The 10th GEOSS Asia-Pacific Symposium

Hanoi, Vietnam, 18-20 September 2017

Many countries are vulnerable to rising seas.

Department of Meteorology

Sri Lanka

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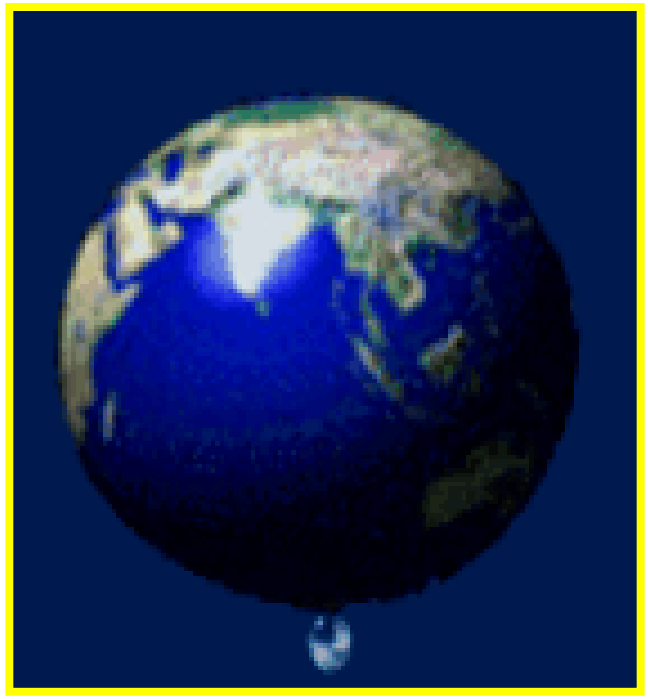
Every human, animal and plant depends on Water for their survival !



nearly one third of the countries (or one billion people) lack adequate quantities of safe water to meet their minimum requirements.

By 2025, nearly 60 % of the countries in the world are expected to be water stressed.

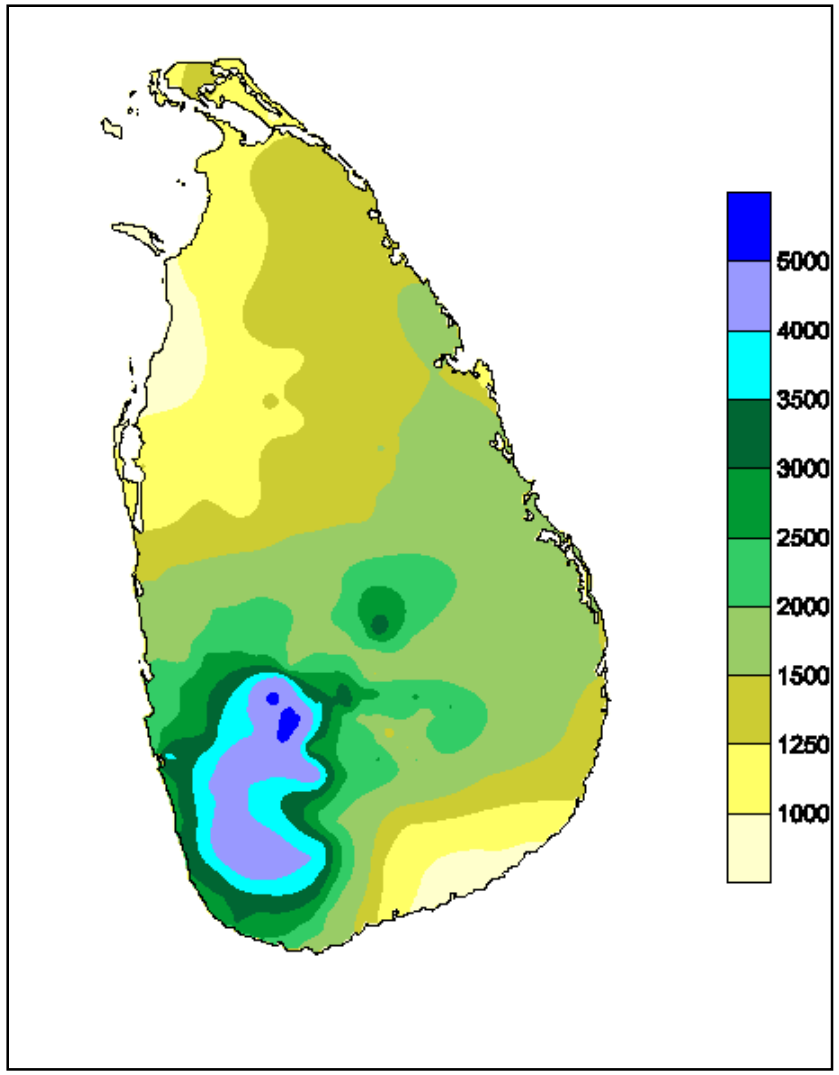
Sri Lanka

Annual rainfall varies between 950 mm to 5500 millimeters

with an average of

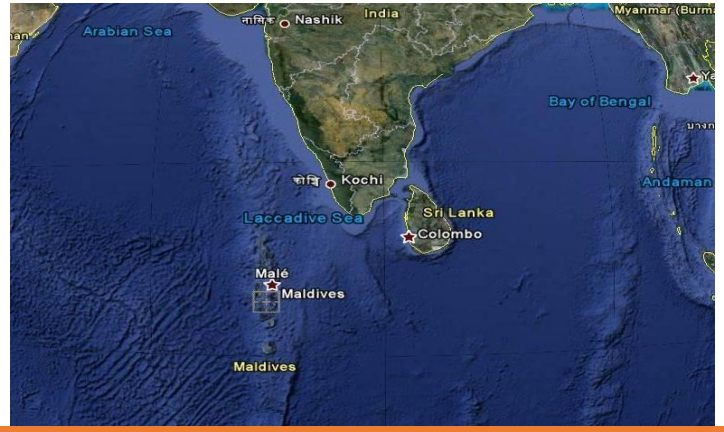
1861.0 mm

Annual Rain Volume – 122 km^3

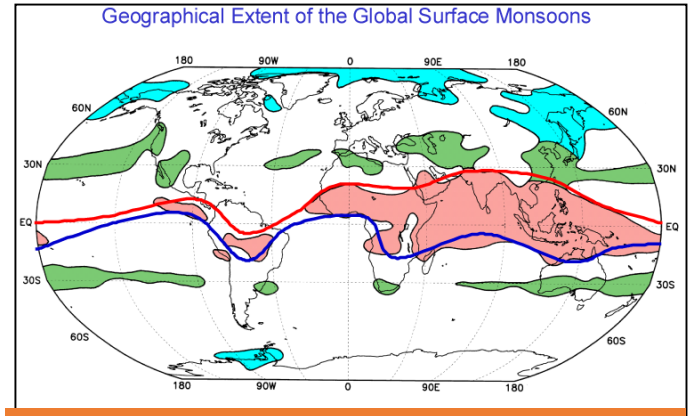


Climate of Sri Lanka

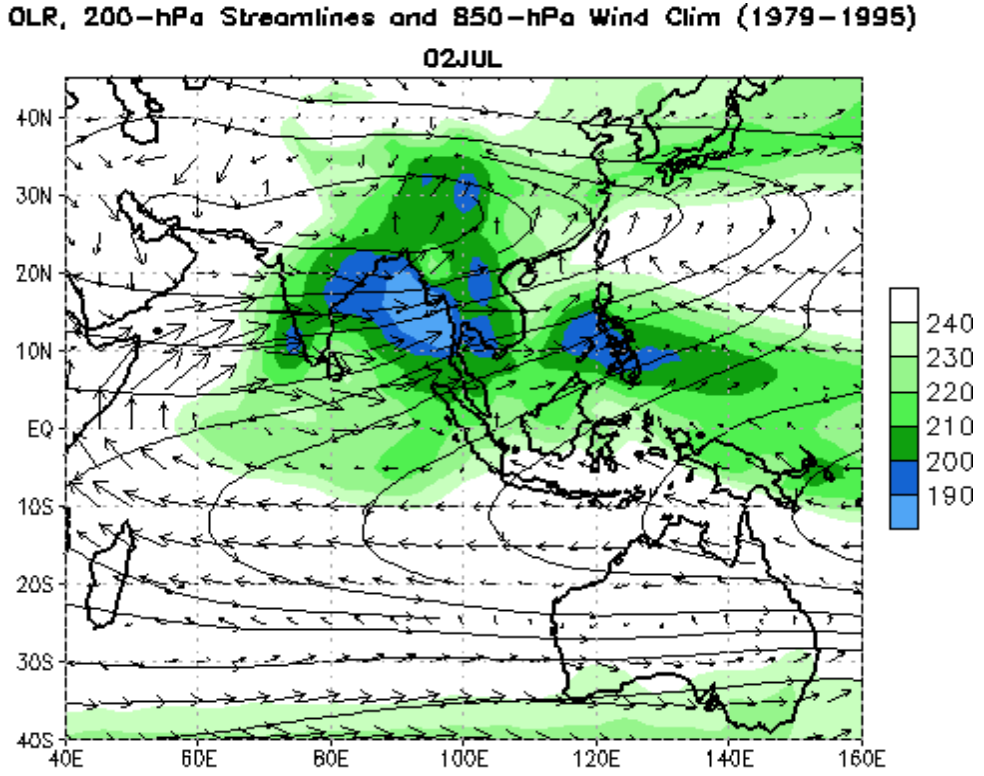
Tropical and Monsoonal



Sri Lanka is an island in the tropics



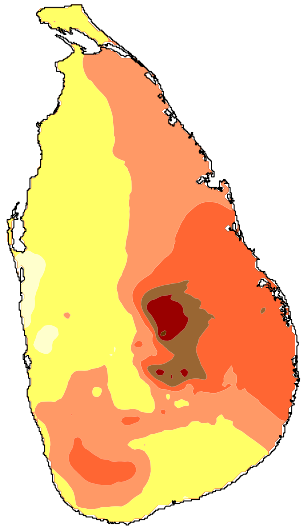
Monsoon region in the world



Data Sources: OLR – NESDIS/ORA, Winds – NCEP CDAS/ Reanalysis

Changing Wind Flow during the year by 180 degrees across the Country

Seasonal Rainfall Distribution of Sri Lanka

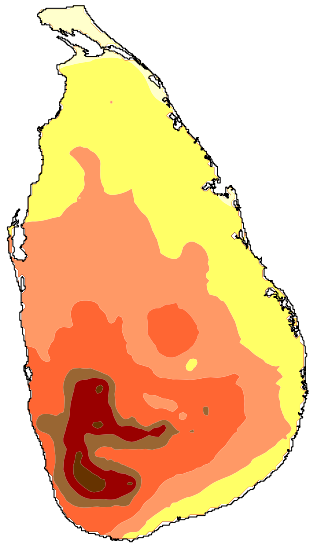


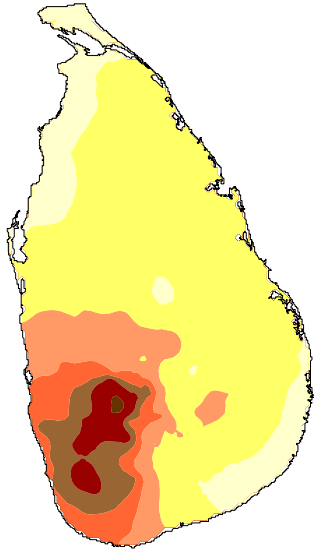
Northeast Monsoon
December to February
479 mm

26%

First Intermonsoon
March-April
268 mm

14%



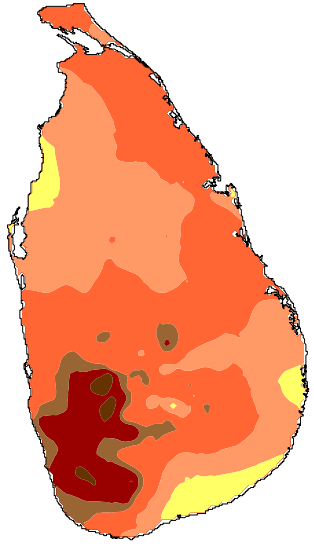


Southwest Monsoon
May to September
556 mm

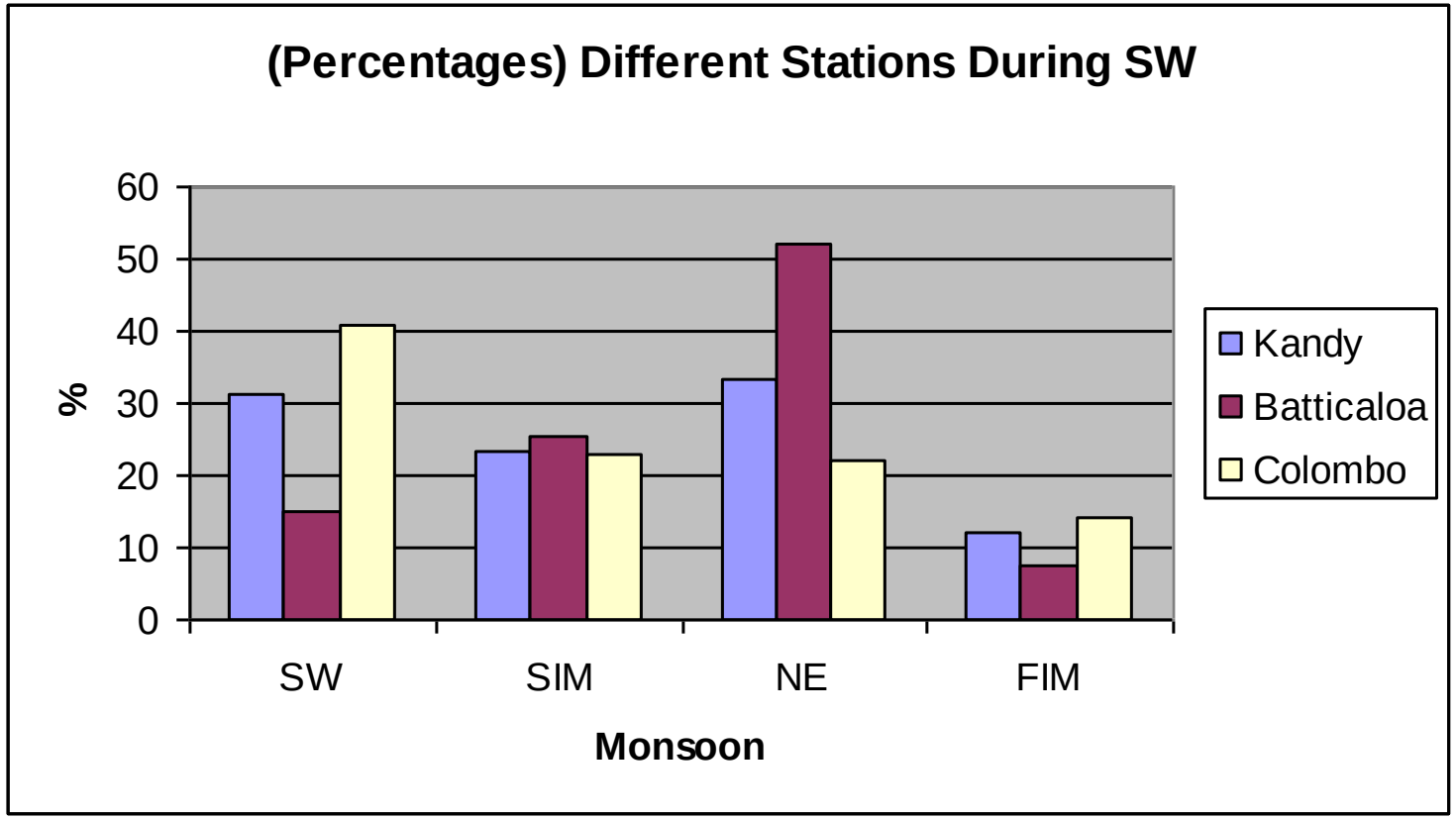
30%

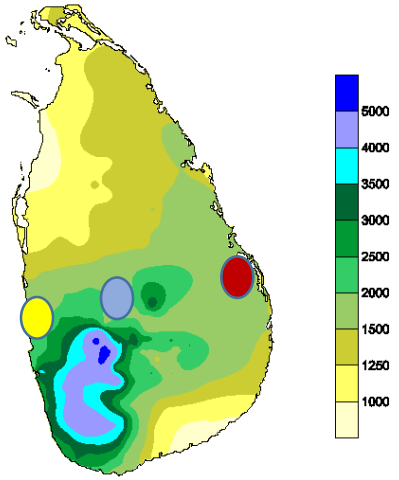
Second Intermonsoon
October to November
558 mm

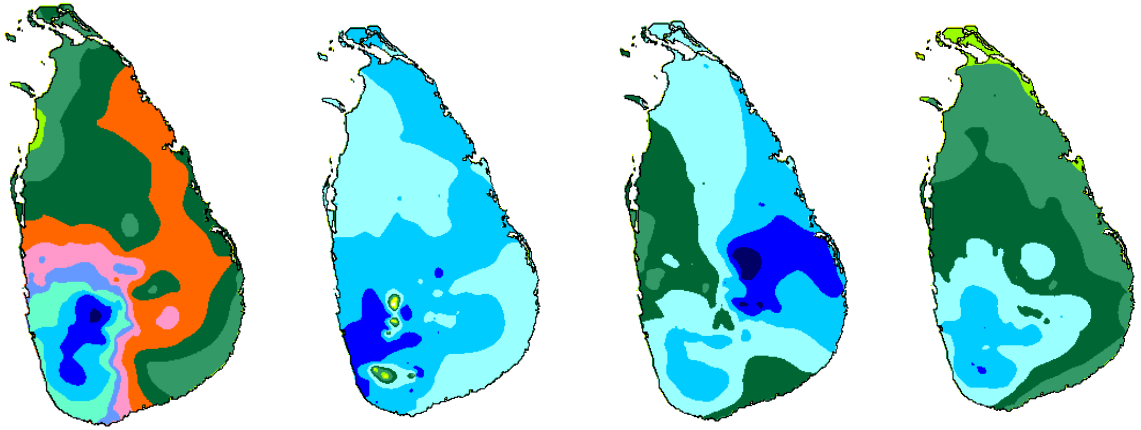
30%



…….. The percentages is varied from place to place







Water Withdrawals – Sri Lanka

Agricultural sector	**-**	**85%**
Domestic	**-**	**6%**
Industrial and other	**-**	**9%**

NWRA, 2003

Average per capita domestic withdrawals – 31 liters/person/day

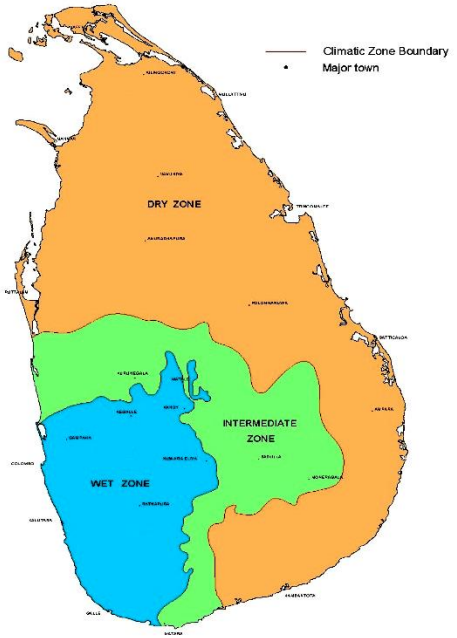
ESCAP, 1995

Climatic zones of Sri Lanka

Average Rainfall
Dry zone
< 1,750 mm

Intermediate zone
1,750-2,500 mm

Wet zone > 2,500 mm

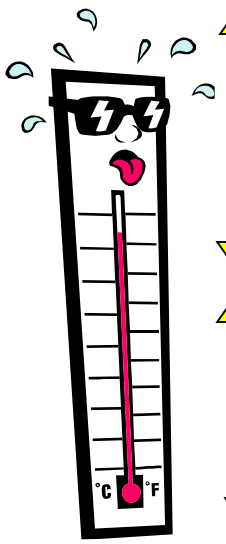


Very high spatial variability of rainfall

46 Agro-ecological regions

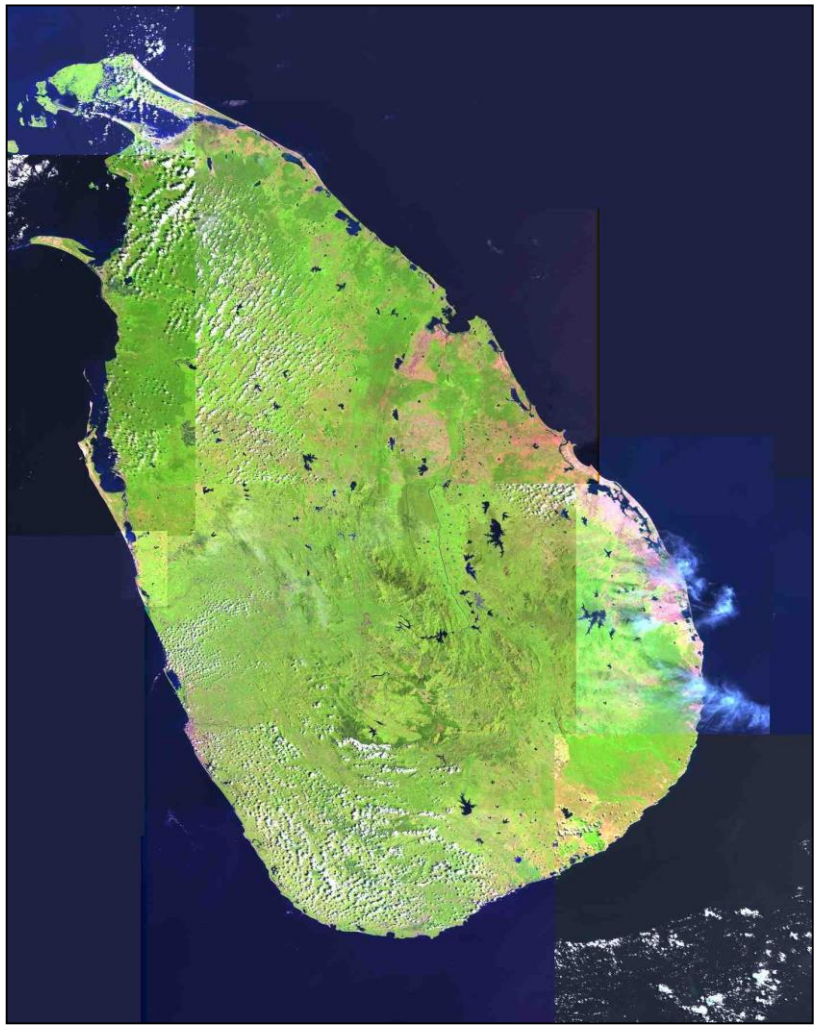
Climate Change Impacts on Water Resources

According to the latest estimates, global average temperature is expected to rise by between <u>1.4 to 5.8</u> <u>ºC</u> during the period 1990-2100.



- Increased Temperature
- Changes in Rainfall
- **Sea level rise**

Rainfall



increase of the variability of rainfall

*****

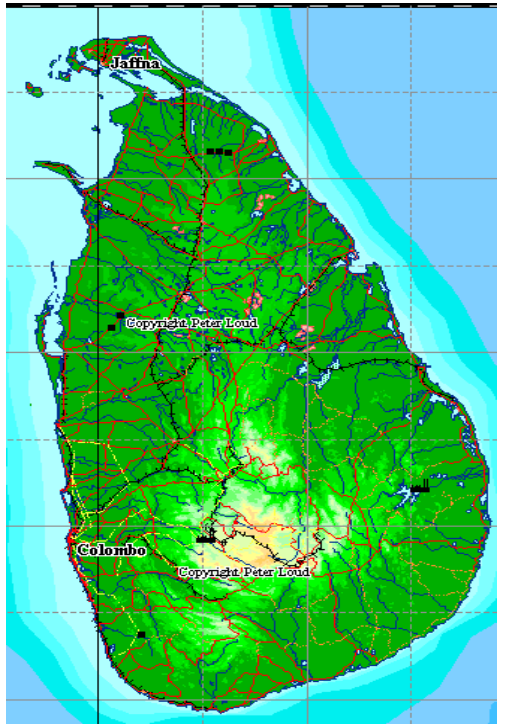
increase in the frequency of extreme events

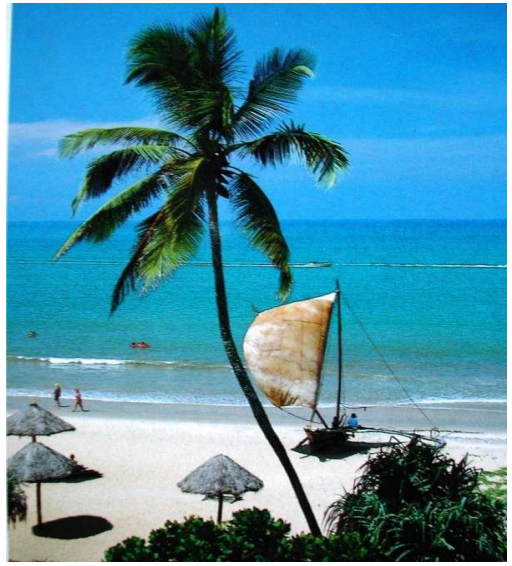
Sea Level Rise

- **Sri Lanka**
  - Has a long coastline of 1660 km
  - Coastal zone contains 24% of land
  - 32% population
  - 80% tourism
  - commercial ports and fishery harbors
  - principal road and rail infrastructure
  - richest areas of bio-diversity - coral reef, lagoons, angroves

- During the period 1860 – 2000, the global mean sea level has risen by between 10-20 cm

- During the next century global mean sea level is expected to rise by between 9 – 88 cm.





Possible weather related hazards during monsoon period in Sri Lanka

Flash flood

Strong winds

Coastal erosion

River flood

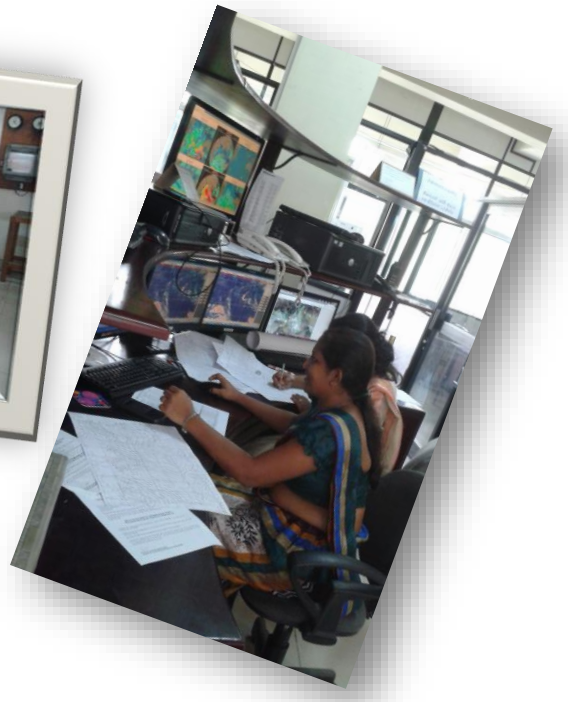
Land slides

Thunder/lightning/Downdraft

MAIN DIVISIONS - (WATER &DISASTERS)

❖Forecasting

- Weather forecasting, advisory and warning issue and Tsunami monitoring
- Marine forecasting
- Numerical weather prediction



❖Observation

❖Communication Centre

RESPONDING TO USER REQUIREMENTS: FORECAST OF VARIOUS TIMESCALES

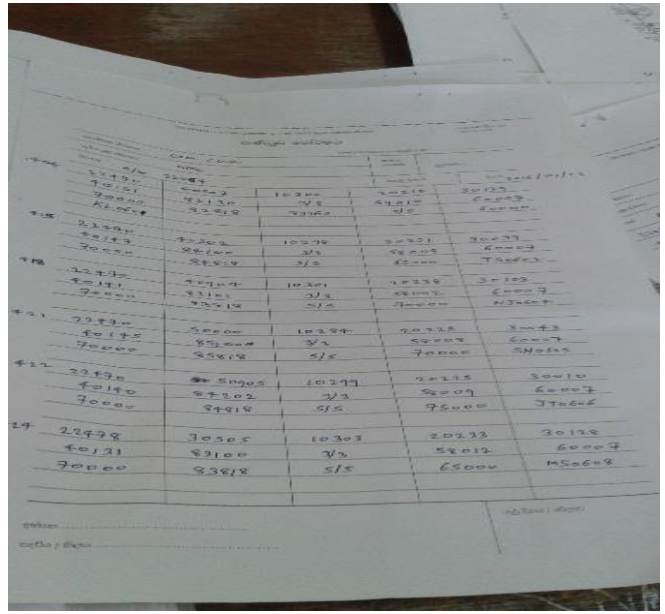
DEVELOPMENT OF FORECAST OF DIFFERENT TIMESCALES IN SRI LANKA BASED ON

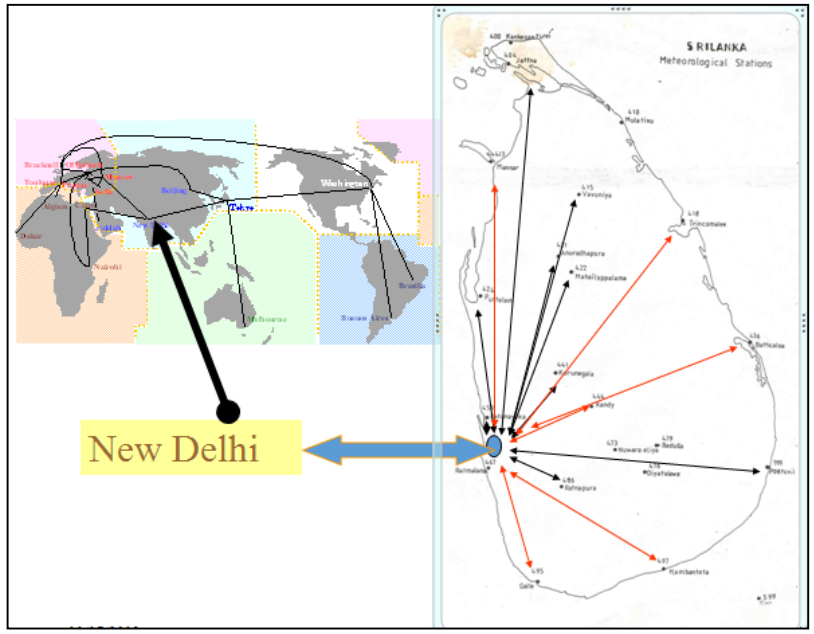
Analyze synoptic data , Study model forecasts, Rainfall forecast, ECWMF model – extreme weather forecast,Total precipitable water, Analyze satellite images (eg: Himawari 8,FY2G, ASCAT, ect.), Numerical Weather Predictions (NWP)

ENHANCEMENTS IN SPATIAL RESOLUTION WERE ALSO INTRODUCED BY DOM; FORECAST FOR SPECIFIC SECTORS EVOLVED

Communication Centre

- Receive synoptic data collected from other **22 main Meteorological stations** around the country **every 3 hours.**
- Upload synoptic data to Global Telecommunication System **(GTS)**
  - **Synoptic data** collected from all the Meteorological stations in the region by **New-Delhi regional center**
  - **Send back regional data through GTS**
- Receive daily rainfall data from **rainfall stations (500)**
- Send **shipping reports**, **fleet reports** etc.
- Download weather charts for Meteorologists
- Fax **weather advisory/warnings** to **media** and other stakeholders



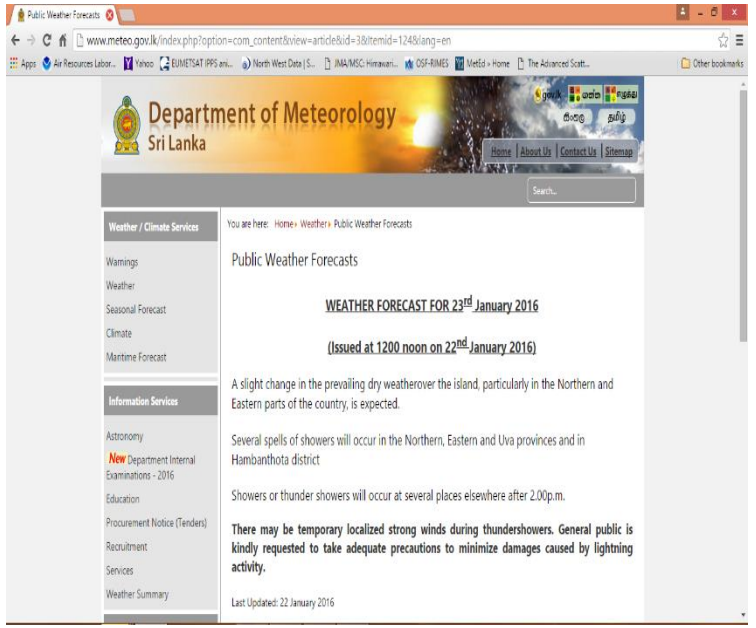


Observations

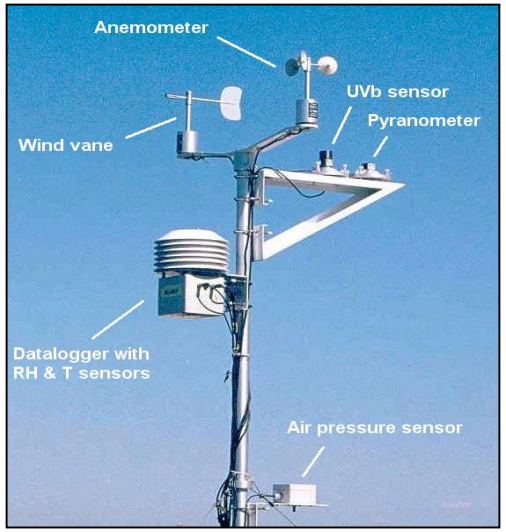
❖Carry out 3 hour observations at the Colombo station

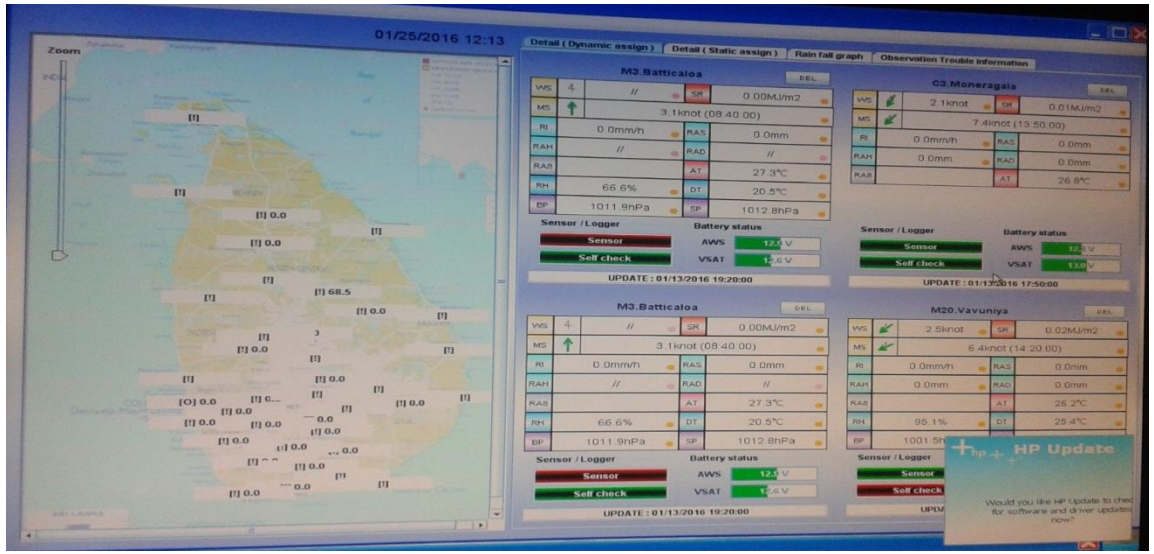
- Web updating

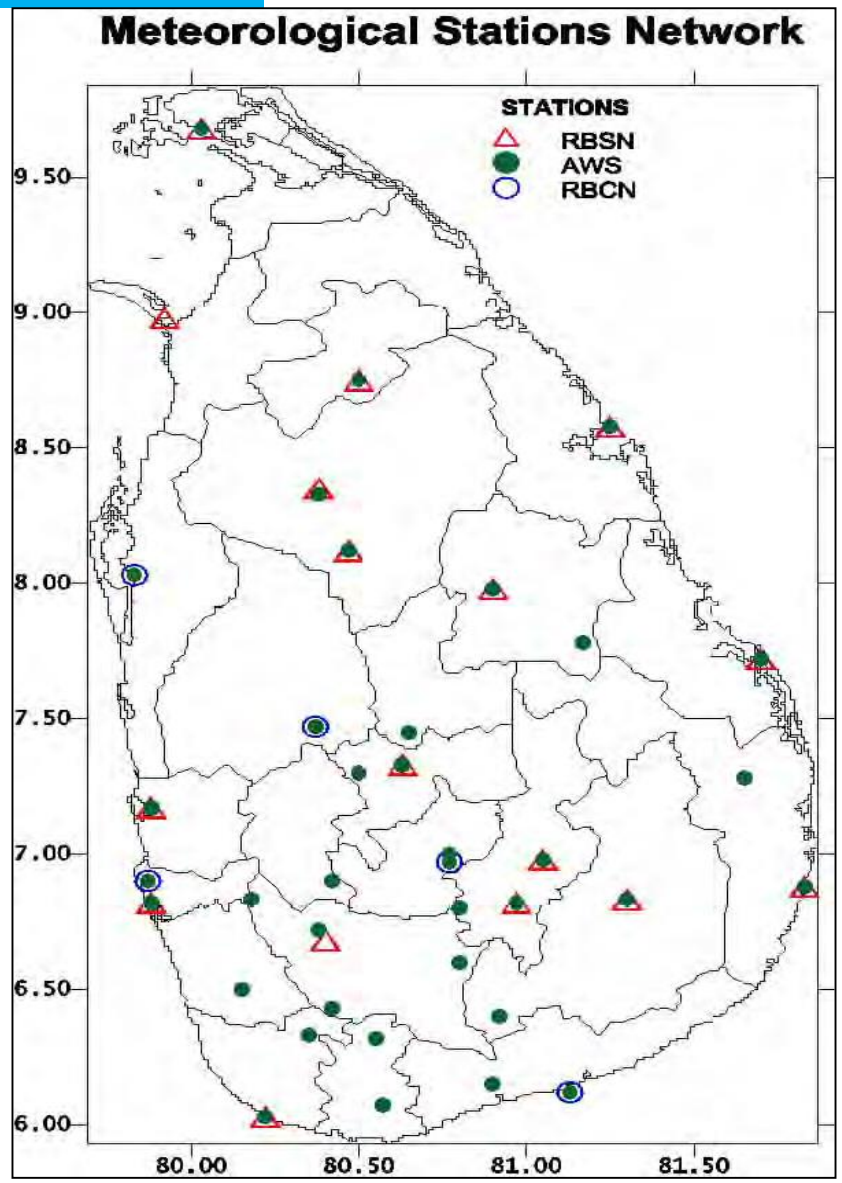
❖Plotting synoptic data received from the out stations



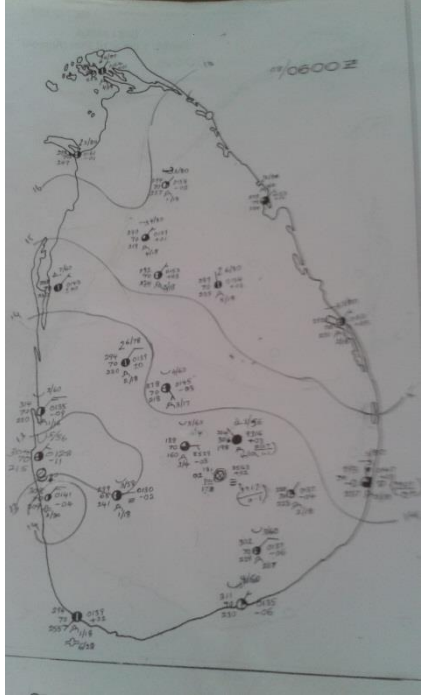
Monitor Automated Weather Stations (AWS)





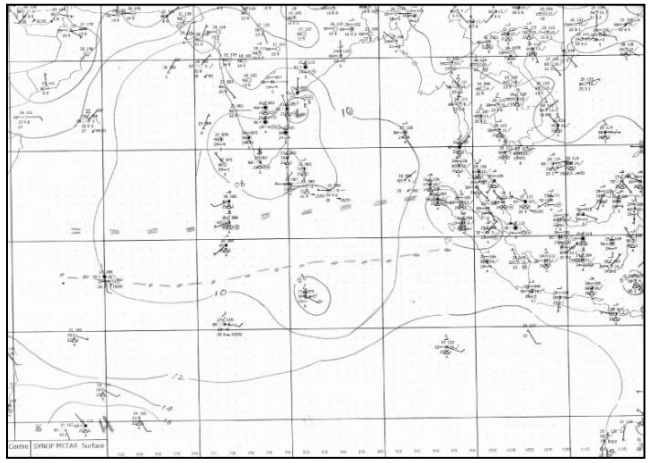


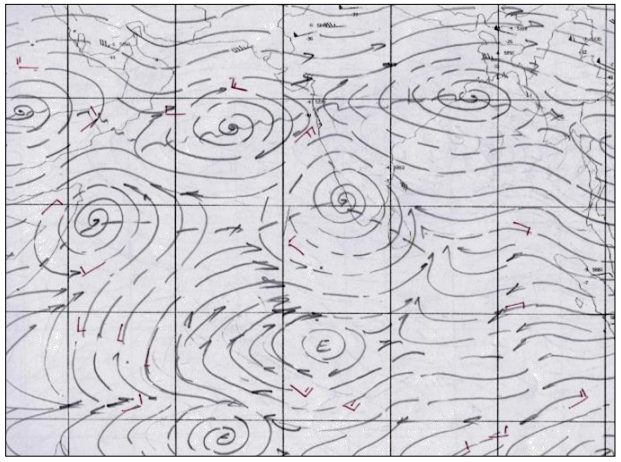
Weather Forecasting



- Issue weather forecasts (0530, 1200 & 1600 hrs)

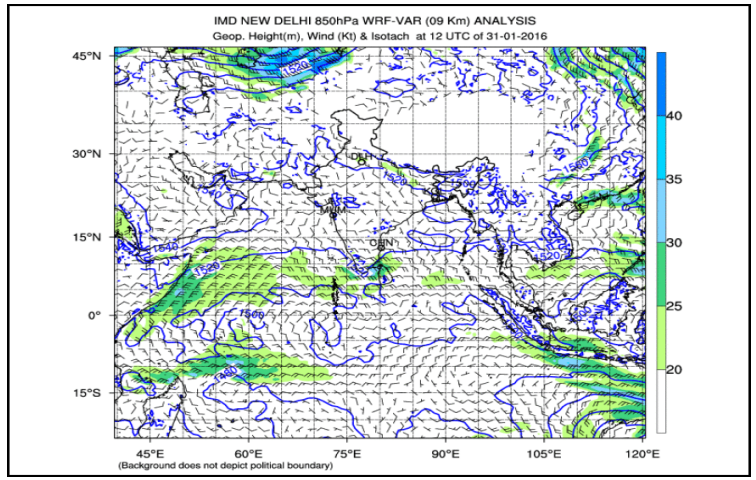
- severe weather advisory and warnings
  - Analyze synoptic data collected 3 hourly by the Observers
  - Analyze regional surface charts and upper wind (850 mb, 700 mb, 500 mb, 300 mb and 200 mb) charts uploaded to GTS system by New-Delhi regional Centre

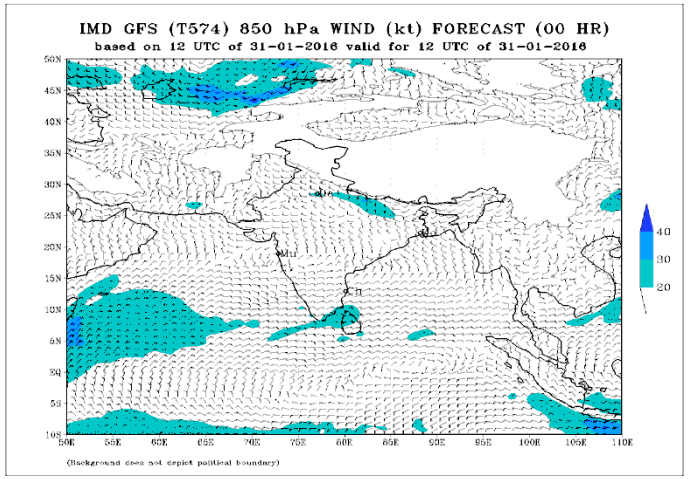


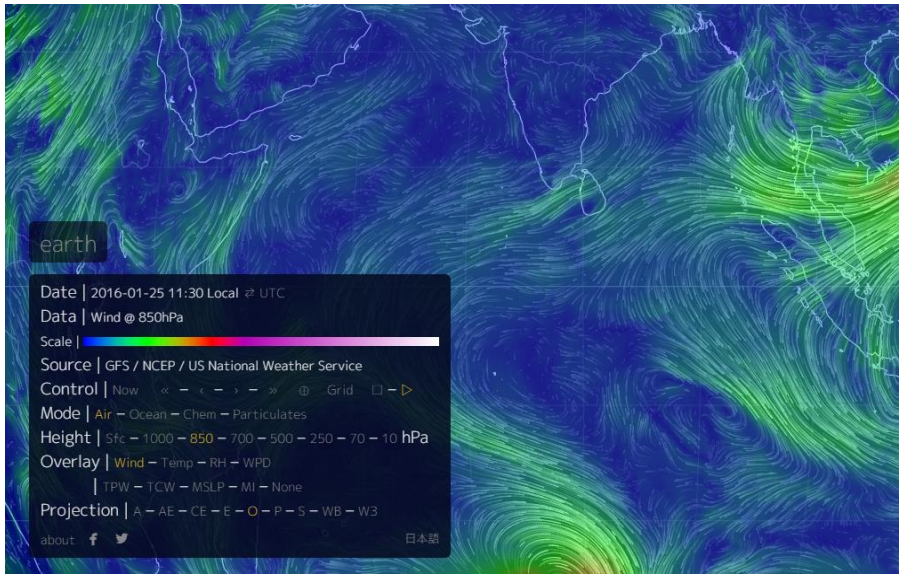


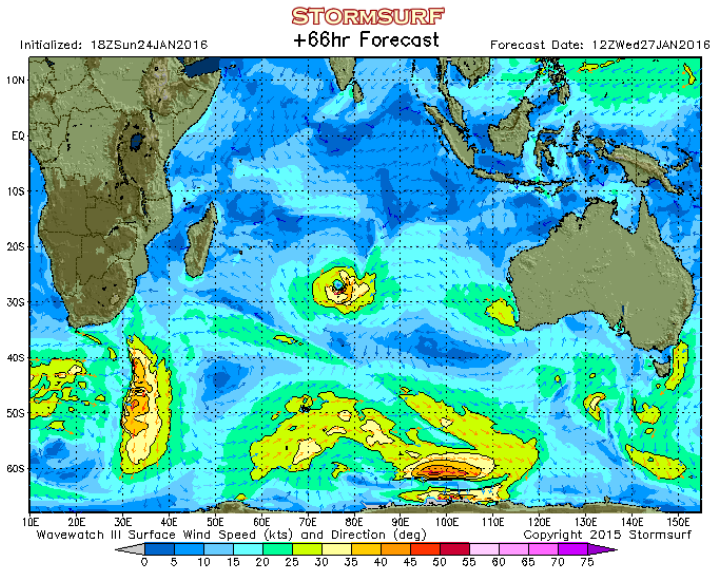
Study model forecasts (eg: Stormsurf, Earth nullsclool, India meteorological website, INCOIS etc.)

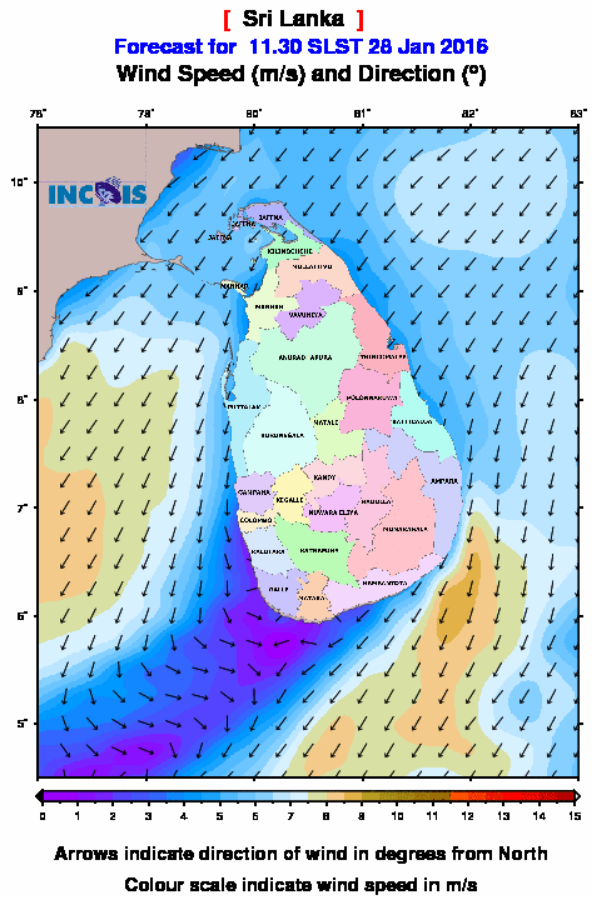
Wind forecast models





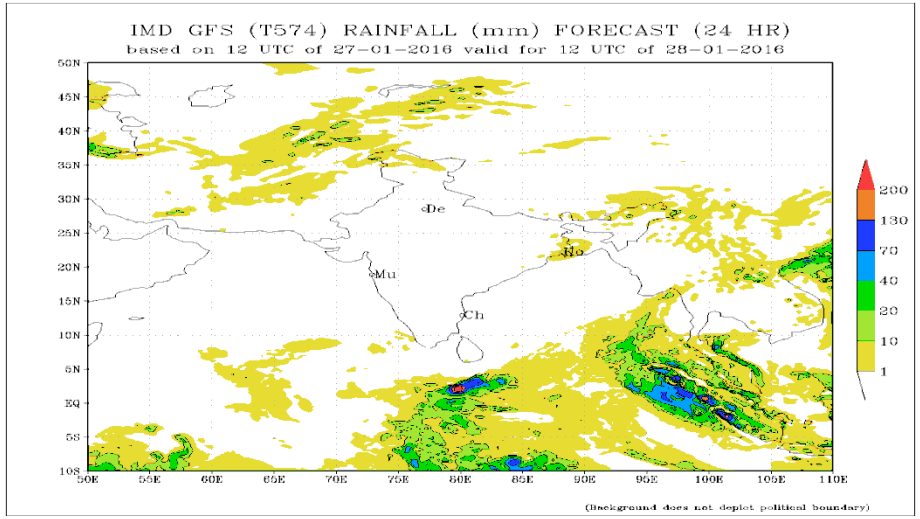


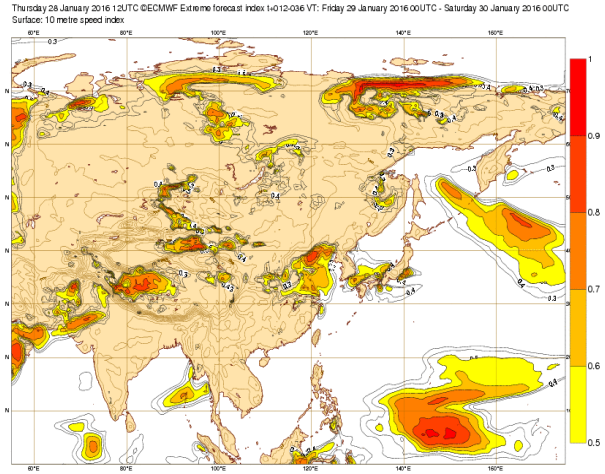




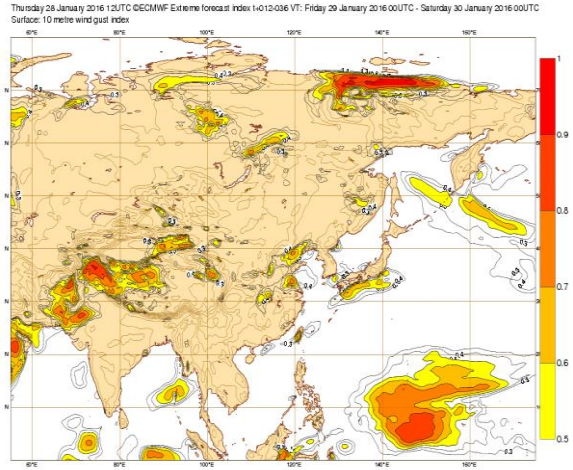
Rainfall forecast

ECWMF model – extreme weather forecast

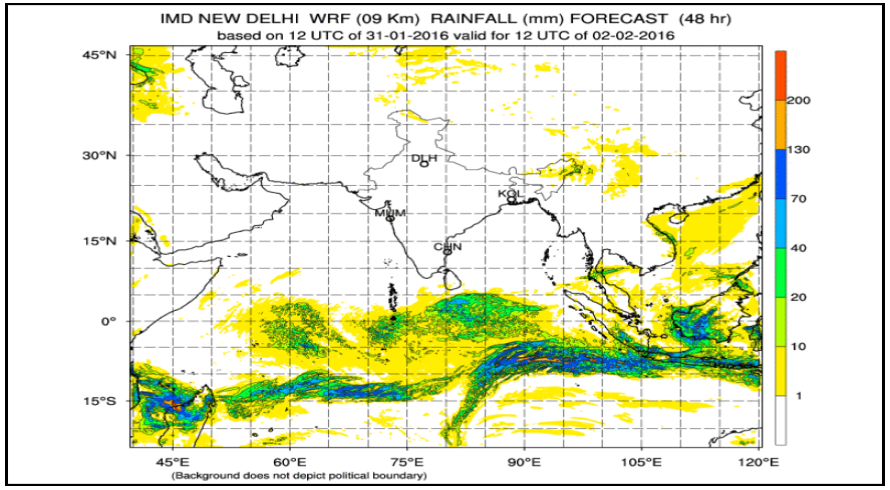


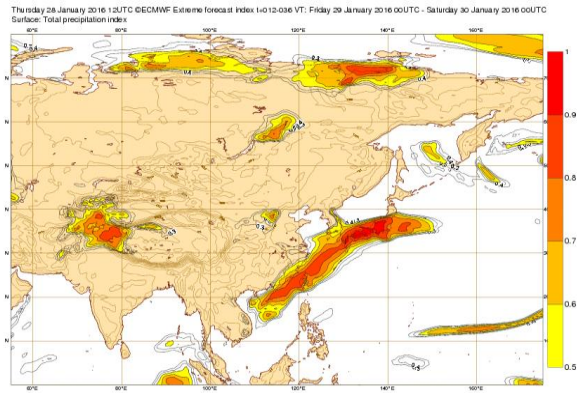


Wind speed



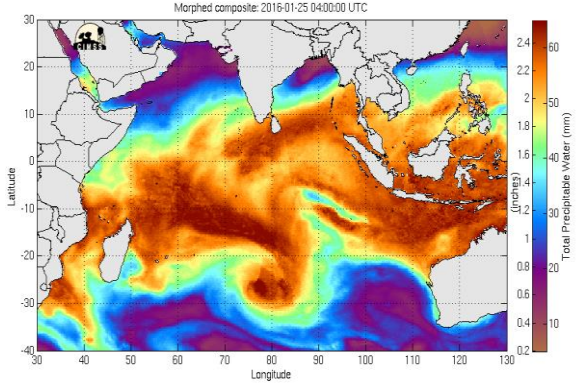
Wind gust



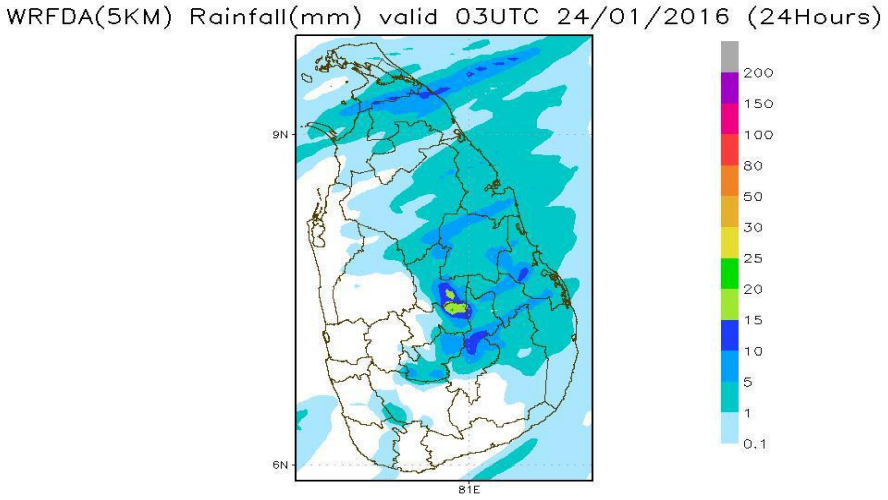


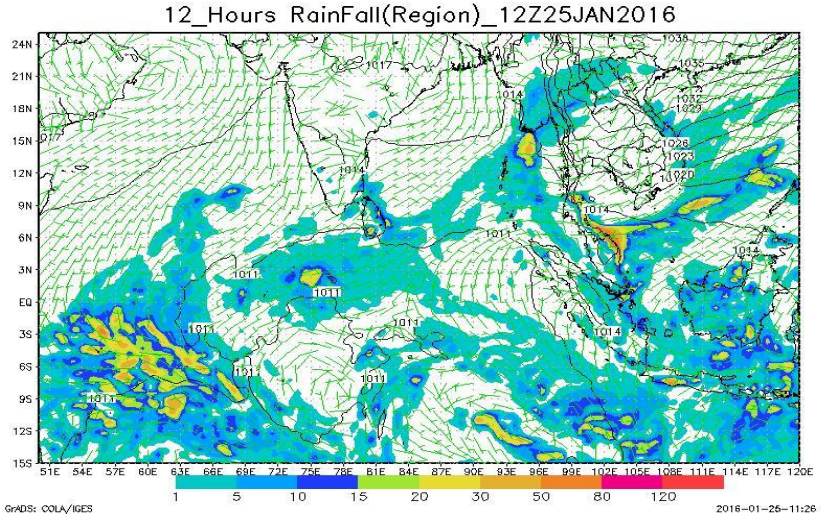
Precipitation

Total precipitable water

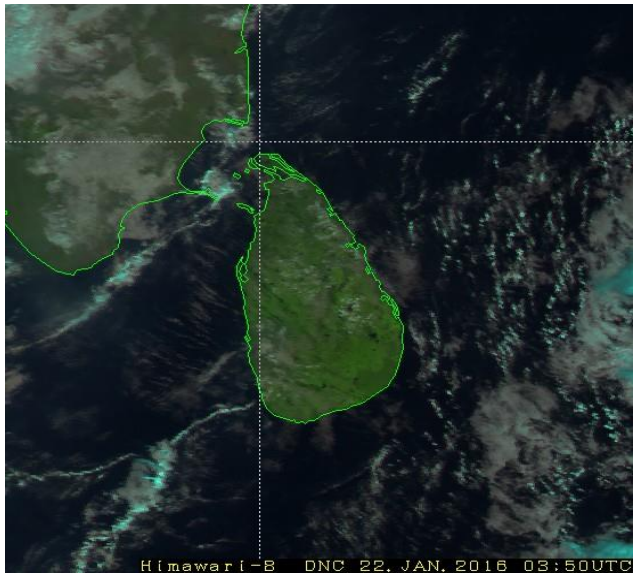


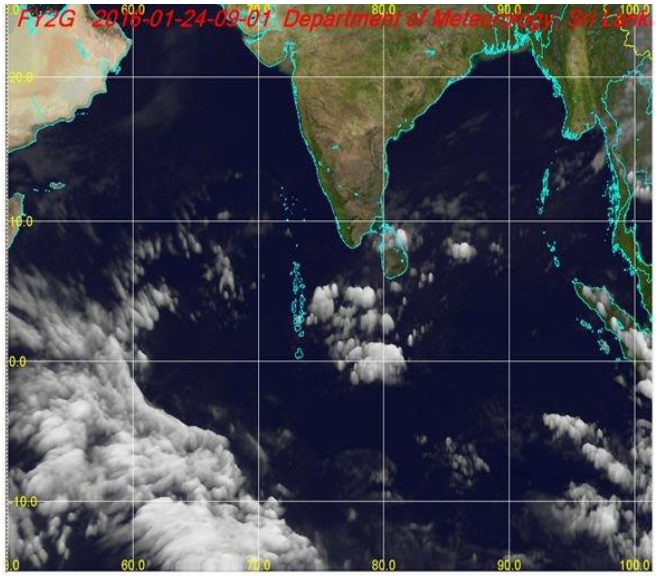
Numerical Weather Predictions (NWP)

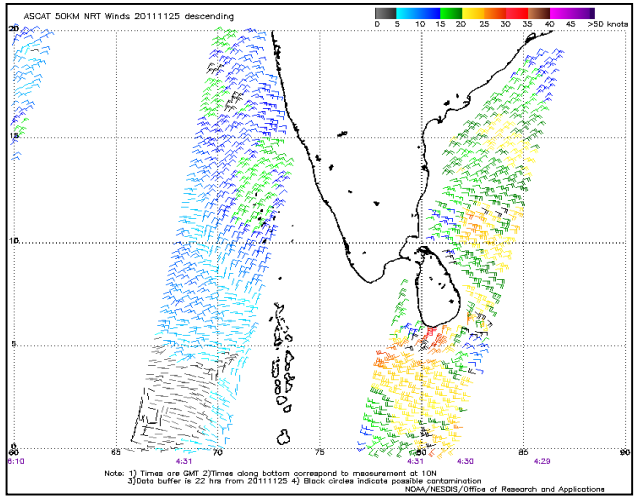




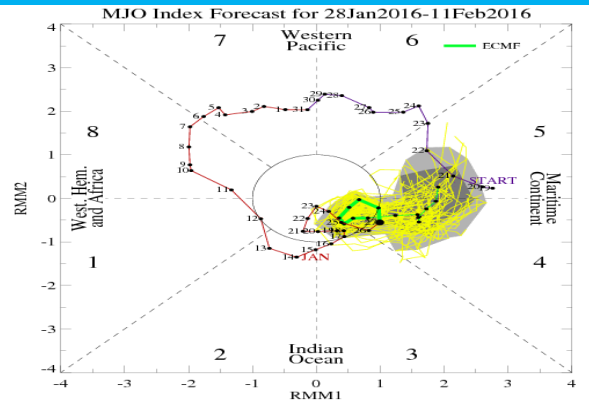
Analyze satellite images (eg: Himawari 8,FY2G, ASCAT, ect.)







Maddern - Jullian Oscillation monitoring



Samples of weather forecasts and severe weather advisory/ warnings

WEATHER FORECAST FOR NEXT 36 HOURS
(ISSUED AT 1600 HOURS ON 07th JUNE 2013)

Gradually increasing of rain in the South-western parts and windy condition over Sri Lanka and neighbouring sea areas are expected.
Showers will occur at times in the Western, Sabaragamuwa, Central and Southern provinces. Showers may extend to Puttalam and Kurunegala districts too.

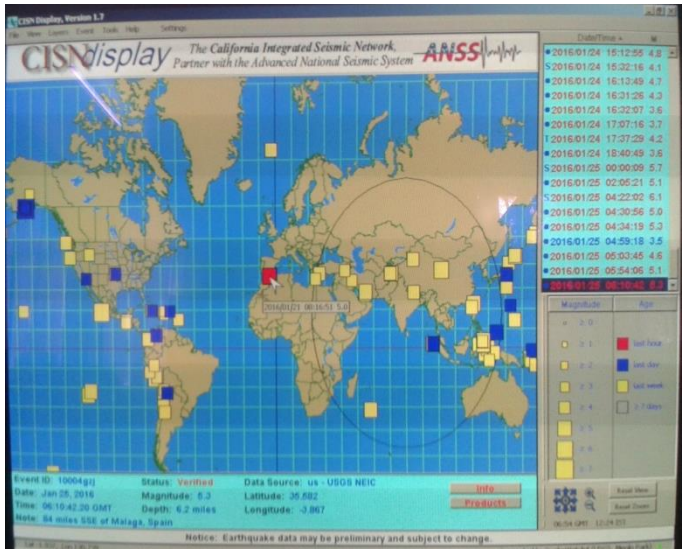
Southwestern monsoonal winds will be strengthen at times over the island and neighborhood.

Sea Conditions –
Naval and fishing communities are requested to be vigilant as deep and shallow sea areas off the coast extending from Mannar to Pottuvil via Colombo and Galle will be rough with strong southwesterly wind upto 80kmp/h.

දිවයිනේ නිරිත දිග කොටසේ ක්‍රමයෙන් වැසි වැඩි වීමක් සහ දිවයින සහ අවට මුහුදු ප්‍රදේශවල සුළං වැඩි වීමක් අපේක්ෂා කෙරේ
දිවයිනේ බස්නාහිර, සබරගමුව, මධ්‍යම සහ දකුණු පලාත් වල විටින් විට වැසි ඇති වේ. පූත්තලම සහ කුරුණෑගල දිස්ත්‍රික්ක වලට ද මෙම වැසි පැතිර යා හැක.
දිවයින හරහා සහ අවට ප්‍රදේශ වල විටින් විට නිරිත දිශින් හමන තරමක තද සුළං ඇති විය හැක.

මුහුදේ තත්ත්වය :-
මන්නාරම් සිට කොළඹ සහ ගාල්ල හරහා පොතුවිල් දක්වා වෙරළට ඔබ්බෙන් වන ගැඹුරු සහ නොගැඹුරු මුහුදු ප්‍රදේශ රළු වන අතර පැ.කි. 80 පමණ දක්වා සුළං ඇති වන නිසා ඒ පිළිබඳව විමසිලිමත් වන ලෙස නාවික සහ ධීවර සහ නාවික ප්‍රජාවගෙන් ඉල්ලා සිටිනු ලැබේ.

Tsunami and Earth Quack monitoring



Weather Forecast for Main Cities — Date: 08/06/2013

City	Temperature (°C)		Relative Humidity		Weather
	Max	Min	Max	Min	
Anuradhapura	32	25	95%	70%	Mainly fair.
Batticaloa	34	26	85%	70%	Mainly fair.
Colombo	29	25	95%	80%	Showers at times.
Galle	29	26	95%	80%	Showers at times.
Jaffna	32	28	85%	70%	Mainly fair.
Kandy	27	22	95%	85%	Showers at times.
Nuwara Eliya	17	13	95%	85%	Showers at times.
Ratnapura	29	23	95%	75%	Showers at times.
Trincomalee	33	26	85%	70%	Mainly fair.
Mannar	31	27	90%	70%	A few showers.

ප්‍රධාන නගර සඳහා කාලගුණ අනාවැකිය — දිනය : 08/06/2013

නගරය	උෂ්ණත්වය (අංශක)		සාපේක්ෂ ආර්ද්‍රතාවය		කාලගුණය
	උපරිම	අවම	උපරිම	අවම	
අනුරාධපුරය	32	25	95%	70%	ප්‍රධාන වශයෙන් වැසි නොමැති යහපත්.
මඩකලපුව	34	26	85%	70%	ප්‍රධාන වශයෙන් වැසි නොමැති යහපත්.
කොළඹ	29	25	95%	80%	විටින් විට වැසි.
ගාල්ල	29	26	95%	80%	විටින් විට වැසි.
යාපනය	32	28	85%	70%	ප්‍රධාන වශයෙන් වැසි නොමැති යහපත්.
මහනුවර	27	22	95%	85%	විටින් විට වැසි.
නුවරඑළිය	17	13	95%	85%	විටින් විට වැසි.
රත්නපුරය	29	23	95%	75%	විටින් විට වැසි.
ත්‍රිකුණාමළය	33	26	85%	70%	ප්‍රධාන වශයෙන් වැසි නොමැති යහපත්.
මන්නාරම්	31	27	90%	70%	වැසි ස්වල්පයක්.

කාලගුණ විද්‍යාඥ (Duty Meteorologist),
කාලගුණ විද්‍යා දෙපාර්තමේන්තුව (Department of Meteorology).

අයහපත් කාලගුණය පිළිබඳ නිවේදනය

2013 මැයි මස 13 දින ඉදිරිපැය 12 සඳහා, පෙ.ව. 05.30 ට නිකුත් කරන ලදී.

(කාලගුණවිද්‍යා දෙපාර්තමේන්තුවේ, ස්වභාවිකවිපත්පිළිබඳපූර්වඅනතුරුඇඟවීමේමධ්‍යස්ථානය)

නිරිත දිග බෙංගාල බොක්ක ප්‍රදේශයේ පවතින සුළිකුණාටුව (තවමත් ප්‍රබල නොවන) 2013 මැයි මස 13 වන දින **පෙ**.ව. 05.30 වන විට (උතුරු අක්ෂාංශ 11.5 හා නැගෙනහිර දේශාංශ 87.0 පමණ) ත්‍රිකුණාමලය සිට ඊසාන දෙසින්කි.මී. 650 ක් පමණ දුරින් කේන්ද්‍රගතව පැවතුනි. මෙම පද්ධතිය බොහෝ දුරට එහි කේන්ද්‍රයේ සිට උතුරු දෙසට, දිවයිනෙන් ඉවතට ගමන්කරනු ඇත.

මෙම පද්ධතියේ බලපෑම මත මන්නාරම සිට ත්‍රිකුණාමලය සහ යාපනය හරහා මඩකලපුව දක්වා වෙරළට ඔබ්බෙන් වන මුහුදු ප්‍රදේශ රළු වන අතර, නිරන්තර වැසි සහ තද සුළං (පැ.කි. 70ට වැඩි) ඇතිවිය හැක.

නැගෙනහිර සහ උතුරු වෙරළට ඔබ්බෙන් වන මුහුදු ප්‍රදේශවල ධීවර හා නාවික කටයුතු වල යෙදීමෙන් වළකින ලෙස ධීවර හා නාවික ප්‍රජාවගෙන් කාරුණිකව ඉල්ලා සිටී. දිවයින සහ අවට ප්‍රදේශ වල නිරිත දෙසින් හමන තරමක් තද සුළං (පැ.කි. 60 පමණ) අපේක්ෂා කල හැක.

දිවයිනේ බොහෝ ප්‍රදේශ වල අහස වලාකුලින් බරව පවතී. යාපනය, කිලිනොච්චි සහ මුලතිව් දිස්ත්‍රික්ක වල නිරන්තර වැසි ඇති වේ . ඇතැම් ස්ථාන වල මි.මී . 200 ට වඩා වැඩි තද වැසි ඇති වේ

මධ්‍යම, සබරගමුව, බස්නාහිර, නැගෙනහිර සහ දකුණු පලාත්වල විටින් විට වැසි ඇති විය හැක. ඇතැම් ස්ථාන වල මි.මී . 100

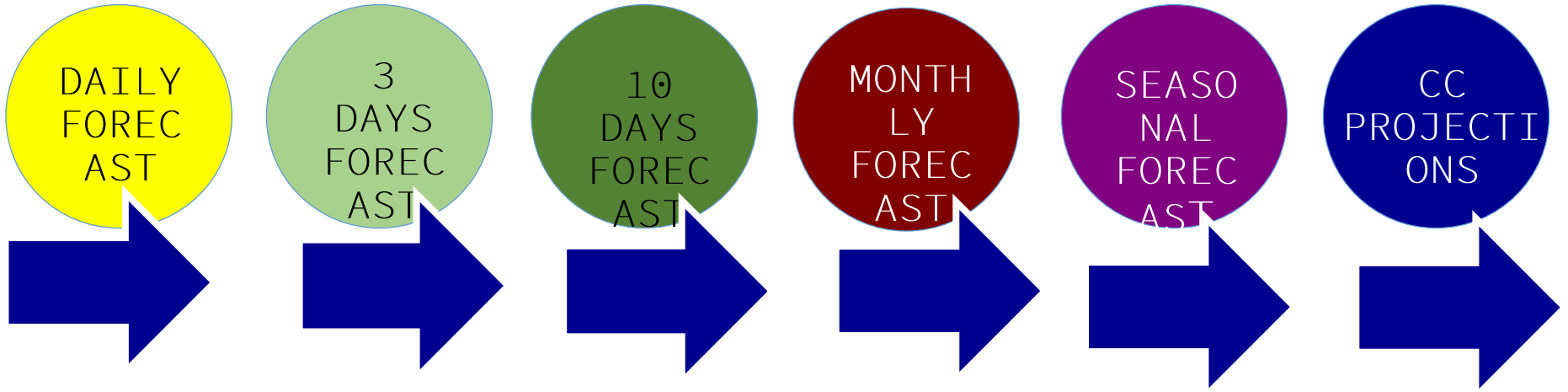
The Monsoon Forum

- Convened by the Department of Meteorology (DOM),
- facilitation from the Regional Integrated Multi-Hazard Early Warning System (RIMES) and support from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)
- the National Monsoon Forum has been a dynamic seasonal platform for informed planning and decision-making by various key economic and disaster management sectors in Sri Lanka
- utilizing information of different timescales (observed, daily, 10 days, monthly and seasonal information), for both resources and risks management.
- The Monsoon Forum – a cyclical, regular process that develops a culture of preparedness
- information generation by DOM
- utilization of information by stakeholder institutions, for seasonal and sub-seasonal planning and decision-making
- sharing of institutional experiences (good practices, challenges, lessons learnt) in utilizing information and articulating recommendations for addressing gaps in both forecast generation and application
- responding to recommendations through applied research, products testing further improvements/customization, as necessary

All Relevant institutions in the country

- *Agriculture*
- *Water Resources*
- *Irrigation*
- *Fisheries*
- *Disaster Risk Management*
- *Other Relevant Organizations*

RESPONDING TO USER REQUIREMENTS: FORECAST OF VARIOUS TIMESCALES



DEVELOPMENT OF FORECAST OF DIFFERENT TIMESCALES IN SRI LANKA BASED ON MONSOON FORUM STAKEHODER DEMANDS

ENHANCEMENTS IN SPATIAL RESOLUTION WERE ALSO INTRODUCED BY DOM; FORECAST FOR SPECIFIC SECTORS EVOLVED

Recommendations

The following are recommendations collated from stakeholder presentations and discussions during the Monsoon Forum:

Information generation

For further enhancing forecast application in the agriculture sector, a priority recommendation is for DOM to generate forecast of finer spatial resolution, based on agro-ecological zones. For application in power generation, seasonal/monthly outlook customized for hydro catchment areas is required

Information Communication

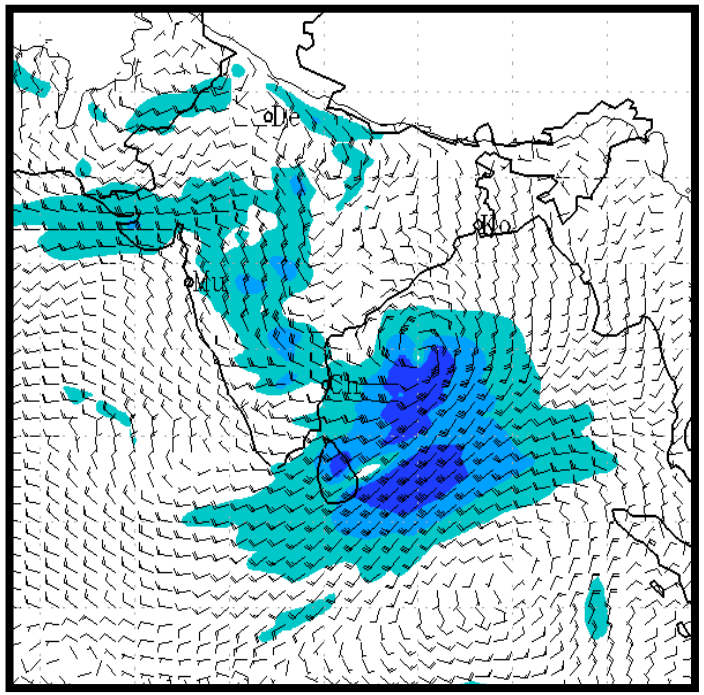
Seasonal outlook and sub-seasonal updates have to be communicated to stakeholders as soon as they are available. Among the stakeholders, CEB requires highest lead time, for planning operational requirements. Due to limitations, however, in generation of long-range forecasts, a balance between accuracy and lead time has been considered.

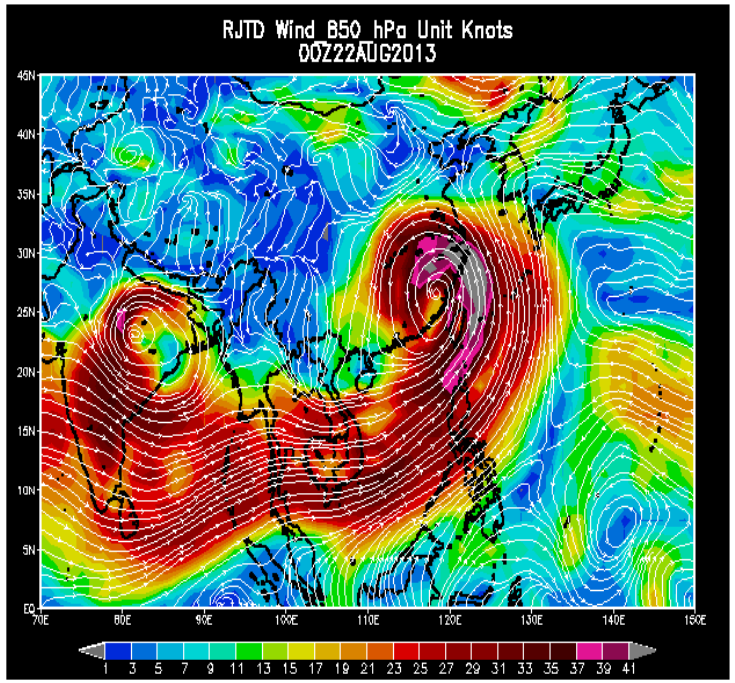
Monsoon Forum Process Evolution

- Stakeholders were unanimous in recommending that institutional mechanisms for taking forward national institutional decisions.
- cascading preparedness actions down to end-users level, have to be forged, through the Monsoon Forum process.
- Further, participation, in the Monsoon Forum, of more relevant officials/staff from stakeholder institutions have to be ensured (e.g. Research and Development Division in RRI).

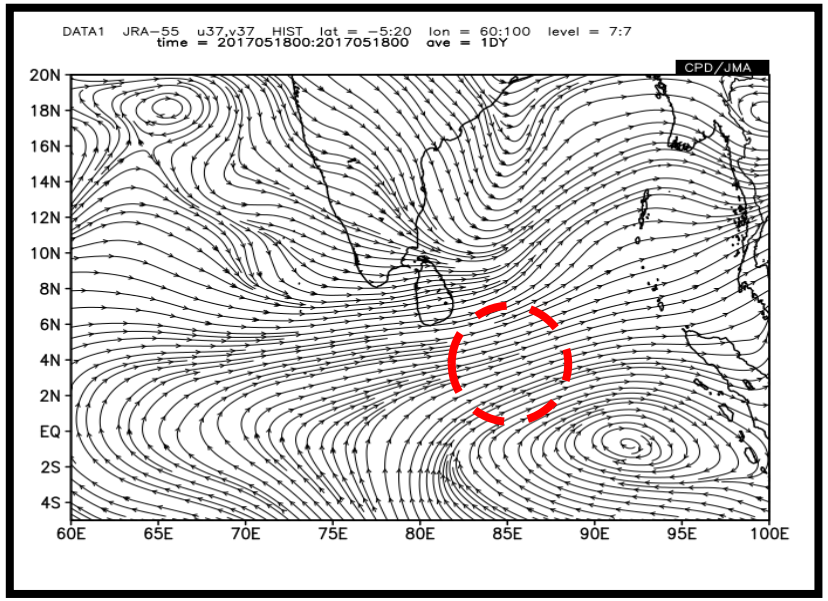
Outlook for Southwest monsoon 2017

Windy and showery condition can be enhanced by cyclones in the Bay of Bengal and Typhoons in Pacific ocean



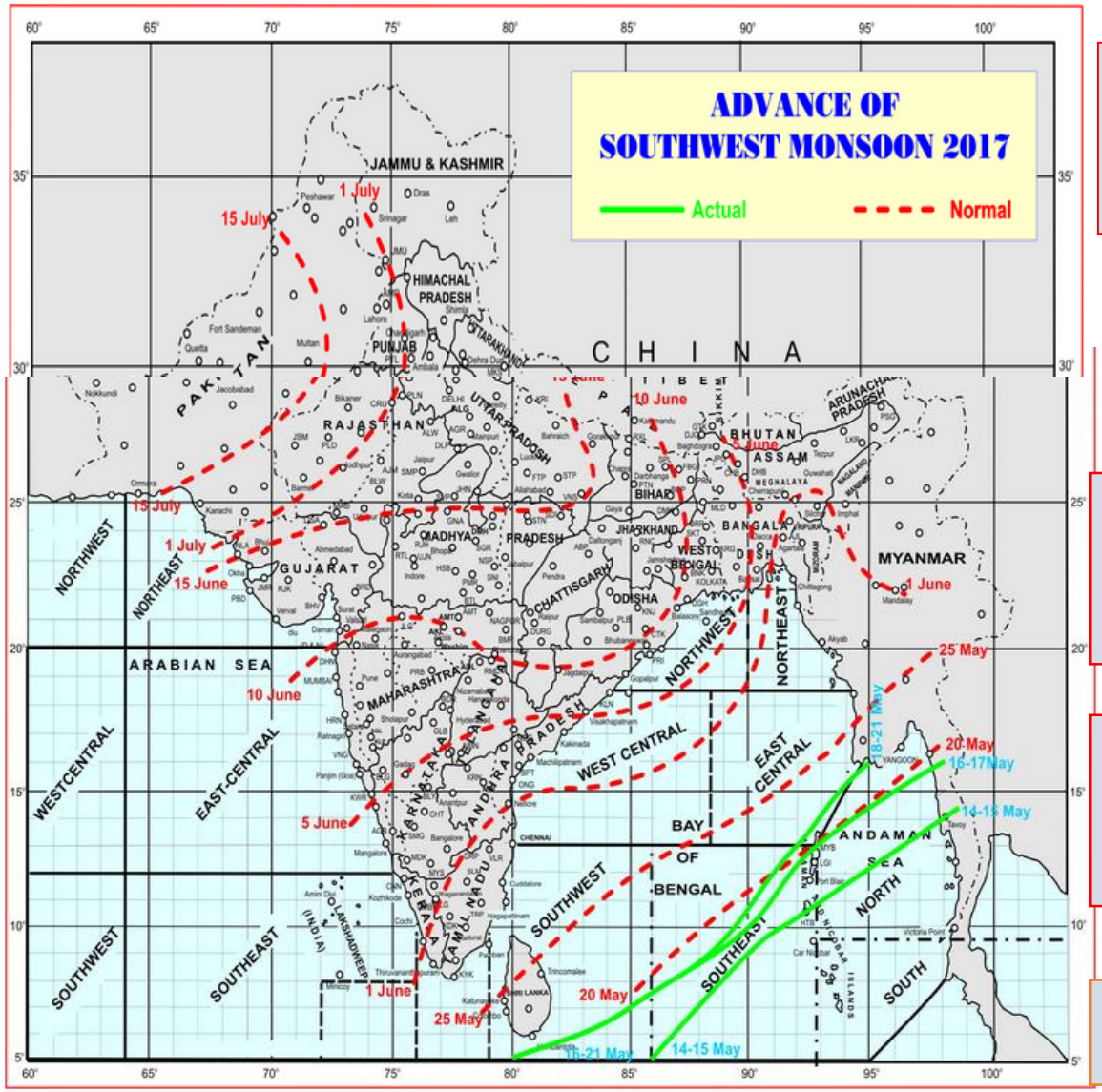


Windy and showery condition can be enhanced by wind convergence /trough to the west/southwest



18th May 2017

SW Monsoon onset Criteria



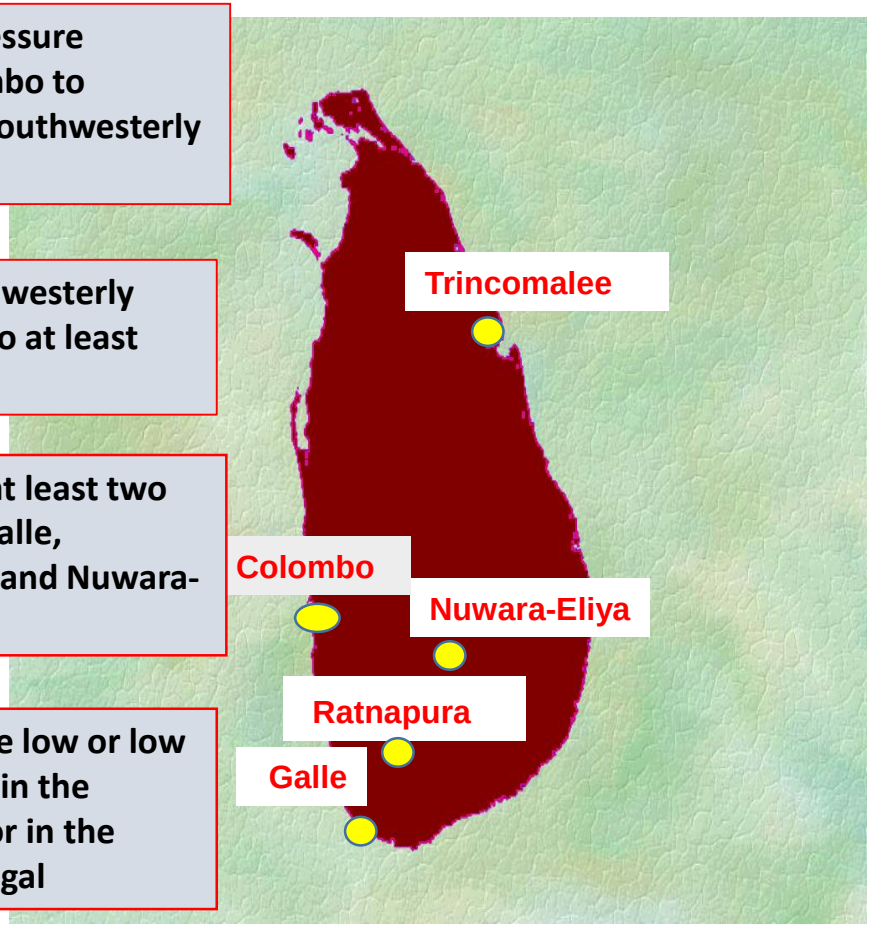
Source-IMD

1.At least 2.5 hpa pressure gradient(from Colombo to Trincomalee) in the southwesterly direction.

2.Extending of Southwesterly winds from surface to at least 18000 feet

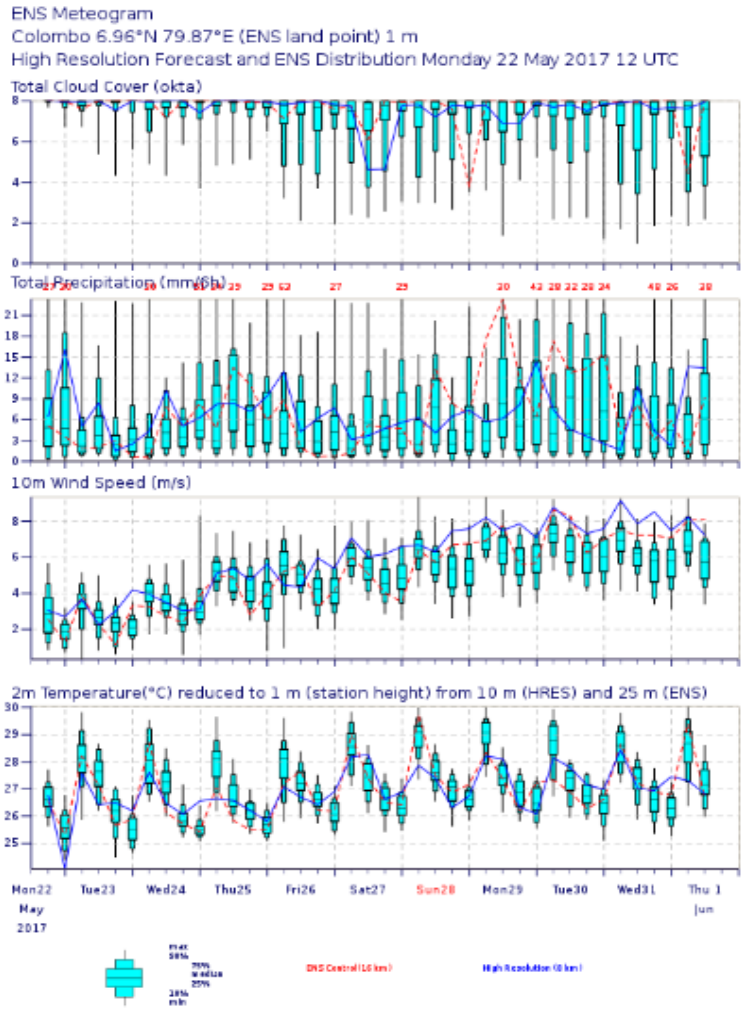
3.Occurrence of rain at least two consecutive days at Galle, Colombo, Ratnapura, and Nuwara-Eliya

4.Formation of surface low or low tropospheric vortices in the vicinity of the island or in the Southwest Bay of Bengal

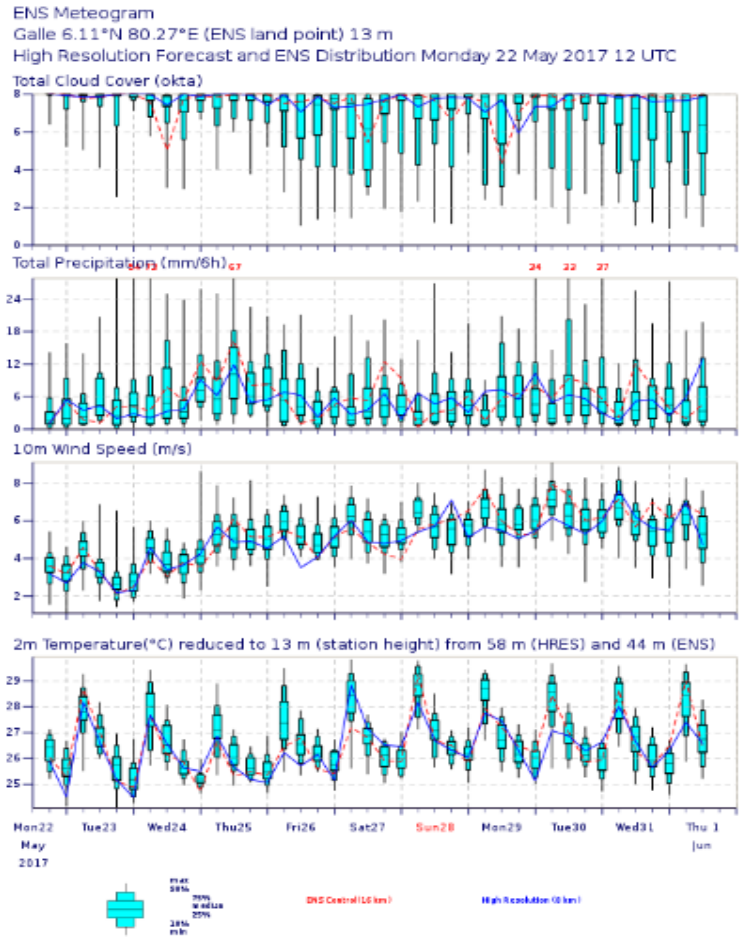


5. About 5- 10 days after the first appearance of Tropical Easterly Jet (over 40kts) around Sri Lanka latitudes.

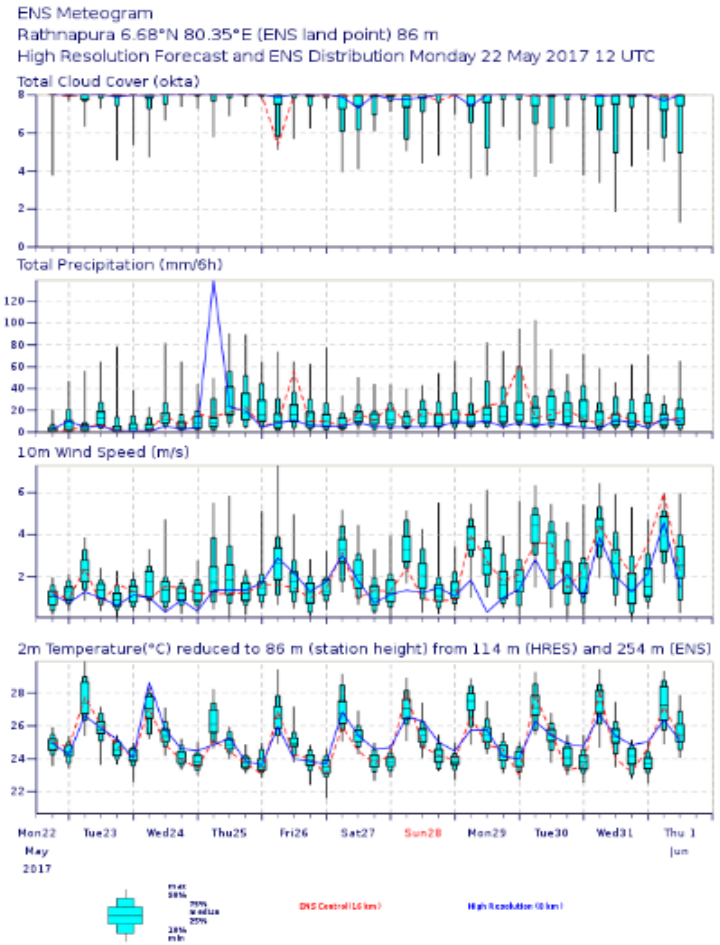
Onset of SW monsoon 2017-10 day forecast from ECMWF



Colombo

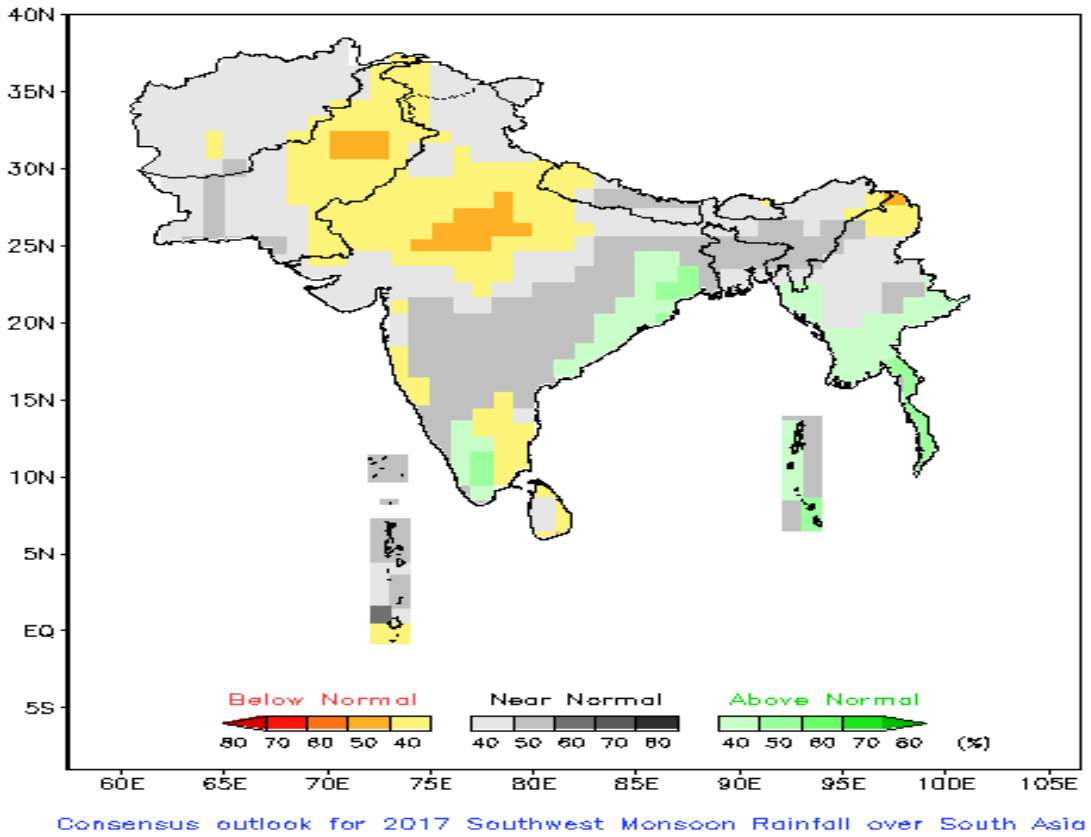


Galle



Rathnapura

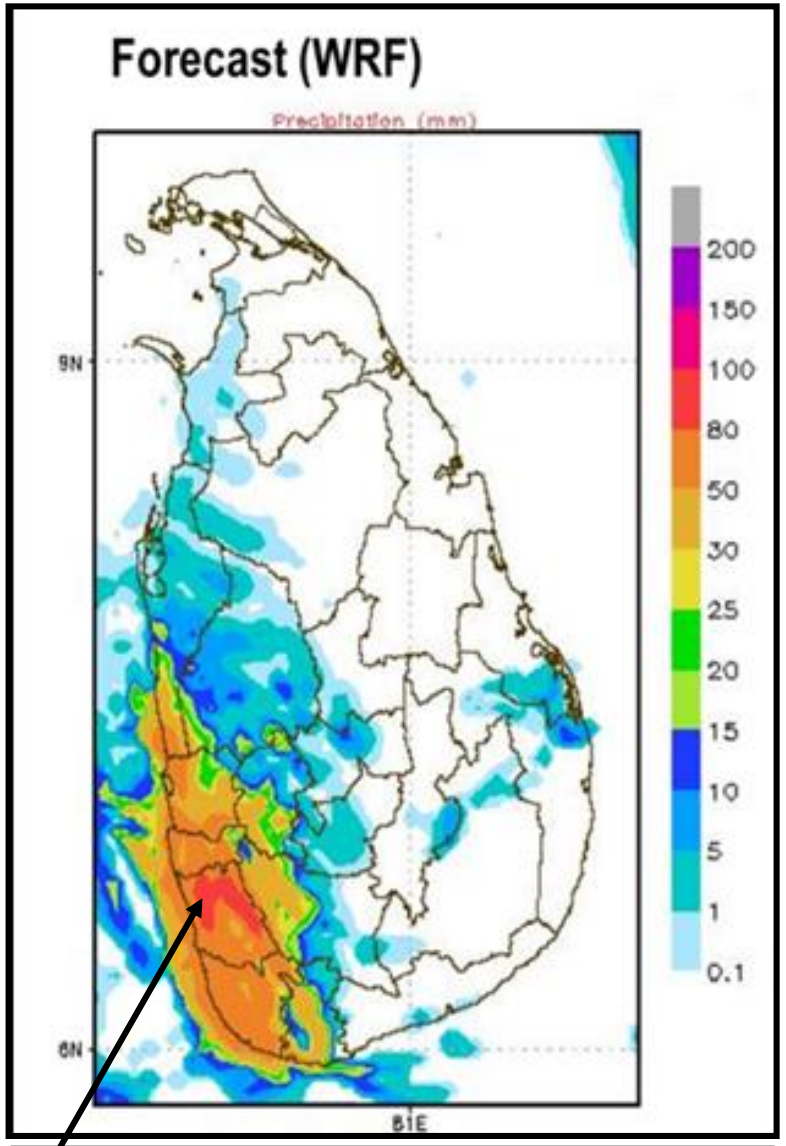
Rainfall probability Forecast for June-September 2017 –SASCOP-

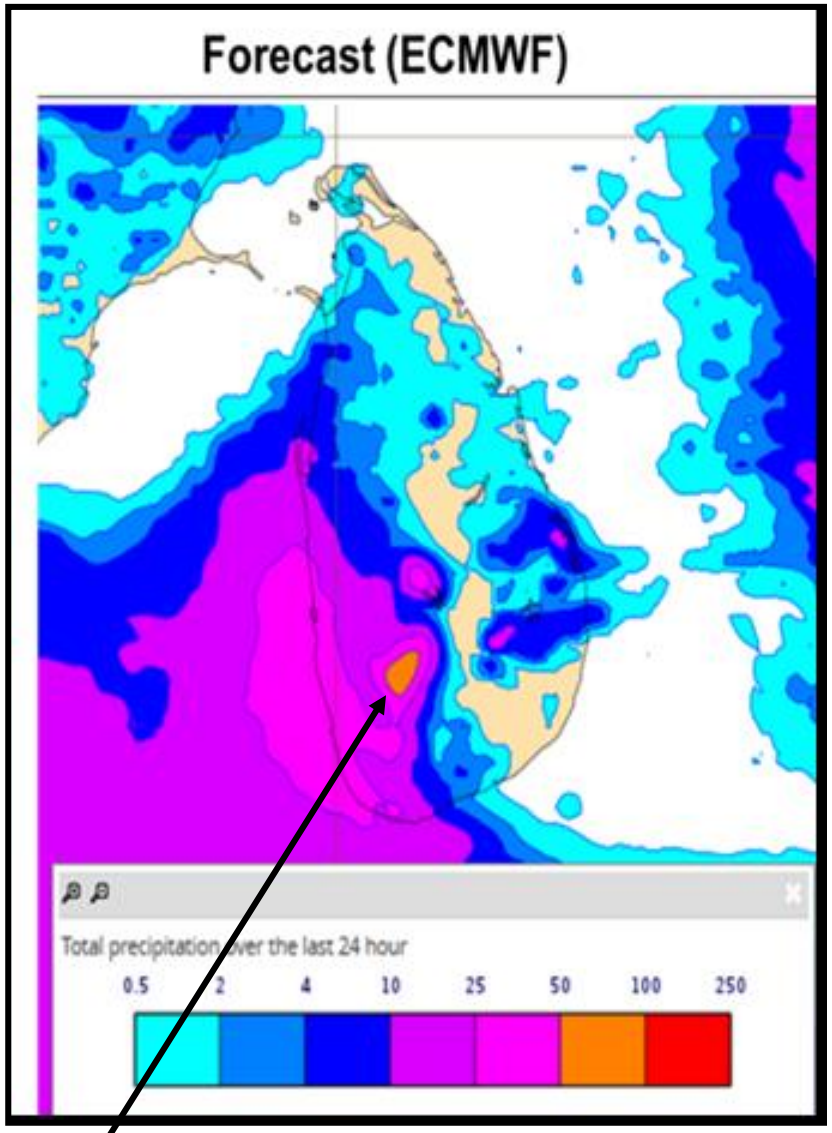


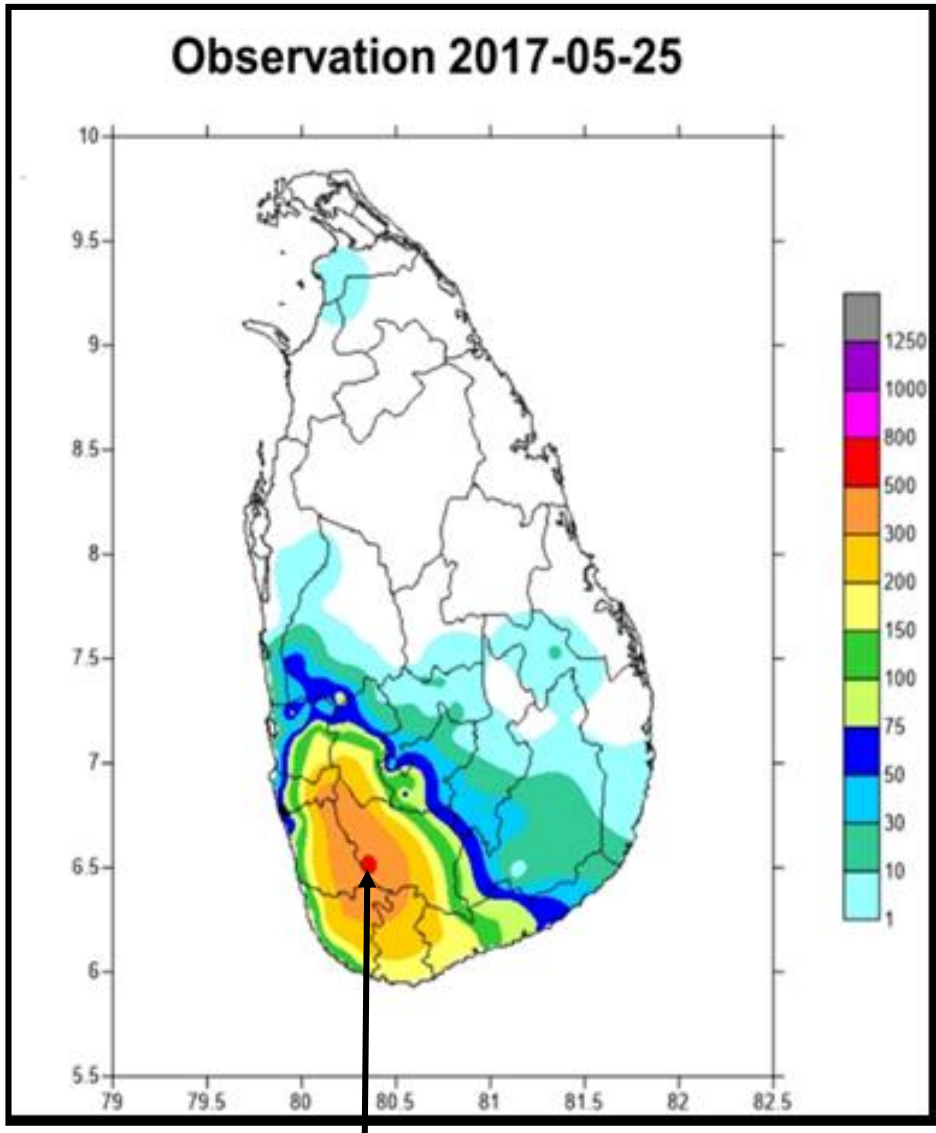
Near normal/ a little below normal

Probability of the most likely category for the 2017 Southwest Monsoon Rainfall over South Asia based on this consensus statement.

The consensus probability forecast map was prepared based on subjective assessment of individual country forecasts from various sources.







Predicted Maximum rainfall for 25th

80-100 mm

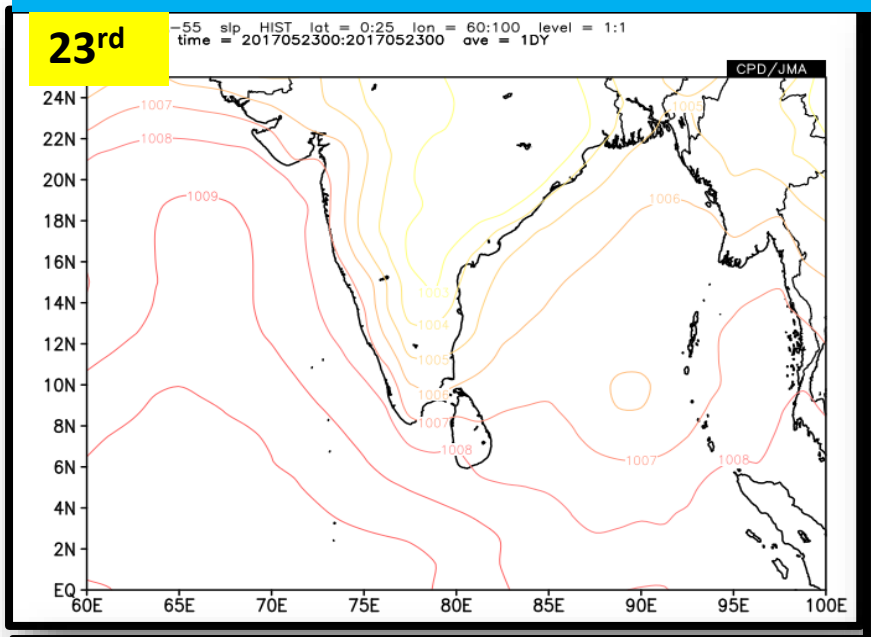
Predicted Maximum rainfall for 25th

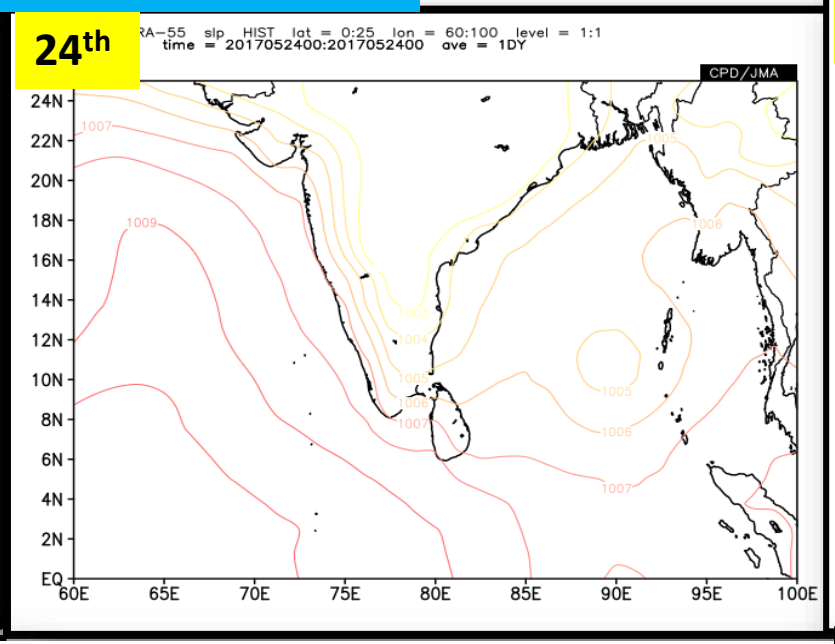
50-100 mm

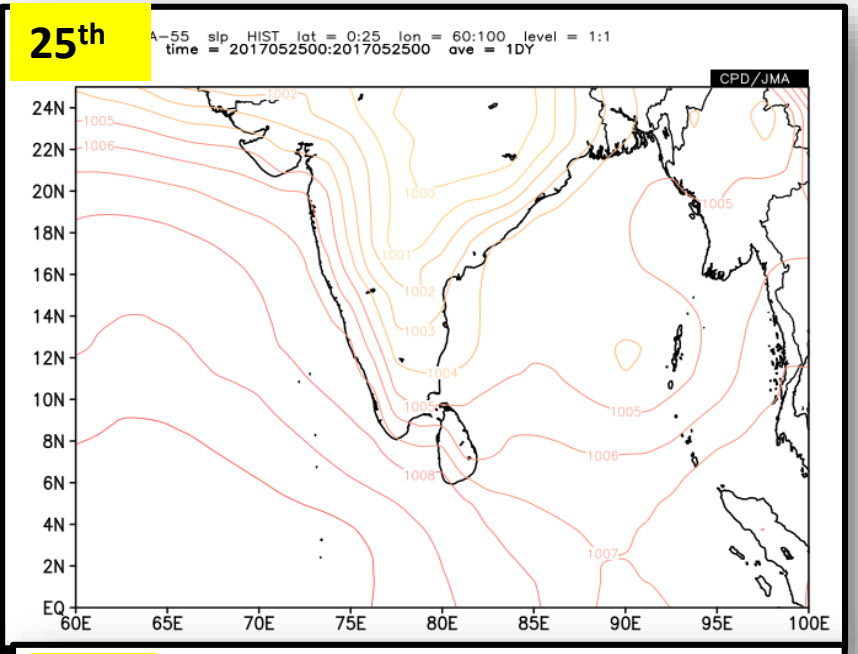
Observed rainfall on 25th

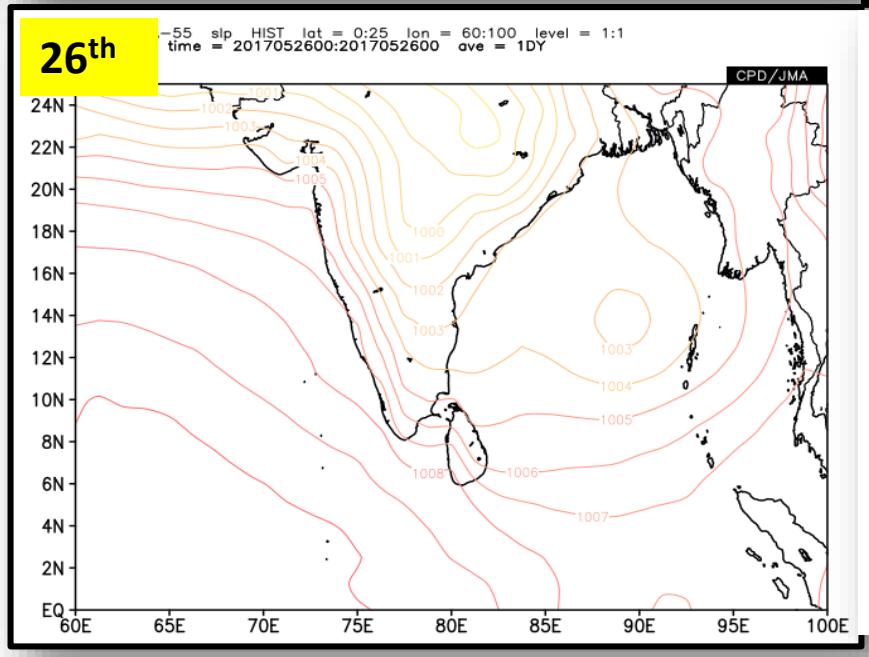
553.5 mm

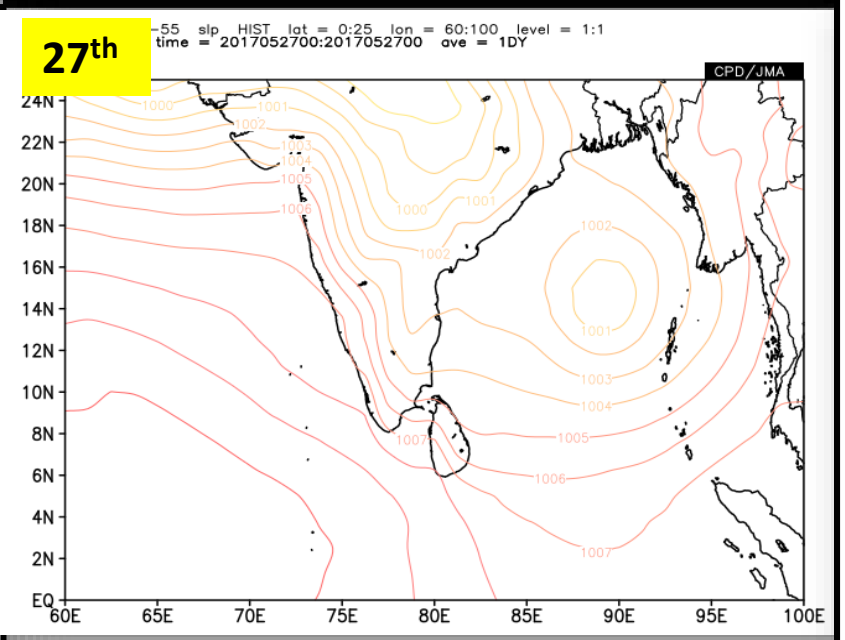
Surface pressure during 23-28th May 2017

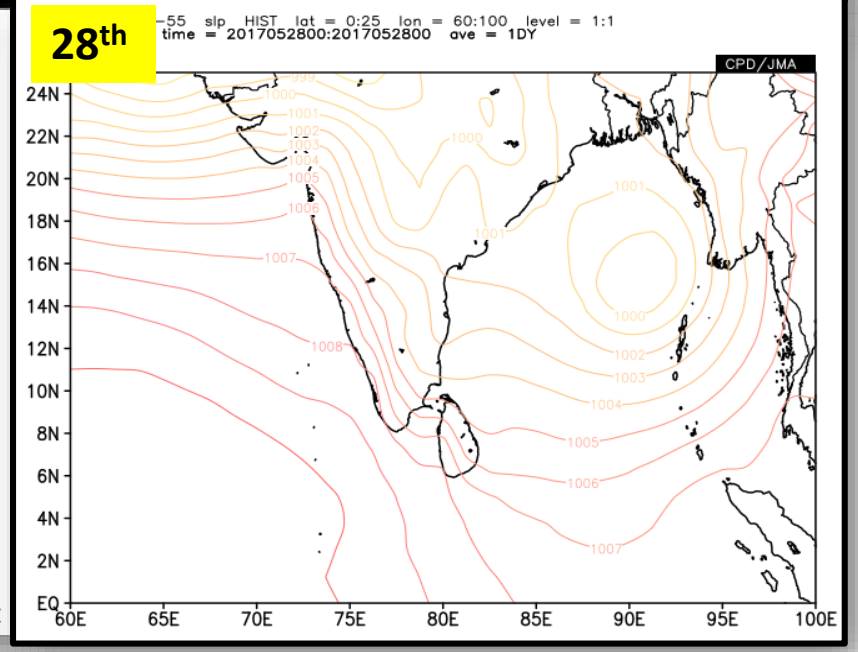






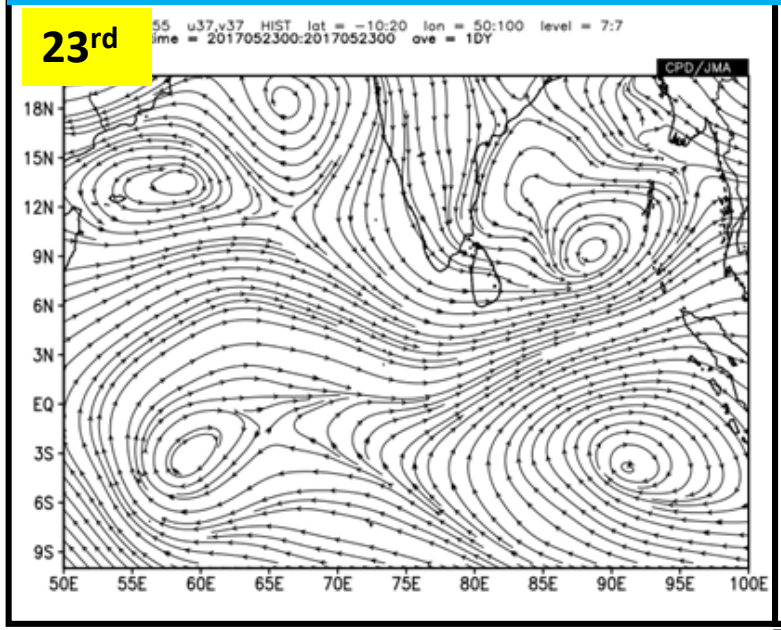




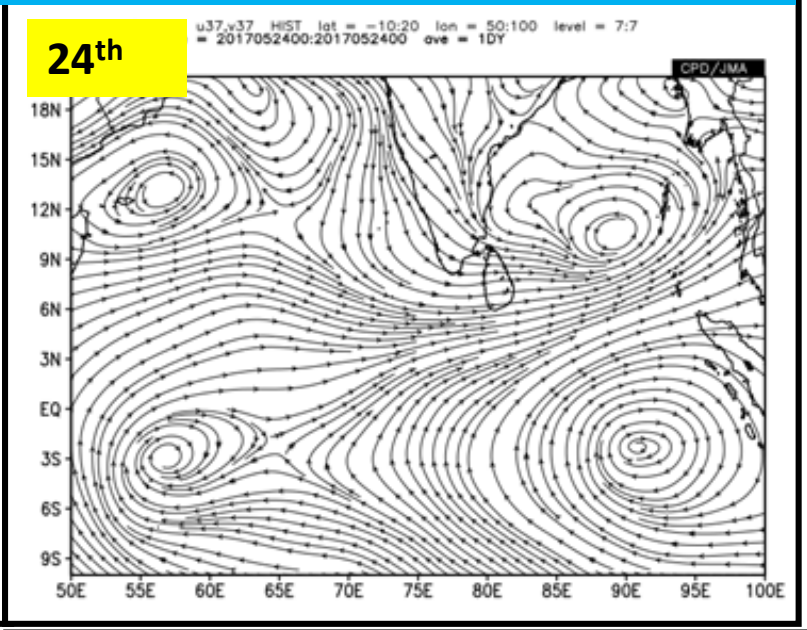


Upper wind pattern (850hpa) during 23-28th May 2017

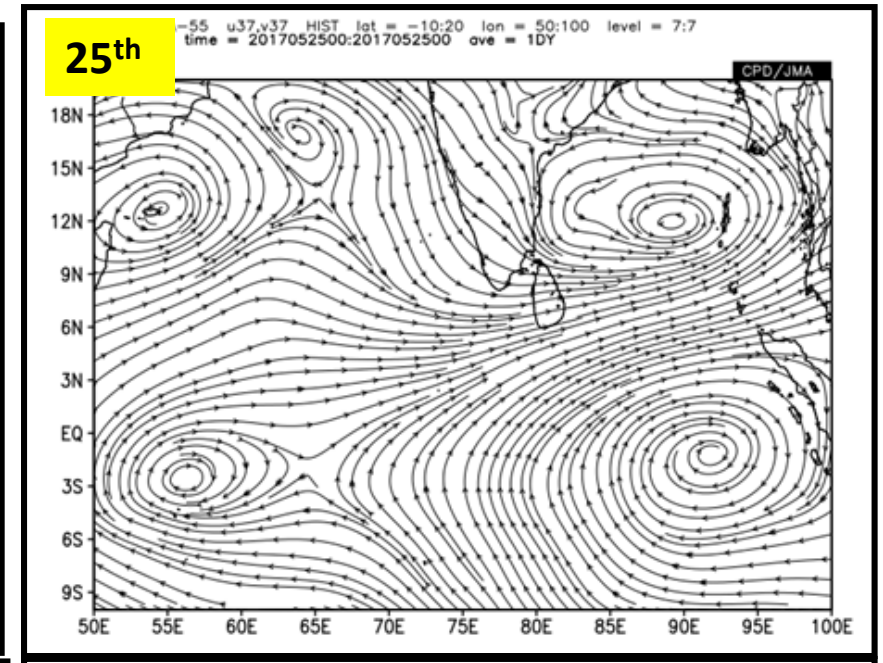
23rd



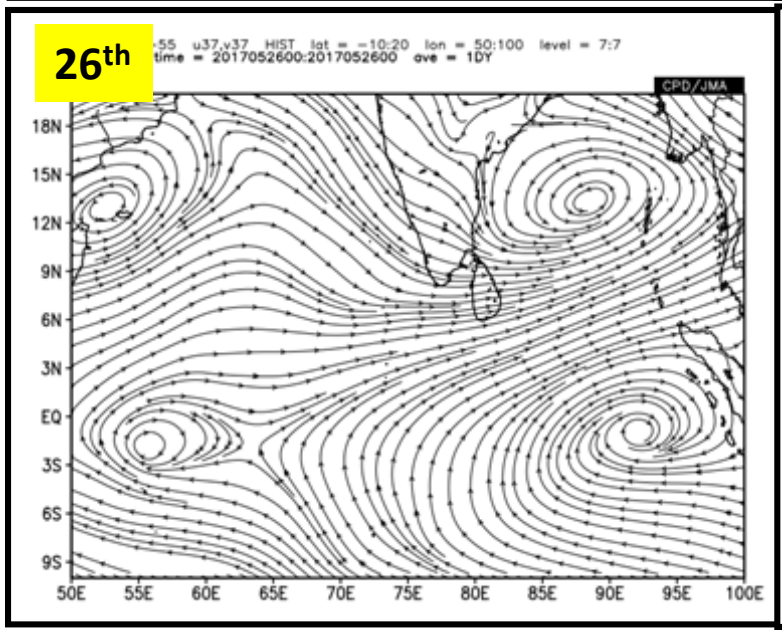
24th



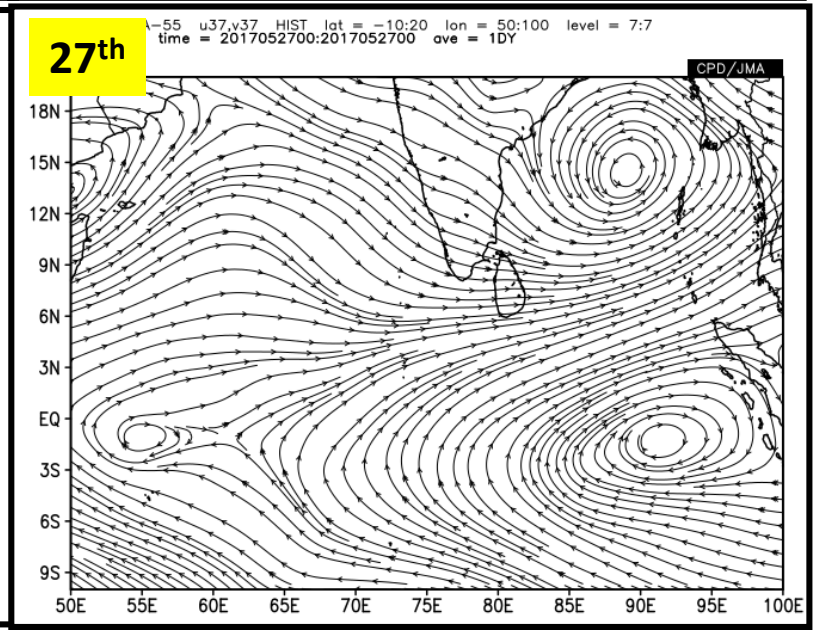
25th



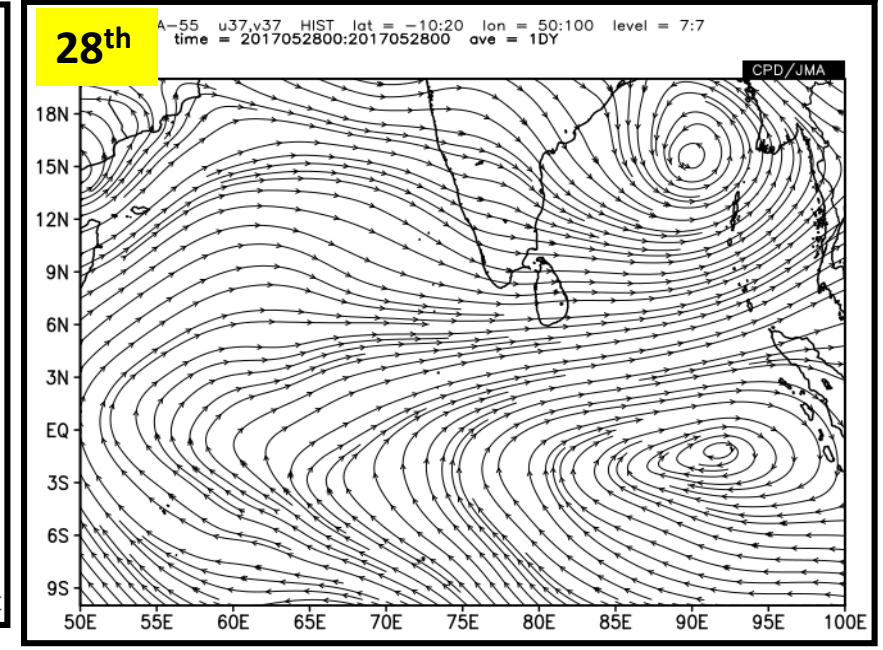
26th



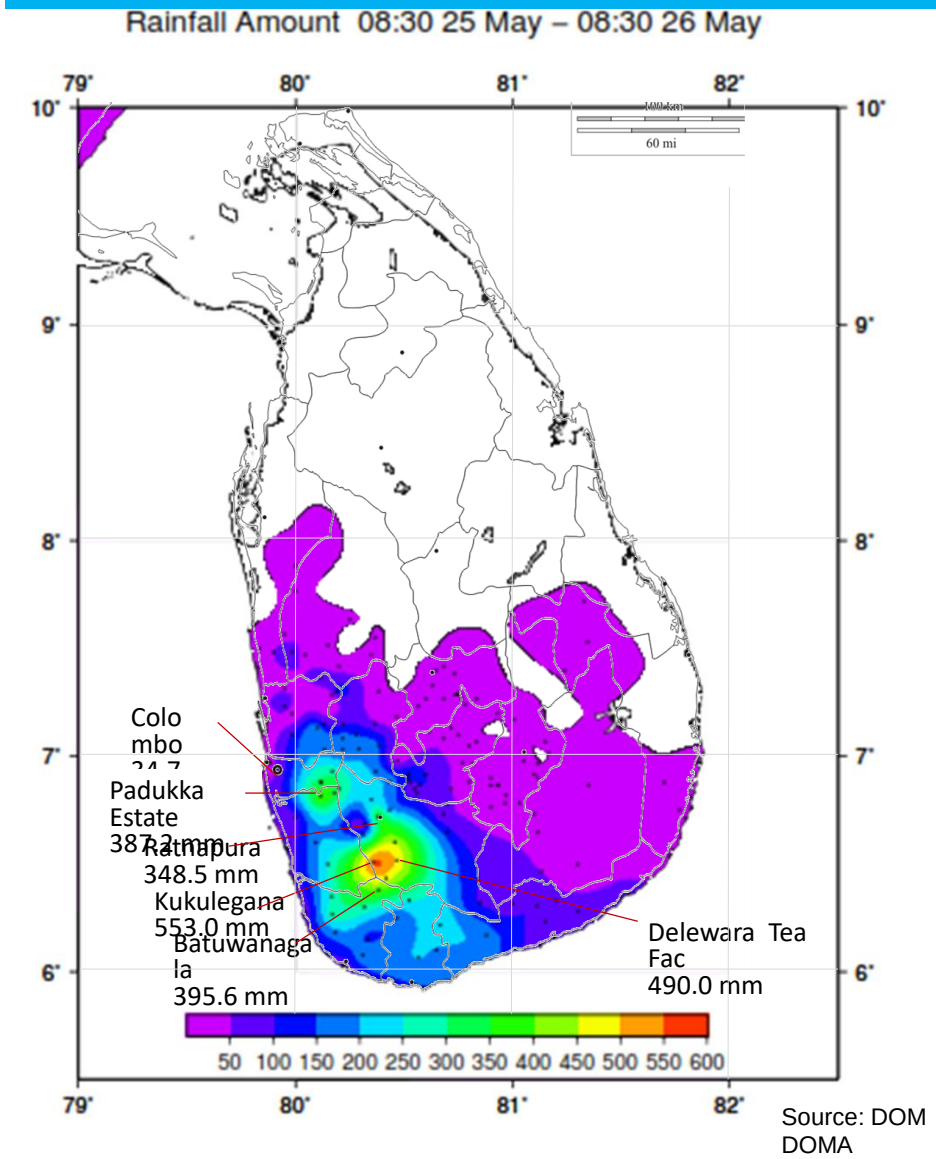
27th



28th



Since 24th May 2017, the unprecedented heavy rainfall caused severe floods and landslides

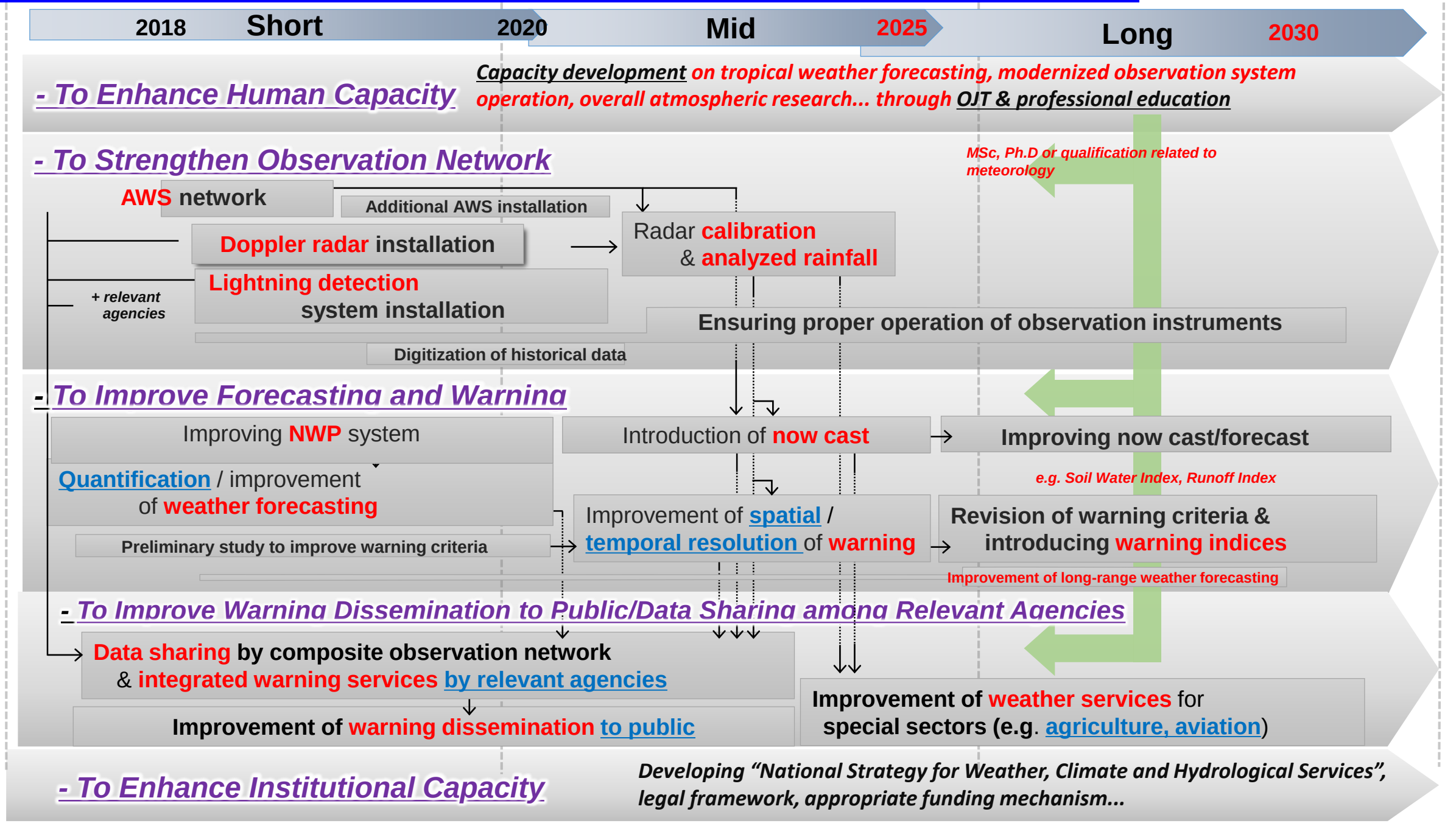


Courtesy-Prof. Ishihara

According to the Government of Sri Lanka as of June 3,2017

- ***211 People have died***
- ***96 People have been missing***
- ***Nearly 704000 People have been affected***
- ***2545 houses were completely deatroyed***
- ***15897 houses were partially damaged***

Image of Action Plans - Weather Forecasting



Thank you