

Supplementary Material

Hydro-Meteorological Disaster Incidents and Associated Weather Systems in Sri Lanka

H.I. Tillekaratne^{1*}, I.M.S.P. Jayawardena², V. Basnayaka³, U. Rathnayake^{4*}, I. Werellagama⁵, S. Herath⁶,
K.W.G.R Nianthi⁷, C.M. Madduma-Bandara⁷, and T.W.M.T.W. Bandara⁷

¹ Disaster Management Centre (DMC), Vidya Mawatha, Colombo 00700, Sri Lanka

² Department of Meteorology, 383, Bauddhaloka Mawatha, Colombo, 00700, Sri Lanka

³ Department of Civil Engineering and Management, University of Twente, 7500 AE Enschede, Netherlands

⁴ Department of Civil Engineering and Construction, Faculty of Engineering and Design, Atlantic Technological University,
Sligo, F91 YW50, Ireland

⁵ The Open Polytechnic, 3 Cleary Street, Waterloo, Lower Hutt 5040, New Zealand

⁶ Enviforecasting LLC, 2-39-17, Tsurumaki, Setagaya-ku, Tokyo, Japan

⁷ Department of Geography, Faculty of Arts, University of Peradeniya, 20400, Sri Lanka

Table S1. Hydro-Meteorological Disasters Incidents Recorded during First Inter-Monsoon and South-West Monsoon. Severe Cyclonic Storm (SCS)

Affected Year	Type of the Disaster	Affected People [House damage]	Deaths + Missing	Maximum Wind Speed (km/h) [Pressure-mb]	Accumulated RF (mm)	Affected (River Basins) (ft. above MSL)	Movement of the system
S1 First Inter Monsoon FIM (1 st March – 30 th April)							
1907-Mar	SCS		64				
2008-April	Flood	180,540	11			Kalu, Kelani, Nilwala (Districts of Kalutara, Ratnapura, Kegalle, Gampaha, Colombo, Matara)	
28-May 01		[2433]					
S2 South-West Monsoon SWM (1 st May -31 st September)							
1937-May	Flood					Kelani 10.33 (Nagalagam-Ng)	
1940 May	Flood					Kelani 11.00 (Nagalagam)	
1947-Aug. 12-15	Flood	400,000			478 Watawala, [Peradeniya 813], [Watawala 1584], [N-Bridge 1556]	Kelani 12.85 (Nagalagam)	
1978-May 10-15	Flood	106,672 [8,687]				Kalu, Nilwala (Hambantota District)	
1984-May,24	Flood	3,070 [614]				(Districts of Kalutara, Kegalle)	
1989-May 30-June 04	Flood	237,960 [6,104]	218			Kelani 9.3 (Ng) (Districts of Kegalle, Kalutara, Ratnapura, Colombo, Gampaha, Galle, Matara)	
1993 May 21-29		290,125 [758]	6			Nilwala (Matara District) Gin (Galle), Kalu (Kalutara, Ratnapura, Colombo)	
2003-May 13-18	SCS, Flash flood	562,368 [33,209]	260 [33, missing]	~140 [980]	360 (Ratnapura), 725 (Deniyaya), 366 (Nilwala)	SW Kalu, Gin, Nilwala (Districts of Matara, Galle, Ratnapura, Kalutara, Hambantota, Colombo, Gampaha, Batticaloa)	East to Northwest/Northerly
2008 May 30; 1 June						Flash Flood Colombo-Kelani Right Bank	
2010 May 15-18	SCS, Flash flood		20	~120 [972]			East to Northwest/Northerly
2016-May 14-16	Flood, Landslides	462,217	211		435 Kelani	Kelani 7.65 (Ng), Kalu, Gin, Kelani (Districts of Colombo, Kalutara, Gampaha, Galle, Kegalle, Ratnapura, Batticaloa, Kurunegala, Puttalam, Kilinochchi, Mulativu, Mannar)	
2017- May 18-19	Cyclone- "Mora" Flood,	725,653	358		500	Kalu, Gin, Nilwala, Kelani (Districts of Colombo, Kalutara,	

2018 May 19-26	Landslides , Mud- Flow Flood	400,000	~45*	Gampaha, Kegalle, Ratnapura, Galle, Matara, Hambantota)
				Kalu (Districts of Gampaha Colombo, Kalutara, Galle, Kegalle, Ratnapura) and Kurunegala, Puttalam)

Table S2. Hydro-Meteorological Disasters Recorded during the Second Inter-Monsoon (SIM) October-November

Affected Year	Disaster	Affected People [House damage]	Deaths + Missing	Maximum Wind Speed (km/h) [Pressure- mb]	Accumulated RF mm 24hrs [Month]	Affected River Basin (areas) (MSL ft.)	Movement
1912 Nov	Cyclone						
1922 Nov	Cyclone					Kelani 12.6 (Ng)	
1930-Oct	Flood					Kelani 10.91 (Ng)	
1966 Oct / Nov	Cyclone						
1967 01 October/ Dec	Cyclone	.				Kelani 9.17 (Ng)	
1978- Nov. 23- 24	SCS-Crossed	1,000,000[250,000]	~1,000	>145 [953]	400-500	Batticaloa	E to NW/WNW/NW
1992 Nov	SCS-Crossed	30,277	4	>120 [998.2]	494 Cmb		E to W/WNW/NW
1993 Oct-08	Cyclone "Karaikal"	20,737	19			Kalutara, Ratnapura, Badulla	
1994	Flood	620,104			498 Cmb	Batticaloa, Trincomalee	
2005 Nov. 19 th – 27 th							
2008 Nov	Flood	400,000			390mm Jaffna	Jaffna, Kilinochci	
2010 Nov.10 th – 11 th		260,000 386,605	11		490 Cmb		
2020 Nov 28 th - Dec.3rd	Cyclonic Storm 'Burevi'						

Table S3. Hydro-Meteorological Disasters Recorded during the North-East Monsoon (NEM)

Affected Year	Disaster	Affected People [House damage]	Deaths + Missing	Maximum Wind Speed (km/h) [Pressure-mb-millibars]	Accumulated RF mm 24hrs [Month]	Affected River Basin (areas) (ft. above MSL)	Movement
1906 Jan.	Cyclone					Kelani 10.8 (Ng)	
1908 Dec.	Cyclone						
1912 Dec.	Cyclone						
1913 Dec.	Cyclone					Kelani 11.0 (Ng)	
1919 Dec.	Cyclone						
1931 Dec.	Cyclone						
1957-Dec. 20-26	Flash Flood-Nachchaduwa Dam Breach	100,000	171		426 A'pura	NE Dry-Zone	
1964-Dec, 23-26	"Rameshwaram" SCS-Crossed, Flood	300,000	>1,000	>161 >215 [>970]		200-250	E to W/WNW/NW
1969-Dec- 25							
2000 25-Dec	SCS-Crossed	500,000	8	~165 [970]		300-350	E to W/WSW/WNW
2007 Dec.		302,539	7			(Districts of Batticaloa, Trincomalee, Jaffna, Kilinochchi, Polonnaruwa, A'pura, Matale,	
2011 Jan 7-11 / Feb 2-11	SCS, Flood, LS	330,000	62	>140 [969]	312 Batticaloa	East DZ (Districts of Batticaloa, Trincomalee, A'pura,	E to N/W/NW
2014 Dec 14-19		1,100,000	216*		200 Badulla	(Districts of Batticaloa, Trincomalee, Kilinochchi, Mulativu, Mannar, Vavunia, A'pura, Polonnaruwa, K'negala, Puttalam, Matale, Kandy, N'Eliya, Badulla.	

Table S4. Classification of Tropical Cyclones over the World (all winds are 10-minute averages) [Source: India Meteorological Department, (2020); Siddiki et al., (2012); WMO, 2022]

Beaufort scale	10-minute sustained winds (knots)	N Indian Ocean IMD	SW Indian Ocean MF	Australia BOM	SW Pacific FMS	NW Pacific TM.	NW Pacific TRWC	NE Pacific & N Atlantic NHC & CPHC
0 ~ 6	<28	Depression	Tropical Disturbance	Tropical Low	Tropical Depression	Tropical Depression	Tropical Depression	Tropical Depression
7	28 ~ 29	Deep Depression	Tropical Depression					
8 ~ 9	30 ~ 33							
8 ~ 9	34 ~ 47	Cyclonic Strom	Moderate Tropical Storm	Tropical Cyclone (1)	Tropical Cyclone	Tropical Storm	Tropical Storm	Tropical Storm
10	48 ~ 55	Severe Cyclonic Storm	Severe Tropical Storm	Tropical Cyclone (2)		Severe Tropical Storm		
11	56 ~ 63							
12	64 ~ 72	Very Severe Cyclonic Storm	Tropical Cyclone	Severe Tropical Cyclone (3)		Typhoon	Typhoon	Hurricane (1)
	73 ~ 85			Severe Tropical Cyclone (3)				Hurricane (2)
	86 ~ 89			Severe Tropical Cyclone (4)				Major Hurricane (3)
	90 ~ 99		Intense Tropical Cyclone	Tropical Cyclone (4)				Major Hurricane (4)
	100 ~ 106			Severe Tropical Cyclone (5)				
	107 ~ 114							
	115 ~ 119		Very Intense Tropical Cyclone				Super Typhoon	Major Hurricane (5)
	>120	Super Cyclonic Storm						

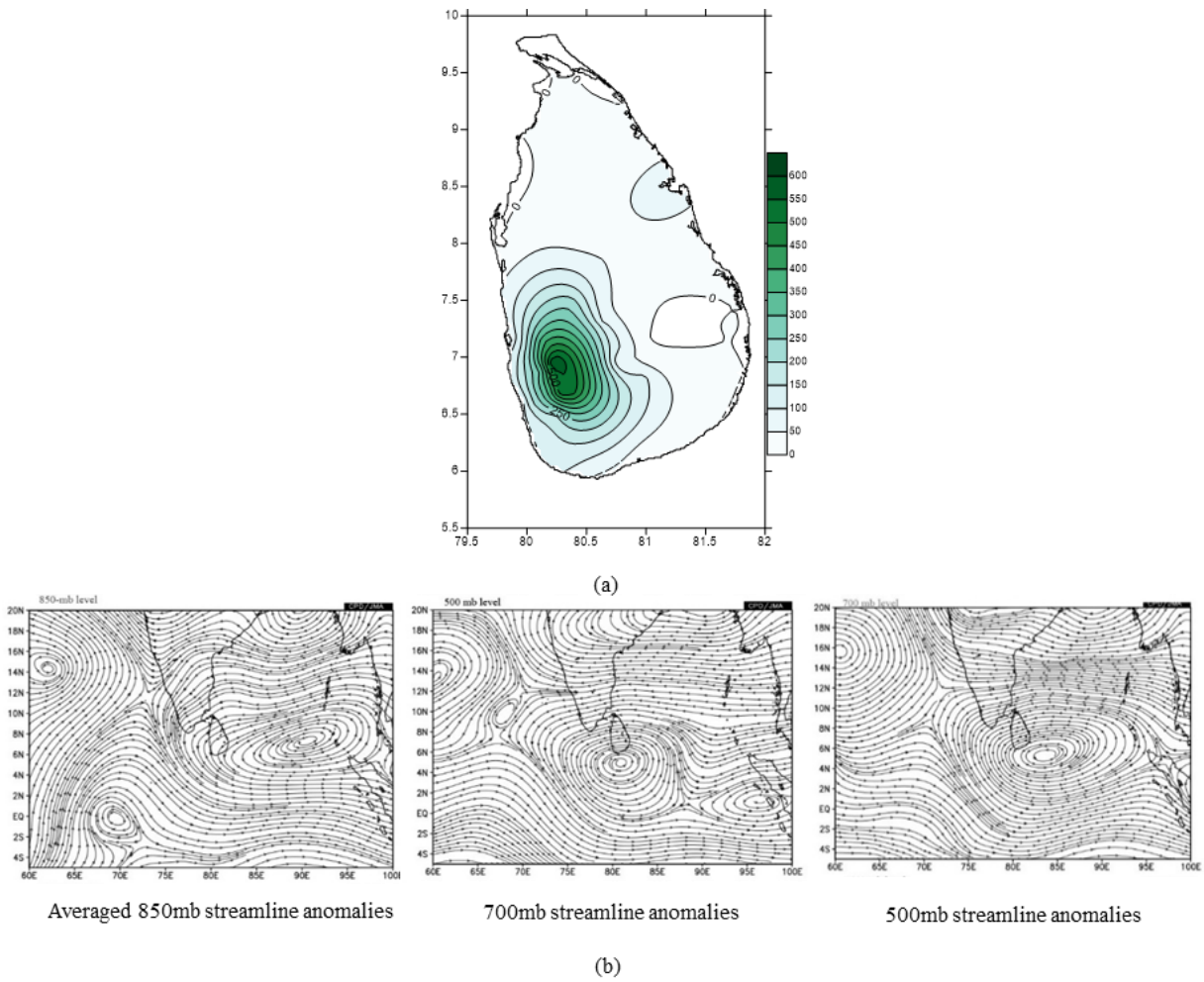


Figure S1. Accumulated Rainfall (mm) for the period from 30th May to 04th June 1989 (b) Streamline anomalies averaged at 850 mb level, 700 mb level and 500 mb level. (Rainfall Source: Department of Meteorology).

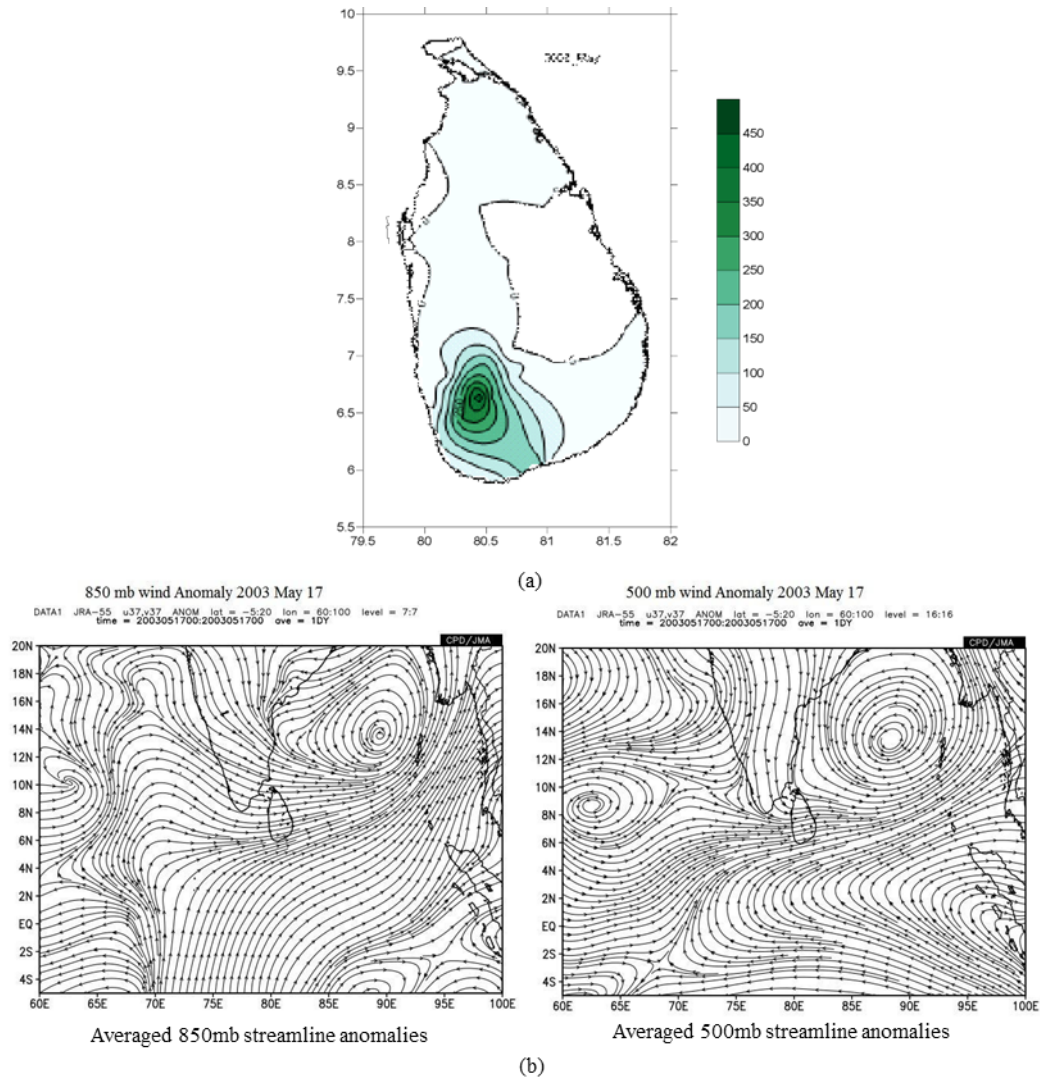


Figure S2. (a) Accumulated Rainfall (mm) for the period from 16th to 17th May 2003 (Top). (b) Streamline anomalies averaged at 850 mb level and 500 mb level for 17th May 2003. (Rainfall Source: Department of Meteorology). Incident in 2003 from 13th to 18th May.

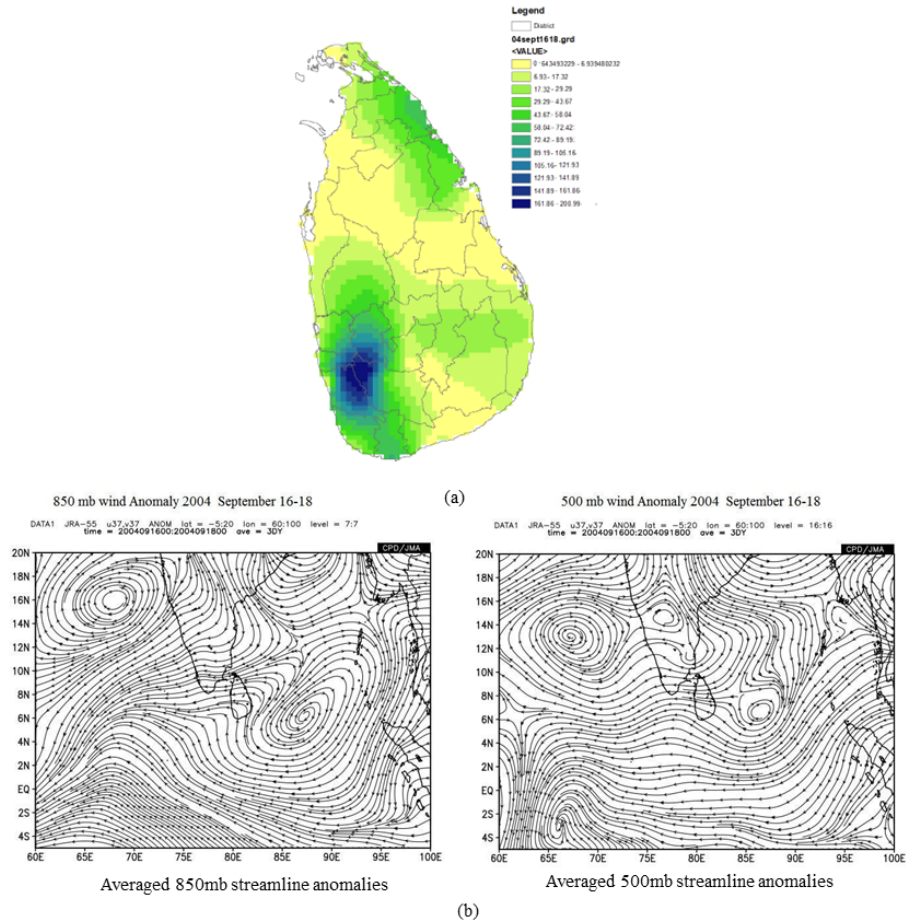
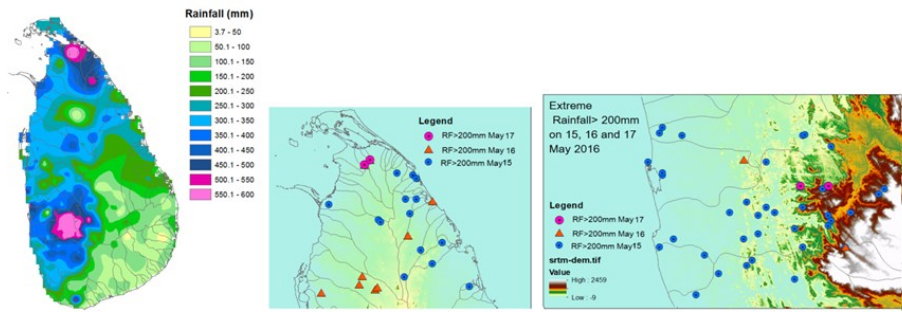
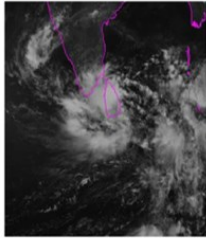


Figure S3. (a) Accumulated Rainfall (mm) for the period from 16th to 18th September 2004 (Top). (b) Streamline anomalies averaged at 850 mb level and 500 mb level for 16th to 18th September 2004. (Rainfall Source: Department of Meteorology).

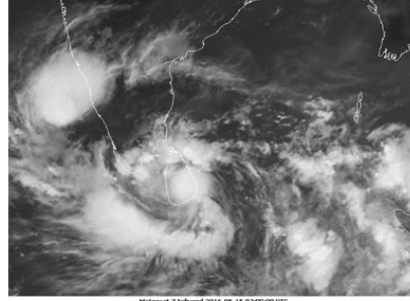
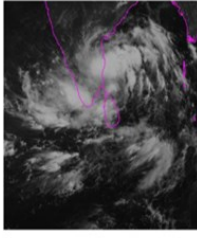
Accumulated Rainfall (mm) May 14-19 2016



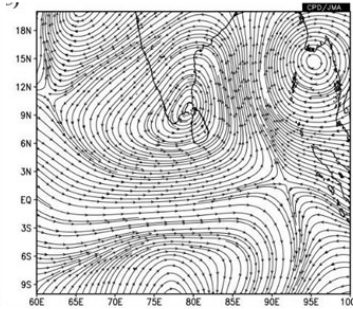
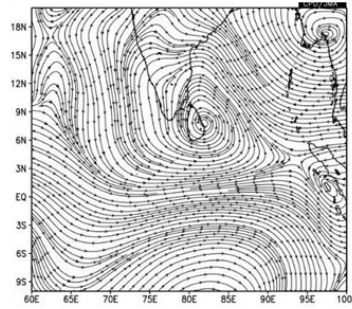
VIS Image 2016.05.15
0630Z



VIS Image 2016.05.17
0630Z



(a)



(b)

Figure S4. (a) Accumulated Rainfall (mm) for the period 14th May 2016 (Top) and the Meteosat IR Images (on 0630 UTC 2016-05-15 and 0630 UTC 2016-05-17). (b) Streamline anomalies averaged at 850 mb level, 700 mb level, and 500 mb level for 14th May 2016. (Rainfall Source: Department of Meteorology).

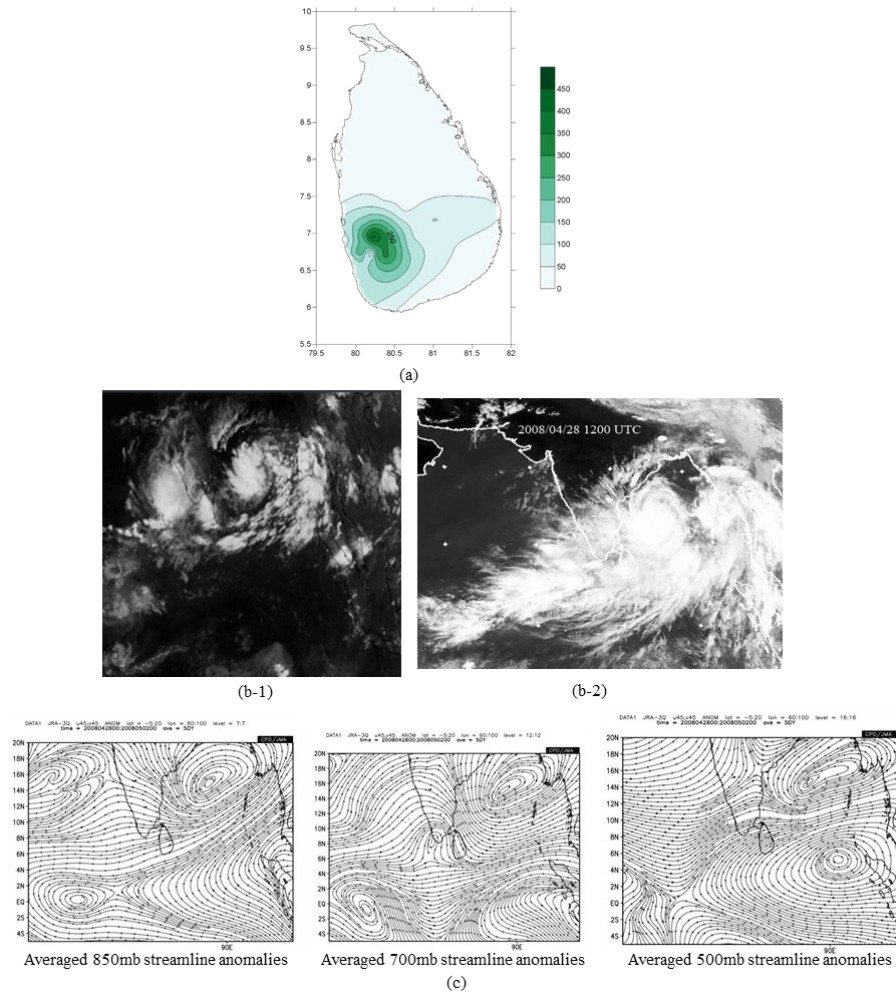


Figure S5. (a) Accumulated Rainfall (mm) for the period from 28th April -21st May 2008 (Top). (b)IR image on 28/04/2008 1200UTC over the Indian Ocean - April 28th – May 01st 2008 flood event. Source: METEOSAT-7. (c) Streamline anomalies averaged at 850 mb level and 500 mb level for 28th April -21st May 2008 (Rainfall Source: Department of Meteorology).

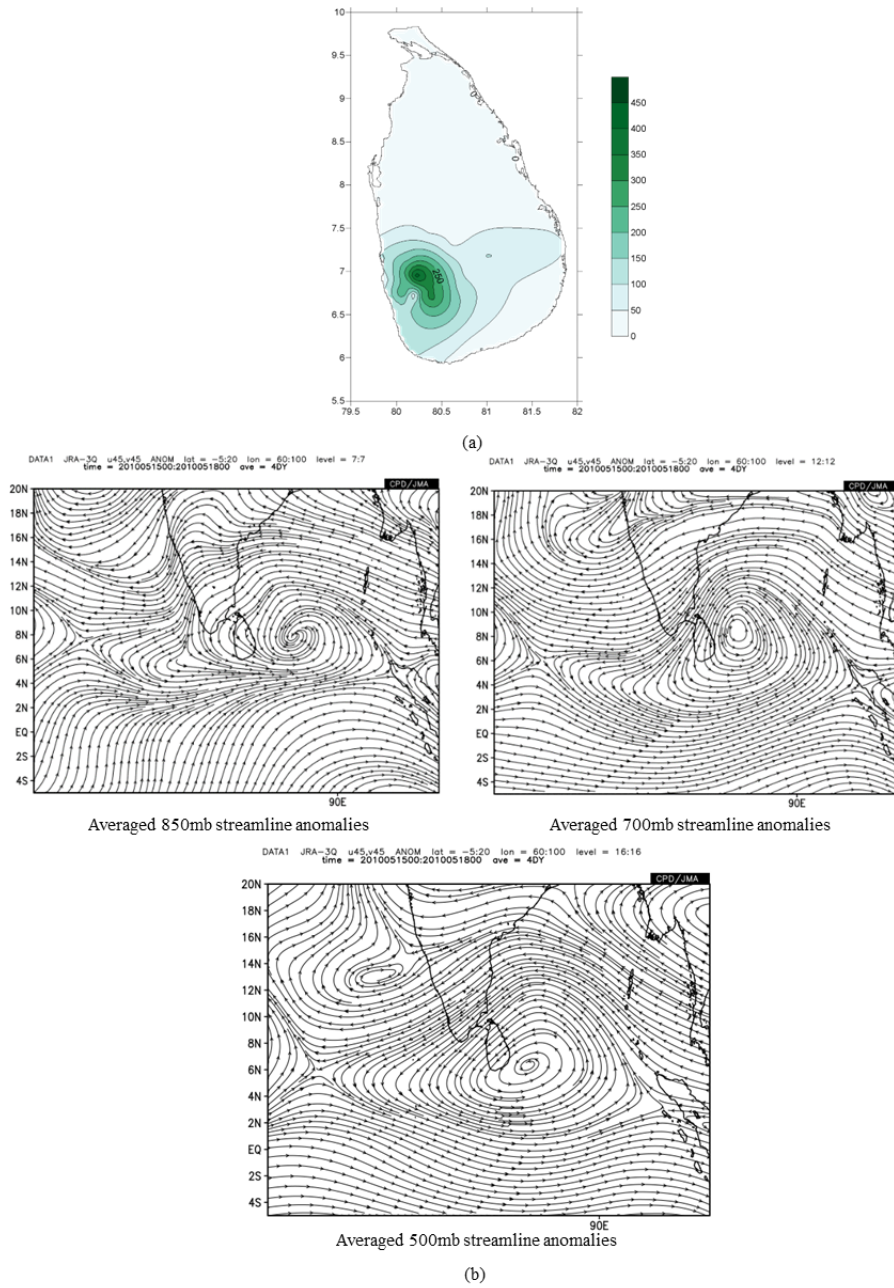


Figure S6. (a) Accumulated Rainfall (mm) for the period from 15th to 18th May 2010 (Top). (b) Streamline anomalies averaged at 850 mb level, 700 mb level, and 500 mb level for 15th to 18th May 2010. (Rainfall Source: Department of Meteorology).

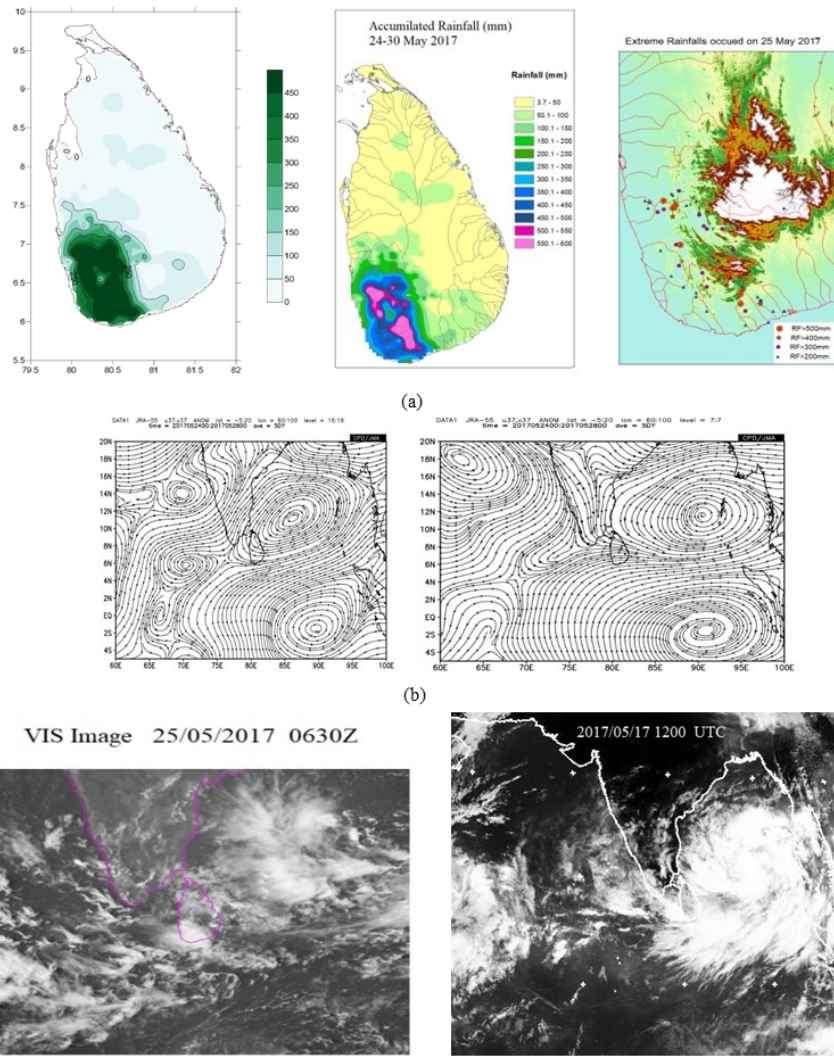


Figure S7. (a) Accumulated Rainfall (mm) for the period 18th -19th May 2017 and 24th -29th May 2017 (Top) (b) Streamline anomalies averaged at 500 mb level, and 850 mb level for 24th May 2017. (c) Meteosat IR Images (on 0630 UTC and 1200 UTC 17 May 2017). (Rainfall Source: Department of Meteorology). Incidents 18th to 29th May, 2017.

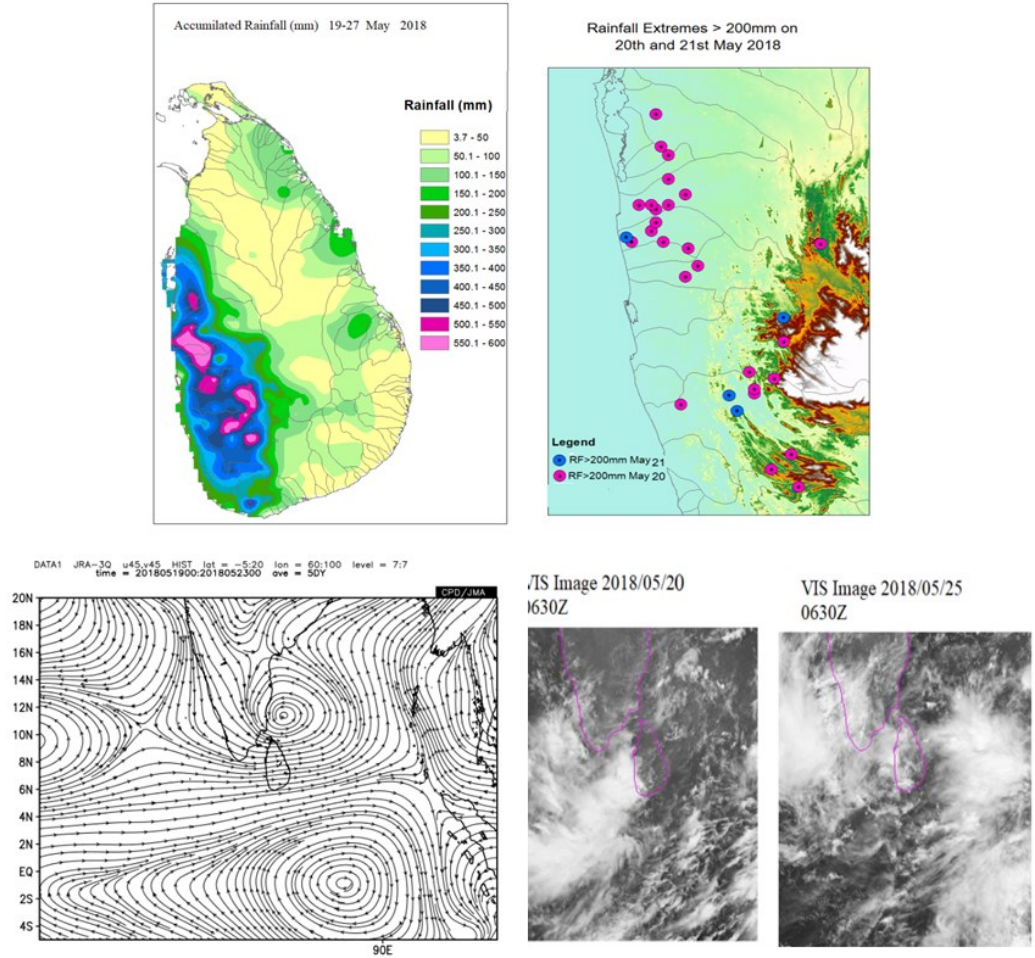


Figure S8. Accumulated Rainfall (mm) for the period 19th -27th May 2018, streamline anomalies averaged at 850 mb level and the Meteosat IR Images (on 0630 UTC 2018-05-20). (Rainfall Source: Department of Meteorology).

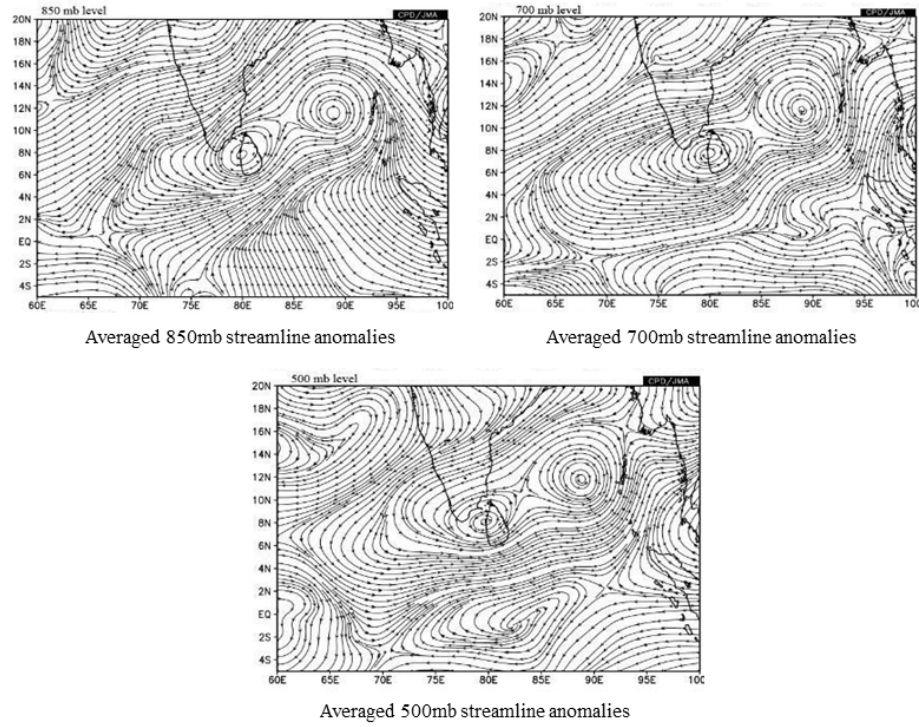


Figure S9. Streamline anomalies averaged at 850 mb level, 700 mb level, and 500 mb level for 01st October 1967. (Rainfall Source: Department of Meteorology).

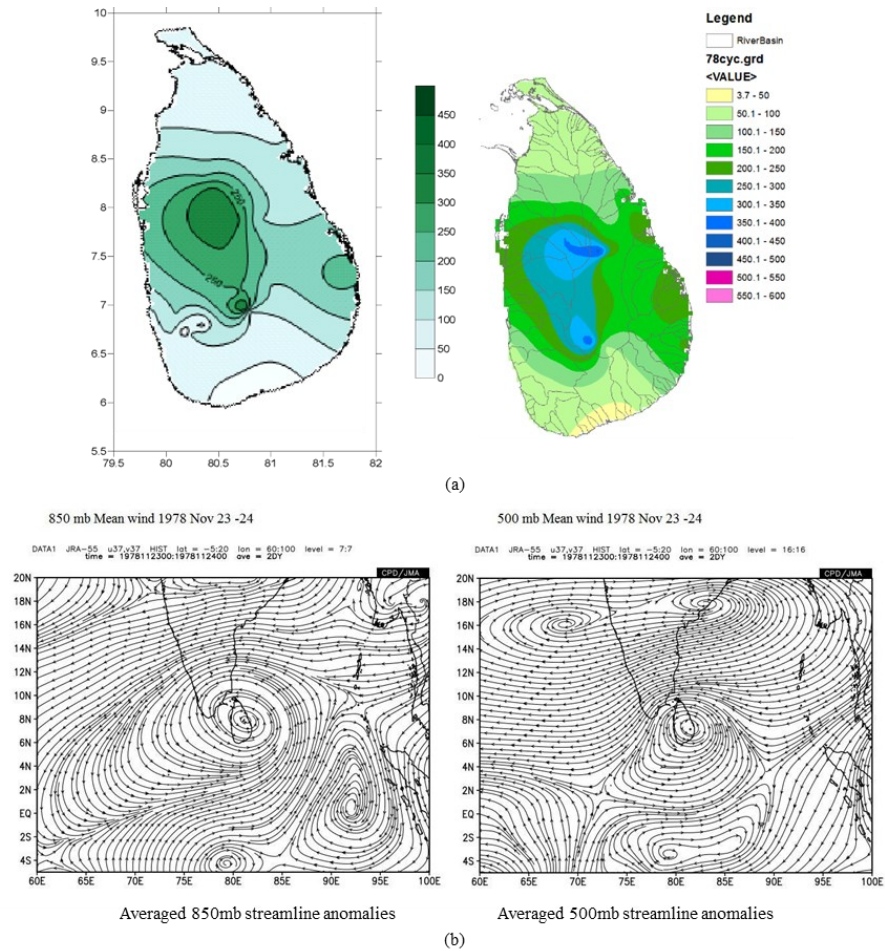


Figure S10. (a) Accumulated Rainfall (mm) for the period from 23rd to 24th November 1978 (Top). (b) Streamline anomalies averaged at 850 mb level, and 500 mb level for 23rd to 24th November 1978. (Rainfall Source: Department of Meteorology).

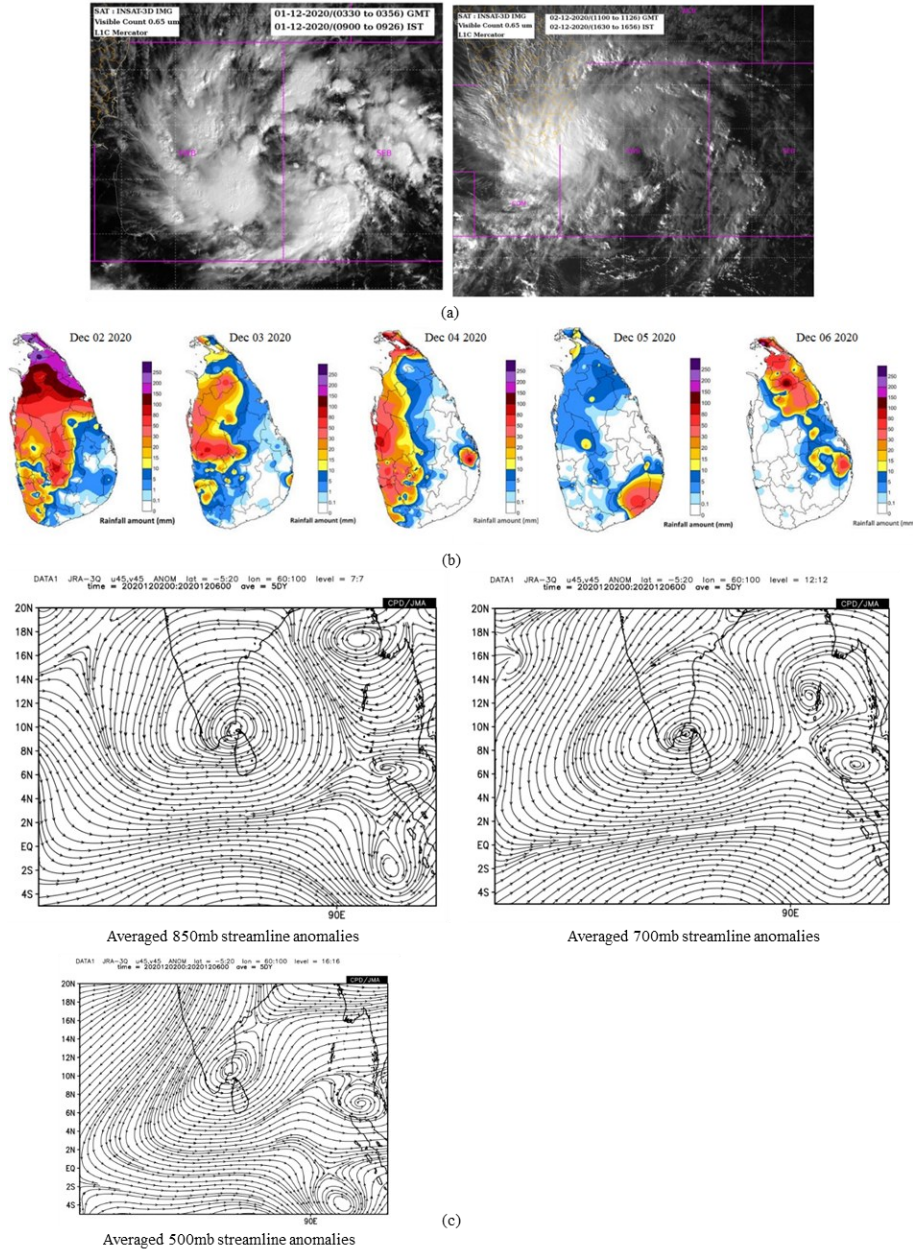


Figure S11. (a) METEOSAT IR Images (on 0356 UTC 2020-12-01) (b), (c) Daily Rainfall (mm) for the period from 2nd to 6th December 2020. (c) Streamline anomalies averaged at 850 mb level, 700 mb level, and 500 mb level for (Rainfall Source: Department of Meteorology). 2020- Cyclonic Storm ‘Burevi’ (1st to 3rd December, 2020).

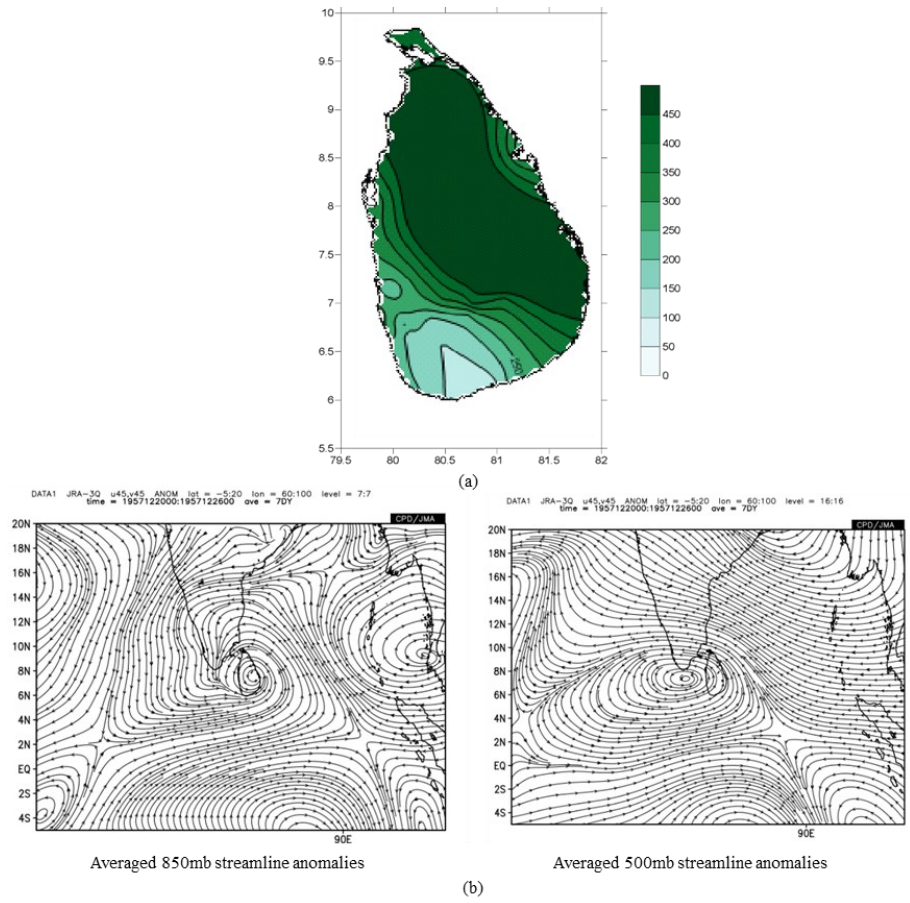


Figure S12. (a) Accumulated Rainfall (mm) (Top). (b) Streamline anomalies averaged at 850 mb level, and 500 mb level for 20th to 26th December 1957. (Rainfall Source: Department of Meteorology).

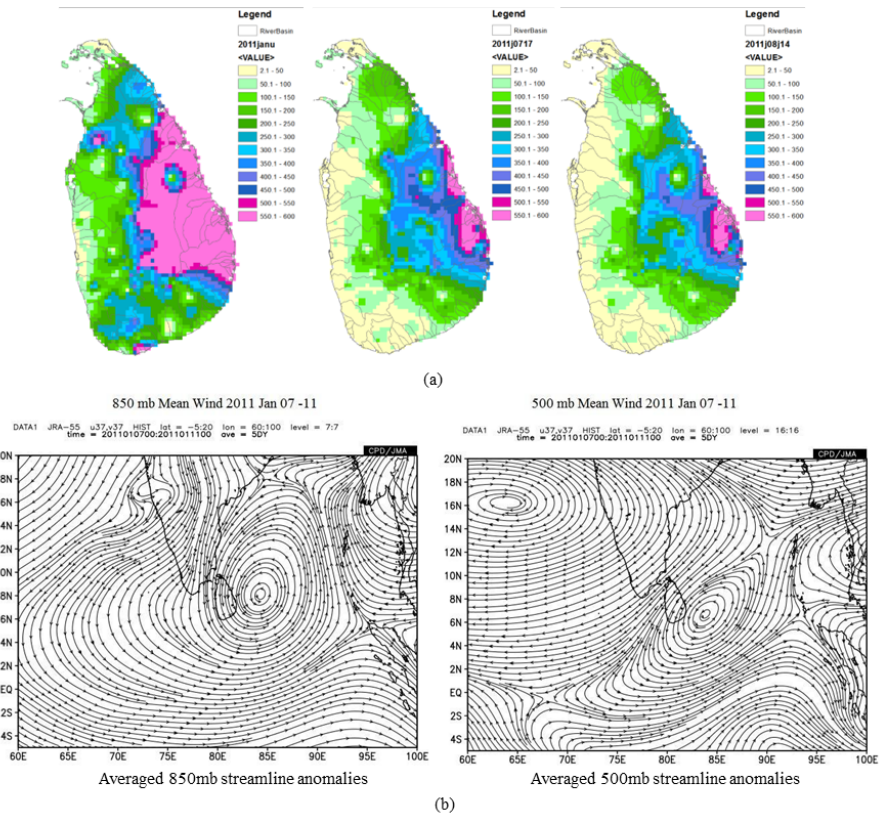


Figure S13. (a) Accumulated Rainfall (mm) for the period from 7th to 11th January 2011 (Top). (b) Streamline anomalies averaged at 850 mb level, and 500 mb level for 7th to 11th January 2011. (Rainfall Source: Department of Meteorology).

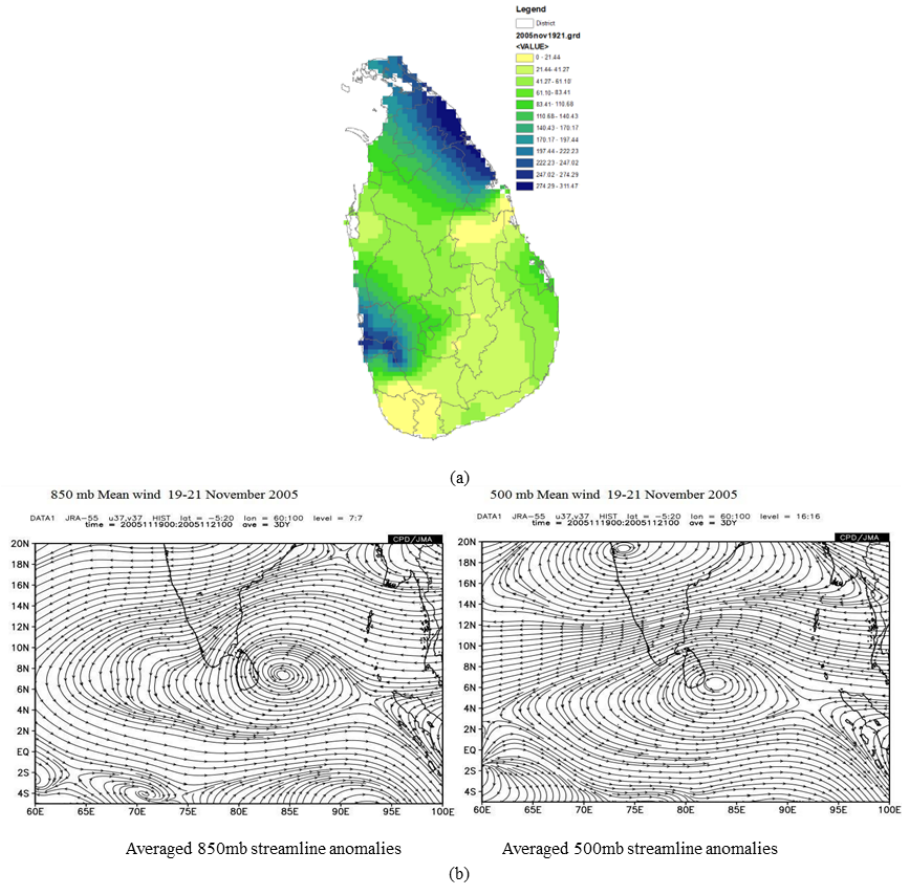
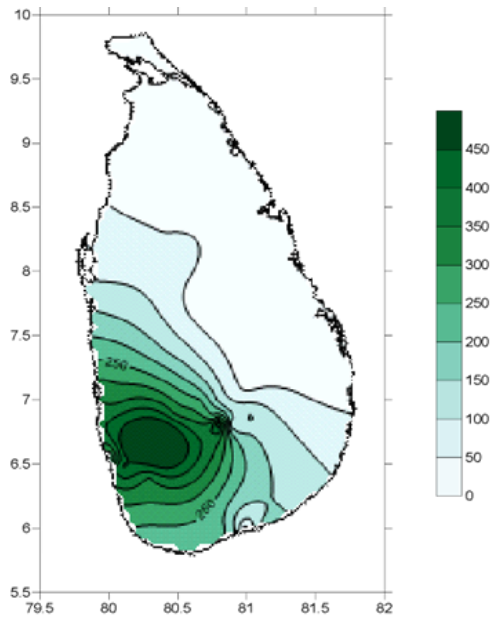
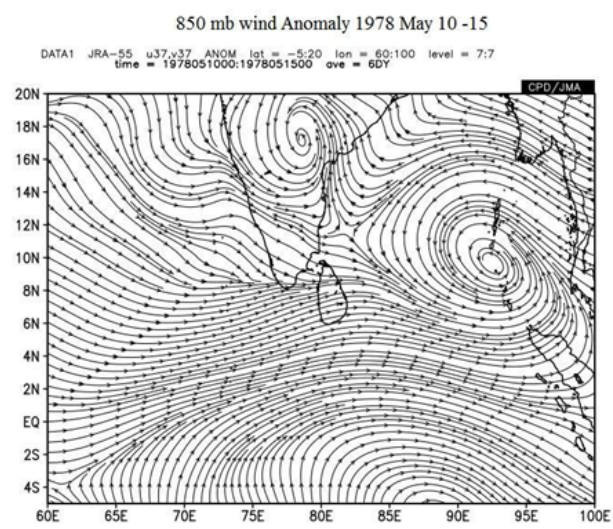


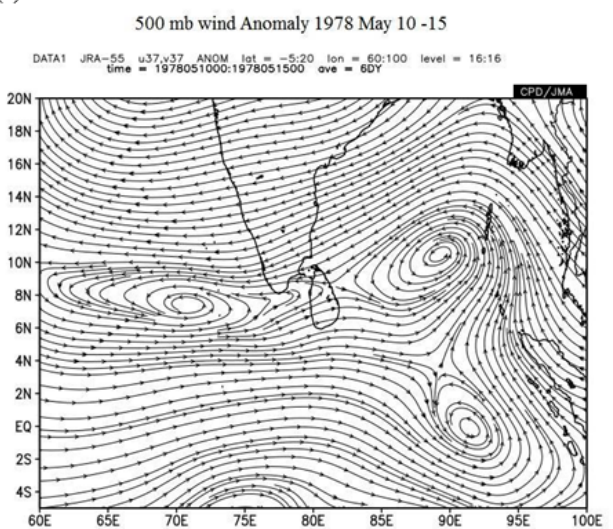
Figure S14. (a) Accumulated Rainfall (mm) for the period from 19th-21st November 2005 (Top). (b) Streamline anomalies averaged at 850 mb level and 500 mb level for 19th to 21st November 2005. (Rainfall Source: Department of Meteorology).



(a)



Averaged 850mb streamline anomalies



Averaged 500mb streamline anomalies

(b)

Figure S15. (a) Accumulated Rainfall (mm) for the period from 10th to 15th May 1978 (Top). (b) Streamline anomalies averaged at 850 mb level and 500 mb level. (Rainfall Source: Department of Meteorology).

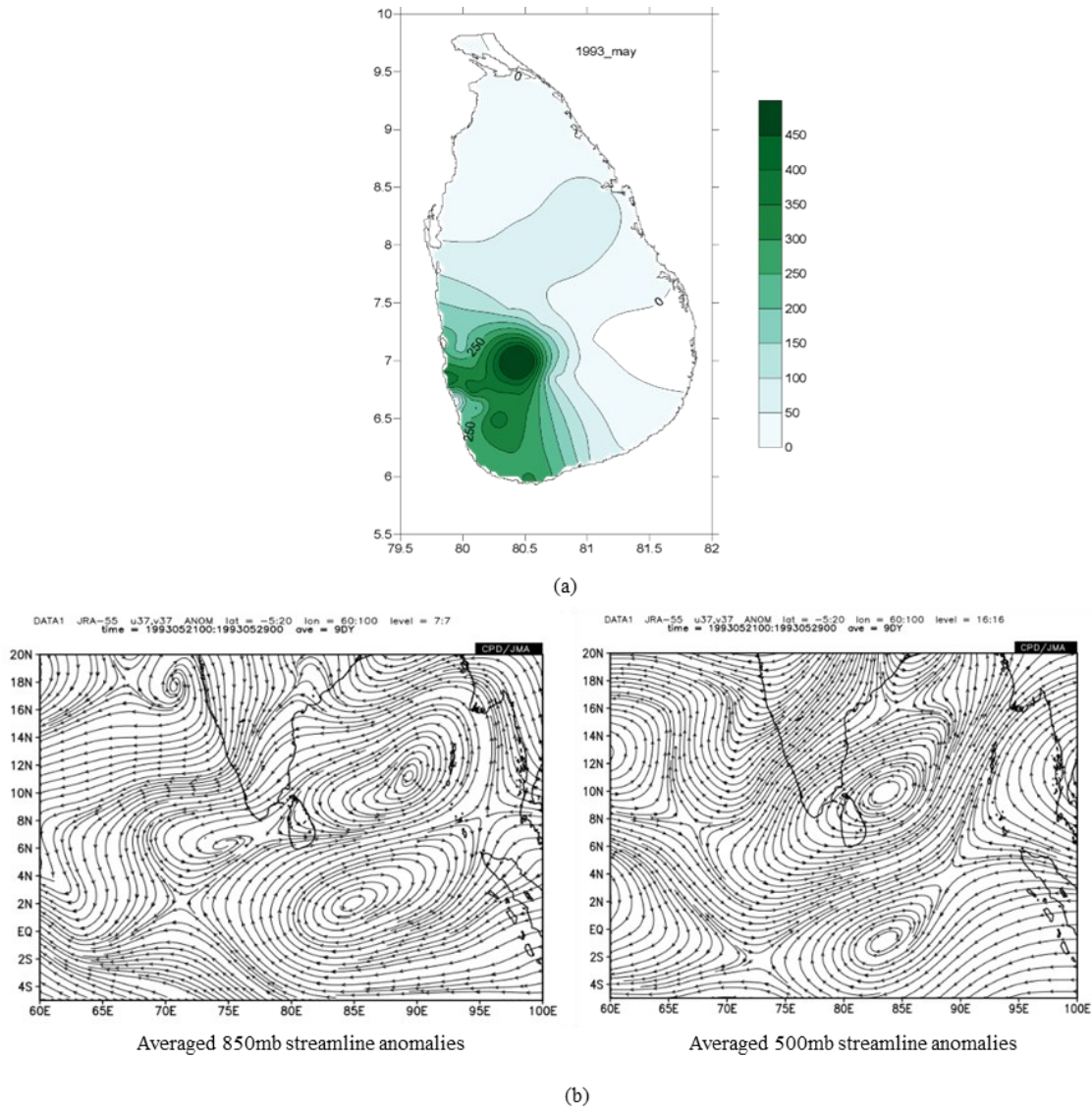


Figure S16. (a) Accumulated Rainfall (mm) for the period from 21st -29th May 1993 (Top). (b)Streamline anomalies averaged at 850 mb level and 500 mb level. (Rainfall Source: Department of Meteorology).

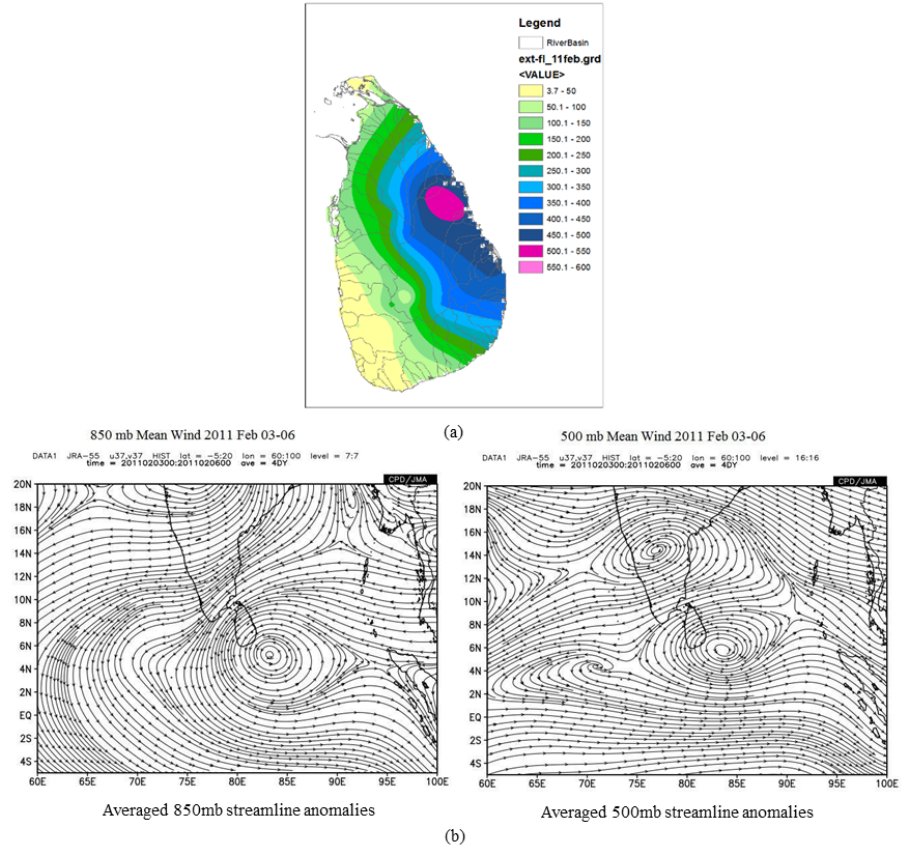


Figure S17. (a) Accumulated Rainfall (mm) for the period from 3rd to 6th February 2011 (Top). (b) Streamline anomalies averaged at 850 mb level, and 500 mb level for 3rd to 6th February 2011. (Rainfall Source: Department of Meteorology). Incidents 2011-February 2nd to 11th.

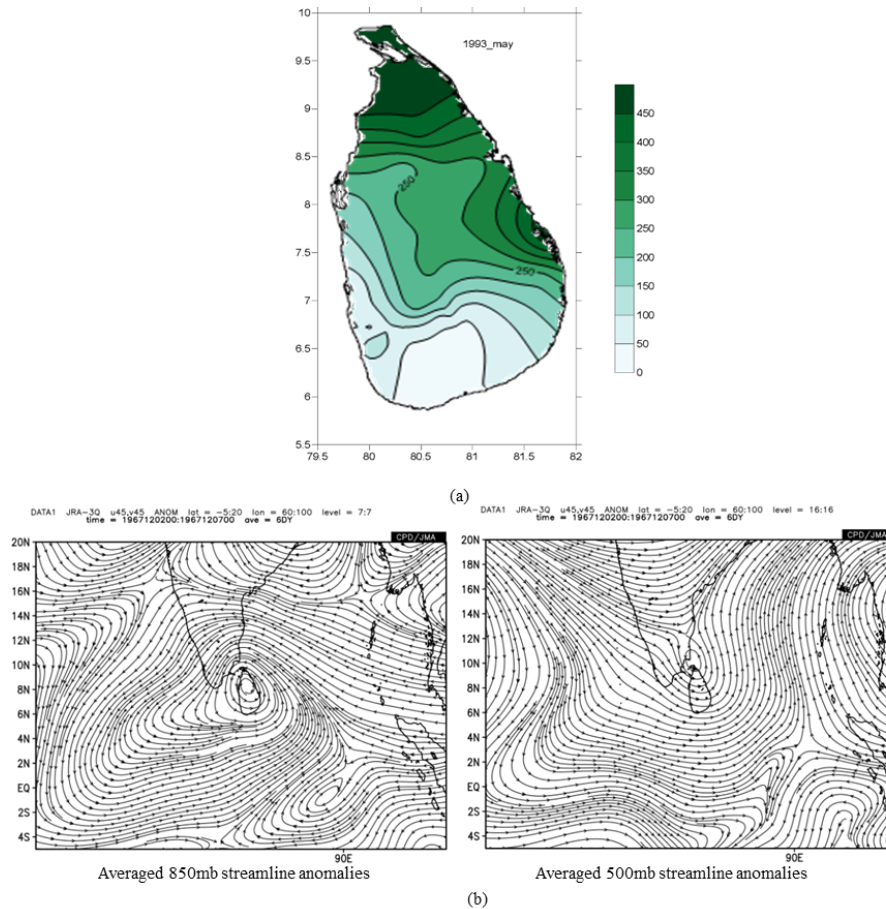


Figure S18. (a) Accumulated Rainfall (mm) for the period from 2nd-7th December 1967 (Top). (b) Streamline anomalies averaged at 850 mb level, and 500 mb level for 2nd to 7th December 1967 (Rainfall Source: Department of Meteorology).

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