



Third Pole Climate Forum



Verification of CMME Outlook for TPCF-3 and TPCF-4

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China Multi-model Ensemble Prediction System



中国多模式集合预测（CMME）系统2.0版本 China Multi-model Ensemble Prediction System v2.0

CMME-CPPS
气候现象
Climate Phenomena
Prediction

厄尔尼诺、热带大气季节内振荡、北极涛动、太平洋副热带高压等
ENSO, MJO, AO, WPSH, et al.

CMME-S2D
季节-年代际
Seasonal to Decadal

年际年代际(建设中)、滚动季、逐月
Interannual & Decadal (under construction), Seasonal, Monthly

CMME-S2S
次季节-季节
Subseasonal to Seasonal

次月、逐旬、逐候、日(过程)
Next month, Ten days, Pentad, Daily

CMME-VECOM
预测检验
Verification and Evaluation

历史回报、实时预测、确定性、概率预测
Hindcast, Forecast, Deterministic Prediction, Probabilistic Prediction

建立多模式预测业务标准
Multi-model prediction
operational standards

投入业务应用，开展实时预测与评分检验
Operational application, realtime prediction
and verification

完成历史回算，评估CMME系统性能
Retrospective prediction and assessment

搭建理论框架，初步建立CMME系统
Build the theory framework, develop
the CMME system

Based on several domestic operationally-run climate models and internationally imported data, Beijing Climate Centre has established the China Multi-model Ensemble Prediction System(CMME). It provides the prediction and verification products of basic climate elements such as temperature and precipitation, as well as the primary climate variability modes.



CMME-CPPS Products

China Multimodel Ensemble Prediction System (CMMEv2.0)

Introduction

Seasonal to Decadal
(CMME-S2D)

Sub-seasonal to Seasonal
(CMME-S2S)

Climate Phenomena
(CMME-CPPS)

Verification and Evaluation
(CMME-CPPS)

Pacific Ocean Index

Indian Ocean Index

Atlantic Ocean Index

WPSH

SAH

MJO AO

Nino34

Nino3

Nino4

Nino12

NinoEP

NinoCP

NinoA

IOBM

IOD

SIOD

NASTI

NTASST

AtlNino

Area Intensity

Ridge Lon

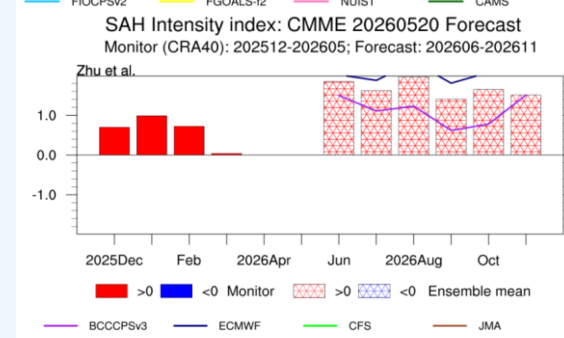
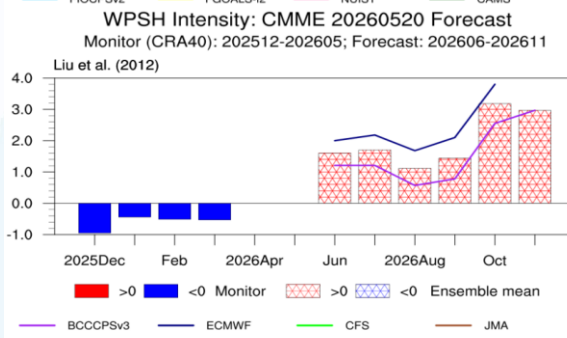
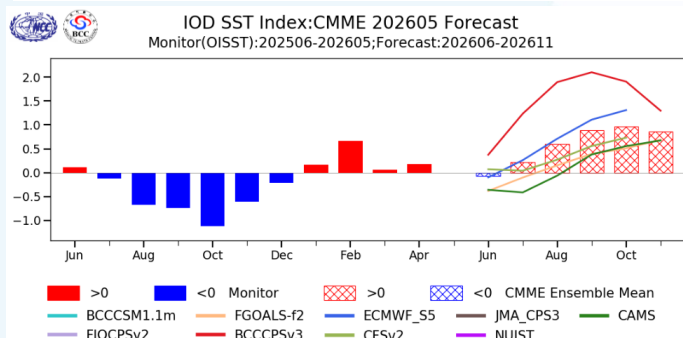
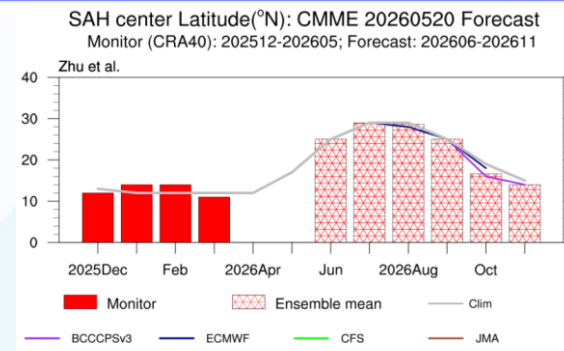
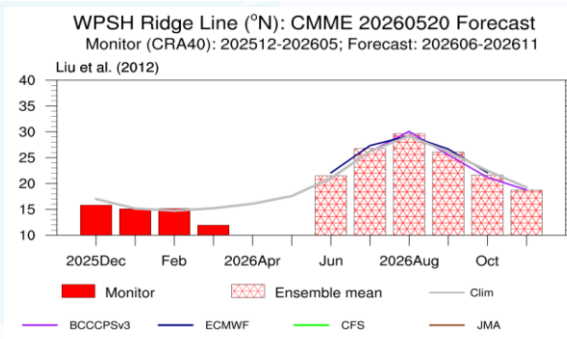
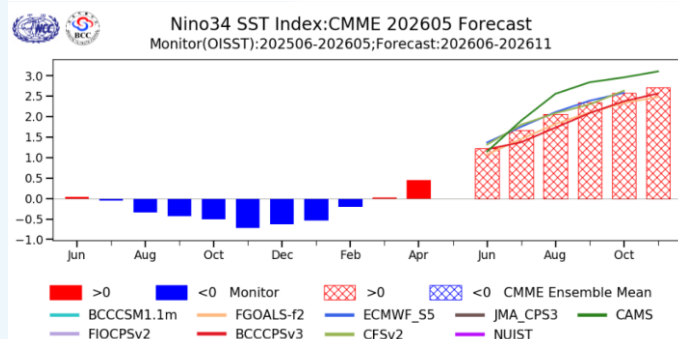
Ridge Lat

Intensity CenterLon

CenterLat

MJO

AO



Monitoring and Multi-model Prediction of Ocean SST Indices

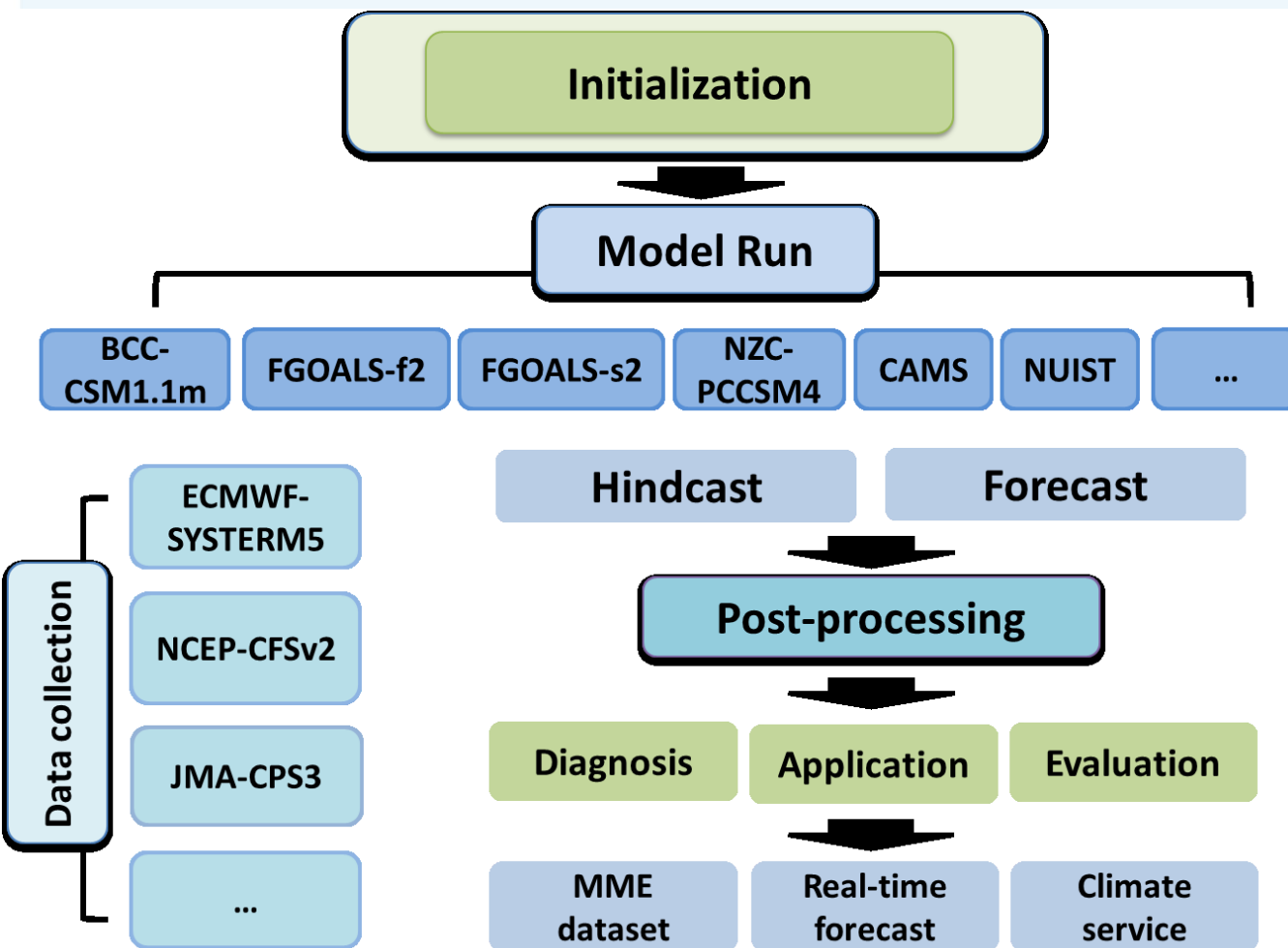
Monitoring and Multi-model Prediction of West Pacific Subtropical High Indices

Monitoring and Multi-model Prediction of South Asian High Indices



CMME-S2D Products

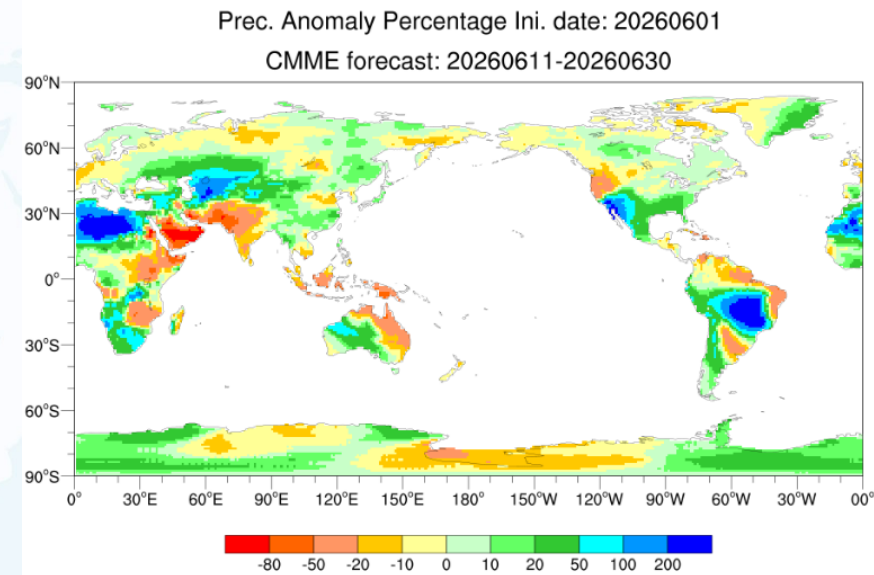
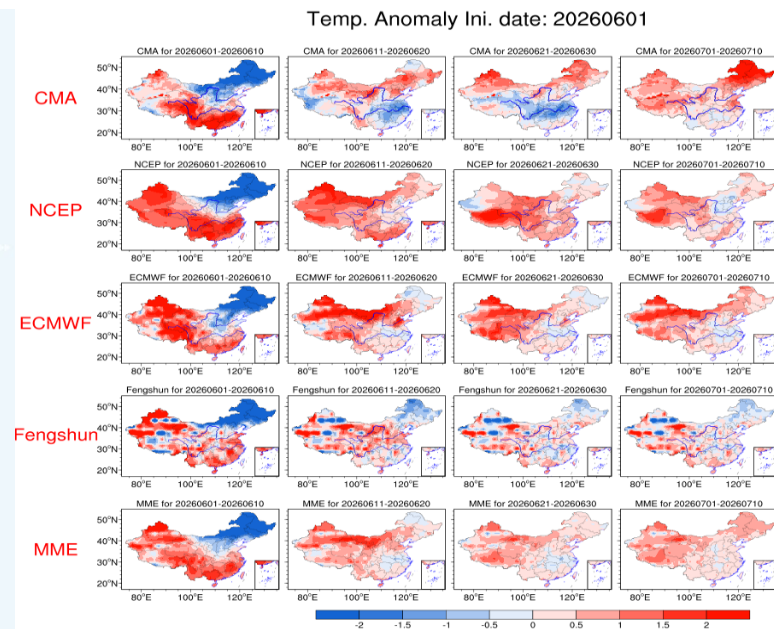
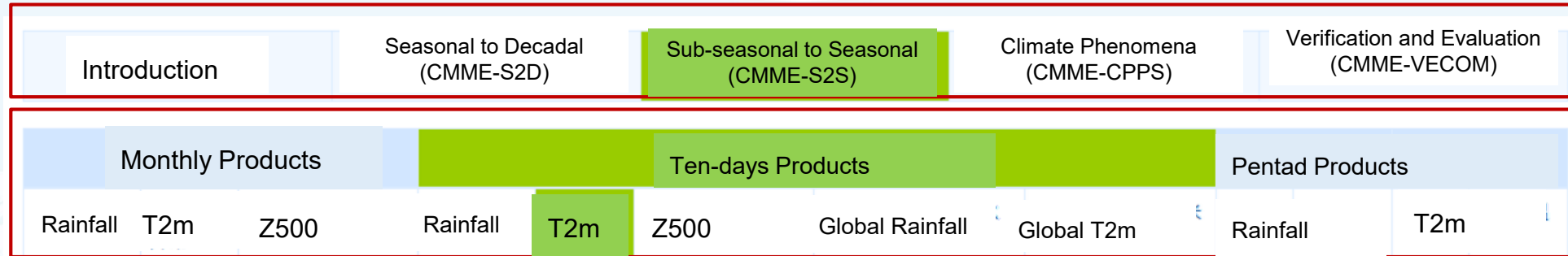
CMME-S2D Structure



CMME Models

Model	Nation	Institut ion	Relea se	Atms Res	Ocean Res	Ens	Fcs Len (mon)
BCCCS M1.1m	China	BCC	2015	T106, L26	1/3°~30 km, L40	24	13
FGOAL S-f2	China	IAP	2017	1×1, L32	1×1, L50	35	6
FIO- CPSv2	China	FIO	2019	0.9×1.25, L30	1.1×(0.2 7- 0.54),L6 1	10	12
ECMWF- S5	Euro	ECMWF	2017	T319, L91	ORCA 0.25, L75	15	6
NCEP- CFSv2	USA	NCEP	2011	T126, L64	1×1, L40	4	10
JMA- CPS3	Japan	JMA	2022	TL319, L100	0.25 x 0.25, L60	100	6
CAMS	China	CAMS	2020	T106, L31	1×1, L50	8	6
NUIST	China	NUIST	2019	T106, L19	2×2(赤道0.5), L40	9	24
CMACP Sv3	China	CMA	2021	T266, L56	1/4°	20	6-7

CMME-S2S Products (Products: ten-day)



Ten-day forecast: Provide forecasts of precipitation, temperature, and H500 for each mode and multimodal ensemble on the first day of each ten-day

Ten-day forecast: Provide forecasts of precipitation and temperature for multimodal ensemble on 1st and 6th day of each month



CMME-VECOM Products



The historic and real-time verification products of each model member in CMME is provided by VECOM

Verification and Evaluation system
of Climate Operational products in prediction Models (VECOMv3.0)

SEASON Models: BCC_CSM1.1m\ECMWF_S5\NCEP_CFS2\FGOALS_f2\
FGOALS_s2\JMA_CPS3\NUIST\CAMS\NZC_PCCSM4...

S2S Models: CMME-S2S

Global、Regional、
China
Grids+Stations

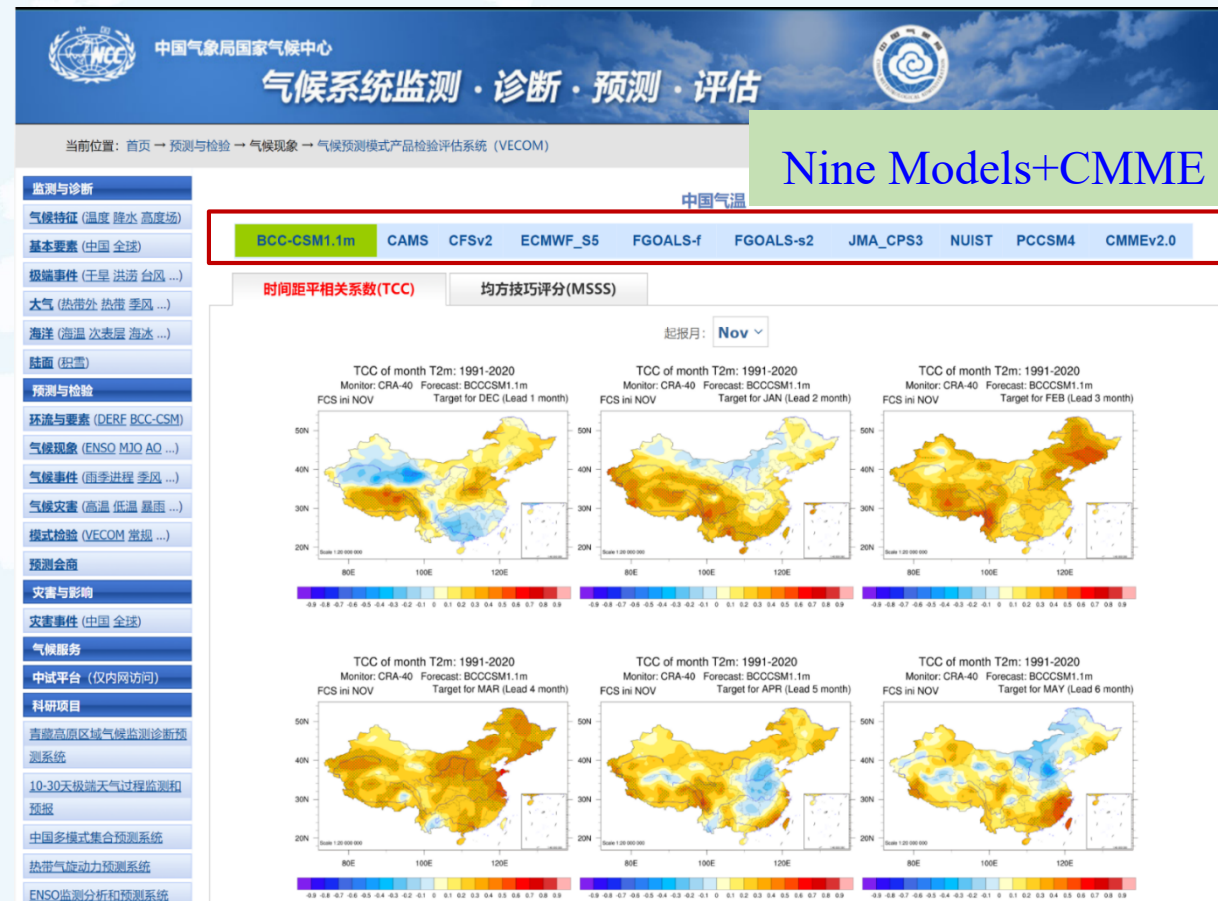
Climate variables
T2m
Pre
Circulations

Climate Phenomenons
ENSO MJO IOD NAST
WPSH
EASM

Deterministic+Probabilistic Predictions

Hindcast Assessment

Real-time Assessment





Verifications for TPCF-3



- Method: ACC, Ps scores et al.

TCC is recommended for **historical verification**

ACC is recommended for **real-time verification**

$$TCC_i = \frac{\sum_{j=1}^N (x_{i,j} - \bar{x}_i)(y_j - \bar{y})}{\sqrt{\sum_{j=1}^N (x_{i,j} - \bar{x}_i)^2} \sqrt{\sum_{j=1}^N (y_j - \bar{y})^2}}$$

$$ACC_j = \frac{\sum_{i=1}^M \Delta x_{i,j} \Delta y_{i,j}}{\sqrt{\sum_{j=1}^M \Delta x_{i,j}^2} \sqrt{\sum_{j=1}^M \Delta y_{i,j}^2}}$$

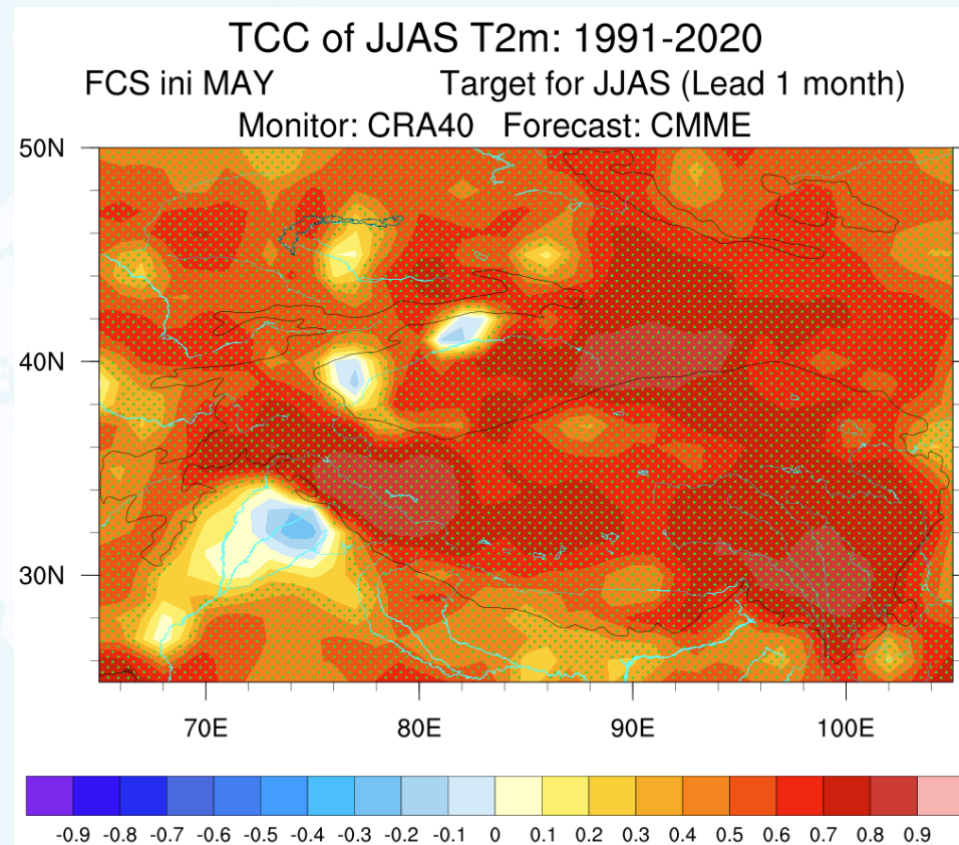
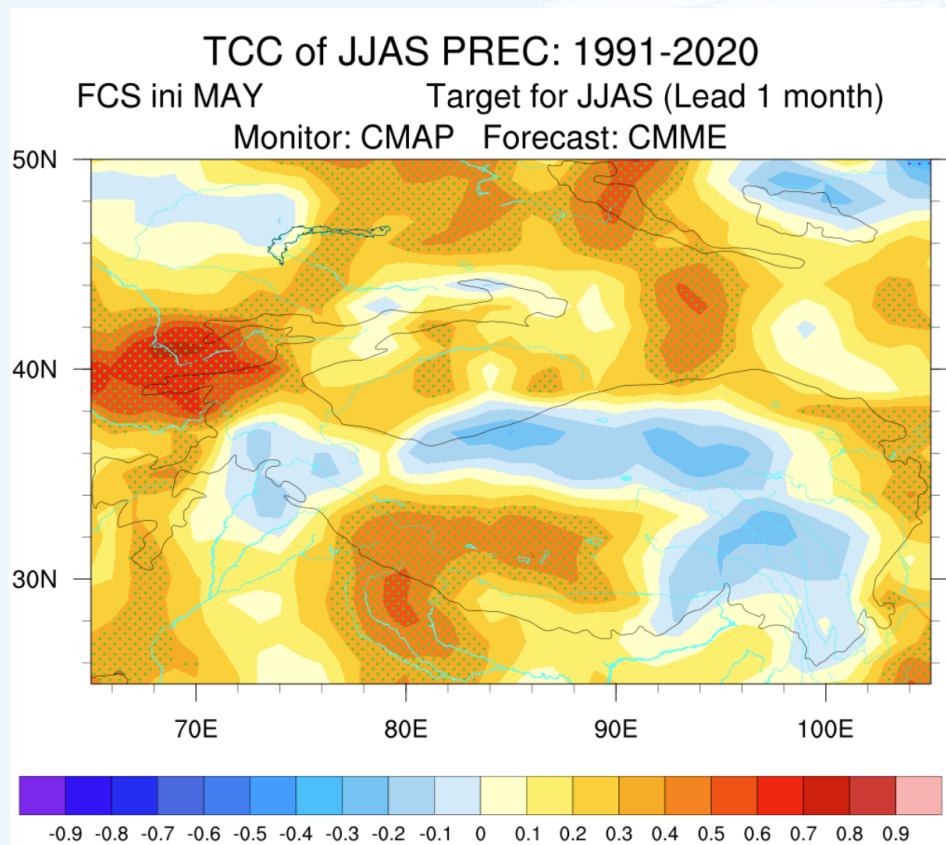
Gridded CRA-40 from CMA and precipitation from CMAP are used for verification



Verifications for TPCF-3



- Method: TCC, ACC, Ps scores et al.





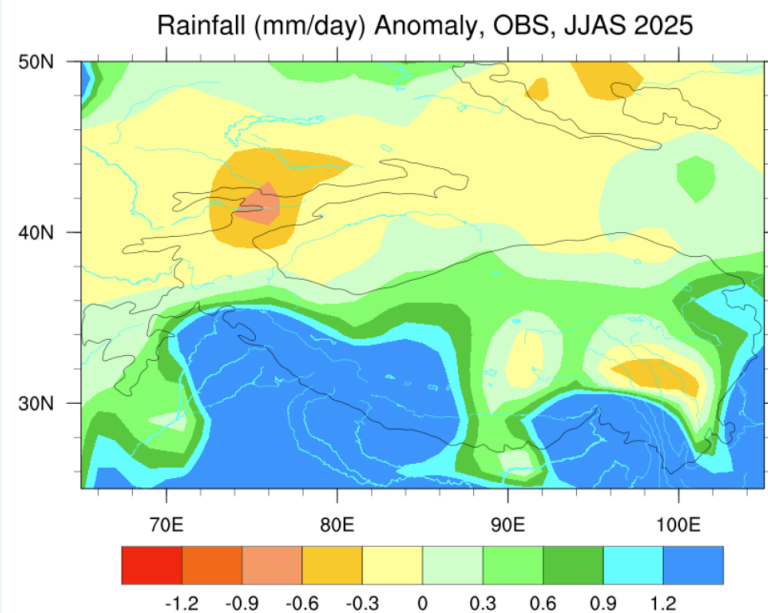
Verification products for TPCF3

CMA Deterministic Prediction



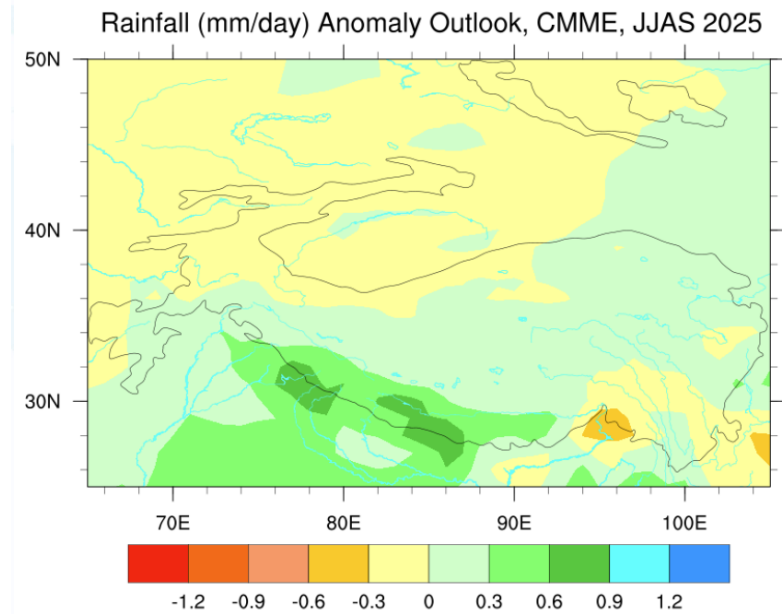
- **Variables:** Precipitation Anomaly, **Relative to:** 1991-2020 **IC:** May

OBS

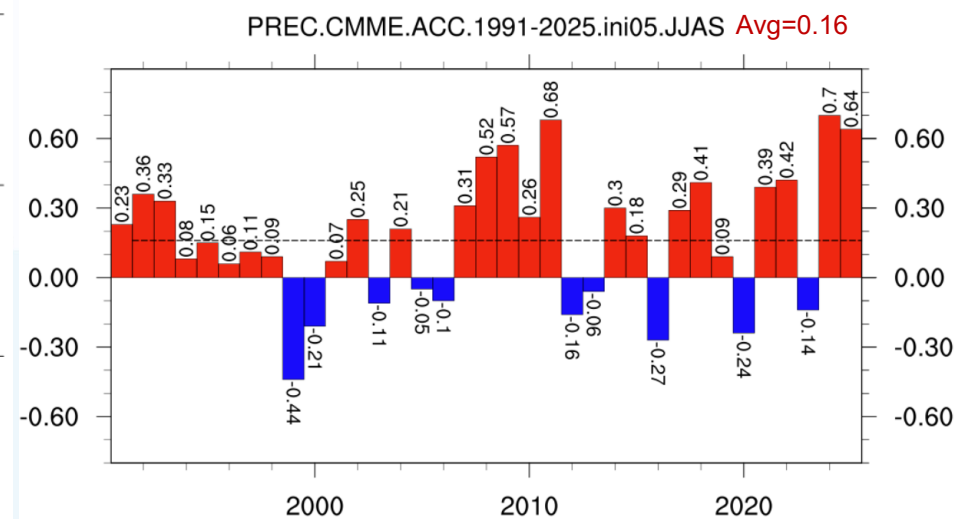


Outlook

ACC=0.64



Record 3rd of ACC since 1991





Verification products for TPCF3

CMA Deterministic Prediction



- Variables: Precipitation Anomaly, Relative to: 1991-2020 IC: May

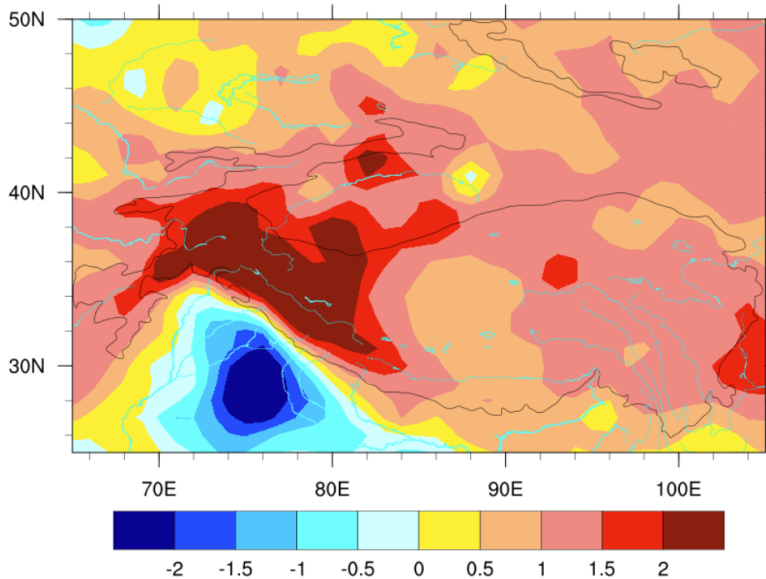
OBS

Outlook

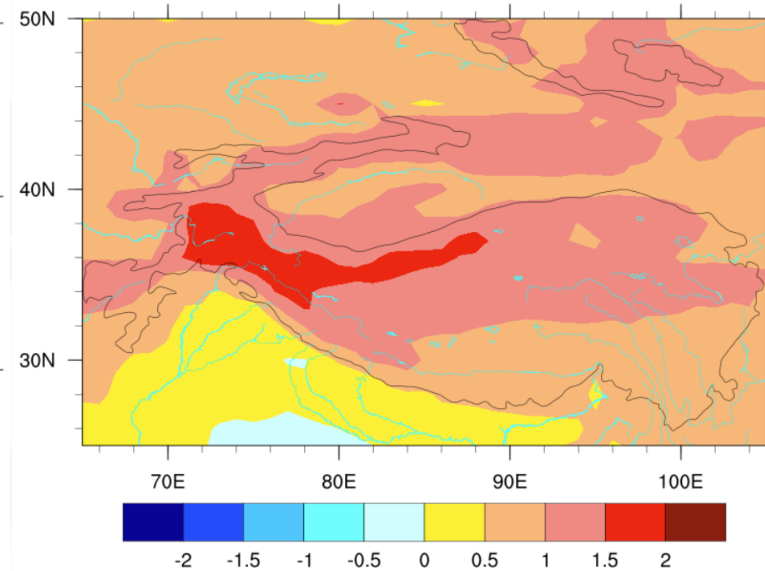
ACC=0.664

Record 3rd of ACC since 1991

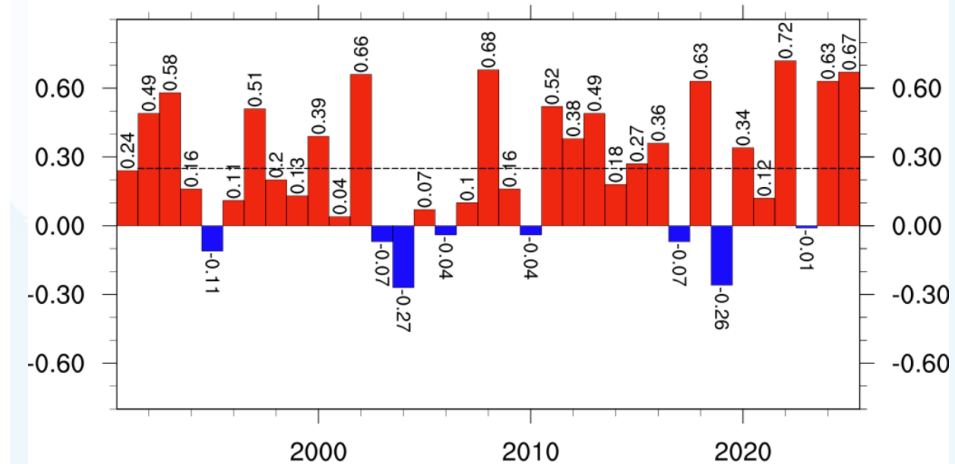
Temperature (degC) Anomaly, OBS, JJAS 2025



Temperature (degC) Anomaly Outlook, CMME, JJAS 2025



T2m.CMME.ACC.1991-2025.ini05.JJAS Avg=0.25



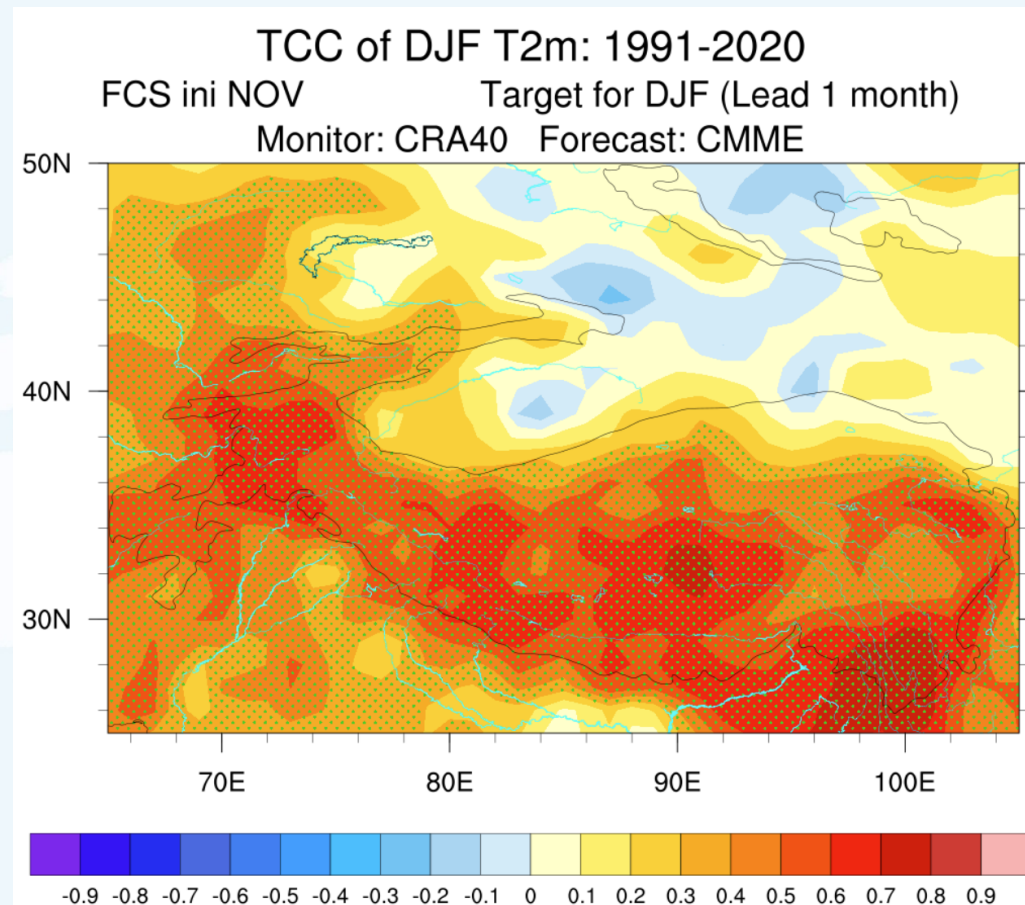
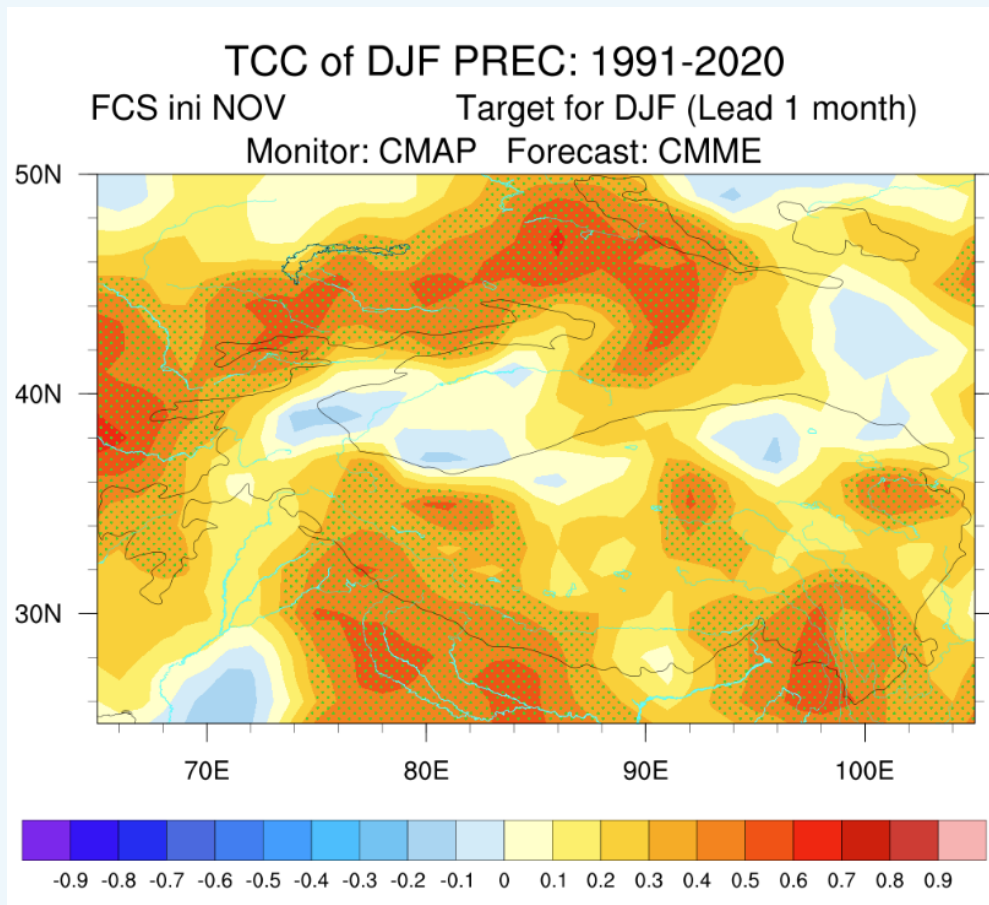


Verifications for TPCF-4



● Method: TCC, ACC scores et al.

● Target: DJF



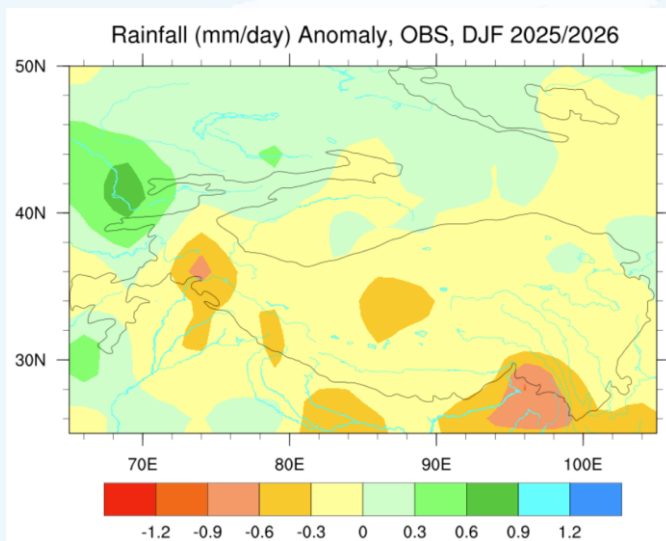
Gridded CRA-40 from CMA and precipitation from CMAP are used for verification

CMME-S2D Deterministic Prediction



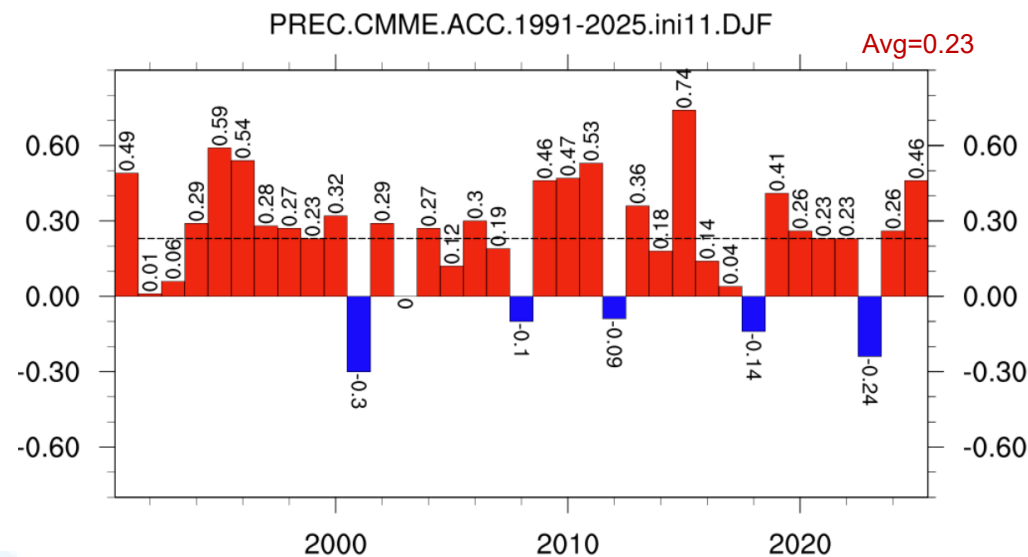
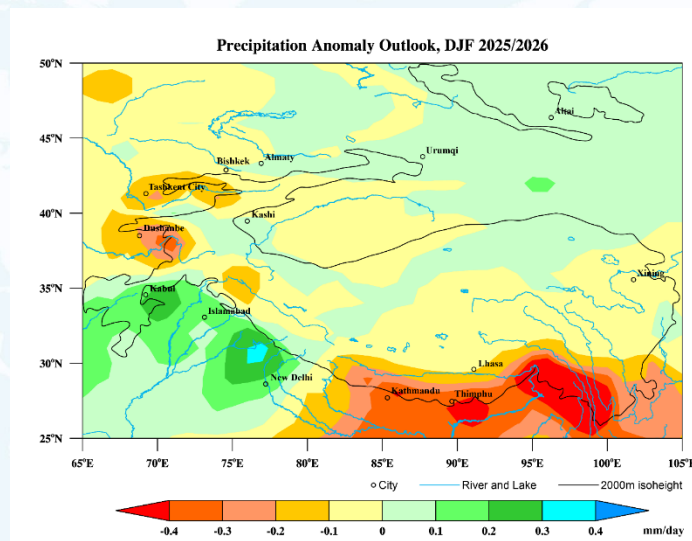
- **Variables:** Precipitation Anomaly, **Relative to:** 1991-2020 **IC: Nov**

OBS



Outlook

ACC=0.46



CMME-S2D Deterministic Prediction



- Variables: T2m anomaly

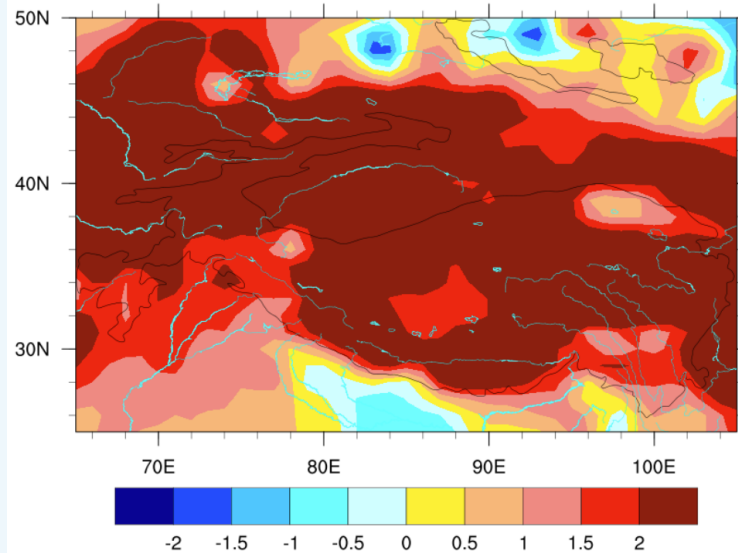
Relative to: 1991-2020 IC: Nov

Outlook

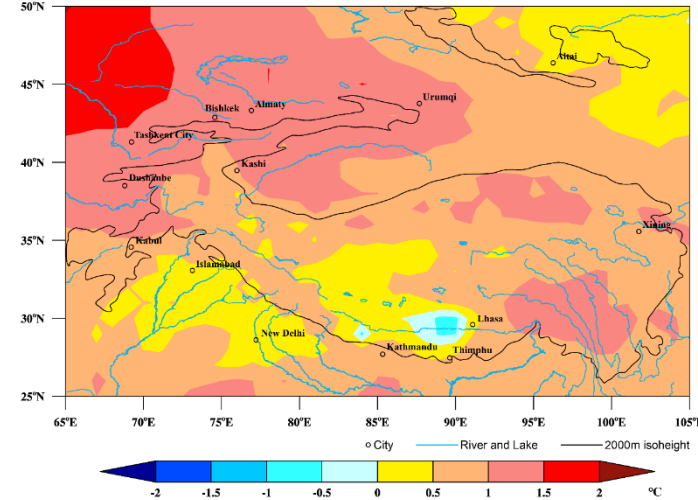
ACC=0.49

OBS

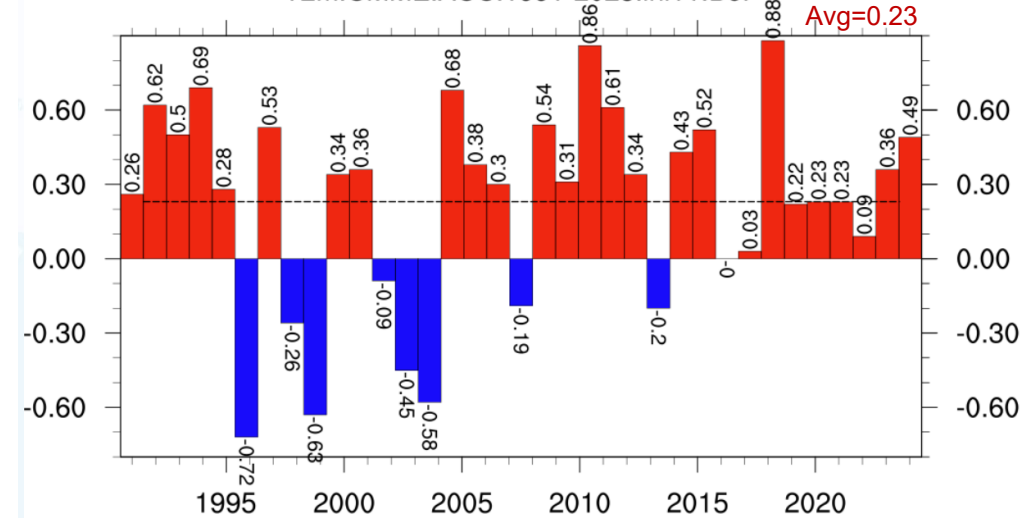
Temperature (degC) Anomaly, OBS, DJF 2025/2026



Temperature Anomaly Outlook, DJF 2025/2026



T2m.CMME.ACC.1991-2025.ini11.DJF





Take-home Messages



Evaluation

- 1. CMME shows reasonable predictability in JJAS and DJF seasons in recent years.
- 2. The TCC of precipitation is relatively higher in DJF than in JJAS. But the TCC of SAT is higher in JJAS than in DJF.
- 3. CMME showed very high skills for TPCF-3 and higher than climatic mean ACC for TPCF-4.



Thanks