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Experimental Climate Monitoring and Prediction

by: Ruchira Lokuhetti, Prabodha Agalawatte, Manusha Lakmali, Zeenas Yahiya, Lareef Zubair and Michael Bell[1] (FECT and IRI[1])

17 November 2016

Highlights

South western regions of the country experienced heavy rainfall during the latter part of previous week from 9th–15th November. The highest rainfall of 100 mm for the period was recorded in Imaduwa region on 14th. Minimum temperature of 15 ^{O}C was recorded from Nuwara Eliya district while most parts of the island recorded a maximum temperature between 30-35 ^{O}C. Up to 20 km/h north easterly winds were recorded in the southern region of the country. For the period after the 16th, November the NOAA NCEP model predicts up to 135 mm of rainfall for Sri Lanka outside the South with highest values in the North, East, North-Central regions.

Monitoring

Rainfall

***Weekly Monitoring*:** On 9th up to 20 mm rainfall was received in Madampe region. On 10th western sea, adjacent to Colombo and Gampaha districts received up to 50 mm rainfall. On 11th Haputale, Bandarawela and Ella areas of Badulla district and Wellawaya, Buttala and Badalkumbura areas of Monaragala district including eastern sea adjacent to Trincomalee received up to 20 mm rainfall. On 12th Gampaha district received up to 50 mm rainfall while Colombo, Galle and Kalutara districts received up to 30 mm rainfall. Up to 20 rainfall was received in Kalutara, Ratnapura, Badulla, Kandy, Nuwara Eliya, Kilinochchi and Jaffna districts including several areas of Mullaitivu, Monaragala and Matara districts. On 13th surrounding areas near the district border of Kurunegala and Kandy received rainfall up to 30 mm. On 14th surrounding areas of Imaduwa of Galle district and Telijjavila of Matara received up to 100 mm rainfall while Hambantota district received up to 50 mm rainfall. Kalutara, Ratnapura, Monaragala and Polonnaruwa districts received up to 20 mm rainfall. On 15th Colombo, Matara and Ratnapura districts received up to 70 mm rainfall while Gampaha, Kegalla, Kalutara districts received up to 50 mm rainfall. Galle and Kandy districts received up to 30 mm rainfall. For the past week, the RFE 2.0 tool shows rainfall up to 100 mm in Colombo, Ratnapura, Kegalla, Galle and Matara districts. Up to 75 mm of rainfall is shown for Gampaha, Kalutara, Kegalla and Hambantota districts. Up to 50 mm rainfall is shown for Puttalam, Kurunegala, Kandy, Matale, Badulla and Nuwara Eliya. Up to 25 mm rainfall is shown for the rest of the country. It also shows an above average rainfall of 25-50 mm in Colombo, Kalutara, Galle and Matara districts. Below average rainfall of 50-100 mm is shown for Monaragala, Batticaloa and Ampara districts, and 25-50 mm for most parts of the island.

***Monthly Monitoring*:** Below average rainfall conditions were experienced in the entire island in the month of October except for coastal regions of Galle district, where monthly average rainfall amount to 450 mm/month. Rainfall did not exceed 210 mm/month for the rest of the island. The CPC Unified Precipitation Analysis tool shows ~100 mm of total rainfall in Gampaha, Colombo, Ratnapura, Galle, Matara, Anuradhapura, Mannar, Vavuniya,, Matale, Kandy and Nuwara Eliya districts ; and ~25 mm of total rainfall in Ampara, Badulla, Monaragala, Kegalla and Jaffna districts.

Temperature

From 6th–12th November the lowest temperature of 10-15 ^{O}C was recorded in Nuwara Eliya. The maximum temperature recorded in Kandy, Badulla, Kegalla and Ratnapura regions was between 25-30 ^{O}C. The maximum temperature range in rest of the country was 30-35 ^{O}C. During this period an above average temperature of 0-1 ^{O}C was recorded by the western, eastern and south eastern regions. Rest of the island experienced an above average temperature of 0-3 ^{O}C.

Wind

At 850 mb level up to 20 km/h north easterly wind was experienced by the southern region of the island. The rest of the country experienced wind in the same direction with speed less than 15 km/h. At 700 mb level southern and central regions experienced north easterly winds with a speed of up to 20 km/h while rest of the country experienced winds with a speed less than 15 km/h in the same direction.

Ocean State

Pacific sea state: November 10, 2016

During early November 2016 the tropical Pacific SST anomaly was slightly cooler than -0.5C, the threshold for weak La Niña. Also, most of the atmospheric variables across the tropical Pacific have been consistent with weak La Niña conditions. The upper and lower atmospheric winds have been suggestive of a strengthened Walker circulation, and the cloudiness and rainfall have also been consistent with weak La Niña conditions. The collection of ENSO prediction models indicates SSTs near or slightly cooler than the threshold of La Niña during the remainder of fall, persisting through mid-winter, then weakening to cool-neutral by later winter. (*Text Courtesy IRI*)

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Indian Ocean State

0.5 ^{O}C below average sea surface temperature was observed in the southern sea of Sri Lanka.

Predictions

Rainfall

14-day prediction: From 16th-22nd November, the NOAA NCEP models predicts total rainfall, more than 135 mm for Northern, North Central and Eastern provinces including Kurunegala, Matale, Badulla, Colombo and Monaragala districts; 125-135 mm in Puttalam and Kandy districts; 115-125 mm in Gampaha, Nuwara Eliya, Ratnapura, Galle and Kegalla districts; and total rainfall between 115-105 mm is expected in Matara and Hambantota districts. For the period 23rd-29th November total rainfall more than 135 mm is expected in Colombo, Kegalla, Ratnapura , Kurunegala, Matale, Polonnaruwa, Trincomalee and Galle regions. Total rainfall more than 95 mm is expected in rest of the country.

Weekly prediction: IMD GFS model predicts rainfall between 20-40 mm in Batticaloa and adjacent sea regions on 17th. Rainfall between 1-10 mm is expected for the rest of the island. On 18th rainfall between 1-10 mm is expected for the entire country except for surrounding regions of Yala. On 19th and 20th Ratnapura region expected to receive40-70 mm rainfall while north western, eastern and south eastern coastal regions expected to receive 20-40 mm rainfall. Rest of the country expected to receive 1-10 mm rainfall. Adjacent western and eastern sea regions are expected to receive rainfall between 70-130 mm on 20th. On 21st rainfall is expected to be increased with northern coastal regions also receiving rainfall between 40-70 mm and adjacent western sea receiving rainfall between 130-200 rainfall. On 22nd surrounding areas of Ratnapura is expected to receive rainfall between 70-130 rainfall while eastern and western coastal regions expected to receive 20-40 mm rainfall. Rest of the island is expected to receive rainfall between 1-10 mm. On 23rd rainfall between 40-70 mm is expected in Kandy and Nuwara Eliya including western, eastern and southern sea regions. Rainfall between 20-40 mm is expected for rest of the central and northern regions of the country while rest of the island expected to receive 1-10 mm rainfall.

IMD WRF & IRI Model Forecast: According to the IMD WRF model up to 124 mm of rainfall is expected in Trincomalee and Polonnaruwa districts on the 11th. Matale, Batticaloa and Anuradhapura regions are expected to receive up to 64 mm rainfall with rest of the central and northern regions of the island expected to receive up to 35 mm rainfall. On 12th rainfall is expected to be increased with Ampara district also receiving rainfall up to 124 mm and, Ratnapura and Mullaitivu regions experiencing rainfall up to 64 mm. Matara and Galle districts are also expected to receive up to 35 mm rainfall.

Seasonal Prediction: As per IRI Multi Model Probability Forecast for November to January 2017, the total 3-month precipitation shall be climatological for the whole island. The 3-month temperature has more than 70-80% likelihood in the entire country of being in the above-normal tercile during this period.

Temperature

NOAA CPC GFS model predicts 35-40 ^{O}C maximum temperature in Hambegamuwa area of Monaragala district. The maximum temperature for the rest of the island will range between 30-35 ^{O}C. For the same period minimum temperature is expected in Nuwara Eliya, Kandy, Ratnapura and Badulla to be between 15-20 ^{O}C.

Wind

The 850 mb level and 700 mb predict up to 30 km/h north easterly wind for northern and central regions of the country. Up to 20 km/h wind in the same direction is expected for the rest of the country.

MJO based OLR predictions

MJO shall not have a significant impact on the rainfall in Sri Lanka for the next 5 days and shall enhance the rainfall during the following 10 days.

[1] International Research Institute for Climate and Society, Earth Institute at Columbia University, New York.

Official hydro-meteorological statements are provided by the Sri Lanka Department of Meteorology and Department of Irrigation.

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Weekly Hydro- Meteorological Report for Sri Lanka

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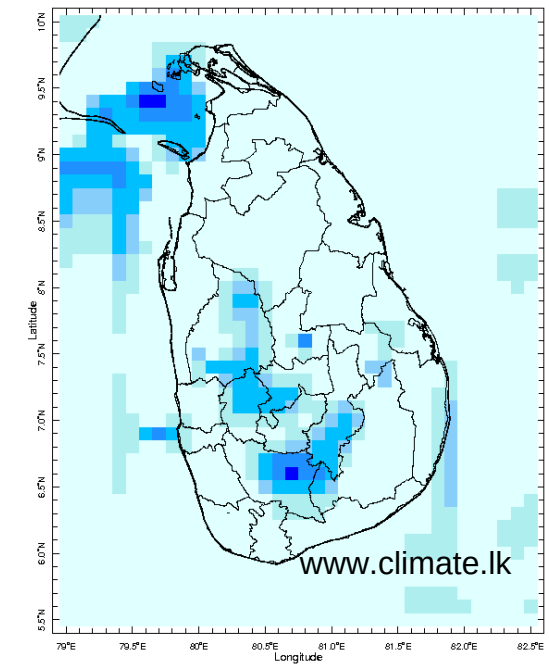
Daily Rainfall Monitoring

The following figures show the satellite observed rainfall in the last 7 days in Sri Lanka.



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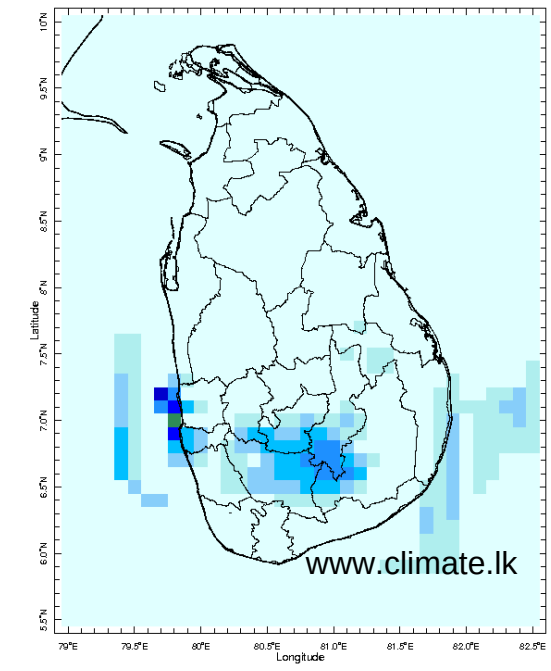

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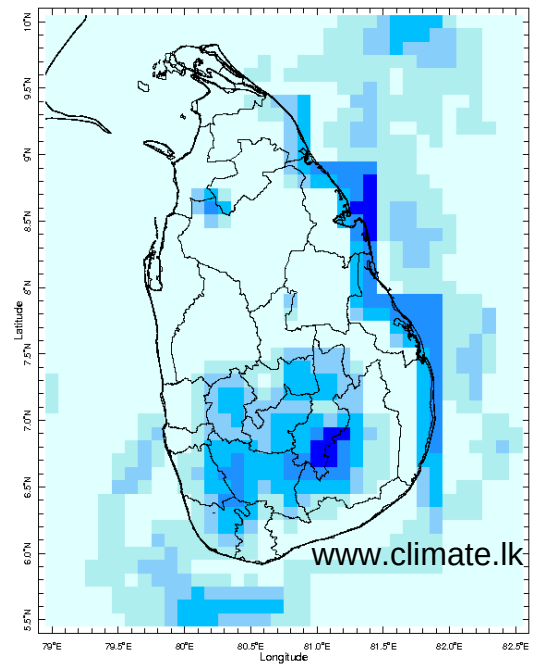

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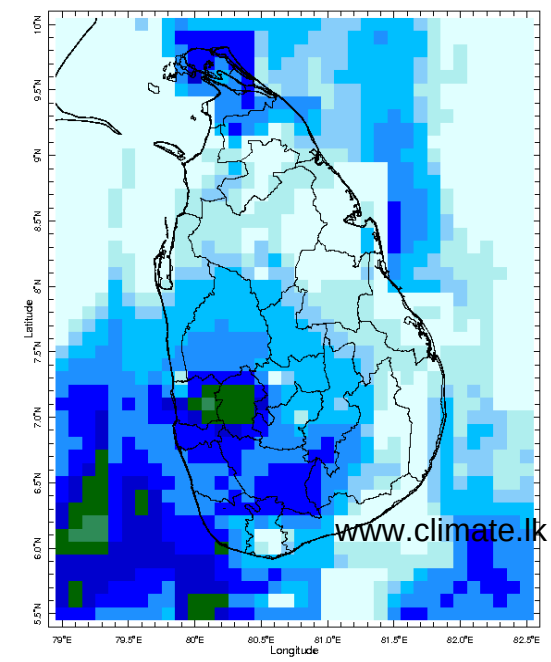

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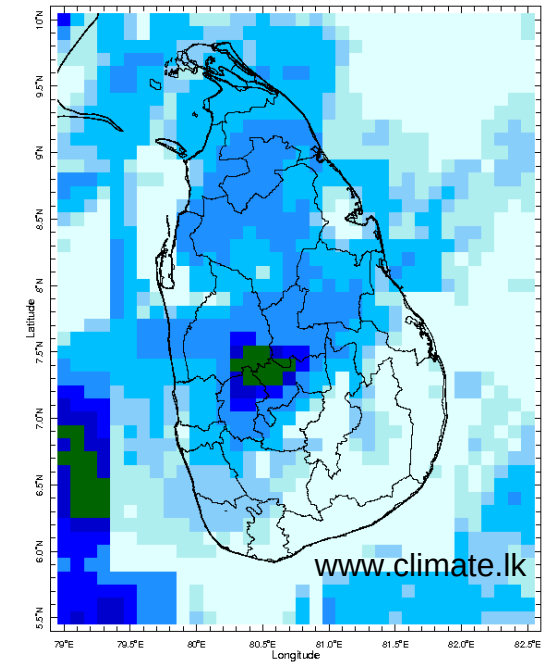

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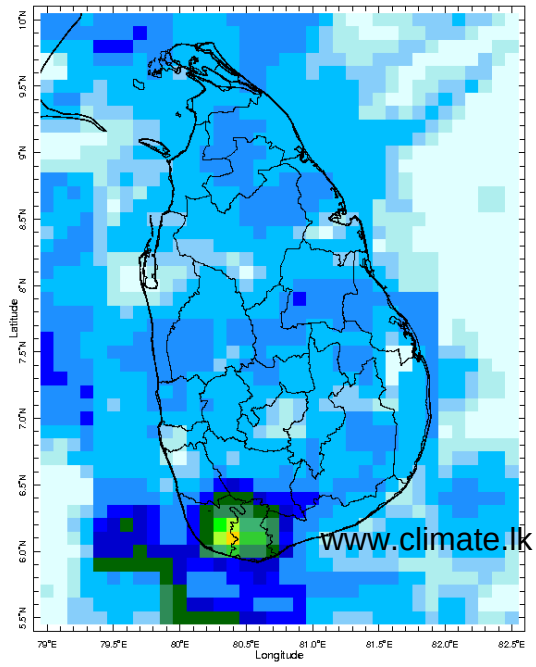

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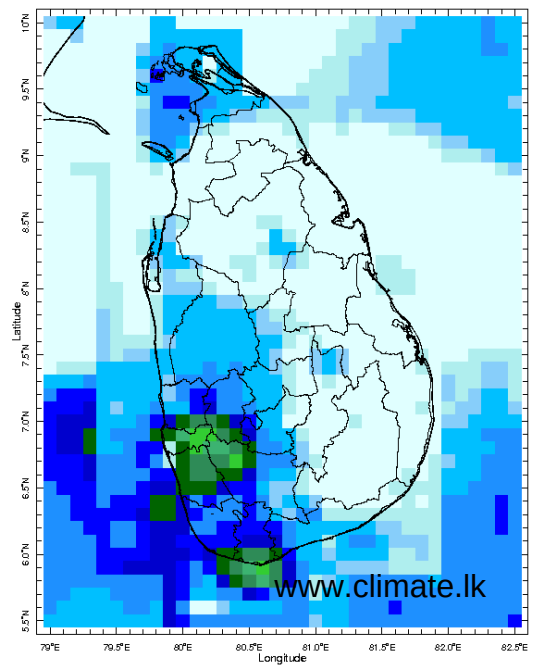

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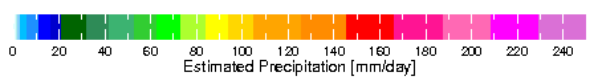
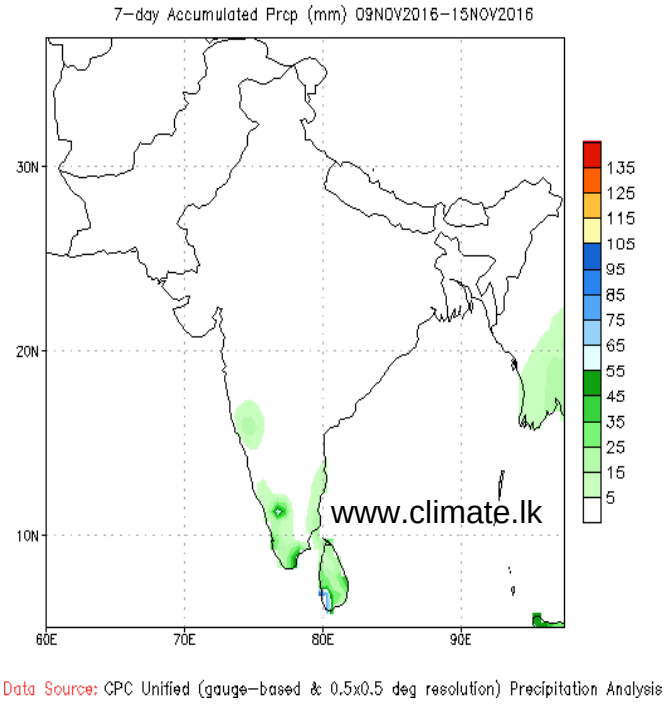
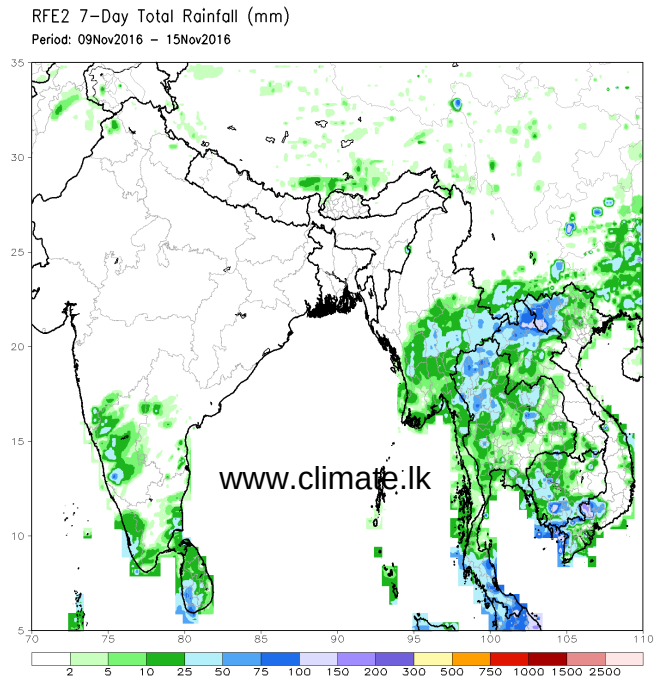


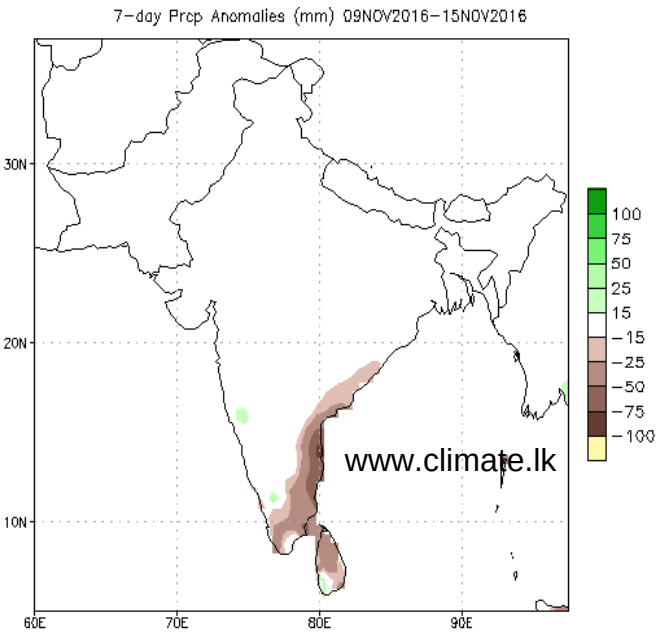
Weekly Rainfall Monitoring

The following figures show the total satellite observed rainfall in the last week in Sri Lanka. The figure in the left is the total 7-day rainfall from NOAA Climate Prediction Center (CPC) Unified Precipitation Analysis and the figure in the right is the total 7-day rainfall from CPC RFE 2.0 Satellite Rainfall Estimates. The bottom two figures are the respective anomalies.

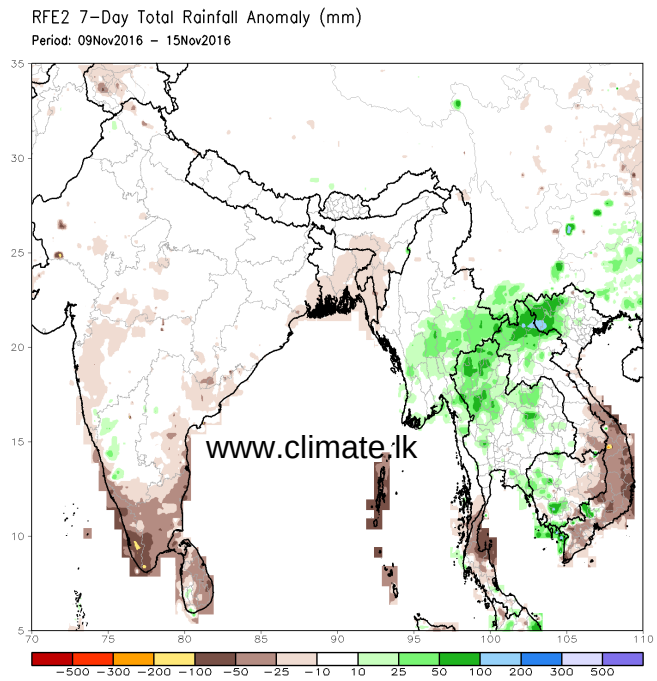


Data Source: CPC Unified (gauge-based & 0.5x0.5 deg resolution) Precipitation Analysis



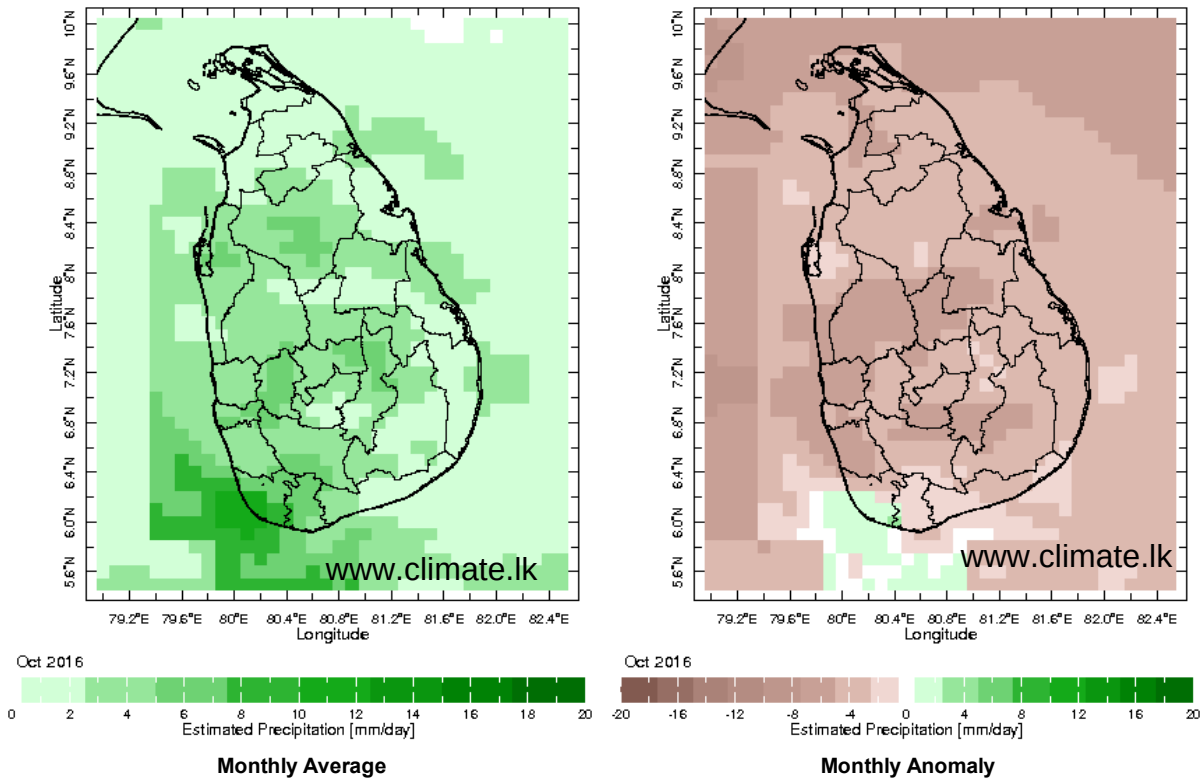


Data Source: CPC Unified (gauge-based & 0.5x0.5 deg resolution) Precipitation Analysis Climatology (1981-2010)

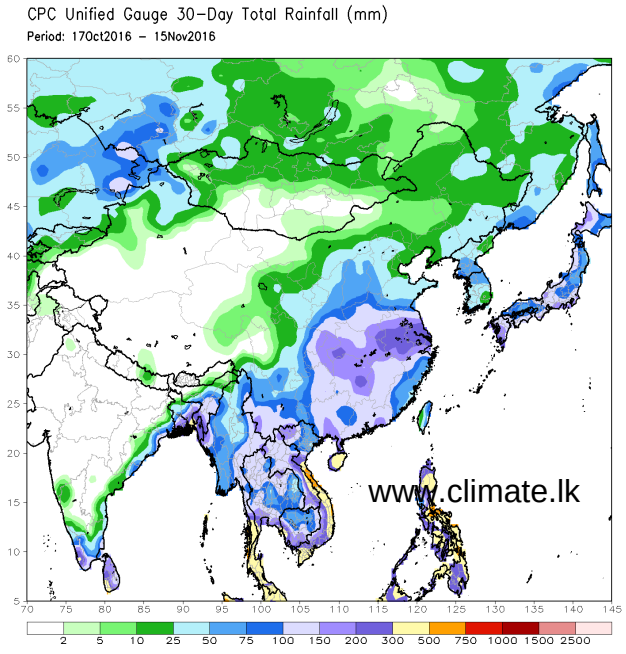


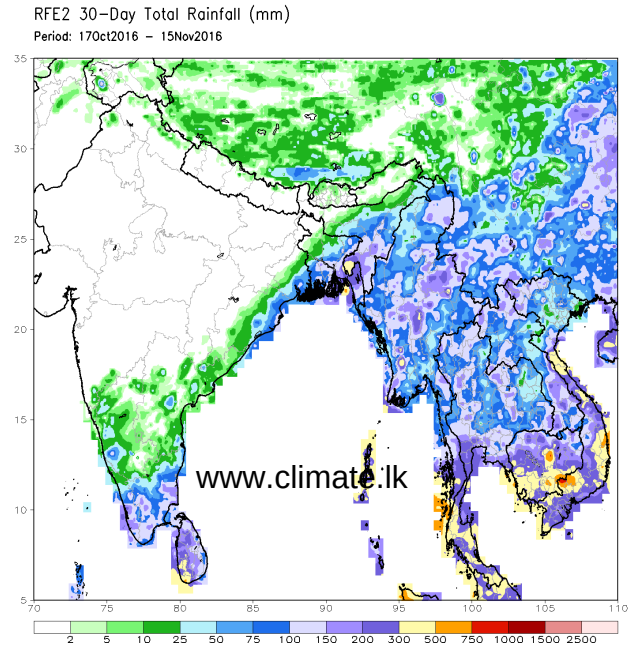
Monthly Rainfall Monitoring

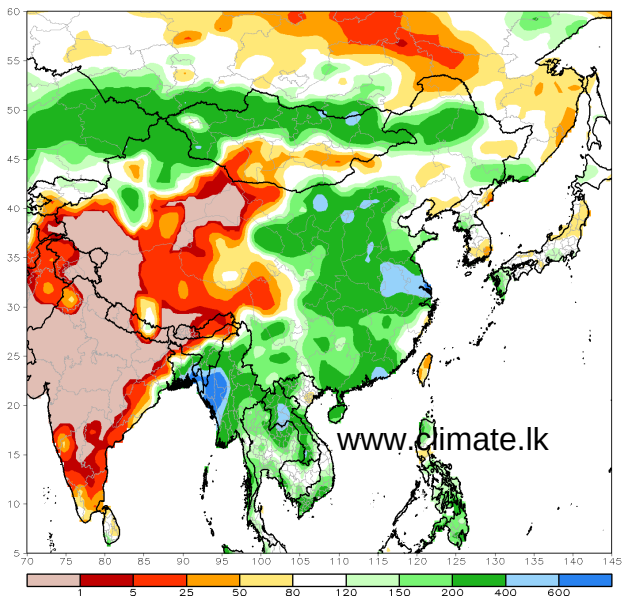
The figure in the left shows the average observed rainfall in the previous month. The rainfall anomaly in the previous month is shown in the figure to the right. The brown color in the anomaly figure shows places which received less rainfall than the historical average while the green color shows places with above average rainfall. Darker shades show higher magnitudes in rainfall

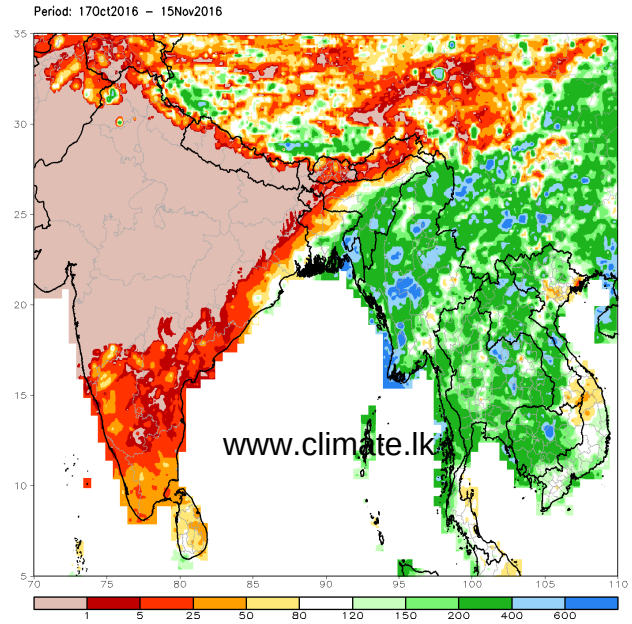


The figure in the top-left shows the total rainfall in the past 30 days from CPC Unified Precipitation Analysis while the figure in the top-right shows the total rainfall for the same period from RFE 2.0 Satellite Rainfall Estimates. The bottom two figures show the percentage of rainfall received in the past 30 days compared to normal rainfall in this period.

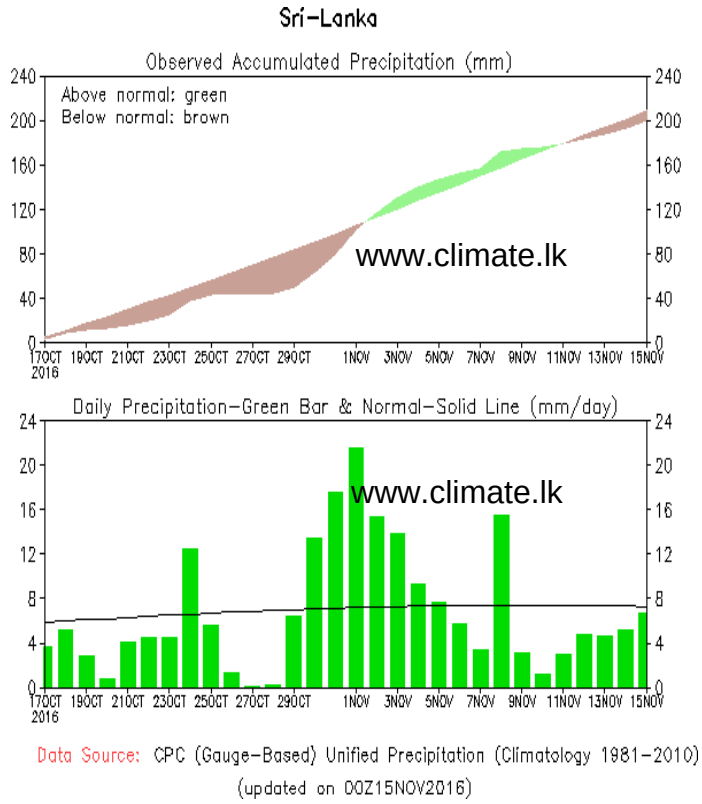




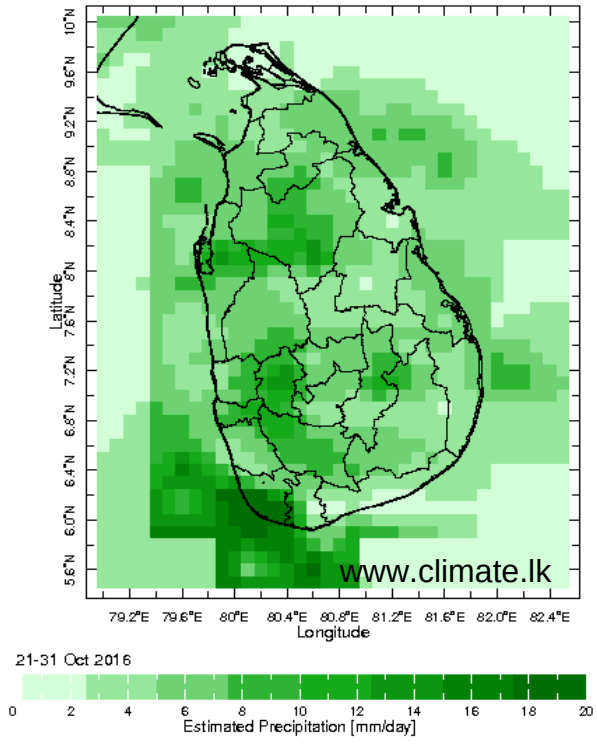


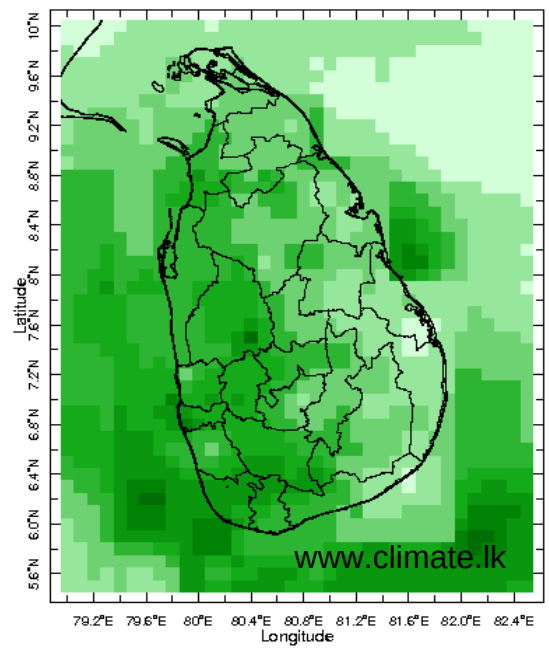


The following figure shows the observed accumulated rainfall (top) and daily observed rainfall (bottom) in Sri Lanka in the last 30 days.

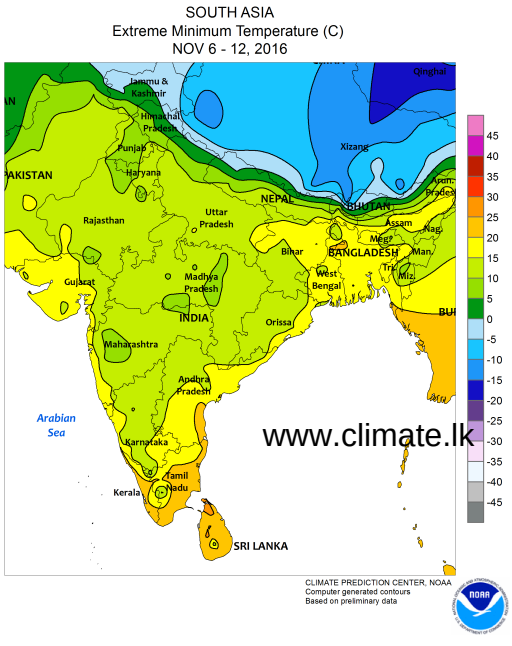


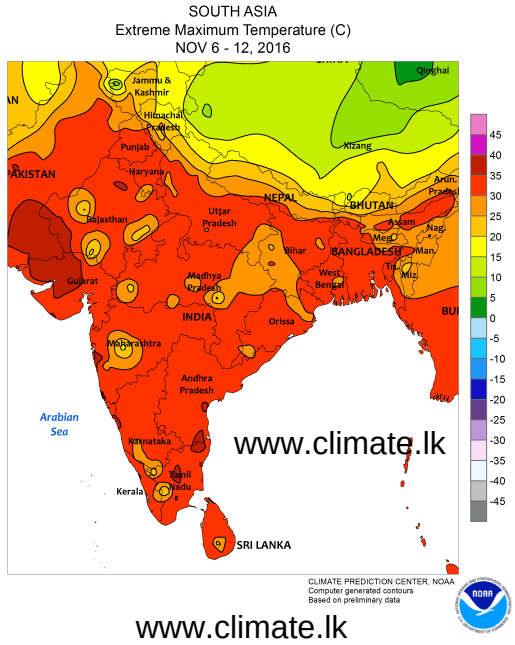
Dekadal (10 Day) Satellite Derived Rainfall Estimates

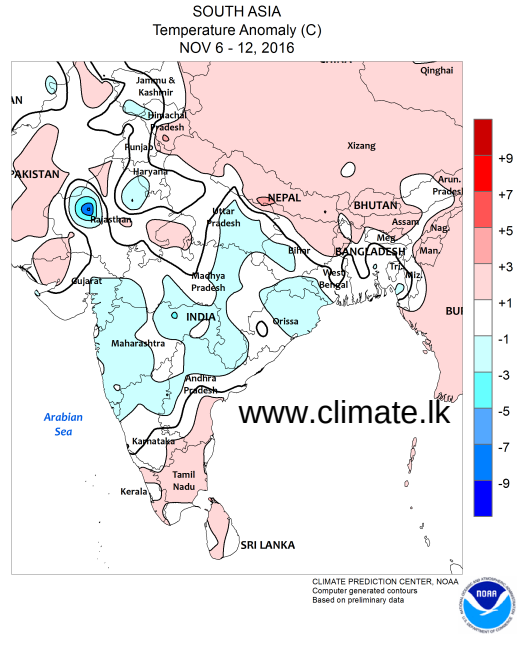




Weekly Temperature Monitoring







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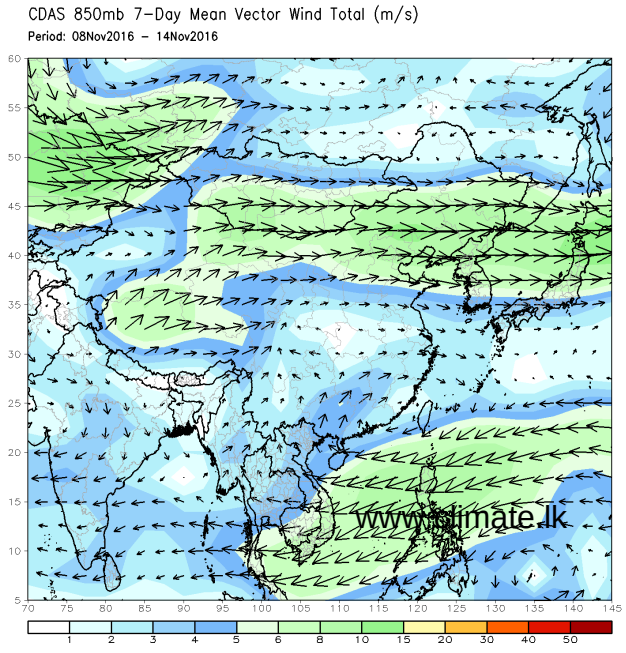
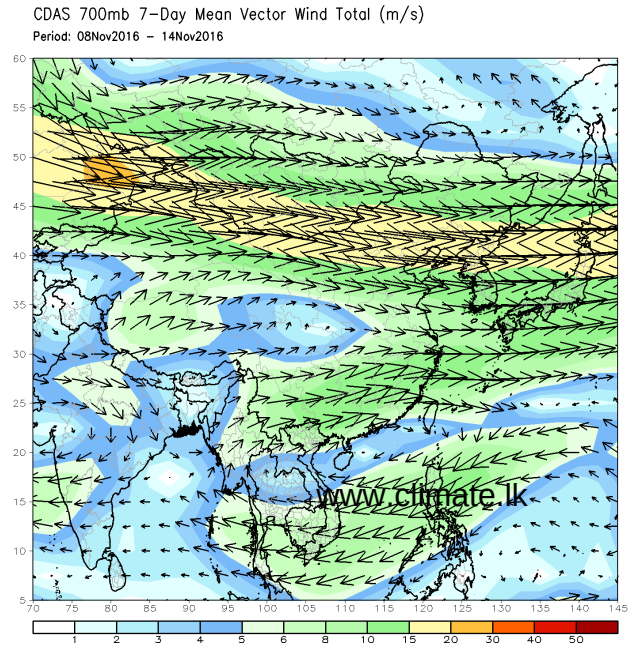
Weekly Wind Monitoring

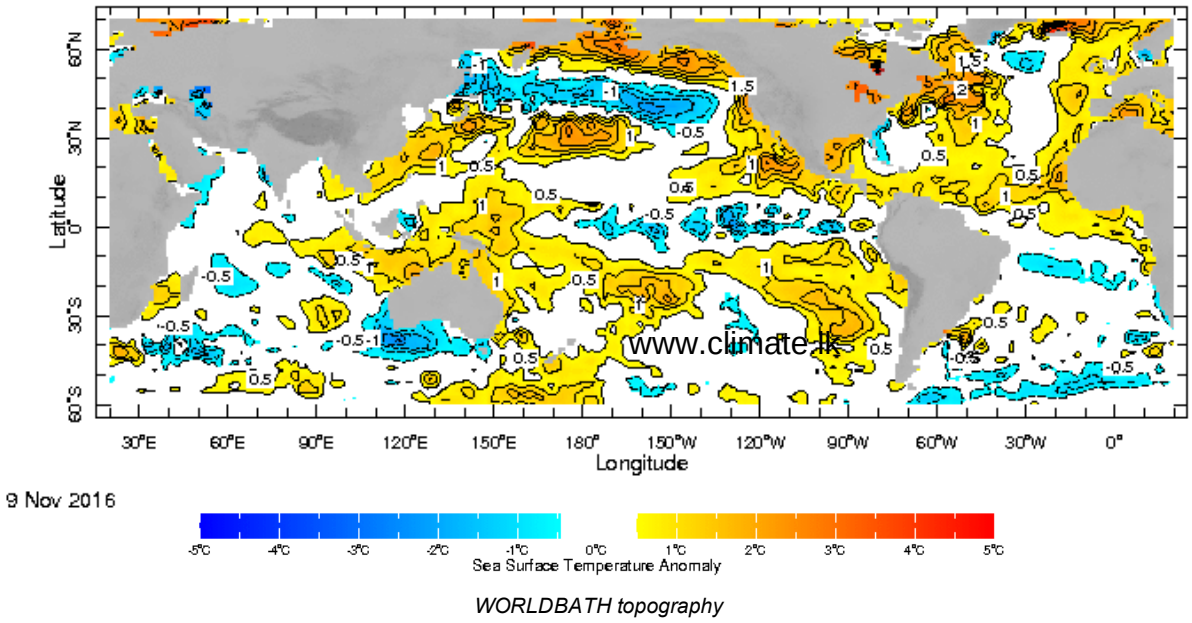
The following figures show the mean vector wind total of the past 7 days near Sri Lanka at two levels. The figure on the left shows 850 mb (~1500 m) level and the figure on the right shows 700 mb (~3000 m) level.





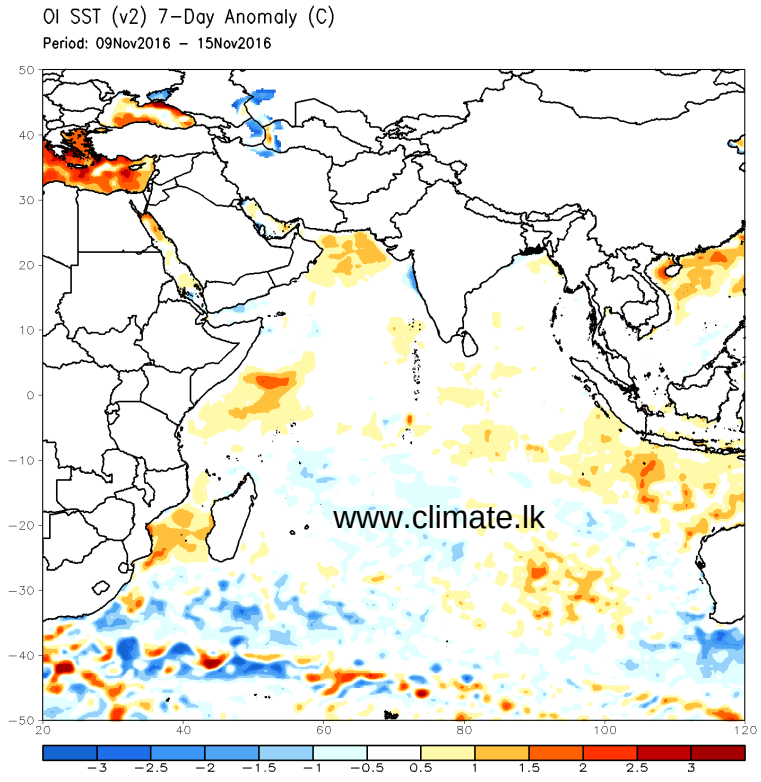
Weekly Average SST Anomalies

Weekly average Sea Surface Temperature (SST) anomaly in the world from NOAA NCEP



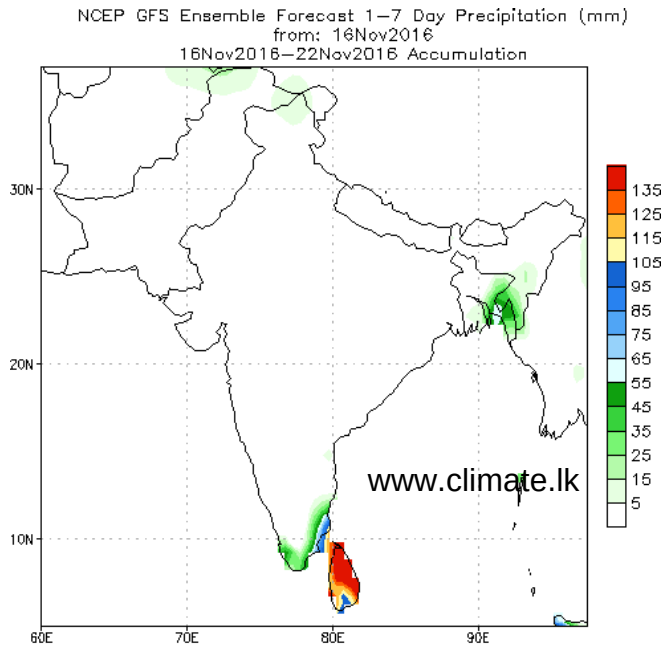
WORLDBATH topography

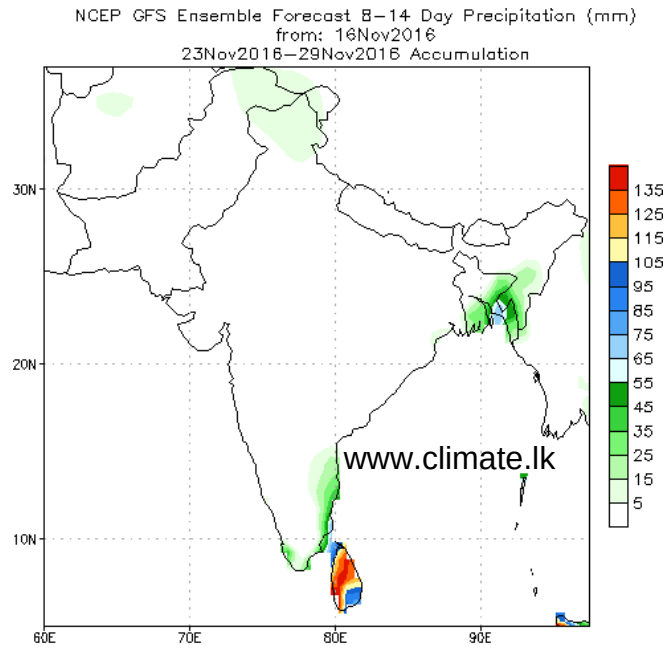
Optimum Interpolated Sea Surface Temperature Anomaly in the Indian Ocean from NOAA CPC



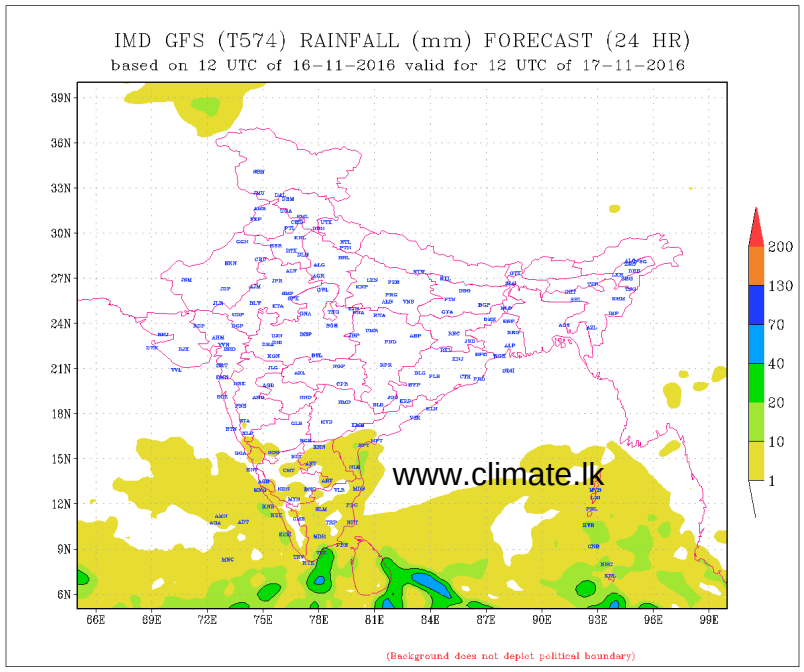
PREDICTIONS

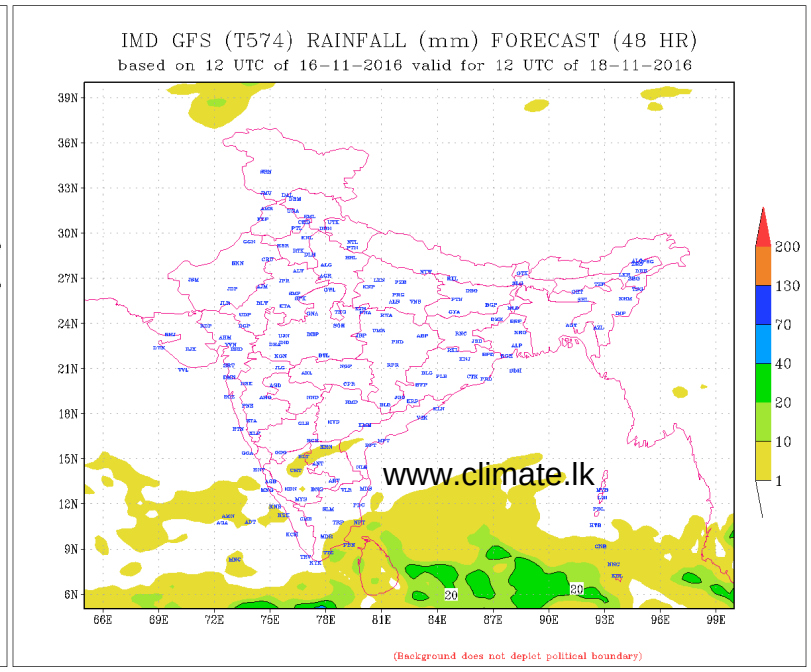
NCEP GFS 1- 14 Day prediction

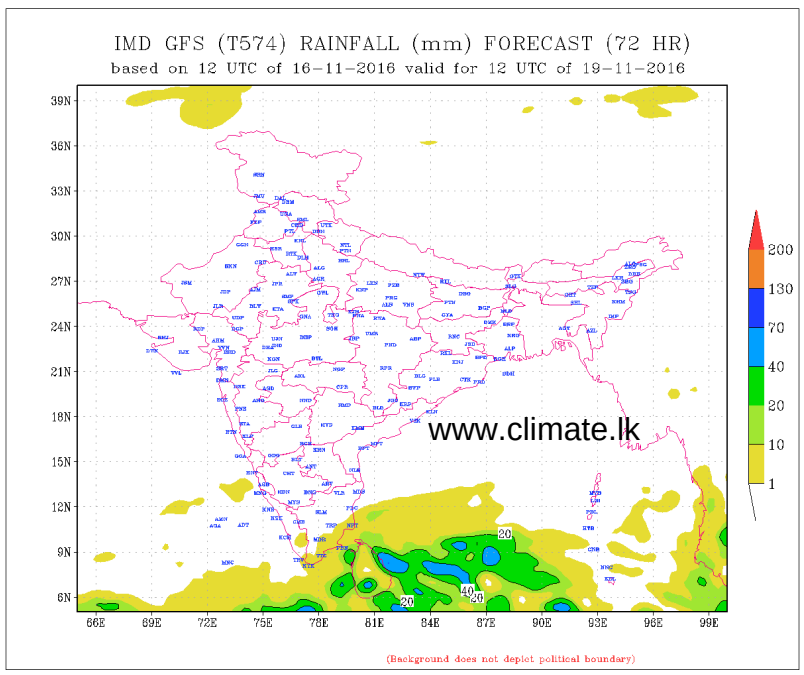


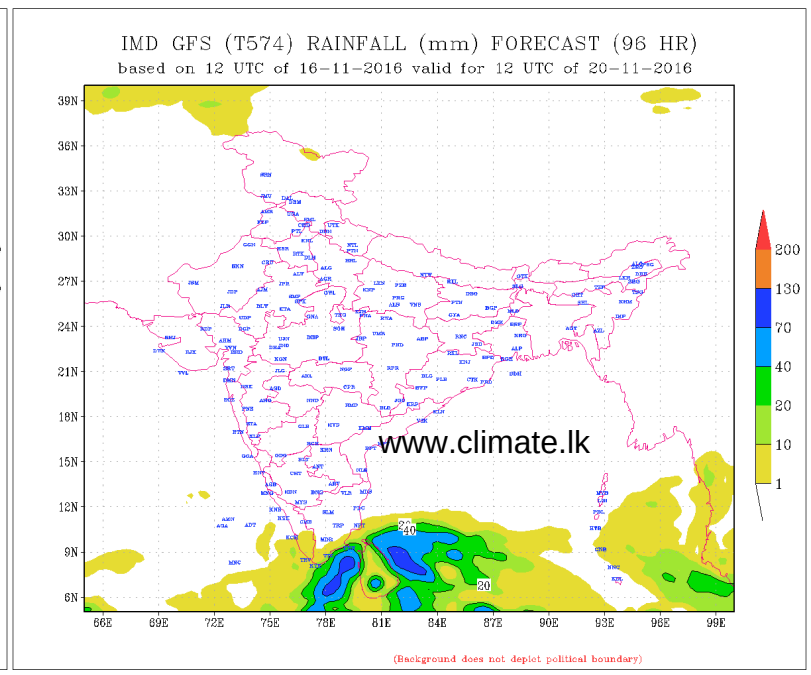


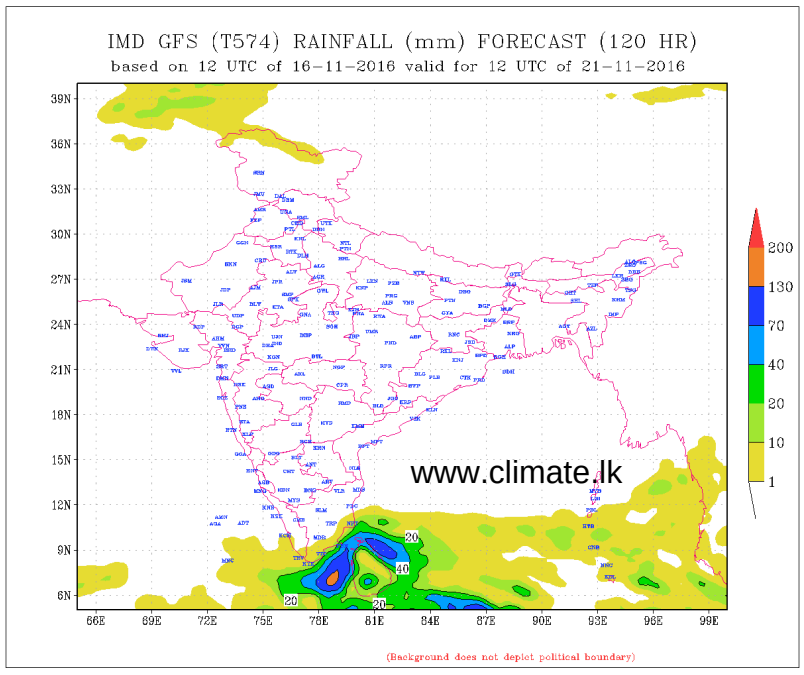
IMD GFS (T574) Model Rainfall Forecast from RMSC New Delhi, India

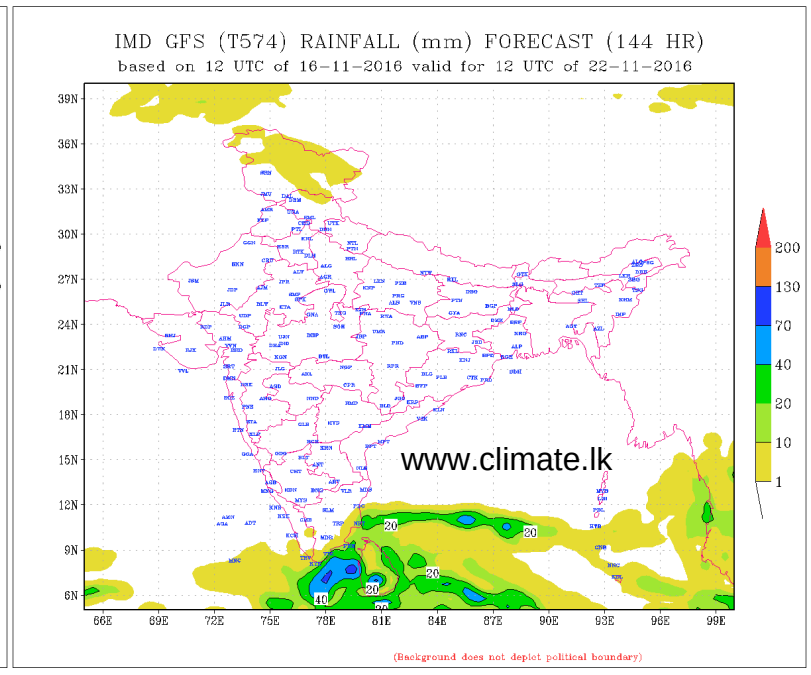


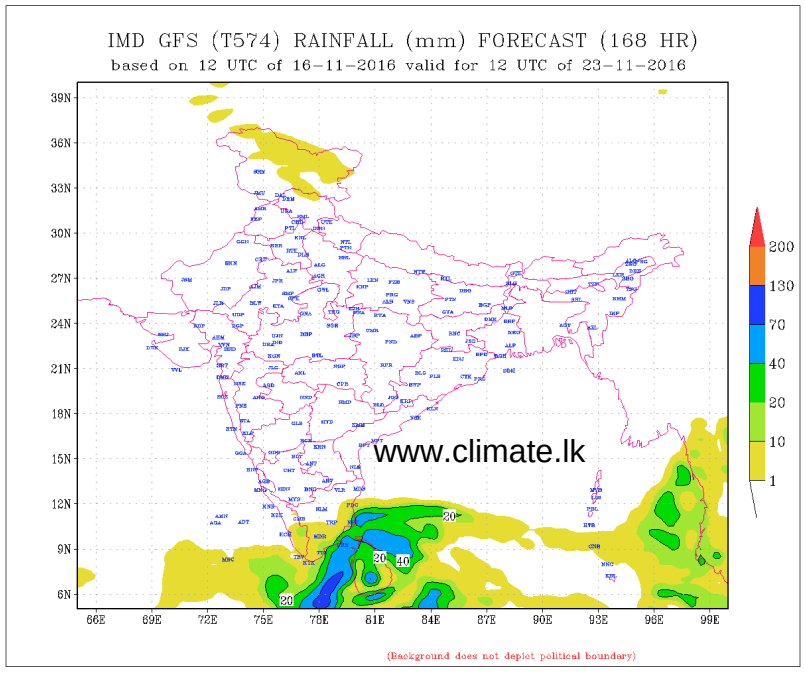











IMD GFS (T574) RAINFALL (mm) FORECAST (168 HR)
based on 12 UTC of 16-11-2016 valid for 12 UTC of 23-11-2016
39N
36N
33N
30N
27N
24N
21N
18N
15N
12N
9N
6N
66E
69E
72E
75E
78E
81E
84E
87E
90E
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96E
99E
200
130
70
40
20
10
1
20
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20
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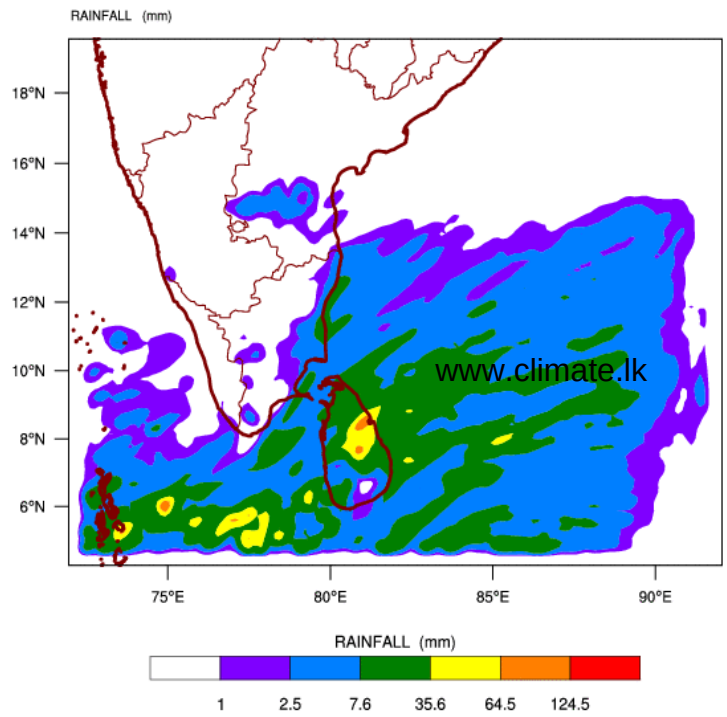
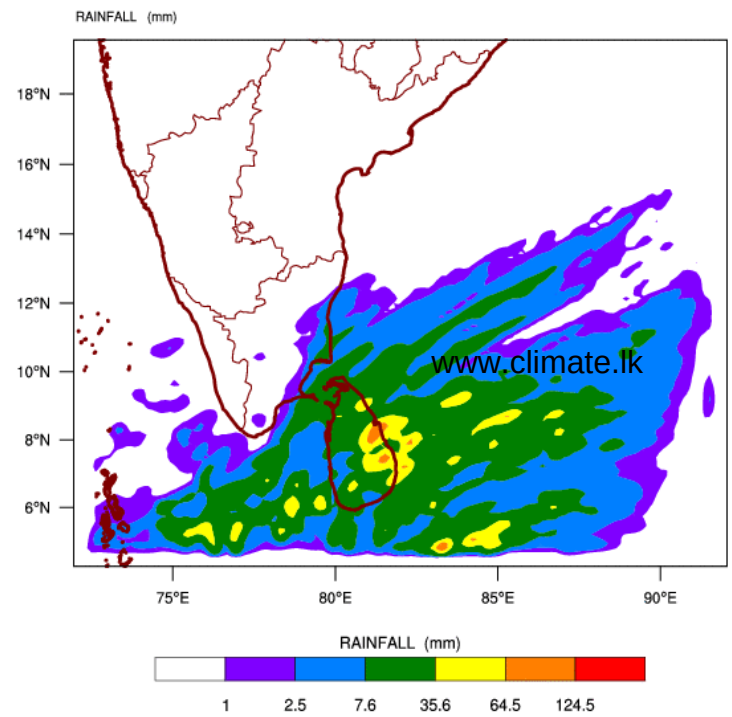
(Background does not deplict political boundary)

WRF Model Forecast (from IMD Chennai)

WRF MODEL FORECAST (48 HR.) RAINFALL(mm)\
based on 00 UTC of 16-11-2016 valid for 03 UTC of 18-11-2016

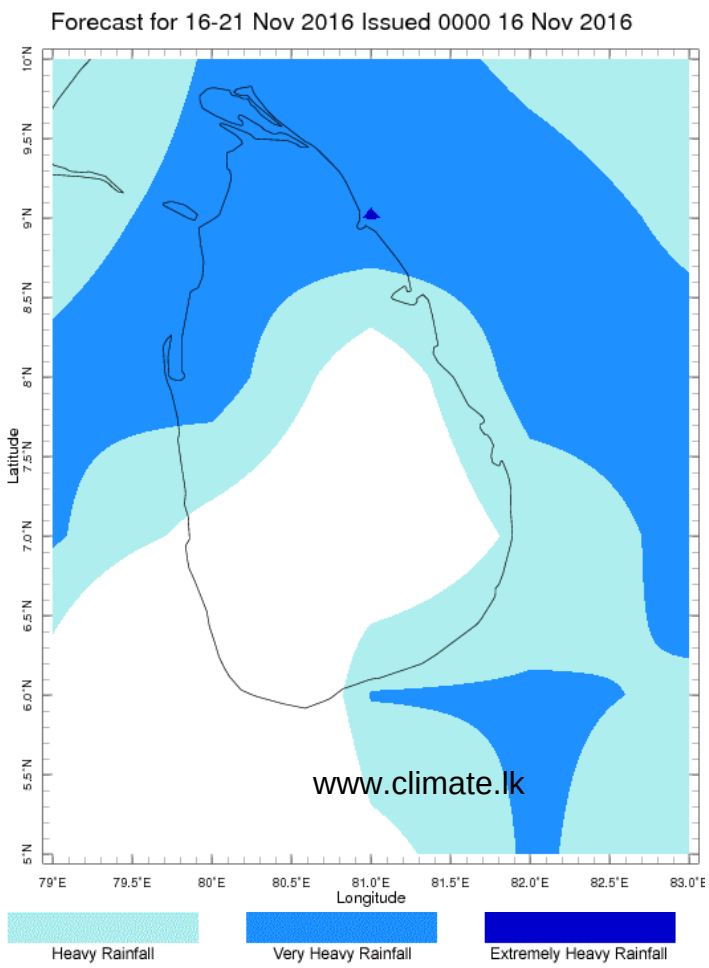


WRF MODEL FORECAST (72 HR.) RAINFALL(mm)\
based on 00 UTC of 16-11-2016 valid for 03 UTC of 19-11-2016

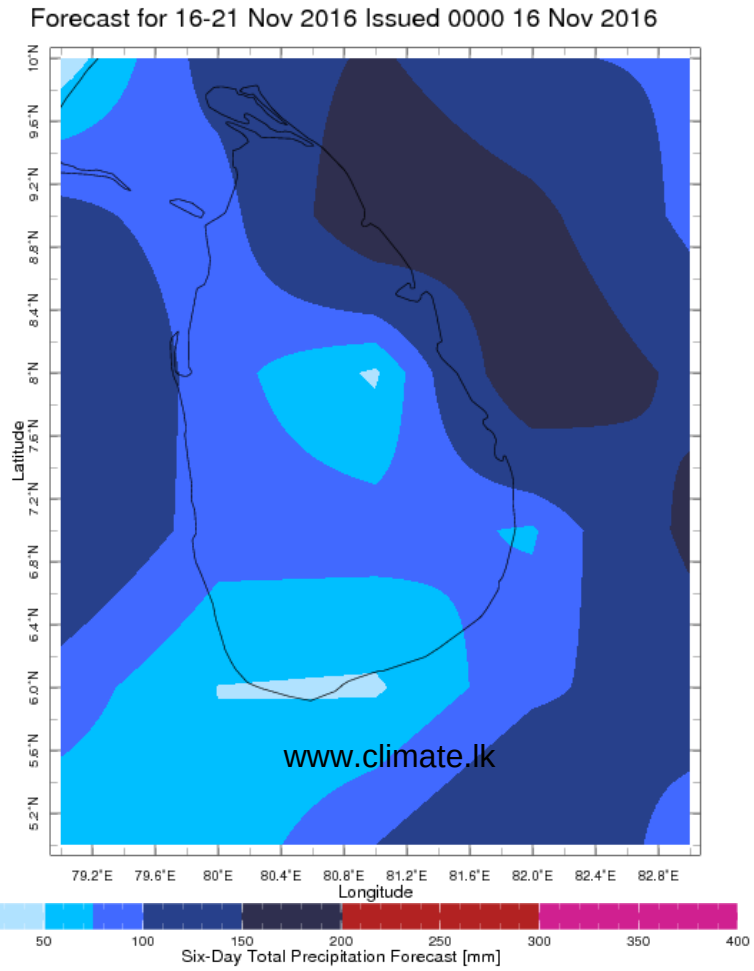


Weekly Rainfall Forecast from IRI

Total rainfall forecast from the IRI for next six days is provided in figures below. The figure to the left shows the expectancy of heavy rainfall events during these six days while the figure to the right is the prediction of total rainfall amount during this period.



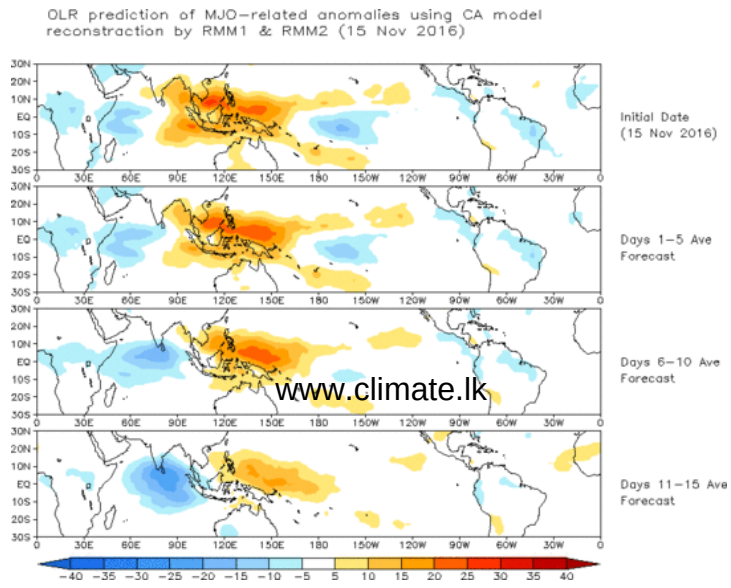
Extreme Rainfall Forecast



Total Six Day Precipitation Forecast

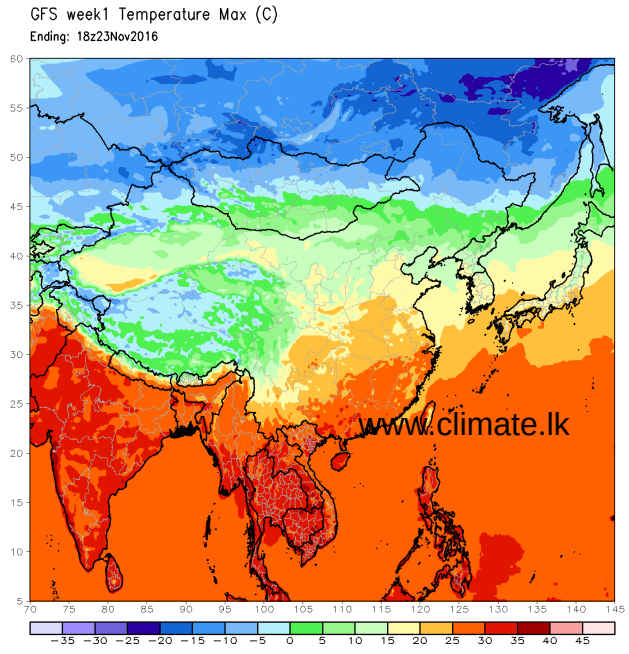
Madden Julian Oscillation (MJO) related Outgoing Longwave Radiation (OLR) Forecast

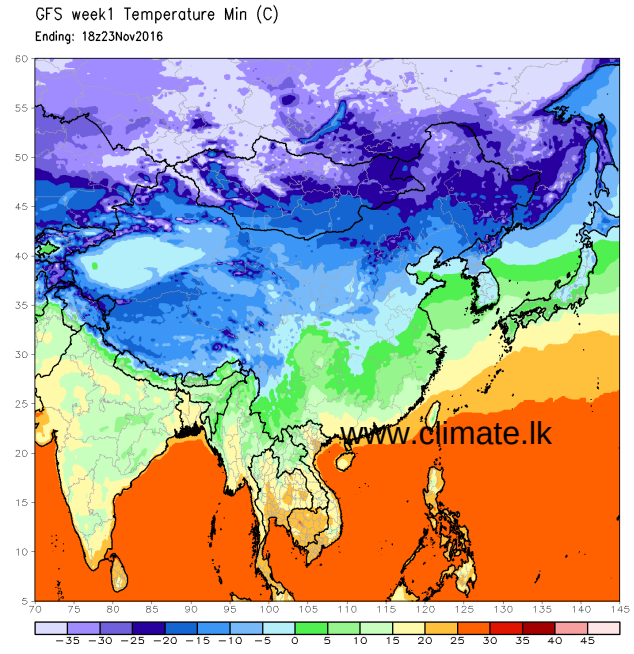
The Outgoing Longwave Radiation (OLR) is a proxy for rainfall. This can be used to identify convective rain clouds based on the MJO phase. Violet and Blue shading indicates enhanced tropical weather and Orange shading indicates suppressed conditions. The following figure shows the forecasts of MJO associated anomolous OLR for the next 15 days from the Constructed Analogue (CA) model forecasts.



Weekly Temperature Forecast

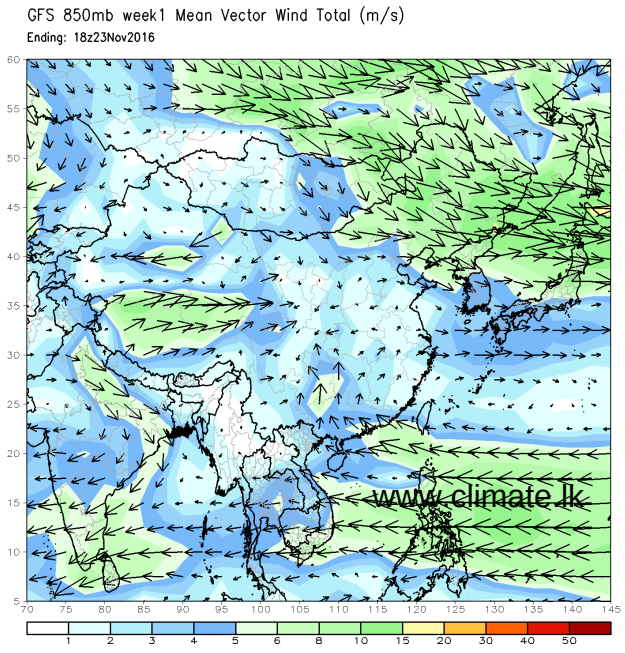
Weekly Minimum and Maximum Temperature prediction from the GFS model (from NOAA CPC)

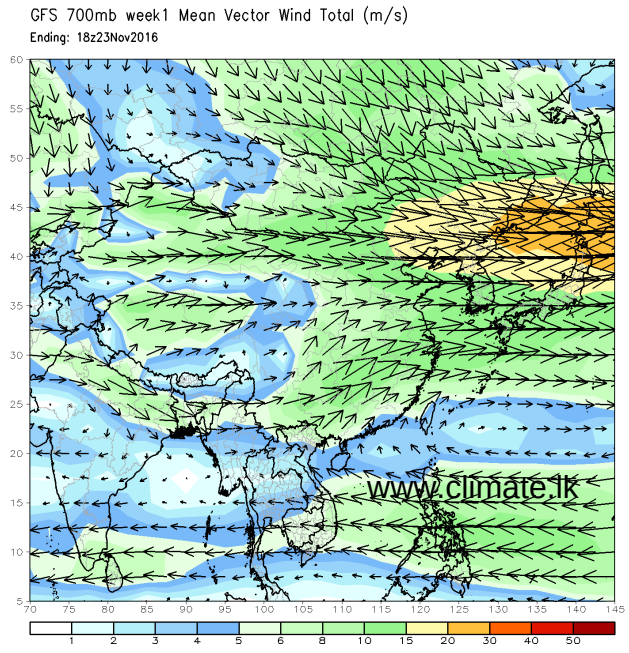




Weekly Wind Forecast

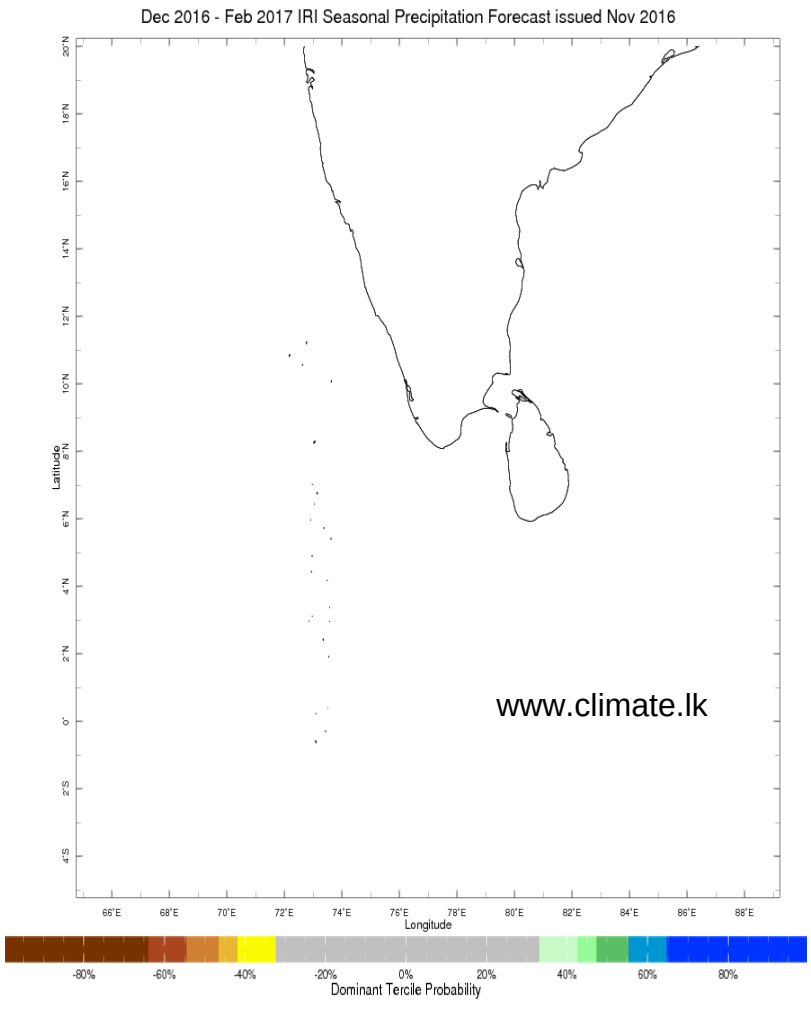
Weekly mean vector wind total prediction from the GFS model at 850 mb (left) and 700 mb (right) levels. (from NOAA CPC)



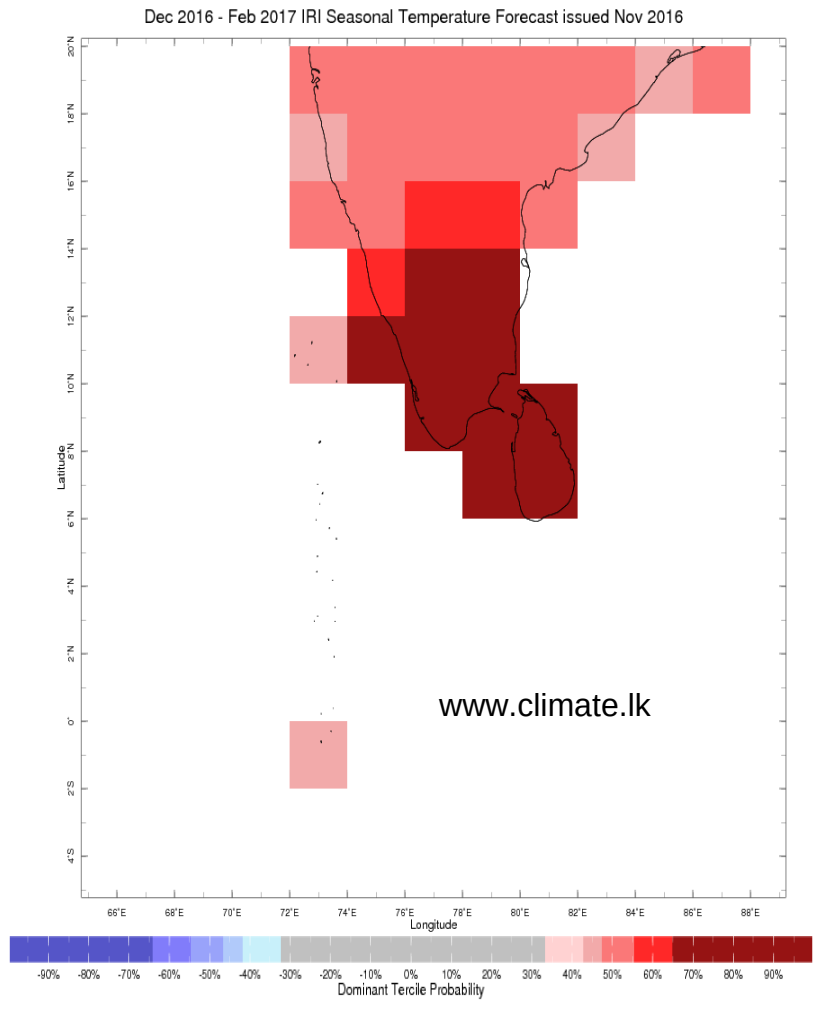


Seasonal Rainfall and Temperature Forecast

Following is the latest seasonal precipitation and temperature prediction for the next 3 months by the IRI. The color shading indicates the probability of the most dominant tercile -- that is, the tercile having the highest forecast probability. The color bar alongside the map defines these dominant tercile probability levels. The upper side of the color bar shows the colors used for increasingly strong probabilities when the dominant tercile is the above-normal tercile, while the lower side shows likewise for the below-normal tercile. The gray color indicates an enhanced probability for the near-normal tercile (nearly always limited to 40%).



Precipitation Forecast



Temperature Forecast

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