

Climate Change and Severe Thunderstorms in Yangon Region, Myanmar

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Abstract

Thunderstorms, lightning, isolated heavy rainfall, and gale-force winds hit Yangon in April 2018, and cause down trees, ripping off roofs and power off and. The strong wind hit for 20 minutes. In Yangon Region, thunderstorm and lightning usually happen during pre-monsoon season, they also occur now during the post-monsoon and even during the monsoon. The objectives of the paper are to analyze the number of occurrences of thunderstorm in last twenty years, to identify the factors causing thunderstorm and lightening. Data are recorded from Kaba-aye, Mingaladon, Khayan, Hmawbi (air) and Coco-island stations in Yangon Region. These data are analyzed with the Monsoon periods, cyclones and other weather disturbances such as El-Nino.

Keywords: El-Nino, Lightning, Monsoon, Thunderstorms, Yangon

Introduction

Study Area

Yangon Region is located in lower part of Myanmar (Figure 1). It is bounded by Bago Region in the North, Kayin State in the East, Ayeyarwady Region in the West and Gulf of Mottama on the South (Figure 1). It has an area of 10,277 km². Total number of population is 7,360, 703 in 2014 Census. Its topography is nearly flat plain.



Figure (1). Location Map of Yangon Region (Source: Topographic Map)

Objectives

Objectives of the paper are to analyze the number of occurrences of thunderstorm in last twenty years and to identify the factors causing thunderstorm and lightening.

Source of Data

Google Earth Image and Topographic map are used for base map.

The Monthly Meteorological Registers (MMR) of the

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Department of the Meteorology and Hydrology of Yangon Region during 1981 to 2010 are used in all occasion. Thunderstorm occurred with or without precipitation has been counted as thunderstorm at stations. Thunderstorm and lightning information have been counted in annual, monthly and daily from Kaba-Aye, Mingaladon, Hmawbi(air), Khayan and Coco-Island.

Data are used as an observation time 00z to 15z for the stations (Kaba-Aye, Mingaladon) and 00z to 12z for the stations (Hmawbi(air), Khayan and Coco-Island).

Methodology

A storm is classified as a thunderstorm only after thunder is heard. Because thunder is produced by lightning, lightning must also be present. At first, record the secondary data for base map. Secondly, the frequency of thunderstorm is tabulated for each year and the data have been analyzed with respect to time of occurrence. Then, distribution patterns of resulted data are shown by mapping.

Result and Discussion

Lightning

Frequency and the rate of Lightning during 1981 to 2010 are shown in Figure 2. They are active in May and October in every station in Yangon Region in the morning and late afternoon. The occurrences in Mingaladon and Kaba-Aye stations are the highest.

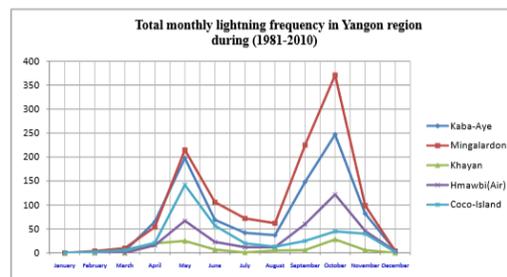


Figure (2). Monthly Lightning Frequency in Yangon Region during 1981-2010. Source: Weather Stations in Yangon Region

Thunderstorm

Thunderstorms are usually highest in pre and early monsoon, and late and post monsoon. The most active months are May, September and October. Hmawbi station is greater amount of thunderstorm than that of the rest stations. Thunderstorms are active in peak monsoon period. At that time air is unstable and favouring the development of Cb clouds which is causing violent wind, hail, lightning and torrential rain (Figure 3 and 4).

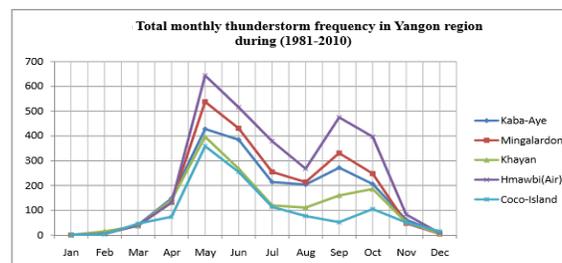


Figure (3). Monthly Thunderstorm Frequency in Yangon Region during 1981-2010. Source: Weather Stations in Yangon Region

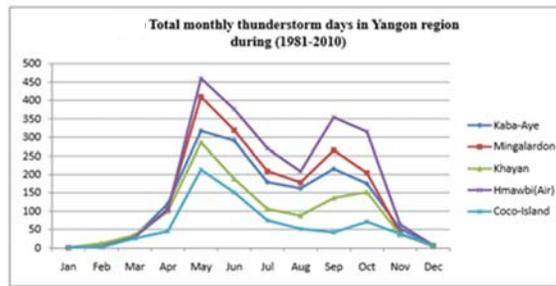


Figure (4). Monthly Thunderstorm Days in Yangon Region during 1981-2010. Source: Weather Stations in Yangon Region

Thunderstorms occur 182 times in 1987 and 55 times in 2003 in Hmawbi station. 37 times in 1982 and 15 times in 2006 in Mingaladon station. In Kaba-Aye station, it is at least about 45 times and the most is about 95 times during 1981-2010. In Coco- island station, it occurs 75 times in 1986 and at least once in 2005. The frequency is decreasing (Figure 5).

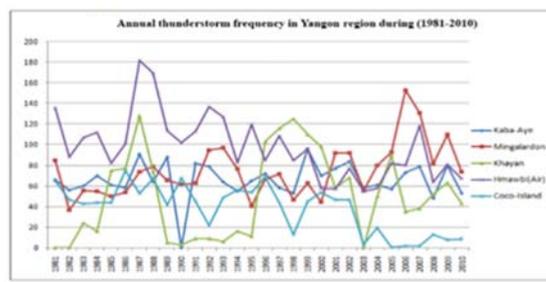


Figure (5). Annual Thunderstorm Frequency in Yangon Region during 1981-2010. Source: Weather Stations in Yangon Region

In Hmawbi station, 131 thunderstorm days were reported in 1987 and 47 days in 2003. In Mingaladon, it was at least 30 thunderstorm days in 1982 and the most 94 days in 2006 (Figure 6).

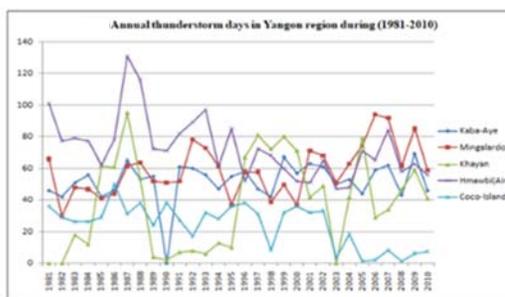


Figure (6). Annual Thunderstorm Days in Yangon Region during 1981-2010. Source: Weather Stations in Yangon Region

Effects of Monsoon Onset and Withdrawal

Normal monsoon onset patterns and withdrawal patterns can be clearly seen in Figure 7. Monsoon onset dates in coastal regions are earlier than that of central and mountain areas and opposite true is in monsoon withdrawal dates (Figure 7).

There is a relationship between monsoon onset date and withdrawal date – if the onset is earlier, withdrawal is also. However, withdrawal dates have much more variations than onset dates (Figure 8).

During the peak monsoon, occurrence of lightning and thunderstorm are found the relatively high.

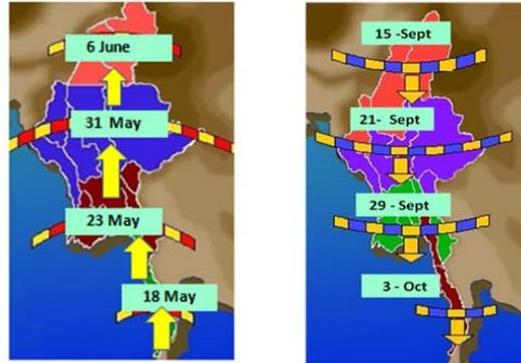


Figure (7). Normal Monsoon Onset Dates and Withdrawal Dates during 1981-2010. Source: Weather Stations in Yangon Region and Ei Ei Phyu, Meteorology Department

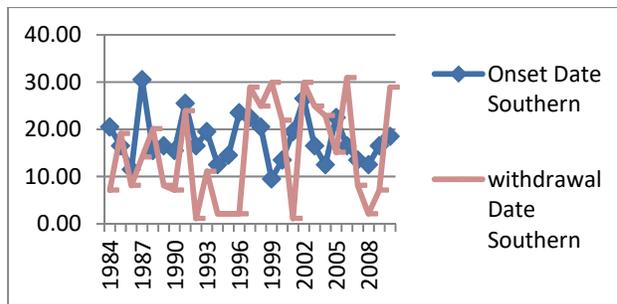


Figure (8). Monsoon Onset Dates and Withdrawal Dates in Southern Myanmar during 1981-2010. Source: Weather Stations in Yangon Region and Table 1

Effect of Cyclone formation in Bay of Bengal

A tropical cyclone is a storm system characterized by a low-pressure center and numerous thunderstorms that produce strong winds and flooding rain. A tropical cyclone feeds on heat released when moist air rises, resulting in condensation of water vapour contained in the moist air.

Thunderstorms and cyclones can be caused due to excessive rain and heavy winds, which bring a lot of destruction of property and life.

Low pressure area in Bay of Bengal effects on the activities of thunderstorm & lightning. These activities occurred in Yangon Region (Figure 9 and 10)

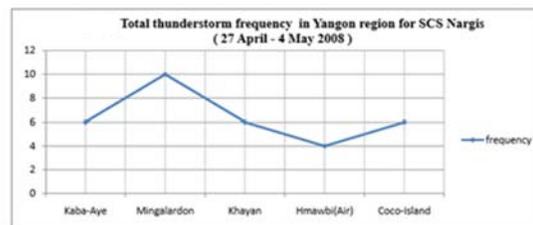


Figure (9). Thunderstorm Frequency in April and May 2008

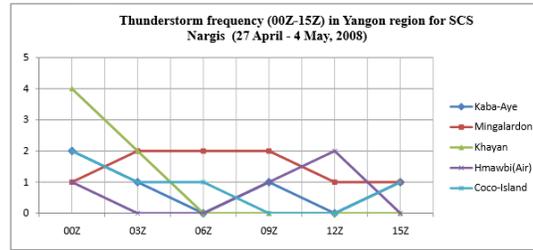


Figure (10). Thunderstorm Frequency in April and May 2008

Effect of El Nino and La Nina events

Table (3). El Nino and La Nina Events in Myanmar

weak	strong	very strong	weak	mod	strong
1951-52	1963-64	1982-83	1950-51	1955-56	1973-74
1952-53	1986-87	1997-98	1954-55	1970-71	1975-76
1953-54	1987-88	2015-16	1964-65	1998-99	1988-89
1958-59	1991-92		1967-68	1999-00	
1968-69	2002-03		1971-72	2007-08	
1969-70	2009-10		1974-75	2010-11	
1976-77			1983-84		
1977-78			1984-85		
1979-80			1995-96		
1994-95			2000-01		
2004-2005			2011-12		
2006-2007					

Source: ggweather.com updated 15 Feb 2018

Very severe El Nino events occurred in Myanmar in 1982-83 and 1997-98 during the period of 1981 to 2010. The last very severe year was 2015-16. Strongest El Nino occurs about 15 years interval.

Strong La Nina events occurred in Myanmar in 1973-74, 1975-76 and 1988-89. It is difficult to predict the interval year of occurrences.

Conclusion

Myanmar is located in tropical region and thunderstorms occur year-round. Yangon Region is one of the highest lightning strikes causing deaths in Myanmar. Lightning strikes may generate irregular rain patterns due to the forming of "cumulonimbus clouds", which are dense towering vertical clouds associated with thunderstorms and atmospheric instability.

Cumulonimbus clouds are formed in the evening due to the high temperature during the day and can result in thunderstorms, hail storms and isolated showers later in the day.

Thunderstorms may damage lives and properties. It contains many of the most severe atmospheric hazards to flight. They are almost always accompanied by strong winds, severe turbulence, lightning and heavy rain-shower.

Over the past few years, lightning strikes have occurred frequently immediately before and after the monsoon season in Yangon Region.

But last year, cumulonimbus clouds causing thunderstorms formed during the whole rainy season, inducing more rains that triggered massive floods and displaced thousands of people.

The present study reveals that afternoon and evening thunderstorms events are the highest frequency. Thunderstorm events are peak in early and late monsoon periods in Yangon Region and its surrounding.

During the periods of monsoon onset phase, thunderstorms are minor events due to the impact of El Nino over deltaic areas in May 1998. Therefore, thunderstorm events depend on southwest monsoon onset and withdrawal, low pressure area in Bay of Bengal.

These facts and figures examining thunderstorm activities and lightning can be applied to avoid hazard in coastal area, in public safety and in urban disaster management.

Climate data such as temperature and precipitation should be combined with the frequency of thunderstorm activities and lightning to point out the more detailed answers and predictions.

Table (1). Monsoon Onset and Withdrawal Dates During

Year	Onset Date					Withdrawal Date		
	S	D	C	N	N	C	D	S
1984	20.50	21.50	25.50	29.50	26.90	3.10	7.10	7.10
1985	16.50	16.50	25.50	25.50	2.10	3.10	6.10	19.10
1986	11.50	17.50	3.60	7.60	29.90	2.10	6.10	8.10
1987	30.50	1.60	4.60	8.60	2.10	8.10	11.10	14.10
1988	15.50	15.50	22.50	30.50	8.10	8.10	19.10	20.10
1989	16.50	23.50	11.60	12.60	22.90	29.90	2.10	8.10
1990	15.50	20.50	4.60	4.60	25.90	26.90	30.90	7.10
1991	25.50	31.50	2.60	6.60	9.90	16.90	23.90	23.90
1992	16.50	17.50	15.60	16.60	20.90	23.90	27.90	1.10
1993	19.50	26.50	1.60	13.60	19.90	26.90	3.10	11.10
1994	12.50	29.50	5.60	9.60	20.90	22.90	27.90	2.10
1995	14.50	16.50	5.60	6.60	11.90	19.90	30.90	2.10
1996	23.50	24.50	27.50	2.60	8.90	9.90	26.90	2.10
1997	22.50	5.60	9.60	9.60	10.90	11.90	14.90	28.90
1998	20.50	31.50	10.60	14.60	9.90	16.90	21.90	24.90
1999	9.50	16.50	20.50	26.50	12.90	22.90	26.90	29.90
2000	13.50	15.50	20.50	24.50	10.90	15.90	20.90	21.90
2001	19.50	23.50	26.50	4.60	16.90	29.90	23.90	1.10
2002	26.50	29.50	5.60	11.60	4.90	12.90	22.90	29.90
2003	16.50	20.50	4.60	10.60	7.90	17.90	22.90	24.90
2004	12.50	15.50	19.50	15.60	8.90	17.90	20.90	22.90
2005	22.50	30.50	11.60	15.60	4.90	7.90	22.90	15.10
2006	16.50	20.50	24.50	27.50	7.90	22.90	25.90	30.90
2007	13.50	18.50	5.60	7.60	12.90	20.90	24.90	8.10
2008	12.50	15.50	29.50	1.60	4.90	12.90	29.90	2.10
2009	16.50	23.50	24.50	26.50	11.90	21.90	5.10	7.10
2010	18.50	21.50	24.50	6.60	13.90	19.90	26.90	28.90

Source: Weather Stations in Yangon Region

S = Southern Myanmar D = Deltaic Myanmar C = Central Myanmar N = Northern Myanmar

Table (2). The number of depressions forming in the Bay of Bengal during 1981 to 2010

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1981	-	-	-	-	-	-	-	2	4	-	5	2	13
1982	-	-	-	-	3	2	-	1	2	4	1	-	13
1983	-	-	-	-	-	1	-	-	-	3	7	1	12
1984	-	-	-	-	1	-	1	-	1	1	2	2	8
1985	-	-	-	-	3	-	-	-	1	2	1	1	8
1986	1	-	-	-	-	-	-	1	2	2	2	-	8
1987	2	-	-	-	-	1	-	-	-	3	3	1	10
1988	-	-	-	-	2	-	-	-	-	1	4	1	8
1989	-	-	-	-	1	-	2	-	-	1	3	-	7
1990	-	-	-	1	2	-	-	2	1	2	2	2	12
1991	-	-	-	1	1	-	1	1	-	2	1	-	7
1992	-	-	-	-	1	-	-	-	-	2	3	-	6
1993	-	-	-	-	-	1	-	-	2	-	-	1	4
1994	-	-	1	1	-	-	-	-	-	2	-	-	4
1995	-	-	-	-	1	-	-	-	1	-	2	-	4
1996	-	-	-	-	2	1	-	-	-	2	3	1	9
1997	-	-	-	-	1	-	-	2	1	1	1	-	6
1998	-	-	-	-	1	-	-	-	-	2	1	-	4
1999	-	-	-	-	-	2	-	1	-	2	-	-	5
2000	-	-	1	-	-	1	-	1	-	1	1	1	6
2001	-	-	-	-	-	-	-	-	1	1	1	-	3
2002	-	-	-	-	1	-	-	-	-	1	2	1	5
2003	-	-	-	-	1	1	-	-	-	2	1	1	6
2004	-	-	-	-	1	2	-	-	1	2	1	-	7
2005	1	-	-	-	-	1	1	-	2	1	2	2	10
2006	1	-	-	1	-	-	1	4	3	1	-	1	12
2007	-	-	-	-	2	2	1	-	1	1	1	-	8
2008	-	-	-	1	-	-	-	1	1	1	2	1	7
2009	-	-	-	1	1	-	1	-	1	-	-	1	5
2010	-	-	-	-	1	-	-	-	-	3	1	1	6
Total	5	-	2	6	26	15	8	16	25	46	53	21	223

Source: Weather Stations in Yangon Region

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