Third Pole Climate Forum

WMO Third Pole RCC Network (In Demonstration Phase)

Seasonal Prediction based on Objective Approach for Third Pole

India Meteorological Department

THE 3rd SESSION OF THE THIRD POLE CLIMATE FORUM

New Delhi, India

3 to 5 June 2025

Outline

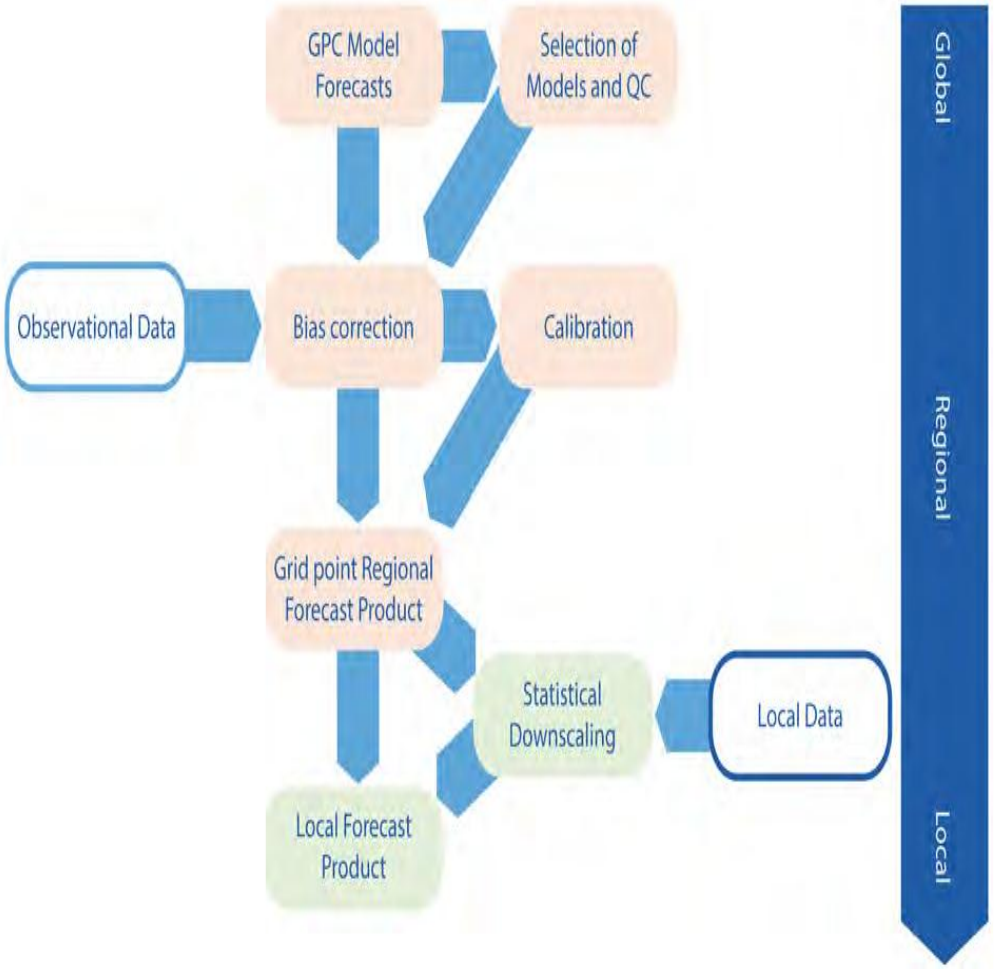
- Procedure for Preparation of Objective Forecast
- Performance of the different climate models
- Objective Seasonal Forecast production for Third Pole

TPRCC Southern Node: Developments so far

Institutions	Role
India Meteorological Department	**Southern TP Node** Coordination with Consortia Members **Operational Data Services**, to support **operational LRF** and **climate monitoring** Develop quality controlled regional climate datasets, gridded where applicable Collection the data of the integrated observing network and their quality assessment **Other Functions** Long Range Forecast Operational Activities for Climate Monitoring Climate Applications Training and capacity building Research and Development
Support Role	
Indian Institute of Tropical Meteorology	**High-resolution global climate modeling for the Himalayan region, CORDEX South Asia-Downscaled climate change Projections for the Hindu Kush Himalayan region**
NCMRWF, INCOIS	**Modelling Activities for Long Range Mountain Weather Forecast**
MoEF&CC, Mountain Division	**Meteorological Data Network, RCC Users involvement**
ISRO, IMD	**Himalayan Cryospheric Applications using Space based Observations**
NCPOR, WIHG	**Monitoring of Himalayan Glaciers using Space and Ground based Observations**
Cryosphere Studies in the Himalaya	**Jawaharlal Nehru University, University of Kashmir, IISER, IITs, other institutes**
National Centre for Disease Control, New Delhi	**Climate Change and Health over the Mountain regions**

Implementation of the Objective Approach for Seasonal Forecast Outlook

Concept of Objective Approach for a Regional Forecast Production



Source: Guidance on Operational Practices for Objective Seasonal Forecasting, WMO 2019

For operationalization of objective seasonal forecasts the following are provided routinely :

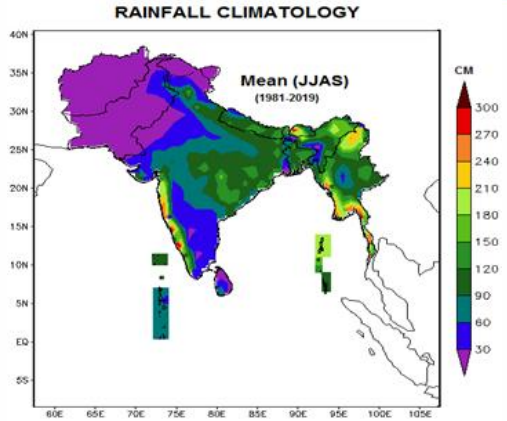
1. Model Hindcasts : to compute bias and skill of the model and calibrate model output
2. Model Forecasts: For generating bias corrected, calibrated forecast.
3. Observed data : To correct model output through the process of bias correction and calibration and verification of the model hindcasts and forecasts.
4. Local Forecast Products for delivery to users and verification.
5. Training on Objective LRF (Long Range Forecasting) steps at Pre-COF Workshops introduced/

- Access and use of WMO LC-LRFMME and other dynamical LRF products, including those from WMO RCCs.
- Tools and approaches for the selection of models and blending of forecasts
- Assessment of model skills over the region
- Predictability of the region and Climate Drivers.
- Calibration and downscaling methods including generation of national products from regionally optimized inputs

Development of A Good Quality standard Rainfall data set Over South Asia for calibration and Verification

Developed a new monthly gridded rainfall data set at a spatial resolution (1ºx1º, latitude x longitude) covering a period of 39 years (1981-2020) over the South Asian region by merging various rainfall data sets over the region. Data sets used for preparing the merged data are; Climate Hazards Group Infra-Red Precipitation with Station data (CHIRPS) data, India Meteorological Department (IMD) 1ºx1º spatial resolution daily gridded rainfall data set for the Indian Region (Indian mainland and Indian islands), Bangladesh Meteorological Department (BMD) data of 0.25º x0.25º resolution for Bangladesh converted into 1ºx1º resolution and GPCP monthly estimated data for various latitude and longitude points over Maldives for the period 1981-1992 and station data 1993 onwards.

This Rainfall data set was started using from summer SASCOF-2020.



Rainfall climatology for the period 1981-2020 over South Asia
Source: Merged rainfall data over south Asia of RCC, Pune)

Evaluation of performance of Climate Model forecast

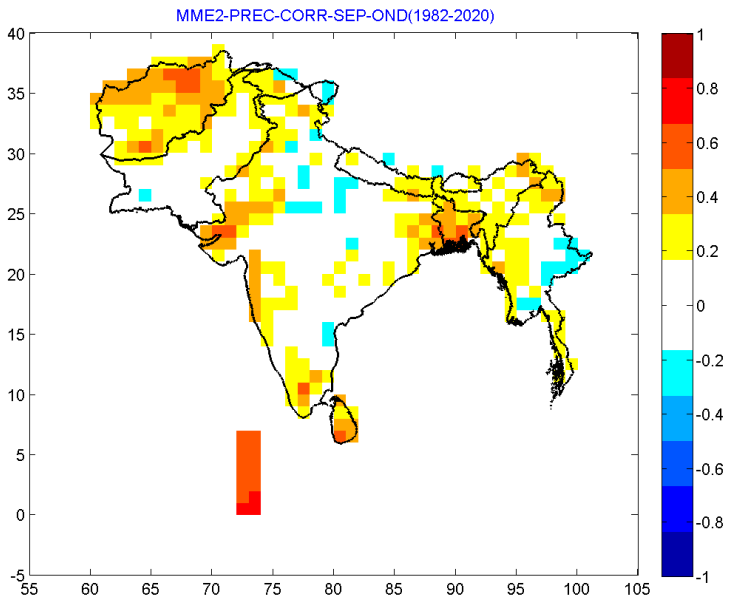
The evaluate the performance of climate model forecast for the South Asia Region.

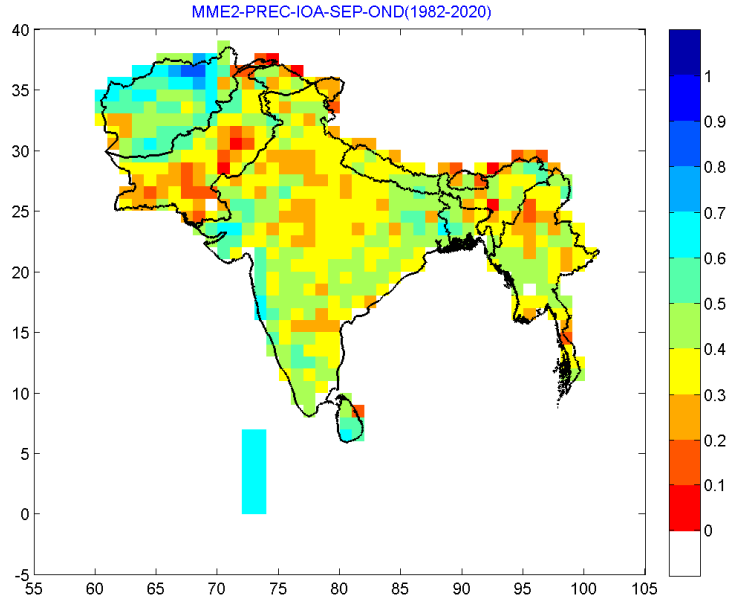
As a part of WMO objective seasonal forecast guideline conducted evaluation of Climate model forecast for rainfall and temperature (Tmax & Tmin) for various season before issue SASCOf outlook.

J. Stacey et al, Climate Dynamics, 1 April 2023, volume 61, pages3857–3874 (2023)

Diverse skill of seasonal dynamical models in forecasting South Asian monsoon precipitation and the infuence of ENSO and IOD

Correlation Coefficient (C.C)





Index of Agreement (IOA)

Models Used for Multi Model Ensemble forecast

S.NO	System name	Centre / Country	Hindcast Ensemble size	Hindcast /Forecast Period
1	CanCIP-C3	NMHS/Canada	10	1981 - 2020
2	GEM-NEMO	NMHS/Canada	10	1981 - 2020
3	CMCC SPSv3	Italy	40	1993 - 2020
4	NCAR-CCSM4	NCAR/USA	10	1982 - 2020
5	DWD GCFS2p0	NMHS/Germany	30	1993 - 2020
6	GFDL	NOAA/USA	10	1993-2020
7	JMA	NMHS/Japan	10	1991 - 2016
8	Meteo-France 7	NMHS/France	25	1993 - 2020
9	GloSea-5	NMHS/ UK	28	1993 - 2017
10	NCEP CFS2	NMHS/ USA	24	1982 - 2020
11	MMCFS	NMHS/IMD	14	1982-2020
12	ECMWF, SEAS-5	ECMWF	25	1981 - 2016
13	NASA	USA	10	1981 - 2016

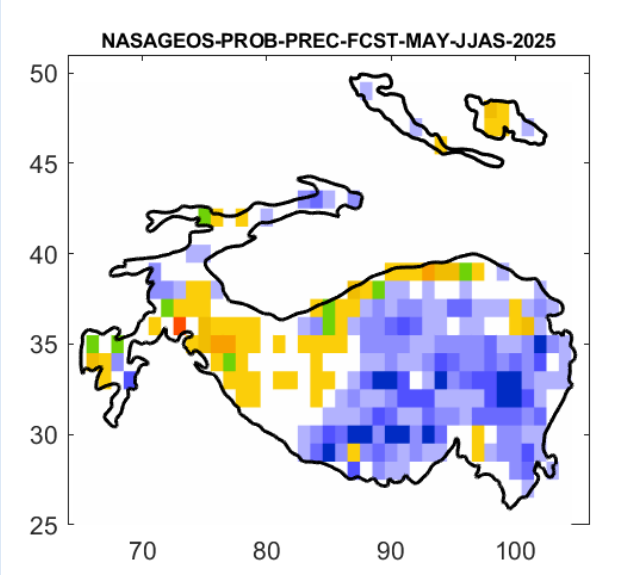
MMCFS Model Details

- **Atmospheric Component: Global Forecast System (GFS) with spectral resolution of T382 and 64 hybrid vertical levels**
- **Ocean Component: Geophysical Fluid Dynamics Laboratory (GFDL) Flexible Modeling System (FMS) & Modular Ocean Model version 4 (MOM4; Griffies et al. 2004). The horizontal resolution of the ocean component (MOM4) is 0.25° between 10°S to 10°N latitude band and 0.5° elsewhere.**
- **In addition to the atmosphere and ocean component, the CFSv2 also employs a four-layer NOAH land surface model [*Ek et al*., 2003] with dynamic vegetation as well as a three-layer (one layer of snow and two layers of sea ice) interactive sea ice model [*Winton*, 2000].**
- **The ocean and atmosphere are coupled without flux correction.**

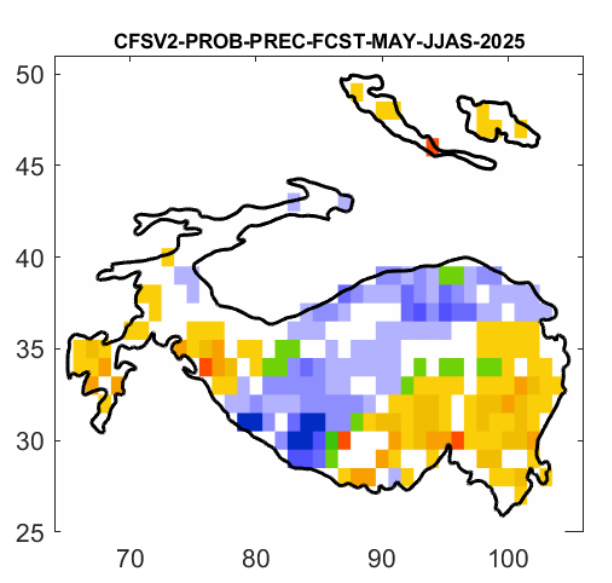
- **Model resolution: T328L64**
- **Ensemble size: 14 members for Hindcast and 40 members for forecast**
- **Forecasts period: 9 months**
- **Initial Condition:**
  - **Ocean Initial Condition: From INCOIS**
  - **Atmospheric Initial Condition: From NCMRWF**

Climate Model Precipitation forecast 2025 June-September season (May IC)

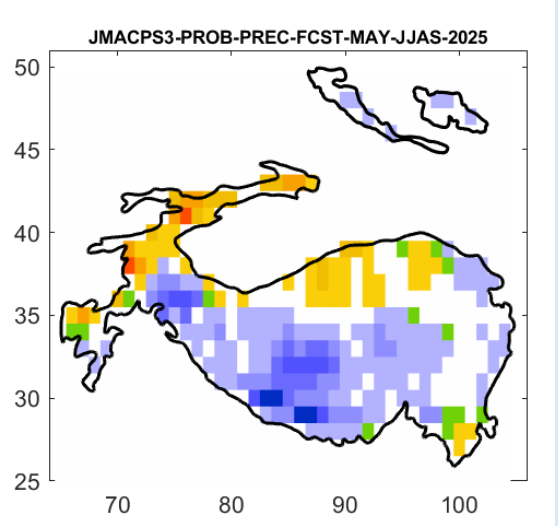
NASA



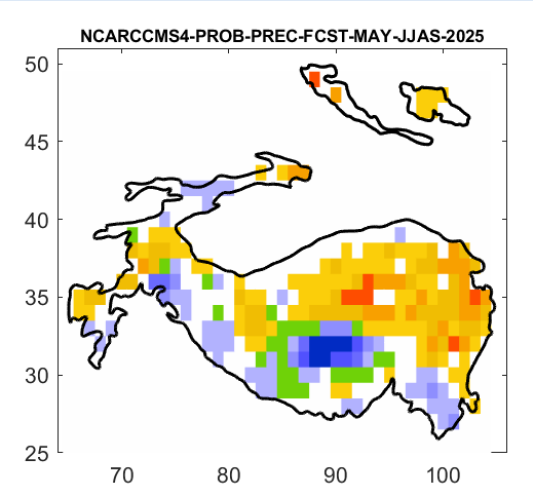
CFSv2



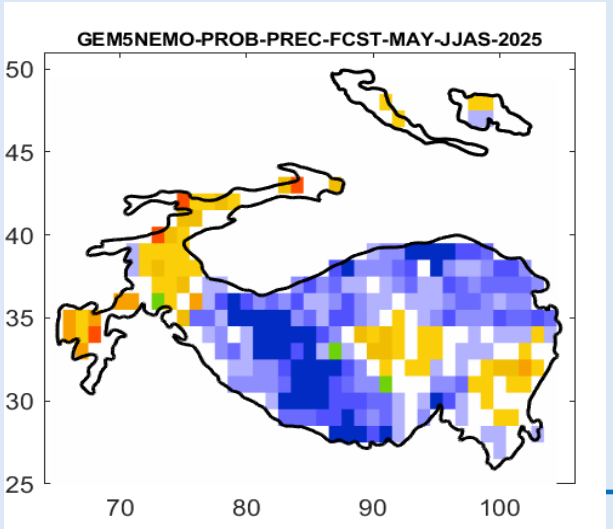
JMA



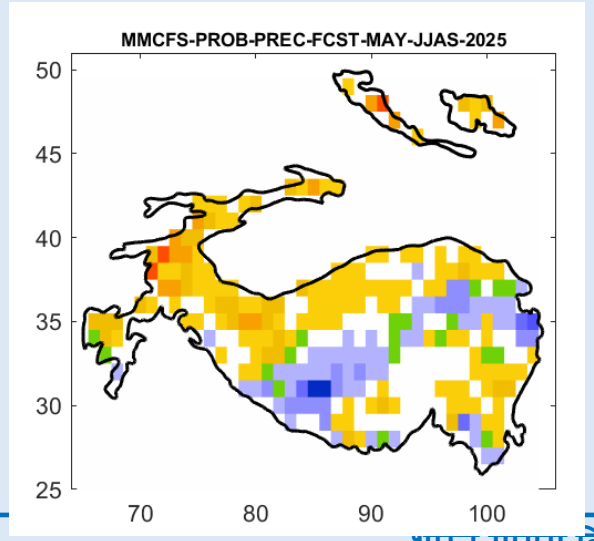
NCAR-CCSM



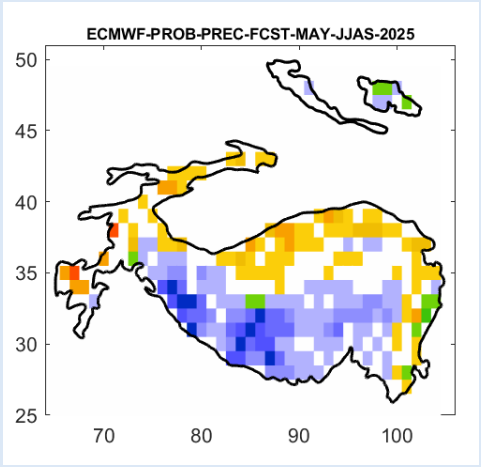
GEM-NEMO



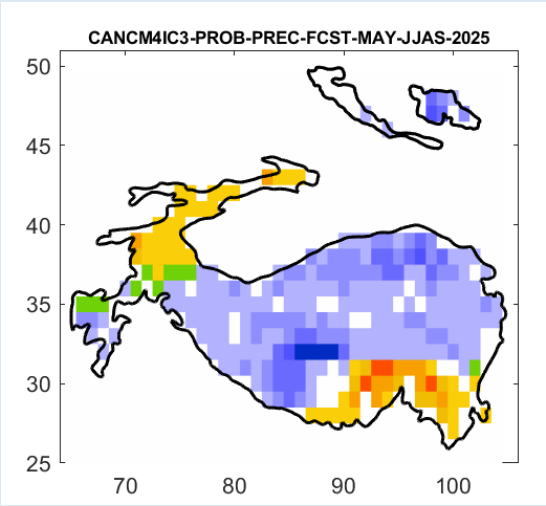
MMCFS

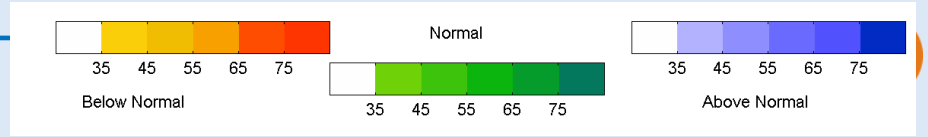


ECMWF



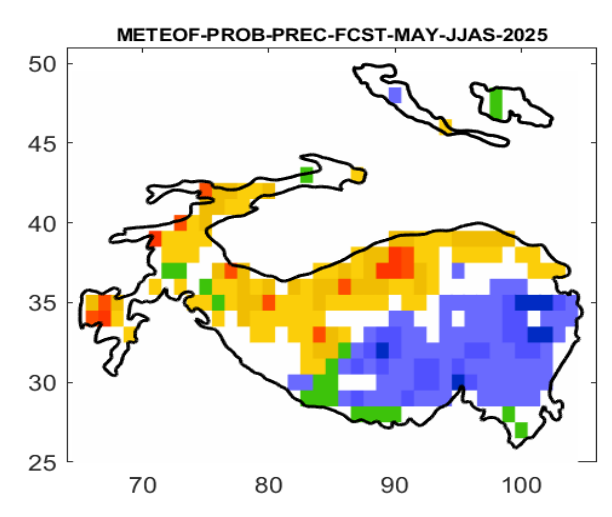
CANCM-4i



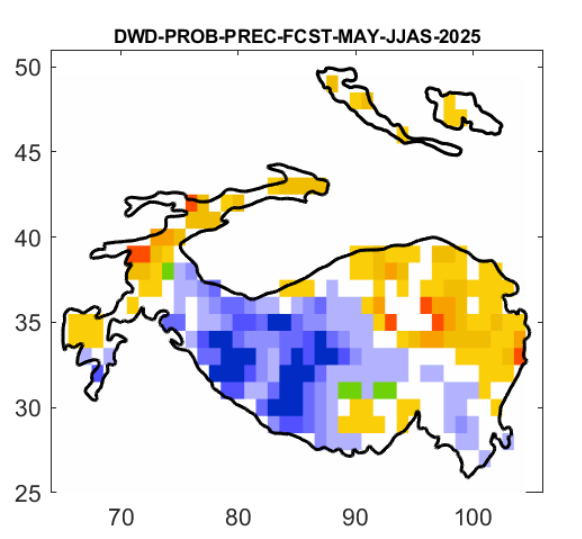


Climate Model Precipitation forecast 2025 June-September season (May IC)

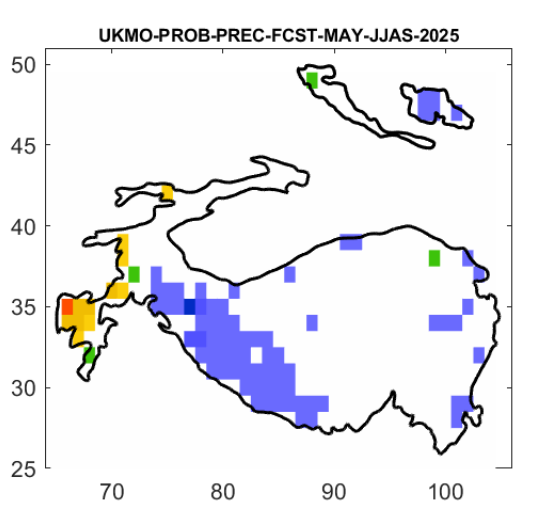
METEO_FR



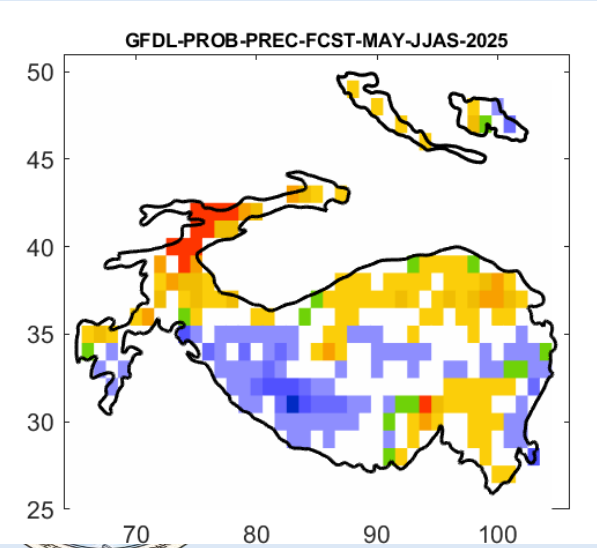
DWD



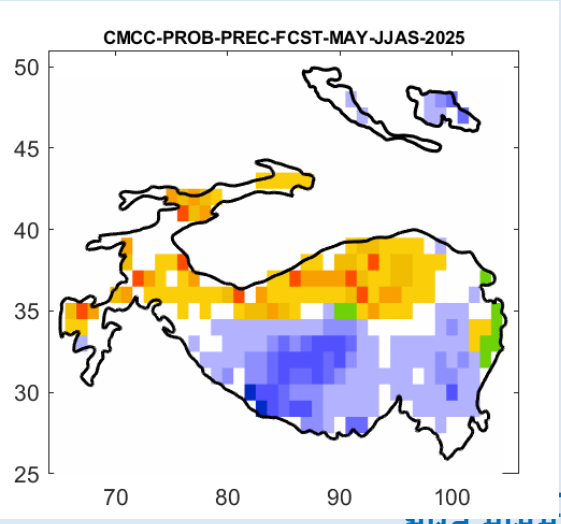
UKMO



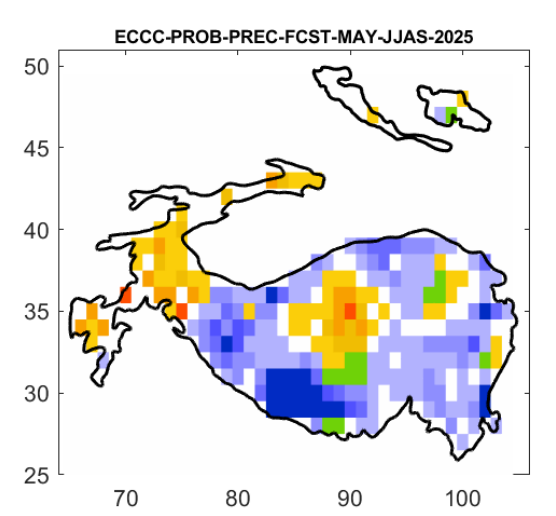
GFDL

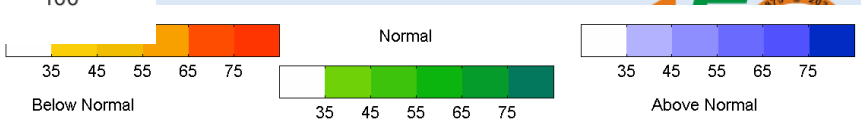


CMCC



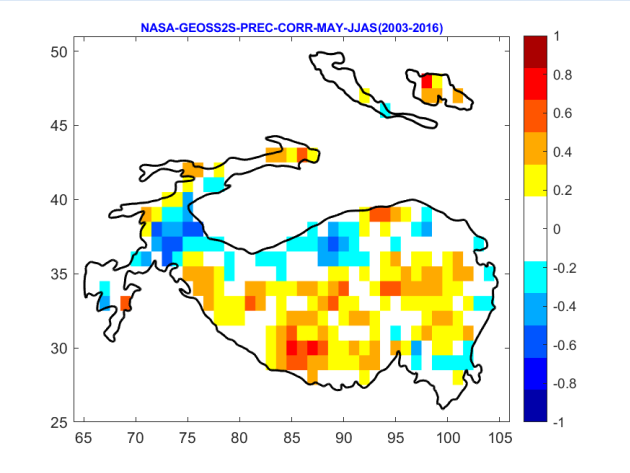
ECCC



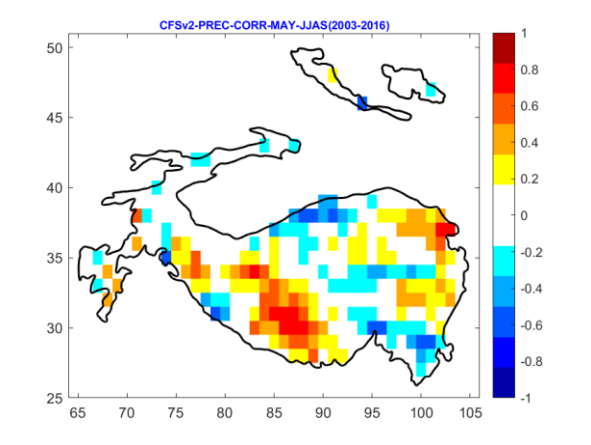


Skill (Correlation Coefficient) of Climate Model Precipitation forecast June-September season (May IC)

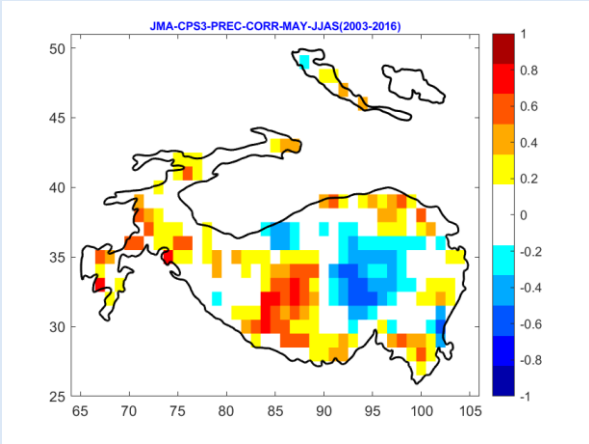
NASA



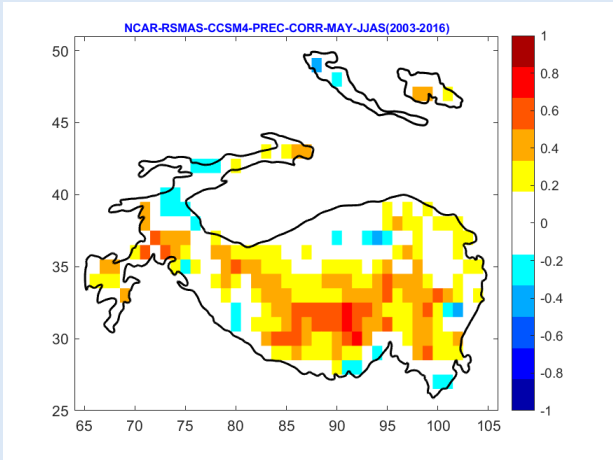
CFSv2



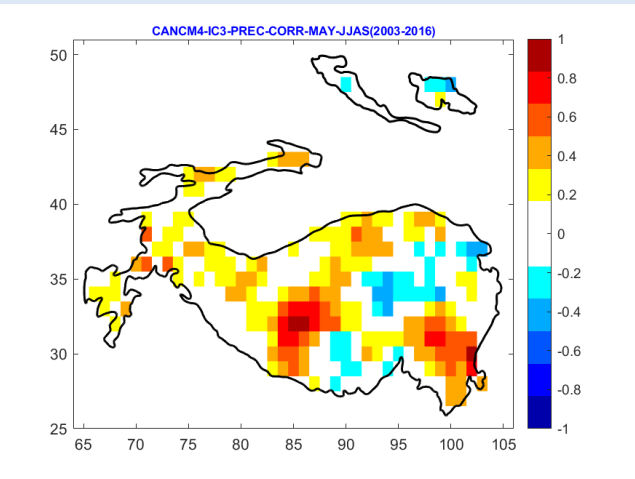
JMA



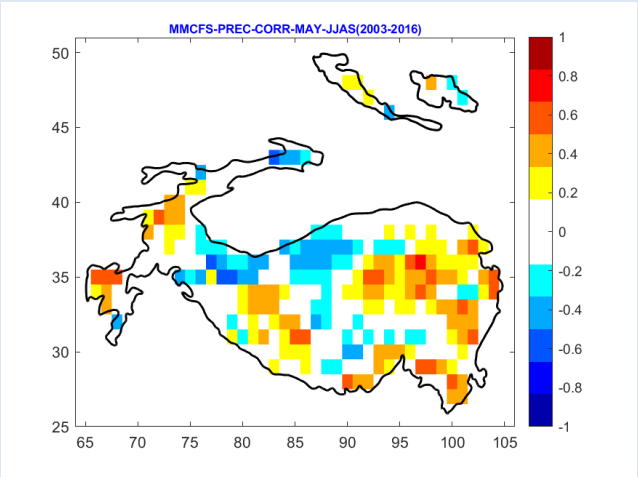
NCAR-CCSM



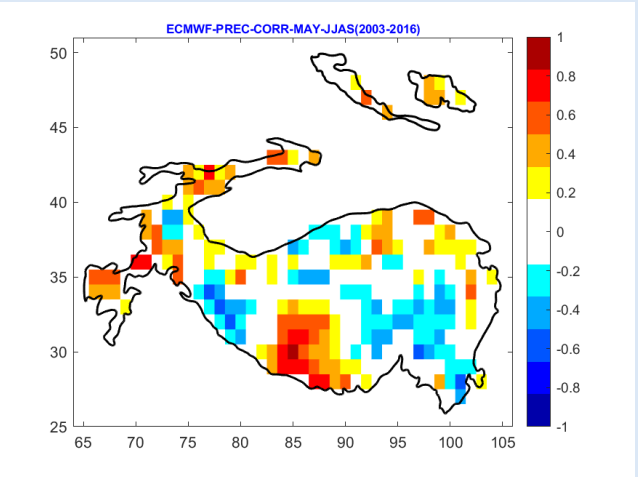
GEM-NEMO



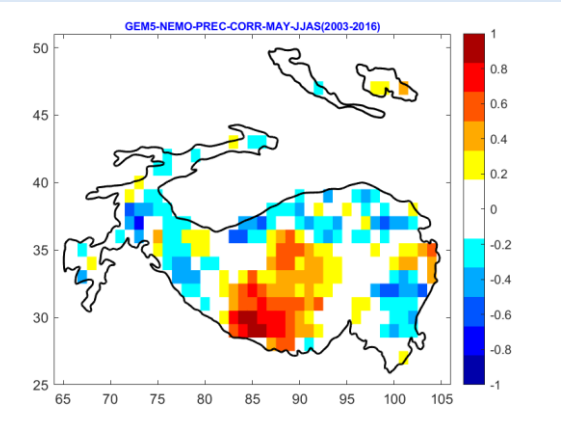
MMCFS



ECMWF

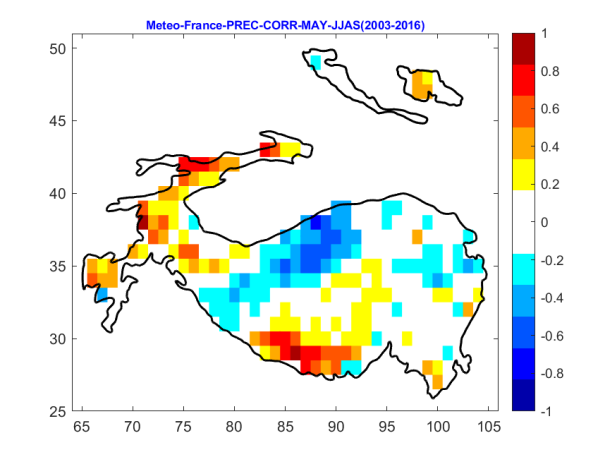


CANCM-4i

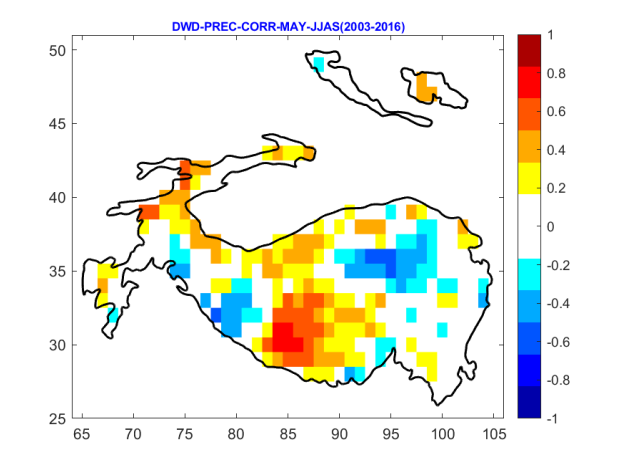


Skill (Correlation Coefficient) of Climate Model Precipitation forecast June-September season (May IC)

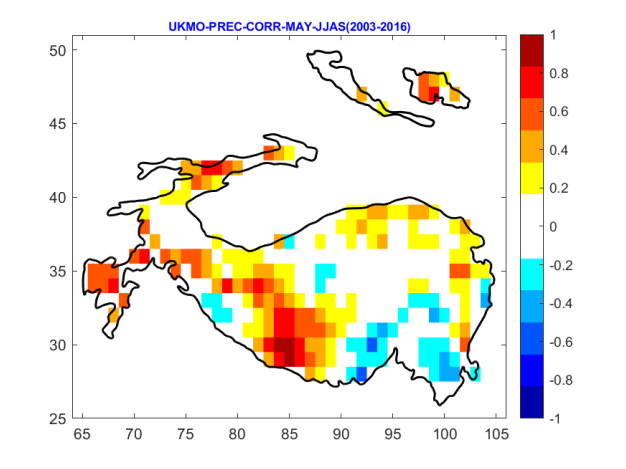
METEO_FR



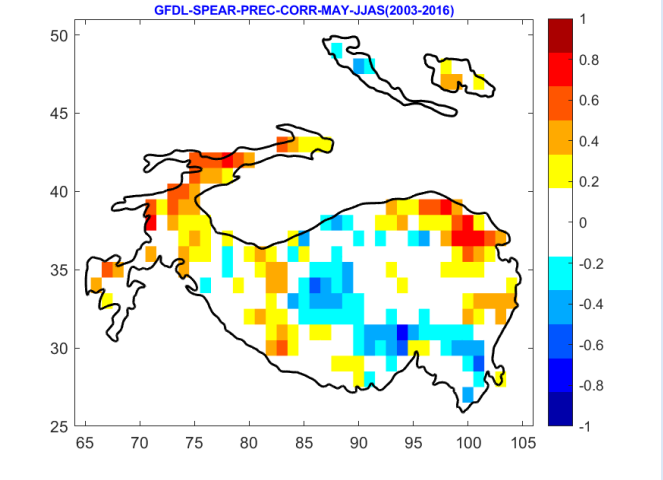
DWD



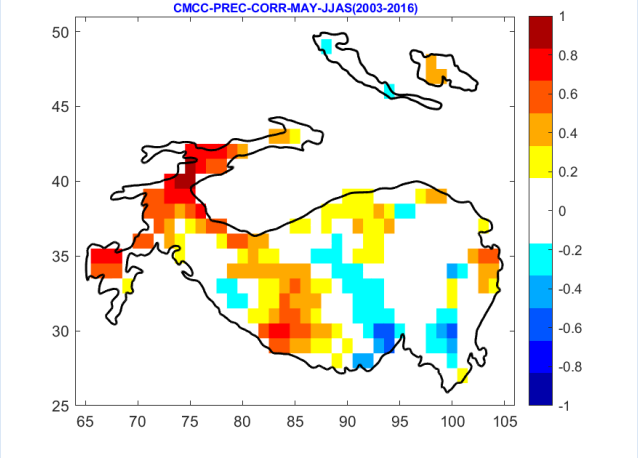
UKMO



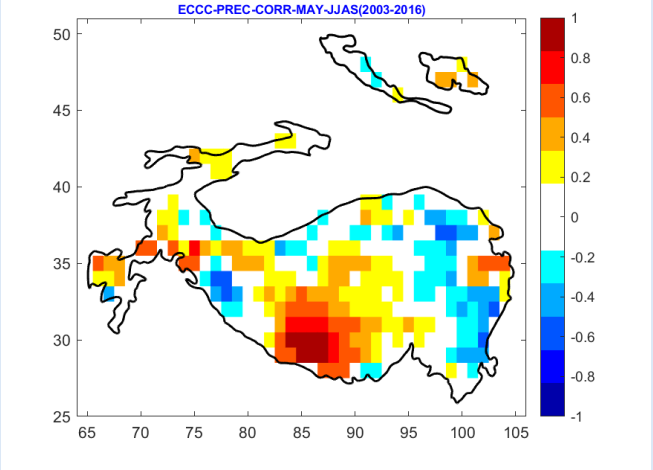
GFDL



CMCC

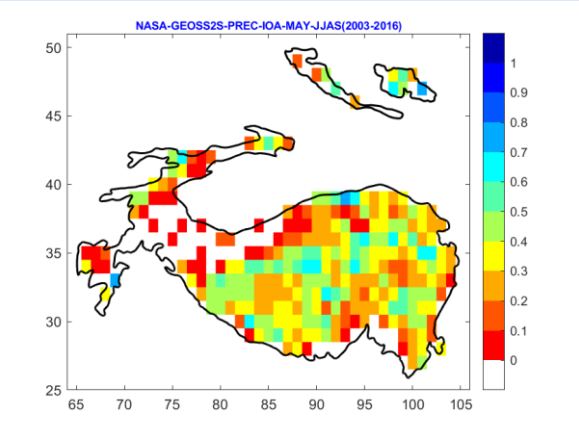


ECCC

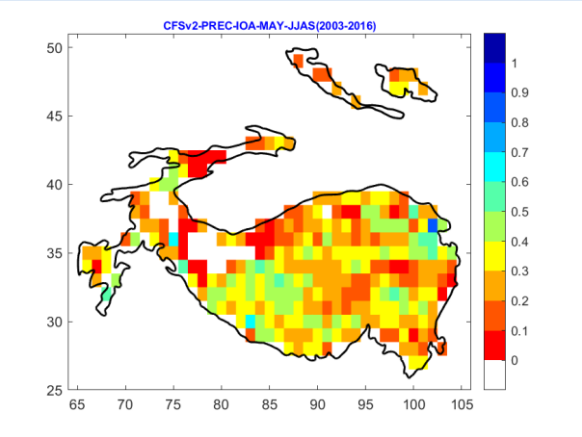


Skill (Index of Agreement) of Climate Model Precipitation forecast June-September season (May IC)

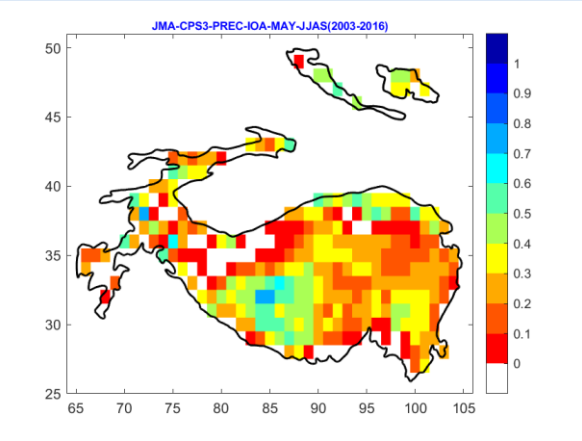
NASA



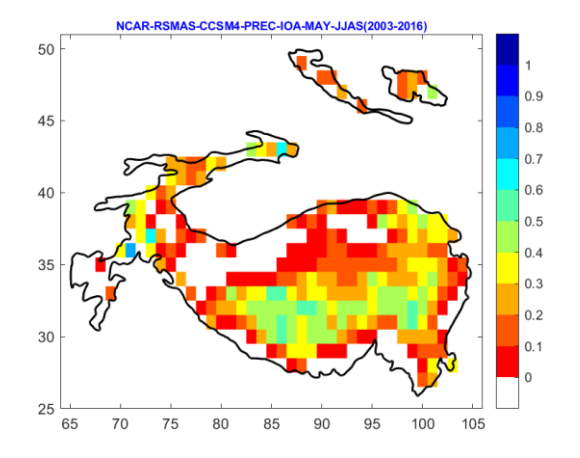
CFSv2



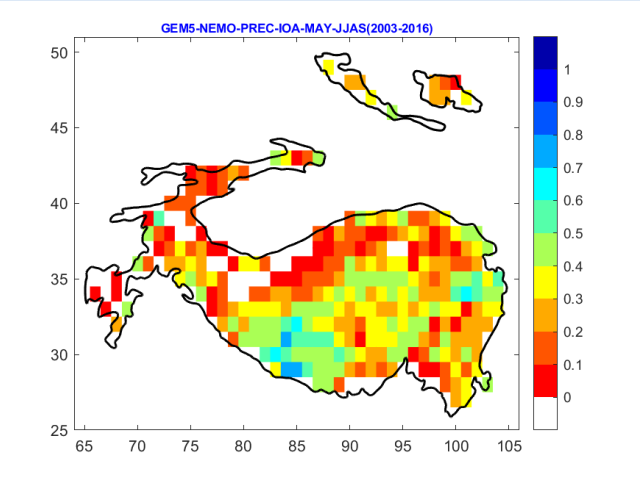
JMA



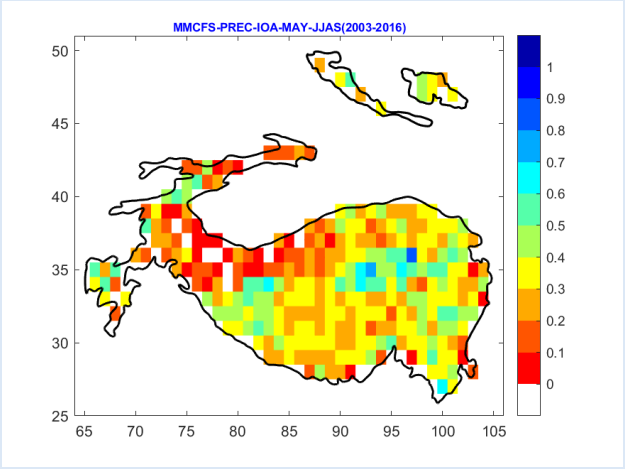
NCAR-CCSM



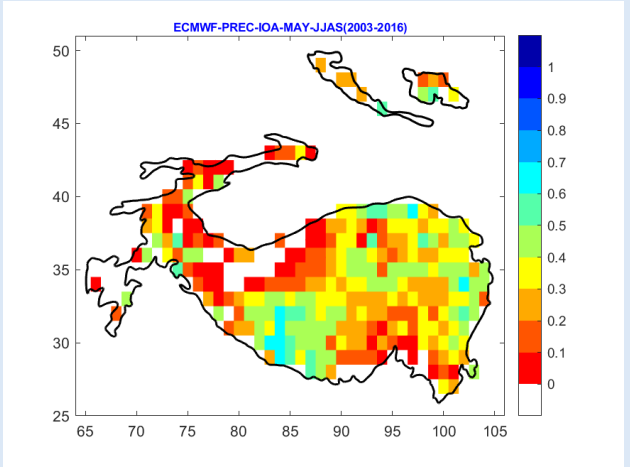
GEM-NEMO



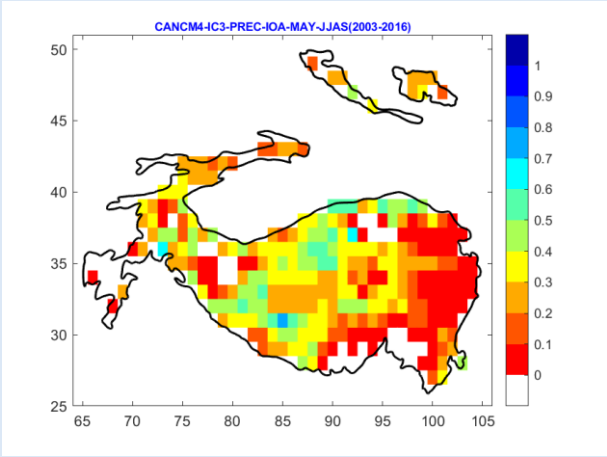
MMCFS



ECMWF

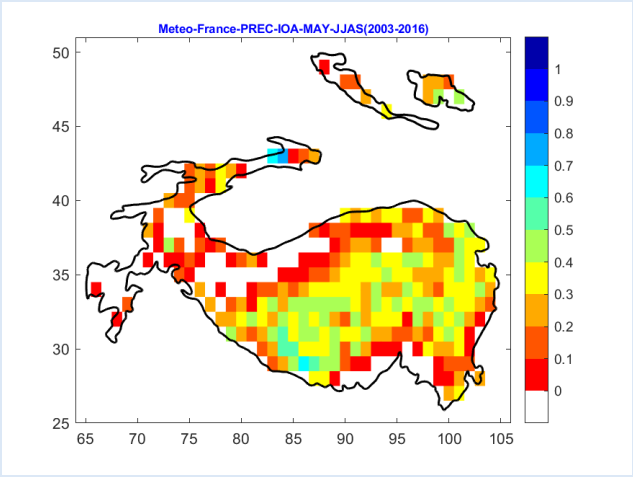


CANCM-4i

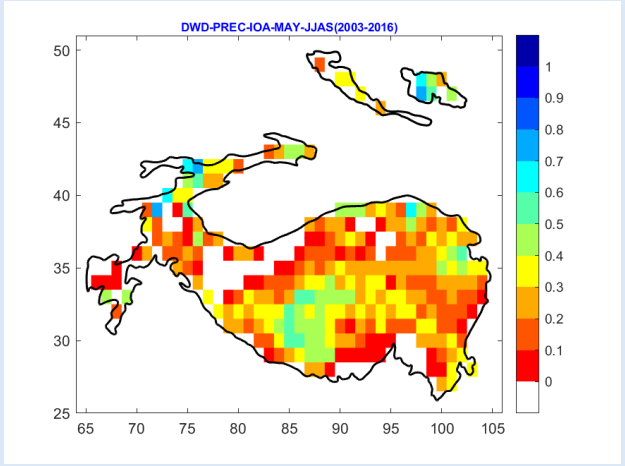


Skill (Index of Agreement) of Climate Model Precipitation forecast June-September season (May IC)

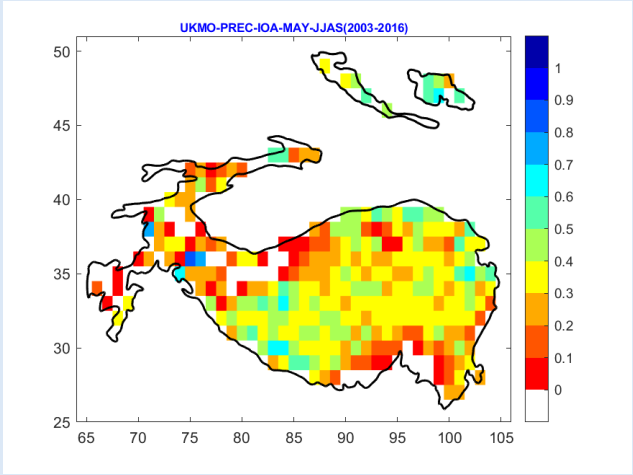
METEO_FR



DWD



UKMO



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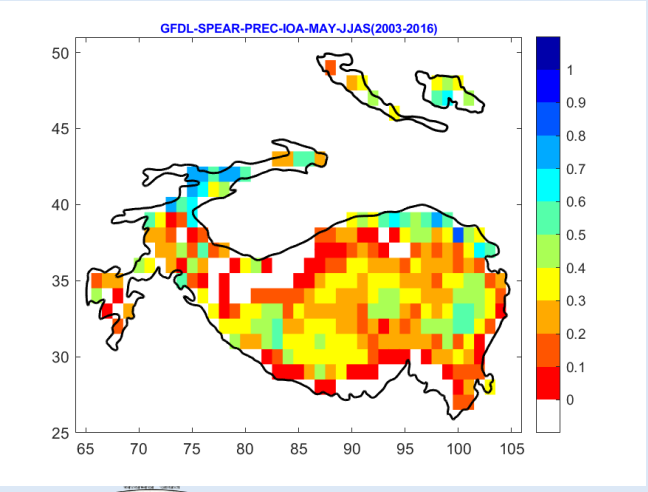
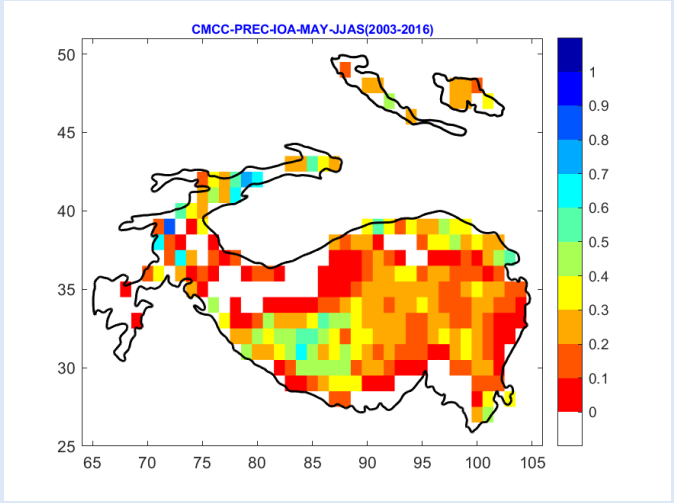
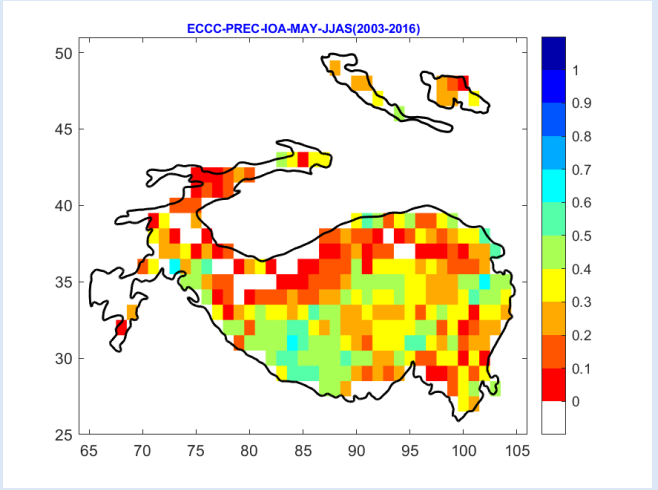


CMCC



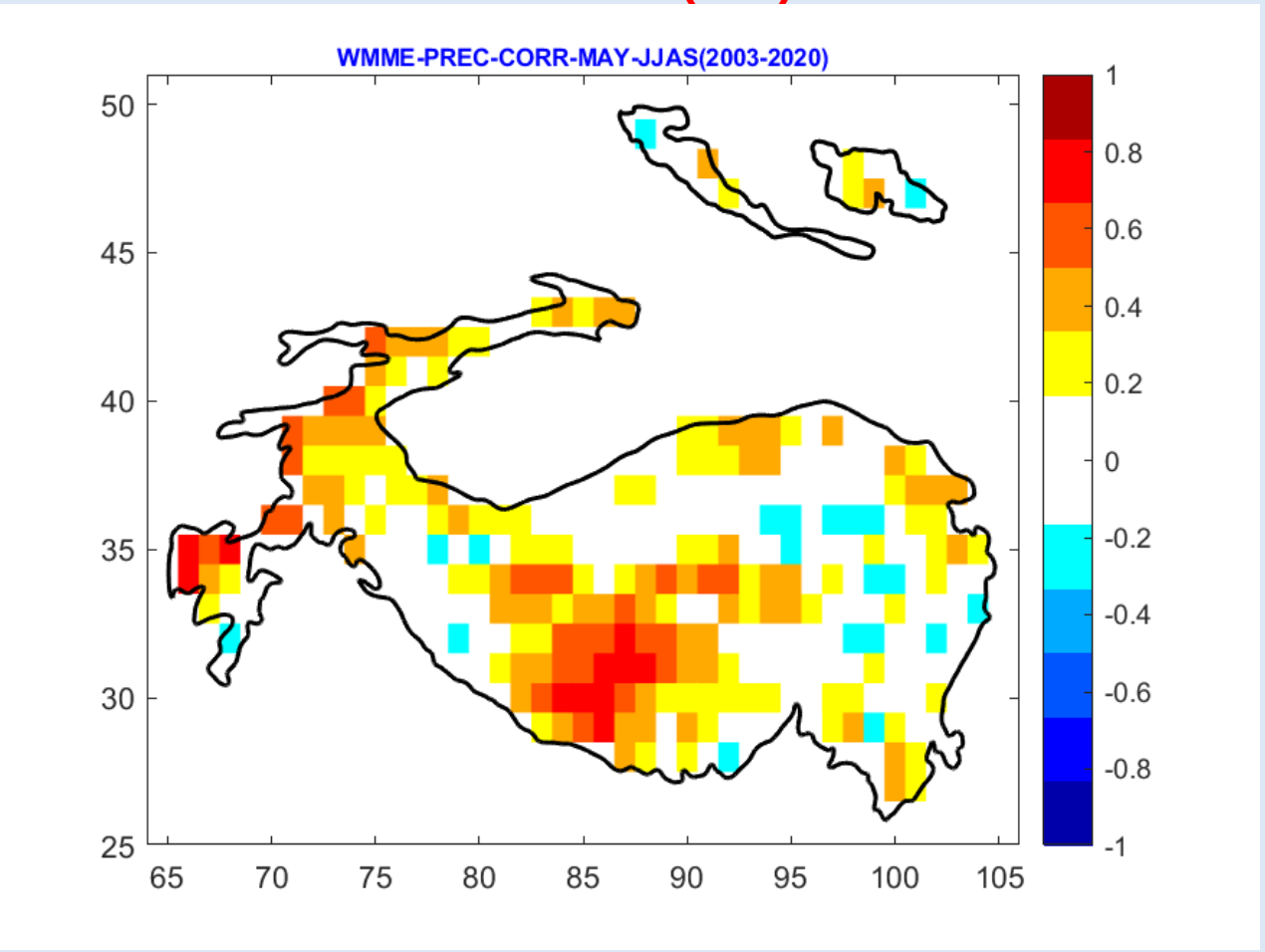
ECCC



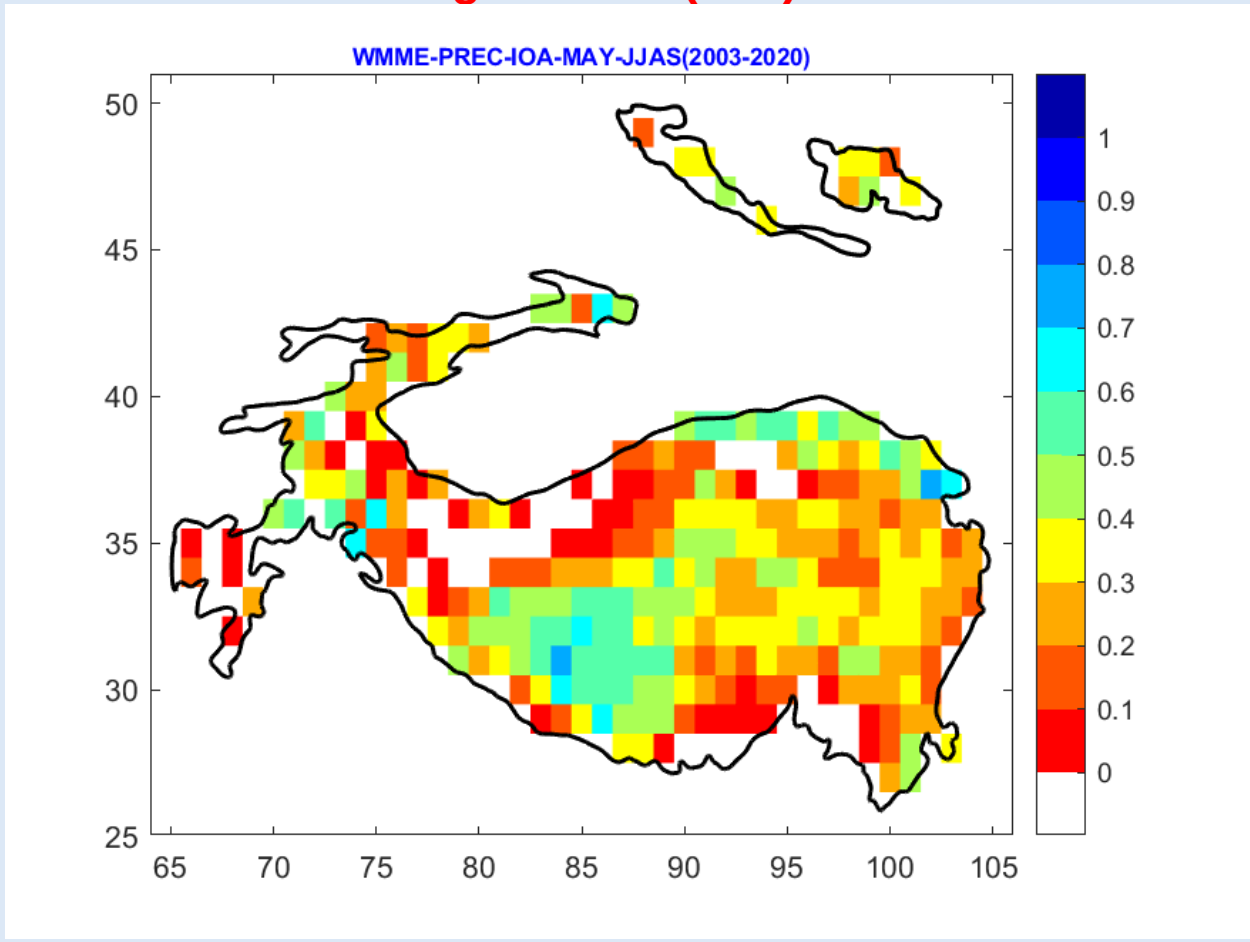
Models Name	Models Skills (CC)	Model Skill (IOA)
GEM5NEMO	0.8	0.31
ECCC	0.69	0.27
NCARCCMS4	0.64	0.1
CANSIPIC3	0.34	0.16
CMCC	0.3	0.11
DWD	0.27	0.15
JMACPS3	0.21	0.17
CANCM4IC3	0.14	0.11
METEOF	0.11	0.15
GFDL	0.1	0.16
MMCFS	0.08	0.44
UKMO	0.03	0.2
ECMWF	0.01	0.22
NASAGEOS	0	0.2
CFSV2	-0.22	0.29

Skill (Index of Agreement) Precipitation forecast June-September season (May IC)

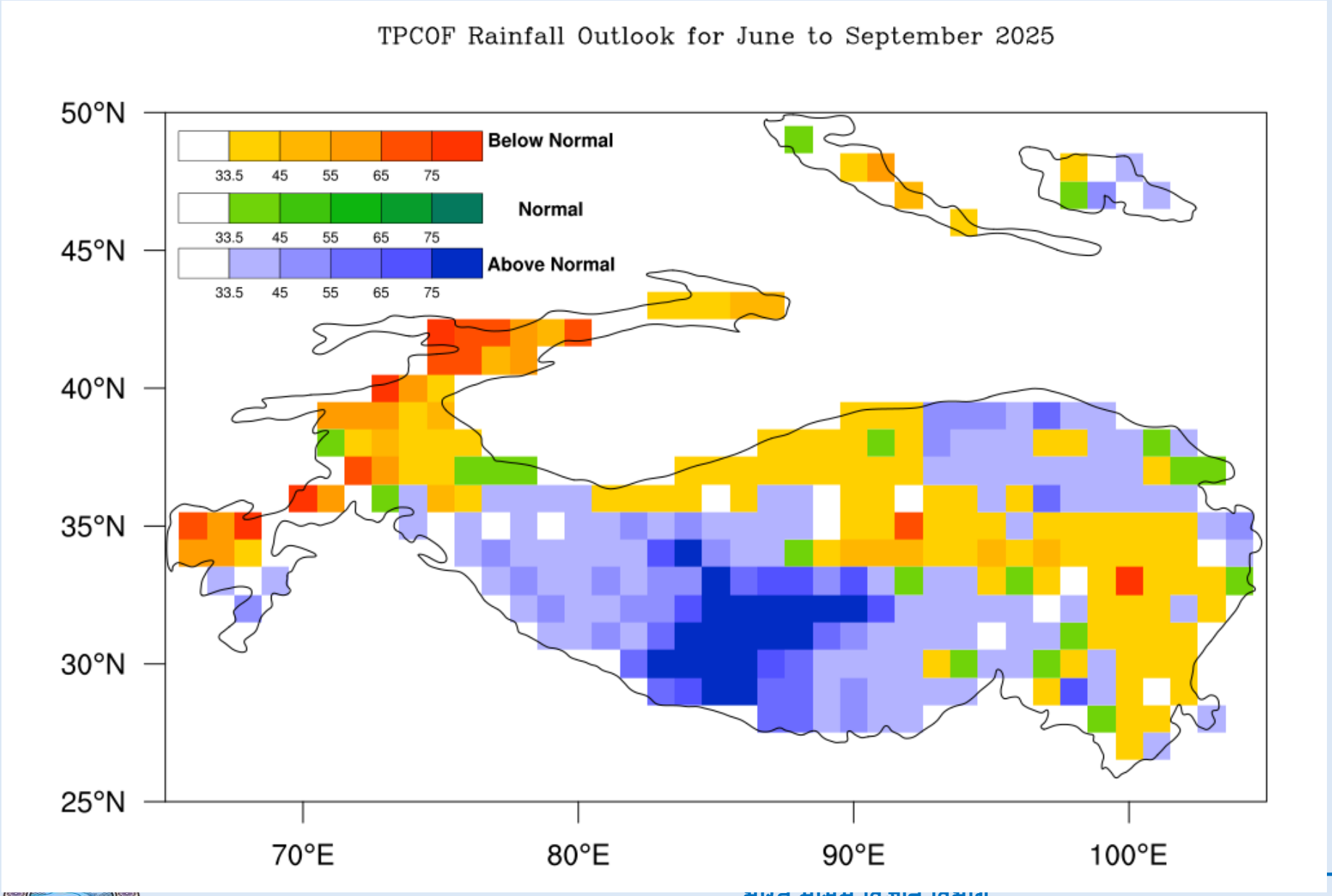
Correlation (C.C)



Index of Agreement (IOA)



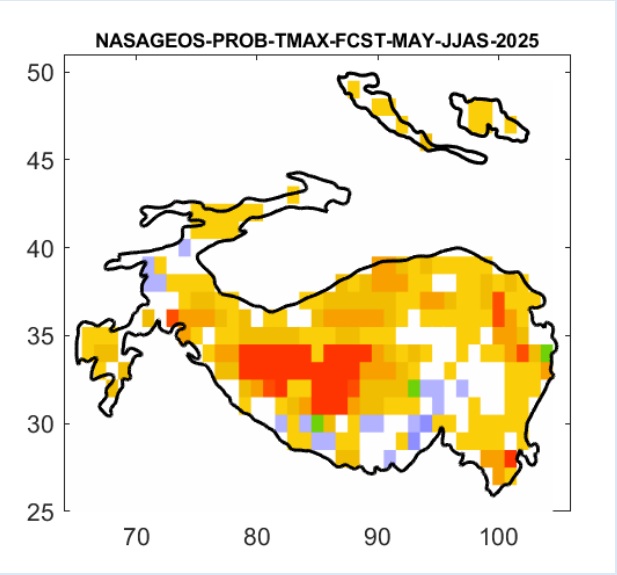
Precipitation Outlook for 2025 June-September season (May IC)



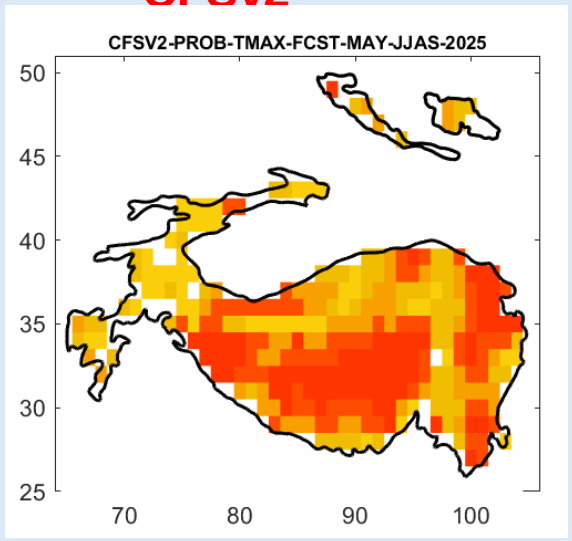
Above-normal precipitation is most likely during the Monsoon season (June to September 2025) over most parts of the Third Pole Region.

Climate Model Temperature (Tmax) forecast 2025 June-September season (May IC)

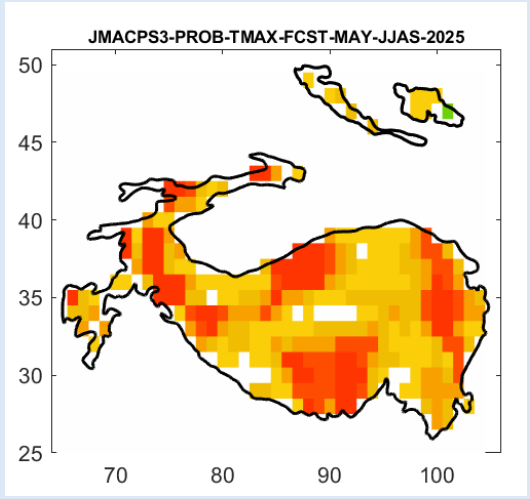
NASA



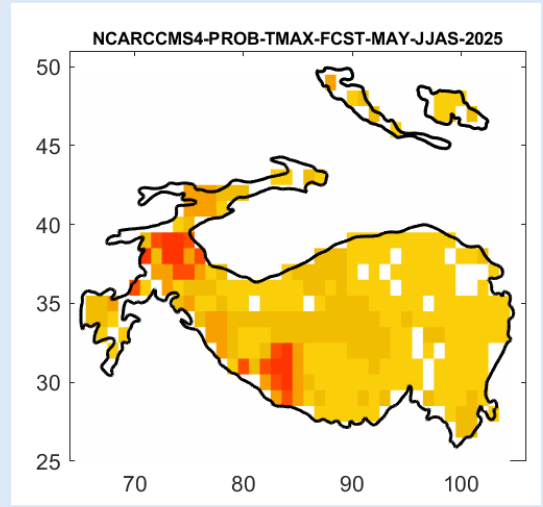
CFSv2



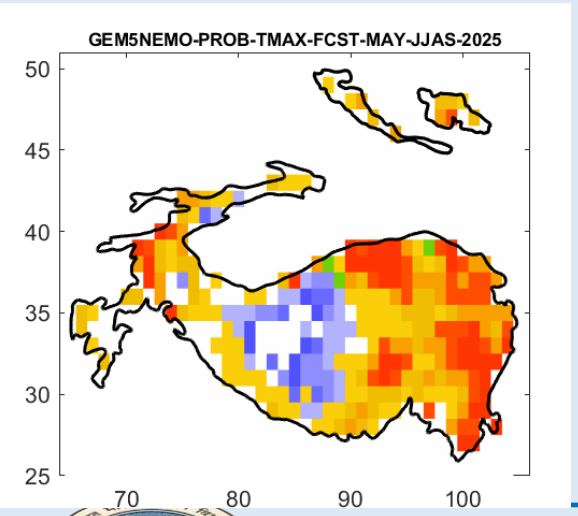
JMA



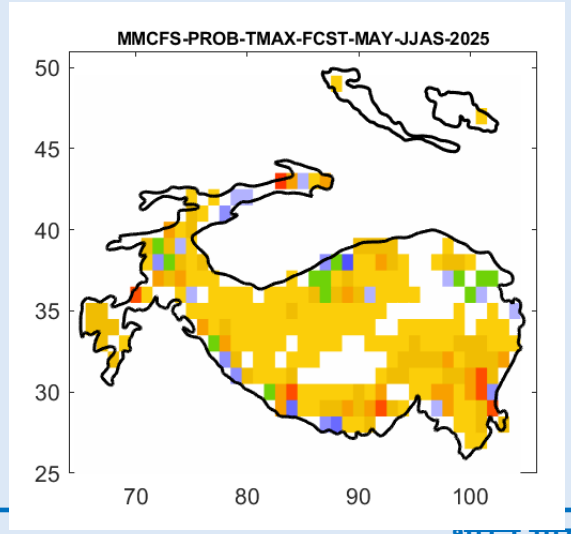
NCAR-CCSM



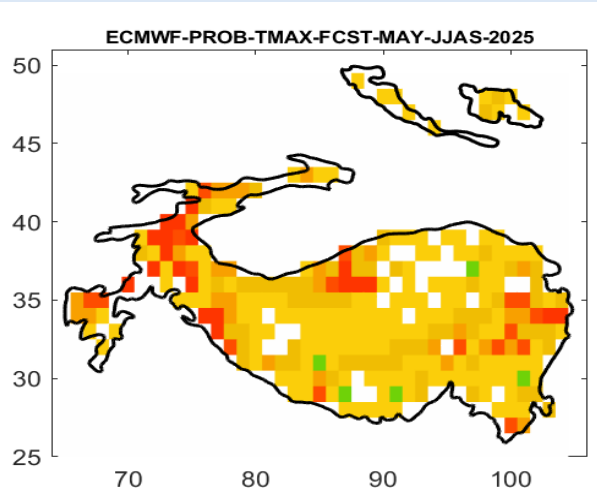
GEM-NEMO



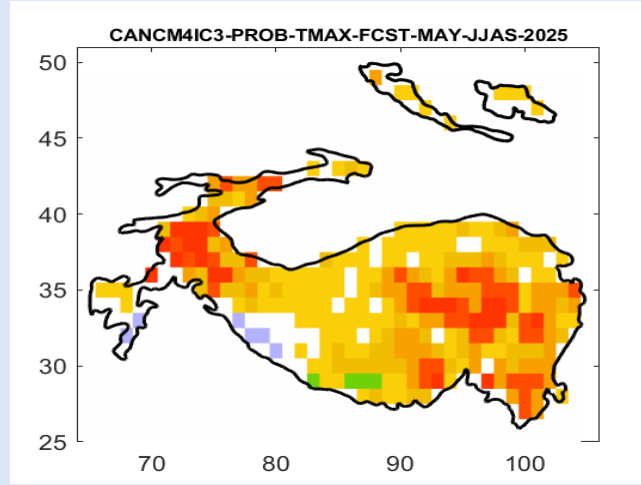
MMCFS

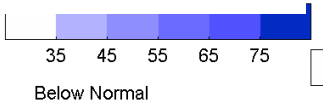


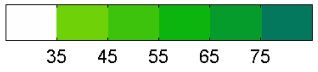
ECMWF

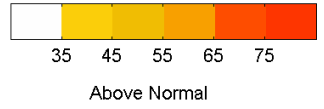


CANCM-4i









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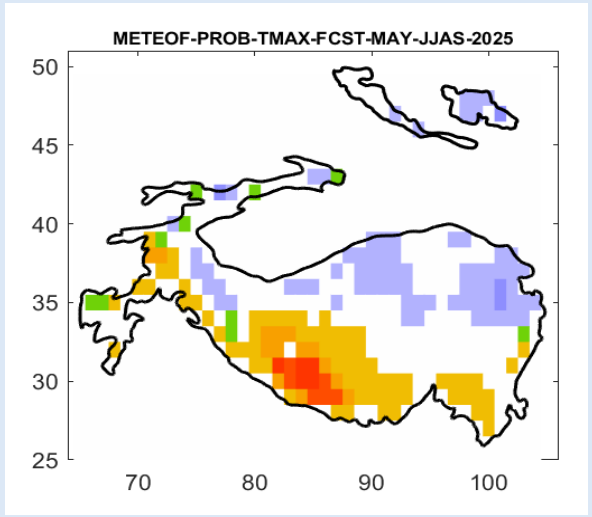
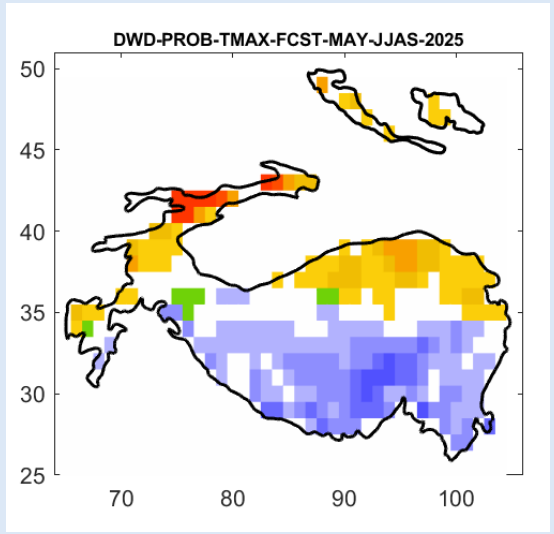
INDIA METEOROLOGICAL DEPARTMEN

Climate Model Temperature (Tmax) forecast 2025 June-September season (May IC)

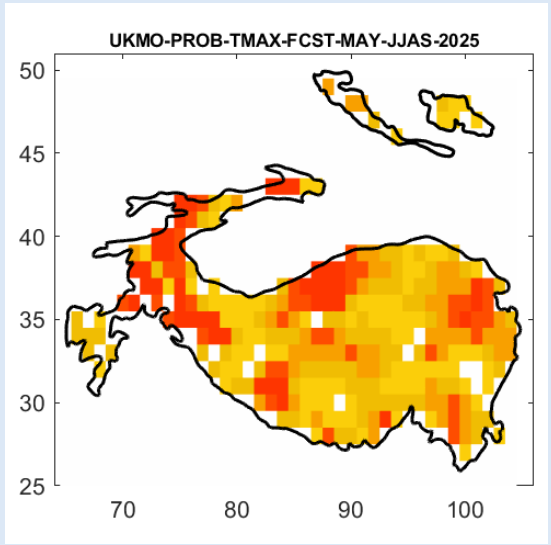
METEO_FR



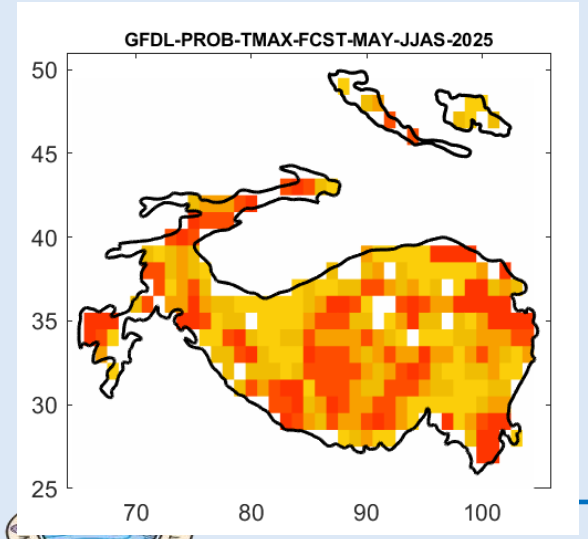
DWD



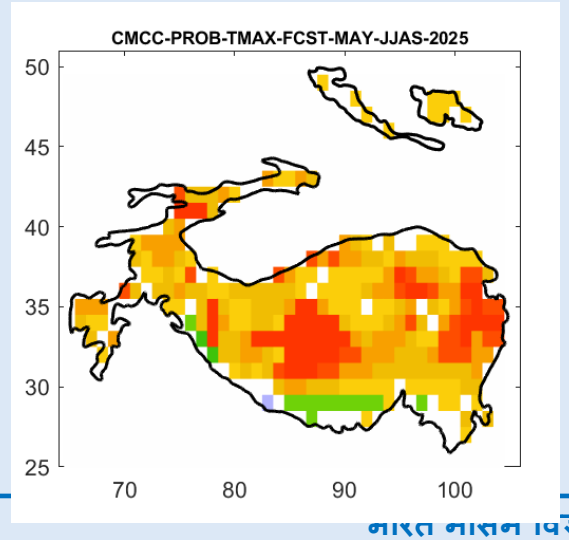
UKMO



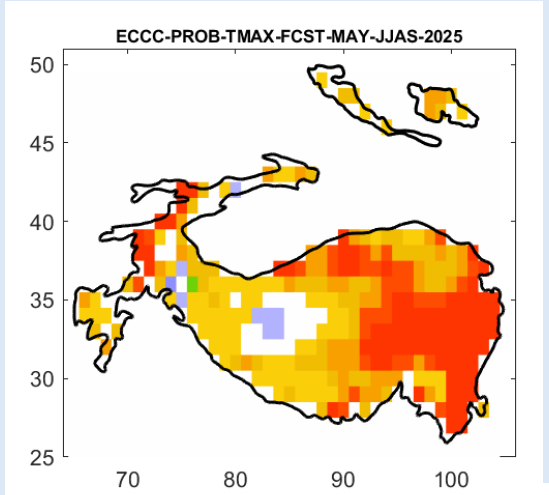
GFDL

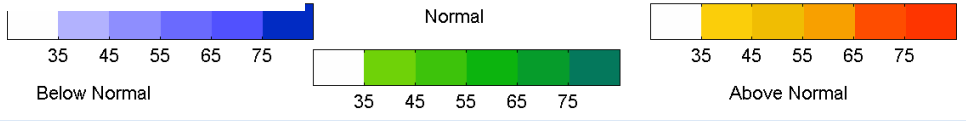


CMCC



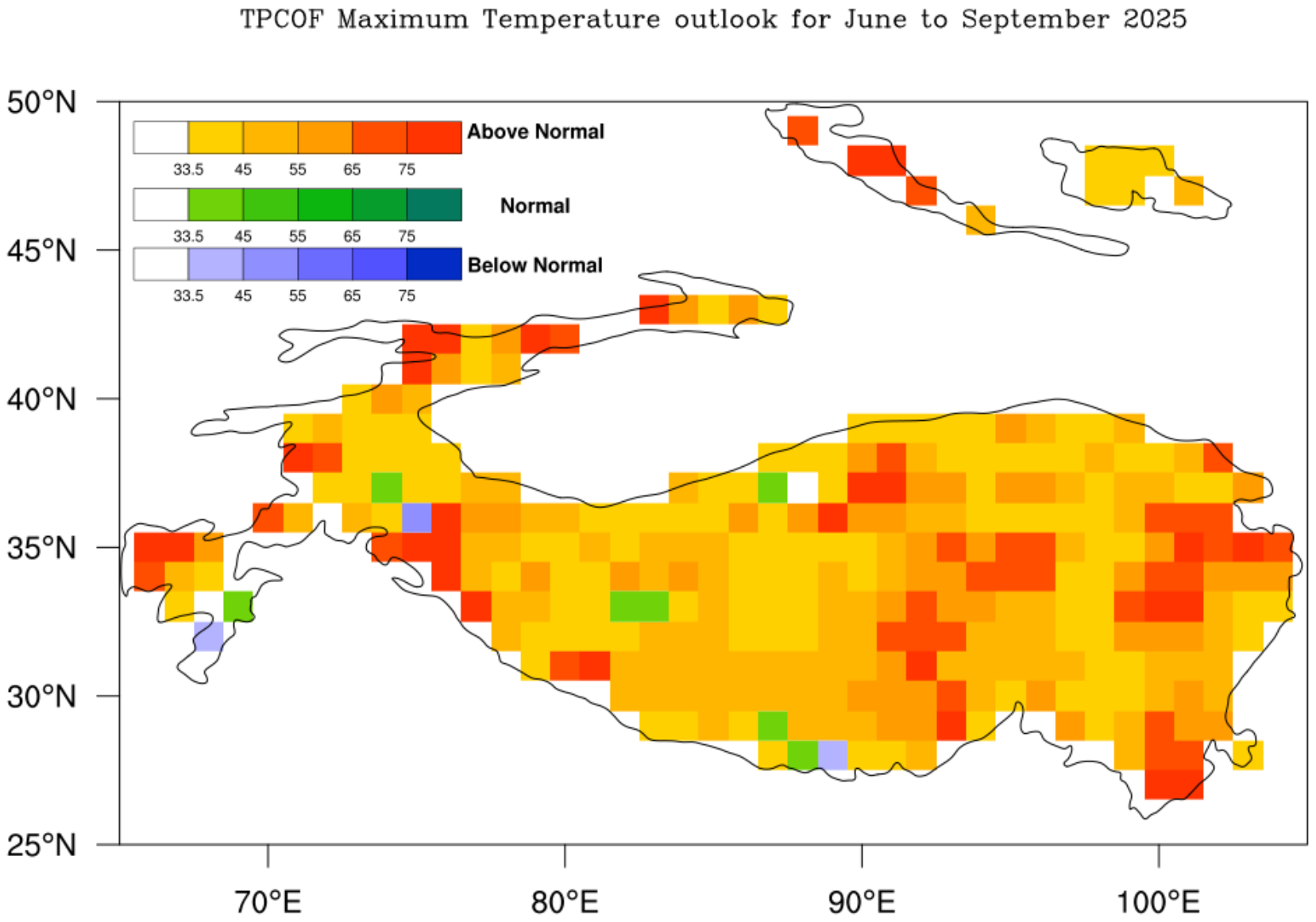
ECCC





Models Name	Models Skills (CC)	Model Skill (IOA)
CANSIPIC3	0.46	0.14
CFSV2	0.44	0.06
GEM5NEMO	0.41	0.09
ECCC	0.36	0.07
NCARCCMS4	0.31	0.08
CANCM4IC3	0.29	0.3
DWD	0.29	0.1
GFDL	0.22	0.22
NASAGEOS	0.2	0.1
ECMWF	0.17	0.08
MMCFS	0.16	0.1
CMCC	0.05	0.03
UKMO	0	0.04
METEOF	-0.05	0.08
JMACPS3	-0.12	0.02

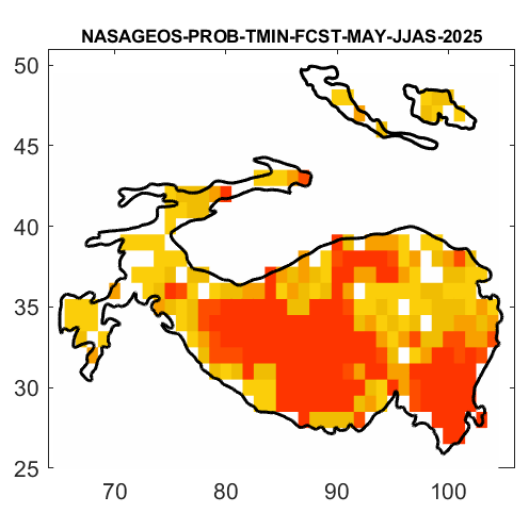
Maximum Temperature Outlook for 2025 June-September season (May IC)



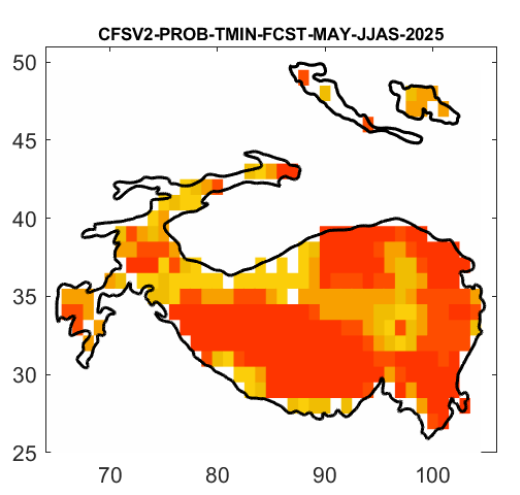
Above-normal Maximum temperature is most likely during the Monsoon season (June to September 2025) over most parts of the Third Pole Region.

Climate Model Temperature (Tmin) forecast 2025 June-September season (May IC)

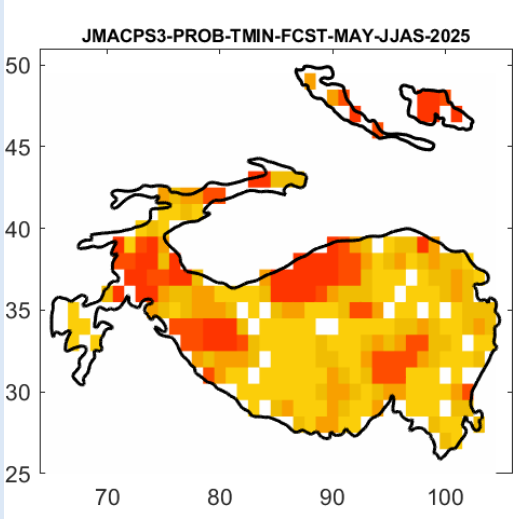
NASA



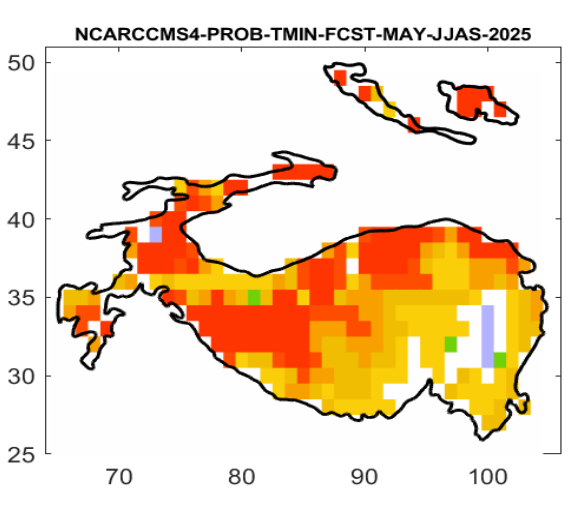
CFSv2



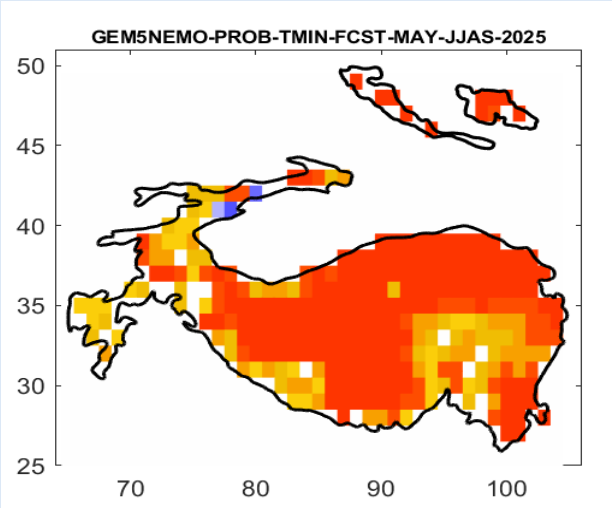
JMA



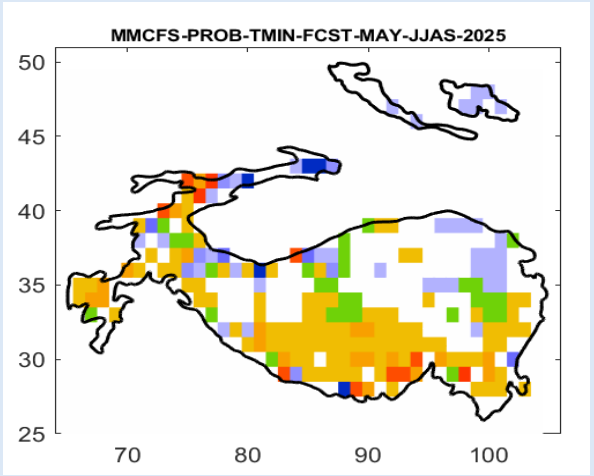
NCAR-CCSM



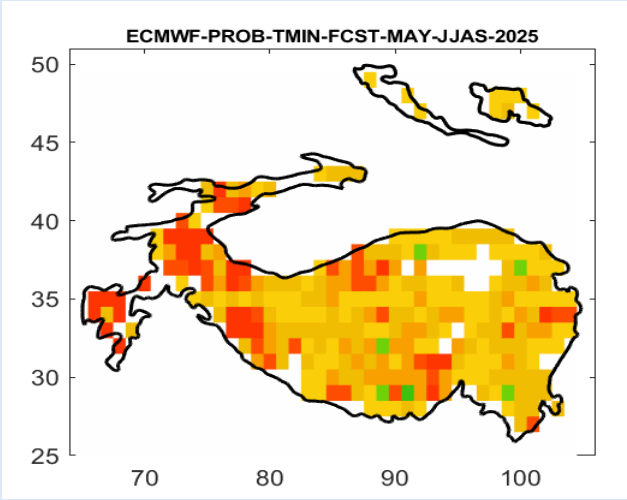
GEM-NEMO



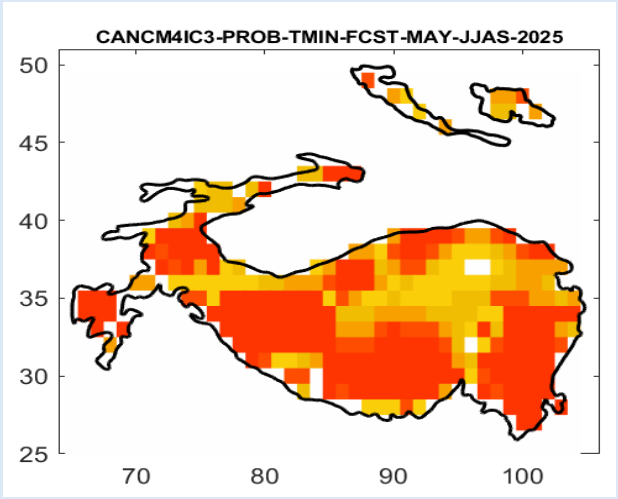
MMCFS

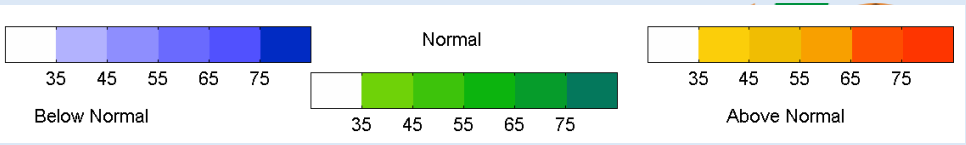


ECMWF



CANCM-4i

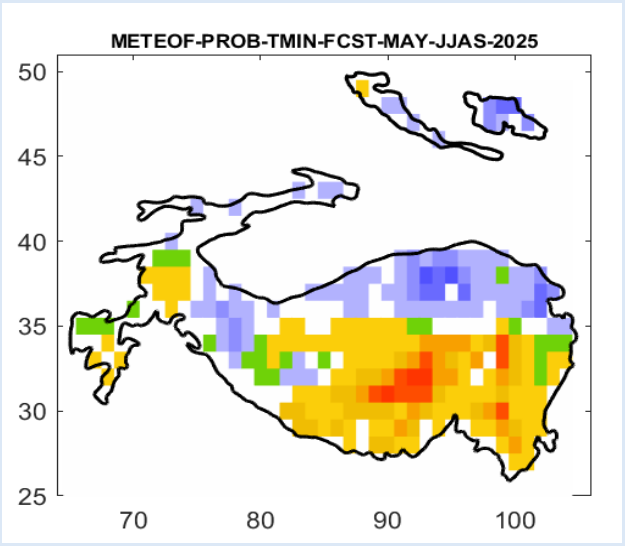




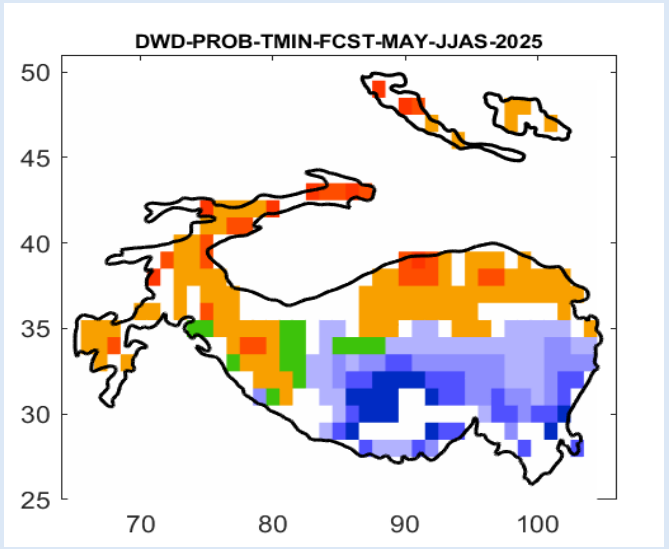
भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMEN

Climate Model Temperature (Tmin) forecast 2025 June-September season (May IC)

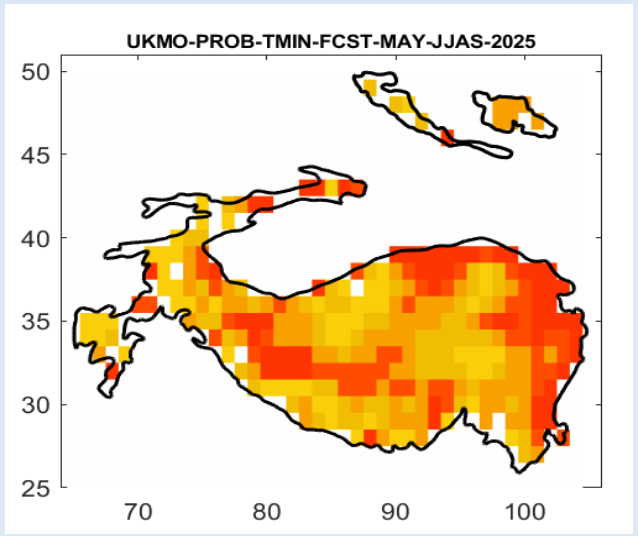
METEO_FR



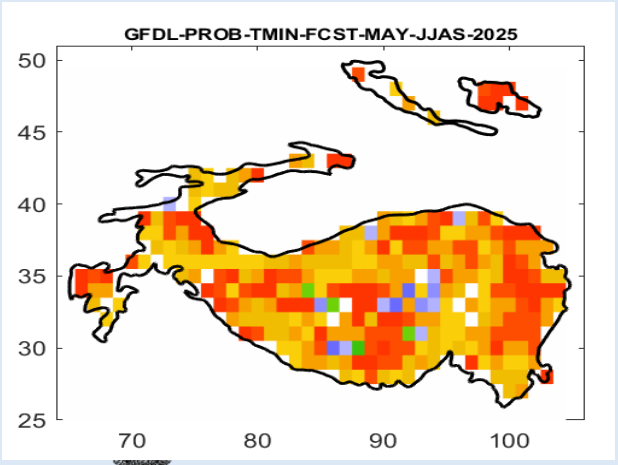
DWD



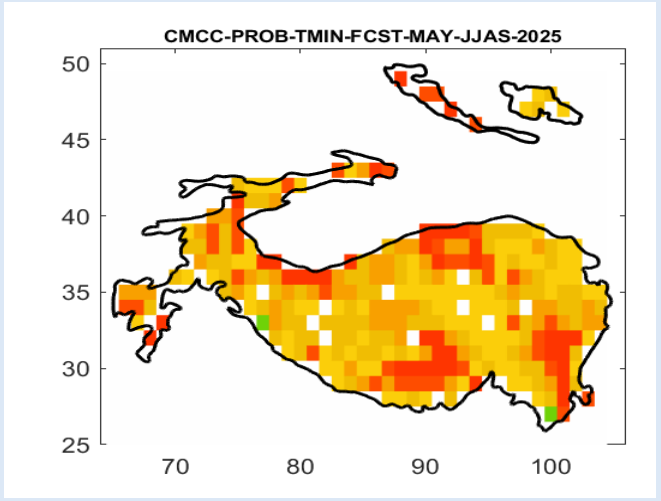
UKMO



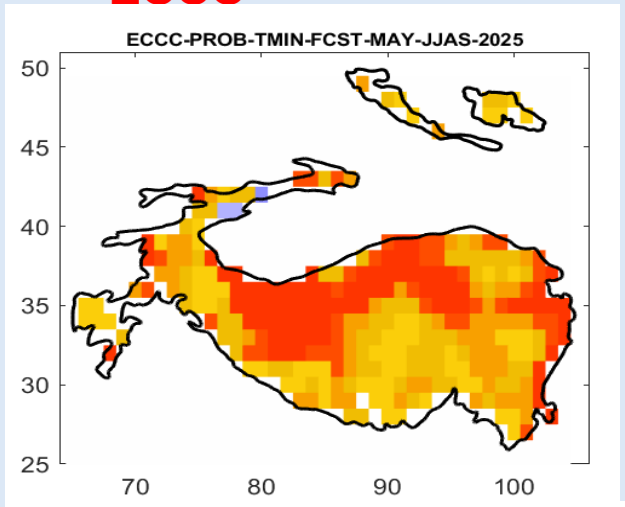
GFDL

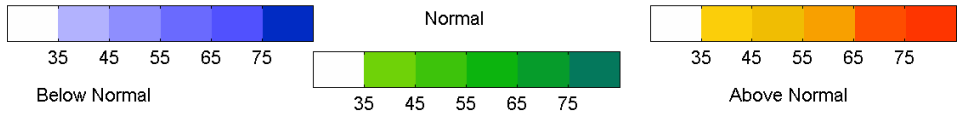


CMCC



ECCC

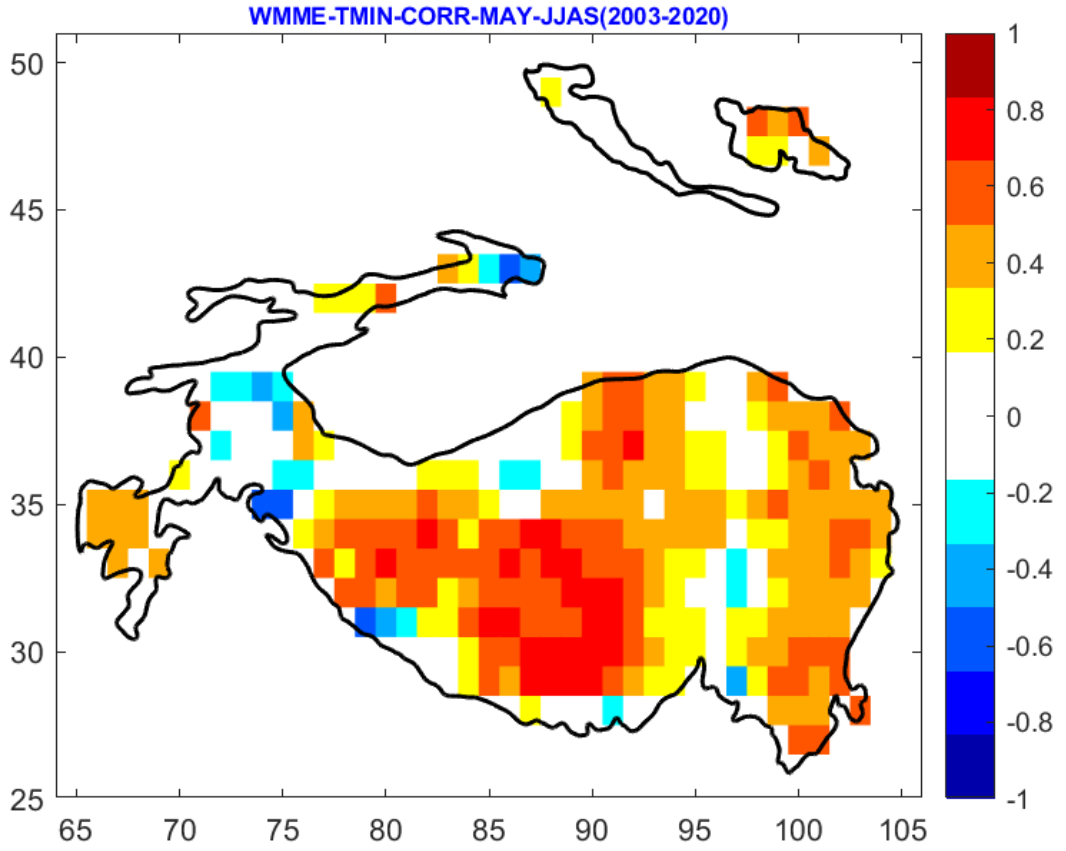




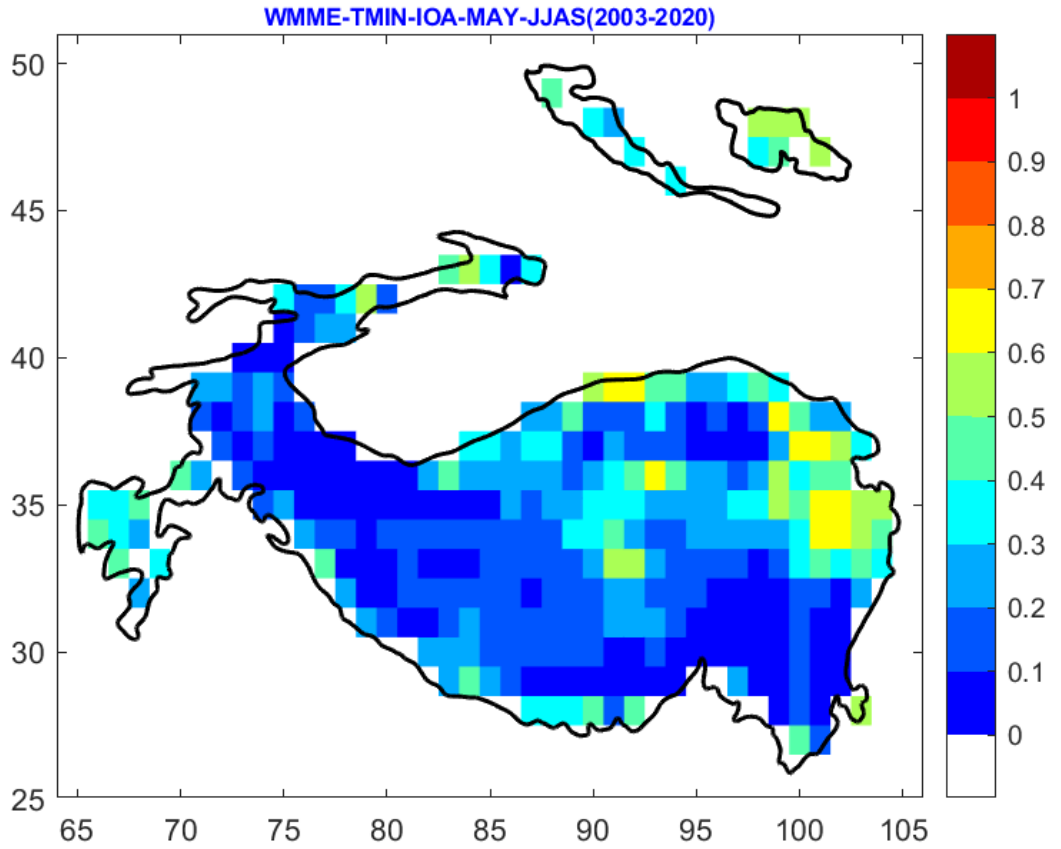
Models Name	Models Skills (CC)	Model Skill (IOA)
CFSV2	0.71	0.26
CANSIPIC3	0.69	0.15
NASAGEOS	0.68	0.1
GEM5NEMO	0.65	0.12
GFDL	0.61	0.05
NCARCCMS4	0.58	0.38
DWD	0.58	0.38
CANCM4IC3	0.54	0.2
ECCC	0.5	0.11
METEOF	0.49	0.1
UKMO	0.27	0.12
MMCFS	-0.12	0.18
ECMWF	-0.21	0.09
CMCC	-0.5	0.07
JMACPS3	-0.51	0.08

Skill (CC & Index of Agreement) Minimum Temperature forecast June-September season (May IC)

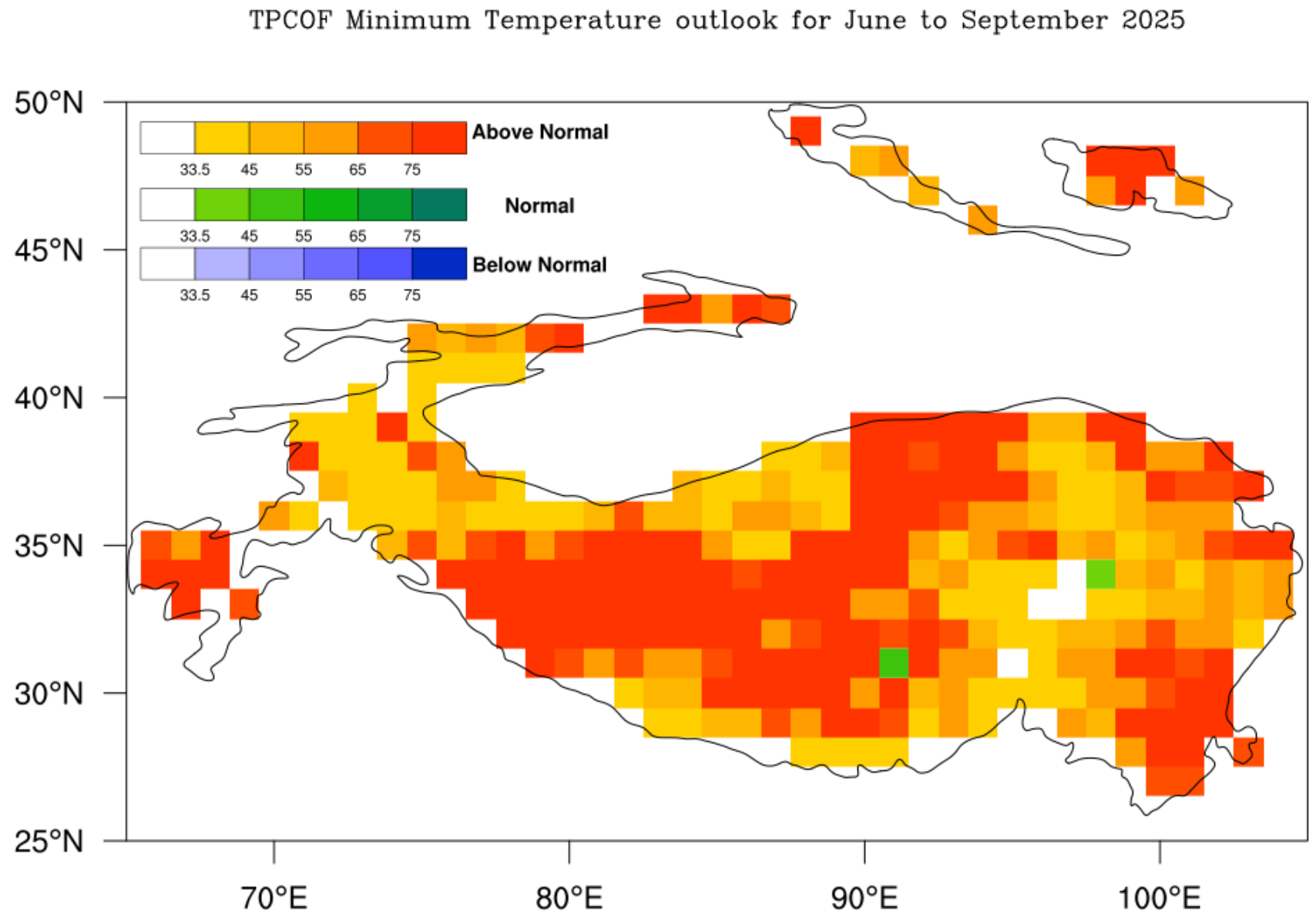
Correlation (C.C)



Index of Agreement (IOA)



Minimum Temperature Outlook for 2025 June-September season (May IC)

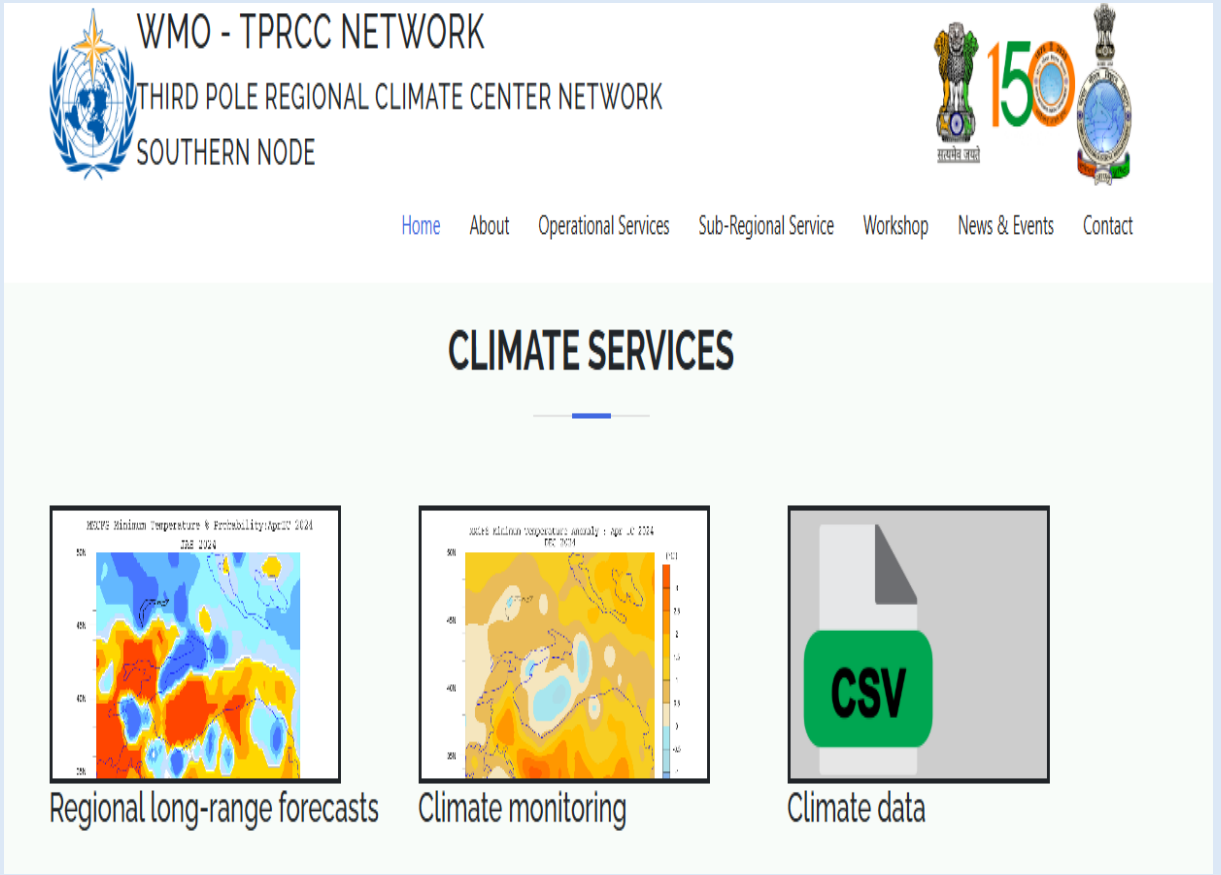


Above-normal Minimum temperature is most likely during the Monsoon season (June to September 2025) over most parts of the Third Pole Region.

Summary

- Currently, ENSO-neutral conditions are prevailing over the tropical Pacific Ocean. MMCFS forecast indicates ENSO neutral conditions are likely to continue during the 2025 Southwest Monsoon Season.
- MMCFS outlook indicates above-normal precipitation over most parts of the Third Pole region during the June to September 2025 season.
- Above-normal Maximum and Minimum temperatures are most likely during the Southwest Monsoon season 2025 over the Third Pole Region.

https://mausam.imd.gov.in/tprcc/



Thank you

धन्यवाद