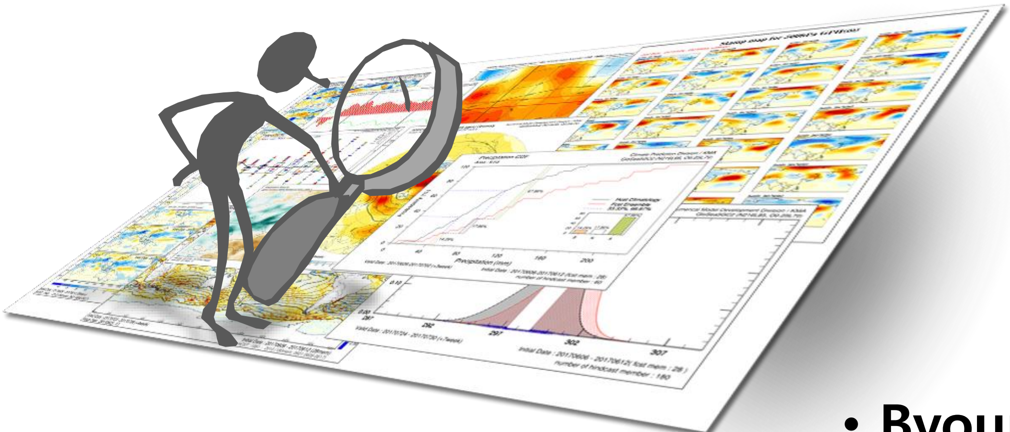
Using climate indices calculated from GloSea5 for Sub-seasonal Prediction



- Byoung-Kwon Park
- Jiseon Bak
- Chanil Jeon

Korea Meteorological Administration

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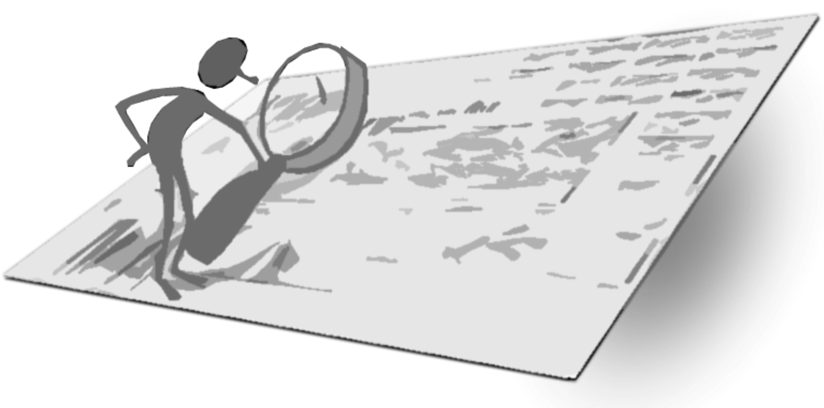


Background

The term 'monsoon' stems from seasonal variations in winds.

East Asian monsoon is one of **the most active components** in the global climate system and has substantial social and economic influences.

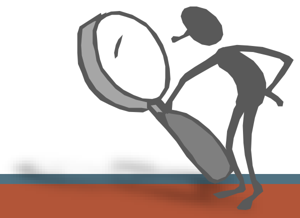
Given this importance, it is necessary to quantify the strength of the monsoon.

And **many monsoon indices have been proposed** based on different variables at different levels.

Even if **the world class model has poor skills** in prediction of the monsoon rainfall, **using concise and meaningful indices to characterize monsoon variability** can aid the capability of numerical model in reproducing monsoon variability.

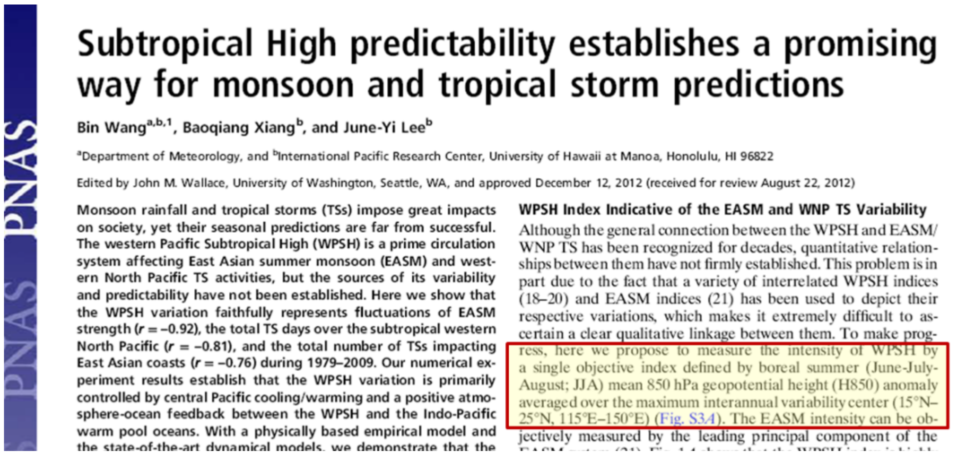
The **climate indices** including monsoons and ENSO calculated from **GloSea5 Hindcast** data are evaluated and applied to the monthly forecast.

Western North Pacific Subtropical High



Western North Pacific Subtropical High

(Wang et al, 2013)



Subtropical High predictability establishes a promising way for monsoon and tropical storm predictions

Bin Wang[a,b,1], Baoqiang Xiang[b], and June-Yi Lee[b]

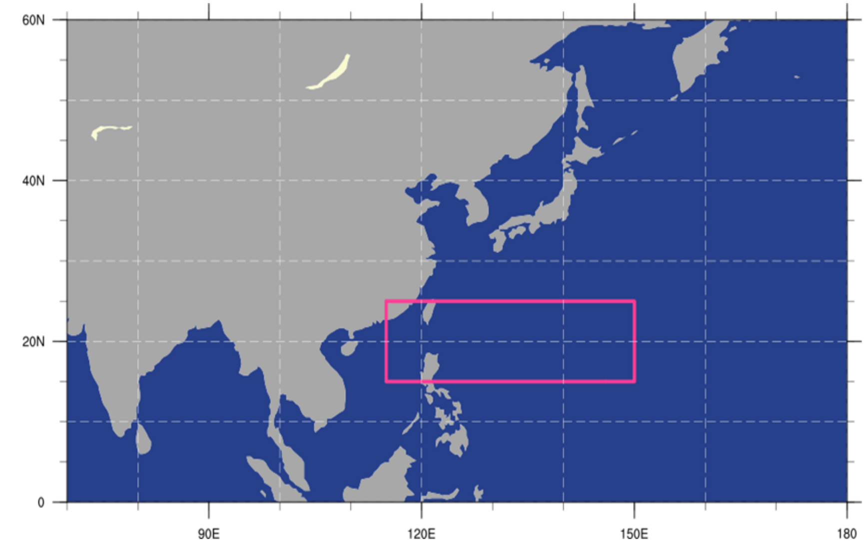
[a]Department of Meteorology, and [b]International Pacific Research Center, University of Hawaii at Manoa, Honolulu, HI 96822

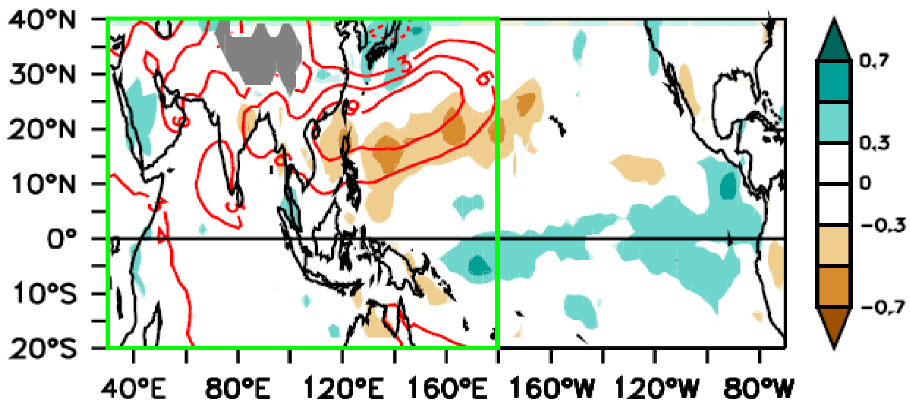
Edited by John M. Wallace, University of Washington, Seattle, WA, and approved December 12, 2012 (received for review August 22, 2012)

Monsoon rainfall and tropical storms (TSs) impose great impacts on society, yet their seasonal predictions are far from successful. The western Pacific Subtropical High (WPSH) is a prime circulation system affecting East Asian summer monsoon (EASM) and western North Pacific TS activities, but the sources of its variability and predictability have not been established. Here we show that the WPSH variation faithfully represents fluctuations of EASM strength ($r = -0.92$), the total TS days over the subtropical western North Pacific ($r = -0.81$), and the total number of TSs impacting East Asian coasts ($r = -0.76$) during 1979–2009. Our numerical experiment results establish that the WPSH variation is primarily controlled by central Pacific cooling/warming and a positive atmosphere-ocean feedback between the WPSH and the Indo-Pacific warm pool oceans. With a physically based empirical model and the state-of-the-art dynamical models, we demonstrate that the

WPSH Index Indicative of the EASM and WNP TS Variability

Although the general connection between the WPSH and EASM/WNP TS has been recognized for decades, quantitative relationships between them have not firmly established. This problem is in part due to the fact that a variety of interrelated WPSH indices (18–20) and EASM indices (21) has been used to depict their respective variations, which makes it extremely difficult to ascertain a clear qualitative linkage between them. To make progress, here we propose to measure the intensity of WPSH by a single objective index defined by boreal summer (June-July-August; JJA) mean 850 hPa geopotential height (H850) anomaly averaged over the maximum interannual variability center (15°N–25°N, 115°E–150°E) (Fig. S3A). The EASM intensity can be objectively measured by the leading principal component of the





Spatial pattern(contours) of the leading EOF mode derived from summer H850.
Shown is also the correlated precipitation(shade)

Normalized H850 Anomaly
Spatial average [15N-25N, 115E-150E]

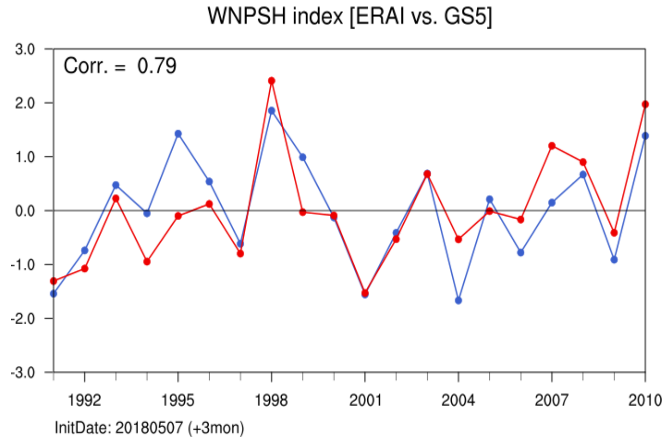
기상청

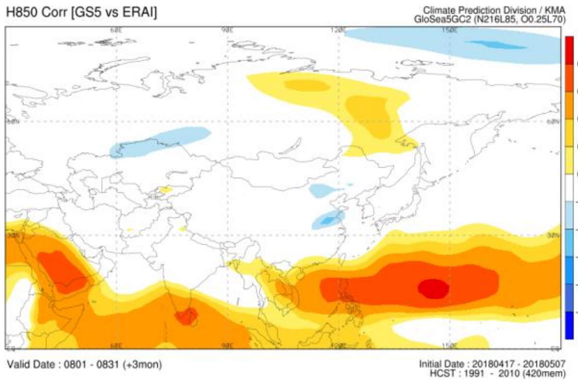
WNPSH [Aug. 1991~2010]

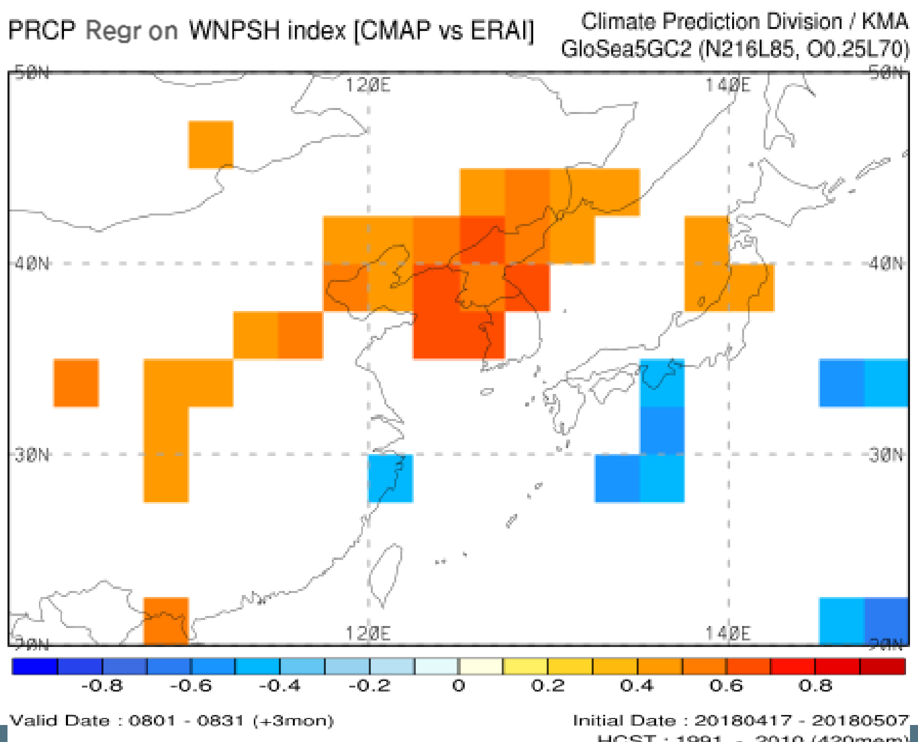
20180507/+3mon

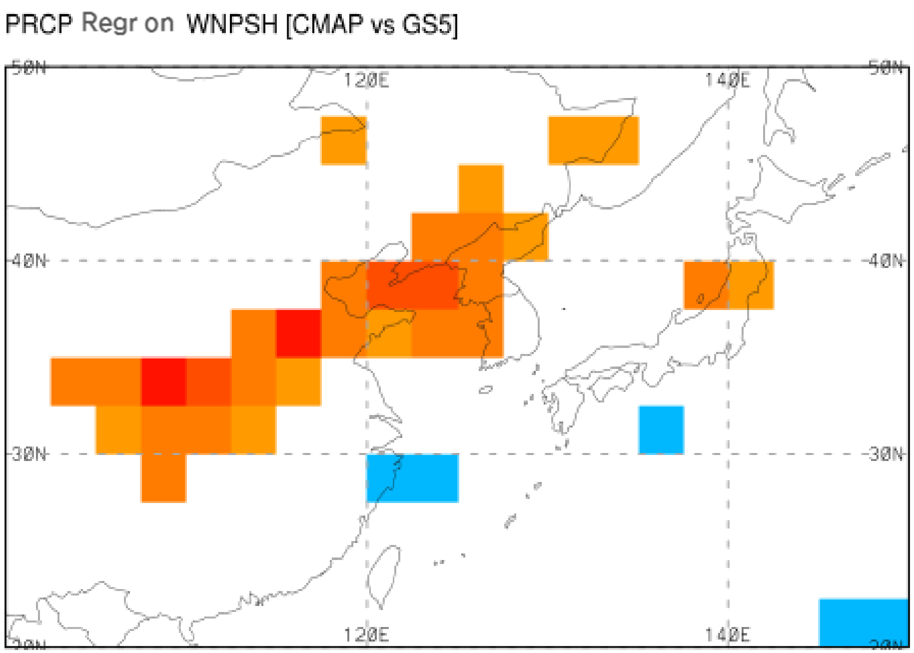
Prcp/Aug./-0.57

① Predictability	0.79
② Sensitivity	0.46
③ Application	0.39









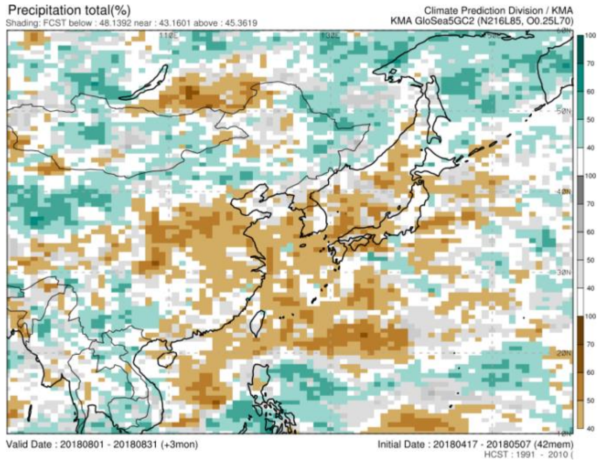
기상청

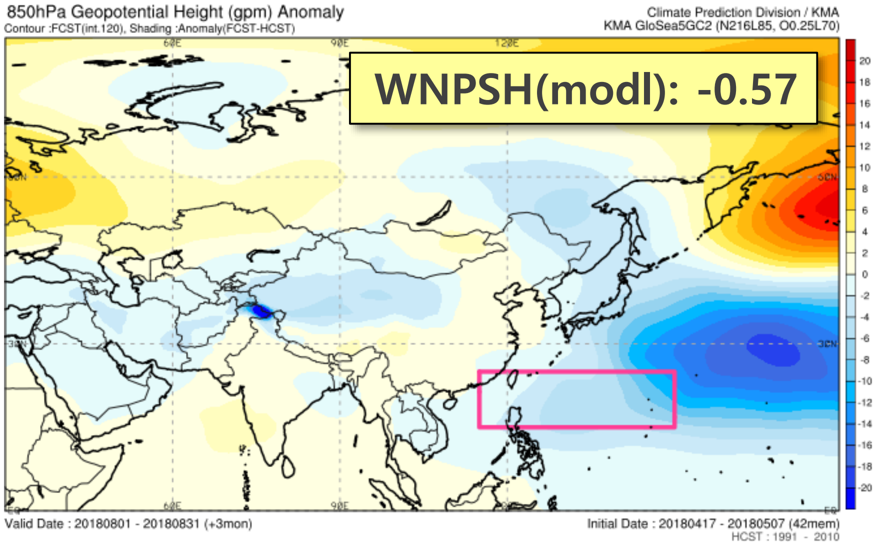
WNPSH [Aug. 2018]

20180507/+3mon

Forecast

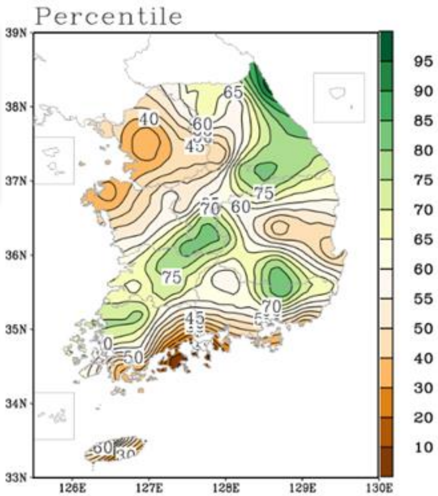
A: 19%
N: 45%
B: 36%

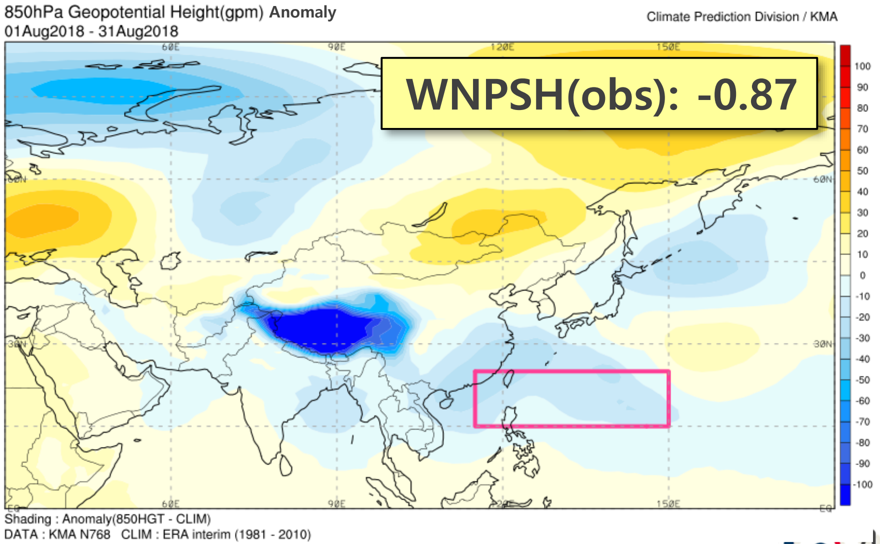




Observation

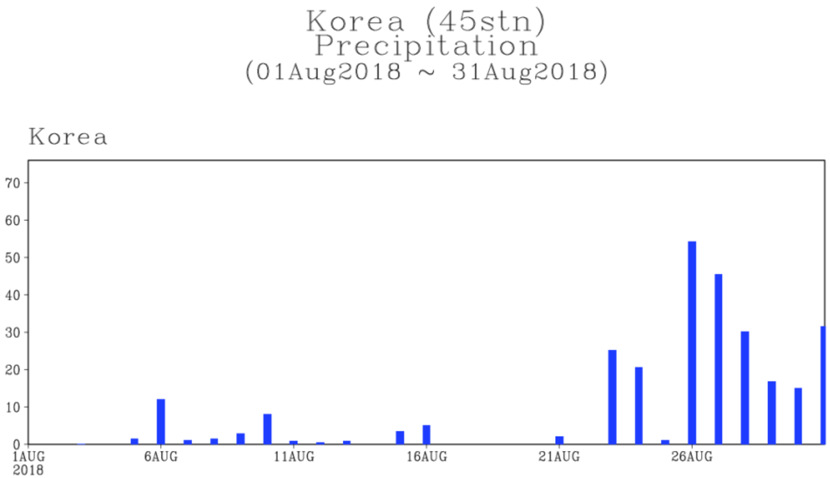
Total: 282.1 mm
Percentile: 56.5
Near Normal



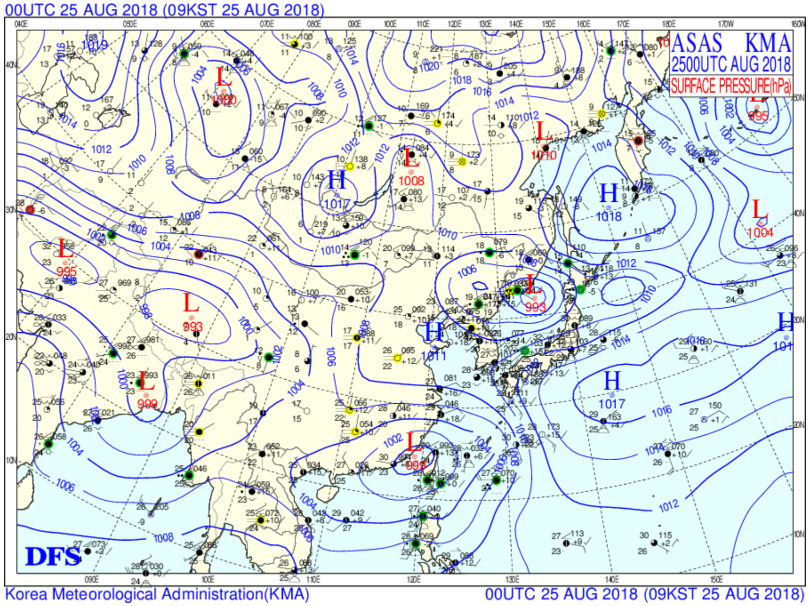


기상청

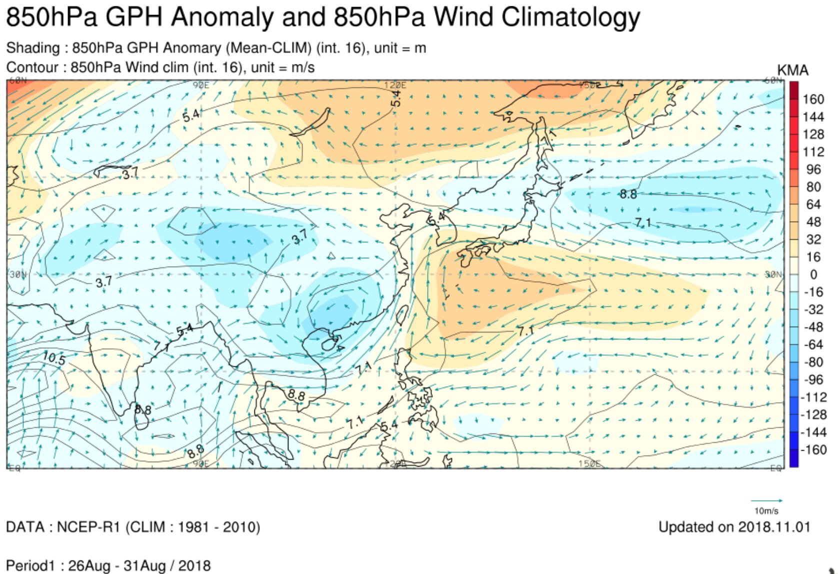
[Aug. 2018]



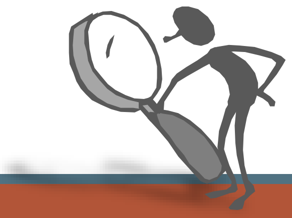
Korea (45stn)
Precipitation
(01Aug2018 ~ 31Aug2018)
Korea
70
60
50
40
30
20
10
0
1AUG
2018
6AUG
11AUG
16AUG
21AUG
26AUG



00UTC 25 AUG 2018 (09KST 25 AUG 2018)
ASAS KMA
2500UTC AUG 2018
SURFACE PRESSURE(hPa)
DFS
Korea Meteorological Administration(KMA)
00UTC 25 AUG 2018 (09KST 25 AUG 2018)



850hPa GPH Anomaly and 850hPa Wind Climatology
Shading : 850hPa GPH Anomary (Mean-CLIM) (int. 16), unit = m
Contour : 850hPa Wind clim (int. 16), unit = m/s
KMA
160
144
128
112
96
80
64
48
32
16
0
-16
-32
-48
-64
-80
-96
-112
-128
-144
-160
10m/s
DATA : NCEP-R1 (CLIM : 1981 - 2010)
Updated on 2018.11.01
Period1 : 26Aug - 31Aug / 2018



Western North Pacific Summer Monsoon

Western North Pacific Summer Monsoon

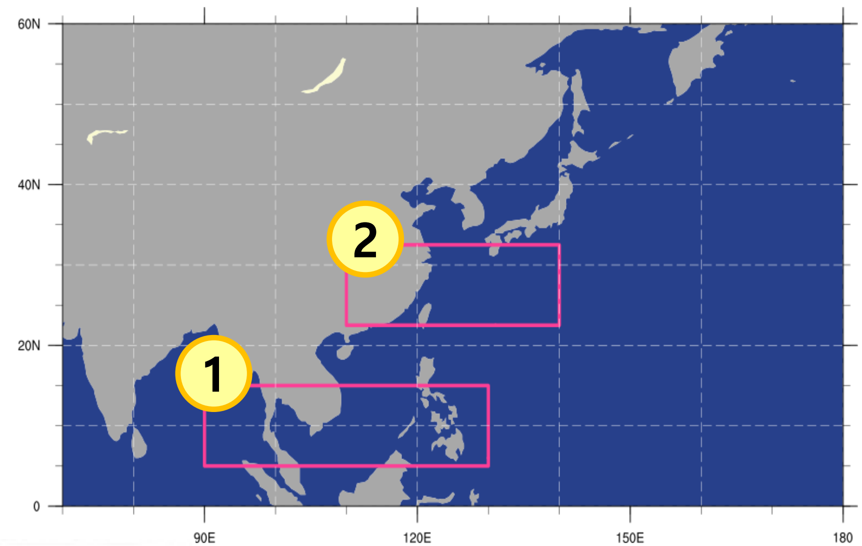
Choice of South Asian Summer Monsoon Indices*

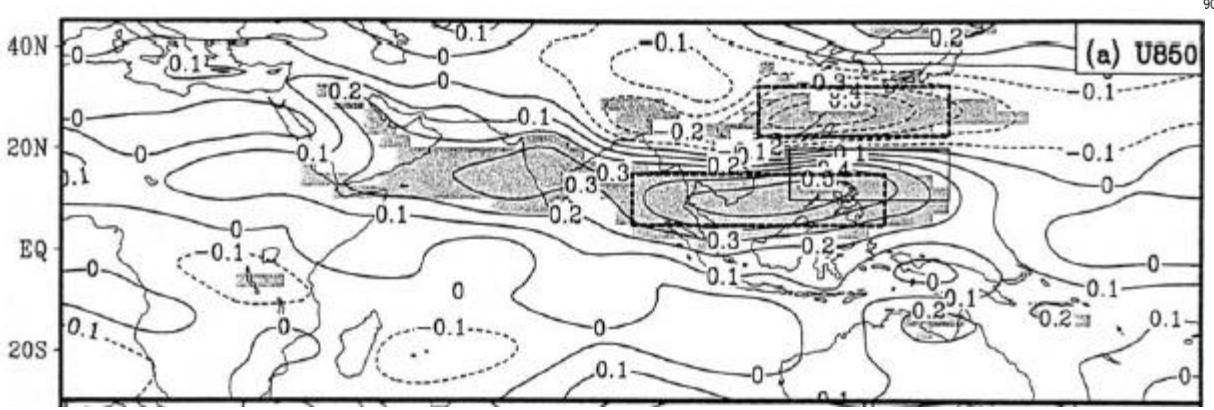
Bin Wang and Zhen Fan
Department of Meteorology, University of Hawaii at Manoa, Honolulu, Hawaii

ABSTRACT

In the south Asian region, two of the major precipitation maxima associated with areas of intensive convective activity are located near the Bay of Bengal and in the vicinity of the Philippines. The variations of monthly mean outgoing longwave radiation in the two regions are poorly correlated, particularly in the decade of 1980s. The enhanced convection over the Bay of Bengal and Indian subcontinents is coupled with reinforced monsoon circulation west of 80°E over India, the western Indian Ocean, and the tropical northern Africa. In contrast, the enhanced convection in the vicinity of the Philippines corresponds to intensified monsoon circulation primarily east of 80°E over southeast Asia including the Indochina peninsula, South China Sea, Philippine Sea, and the Maritime Continent. To better reflect regional monsoon characteristics, two convection indices (or associated circulation indices that are dynamically coherent with the convection indices) are suggested to measure the variability of the Indian summer monsoon (ISM) and the southeast Asian summer monsoon, respectively.

(Wang and Fan, 1999)





correlation coefficients of zonal winds at 850hPa with respect to OLR

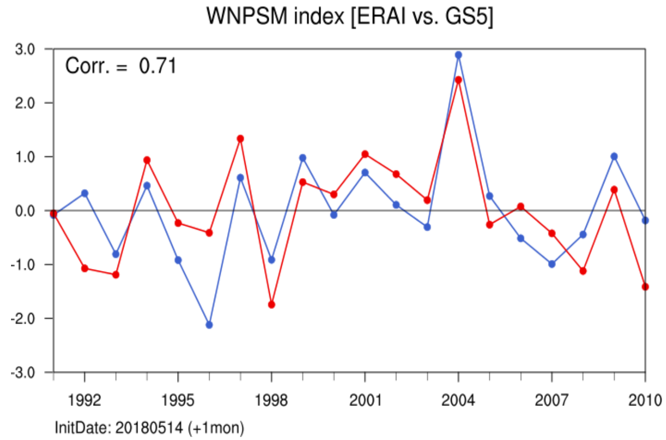
Normalized U850 Anomaly
difference between spatial averages of the two regions
[5N-15N, 90E-130E] – [22.5N-32.5N, 110E-140E]
1 2

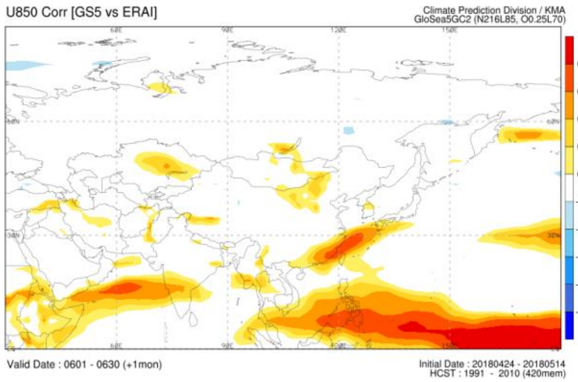
WNPSM [Jun. 1991~2010]

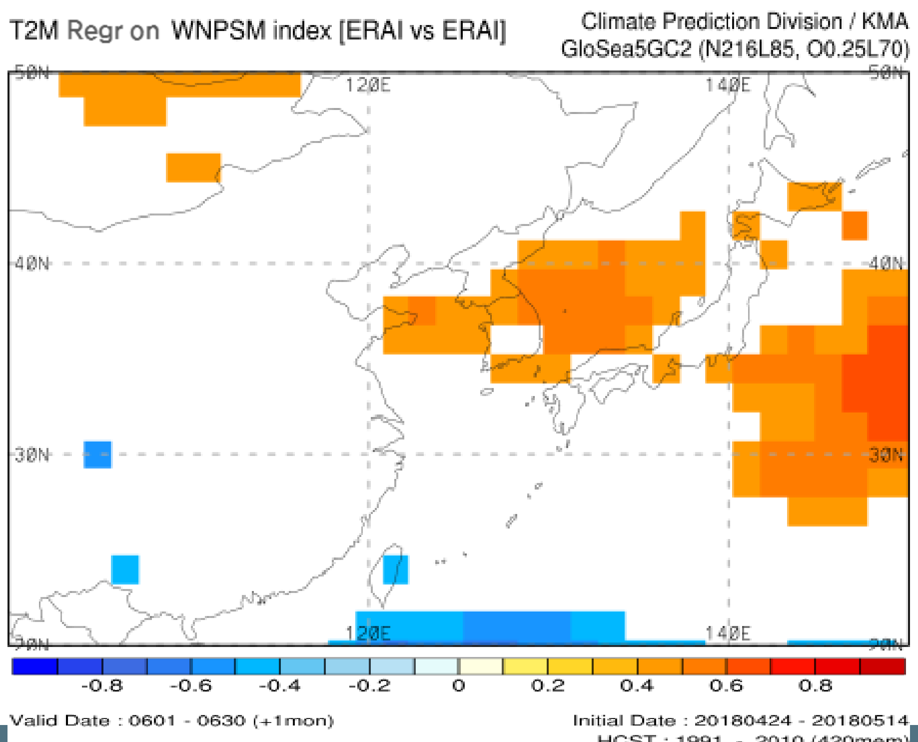
20180514/+1mon

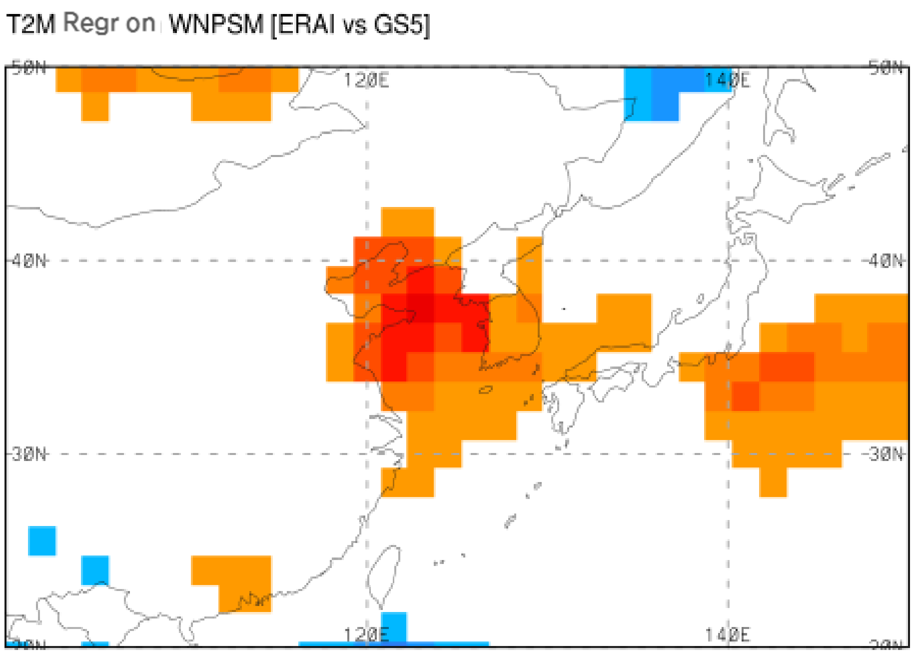
Temp/Jun/0.8

① Predictability	0.71
② Sensitivity	0.41
③ Application	0.43









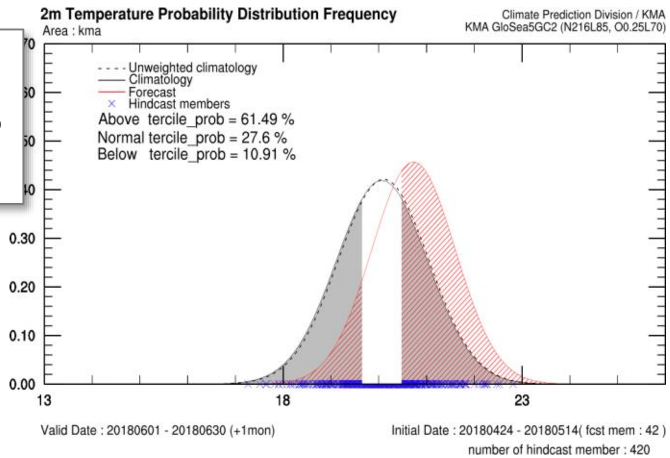
기상청

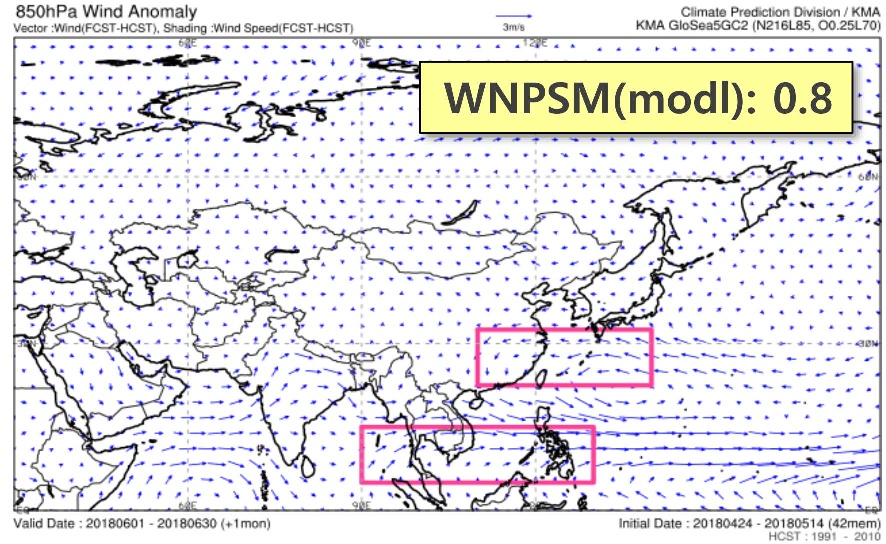
WNPSM [Jun. 2018]

20180514/+1mon

Forecast

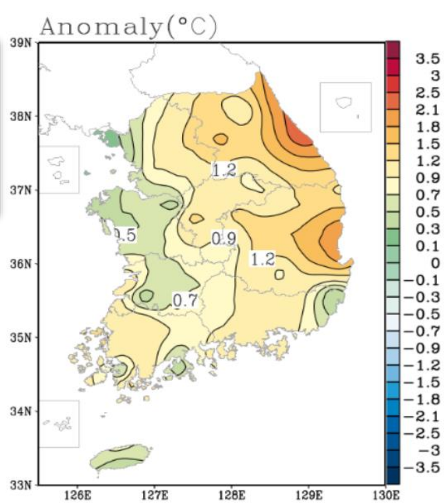
A: 61%
N: 28%
B: 11%

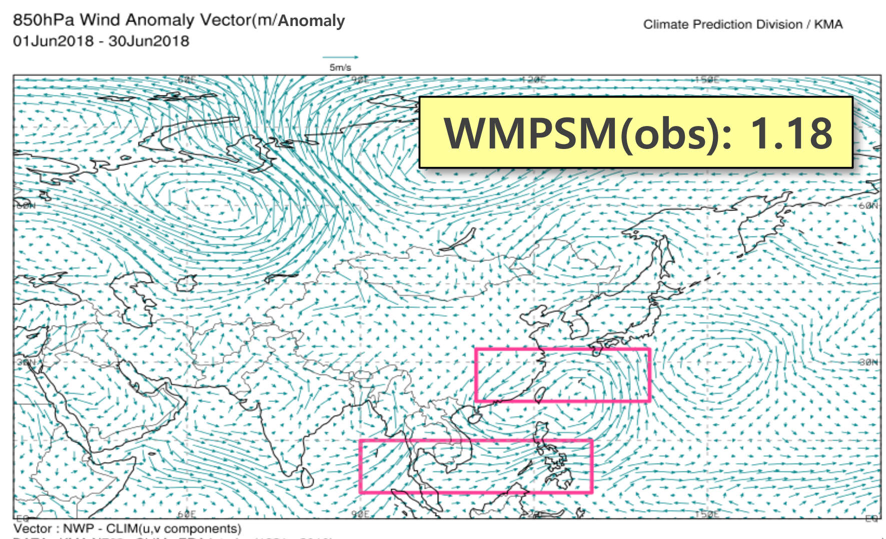




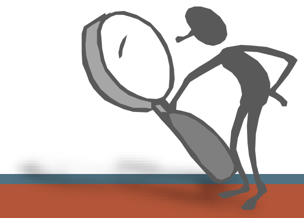
Observation

Mean: 22.2 ℃
Anom: +1.0 ℃
Above Normal





East Asian Summer Monsoon



East Asian Summer Monsoon

(Zhao et al., 2015)

A New Upper-Level Circulation Index for the East Asian Summer Monsoon Variability

GUIJIE ZHAO

State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, and College of Earth Science, University of Chinese Academy of Sciences, Beijing, China

GANG HUANG

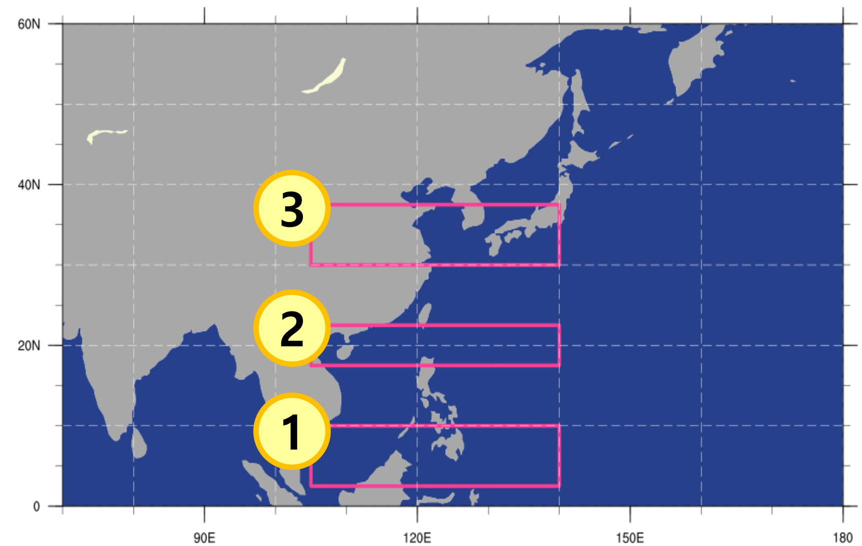
State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, and Joint Center for Global Change Studies, Beijing, China

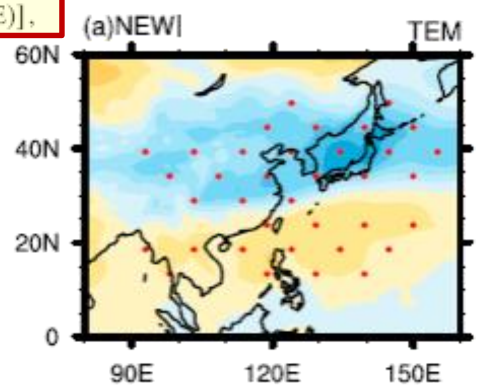
RENGUANG WU, WEICHEN TAO, HAINAN GONG, XIA QU, AND KAIMING HU

Center for Monsoon System Research, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

(Manuscript received 8 April 2015, in final form 16 September 2015)

$$\begin{aligned}\mathrm{NEWI} = \mathrm{Nor}[&u(2.5°\text{–}10°\mathrm{N}, 105°\text{–}140°\mathrm{E}) \\ &- u(17.5°\text{–}22.5°\mathrm{N}, 105°\text{–}140°\mathrm{E}) \\ &+ u(30°\text{–}37.5°\mathrm{N}, 105°\text{–}140°\mathrm{E})],\end{aligned}$$





Regression anomalies of temperature against the NEWI

Normalized U200 Anomaly

difference between spatial averages of the three regions

[2.5N-10N, 105E-140E]- [17.5N-22.5N, 105E-140E]+ [30N-37.5N, 105E-140E]

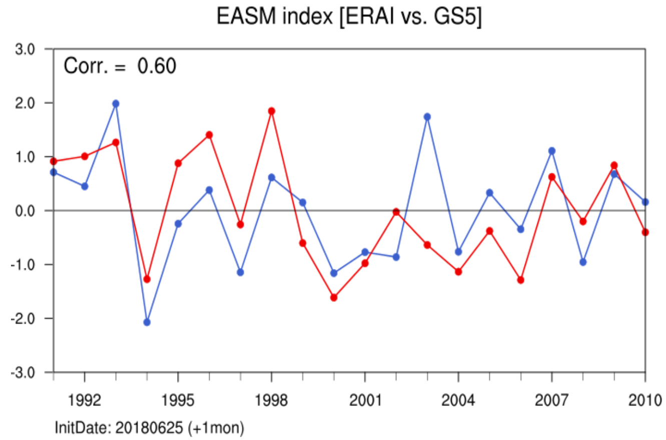
1 2 3

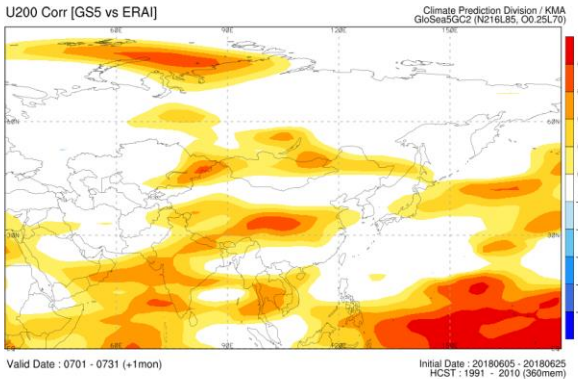
기상청

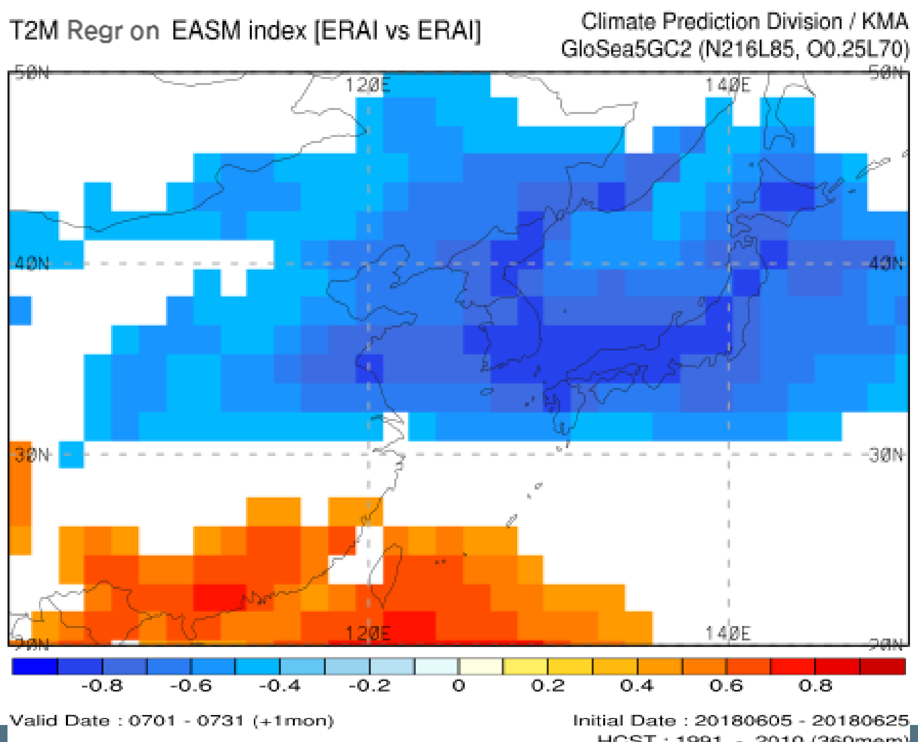
EASM [Jul. 1991~2010] 20180625/+1mon

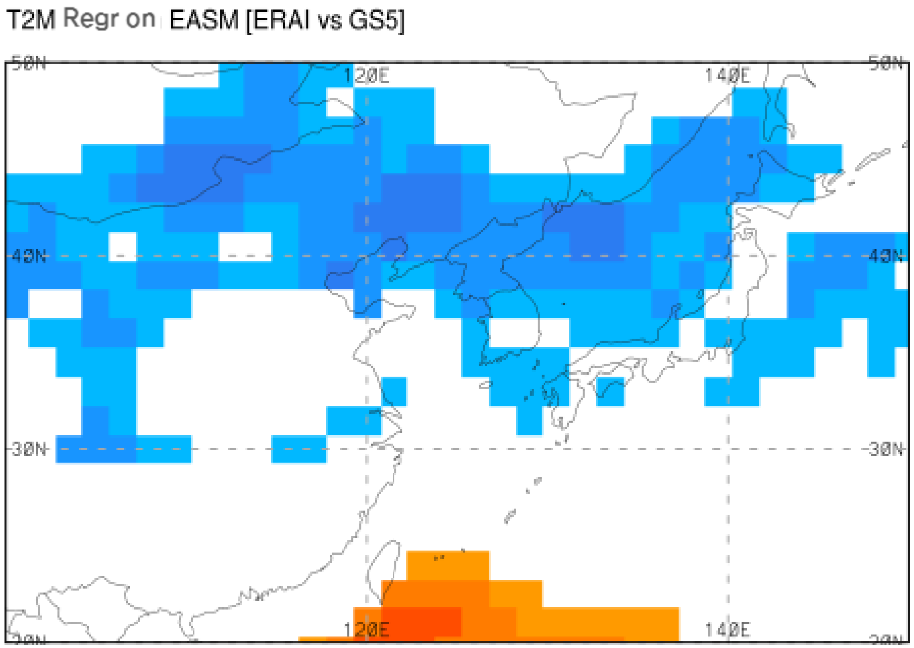
Temp/Jul/-1.78

① Predictability	0.60
② Sensitivity	-0.82
③ Application	-0.42









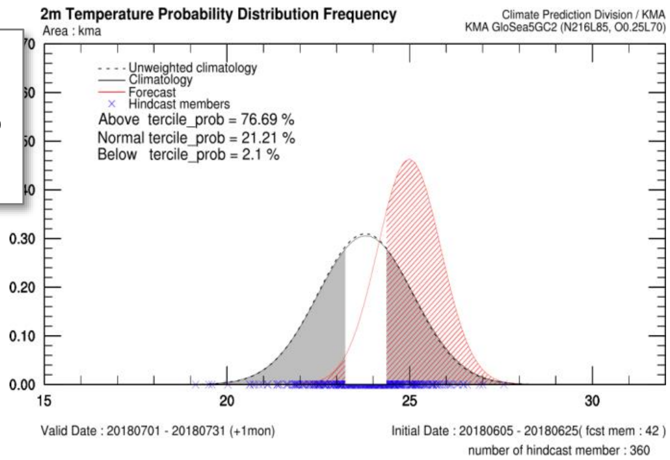
기상청

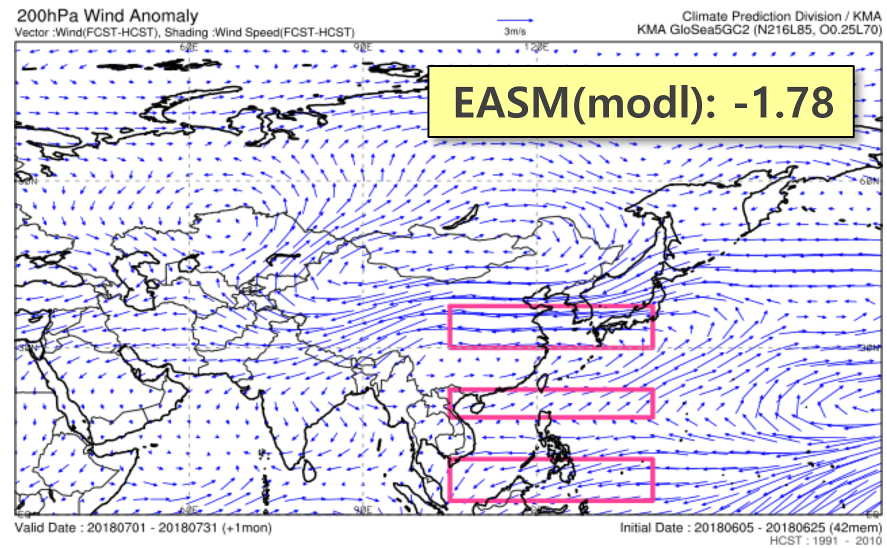
EASM [Jul. 2018]

20180625/+1mon

Forecast

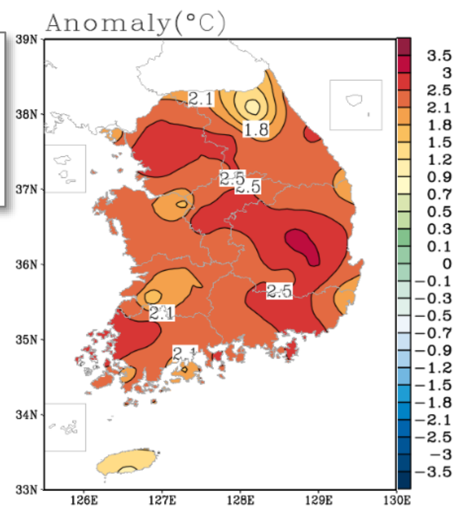
A: 77%
N: 21%
B: 2%

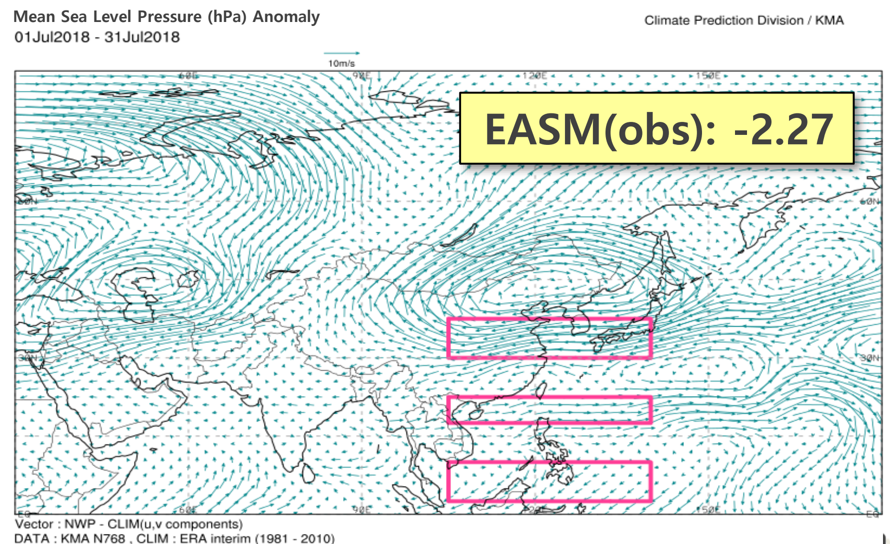




Observation

Mean: 26.8 ℃
Anom: +2.3 ℃
Above Normal

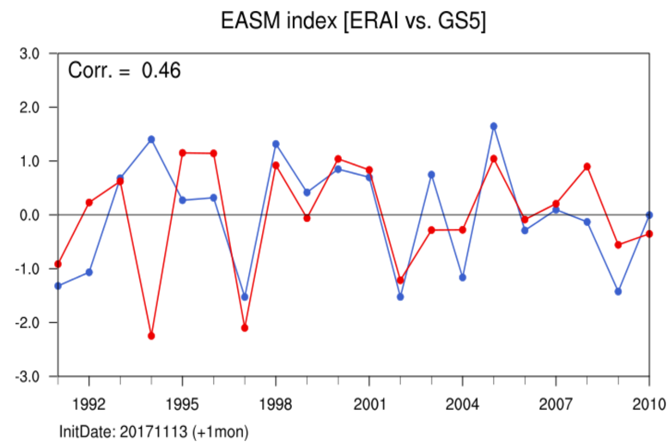


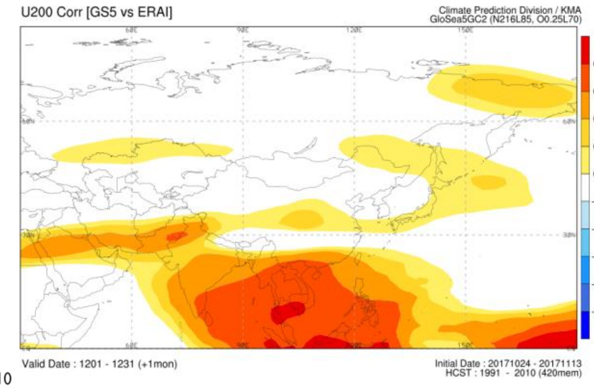


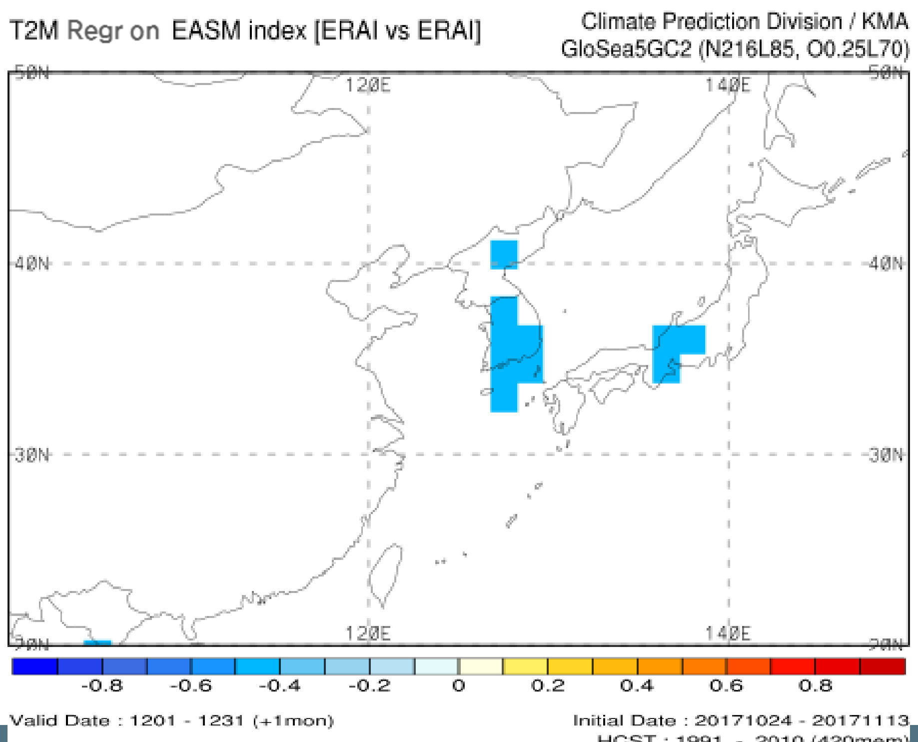
EASM [Dec. 1991~2010] 20171113/+1mon

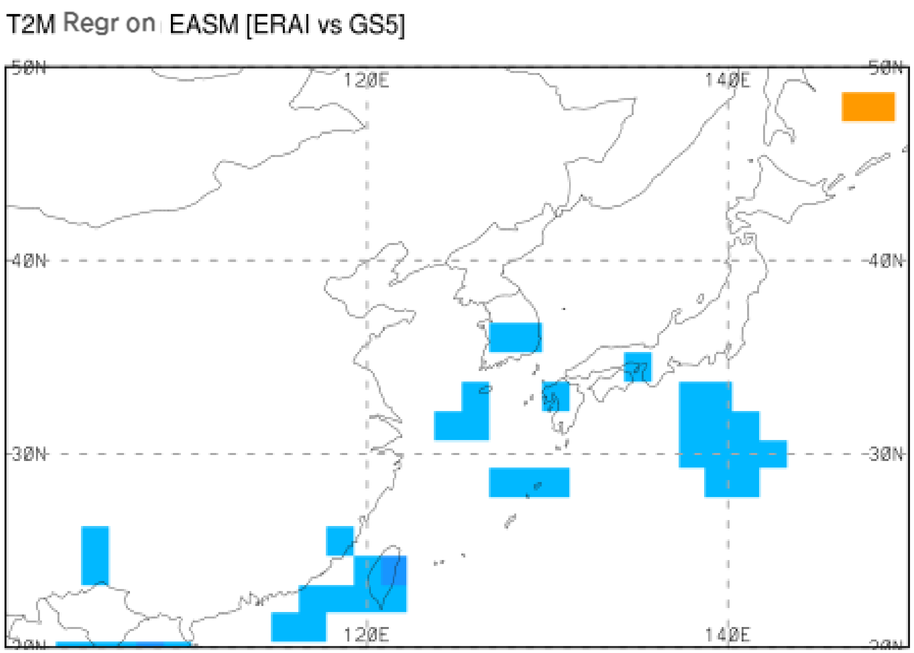
Temp/Dec/0.92

① Predictability	0.46
② Sensitivity	-0.43
③ Application	-0.41









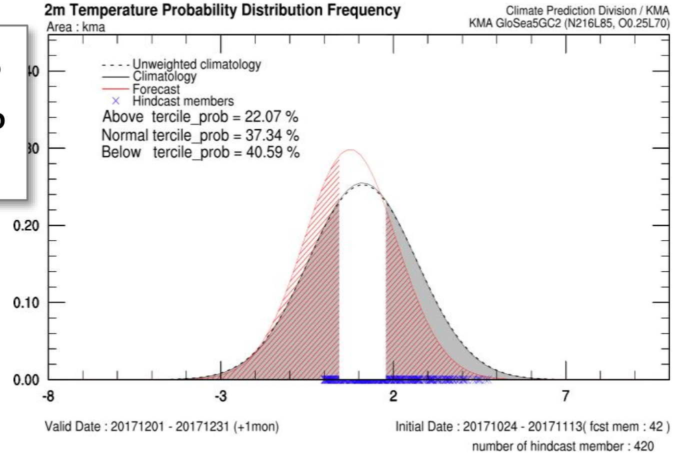
기상청

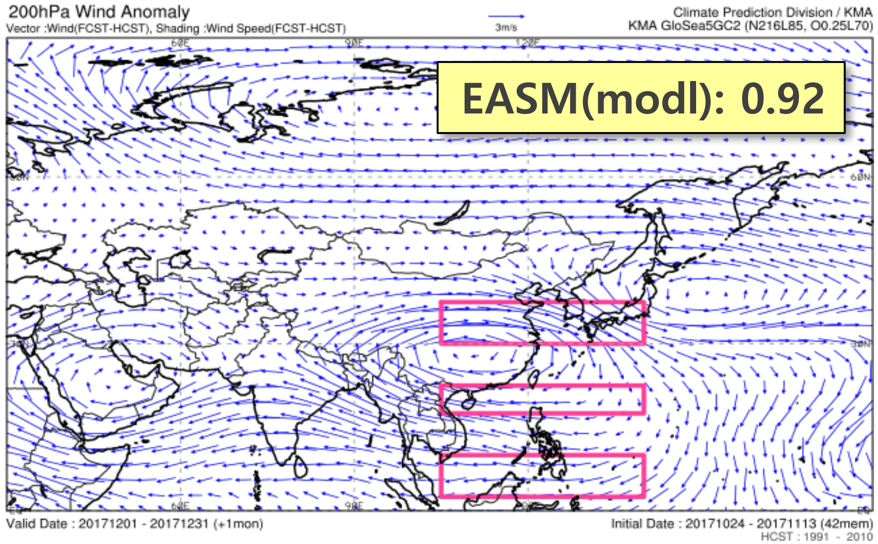
EASM [Dec. 2017]

20171113/+1mon

Forecast

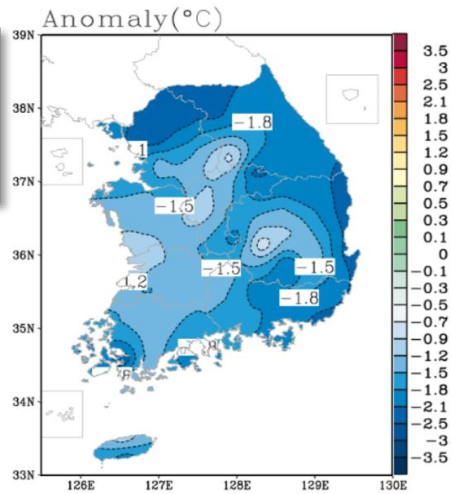
A: 22%
N: 37%
B: 41%

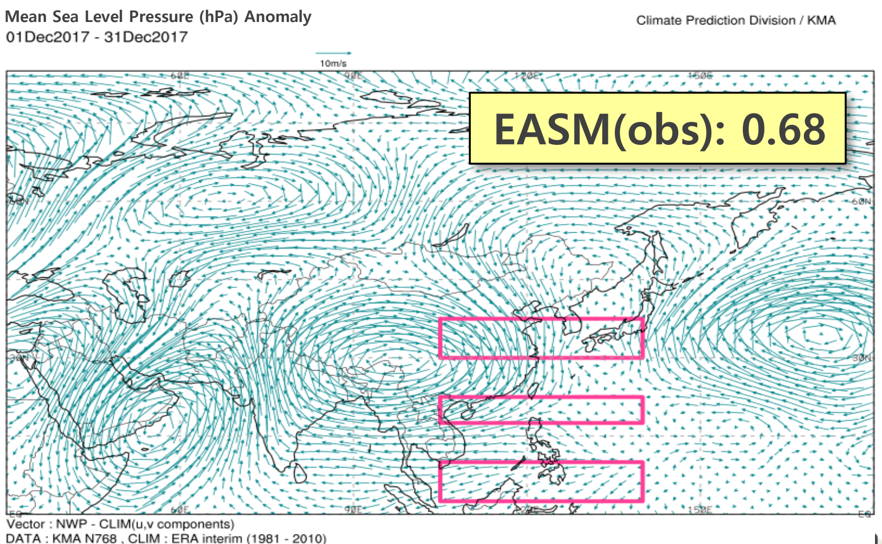




Observation

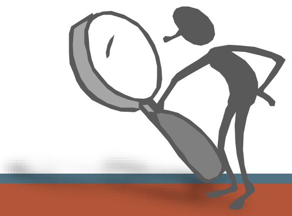
Mean: -0.2 ℃
Anom: -1.7 ℃
Below Normal





기상청

ENSO index

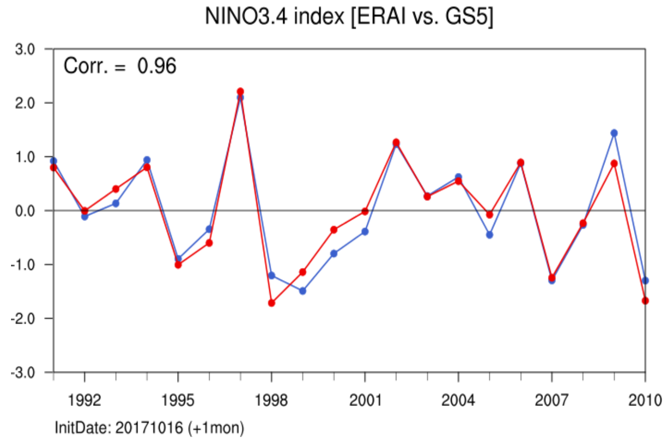


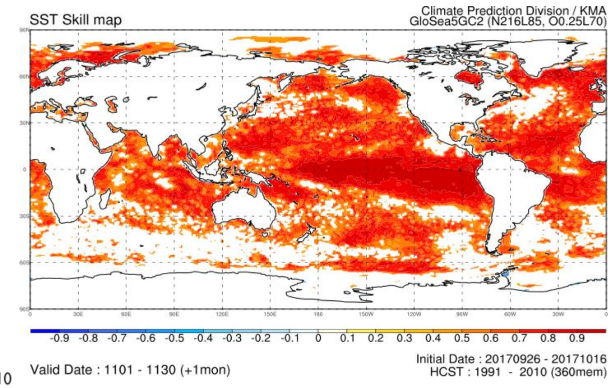
ENSO index(NINO3.4) [Nov. 1991~2010]

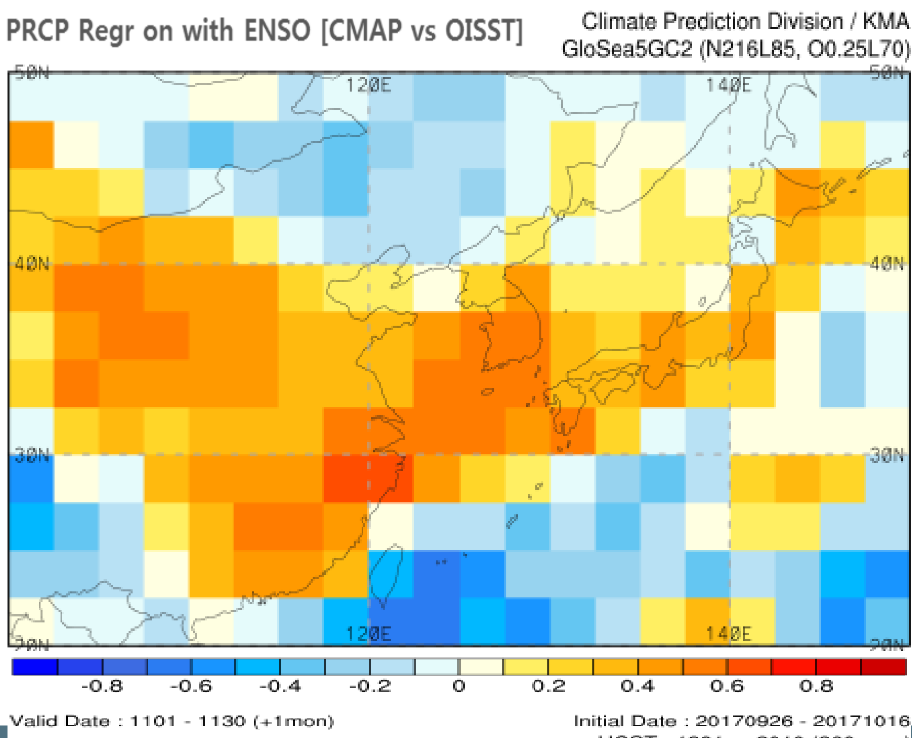
20171016/+1mon

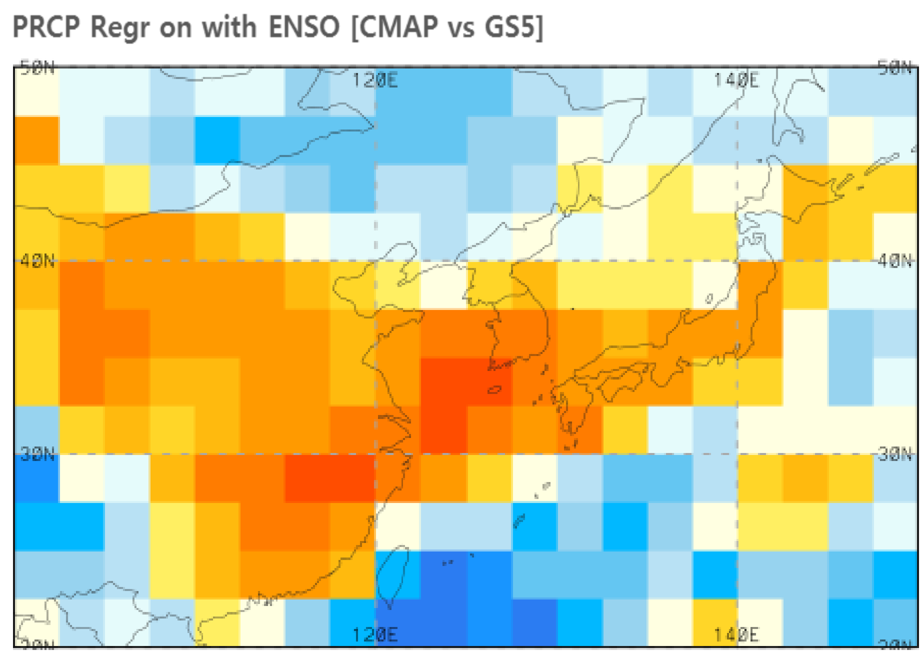
Prcp/Nov/-0.99

① Predictability	0.96
② Sensitivity	0.57
③ Application	0.59







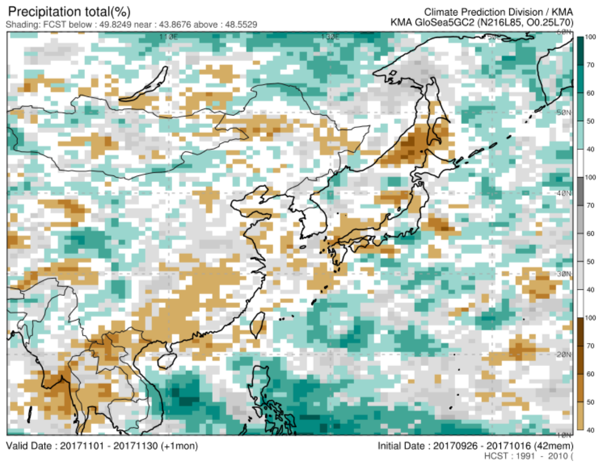


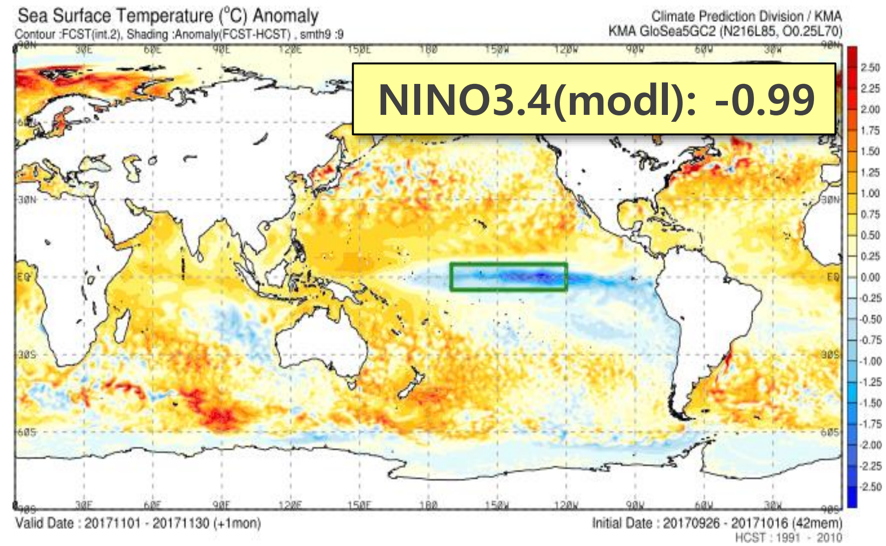
기상청

ENSO index(NINO3.4) [Nov. 2017] 20171016/+1mon

Forecast

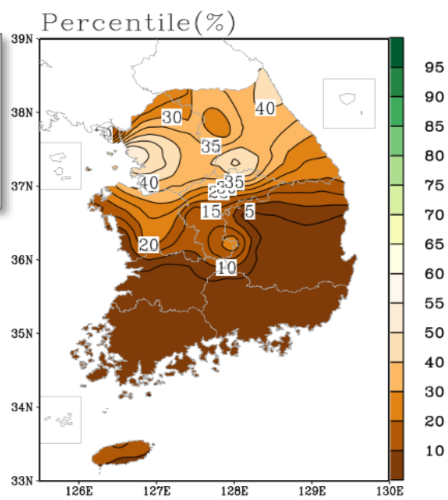
A: 31%
N: 33%
B: 36%



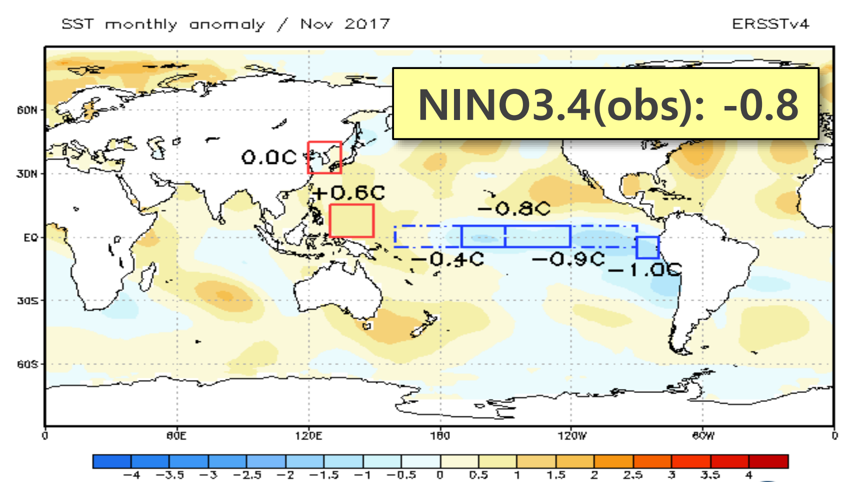


Observation

Total: 12.7 mm
Percentile: 4.3
Below Normal



Mean Sea Level Pressure (hPa) Anomaly



ENSO index(NINO3.4) [Nov. 1991~2010]

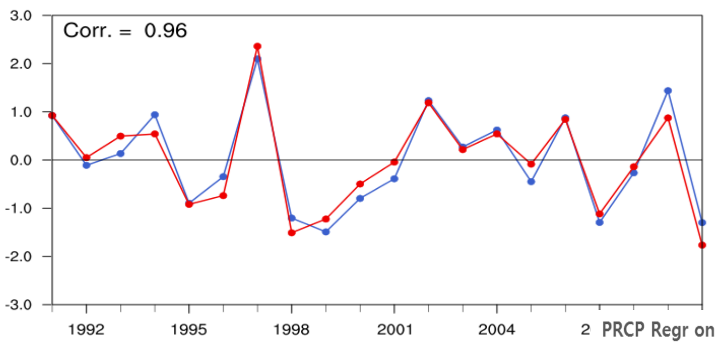
+2mon

① Predictability	0.96
② Sensitivity	0.57
③ Application	0.60

+3mon

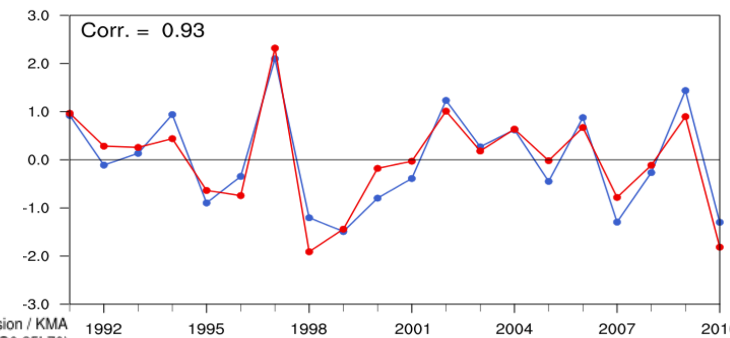
① Predictability	0.93
② Sensitivity	0.57
③ Application	0.57

NINO3.4 index [ERAI vs. GS5]



InitDate: 20170918 (+2mon)

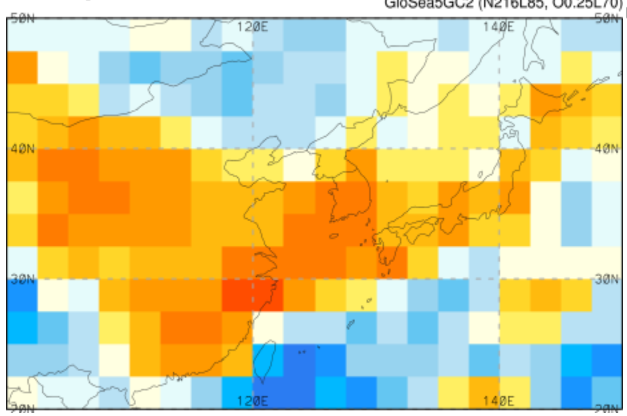
NINO3.4 index [ERAI vs. GS5]



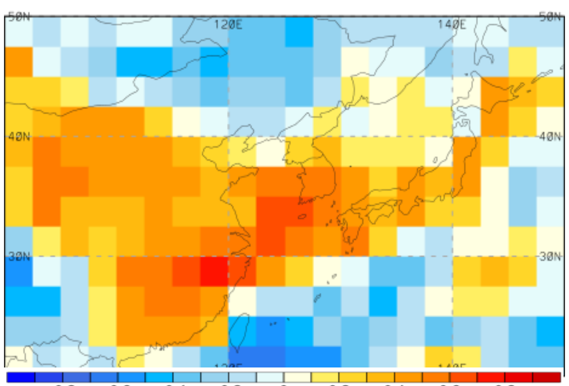
InitDate: 20170814 (+3mon)

PRCP Regr on with ENSO [CMAP vs OISST]

Climate Prediction Division / KMA
GloSea5GC2 (N216L85, O0.25L70)



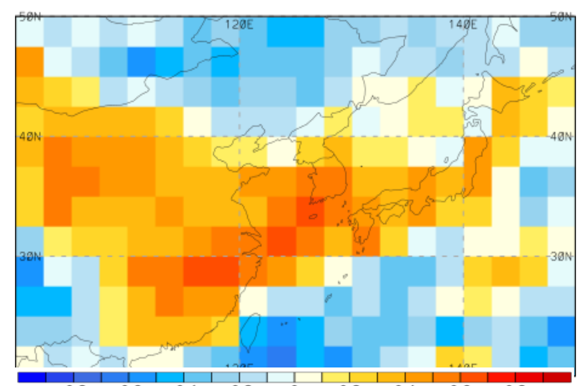
PRCP Regr on with ENSO [CMAP vs GS5]



Valid Date : 1101 - 1130 (+2mon)

Initial Date : 20170829 - 20170918
HCST : 1991 - 2010 (420mem)

PRCP Regr on with ENSO [CMAP vs GS5]



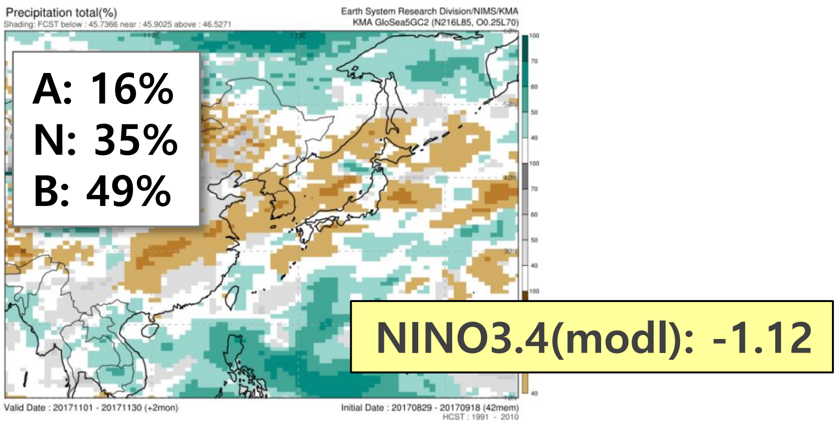
Valid Date : 1101 - 1130 (+3mon)

Initial Date : 20170725 - 20170814
HCST : 1991 - 2010 (420mem)

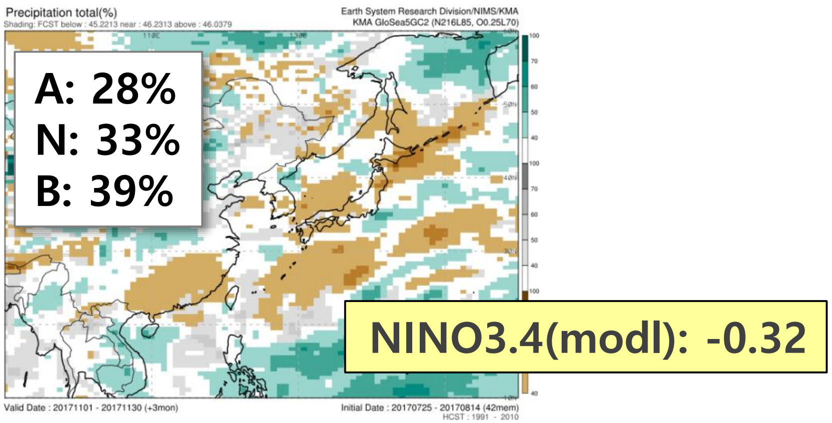
기상청

ENSO index(NINO3.4) [Nov. 2017]

Forecast +2mon

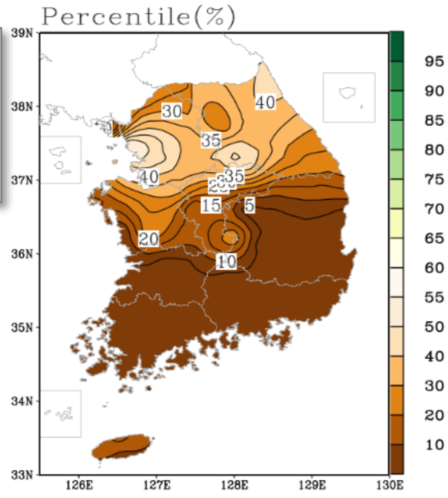


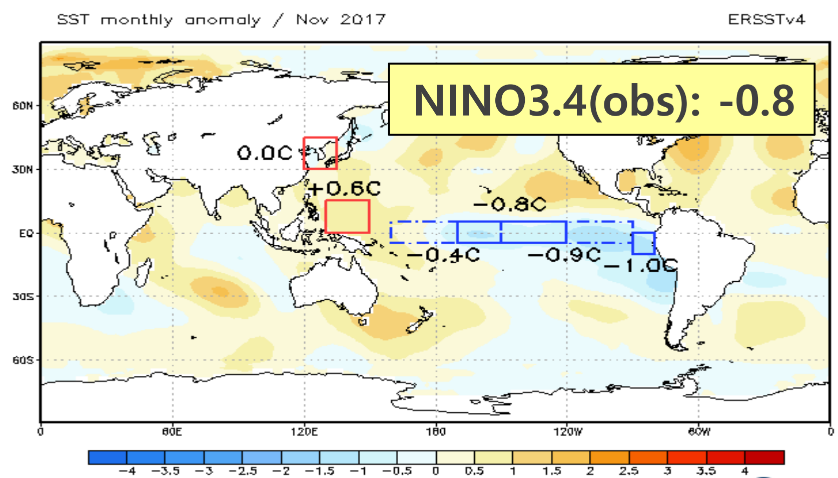
Forecast +3mon



Observation

Total: 12.7 mm
Percentile: 4.3
Below Normal



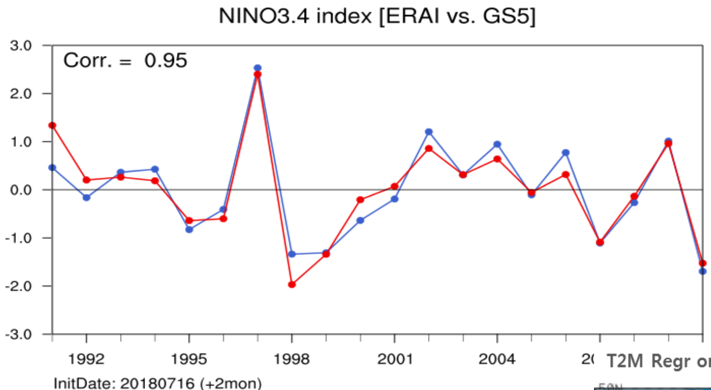


기상청

ENSO index(NINO3.4) [Sep. 1991~2010]

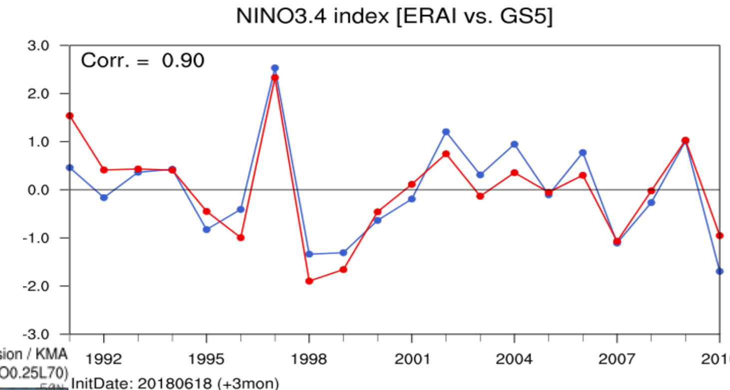
+2mon

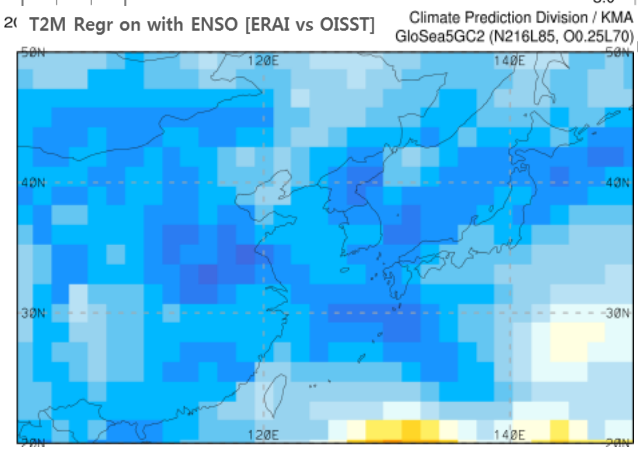
① Predictability	0.95
② Sensitivity	-0.52
③ Application	-0.54

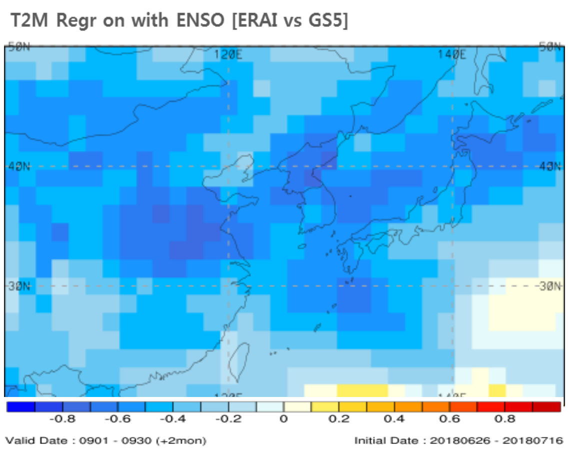


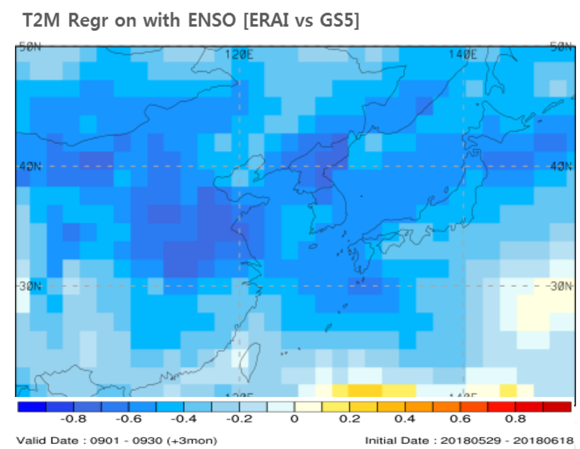
+3mon

① Predictability	0.90
② Sensitivity	-0.52
③ Application	-0.54







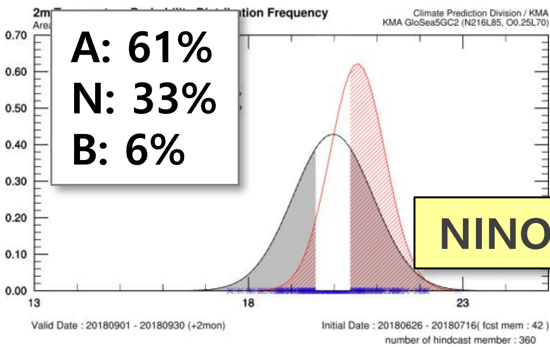


기상청

ENSO index(NINO3.4) [Sep. 2018]

Forecast +2mon

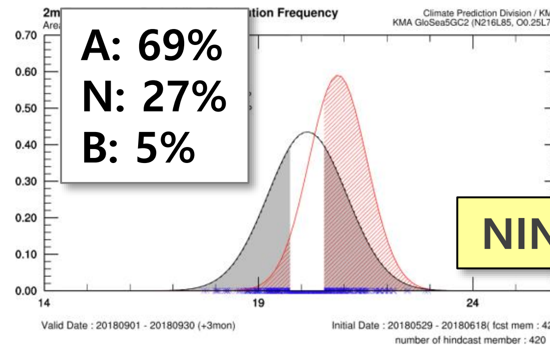
A: 61%
N: 33%
B: 6%



NINO3.4(modl): 1.02

Forecast +3mon

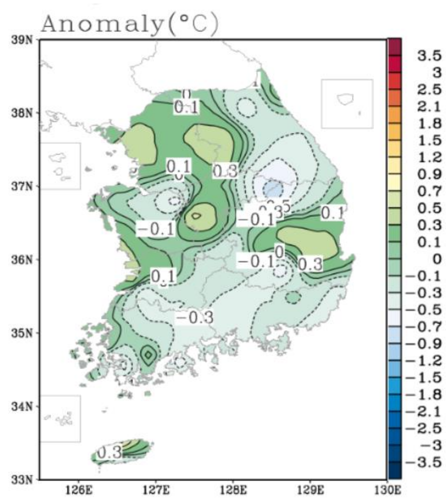
A: 69%
N: 27%
B: 5%

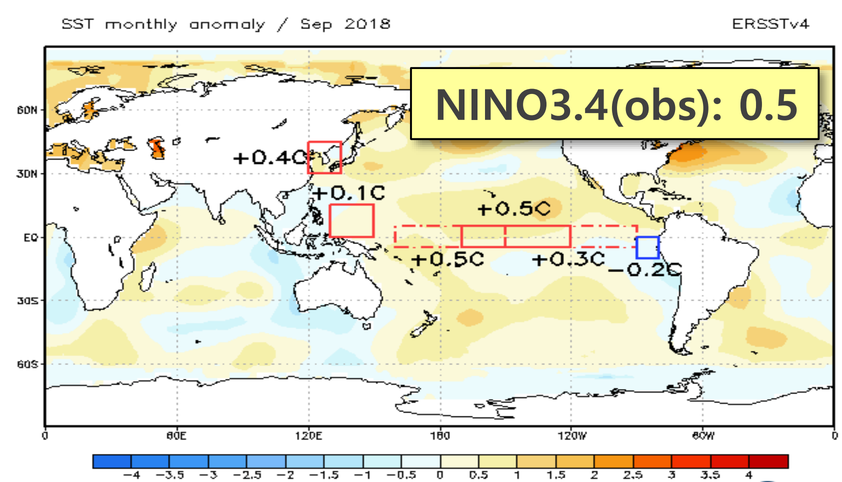


NINO3.4(modl): 0.9

Observation

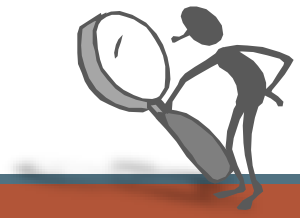
Mean: 20.4 ℃
Anom: -0.1 ℃
Near Normal





NINO3.4(obs): 0.5

Summary



The Climate indices were calculated from GloSea5 data and investigated the influences on temperature and precipitation over Korea.

temp.	Jan	Feb	Mar	**Apr**	May	**Jun**	**Jul**	**Aug**	**Sep**	Oct	Nov	**Dec**
EASM							-		-			-
WNPSH												
WNPSM						+						
NINO3.4									-			

prcp.	Jan	Feb	Mar	**Apr**	May	Jun	Jul	**Aug**	**Sep**	Oct	**Nov**	**Dec**
EASM									-			
WNPSH								+			+	
WNPSM												-
NINO3.4									-		+	

THANK YOU

Korea Meteorological Administration