WMO Third Pole RCC Network
(In Demonstration Phase)

Methodology for the Operational Climate Prediction

1. The Seasonal Outlook Logistics:

The Pakistan Meteorological Department (PMD), as the lead of the Western Node, is responsible for developing climate prediction (CP) function for the service domain of TPRCC-Network on an operational basis using outputs from Global Circulation Models (GCMs). Model selection for monthly and seasonal outlooks is based on their performance skill against observed datasets, with only sufficiently skillful models retained. These selected models form the basis of the Multi-Model Ensemble (MME) monthly and seasonal prediction. The models currently utilized for this purpose are listed below, including their institutional affiliations and modeling systems. The number of ensemble members for each model for their respective hindcast and forecast outputs are also included:

	Institution/Modeling System	Ens (Hindcast/Forecast)
1	APCC-SCoPS	10/10
2	BOM-ACCESS-S2	3/11
3	CMCC-SPS3.5	40/50
4	CWA-TCWA1Tv1.1	30/30
5	HMC-SL-AV	10/20
6	KMA-GloSea6GC3.2	12/42
7	METFR-SYS9	25/51
8	MGO-MGOAM2.4	6/10
9	NASA-GEOS-S2S-2.1	4/10
10	PNU-CGCMv2	35/35
11	UKMO-GLOSEA6	28/42
12	ECCC-CANSIPSv3	20/20

This document focuses on the selection of forecast models for operational seasonal outlooks, for each month and the rolling seasons.

Deterministic Outlook

The deterministic outlook is produced using the Simple Composite Method (SCM), whereby the ensemble mean of recommended individual model outputs is computed with equal weighting, regardless of individual performance (Min et al., 2014). Model anomalies are calculated relative to their own hindcast climatology for the 1993–2016 reference period.

Probabilistic Outlook

The tercile-based probabilistic outlook incorporates all ensemble members and presents the probabilities of Above Normal, Near Normal, or Below Normal conditions for each parameter, following the approach proposed by (Min et al., 2009).

2. MME Model Selection Criteria

Seasonal climate outlooks rely on selecting skillful models for reliable forecasts. Model selection is guided by statistical performance metrics; correlation, Index of Agreement (IOA), and Root Mean Square Error (RMSE) to evaluate accuracy against observations.

Observation datasets:

- Precipitation: NOAA Climate Prediction Center (CPC) monthly data
- Surface air temperature: ECMWF Reanalysis v5 (ERA5) data

These datasets are compared with GCM Hindcasts to compute skill scores for model assessment.

Model Skill Assessment

Figures 1-3 showing on the webpage represent the spatial maps of correlation, IOA and RMSE respectively between observed and simulated precipitation and temperature in each season. The area-averaged statistical metrics for precipitation and temperature are annexed to this document.

The tables in Annex-I summarize the metrics in the rolling seasons, whereas the tables in Annex-II contain the metrics outputs for each month of the year. For each season and variable, models are ranked according to their performance in the respective statistical metrics. A total rank is computed by assigning equal weight to all metrics. Models are then ordered based on their total rank values, with lower scores indicating better overall performance. This systematic approach facilitates the identification of models demonstrating comparatively higher predictive skill.

However, the rank-based assessment is not applied mechanically. In cases where a model exhibits physically inconsistent or unsatisfactory performance in a key metric, such as a negative correlation coefficient, it is excluded from selection, even if it performs well in other measures (e.g., higher Index of Agreement (IOA) or lower RMSE) and attains a favorable total rank. This safeguard prevents compensatory effects among metrics from masking fundamental deficiencies and ensures that only models with consistent and robust predictive skill are considered for operational outlook preparation.

Nevertheless, if strict application of this criterion results in the exclusion of a majority of models for a particular season, a pragmatic compromise is adopted. In such cases, models demonstrating comparatively better performance in the remaining metrics are retained to maintain an adequate

ensemble size. For example, for precipitation outlook for the AMJ season, models such as ECCC, KMA, UKMO, and METFR are selected despite exhibiting negative correlation coefficients, as they show comparatively stronger performance in IOA and RMSE relative to other available models. This balanced approach ensures both methodological rigor and operational feasibility in MME construction.

3. Summary

The model evaluation demonstrates that the selection of GCMs for MME forecasting should be based on a balanced assessment of correlation, IOA, and RMSE, ensuring the inclusion of models with consistent skill across different metrics and seasons. By excluding low-skill models, the MME approach improves forecast reliability, reducing noise from poorly performing models. Consistent application of this methodology ensures a robust operational system for both seasonal and monthly forecasts in the region.

Below tables summarize the outcomes of the model screening process for precipitation (Table 1 and 3) and temperature (Table 2 and 4), indicating the models retained or excluded for operational seasonal (Table 1 and 2) and monthly (Table 3 and 4) outlook preparation.

Table 1 Model Retention Matrix for Seasonal Precipitation Outlook

Model	Precipitation											
	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ	DJF
APCC	-	-	-	-	-	-	-	-	-	-	✓	-
BOM	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMCC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CWA	-	-	✓	-	-	-	✓	-	-	-	✓	-
ECCC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HMC	✓	-	✓	-	✓	✓	✓	✓	✓	-	-	✓
KMA	✓	✓	-	✓	-	-	✓	✓	✓	✓	✓	✓
METFR	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	✓
MGO	-	-	-	-	-	✓	✓	✓	✓	-	✓	✓
NASA	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓
PNU	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓	✓
UKMO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 2 Model Retention Matrix for Seasonal Temperature Outlook

Model	Temperature											
	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ	DJF
APCC	-	-	-	-	-	-	-	-	-	-	-	-

BOM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMCC	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
CWA	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	-
ECCC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HMC	✓	✓	✓	-	-	-	✓	✓	✓	✓	✓	✓
KMA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
METFR	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
MGO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NASA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
PNU	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓
UKMO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 3 Model Retention Matrix for Monthly Precipitation Outlook

Model	**Precipitation**											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
APCC	-	-	✓	-	✓	-	✓	✓	-	-	✓	-
BOM	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓
CMCC	-	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓
CWA	✓	-	-	✓	-	-	-	✓	✓	-	✓	✓
ECCC	✓	✓	✓	-	-	✓	✓	✓	✓	-	✓	✓
HMC	✓	✓	-	✓	✓	✓	✓	✓	-	✓	✓	✓
KMA	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓
METFR	-	✓	✓	-	-	✓	✓	✓	✓	-	✓	✓
MGO	-	-	-	-	-	✓	✓	✓	✓	-	-	✓
NASA	-	✓	-	✓	-	-	-	✓	✓	✓	✓	✓
PNU	-	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓
UKMO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 4 Model Retention Matrix for Monthly Temperature Outlook

Model	**Temperature**											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
APCC	-	-	-	-	-	-	-	-	-	-	-	✓
BOM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
CMCC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CWA	✓	✓	-	✓	✓	✓	-	✓	✓	✓	✓	✓
ECCC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HMC	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-

KMA	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
METFR	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MGO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NASA	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
PNU	✓	✓	-	✓	✓	-	✓	✓	✓	✓	✓	✓
UKMO	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

The results reaffirm that model skill varies significantly between parameters and seasons, making it essential to conduct independent evaluations for each variable and period. This targeted selection process enhances forecast accuracy, ultimately supporting better climate-related decision-making in the region.

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References

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Annex-I Model screening process at seasonal scale

Tables **I.**1–**I.**12 summarize the area-averaged statistical metrics for precipitation during the rolling seasons. Similarly, Tables **I.**13–**I.**24 present the corresponding results for temperature. These metrics provide a quantitative evaluation of each model's forecasting skill relative to observations. The models highlighted in red are those excluded due to lower skill based on various statistical metrics. In the event that data from any of the selected models are **not updated or become unavailable in due time**, an **alternative model with comparable skill**, as identified during the model evaluation phase, will be utilized to ensure the **continuity and consistency** of the forecast preparation process. Additionally, the procedure can still proceed even if a single model is excluded from the ensemble, as the impact is generally minimal when the forecast is based on a sufficient number of other **skillful models**.

Table I.1 Area averaged statistical metrics for precipitation (JFM)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
ECCC	0.44	0.28	0.38	5	2	3	10
BOM	0.50	0.25	0.44	2	4	5	11
KMA	0.43	0.28	0.38	7	3	2	12
CMCC	0.52	0.21	0.56	1	6	6	13
NASA	0.11	0.30	0.33	11	1	1	13
METFR	0.48	0.20	0.61	3	7	8	18
UKMO	0.37	0.25	0.44	9	5	4	18
PNU	0.44	0.19	0.66	4	9	9	22
APCC	-0.24	0.19	0.59	12	8	7	27
HMC	0.42	0.17	0.75	8	10	10	28
CWA	0.44	0.10	1.37	6	12	12	30
MGO	0.19	0.14	0.86	10	11	11	32

Table I.2 Area averaged statistical metrics for precipitation (FMA)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
NASA	0.37	0.28	0.49	5	1	1	7
ECCC	0.32	0.26	0.52	6	2	2	10
KMA	0.15	0.22	0.63	9	3	3	15
METFR	0.52	0.19	0.81	1	7	7	15
UKMO	0.24	0.21	0.67	8	4	5	17
BOM	0.24	0.21	0.68	7	5	6	18
CMCC	0.43	0.17	0.88	4	8	8	20
PNU	0.45	0.17	0.92	2	9	9	20
APCC	-0.07	0.20	0.67	12	6	4	22

CWA	0.44	0.11	1.53	3	12	12	27
HMC	0.09	0.14	1.12	10	10	10	30
MGO	0.08	0.13	1.25	11	11	11	33

Table I.3 Area averaged statistical metrics for precipitation (MAM)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
NASA	0.25	0.21	0.65	3	1	1	5
ECCC	0.14	0.20	0.71	7	2	2	11
UKMO	0.25	0.16	0.93	4	3	6	13
BOM	0.05	0.16	0.91	9	4	4	17
KMA	0.03	0.16	0.91	10	5	5	20
APCC	-0.24	0.16	0.89	12	6	3	21
CWA	0.32	0.13	1.23	2	9	9	20
CMCC	0.20	0.13	1.21	6	8	8	22
HMC	0.41	0.10	1.56	1	11	11	23
METFR	-0.02	0.15	1.02	11	7	7	25
PNU	0.24	0.12	1.29	5	10	10	25
MGO	0.05	0.09	1.75	8	12	12	32

Table I.4 Area averaged statistical metrics for precipitation (AMJ)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
NASA	0.19	0.26	0.62	1	1	1	3
BOM	0.09	0.18	0.99	2	4	4	10
ECCC	-0.18	0.21	0.79	9	2	2	13
KMA	-0.14	0.18	0.96	8	3	3	14
UKMO	-0.11	0.18	0.99	7	5	5	17
METFR	-0.05	0.16	1.16	5	6	8	19
CMCC	0.06	0.13	1.42	3	9	9	21
CWA	-0.56	0.16	1.13	12	7	6	25
APCC	-0.47	0.15	1.15	11	8	7	26
HMC	-0.02	0.11	1.81	4	11	11	26
PNU	-0.11	0.13	1.46	6	10	10	26
MGO	-0.32	0.09	2.13	10	12	12	34

Table I.5 Area averaged statistical metrics for precipitation (MJJ)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
NASA	0.03	0.34	0.55	8	1	1	10
ECCC	0.05	0.26	0.78	7	2	2	11
UKMO	0.05	0.23	0.98	6	4	5	15

BOM	0.06	0.22	1.02	5	6	6	17
KMA	-0.17	0.23	0.91	11	3	3	17
METFR	0.18	0.20	1.20	3	7	7	17
PNU	0.28	0.17	1.42	2	9	9	20
CMCC	0.43	0.17	1.47	1	10	10	21
CWA	-0.52	0.22	0.94	12	5	4	21
APCC	-0.16	0.18	1.27	10	8	8	26
HMC	0.15	0.13	1.88	4	11	11	26
MGO	-0.03	0.11	2.23	9	12	12	33

Table I.6 Area averaged statistical metrics for precipitation (JJA)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
NASA	0.29	0.39	0.55	5	1	1	7
ECCC	0.29	0.34	0.69	4	2	2	8
METFR	0.30	0.24	1.15	3	7	7	17
UKMO	0.25	0.27	0.96	7	5	5	17
CWA	-0.34	0.29	0.80	12	3	3	18
KMA	0.08	0.29	0.87	10	4	4	18
PNU	0.49	0.22	1.35	1	8	9	18
BOM	0.21	0.26	1.03	9	6	6	21
CMCC	0.45	0.21	1.40	2	10	10	22
HMC	0.29	0.17	1.77	6	11	11	28
APCC	-0.21	0.22	1.24	11	9	8	28
MGO	0.22	0.17	1.87	8	12	12	32

Table I.7 Area averaged statistical metrics for precipitation (JAS)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
ECCC	0.46	0.40	0.58	7	1	1	9
KMA	0.40	0.33	0.76	8	3	3	14
NASA	0.36	0.36	0.67	10	2	2	14
UKMO	0.49	0.32	0.85	6	4	4	14
BOM	0.54	0.31	0.89	5	5	5	15
METFR	0.57	0.27	1.04	2	7	6	15
PNU	0.56	0.27	1.04	3	6	7	16
CMCC	0.63	0.25	1.17	1	8	10	19
HMC	0.55	0.20	1.52	4	12	12	28
APCC	-0.11	0.24	1.08	12	9	8	29
CWA	0.10	0.24	1.15	11	10	9	30
MGO	0.37	0.22	1.37	9	11	11	31

Table I.8 Area averaged statistical metrics for precipitation (ASO)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
BOM	0.54	0.32	0.63	2	4	4	10
ECCC	0.45	0.33	0.59	7	1	2	10
KMA	0.43	0.33	0.59	9	2	1	12
NASA	0.43	0.32	0.60	8	3	3	14
PNU	0.53	0.29	0.72	3	6	6	15
UKMO	0.47	0.31	0.66	6	5	5	16
CMCC	0.65	0.24	0.93	1	9	9	19
METFR	0.48	0.25	0.86	5	8	8	21
CWA	-0.07	0.27	0.73	12	7	7	26
HMC	0.48	0.20	1.17	4	12	12	28
APCC	0.07	0.23	0.94	11	10	10	31
MGO	0.23	0.22	0.97	10	11	11	32

Table I.9 Area averaged statistical metrics for precipitation (SON)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
BOM	0.71	0.31	0.41	1	1	2	4
ECCC	0.42	0.30	0.42	5	2	3	10
KMA	0.33	0.30	0.41	7	3	1	11
NASA	0.49	0.26	0.51	4	5	5	14
UKMO	0.38	0.28	0.45	6	4	4	14
CMCC	0.53	0.22	0.65	2	6	6	14
METFR	0.10	0.20	0.70	10	7	7	24
PNU	0.16	0.20	0.70	9	8	8	25
MGO	0.50	0.17	0.90	3	12	12	27
HMC	0.30	0.19	0.76	8	10	10	28
APCC	0.09	0.19	0.73	11	9	9	29
CWA	0.07	0.18	0.77	12	11	11	34

Table I.10 Area averaged statistical metrics for precipitation (OND)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
BOM	0.17	0.27	0.29	3	2	2	7
KMA	0.12	0.27	0.29	5	1	1	7
UKMO	0.14	0.25	0.32	4	3	3	10
CMCC	0.30	0.19	0.45	1	6	6	13
METFR	0.26	0.17	0.52	2	8	8	18
ECCC	-0.04	0.23	0.35	10	4	5	19
NASA	-0.13	0.22	0.34	11	5	4	20
APCC	-0.02	0.17	0.51	9	7	7	23

PNU	0.12	0.13	0.68	6	10	10	26
HMC	-0.13	0.16	0.54	12	9	9	30
MGO	-0.02	0.11	0.81	8	11	11	30
CWA	0.01	0.08	1.15	7	12	12	31

Table I.11 Area averaged statistical metrics for precipitation (NDJ)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
KMA	0.59	0.41	0.23	2	1	1	4
BOM	0.57	0.37	0.25	4	2	2	8
UKMO	0.55	0.35	0.27	6	3	3	12
CMCC	0.59	0.27	0.37	3	6	6	15
ECCC	0.42	0.28	0.34	8	5	5	18
NASA	0.35	0.30	0.31	10	4	4	18
METFR	0.50	0.24	0.42	7	7	7	21
PNU	0.62	0.19	0.62	1	10	10	21
APCC	0.29	0.23	0.44	11	8	8	27
CWA	0.57	0.15	0.77	5	11	12	28
HMC	0.07	0.20	0.49	12	9	9	30
MGO	0.35	0.15	0.76	9	12	11	32

Table I.12 Area averaged statistical metrics for precipitation (DJF)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
BOM	0.70	0.39	0.27	3	2	2	7
KMA	0.56	0.44	0.23	6	1	1	8
CMCC	0.74	0.35	0.33	1	5	5	11
UKMO	0.61	0.39	0.27	5	3	3	11
ECCC	0.73	0.31	0.36	2	6	6	14
NASA	0.34	0.35	0.28	10	4	4	18
METFR	0.48	0.29	0.39	9	7	7	23
MGO	0.68	0.18	0.73	4	11	11	26
HMC	0.15	0.24	0.47	11	8	9	28
PNU	0.51	0.21	0.59	8	10	10	28
APCC	-0.19	0.23	0.45	12	9	8	29
CWA	0.52	0.16	0.79	7	12	12	31

Table I.13 Area averaged statistical metrics for temperature (JFM)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
PNU	0.43	0.52	0.86	5	4	1	10
CMCC	0.43	0.55	1.21	6	1	4	11

MGO	0.44	0.53	1.29	4	3	5	12
CWA	0.36	0.54	0.89	9	2	2	13
NASA	0.46	0.48	1.91	2	5	8	15
UKMO	0.31	0.47	0.90	10	6	3	19
HMC	0.38	0.46	1.88	8	7	7	22
KMA	0.46	0.44	2.17	3	9	10	22
METFR	0.49	0.40	2.52	1	11	11	23
ECCC	0.30	0.46	1.82	11	8	6	25
APCC	0.41	0.30	3.88	7	12	12	31
BOM	0.20	0.41	2.15	12	10	9	31

Table I.14 Area averaged statistical metrics for temperature (FMA)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.52	0.59	0.69	2	1	1	4
CMCC	0.39	0.50	1.22	8	3	3	14
MGO	0.29	0.53	0.92	11	2	2	15
PNU	0.50	0.47	1.58	3	6	6	15
ECCC	0.47	0.42	1.94	4	7	7	18
NASA	0.33	0.49	1.46	10	4	5	19
CWA	0.29	0.48	1.24	12	5	4	21
HMC	0.55	0.35	2.73	1	11	11	23
METFR	0.40	0.40	2.04	7	8	8	23
KMA	0.45	0.39	2.27	5	9	10	24
BOM	0.37	0.38	2.26	9	10	9	28
APCC	0.41	0.24	4.43	6	12	12	30

Table I.15 Area averaged statistical metrics for temperature (MAM)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.63	0.73	0.54	3	1	1	5
KMA	0.67	0.71	0.54	2	2	2	6
MGO	0.46	0.53	0.66	7	4	3	14
ECCC	0.68	0.46	1.59	1	7	7	15
NASA	0.46	0.56	0.89	8	3	4	15
BOM	0.57	0.49	1.38	5	6	6	17
METFR	0.44	0.52	1.00	9	5	5	19
PNU	0.58	0.34	2.32	4	8	9	21
HMC	0.49	0.28	3.18	6	10	10	26
CWA	0.05	0.33	2.30	11	9	8	28
APCC	0.39	0.22	4.23	10	11	11	32
CMCC	-0.08	0.00	4.45	12	12	12	36

Table I.16 Area averaged statistical metrics for temperature (AMJ)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.63	0.74	0.36	3	1	1	5
KMA	0.65	0.73	0.40	2	2	2	6
MGO	0.60	0.66	0.40	5	4	3	12
BOM	0.59	0.72	0.44	6	3	4	13
ECCC	0.68	0.49	0.97	1	7	8	16
CMCC	0.47	0.58	0.49	8	5	5	18
METFR	0.51	0.57	0.52	7	6	6	19
PNU	0.62	0.23	2.60	4	10	10	24
NASA	0.36	0.46	0.87	11	8	7	26
CWA	0.47	0.25	2.27	9	9	9	27
APCC	0.43	0.15	4.18	10	12	12	34
HMC	0.31	0.18	3.45	12	11	11	34

Table I.17 Area averaged statistical metrics for temperature (MJJ)

Models	**Correlation**	**IOA**	**RMSE**	**Rank_Corr**	**Rank_IA**	**Rank_RMSE**	**Total_Rank**
ECCC	0.69	0.71	0.41	1	1	2	4
UKMO	0.65	0.58	0.51	3	2	4	9
CMCC	0.54	0.55	0.45	9	3	3	15
MGO	0.43	0.52	0.35	11	4	1	16
BOM	0.57	0.44	0.76	7	5	5	17
KMA	0.58	0.43	0.83	6	6	6	18
METFR	0.59	0.33	1.18	5	7	7	19
HMC	0.68	0.16	3.08	2	11	11	24
PNU	0.60	0.19	2.48	4	10	10	24
NASA	0.49	0.31	1.25	10	8	8	26
CWA	0.36	0.23	2.00	12	9	9	30
APCC	0.56	0.13	3.91	8	12	12	32

Table I.18 Area averaged statistical metrics for temperature (JJA)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.69	0.47	0.69	3	3	3	9
MGO	0.62	0.49	0.59	8	2	2	12
CMCC	0.56	0.42	0.77	9	5	4	18
BOM	0.62	0.40	0.89	7	6	6	19
KMA	0.66	0.37	1.00	5	7	7	19
CWA	0.53	0.44	0.80	11	4	5	20

METFR	0.76	0.28	1.46	1	10	10	21
ECCC	0.65	0.35	1.10	6	8	8	22
NASA	0.69	0.28	1.45	4	9	9	22
HMC	0.55	0.17	2.75	10	12	12	34
PNU	0.33	0.19	2.37	13	11	11	35
APCC	0.51	0.12	4.00	12	13	13	38

Table I.19 Area averaged statistical metrics for temperature (JAS)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
BOM	0.76	0.57	0.51	4	1	1	6
UKMO	0.78	0.53	0.56	2	2	2	6
KMA	0.74	0.41	0.83	6	3	3	12
ECCC	0.74	0.40	0.86	5	4	4	13
METFR	0.77	0.32	1.15	3	6	6	15
NASA	0.80	0.29	1.33	1	7	8	16
CMCC	0.68	0.36	0.92	9	5	5	19
PNU	0.68	0.22	1.99	8	9	9	26
MGO	0.24	0.28	1.23	12	8	7	27
CWA	0.60	0.20	2.17	10	10	10	30
APCC	0.71	0.11	4.11	7	12	12	31
HMC	0.44	0.19	2.18	11	11	11	33

Table I.20 Area averaged statistical metrics for temperature (ASO)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.81	0.83	0.28	1	2	2	5
BOM	0.80	0.86	0.25	4	1	1	6
KMA	0.80	0.68	0.45	3	3	3	9
ECCC	0.81	0.66	0.55	2	4	4	10
METFR	0.72	0.53	0.60	6	5	5	16
CMCC	0.70	0.46	0.80	7	6	6	19
MGO	0.64	0.32	1.39	9	8	8	25
NASA	0.52	0.39	1.01	11	7	7	25
PNU	0.80	0.31	1.59	5	10	10	25
HMC	0.43	0.32	1.41	12	9	9	30
APCC	0.68	0.14	4.07	8	12	12	32
CWA	0.59	0.22	2.34	10	11	11	32

Table I.21 Area averaged statistical metrics for temperature (SON)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank

UKMO	0.67	0.76	0.40	4	1	1	6
BOM	0.65	0.72	0.51	6	2	3	11
KMA	0.63	0.70	0.49	8	3	2	13
CMCC	0.68	0.56	0.75	3	5	5	13
METFR	0.63	0.70	0.51	7	4	4	15
ECCC	0.75	0.45	1.26	1	9	9	19
PNU	0.53	0.53	0.80	9	7	6	22
CWA	0.74	0.31	2.12	2	11	11	24
HMC	0.45	0.53	0.82	12	6	7	25
NASA	0.52	0.45	1.04	10	8	8	26
APCC	0.67	0.19	3.84	5	12	12	29
MGO	0.50	0.40	1.32	11	10	10	31

Table I.22 Area averaged statistical metrics for temperature (OND)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.52	0.68	0.53	5	1	1	7
CWA	0.54	0.66	0.66	3	2	4	9
HMC	0.52	0.60	0.65	4	5	3	12
KMA	0.46	0.62	0.61	8	3	2	13
BOM	0.48	0.60	0.74	7	4	6	17
MGO	0.61	0.47	1.25	1	8	8	17
PNU	0.45	0.54	0.73	10	7	5	22
CMCC	0.42	0.55	0.80	11	6	7	24
ECCC	0.57	0.42	1.55	2	11	11	24
METFR	0.45	0.46	1.28	9	9	9	27
APCC	0.50	0.25	3.31	6	12	12	30
NASA	0.39	0.43	1.44	12	10	10	32

Table I.23 Area averaged statistical metrics for temperature (NDJ)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
CMCC	0.45	0.59	0.80	1	1	1	3
KMA	0.37	0.55	0.83	2	4	4	10
BOM	0.36	0.58	0.92	5	2	6	13
CWA	0.31	0.57	0.80	9	3	1	13
PNU	0.36	0.48	1.35	3	6	7	16
UKMO	0.30	0.54	0.80	10	5	3	18
MGO	0.36	0.46	1.51	4	8	8	20
HMC	0.21	0.46	0.86	11	7	5	23
ECCC	0.34	0.45	1.56	6	9	9	24
METFR	0.33	0.44	1.78	7	10	10	27

NASA	0.31	0.42	1.84	8	11	11	30
APCC	0.11	0.30	3.17	12	12	12	36

Table I.24 Area averaged statistical metrics for temperature (DJF)

Models	Correlation	IOA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
CMCC	0.45	0.58	0.78	2	2	1	5
UKMO	0.39	0.58	0.82	3	1	2	6
KMA	0.34	0.51	0.84	4	3	3	10
MGO	0.46	0.47	1.72	1	6	8	15
HMC	0.19	0.49	1.12	7	5	5	17
BOM	0.18	0.49	1.16	8	4	6	18
PNU	0.30	0.43	1.86	5	8	9	22
ECCC	0.14	0.46	1.55	10	7	7	24
CWA	0.10	0.36	0.93	11	11	4	26
METFR	0.15	0.39	2.14	9	9	10	28
APCC	0.26	0.34	2.89	6	12	12	30
NASA	0.07	0.38	2.24	12	10	11	33

Annex-II Model screening process at monthly scale

Similar to Annex-I, Tables II.1–12 summarize the area-averaged statistical metrics for precipitation in each month, while Tables II.13–24 present the corresponding results for temperature in each month.

Table II.1 Area averaged statistical metrics for precipitation (January)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
KMA	0.31	0.28	0.25	1	1	2	4
BOM	0.02	0.24	0.3	3	3	4	10
UKMO	0.01	0.24	0.27	4	3	3	10
ECCC	0.02	0.24	0.30	6	3	4	13
NASA	-0.36	0.26	0.21	12	2	1	15
HMC	0.23	0.18	0.45	2	7	8	17
CMCC	0.00	0.22	0.32	6	6	6	18
METFR	-0.20	0.17	0.44	9	8	7	24
PNU	-0.10	0.14	0.57	8	9	10	27
APCC	-0.22	0.14	0.5	10	9	9	28
CWA	0.01	0.08	1.14	4	12	12	28
MGO	-0.26	0.12	0.67	11	11	11	33

Table II.2 Area averaged statistical metrics for precipitation (February)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
NASA	0.26	0.43	0.28	3	1	1	5
ECCC	0.29	0.38	0.36	2	2	2	6
UKMO	0.38	0.37	0.41	1	4	4	9
BOM	0.21	0.35	0.42	4	5	5	14
KMA	0.17	0.37	0.37	10	3	3	16
CMCC	0.19	0.33	0.46	7	6	6	19
PNU	0.20	0.28	0.59	6	7	8	21
HMC	0.21	0.26	0.69	4	10	10	24
METFR	0.19	0.28	0.61	7	9	9	25
APCC	-0.03	0.28	0.56	12	8	7	27
CWA	0.19	0.16	1.29	7	12	12	31
MGO	0.00	0.22	0.82	11	11	11	33

Table II.3 Area averaged statistical metrics for precipitation (March)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
ECCC	0.37	0.27	0.59	6	1	1	8
UKMO	0.55	0.23	0.77	2	3	5	10
KMA	0.36	0.22	0.77	7	4	4	15
BOM	0.30	0.22	0.75	9	4	3	16

NASA	-0.07	0.25	0.59	12	2	2	16
PNU	0.51	0.20	0.90	3	9	9	21
APCC	0.17	0.22	0.79	11	6	6	23
CMCC	0.31	0.20	0.85	8	8	8	24
METFR	0.29	0.21	0.82	10	7	7	24
HMC	0.46	0.16	1.14	5	10	10	25
MGO	0.59	0.14	1.34	1	12	12	25
CWA	0.50	0.14	1.30	4	11	11	26

Table II.4 Area averaged statistical metrics for precipitation (April)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
NASA	0.43	0.27	0.70	1	1	1	3
BOM	0.25	0.19	1.03	2	4	4	10
ECCC	-0.08	0.22	0.82	12	2	2	16
APCC	-0.03	0.22	0.88	11	3	3	17
UKMO	0.04	0.18	1.08	7	6	6	19
METFR	0.00	0.19	1.04	10	5	5	20
CMCC	0.07	0.16	1.29	5	9	9	23
KMA	0.02	0.18	1.09	9	7	7	23
CWA	0.04	0.17	1.22	8	8	8	24
PNU	0.10	0.16	1.31	4	10	10	24
HMC	0.17	0.13	1.61	3	11	11	25
MGO	0.05	0.11	1.97	6	12	12	30

Table II.5 Area averaged statistical metrics for precipitation (May)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.21	0.18	1.02	2	3	4	9
ECCC	-0.02	0.19	0.88	7	2	2	11
KMA	0.02	0.18	1.00	5	3	3	11
NASA	-0.08	0.22	0.76	11	1	1	13
BOM	0.00	0.17	1.05	6	5	6	17
CMCC	0.32	0.13	1.47	1	9	9	19
APCC	0.03	0.14	1.28	4	8	8	20
METFR	-0.03	0.15	1.21	8	7	7	22
CWA	-0.52	0.16	1.04	12	6	5	23
HMC	0.15	0.10	1.99	3	11	11	25
PNU	-0.07	0.12	1.60	9	10	10	29
MGO	-0.08	0.08	2.33	10	12	12	34

Table II.6 Area averaged statistical metrics for precipitation (June)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.23	0.28	1.03	2	3	4	9
ECCC	0.12	0.31	0.90	6	2	2	10
NASA	-0.05	0.34	0.62	8	1	1	10
KMA	-0.15	0.28	0.97	11	4	3	18
BOM	-0.14	0.26	1.08	10	5	5	20
CMCC	0.16	0.19	1.70	3	9	9	21
METFR	0.04	0.24	1.21	7	7	7	21
PNU	0.38	0.19	1.77	1	10	10	21
CWA	-0.48	0.24	1.11	12	6	6	24
APCC	-0.10	0.20	1.56	9	8	8	25
HMC	0.13	0.17	1.97	5	11	11	27
MGO	0.15	0.15	2.43	4	12	12	28

Table II.7 Area averaged statistical metrics for precipitation (July)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
ECCC	0.29	0.37	0.73	8	1	2	11
UKMO	0.48	0.31	1.05	3	4	4	11
BOM	0.54	0.30	1.10	1	5	6	12
NASA	0.05	0.36	0.69	11	2	1	14
KMA	0.24	0.32	0.95	9	3	3	15
APCC	0.18	0.29	1.06	10	6	5	21
CMCC	0.50	0.23	1.47	2	10	9	21
METFR	0.38	0.28	1.15	7	7	7	21
PNU	0.42	0.24	1.47	5	9	10	24
MGO	0.43	0.21	1.67	4	11	11	26
CWA	0.03	0.26	1.21	12	8	8	28
HMC	0.39	0.19	1.88	6	12	12	30

Table II.8 Area averaged statistical metrics for precipitation (August)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
NASA	0.33	0.39	0.69	9	1	2	12
KMA	0.37	0.36	0.82	7	3	3	13
CWA	0.20	0.38	0.68	11	2	1	14
MGO	0.43	0.35	0.87	5	4	5	14
BOM	0.50	0.35	0.89	4	6	6	16
ECCC	0.35	0.35	0.87	8	5	4	17
METFR	0.58	0.34	0.92	2	7	8	17
PNU	0.56	0.33	1.00	3	9	9	21

UKMO	0.39	0.33	0.92	6	8	7	21
CMCC	0.64	0.28	1.21	1	11	11	23
APCC	0.14	0.30	1.06	12	10	10	32
HMC	0.30	0.21	1.73	10	12	12	34

Table II.9 Area averaged statistical metrics for precipitation (September)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
ECCC	0.55	0.47	0.48	2	1	1	4
BOM	0.54	0.42	0.61	3	2	3	8
KMA	0.35	0.41	0.60	8	3	2	13
NASA	0.50	0.38	0.72	4	5	5	14
CMCC	0.57	0.32	0.89	1	7	7	15
UKMO	0.43	0.39	0.67	7	4	4	15
CWA	0.31	0.35	0.76	9	6	6	21
METFR	0.46	0.31	0.92	5	8	9	22
MGO	0.45	0.30	0.91	6	9	8	23
PNU	0.27	0.29	0.97	10	10	10	30
APCC	0.19	0.28	1.04	11	11	11	33
HMC	0.15	0.26	1.10	12	12	12	36

Table II.10 Area averaged statistical metrics for precipitation (October)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
KMA	0.33	0.36	0.43	1	2	3	6
BOM	0.21	0.38	0.39	5	1	1	7
UKMO	0.30	0.35	0.46	2	4	5	11
NASA	0.12	0.36	0.43	7	3	4	14
CMCC	0.27	0.27	0.66	3	6	6	15
ECCC	-0.29	0.35	0.42	11	5	2	18
HMC	0.17	0.27	0.67	6	7	7	20
PNU	0.25	0.23	0.81	4	10	10	24
METFR	-0.01	0.25	0.71	8	8	9	25
APCC	-0.14	0.24	0.71	9	9	8	26
CWA	-0.27	0.17	1.19	10	12	12	34
MGO	-0.32	0.20	0.92	12	11	11	34

Table II.11 Area averaged statistical metrics for precipitation (November)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
KMA	0.45	0.41	0.24	3	1	1	5
BOM	0.42	0.40	0.25	4	2	2	8

UKMO	0.39	0.37	0.27	6	3	3	12
ECCC	0.27	0.30	0.36	10	4	4	18
APCC	0.36	0.28	0.43	7	6	6	19
CMCC	0.40	0.27	0.44	5	7	7	19
PNU	0.56	0.22	0.60	1	10	10	21
NASA	0.13	0.29	0.37	12	5	5	22
CWA	0.50	0.18	0.75	2	11	11	24
METFR	0.32	0.26	0.46	8	8	8	24
HMC	0.30	0.24	0.49	9	9	9	27
MGO	0.18	0.17	0.79	11	12	12	35

Table II.12 Area averaged statistical metrics for precipitation (December)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
BOM	0.70	0.40	0.26	3	2	2	7
KMA	0.58	0.46	0.22	6	1	1	8
UKMO	0.64	0.40	0.27	4	2	3	9
CMCC	0.73	0.35	0.33	1	4	5	10
ECCC	0.72	0.32	0.36	2	6	6	14
NASA	0.20	0.34	0.29	11	5	4	20
METFR	0.52	0.30	0.38	7	7	7	21
HMC	0.27	0.26	0.44	10	8	8	26
MGO	0.59	0.18	0.72	5	11	11	27
PNU	0.49	0.22	0.58	8	10	10	28
APCC	-0.29	0.23	0.44	12	9	8	29
CWA	0.42	0.16	0.79	9	12	12	33

Table II.13 Area averaged statistical metrics for temperature (January)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
CMCC	0.44	0.58	1.29	1	1	1	3
PNU	0.33	0.48	2.02	2	3	6	11
ECCC	0.19	0.50	1.70	6	2	5	13
CWA	0.20	0.47	1.66	5	5	4	14
MGO	0.23	0.47	2.09	4	4	7	15
METFR	0.27	0.44	2.64	3	8	10	21
HMC	0.11	0.43	1.56	10	9	3	22
KMA	0.17	0.45	2.17	7	6	9	22
UKMO	0.15	0.34	1.30	8	12	2	22
BOM	0.11	0.45	2.12	11	7	8	26
APCC	0.11	0.40	2.92	9	11	12	32

NASA	0.01	0.40	2.67	12	10	11	33

Table II.14 Area averaged statistical metrics for temperature (February)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.69	0.54	1.34	1	2	1	4
HMC	0.47	0.57	2.02	2	1	7	10
PNU	0.45	0.50	1.44	3	5	2	10
MGO	0.41	0.52	1.92	4	3	5	12
ECCC	0.39	0.52	1.99	5	4	6	15
CMCC	0.24	0.47	1.86	9	6	4	19
CWA	0.37	0.42	1.49	6	11	3	20
METFR	0.37	0.46	3.00	7	8	9	24
NASA	0.21	0.47	2.39	11	7	8	26
BOM	0.37	0.45	3.01	8	9	10	27
KMA	0.14	0.45	3.11	12	10	11	33
APCC	0.23	0.39	4.08	10	12	12	34

Table II.15 Area averaged statistical metrics for temperature (March)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.58	0.68	1.01	1	1	1	3
KMA	0.41	0.53	1.16	4	2	2	8
ECCC	0.39	0.51	1.83	5	3	6	14
METFR	0.49	0.49	2.14	3	5	8	16
CMCC	0.32	0.49	1.25	8	6	3	17
MGO	0.21	0.50	1.58	9	4	5	18
NASA	0.12	0.48	1.55	10	7	4	21
HMC	0.51	0.45	2.77	2	10	11	23
BOM	0.34	0.46	2.54	7	9	10	26
PNU	0.06	0.46	1.89	11	8	7	26
APCC	0.37	0.34	4.15	6	12	12	30
CWA	-0.01	0.44	2.14	12	11	9	32

Table II.16 Area averaged statistical metrics for temperature (April)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
KMA	0.65	0.74	0.60	1	1	1	3
UKMO	0.57	0.68	0.66	3	2	2	7
BOM	0.62	0.62	1.04	2	3	7	12
CMCC	0.44	0.55	0.97	8	4	5	17
MGO	0.50	0.50	0.69	7	7	3	17

ECCC	0.53	0.46	1.74	5	8	8	21
METFR	0.26	0.52	0.99	10	5	6	21
NASA	0.23	0.50	0.94	11	6	4	21
CWA	0.52	0.36	2.41	6	9	9	24
PNU	0.55	0.36	2.50	4	10	10	24
APCC	0.33	0.23	4.35	9	12	12	33
HMC	0.17	0.28	3.48	12	11	11	34

Table II.17 Area averaged statistical metrics for temperature (May)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.60	0.70	0.49	3	1	1	5
ECCC	0.68	0.67	0.65	1	2	4	7
METFR	0.65	0.61	0.72	2	3	6	11
BOM	0.58	0.60	0.66	4	4	5	13
CMCC	0.45	0.56	0.54	6	5	2	13
KMA	0.48	0.53	0.77	5	6	7	18
MGO	0.22	0.40	0.59	12	8	3	23
NASA	0.29	0.44	1.00	11	7	8	26
CWA	0.30	0.33	1.91	10	9	9	28
PNU	0.38	0.27	2.60	9	10	10	29
HMC	0.43	0.24	3.14	8	11	11	30
APCC	0.43	0.20	3.86	7	12	12	31

Table II.18 Area averaged statistical metrics for temperature (June)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.58	0.64	0.38	1	1	1	3
MGO	0.53	0.59	0.43	2	2	2	6
KMA	0.50	0.46	0.70	4	5	4	13
CMCC	0.32	0.48	0.57	10	3	3	16
CWA	0.39	0.47	0.77	8	4	5	17
ECCC	0.47	0.42	0.85	6	6	6	18
BOM	0.43	0.39	0.94	7	7	7	21
METFR	0.49	0.29	1.52	5	9	9	23
HMC	0.50	0.16	3.26	3	11	11	25
NASA	0.32	0.29	1.46	9	8	8	25
PNU	-0.04	0.19	2.64	12	10	10	32
APCC	0.20	0.13	3.94	11	12	12	35

Table II.19 Area averaged statistical metrics for temperature (July)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
CMCC	0.58	0.37	1.06	4	2	2	8
UKMO	0.56	0.43	0.87	6	1	1	8
BOM	0.66	0.36	1.18	2	4	4	10
METFR	0.70	0.29	1.53	1	6	6	13
KMA	0.57	0.34	1.27	5	5	5	15
MGO	0.25	0.36	1.08	11	3	3	17
ECCC	0.60	0.27	1.69	3	8	8	19
CWA	0.49	0.29	1.58	8	7	7	22
NASA	0.55	0.25	1.84	7	9	9	25
PNU	0.34	0.21	2.28	10	10	10	30
HMC	0.41	0.19	2.64	9	11	11	31
APCC	0.22	0.13	3.95	12	12	12	36

Table II.20 Area averaged statistical metrics for temperature (August)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
ECCC	0.70	0.70	0.46	3	1	1	5
UKMO	0.76	0.60	0.59	1	3	3	7
BOM	0.65	0.63	0.51	7	2	2	11
KMA	0.69	0.47	0.88	4	4	4	12
MGO	0.66	0.43	1.04	6	5	5	16
METFR	0.68	0.40	1.13	5	7	7	19
CMCC	0.50	0.40	1.05	9	6	6	21
PNU	0.70	0.27	2.03	2	9	10	21
NASA	0.58	0.35	1.33	8	8	8	24
CWA	0.46	0.27	1.96	10	10	9	29
HMC	0.41	0.24	2.21	12	11	11	34
APCC	0.43	0.14	4.21	11	12	12	35

Table II.21 Area averaged statistical metrics for temperature (September)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
BOM	0.62	0.74	0.42	3	2	2	7
KMA	0.65	0.67	0.50	2	3	3	8
UKMO	0.61	0.76	0.36	6	1	1	8
ECCC	0.53	0.55	0.67	8	4	5	17
NASA	0.62	0.49	0.89	5	6	7	18
METFR	0.43	0.54	0.56	11	5	4	20

PNU	0.74	0.32	1.64	1	10	10	21
CMCC	0.48	0.45	0.82	9	7	6	22
APCC	0.62	0.15	4.07	4	12	12	28
HMC	0.48	0.33	1.44	10	9	9	28
MGO	0.40	0.44	0.89	12	8	8	28
CWA	0.56	0.25	2.06	7	11	11	29

Table II.22 Area averaged statistical metrics for temperature (October)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
UKMO	0.77	0.77	0.50	1	1	1	3
KMA	0.75	0.75	0.50	2	2	2	6
BOM	0.70	0.70	0.66	6	3	4	13
NASA	0.71	0.68	0.72	5	5	5	15
HMC	0.73	0.67	0.77	4	6	6	16
METFR	0.65	0.68	0.57	9	4	3	16
CMCC	0.65	0.59	0.77	8	7	7	22
ECCC	0.75	0.49	1.49	3	10	11	24
PNU	0.58	0.56	0.99	10	8	9	27
CWA	0.66	0.49	1.40	7	11	10	28
MGO	0.37	0.52	0.80	12	9	8	29
APCC	0.54	0.23	4.01	11	12	12	35

Table II.23 Area averaged statistical metrics for temperature (November)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank
KMA	0.34	0.51	1.11	1	2	3	6
CWA	0.29	0.54	1.15	5	1	5	11
BOM	0.29	0.50	1.08	6	4	2	12
HMC	0.32	0.44	1.05	2	10	1	13
MGO	0.32	0.49	1.49	3	6	8	17
PNU	0.32	0.45	1.21	4	9	6	19
CMCC	0.28	0.47	1.21	7	7	7	21
METFR	0.23	0.51	1.58	9	3	9	21
UKMO	0.21	0.47	1.13	10	8	4	22
ECCC	0.28	0.49	1.68	8	5	11	24
NASA	0.13	0.44	1.65	11	11	10	32
APCC	0.03	0.33	3.68	12	12	12	36

Table II.24 Area averaged statistical metrics for temperature (December)

Models	Correlation	IA	RMSE	Rank_Corr	Rank_IA	Rank_RMSE	Total_Rank

CMCC	0.46	0.58	0.78	1	2	1	4
UKMO	0.42	0.60	0.81	3	1	2	6
KMA	0.29	0.47	0.86	6	4	3	13
CWA	0.24	0.48	0.89	7	3	4	14
MGO	0.45	0.47	1.72	2	5	8	15
PNU	0.35	0.44	1.87	4	8	9	21
BOM	0.07	0.47	1.23	10	6	6	22
ECCC	0.14	0.46	1.57	9	7	7	23
HMC	-0.02	0.39	1.23	12	10	5	27
METFR	0.22	0.40	2.13	8	9	10	27
APCC	0.32	0.35	2.88	5	12	12	29
NASA	0.07	0.38	2.23	11	11	11	33