Introduction to

WMO LC-LRFMME
(WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble)

&

Climate Forecasting Service

HA Wonsil

Korea Meteorological Administration

11th East Asia Winter Climate Outlook Forum, Nov. 7, 2023

Contents

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Administration

1. WMO LC-LRFMME

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History

WMO CBS-XIV
(April, Croatia)

LC-LRFMME was
officially endorsed

LC-LRFMME started
to provide Probabilistic MME
predictions in terms
of tercile-based categorical
probabilities (April)

2009 — Apr — **2011** — Apr
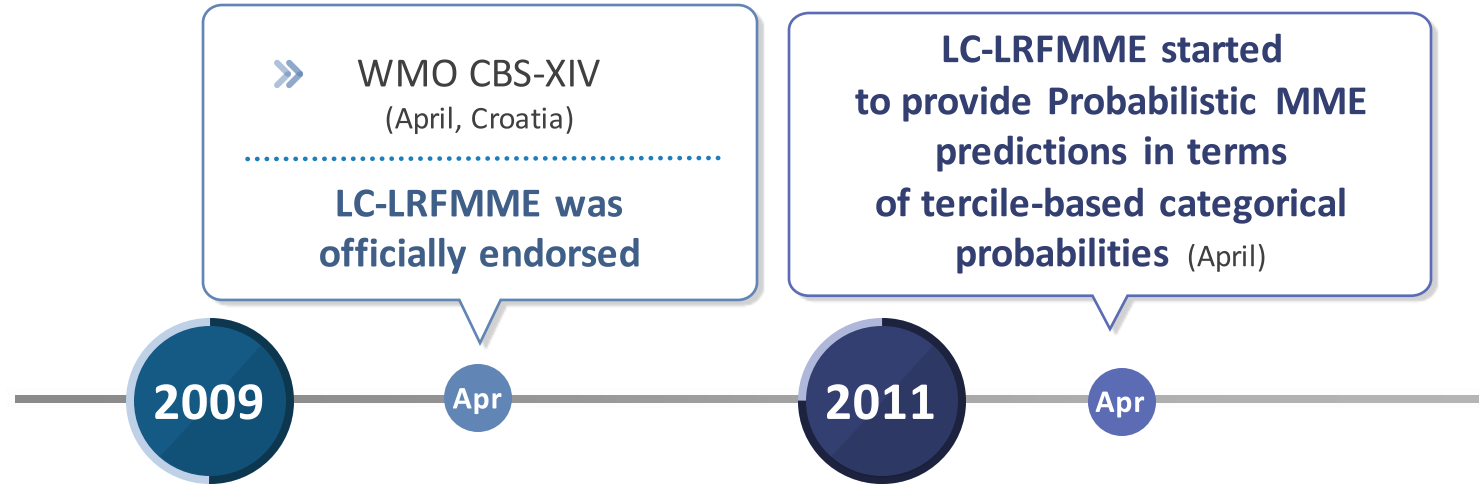
Objectives

✓ From the end-user perspective, the sub-seasonal to seasonal time range is a very important one, as many management decisions in agriculture and food security, water, disaster risk reduction and health fall into this range.

✓ Improved LRFs can help reduce socioeconomic losses associated with seasonal variability and protect life and property.

✓ The LC-LRFMME aims to support collecting and sharing GPCs forecast information to increase the reliability of Long-range Forecasts.

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Functions
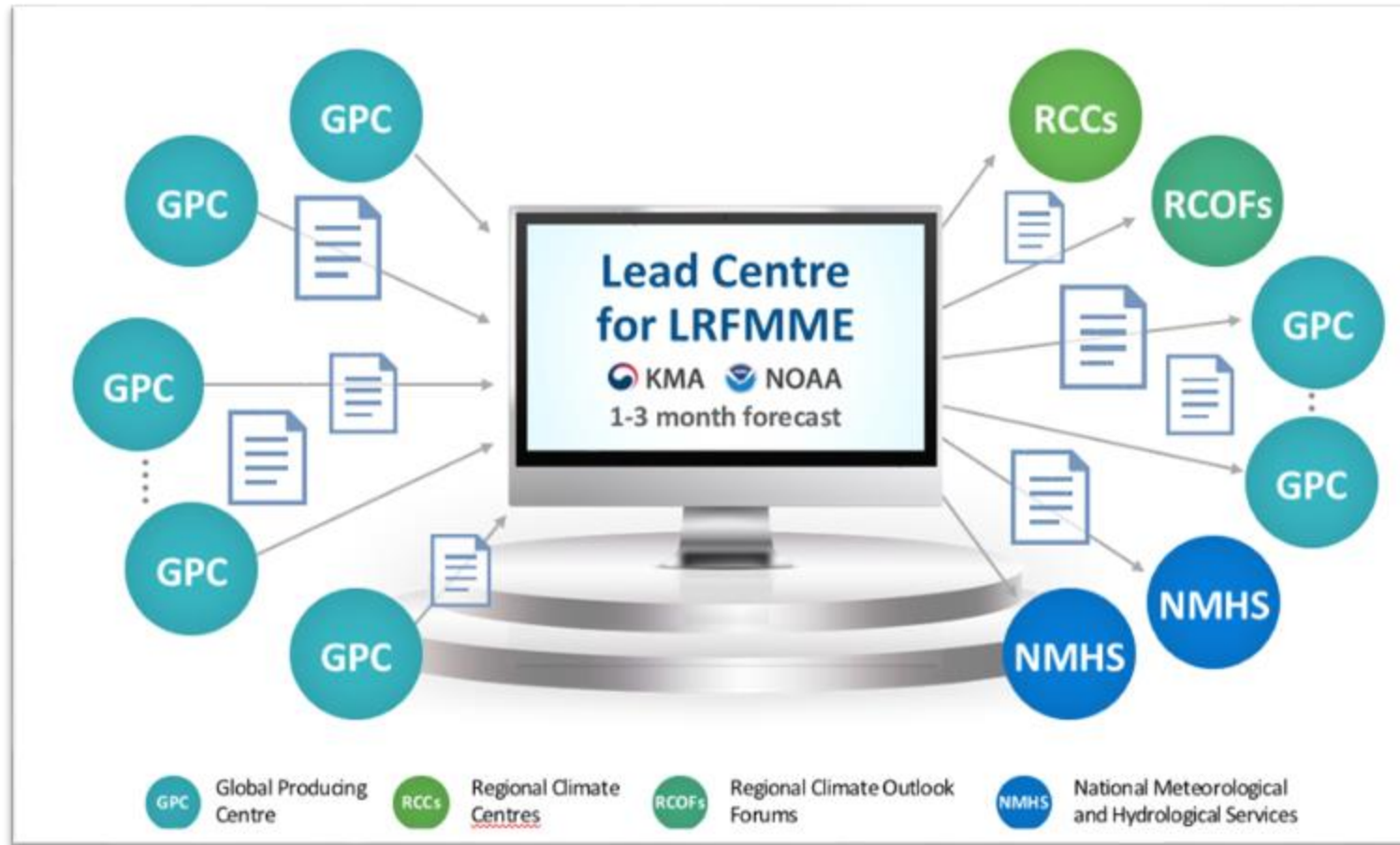
LC-LRFMME provides a conduit between GPC and NMHS, RCC, RCOF, etc.

1-1. WMO LC-LRFMME

15 WMO Global Producing Centers for LRF

- **Beijing:** China Meteorological Administration (CMA) / Bejing Climate Center (BCC)
- **CMCC:** Centro Euro-Mediterraneo sui Cambiamenti Climatici, Italy
- **CPTEC:** Center for Weather Forecasting and Climate Research / National Institute for Space Research (INPE), Brazil
- **ECMWF:** European Centre for Medium-Range Weather Forecasts
- **Exeter:** Met Office, United Kingdom
- **Melbourne:** Bureau of Meteorology (BOM), Australia
- **Montreal:** Meteorological Service of Canada (MSC)
- **Moscow:** Hydrometeorological Centre of Russia
- **Offenbach:** Deutsher Wetterdienst Wetter und Klima aus einer Hand
- **Pretoria:** South African Weather Services (SAWS)
- **Seoul:** Korea Meteorological Administration (KMA)
- **Tokyo:** Japan Meteorological Agency (JMA) / Tokyo Climate Center (TCC)
- **Toulouse:** Météo-France, France
- **Washington:** Climate Prediction Center (CPC) / National Oceanic and Atmospheric Administration (NOAA), United States of America
- **Pune:** India Meteorological Department / Regional Climate Center

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1-1. WMO LC-LRFMME

KMA activities

- ✓ **Every year, KMA use the operating cost about $ 100,000**
  - · To renew the website, upgrade the graphic quality, maintenance, reinforcement of operation system, etc..

- ✓ **Lack of manpower for operation in KMA,**
  - · Supported by APCC for LC-LRFMME Website operation

- ✓ **Website is improving every year** including the requirement from GPCs and Users

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1-2. Website Service

■ **Website**

forecasting data, etc

Latest Forecast data

LC-ADCP link

Link to 15 GPCs

1-2. Website Service

■ Service

GSCU

GLOBAL SEASONAL CLIMATE UPDATE

TARGET SEASON: November-December-January 2023-24

Prepared: 20 October 2023
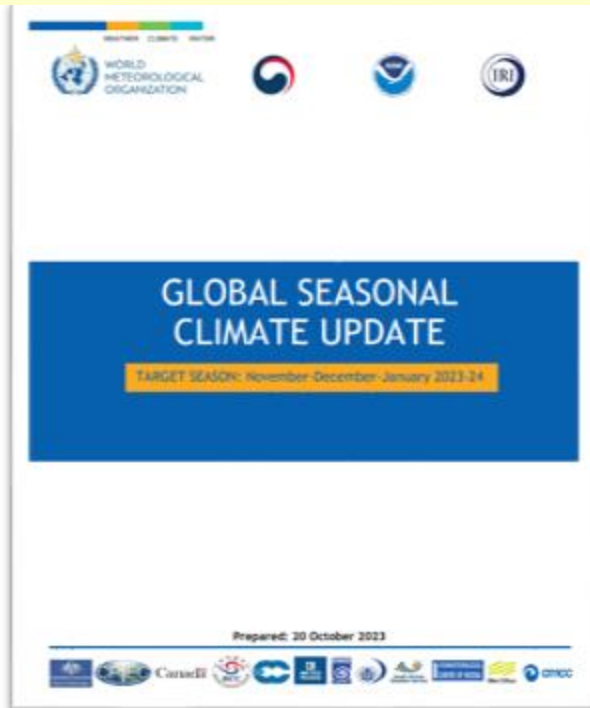
Digital products

Both forecast and hindcast of monthly mean anomalies of the GPCs' ensemble mean for lead time of 1~3 month, following the month of submission.

- 2m surface temperature
- Precipitation
- Mean sea level pressure
- 850hPa temperature
- 500hPa geopotential height
- Sea surface temperature
- 850hPa zonal wind
- 850hpa meriodional wind

Graphical products

Individual forecast
- Plots for each GPCs' forecast anomalies in common graphical format / Consistency map

Indices
- SST indices (Nino1+2, 3,4, 3.4, DMI, etc.)

Deterministic MME
- Simple composite mean(SCM)
- Regular Multiple Regression
- Sigular Value Decomposition(SVD)
- Genetic Algorithm(AG)

Probabilistic MME
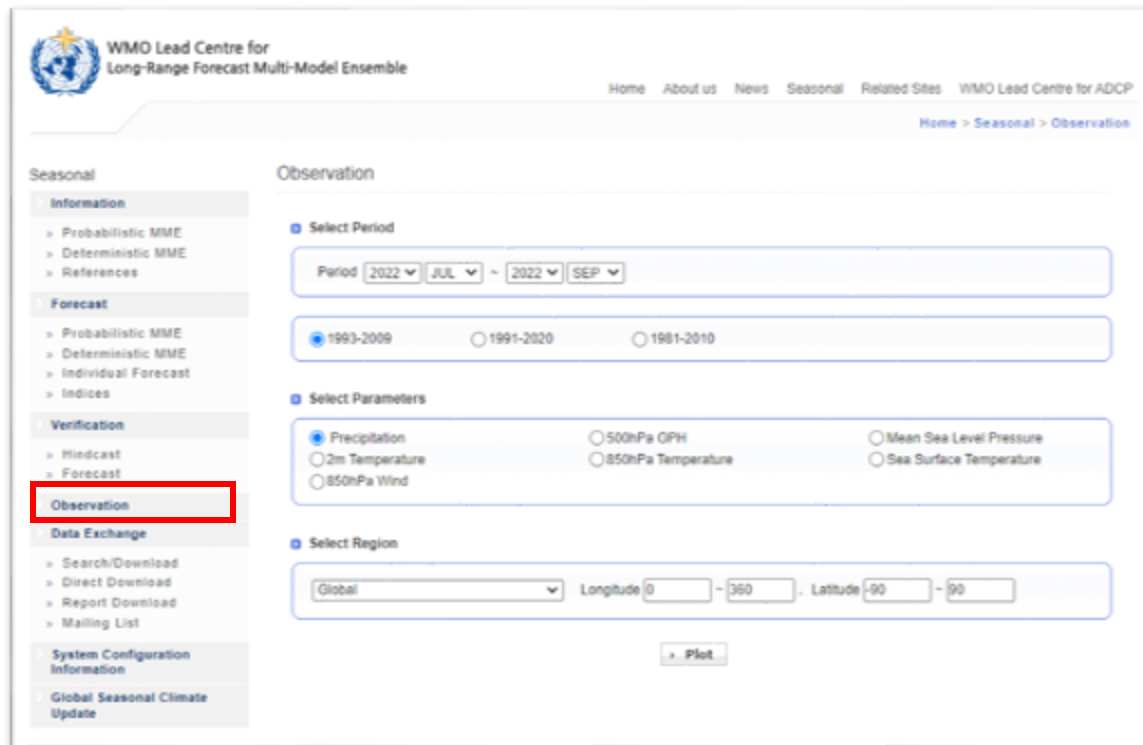- Tercile-based categorical probabilities

Verification
- Hindcast for both MME and Individual GPCs
- Forecast for MME

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1-2. Website Service

2021

■ **WMO LC Website improvement in 2021 (1)**

- ■ **Adding GPC-CMCC**(Centro Euto-Mediterraneo sui Cambiamenti Cliamtici, Italy)

- ■ **Adding Observation menu**

  - ERA5 anomaly plot relative to three normal periods (1993-2009, 1991-2020, 1981-2010)

1-2. Website Service

2021

■ **WMO LC Website improvement in 2021 (2)**

■ **Adding reanalysis data for verification**

  - Forecast, NCEP R1 → NCEP R1, EAR5

  - Hindcast, Era-interim → Era-interim, ERA5

■ **Adding verification of Indices for hindcast and forecast**

2022

■ WMO LC Website improvement in 2022

■ **Web-page Improvements**

- **Adding Map Projection:** Rectangular

→ Rectangular, <u>stereographic, Lambert Conformal for PMME, DMME, Individual Forecast</u>
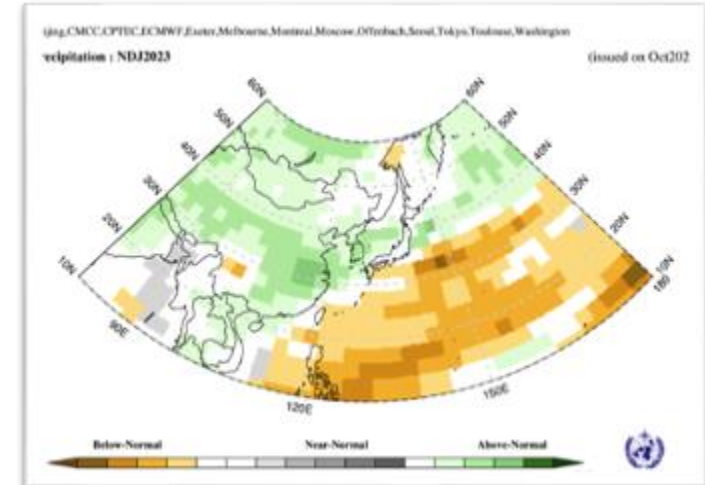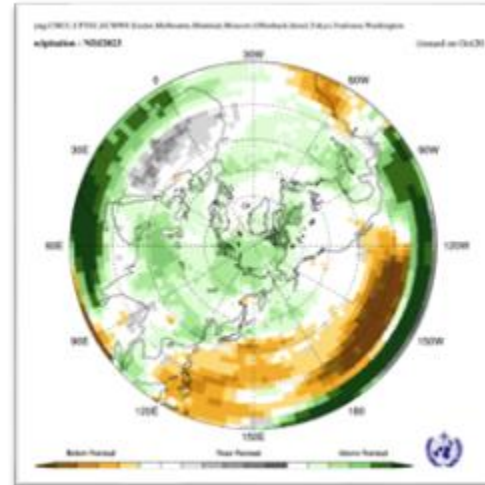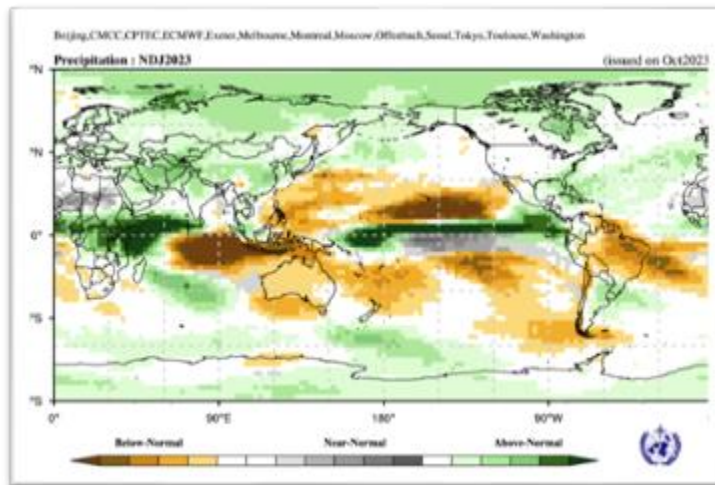
- **Extension of the forecast lead-time in Individual Forecast:** 3months → <u>6months</u>

- **Changing Language:** NCL, Shell → <u>python</u>

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1-2. Website Service

■ WMO LC Website improvement in 2023 (1)

■ **Data policy: Free access to download the digital data**

- **Open schedule**: July 26, 2023 (Wednesday) 9:00~

- **Materials provided**

  1) Models: 15 organizational models, multiple model ensemble (deterministic, probabilistic) models

  2) factors: temperature, precipitation, sst, sea surface atmospheric pressure, 850 hpa, etc

  3) period: 3 months ~ 6months

- **Delivery Cycle/Form of Delivery**: Monthly/Image and Digital
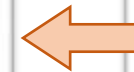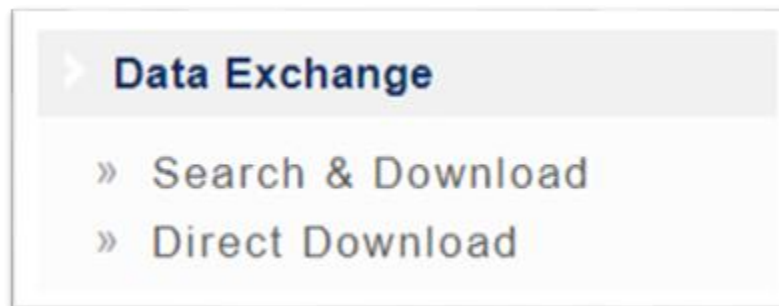
■ **Adding GPC-PUNE**(India Meteorological Department)

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2023

■ WMO LC Website improvement in 2023 (2)

■ **Improving the RCOF data production & presentation system(~2023.12.)**

- Check location and latitude-longitude coordinates for 21 new RCOF
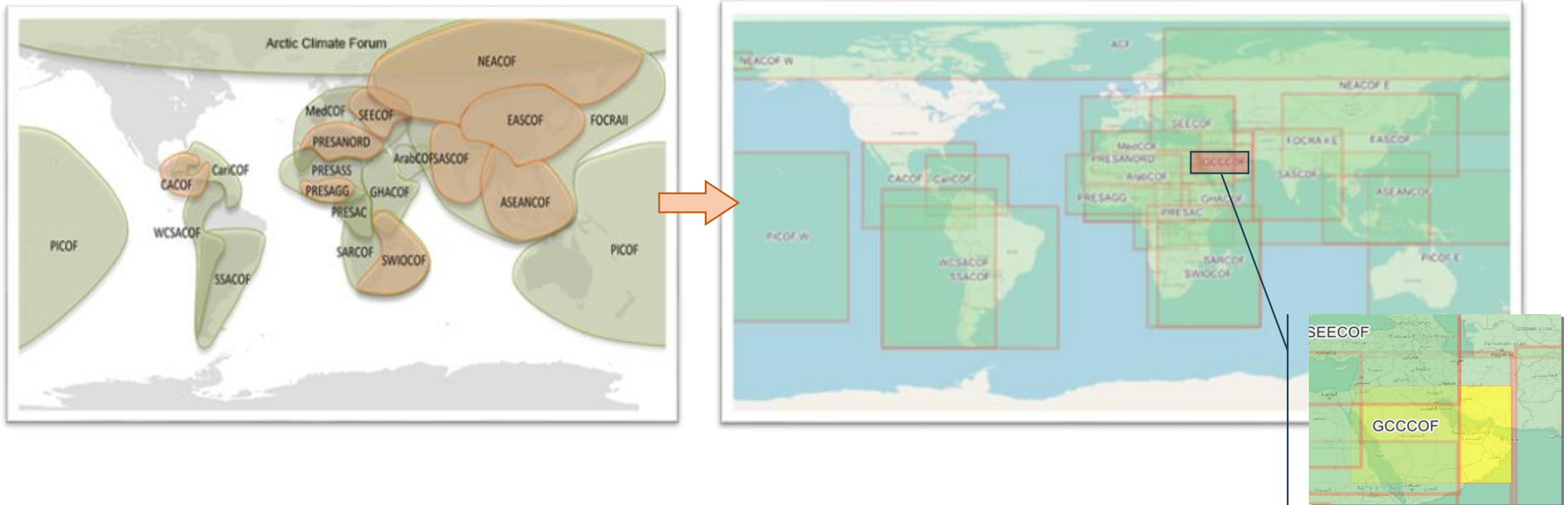
1-2. Website Service

2023

■ WMO LC Website improvement in 2023 (3)

- **Improving the RCOF data production & presentation system(~2023.12.)**

  - Displaying the RCOF Web screen

✓ Map Type

✓ Select Period

✓ Select Model

✓ Select Parameters

✓ Select Region

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■ Satisfaction Survey (1)

- **Why?**

  To diagnose the current status of WMO
  LC-LRFMME and provide better services
  to the website user

- **When?**

  05 June – 08 Jul 2023

- **To whom?**

  All website users

Thank you for using the WMO LC-LRFMME website. The LC-LRFMME is jointly organized and operated by the Korea Meteorological Administration (KMA) and NOAA/NCEP. It provides high-quality climate prediction products and develops advanced climate prediction technology, contributing to reducing the adverse impacts of extreme climate events.
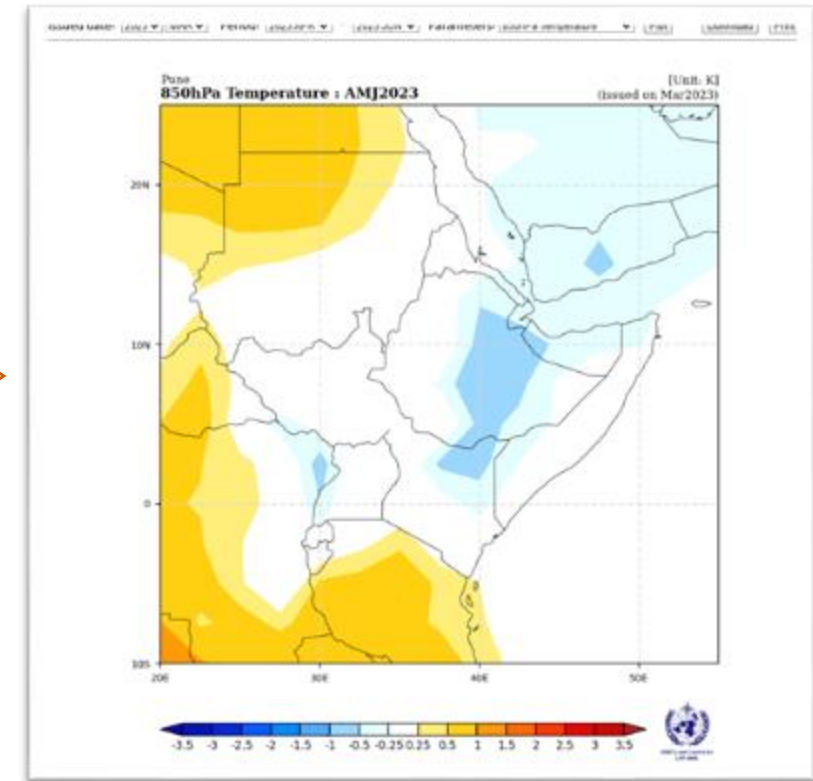
As part of our ongoing efforts to provide better services, we are conducting a survey on our website. We would appreciate it if you could take a few minutes to fill in the survey below.

Q1. Are you a member of the WMO LC-LRFMME website?
1) Yes
2) No

Q2. Which organization do you work for? Or, which organization are you involved with? (Select all that apply)
1) WMO Global Producing Centres (GPCs) for Long Range Forecasts (LRF)
2) National Hydrological and Meteorological Services (NHMS)
3) WMO Regional Climate Centre (RCC)
4) Regional Climate Outlook Forum (RCOF)
5) Other: _____

Q3. How often do you visit our website?
1) More than 12 times a year (at least once a month)
2) 4-12 times (at least once a season)
3) 1-3 times (at least once a year)
4) Less than once a year

Q4. What is your main reason for using forecast information from WMO LC-LRFMME?
1) To use as essential or reference information for operational climate forecasts
2) To use post-processed data as reference information for other fields (e.g. hydrology, agriculture, etc.)
3) To quote in a press release or on a website
4) To use as a reference for policy decision-making
5) To use as research data for seasonal forecasts
6) To use in teaching materials
7) Other (Please specify):

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Satisfaction Survey (2)

≫ Overall satisfaction

≫ Preference

Prediction model

Total (105)

29.5% · 35.2% · 35.2%

✓ ■ Individual forecast ✓ ■ DMME ■ PMME

Data type

Total (105)

9.5% · 3.8% · 86.7%

✓ ■ Forecast ■ Hindcast ■ Verification

Data form

Total (105)

11.4% · 41.9% · 46.7%

■ Digital data ✓ ■ Graphic ■ Climate indices

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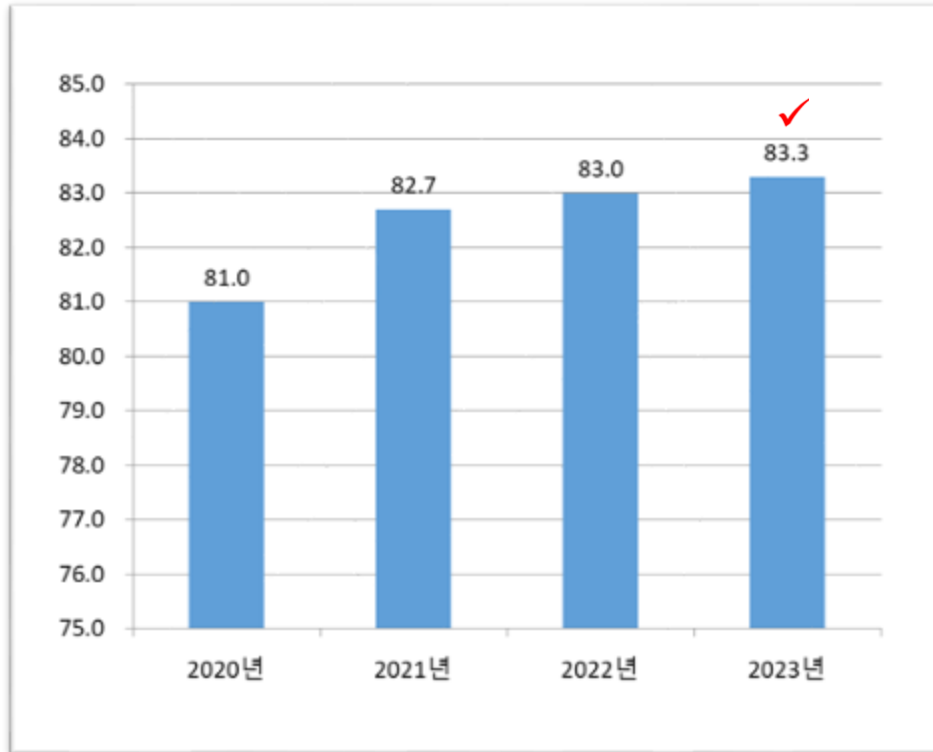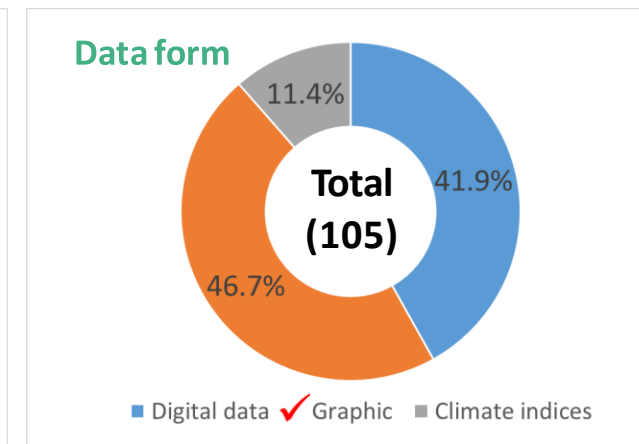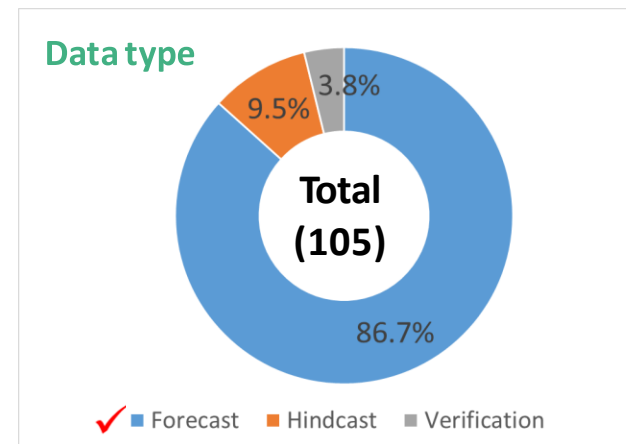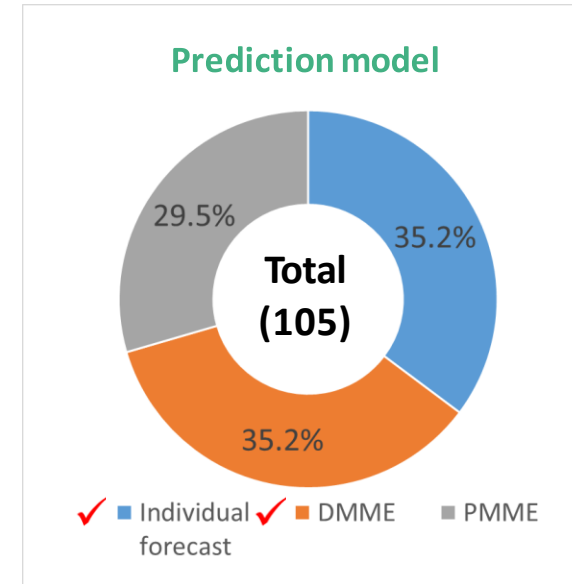
1-3. Satisfaction Survey in 2023

◼ Satisfaction Survey (3)

❯❯ What the user of WMO LC-LRFMME website wants?

Variable

- 2m temperature
- ✓ Precipitation
- 500hPa GPH
- 850hPa temperature
- Mean sea level pressure
- Sea surface temperature
- 850hPa wind

12.4%
53.3%
25.7%
6.7%
0.0%
1.9%

Total
(105)

❯❯ Which item(s) do you think need to be improved in WMO LC-LRFMME? (Select all that apply)
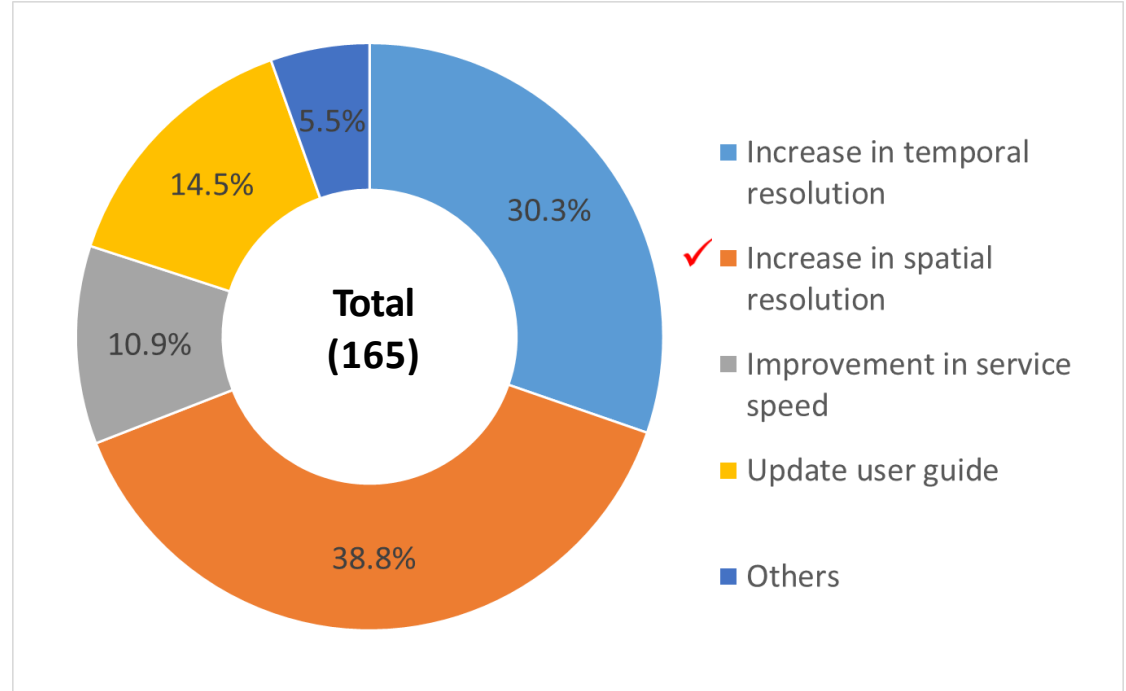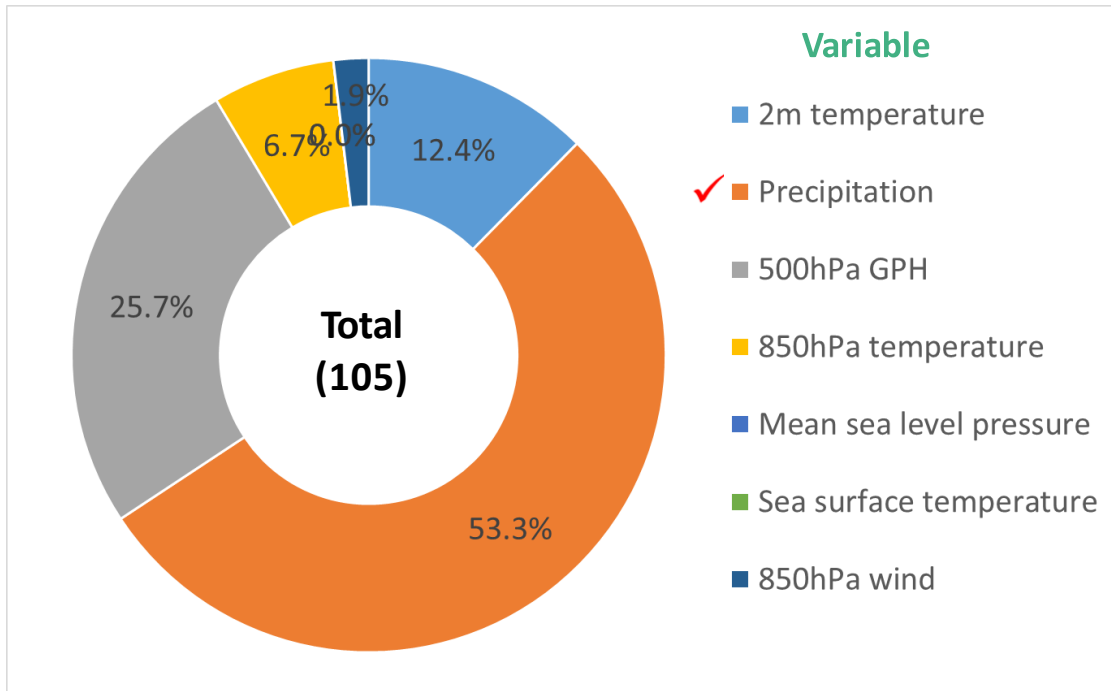
- Increase in temporal resolution
- ✓ Increase in spatial resolution
- Improvement in service speed
- Update user guide
- Others

30.3%
38.8%
10.9%
14.5%
5.5%

Total
(165)

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2. Climate Forecasting Service Plan

Due to the climate crisis era,

the climate forecast period needs to be extended to the near future (~10 years)

Now | **Future**

| 1 day | 1 week | 1 month | 3 month | 1 year | 10 years |

Mid-term forecast

Demand for Forecast Information by Period

Long-range forecast (1~3 months)

Climate forecast (6 months ~ 1 year)

Emergency respons

electricity, water resources, agriculture

disaster plan

sales and manufacturing industry

Resource Planning (Energy, Water, Food)

Finance (insurance, investment, financial asset management), market trade, distribution

Climate change adaptation/reduction policies, construction, forests

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Definition

1 year Climate Prediction Model	10 years Climate Prediction Model	Climate Prediction System
Atmospheric-ocean-ground-sea ice junction model	1 Year Climate Model + Atmospheric Chemistry + Aerosol + Water-Energy-Carbohydrate Circulation + Marine Biochemical Bonding Model	Pre-processing + [1 year climate prediction model or 10 year climate prediction model] + post-processing

Composition

Climate Prediction System

10 years Climate Prediction Model

1 year Climate Prediction Model

Initialization → Atmospheric → Ocean → Ground → Sea Ice → Post-Process

Processing of earth observation data	Atmospheric Chemistry and aerosols	Marine biochemistry	Ground Water-Energy Carbon Cycle	Ensemble prediction
Combined data assimilation				Error Correction

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2. Climate Forecasting Service Plan (2)

■ **Plan Summary**

- ✓ **Research: Academy or University Joint**

- ✓ **Period: For about 2025~2035**

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Thank you

for

your attention