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வளிமண்டலவியல் திணைக்களம்
DEPARTMENT OF METEOROLOGY
ශ්‍රී ලංකාව இலங்கை SRI LANKA

Consensus Seasonal Weather Outlook
July, August and September(JAS2023)
Seasonal Rainfall and Temperature for Sri Lanka

These forecasts are prepared using

- The prevailing global climate conditions.
- Forecasts from different climate models from around the world.
- Statistical downscaling of GCM output using CPT

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and

Research Division

1. Prevailing global climate conditions

Equatorial sea surface temperatures (SSTs) are above average across the east-central and eastern Pacific Ocean. During the last 4 weeks, above-average SSTs in the eastern equatorial Pacific Ocean expanded westward to the east-central Pacific. SSTs near Ecuador and Peru remain strongly above average. (Fig.1 and Fig.2).

1.1 El Nino and La Nina update

The tropical Pacific atmospheric anomalies are consistent with weak El Niño conditions. El Niño conditions are expected to gradually strengthen into the Northern Hemisphere winter 2023-24 (Fig 3a). Recent values of the upper-ocean heat anomalies (above average) and thermocline slope index (slightly below average) are also reflect ElNiño conditions. Nearly all models indicate El Niño will persist into the Northern Hemisphere winter 2023-24. A strong El Niño (values at or greater than 1.5°C) is indicated by the dynamical model average through December 2023-February 2024.

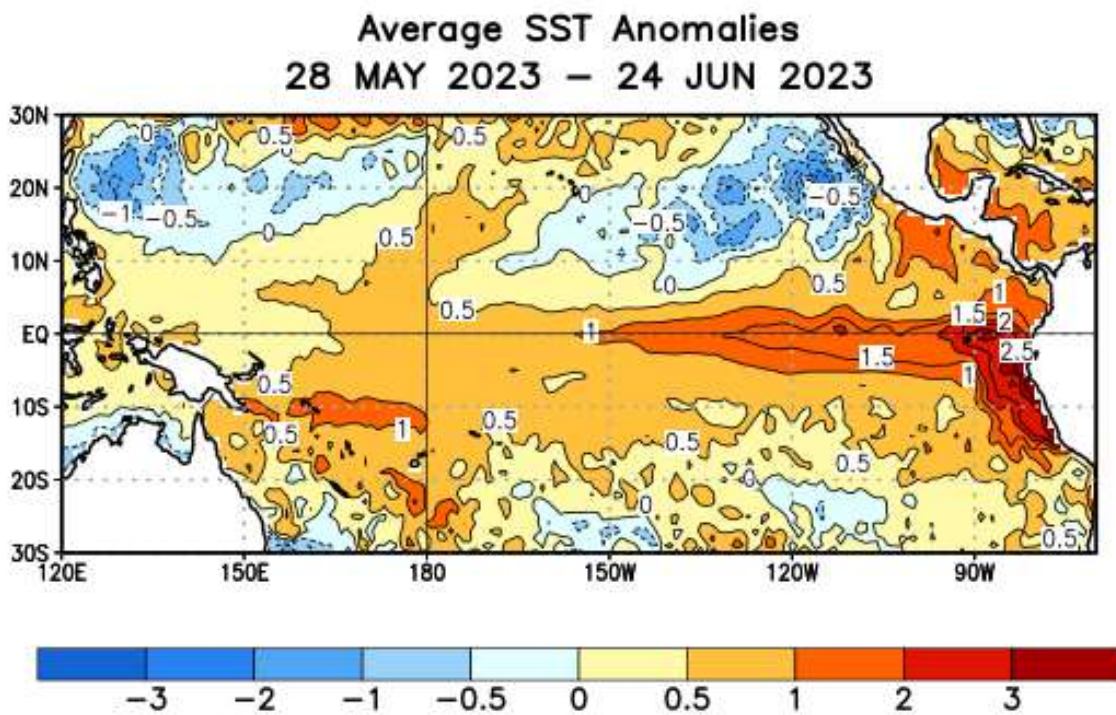


Fig 1: Observed Average sea surface temperature (SST) anomalies (°C)

Weekly SST Anomalies (DEG C)

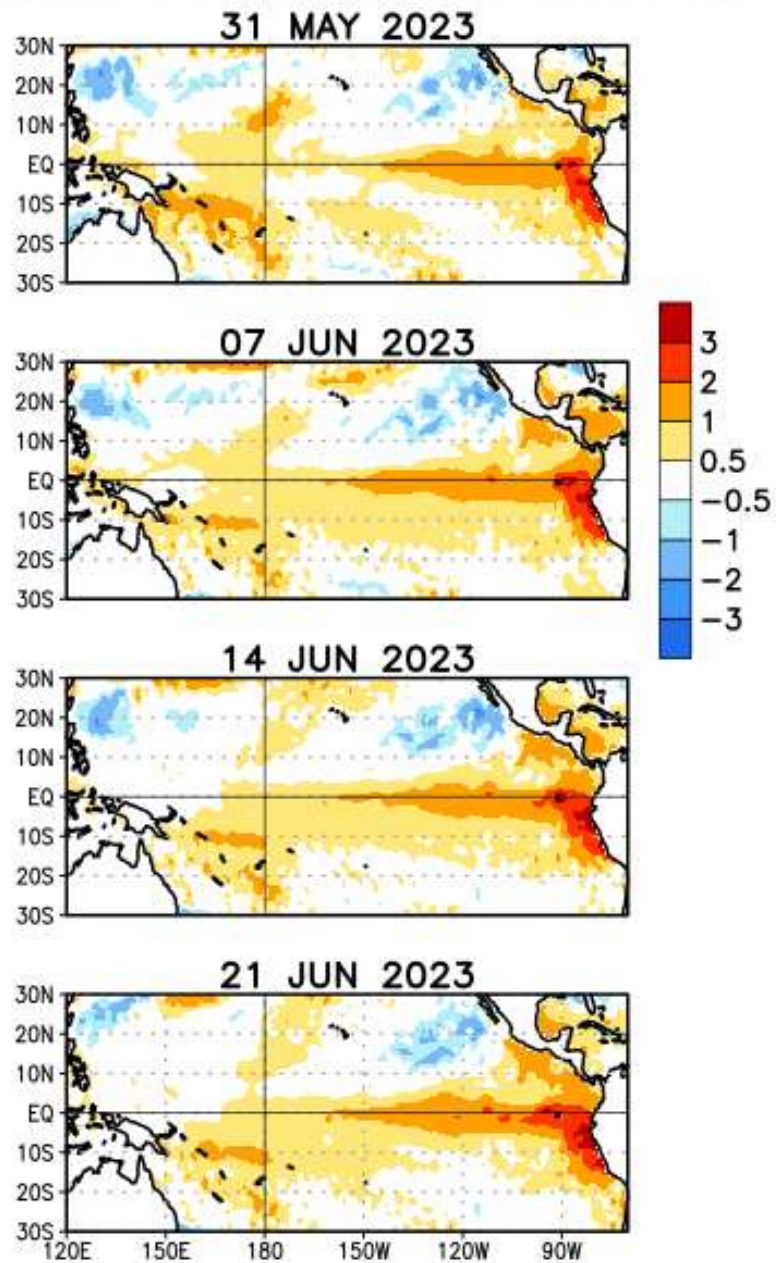


Fig 2: Weekly Observed Average sea surface temperature (SST) anomalies (°C)

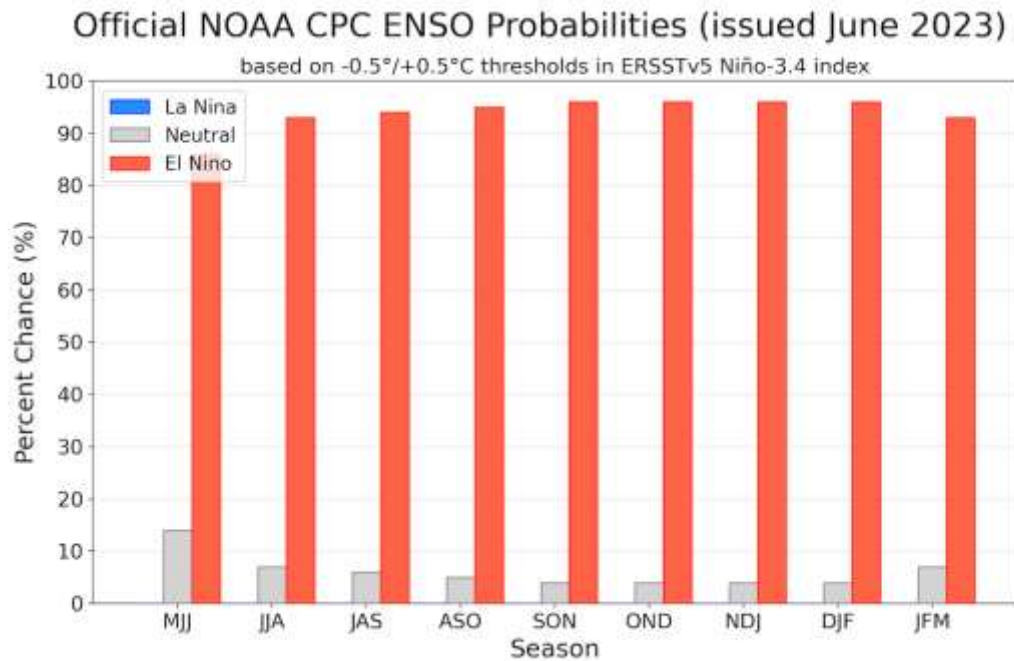


Fig 3a: ENSO forecast from Climate Prediction Center (CPC)/ IRI Forecast

1.1.1 Impacts of El-Niño on monthly rainfall anomaly during July, August and September

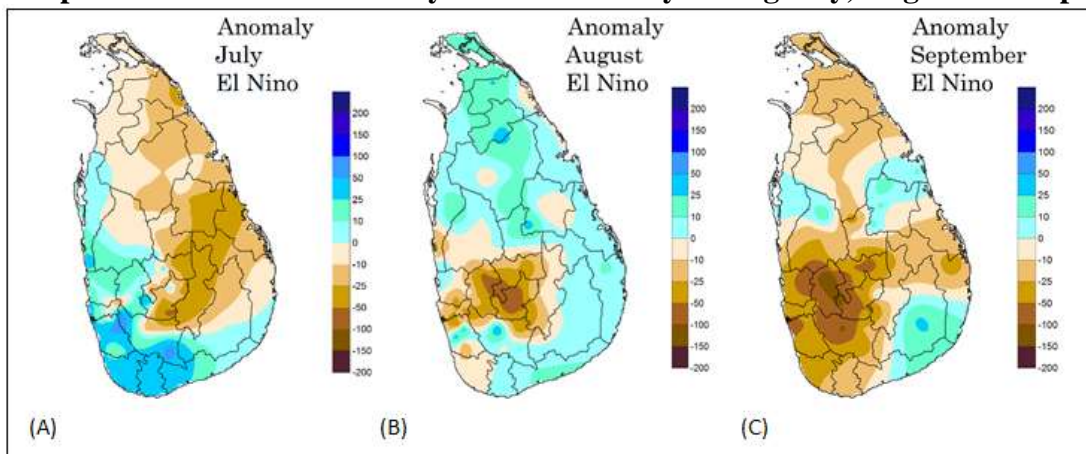


Fig 3b: Monthly Rainfall Anomaly maps of the months of July(A), August (B) and September (C) during El-Niño years (Hapuarachchi et al 2016)

Previous studies conducted by the Department of Meteorology, identified that, during El-Niño years, above normal rainfalls were observed over Western, Southern, Northwestern and Sabaragamuwa provinces and some areas in Monaragala district and below normal rainfalls were observed over remaining areas of the country during the month of July (Fig 3b(A)). During the month of August below normal rainfalls are likely over Western, Sabaragamuwa and Central provinces and some areas in Kurunegala, Badulla, Polonnaruwa and Galle districts and above normal rainfalls are likely over remaining areas of the country (Fig 3b(B)). During the month of September above normal rainfalls are likely over some areas of the Puttalam, Kurunegala, Trincomalee, Polonnaruwa, Monaragala and Hambantota districts and below normal rainfalls are expected over remaining areas of the country when El-Niño conditions were persistent(Fig 3b(C)).

1.2 The Indian Ocean Dipole (IOD) update

The Indian Ocean Dipole (IOD) is currently neutral. The IOD index for the week ending 18 June 2023 was $-0.00\text{ }^{\circ}\text{C}$, which is within neutral bounds (between $-0.40\text{ }^{\circ}\text{C}$ and $+0.40\text{ }^{\circ}\text{C}$).

Weekly sea surface temperatures (SSTs) are above average across most of the tropical Indian Ocean, with close to average SSTs near the Australian north-west coast. Warm anomalies also exist over much of the southern half of the basin, and to the south-west of Australia.

Most of the global climate models suggest a positive IOD event may develop in coming months. A positive IOD can suppress monsoon rainfall over central part of Sri Lanka. Long-range forecasts of the IOD should be viewed with caution beyond August. (Source-Bureau of Meteorology, Australia).

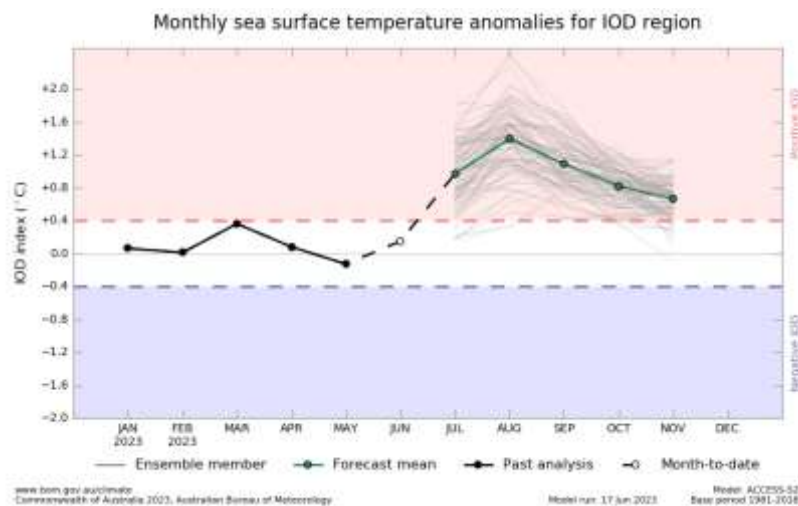


Figure 4a: IOD forecast from Australian Bureau of Meteorology

1.2.1 Impacts of positive IOD on monthly rainfall anomaly during July, August and September

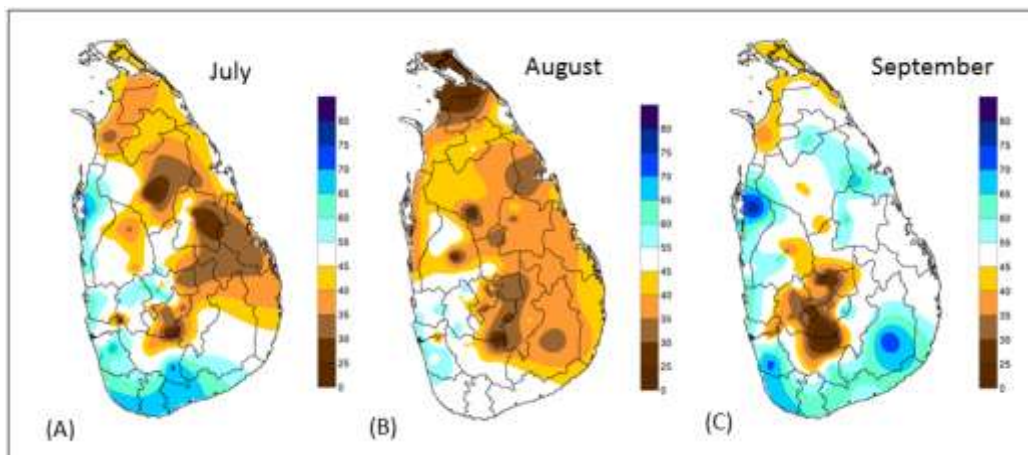


Fig 4b: Median Based Composite maps of Monthly Rainfall during July(A), August (B) and September (c) during positive IOD years (Hapuarachchi et al 2018)

Previous studies conducted by the Department of Meteorology identified that there is a higher probability of getting below normal rainfall over Northern, Northcentral and Eastern provinces and Nuwara Eliya and Badulla districts. Above normal rainfall is expected over Southern province and some parts in Puttalam, Gampaha and Kaluthara districts (Fig 4b(A)) under the positive IOD condition. During the month of August there is no clear signal indicated in Western, Sabaragamuwa and Southern provinces except Kalutara district. Where little above normal rainfall can be expected and below normal rainfalls are likely over remaining areas of the country. (Fig 4b (B)). But in the month of September it is showing the higher probability of getting above normal rainfall in Southern province and Puttalam, Kalutara, Monaragala districts as well as some parts in Anuradhapura and Trincomalee districts. Below normal rainfalls are expected in Sabaragamuwa and Central Provinces. (Fig 4b (C)).

2. Forecasts from different climate models from around the world.

2.1 July to September(JAS) 2023 season

Figure 5 shows the probabilistic multi model ensemble forecast which prepared by using dynamical models from 12 Global Producing Centers (GPC) for JAS season. It can be expected above normal rainfalls over most of the parts of the country except northern province, where no clear signal indicated during July–September(JAS) 2023 season.

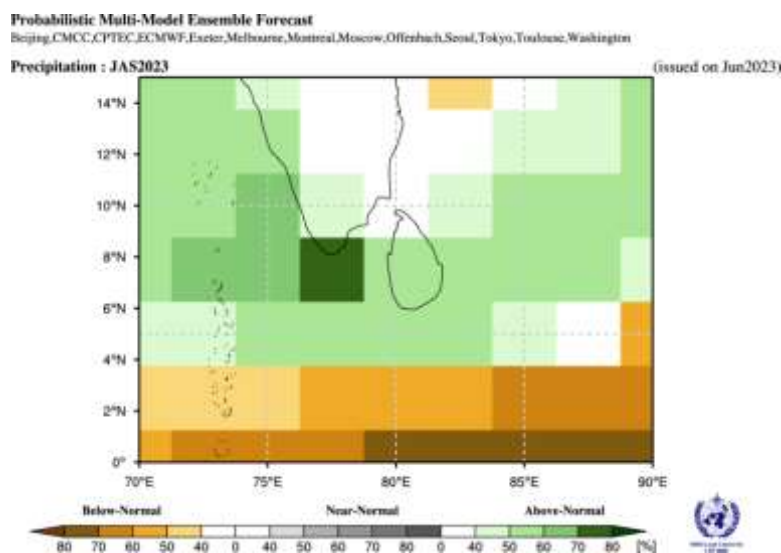


Fig 5: Probabilistic multi model ensemble forecast for JAS using dynamical models from 13 WMO global producing centers (GPC).

Figure 6 depicts individual forecasts provided by same GPC centers for the JAS season. Out of 13 GPC individual models, 8 models predicted slightly **above normal rainfall** over the southern parts of the country. There is **no clear signal** indicated for remaining areas of the country. Accordingly

there is a possibility of having below, about or above normal rainfall over these parts during JAS 2023 season.

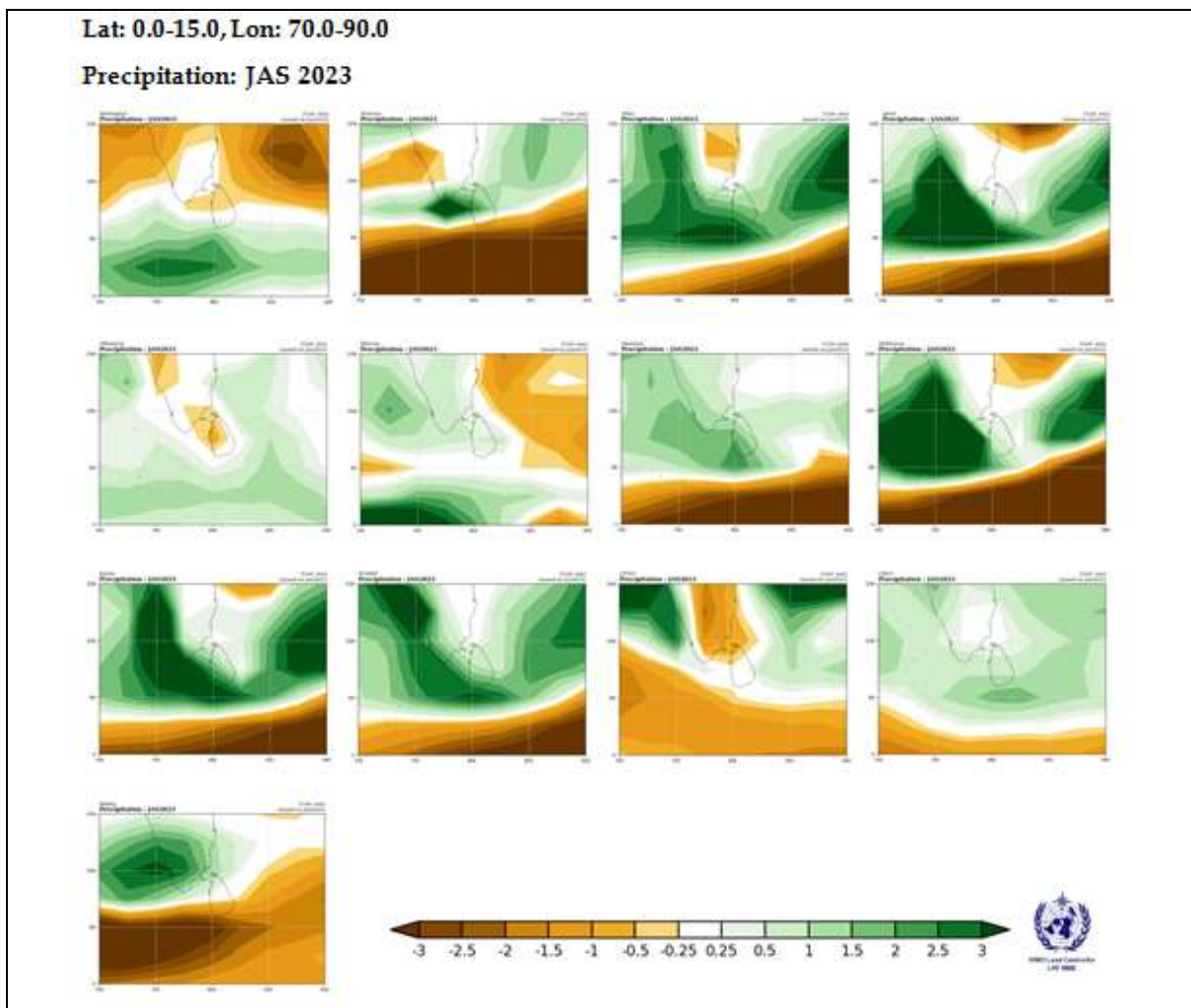


Fig 6: Individual forecasts for JAS 2023 season by dynamical models from 13 WMO global producing centers (GPC).

2.2 Monthly Forecast for July, August and September 2023

Figure 7 shows the probabilistic multi model ensemble forecasts, which are prepared by using dynamical models from 13 global producing centers (GPC), for the months of July, August and September 2023. According to that during the months of July, August and September above normal rainfalls are expected over the country expect northern part. There is no clear signal indicated over the northern part during the months of July and September and near normal rainfalls are expected during the month of August.

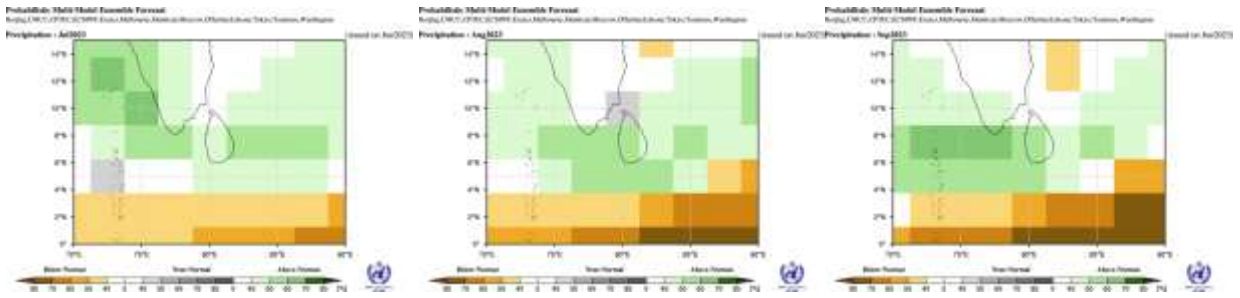


Fig 7: Probabilistic multi model ensemble forecast for July(left), August (middle) and September (right) 2023 using dynamical models from 12 WMO global producing centers (GPC).

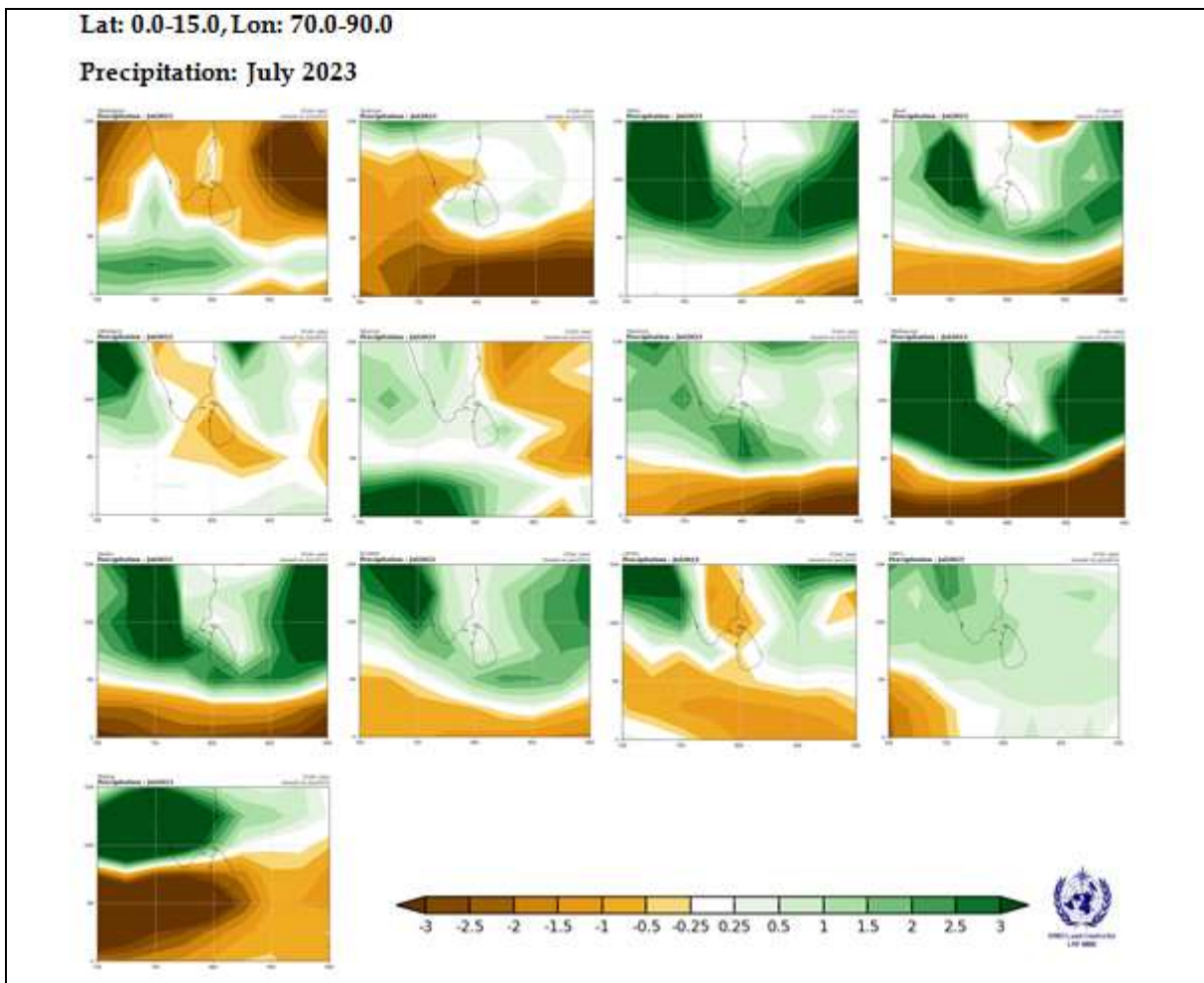


Fig 8: Individual forecast for July 2023 by dynamical models from 13 WMO global producing centers (GPC).

Figure 8 shows the 13 monthly forecasts from individual global producing centers (GPC) for July 2023. Out of 13 GPC forecasts, 7 GPC models predicted above normal rainfalls and 2 GPC models predicted below normal rainfall. There is no clear signal indicated in 4 GPC models. Accordingly there is a possibility of having above normal rainfall over the country during the month of July 2023.

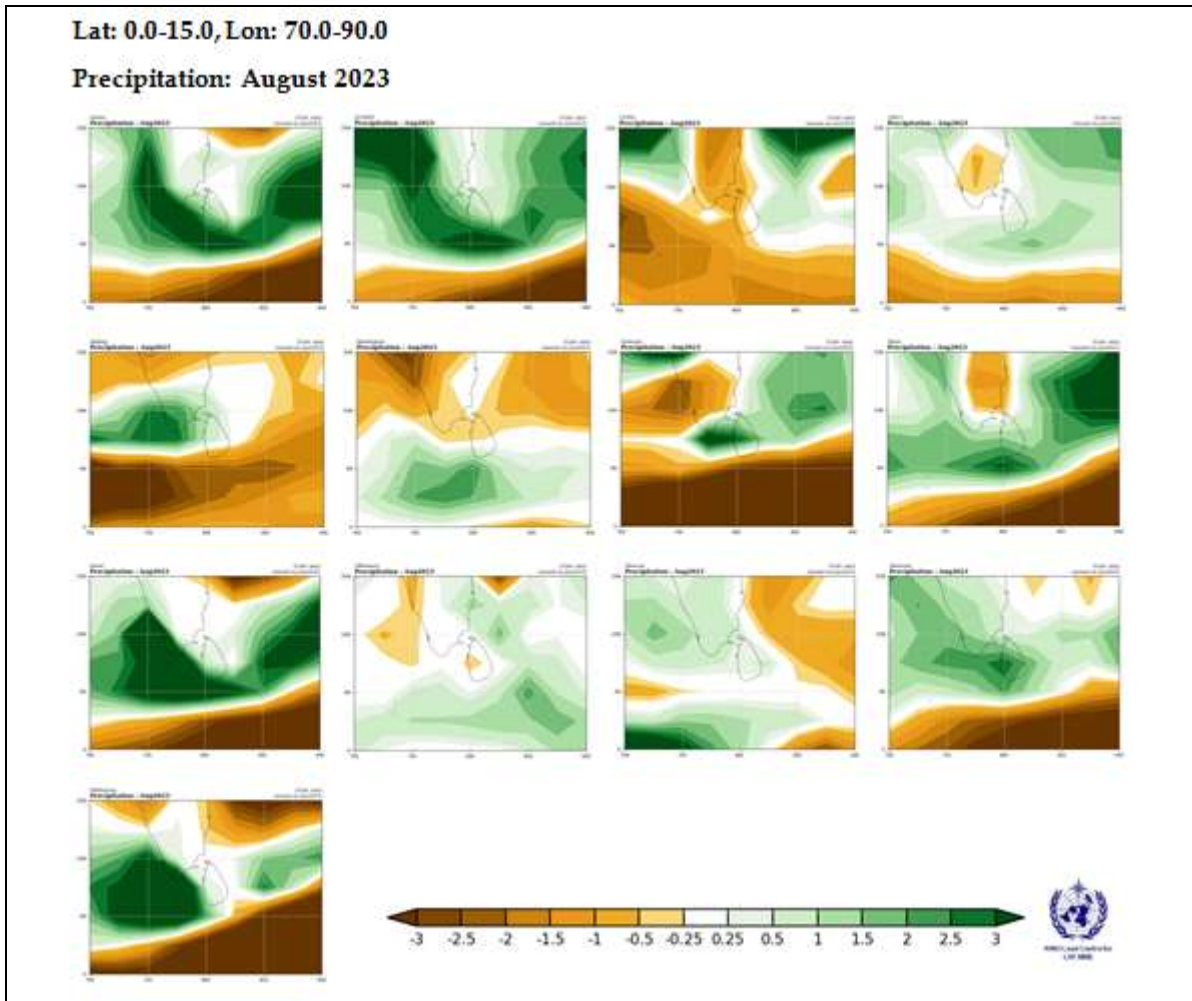


Fig 9: Individual forecast for August 2023 by dynamical models from 13 WMO global producing centers (GPC).

Figure 9 shows the monthly forecasts from individual global producing centers (GPC) for August 2023. Out of 13 GPC forecasts, 7 GPC models predicted slightly above normal rainfalls over the country. There is no clear signal indicated in 6 GPC models. Accordingly above normal rainfalls are expected over the country during the month of August 2023.

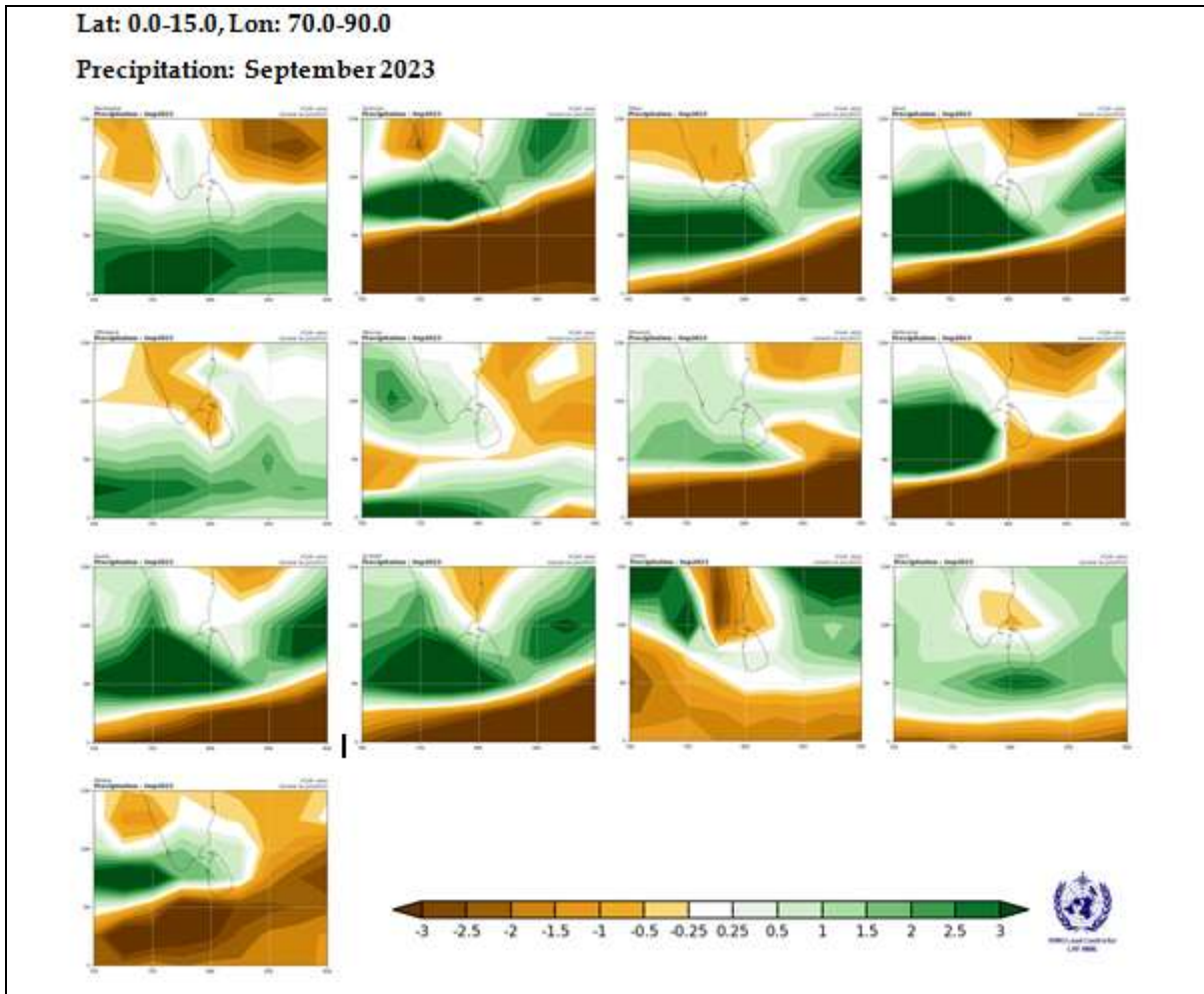


Fig 10: Individual forecast for September 2023 by dynamical models from 13 WMO global producing centers (GPC).

Figure 10 shows the monthly forecasts from 12 individual global producing centers (GPC) for September 2023. Out of 13 GPC forecasts, 7 GPC models indicate slightly above normal rainfall over the Southern parts of the country and there is no clear signal indicated for remaining areas. Accordingly there is a higher possibility of having above normal rainfall over the southern parts and it can be expected below or about or above normal rainfall over the remaining areas of the country during the month of September 2023.

3. Statistical downscaling of CFSv2 global forecast output

3.1 Probabilistic rainfall forecast for JAS season 2023 using Climate Predictability tool (CPT)

The following district wise probabilistic rainfall forecasts for the season of JAS 2023 have been prepared with the multi model ensemble method to downscale, SST data of CFSv2, CCSM4, GFDL and ECMWF by using CPT.

The district wise 30 year average rainfalls during JAS season are given in the column 2 of the table 1. Chance (probability) of receiving below/about/above average is given in the columns 3, 4, and 5 respectively in the table 1.

District	Average rainfall (mm) –JAS	Probability%		
		Below	Normal	Above
Colombo	632.2	55	25	20
Kalutara	898.8	60	20	20
Galle	821.7	55	25	20
Matara	621.9	25	25	50
Hambantota	167.3	20	20	60
Ampara	184.4	20	20	60
Batticaloa	202.2	20	20	60
Trincomalee	256.1	30	30	40
Mullaithivu	170.4	25	30	45
Jaffna	120.9	20	25	55
Killinochchi	108.5	20	20	60
Mannar	79.3	20	20	60
Puttalam	119.3	35	30	35
Gampaha	497.9	45	30	25
Kegalle	922.8	50	30	20
Ratnapura	681.9	15	25	60
Monaragala	184.9	15	25	60
Badulla	266.5	15	25	60
Pollonnaruwa	211.3	15	25	60
Vavuniya	196.8	30	30	40
Anuradapura	161.3	20	25	55
Kurunegala	242.7	25	30	45
Matale	213.9	20	20	60
Kandy	514.5	20	20	60
Nuwaraeliya	747.7	20	20	60

Table 1: Probabilistic Rainfall Forecast for JAS season 2023 using CPT

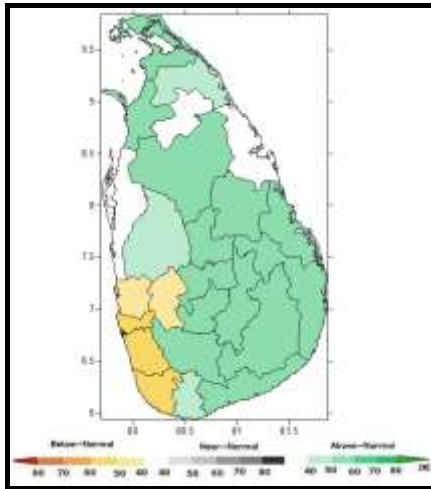


Fig 11: Probabilistic rainfall forecast for July –September 2023 using CPT

According to the CPT (Fig 11 and table 01), below normal rainfalls can be expected in Western province and Kegalle and Galle Districts. There is no clear signal indicated for Puttalam, Vavuniya and Trincomalee districts. Above normal rainfall can be expected over remaining areas of the country for JAS season 2023. Equal chances exist of receiving below, about or above normal rainfall over no signal areas for JAS Season 2023.

3.2 Multi-model ensemble mean forecast of NMME models

This probabilistic forecast is developed by combining direct Forecasts from 5 NMME models (CFS, CanSIPS, GFDL, COLA and NASA) with the forecasts obtained by statistically processing of each models.

According to the Figure 12 above normal rainfall can be expected over the country during the JAS Season 2023

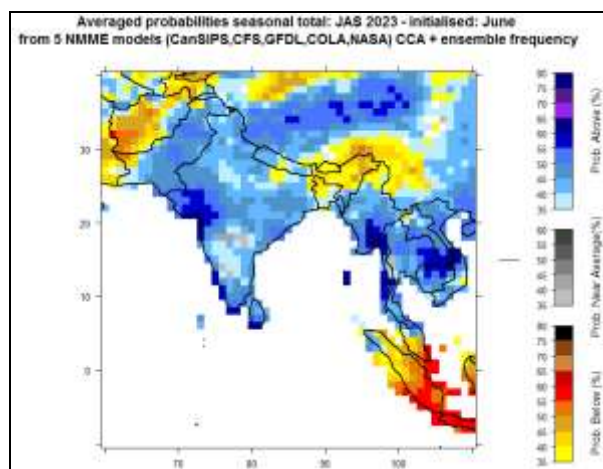


Fig 12. Average probability forecast of NMME models for JAS 2023

3.3 Probabilistic rainfall forecast for JAS 2023 season using RIMES FOCUS System

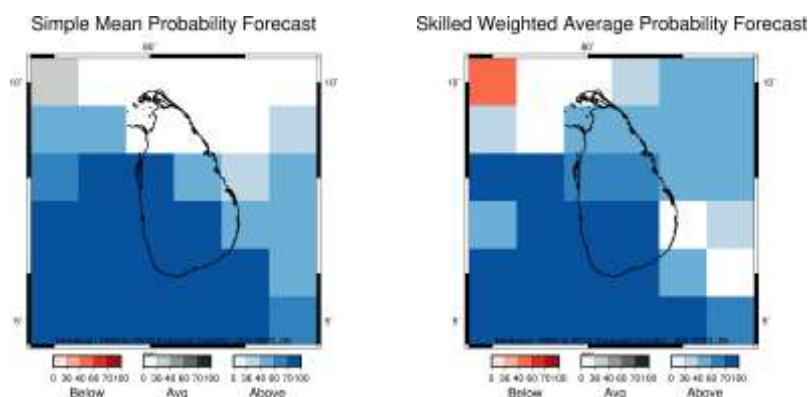


Fig 13. Probabilistic rainfall forecast for July-September 2023 using RIMES FOCUS System

Figure 13 depicts the Probabilistic rainfall forecast for JAS 2023 season, which has been prepared by using RIMES FOCUS System.

According to the model outputs above normal rainfalls are likely over most parts of the country during JAS season 2023.

4. SUMMARY :

SUMMARY of MODEL FORECAST for JAS 2023 season for SRI LANKA						
Season	WMO LC MME	WMO GPC	CPT	FOCUS	Impact of Global conditions	Final Rainfall Forecast
JAS season 2023	No Signal- Northern part AN- Remaining areas	AN- Southern part No Signal- Elsewhere	BN-Colombo, Gambaha, Kalutara, Galle, Kegalle No Signal- Puttalam, Vavuniya, Trincomalee AN- Elsewhere	AN		Near or slightly Above normal over sw coastal areas and below normal over central, Eastern and Northcentral provinces
July 2023	No Signal- Northern part AN- Remaining areas	AN				Below normal over central Sabaragamuwa , Northcentral, Eastern and Northern provinces and in Kurunegala district.. Near normal over Southern and western coastal areas. Near or slightly below over other areas.
August 2023	NN- Northern part AN- Remaining areas	AN				Below normal over Central province and near over Southern and western coastal areas, no signal for other areas.
September 2023	No Signal- Northern part AN- Remaining areas	AN- Southern part No Signal- Elsewhere				Below normal over Central Sabaragamuwa and northern provinces. Near over southern coastal areas and no signal for other areas

BN: Below Normal NN: Near Normal AN: Above Normal CP: Climatological Probability

Table 2: Summary of Model Forecasts for JAS season 2023

4.1 Summary of prevailing global climate conditions

The tropical Pacific atmospheric anomalies are consistent with weak El Niño conditions. El Niño conditions are expected to gradually strengthen into the Northern Hemisphere winter 2023-24.

The Indian Ocean Dipole (IOD) is currently neutral. The IOD index for the week ending 18 June 2023 was -0.00 °C, which is within neutral bounds (between -0.40 °C and $+0.40$ °C). Most of the global climate models suggest a positive IOD event may develop in coming months. A positive IOD can suppress monsoon rainfall over central part of Sri Lanka. Long-range forecasts of the IOD should be viewed with caution beyond August. (Source-Bureau of Meteorology, Australia).

5. Consensus Seasonal outlook for July, August and September 2023

Considering the prevailing global climate conditions, forecasts from different global climate models and statistical downscaling of GCM output using CPT, consensus forecasts for July to September 2023 season is concluded as follows.

5.1 Rainfall forecast for the three months period during July-August-September (JAS) 2023

There is a higher chance of having near or slightly above average rainfalls over Colombo, Gampaha, Kalutara, Galle and Matara, districts and below normal rainfall over Central, Eastern and Northcentral Provinces and there is no clear signal indicated for other areas of the country during JAS 2023 season as a whole. (Fig. 14).

5.2 Rainfall forecast for July 2023

Below normal rainfalls are expected over Central, Sabaragamuwa, Northcentral, Eastern and Northern provinces and in Kurunegala district, near normal rainfalls are likely over Southern and western coastal areas. There is a chance of having near or slightly below normal rainfalls over other areas of the country during the month of July 2023.

5.3 Rainfall forecasts for August 2023

Below normal rainfalls are likely over Central province and near normal over Southern and western coastal areas. There is no signal for other areas of the country for the month of August 2023

5.4 Rainfall forecasts for September 2023

Below normal rainfalls are likely over Central, Sabaragamuwa and northern provinces with a chance of near normal rainfalls over southern coastal areas and no signal for other areas during the month of September 2023

**In addition, the predictability is also limited due to strong day-to-day atmospheric variability caused by the passage of the synoptic scale systems such as lows and depressions. Intraseasonal Oscillations such as Madden Julian Oscillations (MJO) is also another atmospheric phenomena which can't be underestimated.

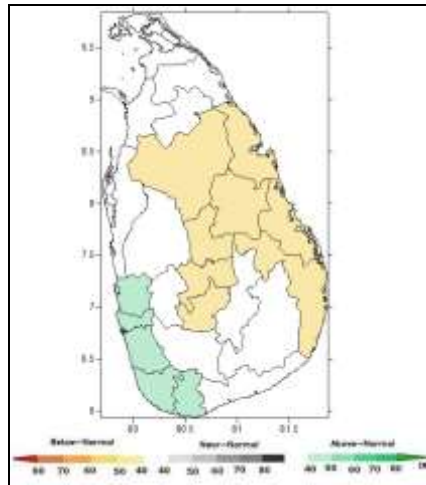


Fig 14. Consensus Probabilistic rainfall forecast for July–September2023

5.5 Probabilistic Temperature Forecast from July to September 2023 (JAS)

The probabilistic Temperature forecast for July, August and September season (JAS) 2023 for Sri Lanka as given below.

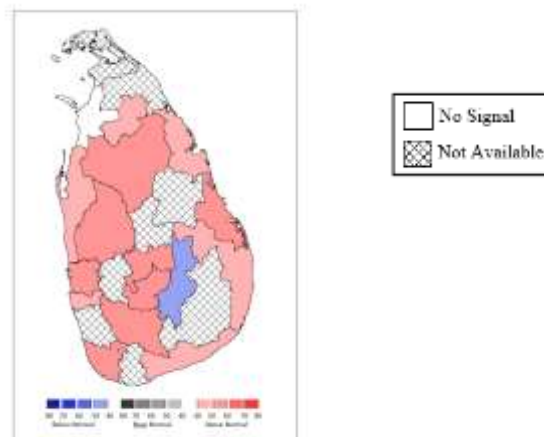


Fig 15: Probabilistic forecast for Maximum Temperatures for JAS season 2023

Fig 15 and Table 3 show the probabilistic forecast for Maximum Temperatures during JAS season 2023.

There is a higher chance of experiencing slightly above the normal Maximum Temperatures in Vavuniya, Anuradhapura, Puttlum, Kurunegala, Colombo, Gampaha, Kandy, Nuwara Eliya, Galle, Hambantota, Rathnapura, Ampara, Trincomalee and Batticaloa districts and slightly below the normal Maximum Temperatures in Badulla district (Fig 15) for the JAS season 2023

The district wise average Maximum Temperatures are given in the column 2 of the table 3 and the chance (probability) of receiving below/about/above averages are given in the columns 3, 4, and 5 respectively.

District	Average Maximum Temperature (⁰ C) – (JAS)	Probability %		
		Below	Normal	Above
Anuradhapura	33.1	25	25	50
Badulla	30.4	45	30	25
Batticaloa	32.9	30	30	40
Colombo	30.1	30	30	40
Galle	28.5	25	20	55
Hambantota	30.2	25	30	45
Katugastota	28.0	20	25	55
Katunayake	30.5	20	25	55
Mannar	30.7	30	35	35
MahaIlluppallama	33.0	25	20	55
NuwaraEliya	18.8	20	30	50
Pottuvil	33.9	25	30	45
Puttalam	31.5	30	25	45
Ratnapura	30.8	30	20	50
Ratmalana	30.2	25	30	45
Trincomalee	34.3	25	30	45
Vavuniya	33.8	35	25	40
Kurunegala	31.1	20	30	50
Bandarawela	25.6	40	30	30

Table 3: probabilistic forecast for Maximum Temperature for JAS season 2023

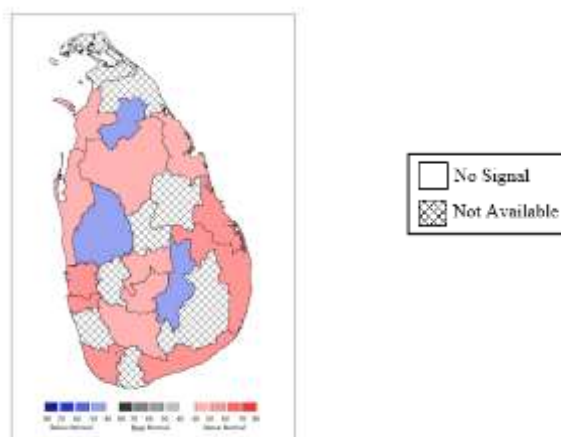


Fig 16: Probabilistic forecast for Minimum Temperatures for JAS season 2023

District	Average Minimum Temperature (°C) – (JAS)	Probability %		
		Below	Normal	Above
Anuradhapura	24.3	30	30	40
Badulla	18.5	45	25	30
Batticaloa	25.1	20	30	50
Colombo	25.0	25	20	55
Galle	24.7	20	30	50
Hambantota	24.6	20	30	50
Katugastota	20.7	25	35	40
Katunayake	24.7	30	20	50
Mannar	26.3	20	35	45
MahaIlluppallama	24.2	30	30	40
NuwaraEliya	12.6	30	25	45
Pottuvil	24.8	25	25	50
Puttalam	25.5	30	30	40
Ratnapura	23.3	30	30	40
Ratmalana	24.8	30	30	40
Trincomalee	25.5	20	35	45
Vavuniya	24.1	45	35	20
Kurunegala	23.6	40	25	35
Bandarawela	16.4	45	25	30

Table 4: Probabilistic forecast for Minimum Temperatures for JAS season 2023

Fig 16 and Table 4 provide the probabilistic forecast for Minimum Temperatures during JAS season 2023.

Accordingly, there is a higher chance of experiencing slightly above the normal Minimum Temperatures in Mannar, Anuradhapura, Puttalam, Colombo, Gampaha, Rathnapura, Hambantota, Galle, Kandy, Nuwara Eliya, Ampara, Trincomalee and Batticaloa districts and slightly below the normal Minimum Temperatures in Kurunegala, Vavuniya and Badulla districts (Fig 16) during JAS season 2023.

Note- Temperature forecasts are not available in **Matara, Kegalle, Kalutara, Monaragala, Polonnaruwa, Jaffna, Killinochchi, Mullativu and Mathale** districts due to unavailability of Climate data.