

Climate Outlook for Winter 2021/22 over Korea

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Outlines

Climate predictors

(Arctic Sea Ice, ENSO, Snow Cover, etc.)

Dynamical Models

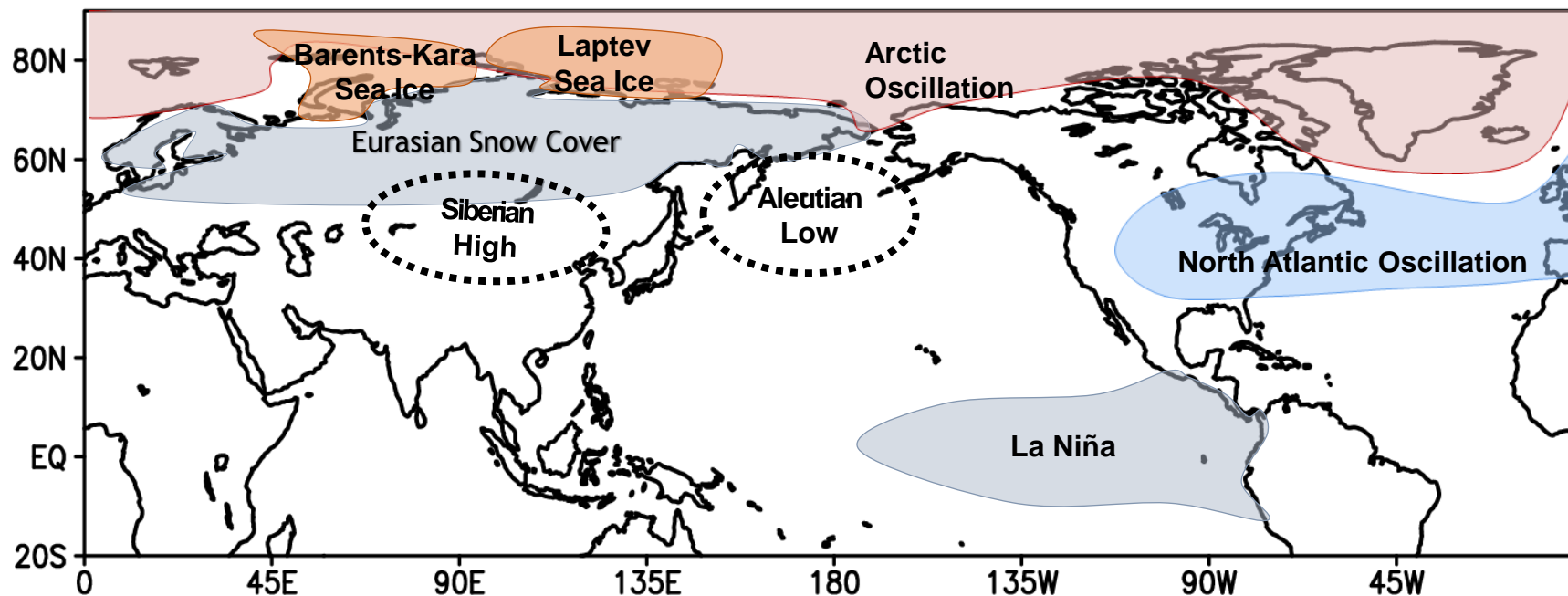
(GloSea5, WMO-LC LRFMME)

Outlook

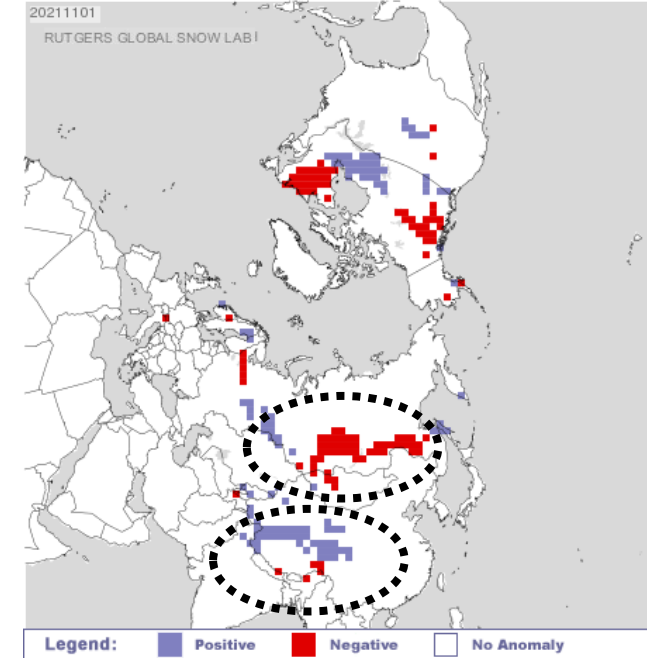
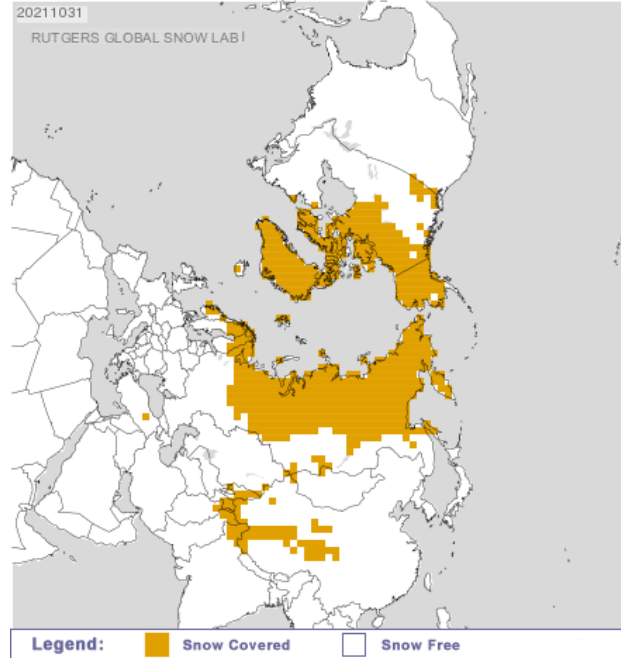
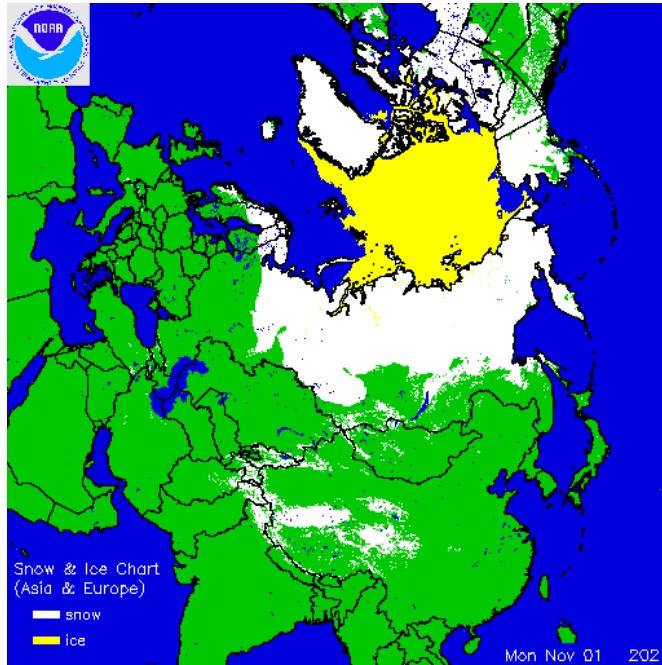
Predictors for Winter Outlook

Box: areas for selected predictors

Temperature	Arctic Oscillation	ENSO	Barents-Kara Sea ice	Laptev Sea Ice	Eurasian Snow Cover
Below	-AO	La Niña	below	below	above, fast

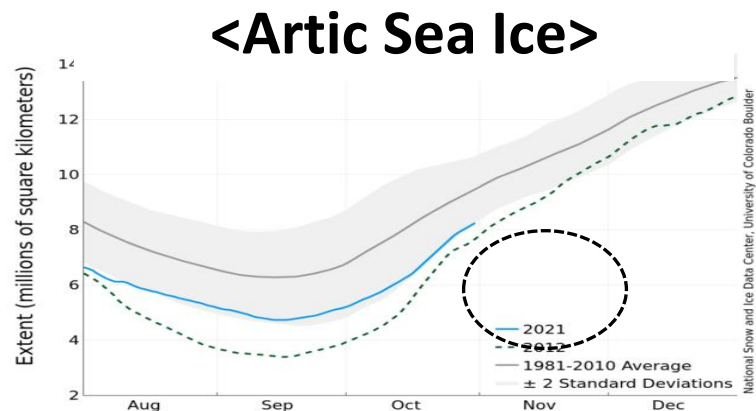
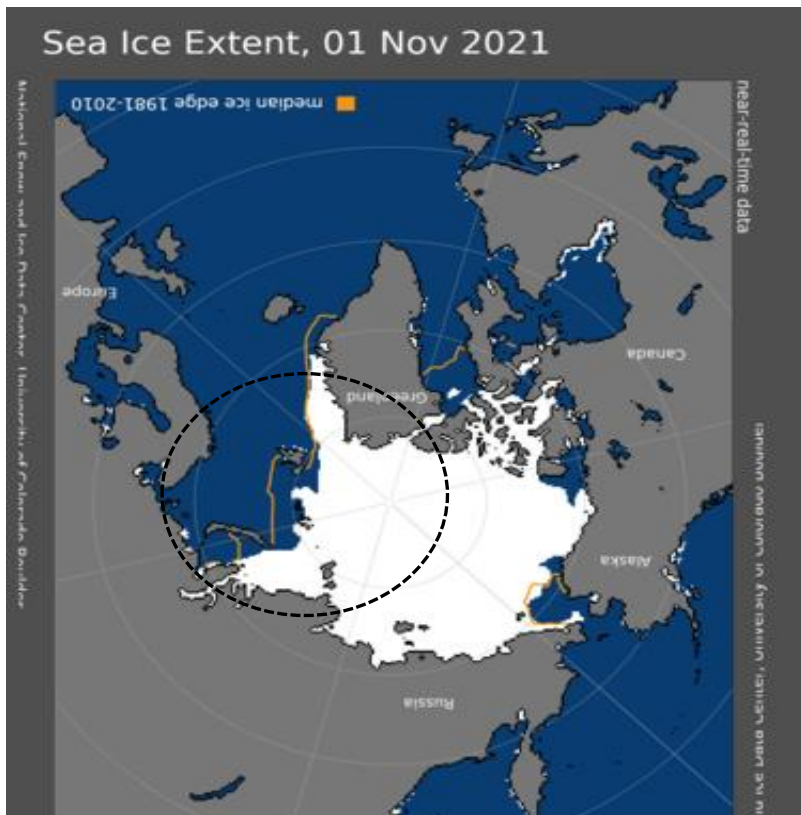


Snow Cover

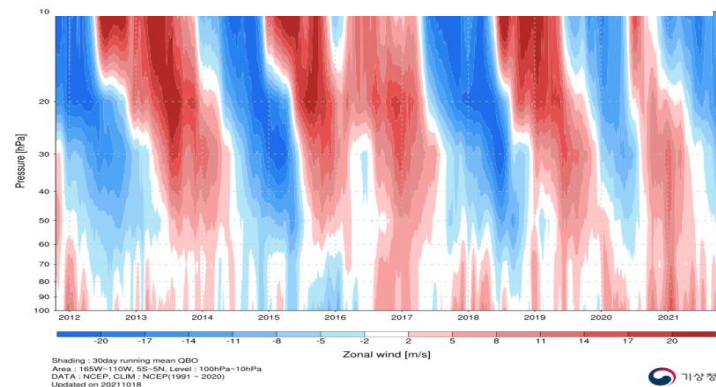


- ▶ Recently Tibetan Plateau snow cover is increasing rapidly.
- ▶ Eurasian snow cover is below normal
 - However the variability is high, so monitoring is needed continuously
 - If more snow cover, it leads to strengthened Siberian High and then colder surface temperature over Korea

Arctic Sea Ice



<QBO>

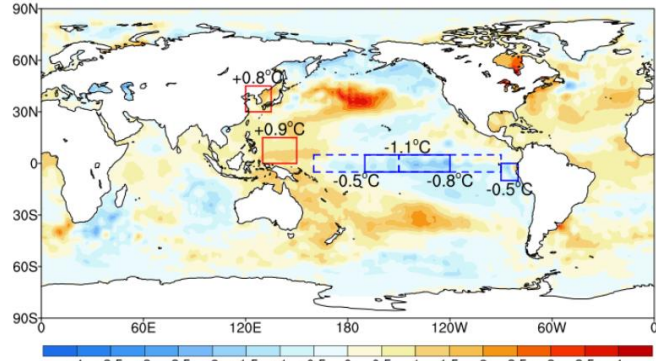


- ▶ Currently, the Arctic Sea Ice anomaly is below zero.
 - ▶ The Barents-Kara sea ice anomaly is also below zero.
 - ▶ Less than normal sea ice over the Barents-Kara Sea is highly related to a Ural blocking
 - ▶ Easterly phase of the Quasi-Biennial Oscillation will be downward propagation
 - ▶ The stratospheric polar vortex is weaker in the EQBO than in the WQBO
- This leads to dry and cold winter over Korea by increasing possibility negative phase of the Arctic Oscillation

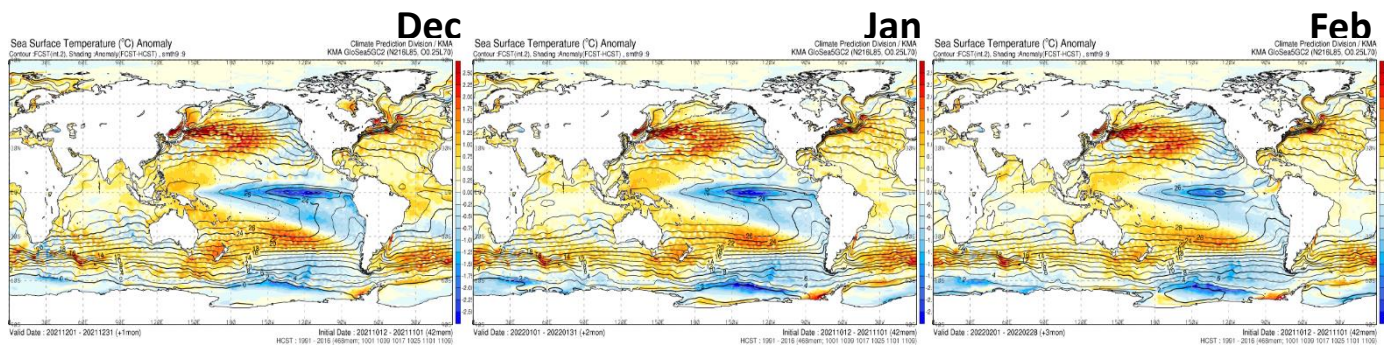
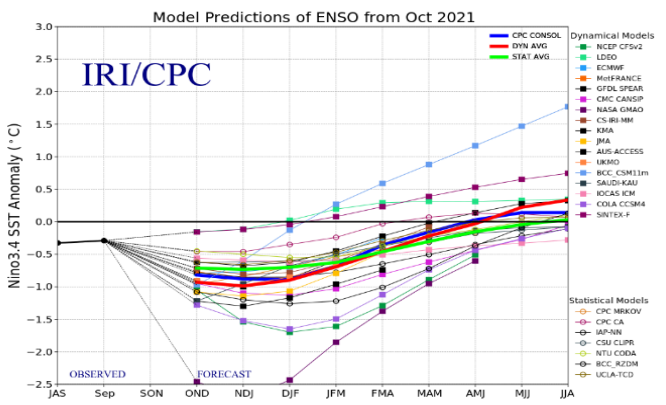
ENSO Condition and Prediction

<SST Weekly Anomaly (OISSTv2)>

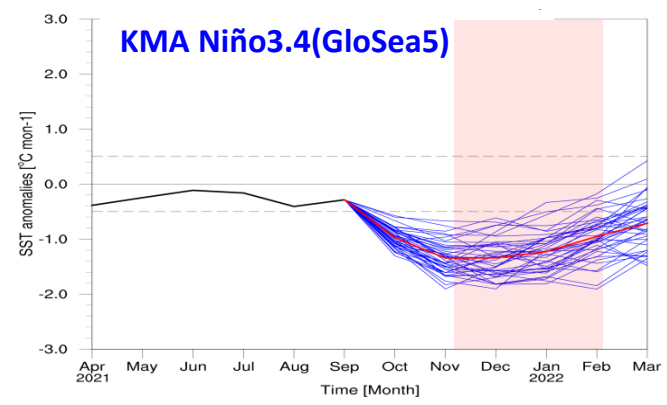
24Oct2021 ~ 30Oct2021



<Model predictions of ENSO>



<KMA Niño 3.4 (GloSea5)>



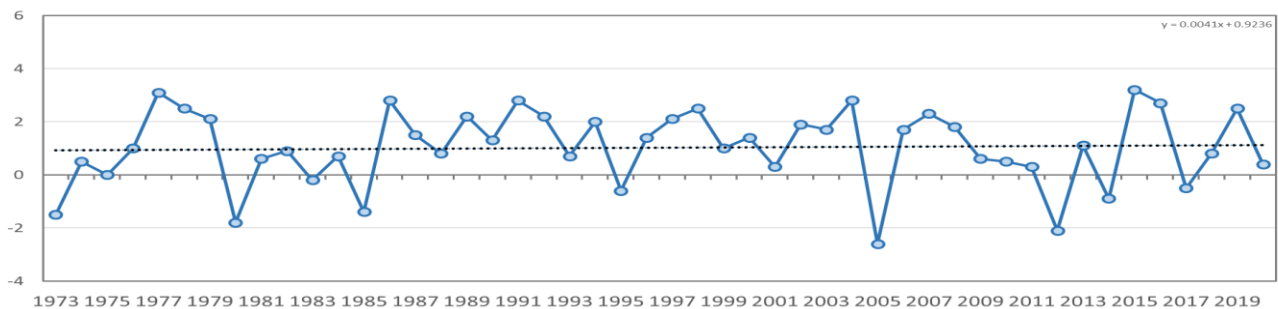
<Mean Temperature anomaly at La Niña>

Year	Dec	Jan	Feb
1984	-0.3	-3.2	-0.4
1988	-0.1	2.2	1.3
1995	-1.7	-0.4	-2.4
1998	1.4	0.8	0
2007	1.2	0.4	-2
2010	-0.6	-4.3	0.3
2011	-0.8	-0.7	-2.4
2016	1.6	0.6	0
2020	-0.8	-0.2	2.1
Tendency	0	-	0

- ▶ Recently Equatorial sea surface temperature of the Niño3.4 region is $-1.1\text{ }^{\circ}\text{C}$ and it is close to weak La Niña
- ▶ Most forecast models (19/24) predict La Niña trend during this winter
- ▶ Winter mean temperature anomaly over Korea is normal or below normal during La Niña events

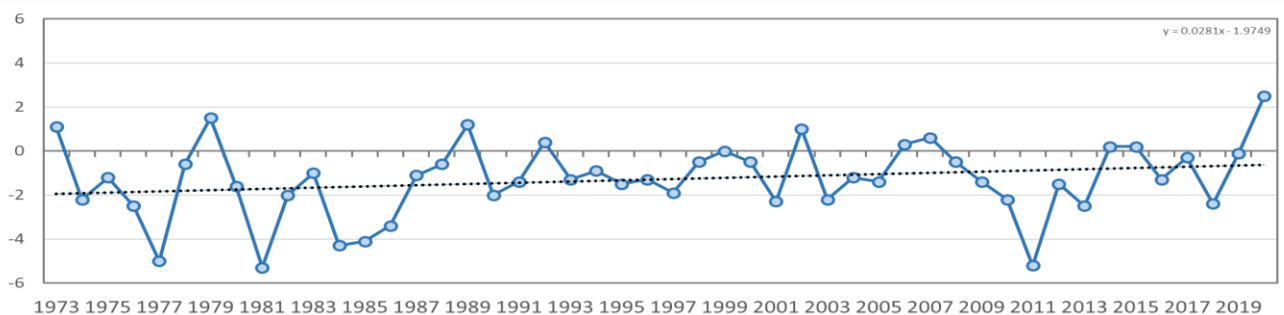
Trend of Observed Temperature

<Trend of Mean Temperature over Korea>



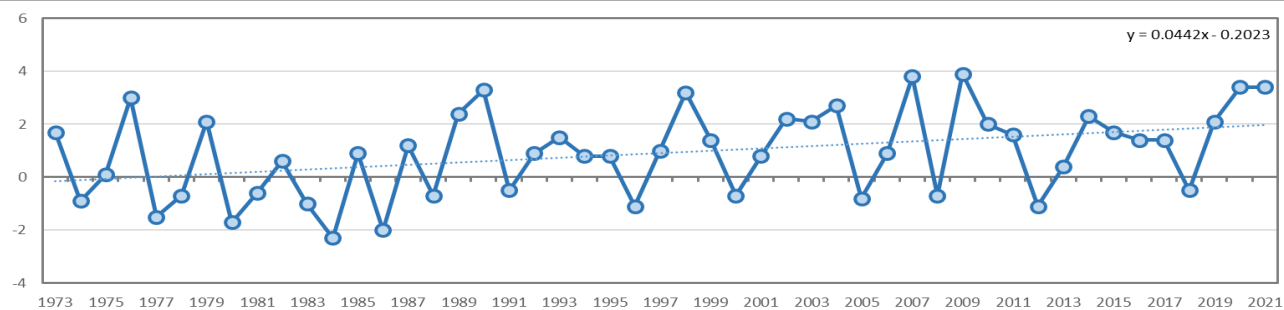
Dec

- average 1.1°C
- **+0.2°C / 48years**



Jan

- average -0.9°C
- **+1.4°C / 49years**



Feb

- average 1.2°C
- **+2.1°C / 49years**

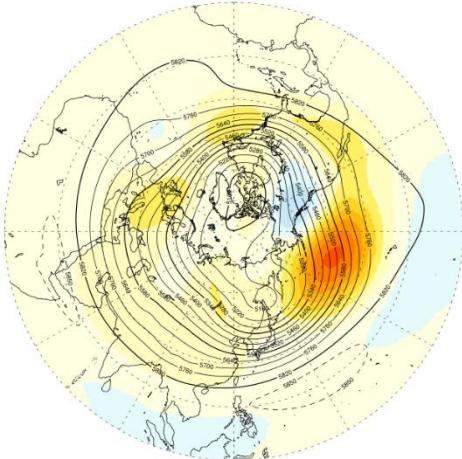
- ▶ Since 1973, the temperature of Korea has increasing trend for each month of winter
- ▶ In February, the warming trend was **+2.1°C/49yrs**, which is higher than other months

500hPa GPH anomaly (GloSea5_initial 11.1)

DJF

500hPa Geopotential Height (gpm) Anomaly
Contour: FCST(int:60), Shading: Anomaly(FCST-HCST)

Climate Prediction Division / KMA
KMA GloSea5G2Z (N216L95, O0.25L70)

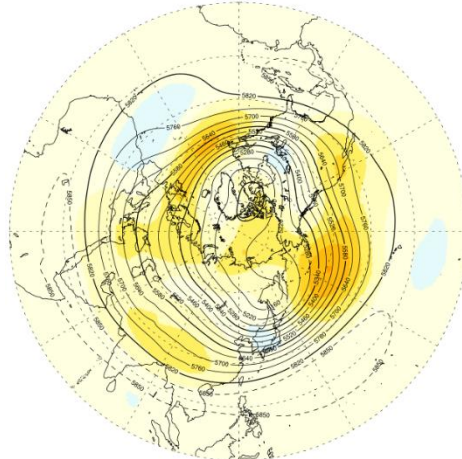


Valid Date : 20211201 - 20220228 (+1 +2 +3 mon) Initial Date : 20211012 - 20211101 (42mem)
HCST: 1991 - 2018 (oldmem: 1001 1006 1019 1028 1101 1109)

Dec

500hPa Geopotential Height (gpm) Anomaly
Contour: FCST(int:60), Shading: Anomaly(FCST-HCST)

Climate Prediction Division / KMA
KMA GloSea5G2Z (N216L95, O0.25L70)

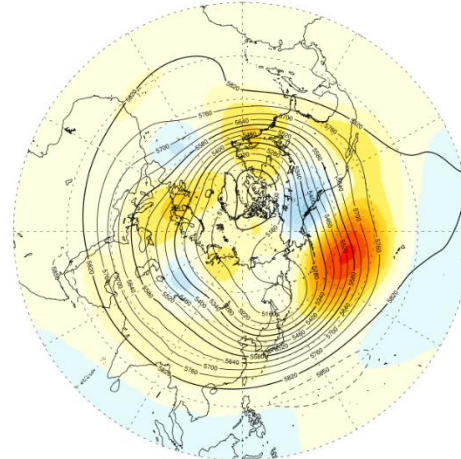


Valid Date : 20211201 - 20211231 (+1mon) Initial Date : 20211012 - 20211101 (42mem)
HCST: 1991 - 2018 (oldmem: 1001 1006 1019 1028 1101 1109)

Jan

500hPa Geopotential Height (gpm) Anomaly
Contour: FCST(int:60), Shading: Anomaly(FCST-HCST)

Climate Prediction Division / KMA
KMA GloSea5G2Z (N216L95, O0.25L70)

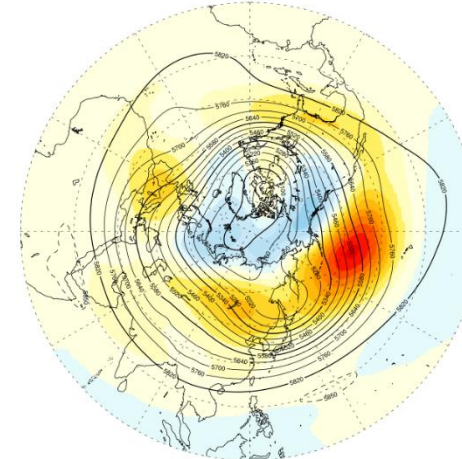


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HCST: 1991 - 2018 (oldmem: 1001 1006 1019 1028 1101 1109)

Feb

500hPa Geopotential Height (gpm) Anomaly
Contour: FCST(int:60), Shading: Anomaly(FCST-HCST)

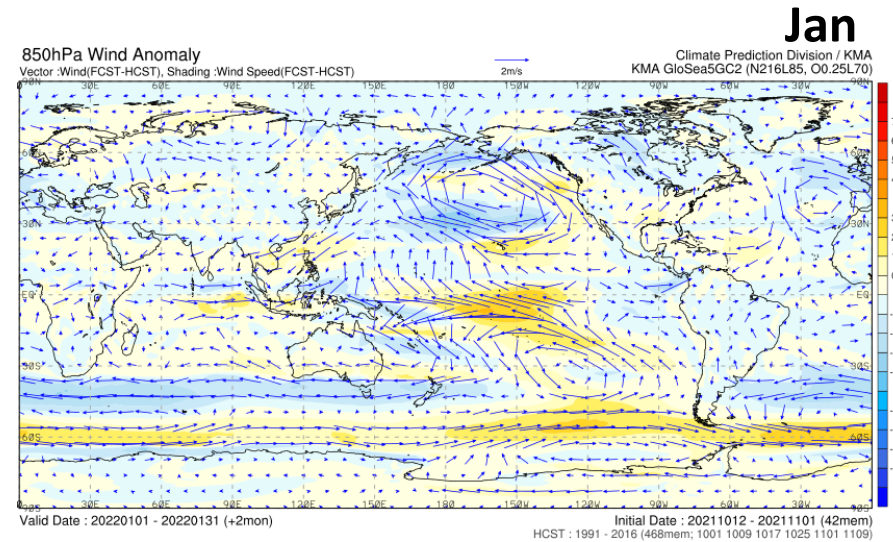
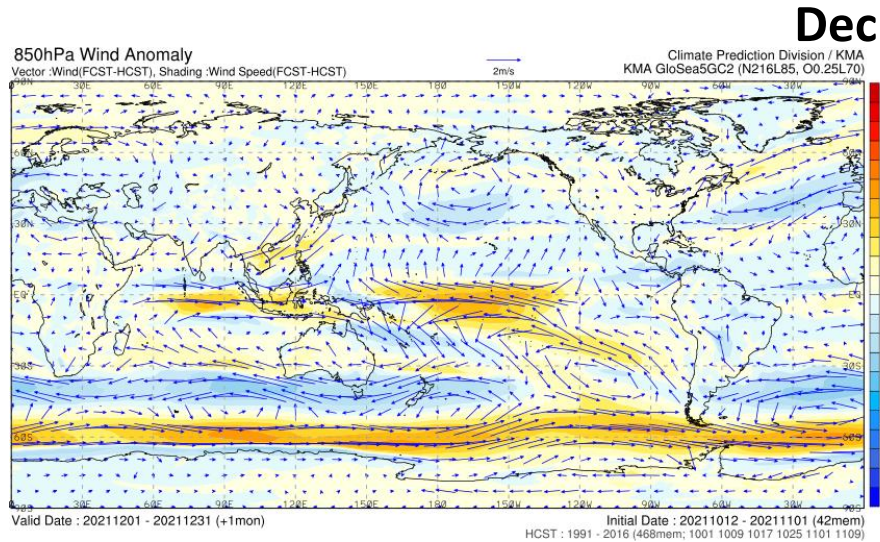
Climate Prediction Division / KMA
KMA GloSea5G2Z (N216L95, O0.25L70)



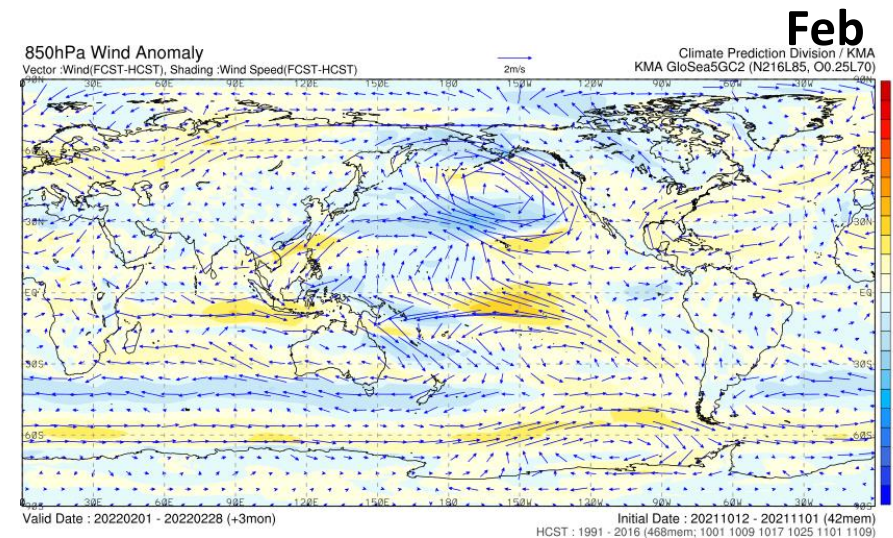
Valid Date : 20220201 - 20220228 (+3mon) Initial Date : 20211012 - 20211101 (42mem)
HCST: 1991 - 2018 (oldmem: 1001 1006 1019 1028 1101 1109)

- ▶ **Positive anomaly over Ural Mt. from December to January, but it changes normal in February**
- ▶ **Strong positive anomaly in Bering Sea during winter, Korea and Japan are expected to be normal or weak negative anomaly**
- ▶ **Winter temperature over Korea is expected to be normal or below normal due to accumulation of cold by blocking in Bering Sea.**
- ▶ **When the cold Siberian High extends in the early winter, the temperature will drop significantly**

850hPa Wind Anomaly (GloSea5_initial 11.1)

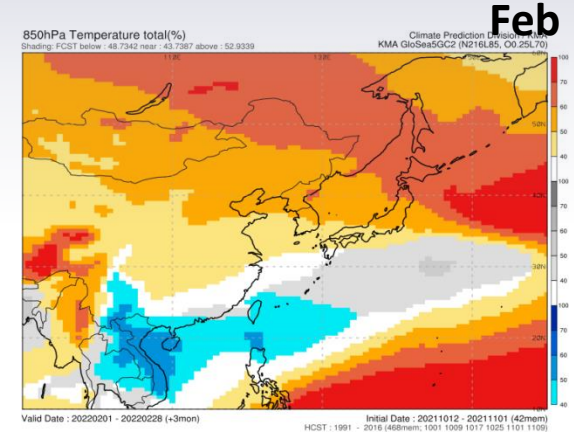
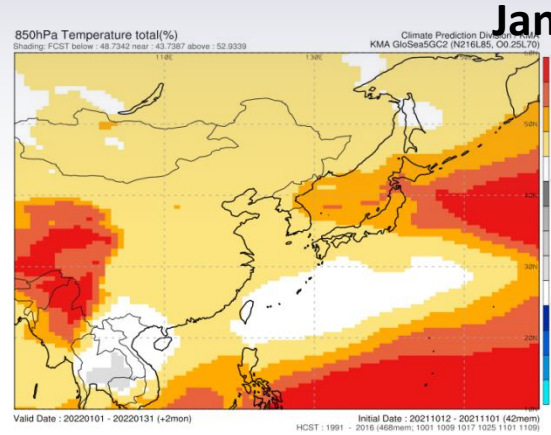
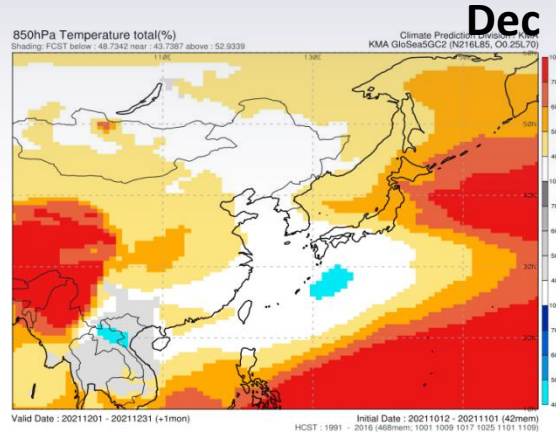


- ▶ (Dec, Jan) anti-cyclonic anomaly over the Bering Sea and the Ural Mt.
 - Korea is expected to be influence by NW wind due to anti-cyclonic circulation over the Ural Mt.
- ▶ (Feb) Korea is expected to be influence by E wind due to cyclonic circulation over the Northwest Pacific



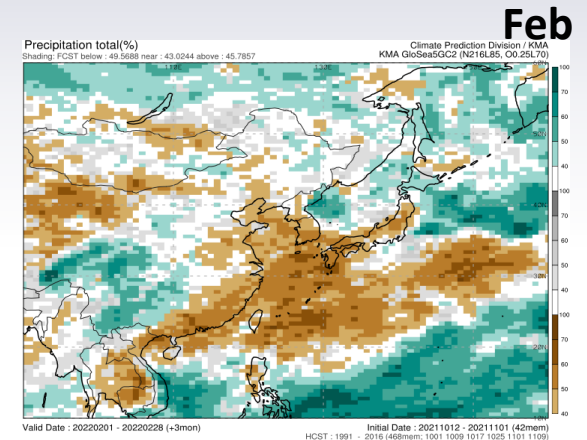
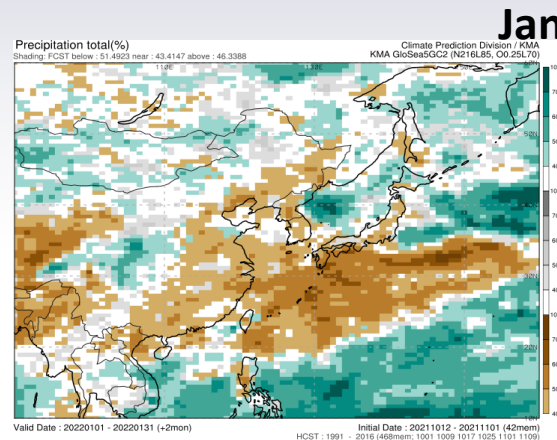
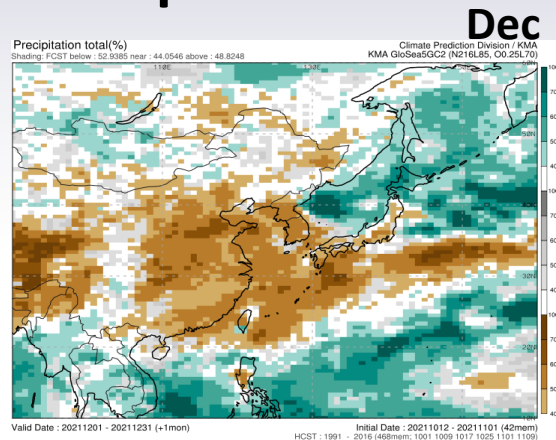
Probabilistic Prediction (GloSea5_initial 11.1)

<Temperature>



- ▶ Near normal or above-normal temperature over East Asian regions and below-normal over Southeast Asia

<Precipitation>



- ▶ Less than normal over East Asian regions

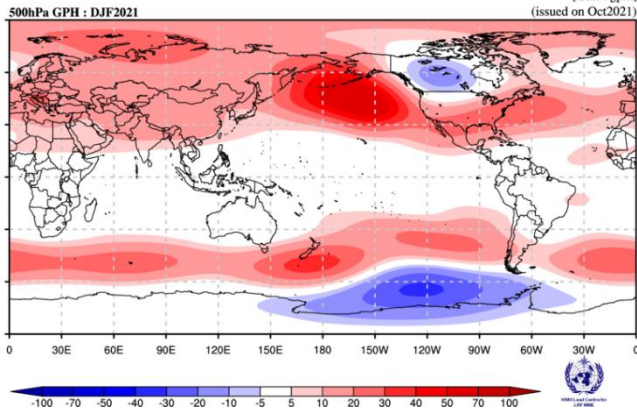
500hPa GPH anomaly (WMO LC-LRFMME)

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DJF

Simple Composite Map
Beijing,CMCC,CPTEC,ECMWF,Exeter,Melbourne,Montréal,Offenbach,Seoul,Toulouse,Washington

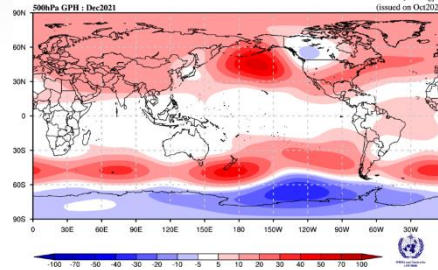
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(issued on Oct2021)



Dec

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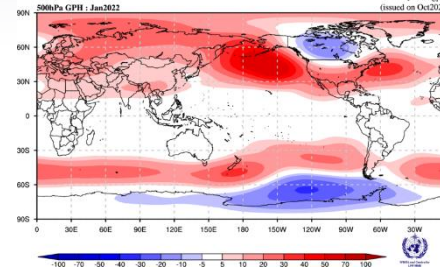
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Jan

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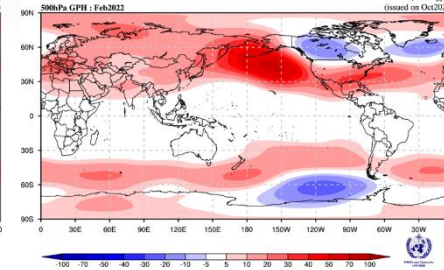
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Feb

Simple Composite Map
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(issued on Oct2021)

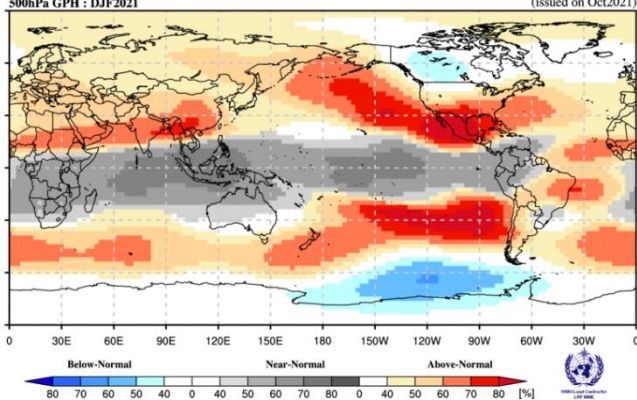


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DJF

Probabilistic Multi-Model Ensemble Forecast
Beijing,CMCC,CPTEC,ECMWF,Exeter,Melbourne,Montréal,Offenbach,Seoul,Toulouse,Washington

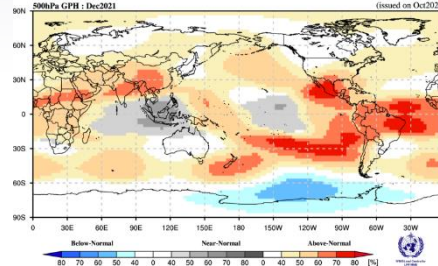
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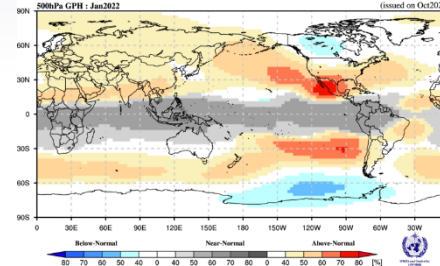
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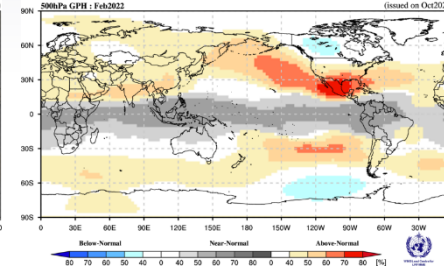
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Feb

Probabilistic Multi-Model Ensemble Forecast
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(issued on Oct2021)



► In both, positive anomaly over East Asia

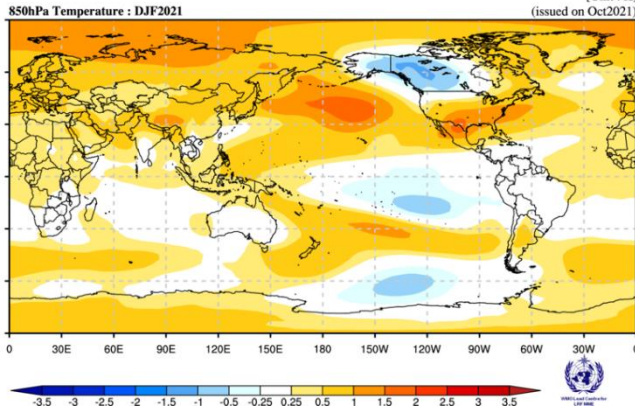
850hPa Temperature anomaly (WMO LC-LRFMME)

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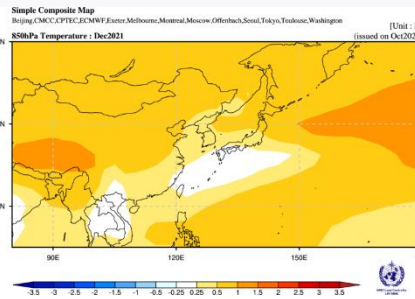
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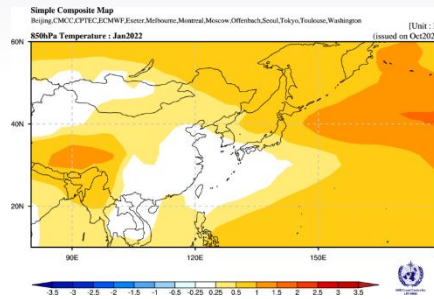
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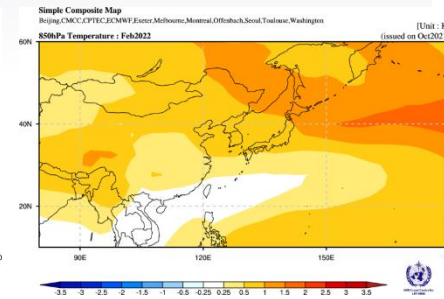
Dec



Jan



Feb

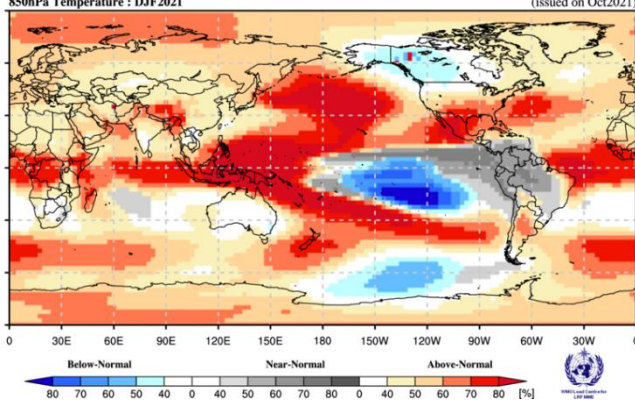


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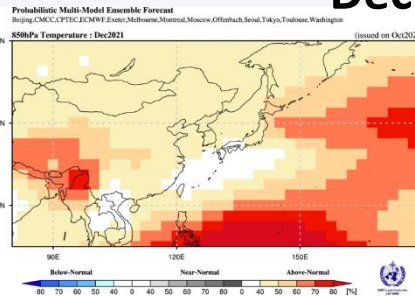
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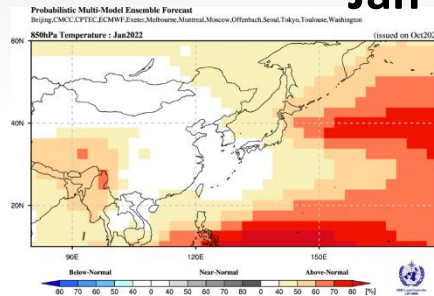
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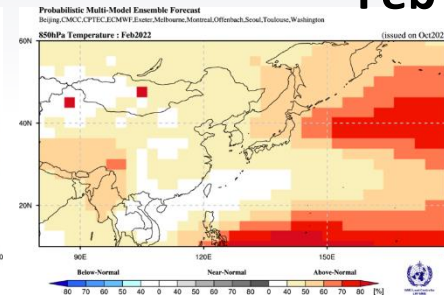
Dec



Jan



Feb



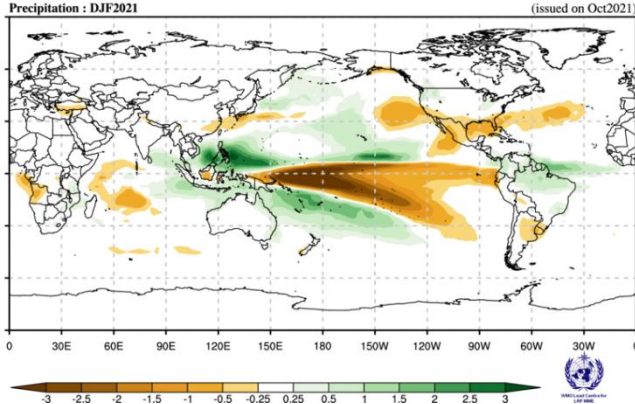
► Most East Asian regions shows near normal or above-normal temperature

Precipitation anomaly (WMO LC-LRFMME)

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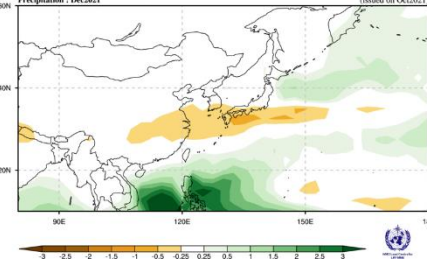
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Simple Composite Map
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[Unit : mm]
(issued on Oct2021)



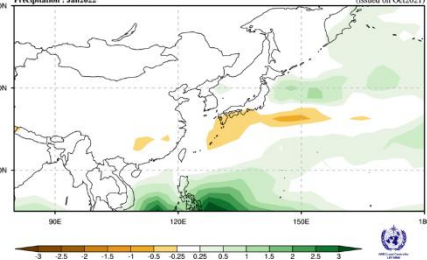
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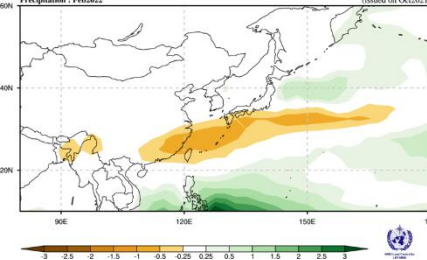
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[Unit : mm]
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Feb

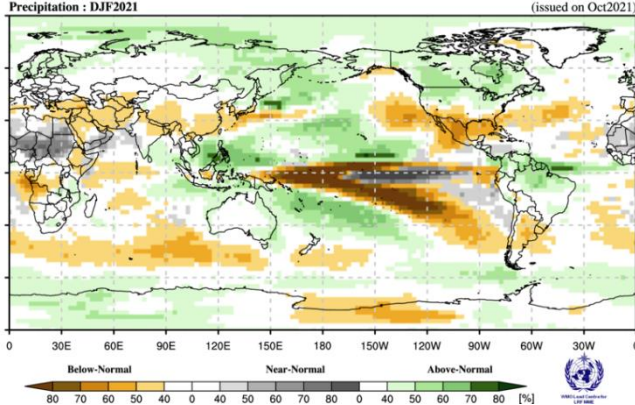
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(issued on Oct2021)



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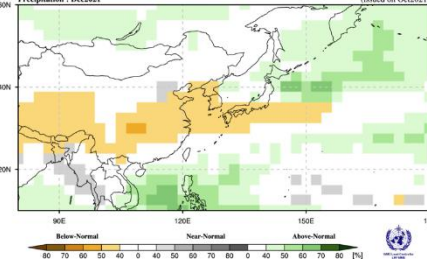
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Probabilistic Multi-Model Ensemble Forecast
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[Unit : %]
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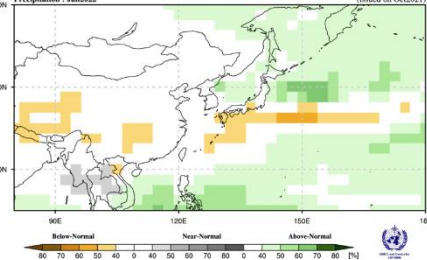
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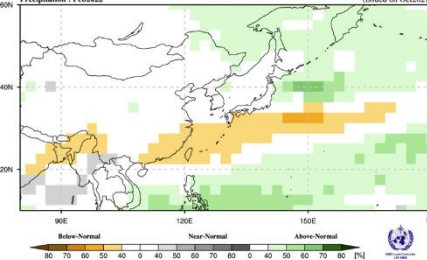
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[Unit : %]
(issued on Oct2021)



- ▶ Below normal over South Korea in December but near normal in January and February
- ▶ Below normal near South China and South Japan during winter

■ Consideration for prediction

- ENSO will be expected to be **La Niña** during the coming winter season.
- Most dynamic model results show **near normal** or **above-normal** temperature and **below-normal** precipitation over Korea.
- Statistical analysis (**Arctic Sea Ice and QBO etc.**) give us a little **below-normal** temperature for winter.

■ 2021/22 winter outlook over KOREA

Temperature	Precipitation
Below Normal	Below Normal

Thank you !!

S2S Operational Model in KMA

KMA Global Seasonal Forecasting System 5 (GloSea5)

		Hindcast	Forecast
Period		1991–2016	From 2017 to the present
Initial condition	atmos	ECMWF ERA-Interim	KMA NWP anal
	land	KMA JULES-JRA55	KMA JULES-JRA55
	ocean	UKMO NEMOVAR	KMA NEMOVAR
Ensemble	run	00Z on 1st, 9th, 17th and 25th	00Z Everyday (75, 240 days)
	member	3mem x 26 yrs	2 mem (75 days)