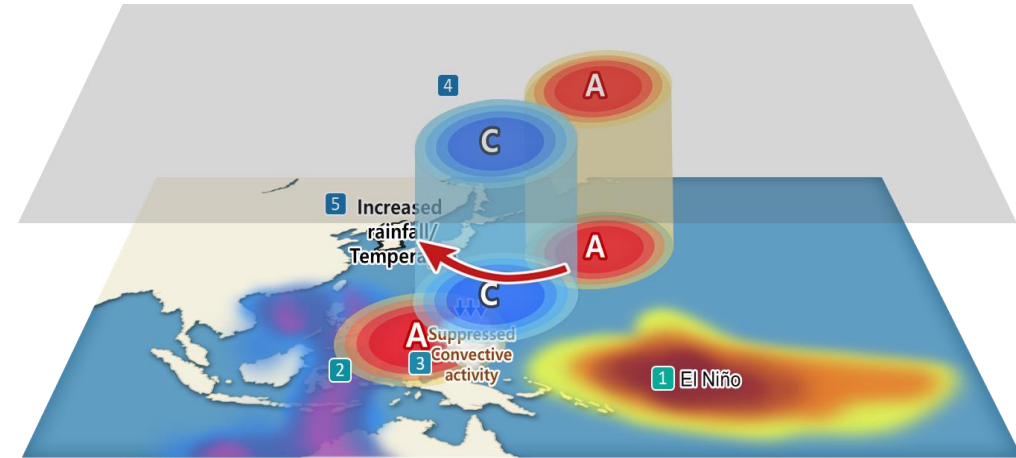
## < KMA Nino3.4 Anomaly (GloSea6) >



## < Mean Temperature anomaly and precipitation during El Niño and Positive IOD winters >

Year	Temp(°C)			Prcp(mm)		
	Dec	Jan	Feb	Dec	Jan	Feb
	±0.6	±0.6	±0.6	19.8~28.6	17.4~26.8	27.5~44.9
1982	-0.2	0.0	-2.1	30.2	19.7	30.4
1986	1.8	-0.2	0.1	45.9	52.8	47.9
1991	1.7	1.3	-0.3	61.4	25.3	27.8
1994	0.9	-0.6	-0.4	15.2	23.7	17.8
1997	1.0	0.4	2.0	55.4	42.3	46.8
2002	0.8	-1.3	0.9	46.1	26.3	49.4
2006	0.6	1.5	2.6	20.9	9.4	45.2
2015	2.1	-0.4	0.2	40.6	24.6	46.7
2018	-0.3	0.8	0.9	28.4	8.0	32.2
2019	1.4	3.4	2.2	26.5	83.7	58.7

Temp.	Above	Near	Below
Prcp.	Above	Near	Below

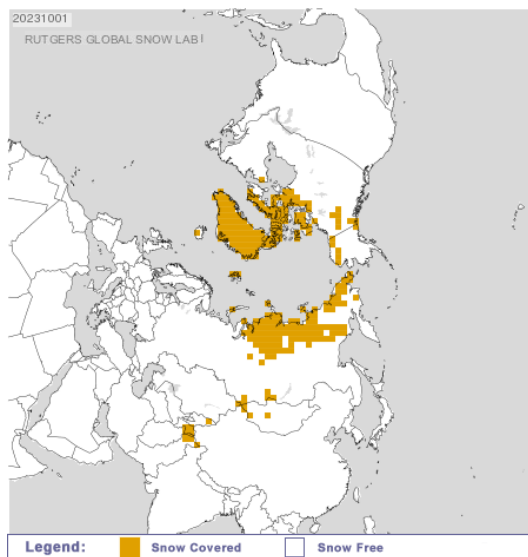


Rainfall/Temperature increase over Korea during El Niño winter

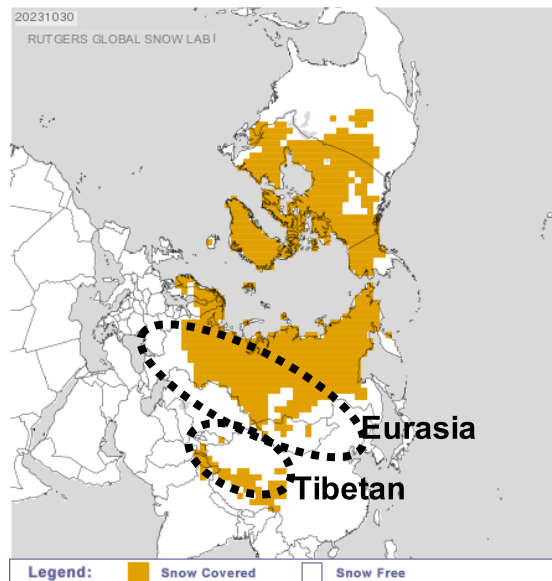
- ▶ El Niño conditions have continued in the equatorial Pacific since spring of 2023
- ▶ GloSea6 predicts that El Niño conditions will continue during this winter.
- ▶ In the Indian Ocean, a SST anomaly pattern similar to the positive phase of the Indian Ocean Dipole (IOD) This conditions could continue at least early winter
- ▶ Temperature and Precipitation tend to normal or above normal during El Niño and Positive IOD winters

## ② Snow Cover

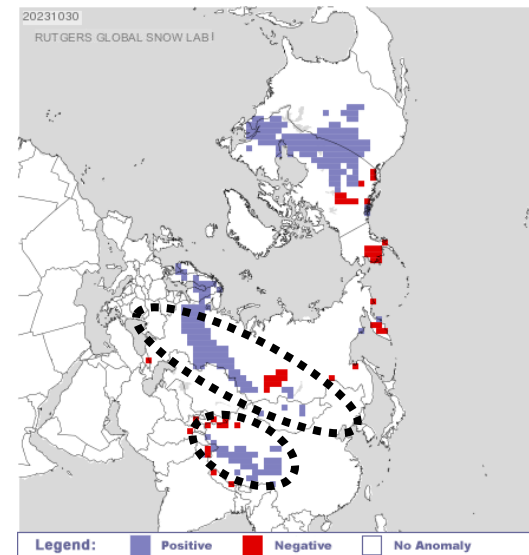
< Snow Cover (Oct. 1) >



< Snow Cover (Oct. 30) >



< Snow Cover Anomaly (Oct. 30) >

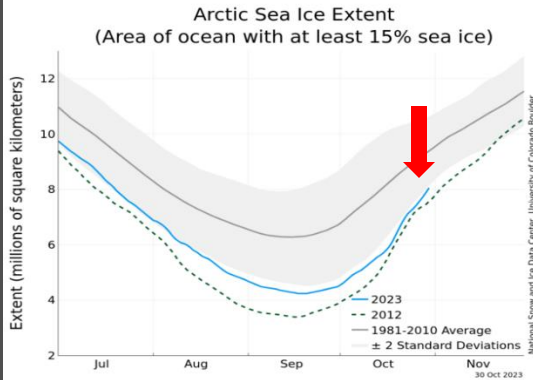
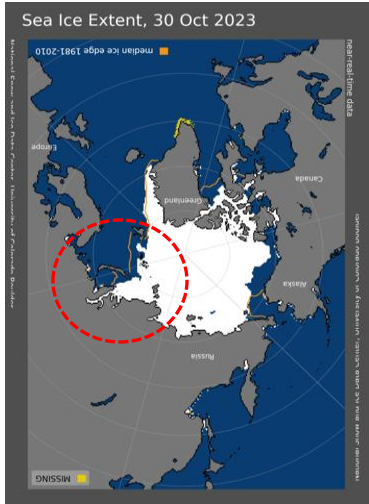


- ▶ Recently, Tibetan Plateau and Eurasia snow cover is increasing rapidly.
- ▶ However the variability is high, so monitoring is needed continuously
  - If more snow cover, it leads to strengthened Siberian High and then colder surface temperature over Korea



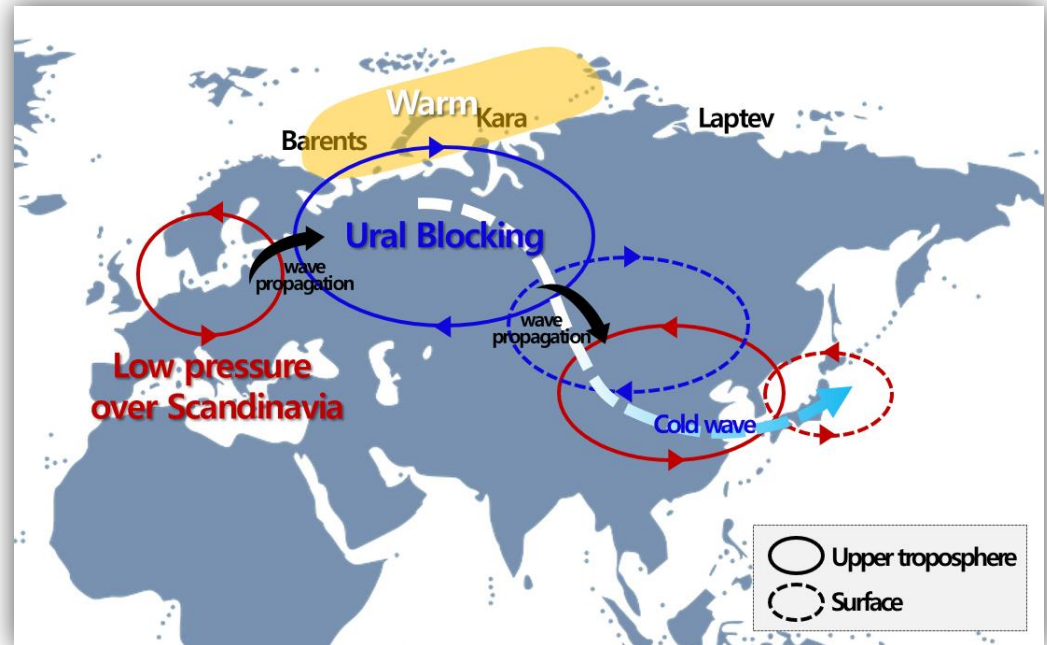
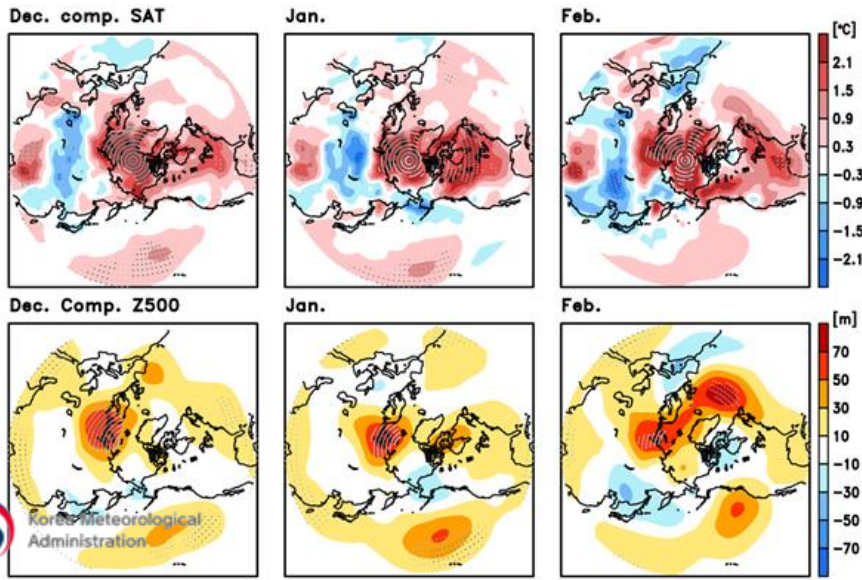
# ③ Arctic Sea Ice

< Sea Ice Extent (Oct. 30) >



- ▶ Currently, Arctic Sea Ice (**Barents-Kara Sea**) is less than normal.
- ▶ When the Arctic region is warmer than normal, there are **anticyclonic** anomalies over the **Ural Mt.** and **cyclonic** anomalies over **East Asia** in the 500hPa height field.
- ▶ This condition might cause strong Ural Blocking, which helps the Siberian High develop and bring cold air to East Asia.

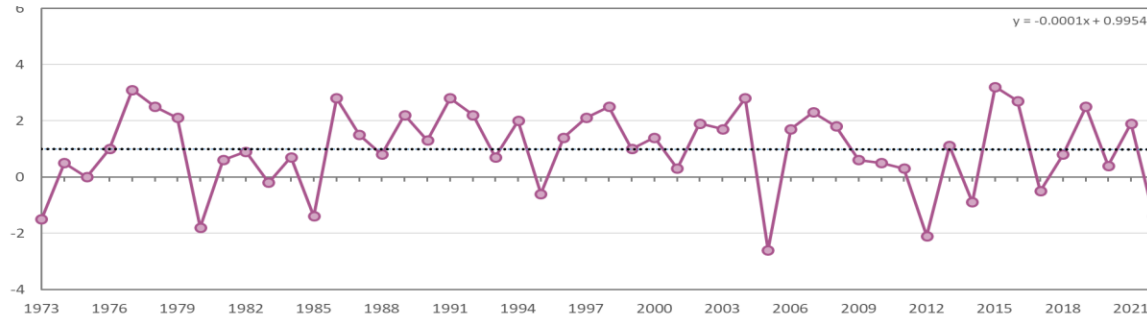
< SAT and 500hPa GPH anomaly composite >



# ④ Trend of Observed Temperatures

< Trend of Mean Temperature over Korea >

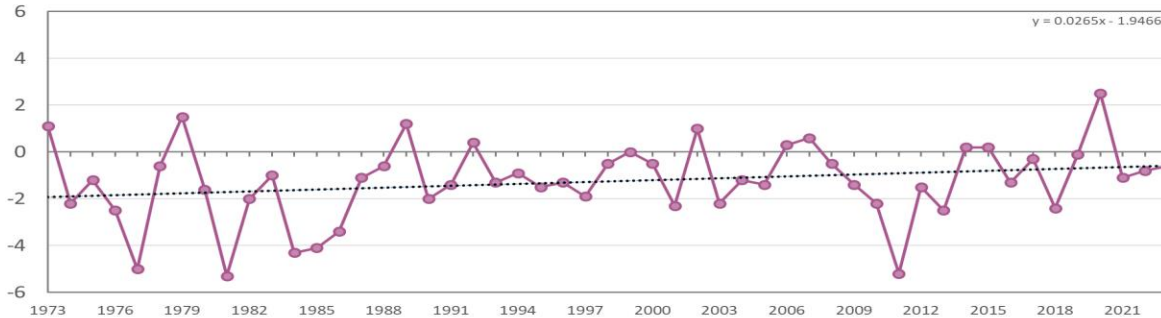
Dec



Dec

- average 1.1°C
- 0.0°C / 50 years

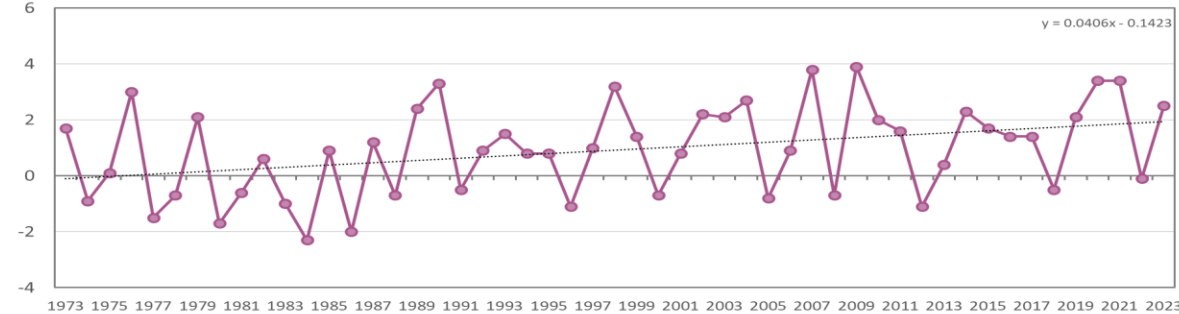
Jan



Jan

- average -0.9°C
- +1.4°C / 51 years

Feb



Feb

- average 1.2°C
- +2.1°C / 51 years

- ▶ Since 1973, the temperatures in Korea have been increasing during the winter season.
- ▶ In February, the warming trend was significantly higher than other months.

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# **2023/24 Winter Outlook**



# Summary

## ■ Consideration for prediction

- **El Niño and Positive IOD condition** is likely to continue during the coming **winter**.
  - ➔ Statistically, temperature in Korea tend to be high in December and February, but there is no signal in January
- Most dynamic model results show **above normal temperature, near normal or above normal precipitation** over Korea.
  - ➔ (Jan., Feb.) Anti-Cyclonic anomalies are predicted over the Ural Mountain and **it causes cold spell over Korea**
- Climate predictors are considered as below.

Trend of Temperature	El Niño +Positive IOD	Barents-Kara Sea ice	Snow Cover Tibetan, Eurasia
Above	Above	Below	Below / Nomal

## ■ 2023/24 Winter Outlook over Korea

	Temperature(%)			Precipitation(%)		
	Below Normal	Near normal	Above normal	Below Normal	Near normal	Above normal
Winter	20	40	40	20	40	40

**Thank you!!  
for  
your attention**