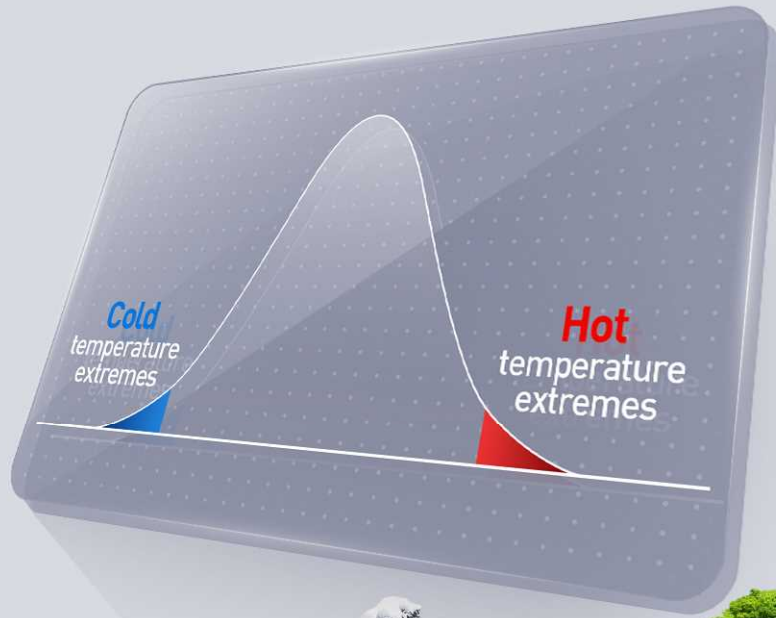


The 7th session of the East Asia Winter Climate outlook Forum. 5-7 November, 2019, Ulaanbaatar, Mongolia



KMA

Extreme Climate Service

- Analysis and Forecast



Korea Meteorological Administration |

Youjin WON, Bo Young YIM, Sangsoon PARK,

Seonyeong Bak, and Cheol Hong Park

Climate Extremes Analysis and Assessment Team

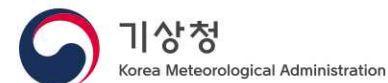


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Part2. Analysis and Forecast

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Part1. Introduction of Extreme Climate Service

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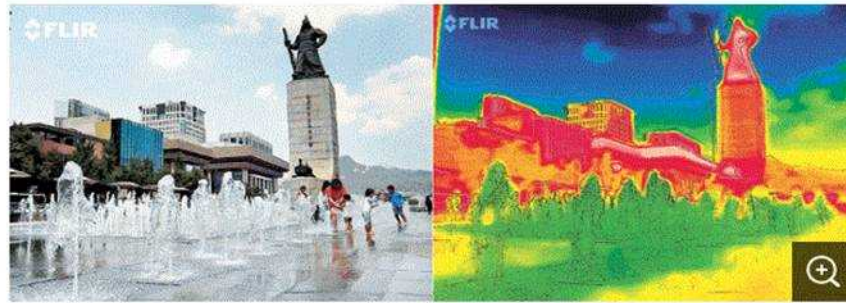
Issue: South Korean heatwave in 2018



Mercury hits record high of 39.6 in Seoul

Aug 04, 2018

Korea JoongAng Daily
Thursday, August 2, 2018



A photo of Gwanghwamun in central Seoul taken by a thermal image camera, right, shows that the temperature in the area is very high. The temperature in Seoul peaked at 39.6 degrees Celsius (103.3 degrees Fahrenheit) at 3:36 p.m. Wednesday. The photo on the left was taken with a normal camera.

Article from Korea Jongang Daily

[<http://koreajoongangdaily.joins.com/news/article/article.aspx?aid=3051452>]

Record-breaking temperatures leave 29 dead in South Korean heatwave
By Jungeun Kim, Jennifer Kim and Euan McKirdy, CNN
Updated 0449 GMT (1249 HKT) August 3, 2018

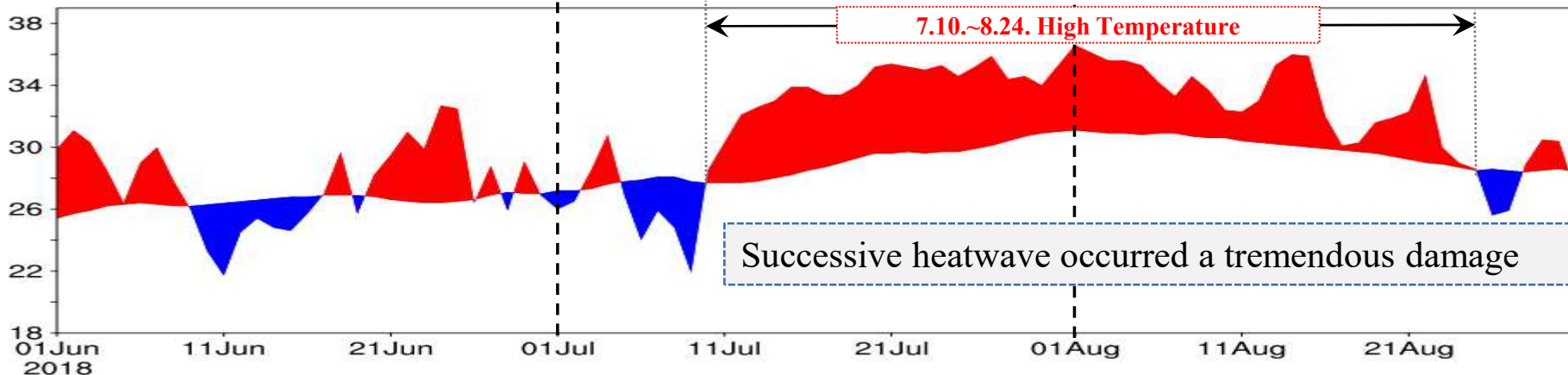
What NOT to do in a heat wave 01:14

Seoul, South Korea (CNN) — As many as 29 people have died due to heatstrokes in South Korea, according to the South Korean Ministry of Health, Welfare and Disease Control.

Article from CNN

[<https://edition.cnn.com/2018/08/02/asia/south-korea-heatwave-deaths-intl/index.html>]

Maximum Temperature(Tmax) in Summer Season of 2018 : **30.5°C (Ranked TOP 2)**



Introduction of Extreme Climate Service



❖ Background and Objective

More Frequent and Severe
Extreme Weather Events
in Recent Decades

1

Large-scale
Damage and Impact

2

Increasing Demands
on Extreme
Climate Service

3

- ✓ Scientific Understanding of Climate Extremes
- ✓ Detection and Prediction Technology of Climate Extremes

**Proactive Detection (Monitoring) and Prediction (Warning)
for Extreme Climate Service
based on Probabilistic Long-Range Forecast**



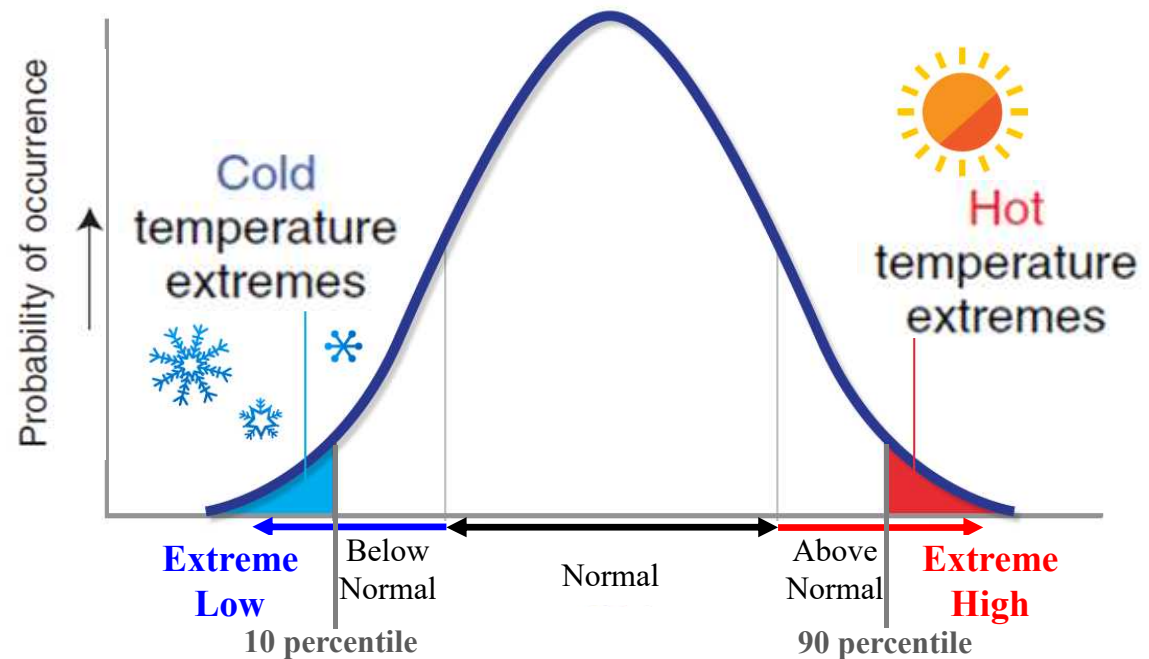
Definition of Climate Extremes

Climate elements such as temperature is unusually (abnormally) higher or lower than Climatological Standard Normal. (for 30 years : 1981 ~ 2010)

Above 90 percentile

or

Below 10 percentile

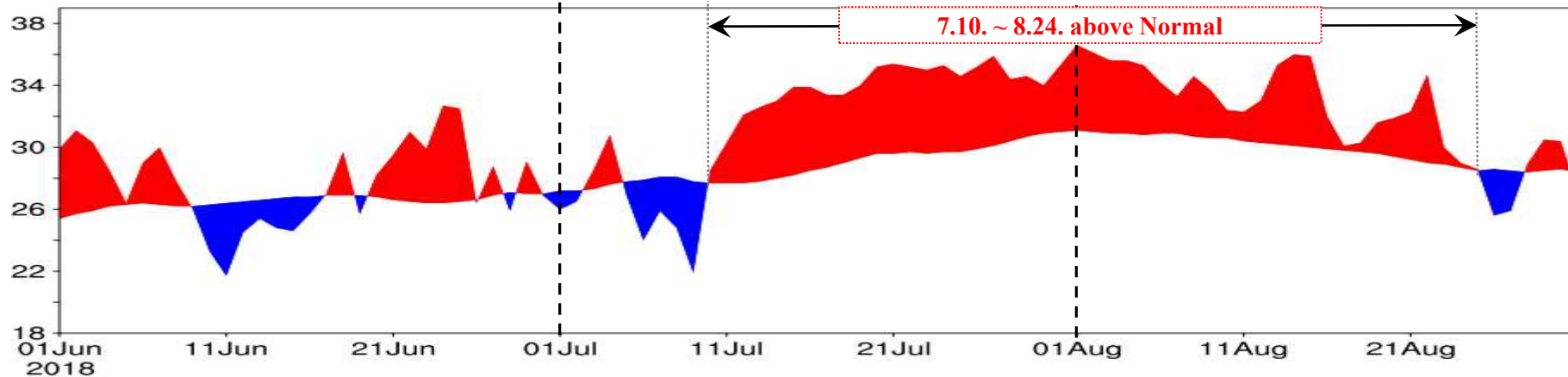


Introduction of Extreme Climate Service

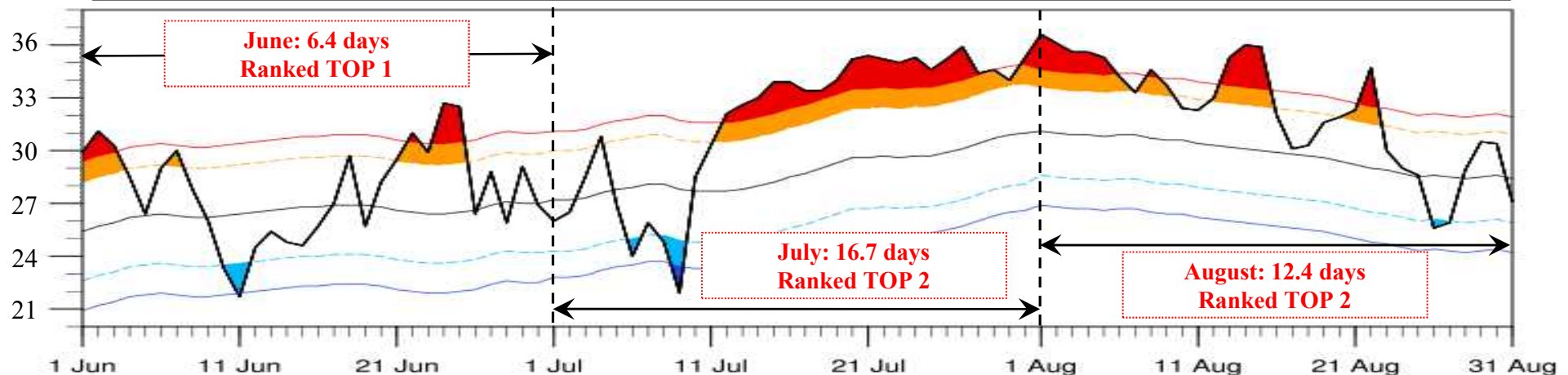


❖ For Example : 2018 Summer Extreme High Temp.

Maximum Temperature(Tmax) in Summer Season of 2018 : **30.5°C (Ranked TOP 2)**



Occurrence Days of Extreme Climate Events (Above 90/80 and Below 10/20 Percentile) of Tmax in Summer Season of 2018



Introduction of Extreme Climate Service



❖ Outline of Service

○ **Start Date of Service: November 23rd in 2018**

○ **Service Method: On-line system**

※ User-specific application : Energy('17) → Agriculture('18) → **Health('19)**

○ **Target: Energy, Agriculture, and Health Organization related to Government**

※ **(Energy)** Ministry of Trade Industry and Energy, Korea Electric Power Corporation, Korea Gas Corporation,
Korea Power Exchange

(Agriculture) Ministry of Agriculture Food and Rural Affairs, Rural Development Administration,
Korea Agro-Fisheries and Food Trade Corporation

(Health) Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention,
Seoul Metropolitan Government

Introduction of Extreme Climate Service



❖ Outline of Service

		Weekly Service	Monthly Service
Issue Date		Once a week (every Thursday)	Once a month (every 23 rd)
Valid Period		The week after next week	Next month
Contents	Monitoring	Status and analysis of extreme climate events over last week	Status and analysis of extreme climate events over this month (1 st ~20 th)
	Forecast	Probability of extreme high and low temperature of weekly average minimum and maximum temperature (Detailed information) Probability of occurrence days of extreme climate events in <u>summer and winter season</u>	Tertile probability (below/normal/above) of occurrence days of extreme high and low temperature

Introduction of Extreme Climate Service



❖ Outline of Service

		Weekly Service	Monthly Service
Issue Date		Once a week (every Thursday)	Once a month (every 23 rd)
Valid Period		The week after next week	Next month
Contents	Monitoring	Status and analysis of extreme climate events over last week	Status and analysis of extreme climate events over this month (1 st ~20 th)
	Forecast	Probability of extreme high and low temperature of weekly average <div style="border: 2px solid red; padding: 5px; background-color: #f2f2f2; margin-top: 5px;"> <p style="color: red; text-align: center;">- Focus on strength of extreme climate events</p> </div>	<div style="border: 2px solid red; padding: 5px; background-color: #f2f2f2; margin-top: 5px;"> <p style="color: red; text-align: center;">- Focus on frequency of extreme climate events</p> </div>
		extreme climate events in <u>summer</u> and <u>winter season</u>	


Introduction of Extreme Climate Service



❖ Infosheet

- Weekly Service

Ex. Energy



기상청
주간정보
[에너지분야]
다음 발표: 8월 29일

이상기후 감시·전망정보

Prediction

● 이상저온 및 이상고온 전망

Tmin Extreme Low Temperature Occurrence Probability is 5% Extreme High Temperature Occurrence Probability is 20% Extreme High and Low : Improbable		Tmax Extreme Low Temperature Occurrence Probability is 5% Extreme High Temperature Occurrence Probability is 30% Extreme High : Probable	

북태평양고기압의 가장자리에 들겠으며, 많은 비가 내릴 때가 있겠습니다.

[주 최저기온] 이상저온(164°C 미만)과 이상고온(210°C 초과)의 발생가능성이 없습니다.
 [주 최고기온] 이상저온(255°C 미만)과 이상고온(297°C 초과)의 발생가능성이 없습니다.

※ 이상기후는 기온, 강수량 등의 기후요소가 평년(1981~2010년)에 비해 현저히 높거나 낮은 수치를 나타내는 극한 현상으로 이상저온은 최저·최고기온 10퍼센타일 미만, 이상고온은 최저·최고기온 90퍼센타일 초과 범위로 정의하였습니다.

※ 퍼센타일은 평년 동일 기간의 기온을 비교하여 낮은 순서대로 몇 번째인지 나타내는 백분위로 이상기후를 정의하는데 사용하였습니다.

Detailed Information

● 이상고온 상세전망

평균기온 강도(기온 편차 기준값)	2일	3일 이상	
80퍼센타일 초과 (9월: 1.4 ~ 1.9°C)			30% 미만
90퍼센타일 초과 (9월: 2.2 ~ 3.1°C)			30% 이상 50% 미만
			50% 이상

※ 기온 강도별 발생일수 전망은 발생가능성(확률) 백분율로 산출하였고, 백분율을 30%와 50%로 구분하여 전망정보를 제공합니다. 괄호 안의 기온 정보는 각 퍼센타일의 기준이 되는 기온 편차값을 나타냅니다.

참고자료

● 전망기간(2019. 9. 2. ~ 9. 8.) 이상저온 및 이상고온 기준 분포도

실선: 기준온도(°C) 채색: 기온편차(°C)

이상저온 기준

이상고온 기준

● 지난주(2019. 8. 12. ~ 8. 18.) 이상기후 발생 현황

◆ 지난주 동안 최저기온과 최고기온의 변화가 크게 나타났습니다. 주 최저기온은 전국 23.5°C(평년 21.9°C)로 경상 일부 내륙과 해안 지역에서, 주 최고기온은 전국 31.4°C(평년 30.0°C)로 남해안 일부 지역(연수 나체)에서 이상고온이 나타났습니다. 특히, 북태평양고기압과 태풍(크로사)의 영향으로, 포항, 영덕에서 5일 나타났습니다.

Monitoring

이상저온 및 이상고온 발생 현황 분포도

최저기온

최고기온

Introduction of Extreme Climate Service



❖ Infosheet

- Monthly Service

Ex. Energy

이상기후 감시·전망정보

2019년 8월 23일 발표

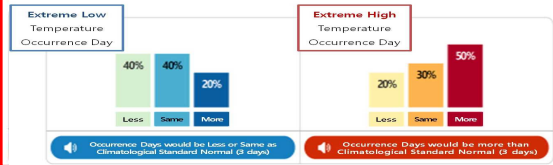


이상기후 전망

북태평양고기압의 가장자리에 들다가 점차 이동성 고기압의 영향을 주로 받게고,

Prediction

전망기간 : 2019년 9월



- ※ 이상기후는 기온, 강수량 등의 기후요소가 평년(1981~2010년)에 비해 현저히 높거나 낮은 수치를 나타내는 극한 현상으로 이상저온은 최저·최고기온 10퍼센타일 미만, 이상고온은 최저·최고기온 90퍼센타일 초과 범위로 정의하였습니다.
- ※ 퍼센타일은 평년 동일 기간의 기온을 비교하여 낮은 순서대로 몇 번째인지 나타내는 백분위수로 이상기후를 정의하는데 사용하였습니다.
- ※ 이상기후 전망정보는 이상저온과 이상고온 발생일수에 대한 발생가능성(확률) 전망을 나타내고, 발생일수를 평년값과 비교하여 3분위(적음, 비슷, 많음)로 구분하여 백분율로 산출합니다.
- ※ 이상저온과 이상고온 발생일수의 평년값은 3일 정도이고, 이 값은 전국의 1/2 지역에서 이상저온이나 이상고온이 6일 정도 발생한 경우와 같은 의미입니다.

확률예보 해석의 기준

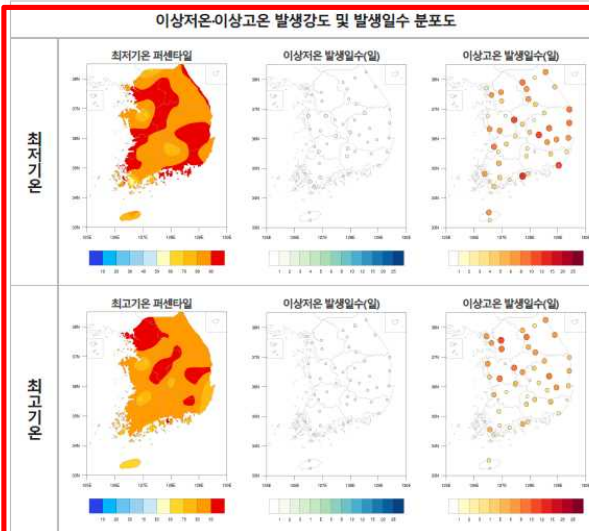
확률(적음:비슷:많음)	해설	확률(적음:비슷:많음)	해설
적음 확률이 50%이상 (20:40:40)	평년보다 적음	적음 확률이 50%이상	평년보다 적음
비슷 확률이 50%이상	평년과 비슷	비슷 확률이 50%이상	평년과 비슷
많음 확률이 50%이상	평년보다 많음	많음 확률이 50%이상	평년보다 많음

최근(2019. 8. 1. ~ 8. 20.) 이상기후 발생 현황

- ◆ 북태평양고기압의 영향을 주로 받아 최저기온과 최고기온이 평년보다 높은 날이 많았고, 온난 다습한 공기가 유입되면서 최저기온은 15일까지 고온이 지속되는 경향을 보였습니다.
- ◆ 이상고온이 최저기온은 전국적으로, 최고기온은 중부지방과 경북내륙에서 많이 발생하였으며, 서울(10일 순), 부산(10일 순) 최고기온이 30도 이상인 날이 있었습니다.

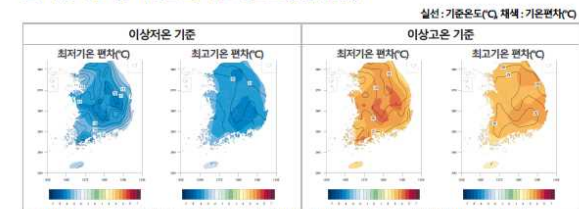
Monitoring

이상저온·이상고온 발생강도 및 발생일수 분포도



참고자료

■ 이상저온 및 이상고온 기준 분포도(9월 15일)



※ 이상저온·고온 발생일 여부는 일별 기준값에 따라 결정됨. 위의 분포도는 해당 월의 15일 기준임.

■ 최근 3년간(2016 ~ 2018) 9월 이상저온 및 이상고온 발생일수 분포도

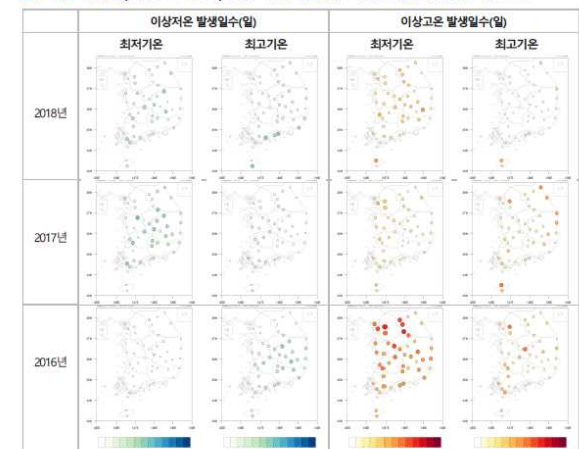
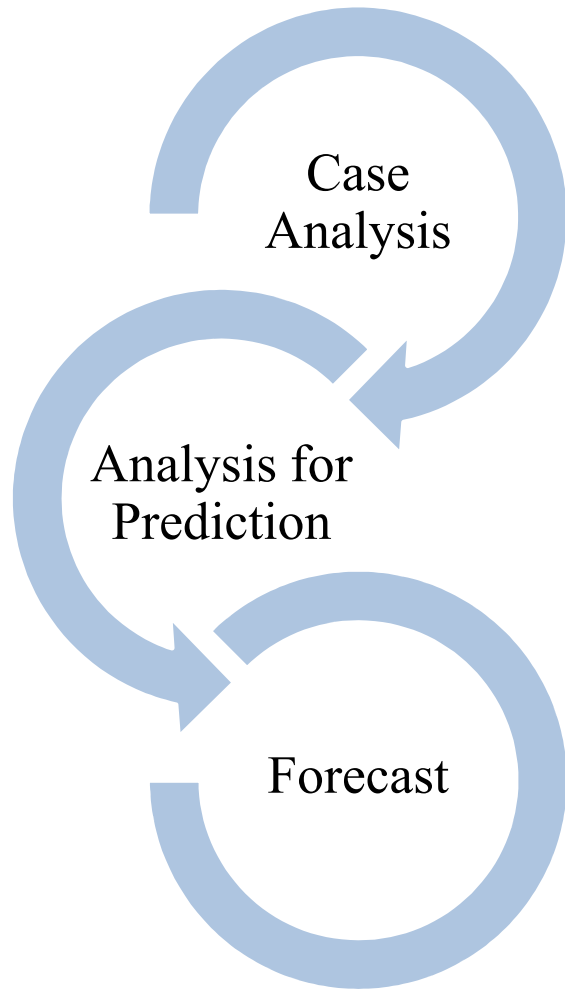


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Part1. Introduction of Extreme Climate Service

Part2. Analysis and Forecast

Analysis and Forecast



- ▶ Status of extreme climate events
- ▶ Characteristic of extreme climate events

- ▶ Observation
 - Monitoring of climate factors
 - Statistical model & Guidance

- ▶ Model

- ▶ Service of information

Analysis and Forecast



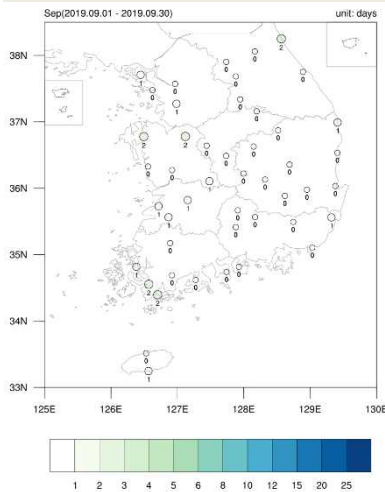
❖ Case Analysis

- Status of extreme climate days

Korean spatial distribution

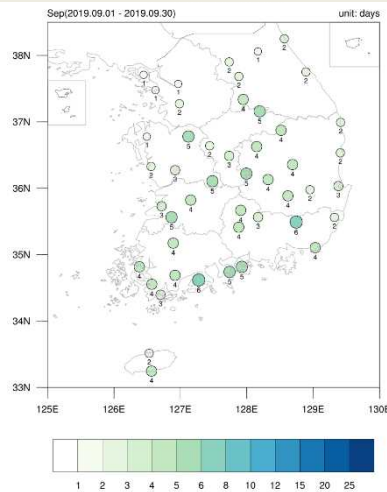
- Figure out how many days of extreme high and low temperature occurred and where it occurred regionally last month

Cold Nights (TN10p)



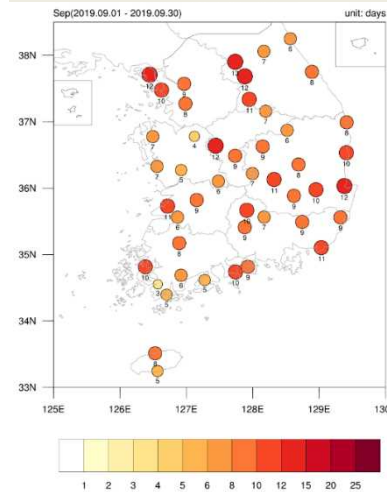
Data : KMA (47 Stations) CLIM : 1981-2010
Created on 2019-10-27
Climate Extremes Analysis and Assessment Team / KMA

Cold Days (TX10p)



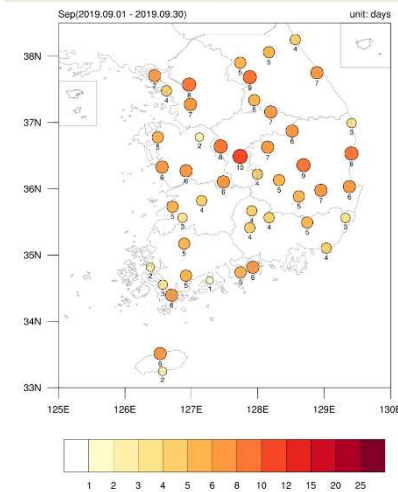
Data : KMA (47 Stations) CLIM : 1981-2010
Created on 2019-10-01
Climate Extremes Analysis and Assessment Team / KMA

Warm Nights (TN90p)



Data : KMA (47 Stations) CLIM : 1981-2010
Created on 2019-10-01
Climate Extremes Analysis and Assessment Team / KMA

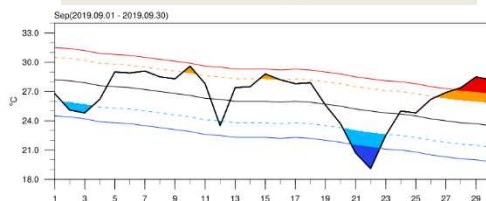
Warm Days (TX90p)



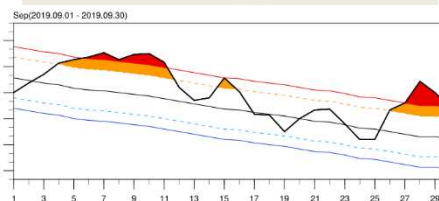
Data : KMA (47 Stations) CLIM : 1981-2010
Created on 2019-10-27
Climate Extremes Analysis and Assessment Team / KMA

Time series

Tmax



Tmin



- Figure out how hard and long extreme high and low days lasted
- Line and shading means 10 / 20 / 80 / 90 percentile of maximum and minimum temperature over Korea.

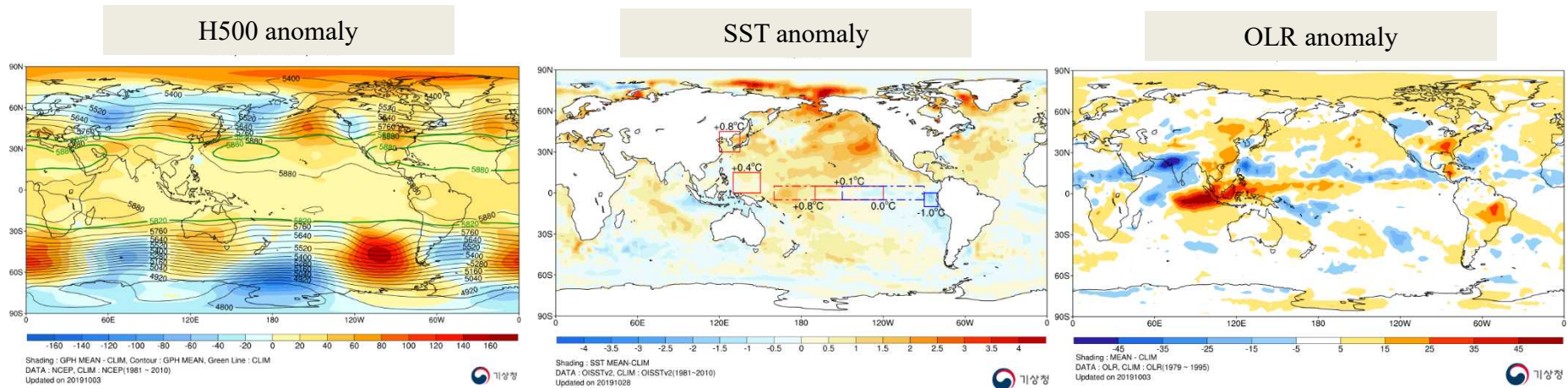
Analysis and Forecast



❖ Case Analysis

- Characteristic of extreme climate events

Global spatial distribution



- **Understanding of global atmospheric and oceanic structure** (Geopotential height, SST, OLR, etc.) for averaged a month and specific period when extreme climate events occurred.
- It is important to **understand the mechanism how global circulation impacted** over the Korea.
- This analysis will be reference for prediction of next year.

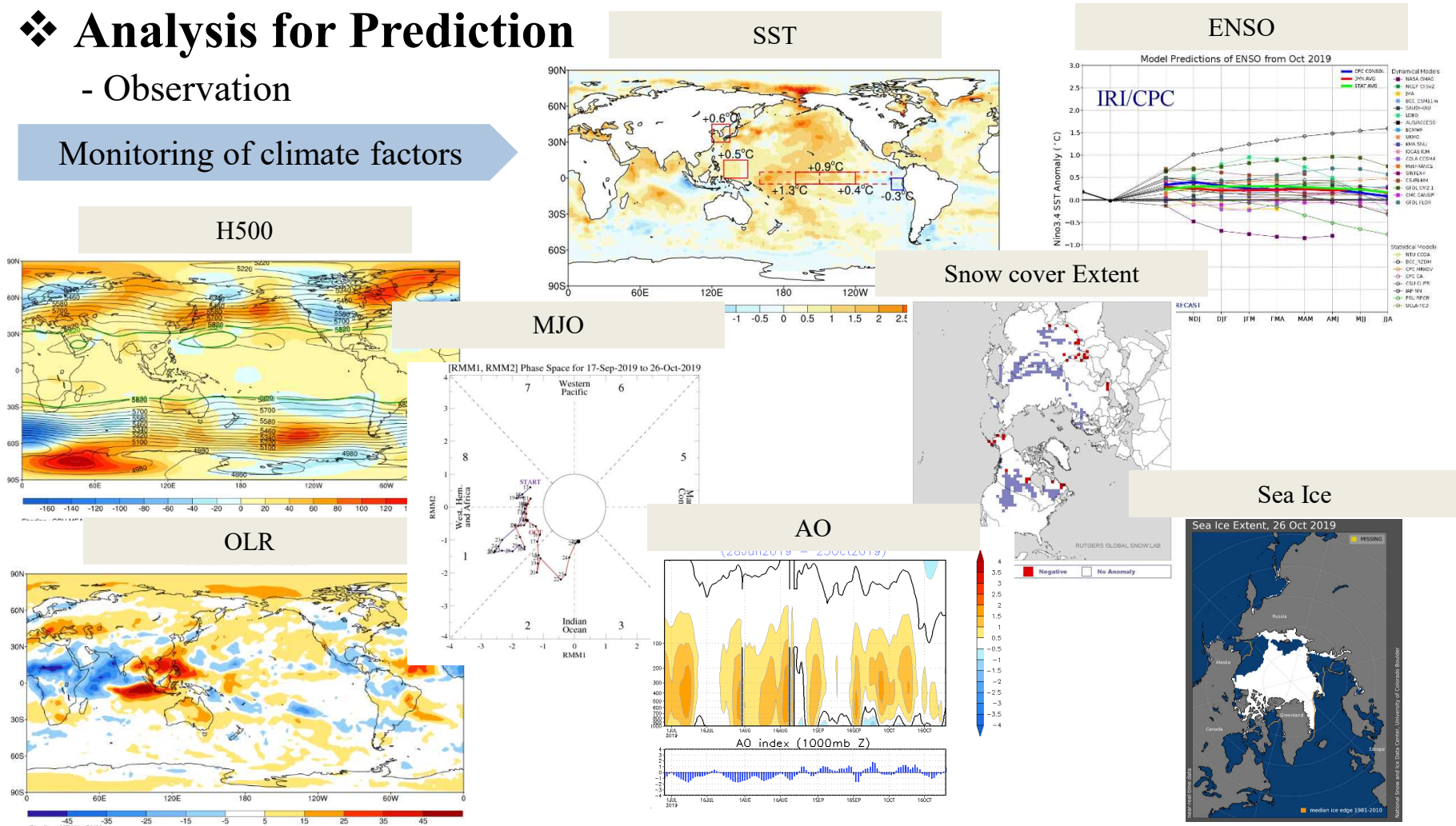
Analysis and Forecast



❖ Analysis for Prediction

- Observation

Monitoring of climate factors



- Monitoring various climate factors
- Considering the relationship, we understand basic condition of forecasting period.

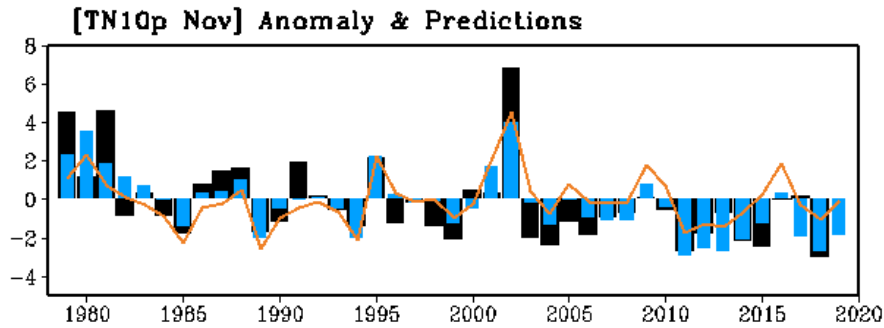
Analysis and Forecast



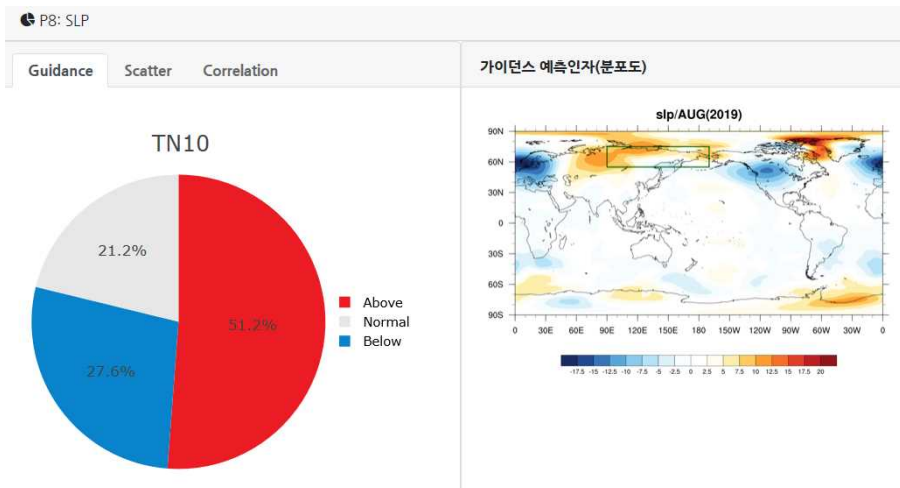
❖ Analysis for Prediction

- Observation

Statistical Model



Guidance* Developing...



- Statistical model and Guidance is developed to forecast the occurrence days of extreme high and low temperature.
- **Statistical model : a multi linear regression method** based on various **climate factors which have lagged teleconnection** with extreme climate days.
- **Guidance : a probabilistic forecast** based on various **climate factors which have lagged teleconnection.**
- Need to **understand mechanism** between extreme climate events and predictants

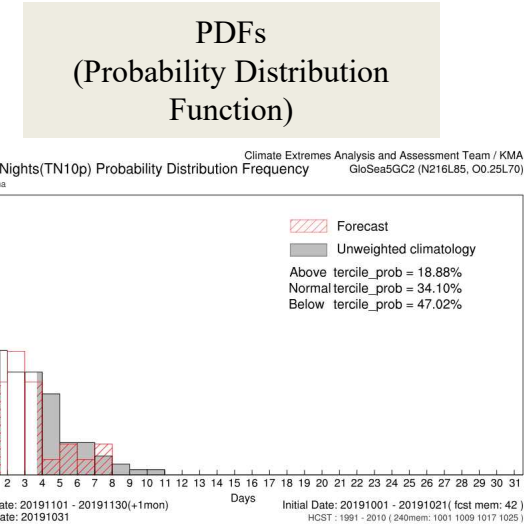
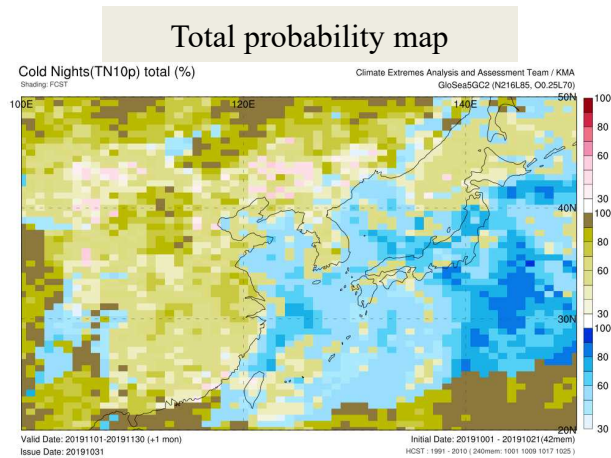
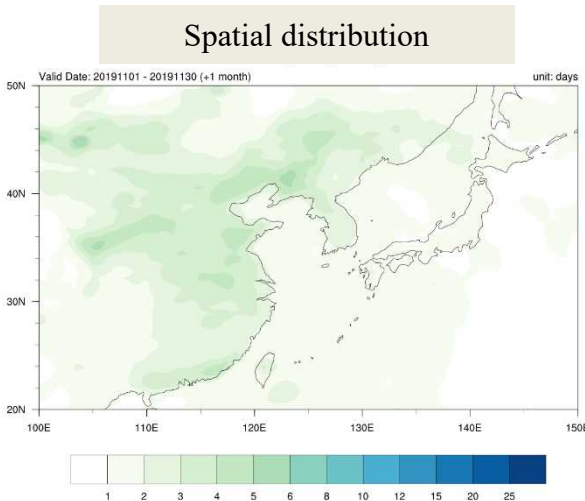
Analysis and Forecast



❖ Analysis for Prediction

- Model

GloSea5



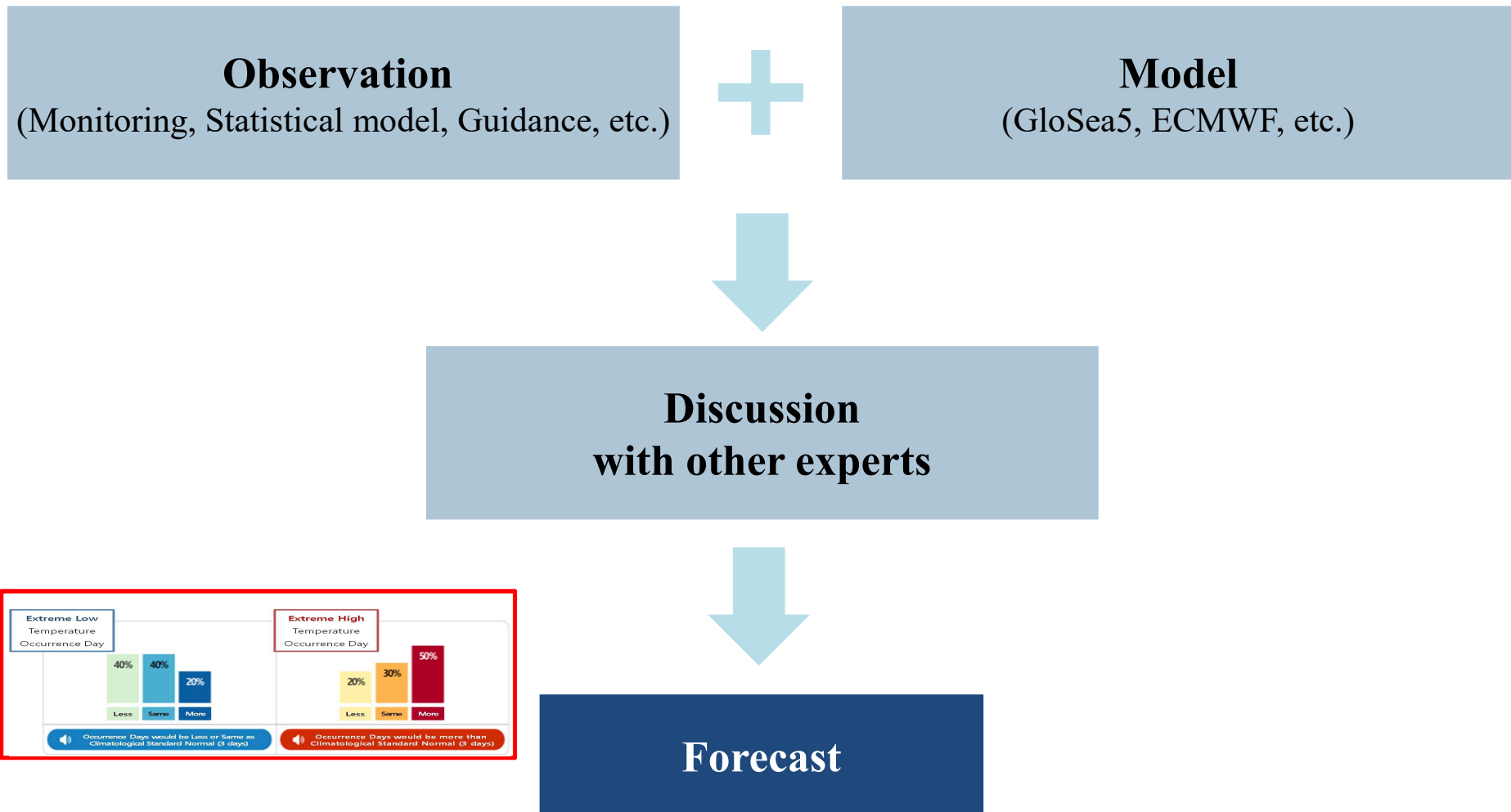
- Calculate GloSea5 (Global Seasonal Forecasting System version 5) data to get a information of extreme climate days
- **Spatial distribution** : the occurrence days of extreme high and low temperature over East Asia.
- **Total probability map** : tertile (below/normal/above) probability distribution of the occurrence days of extreme high and low temperature over East Asia.
- **PDFs** : tertile probability of the occurrence days of extreme high and low temperature over Korea.

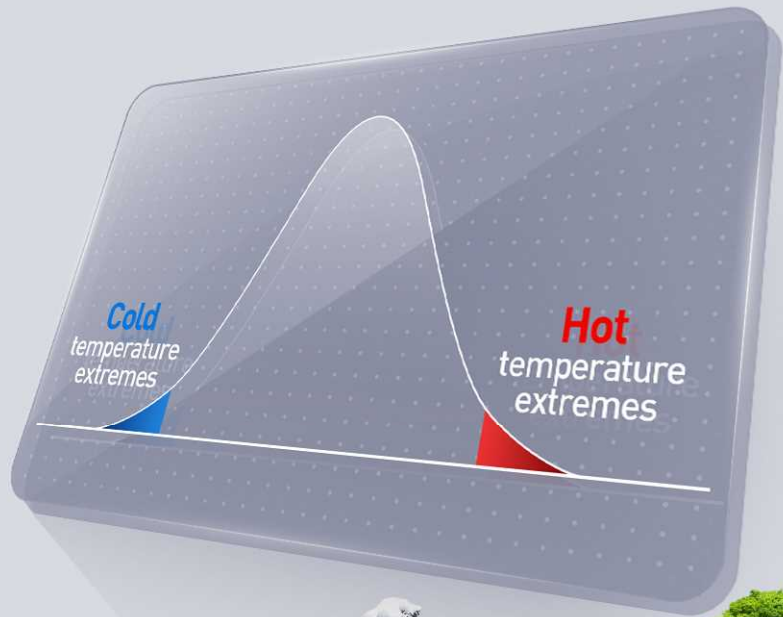
Analysis and Forecast



❖ Forecast

- Service a information





Thank you!

Any Questions?

☞ byyim@korea.kr
wonyj@korea.kr

