

# Pre-Monsoon Disturbances and Extreme Rainfall: Enhancing Early Warning Systems in Sri Lanka

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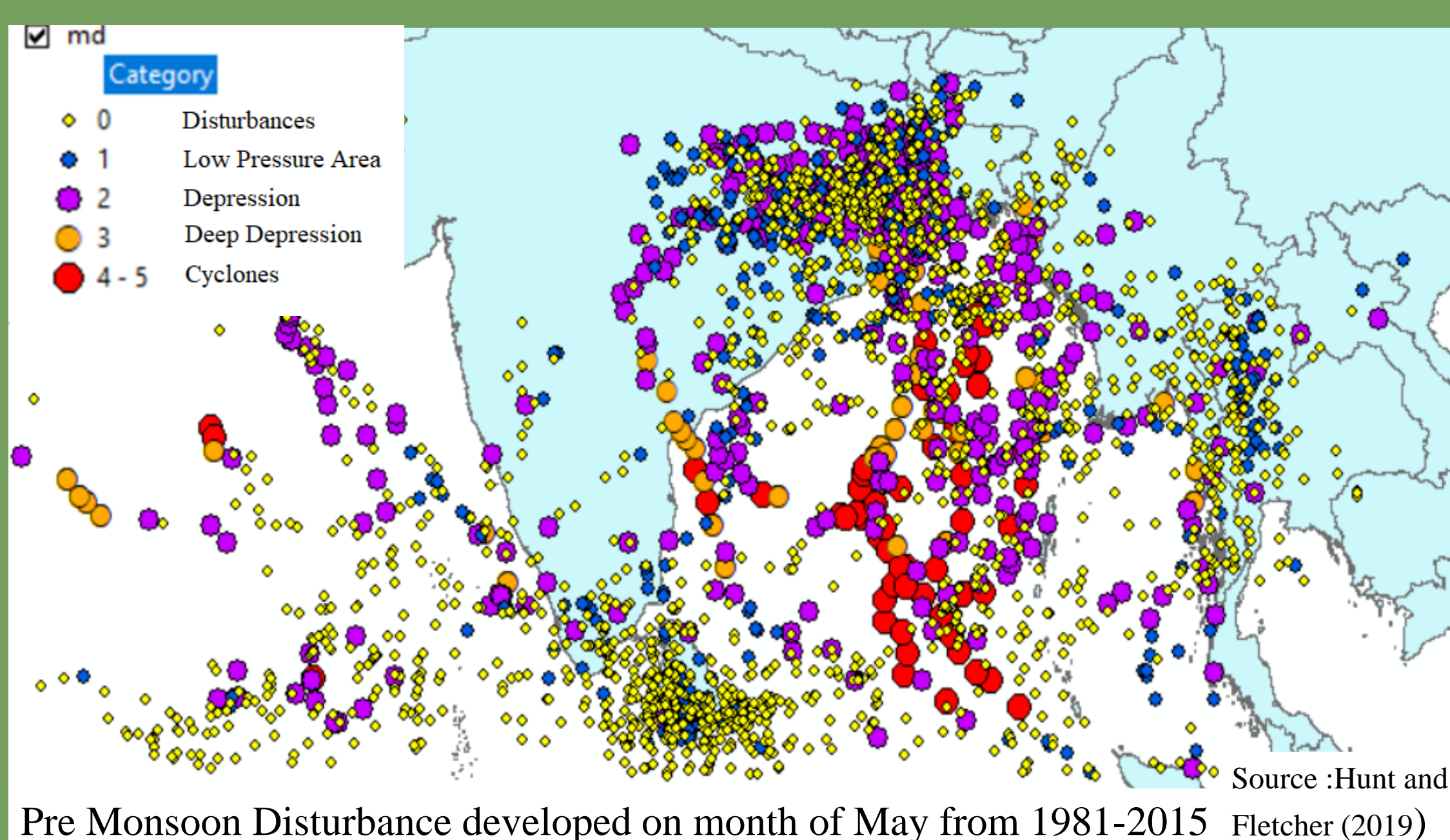
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## Introduction

- This study delves into the profound impact of pre-monsoon disturbances on extreme rainfall events in Sri Lanka.
- These disturbances, coupled with the significant contributions of the Southwest Monsoon (which accounts for nearly 30% of the island's total annual rainfall), play a critical role.
- Notably, the western slopes of the central hills receive 60-65% of their annual rainfall from the Southwest Monsoon. However, this region is also highly vulnerable to landslides during extreme rainfall events.
- Additionally, low-lying areas in the southwestern parts are susceptible to floods.
- These findings underscore the urgent need for a comprehensive understanding of these phenomena and the implementation of effective early warning systems.

## Aim

- To investigate the mechanisms through which pre-monsoon disturbances contribute to extreme rainfall events in Sri Lanka.
- To enhance early warning systems and disaster preparedness by integrating sub seasonal predictions, focusing on the impact of pre-monsoon disturbances on extreme rainfall events in Sri Lanka.

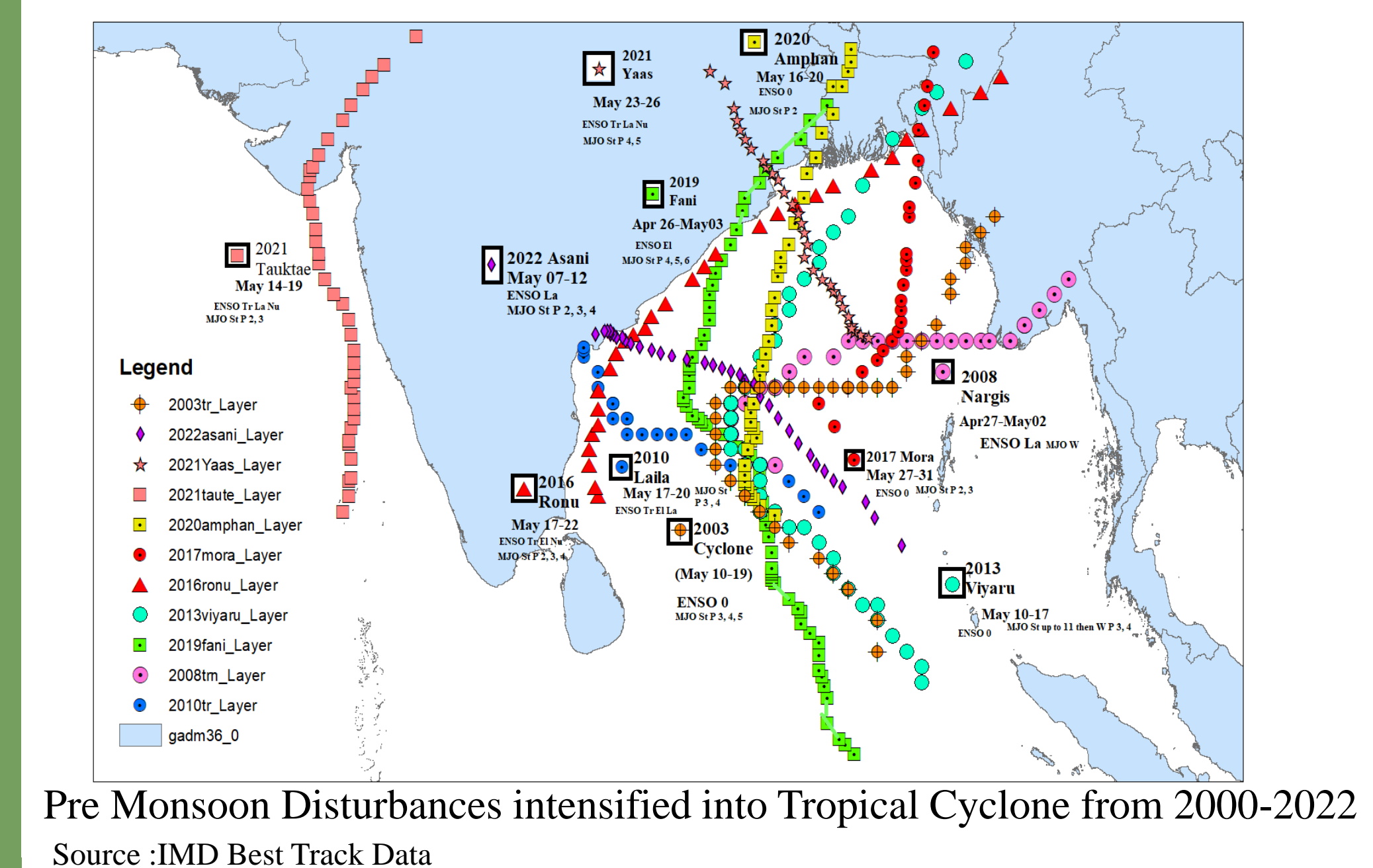


## Data and Methodology

- ERA5 Reanalysis Data, Database of Low-Pressure System (LPS) Tracks from Hunt and Fletcher (2019), IMD best track data
- Oceanic Niño Index (ONI), Dipole Mode Index (DMI) Monthly Time-series HadISST1.1 Dataset; Bimodal ISO Index and RMM Index, Equatorial Waves (Carl Shreck)
- Rainfall Data from the Meteorology Department Sri Lanka, Disaster Management Center Situation Reports:
- Focus on significant years (2003, 2013, 2016, 2017, 2018, 2020, and 2022).

Table 1 : Summary of extreme rainfall Events associated with PMDs and Their Impact (2000-2021)

Event	IMPACT	MJO	BSISO	IOD	ENSO
2003 May 10-19 2003 BoB Cyclone	137,221 families affected , 236 deaths and 19 missing	4,5,6	4	N	N
2010 May 14-18 Laila BoB	458,783 people affected , and 18 deaths	4	4	N	La
2013 May 10-17 Viyaru BoB (ER)	11,663 people affected , 8 deaths and 1 missing	3,4,5	3, 4	-	N
2016 May 14-19 Gen. of Ronu	493,319 people affected , 93 deaths, and 117 are missing	2 , 3	3, 4	N	N
2017 May 25 -31 Gen. of Mora(ER)	601,177 people affected , 213 deaths and 78 Missing	1,2,3	weak	+	N
2018 May 19-27	153,7122 people affected and 20 people have died	1,2	2, 3	N	N
2020 May 14-20 (Amphan BoB)	25,000 people affected , 8 deaths	2, 3	weak	+	N
2021 May 13-15 Gen Tauktae AS, May 24-27 (Yaas BOB)	46500 people affected , 5 people, and 1 missing	2, 3 4, 5	3, 4 4, 5	N	La
2022 May 10-13 Asani	7,337 people affected , 1 death	5, 6			La



## Results

### Genesis of Pre-Monsoon Disturbances:

- Some extremely heavy rainfall events occurred during the genesis of pre-monsoon disturbances and favored by Strong MJO at the phase 2 and 3 (Year 2016, 2017 and 2018)

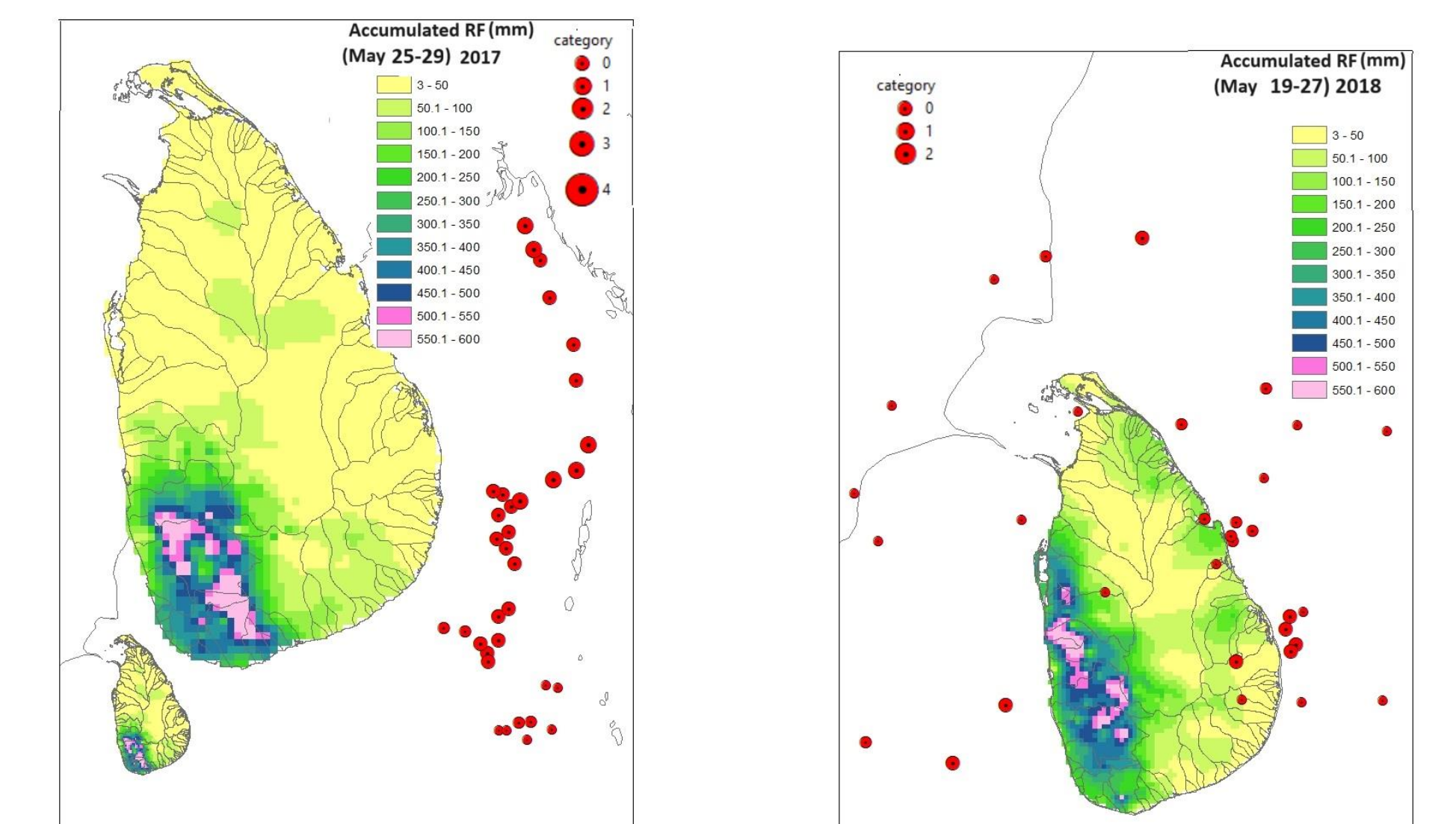
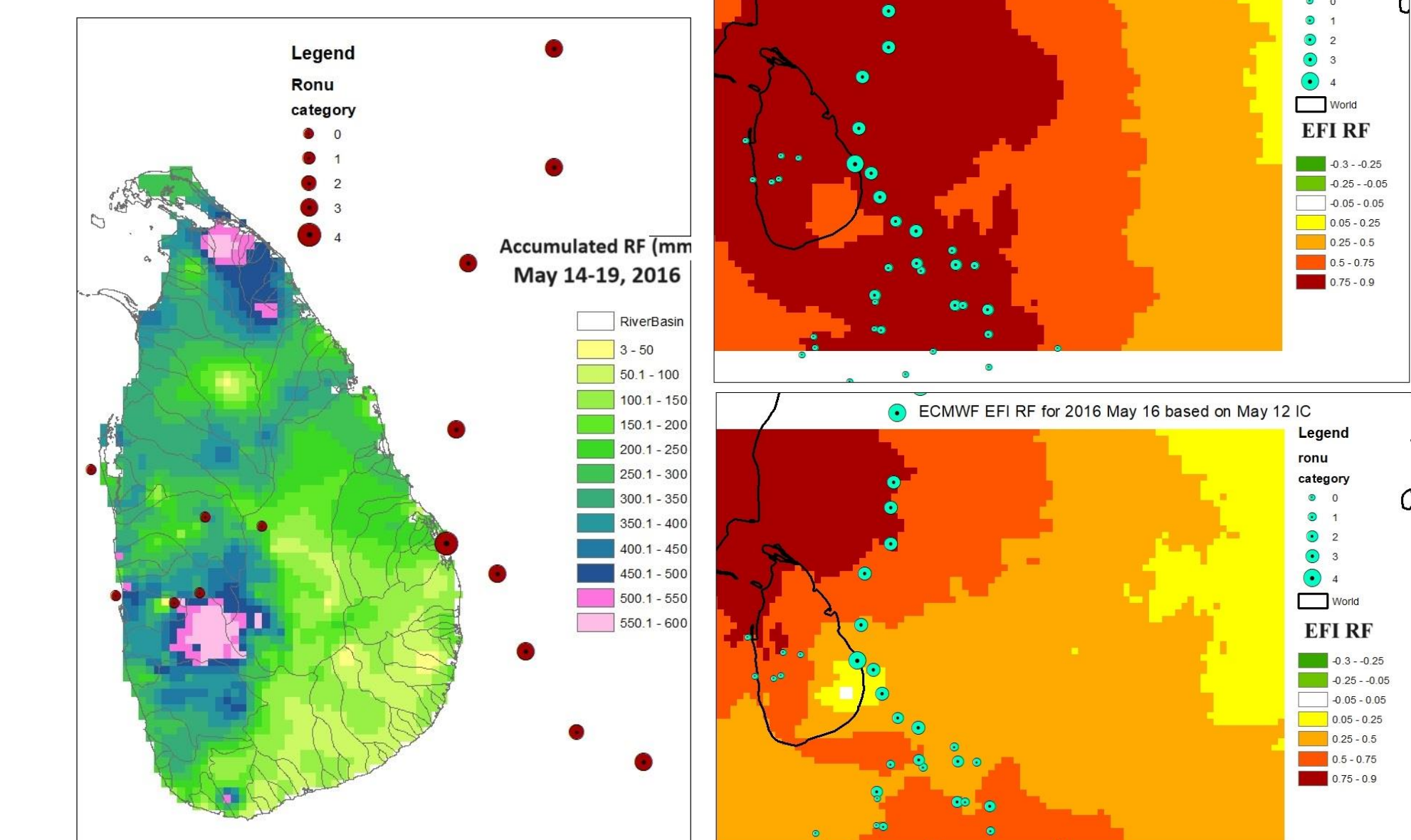
### Ocean-Atmospheric Influences:

- Complex ocean-atmospheric phenomena, including equatorial Rossby waves and the Inter-Tropical Convergence Zone (ITCZ), contribute to extreme rainfall patterns.

### Tropical Cyclone induced extreme rainfall events

- Some extreme rainfall events are associated with pre-monsoon disturbances that intensify into tropical cyclones (observed in 2003, 2013, 2020, and 2022).
- As these cyclones approach the Southwest Bay of Bengal, the strengthening of southwesterly wind flow results in exceptionally heavy rainfall, particularly along the western and southwestern slopes of the central and southern hills.

- ECMWF Extreme Forecast Index (EFI) for Precipitation for 14<sup>th</sup>, 15<sup>th</sup> and 16<sup>th</sup> of May 2016 based on 12 May 00 model run and Accumulated Rainfall from 14-19 May 2016



**Predictability :** ECMWF Extreme Forecast Index (EFI) for Precipitation for 14<sup>th</sup>, 15<sup>th</sup> and 16<sup>th</sup> of May 2016 based on 12 May 00 model run clearly indicated this event 48 hours prior. Since 2018, the DoM has had access to the full suite of high-resolution ECMWF data and products. Leveraging these resources enables more accurate and timely forecasts and early warnings.

## Conclusion

- Pre-monsoon disturbances developed over Bay of Bengal have a significant impact on the rainfall over the southwestern parts.
- Sri Lanka experienced extremely heavy rainfall during the genesis of pre-monsoon disturbances and favored by Strong MJO at the phase 2 and 3 (Year 2016, 2017, 2018 and 2021 Tauktae )
- Some extreme rainfall events are associated with pre-monsoon disturbances that intensify into tropical cyclones and favored by Strong MJO at the phase 4 (2003, 2013, 2020, 2021 Yaas and 2022)
- Since 2018, there has been a noticeable decrease in mortality rates due to the enhancements made in early warning systems and disaster management strategies.

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## Acknowledgements

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