

A Study of Thunderstorm Days in Myanmar

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ABSTRACT

Thunderstorms are very frequent in Myanmar during pre-monsoon season and post-monsoon season. Convective thunderstorms are most prominent with localized squally weather phenomenon including aviation hazardous weather elements. An attempt has been made to study the thunderstorms days in Yangon-KabaAye (48097) for 1971-2000 and 3 stations from Northern Myanmar area for 1991-2000. Study found Bi-modal type monthly highest frequency in May, June and September with the highest frequency of thunderstorms days in afternoon and evening hours.

Keywords: *Thunderstorm Days, Bi-modal, Pre-monsoon, Post-monsoon, Duration and Diurnal Variation.*

1. Introduction

Thunderstorms are known to be generally more severe in the tropic and sub-tropic than elsewhere. This is due to the existence of two very unstable wind converging zones –the ITCZ and the Polar front- Where series of Cumulonimbus clouds are formed extensively. They are sometimes accompanied with hails which cause considerable damage to crops and are also severe hazards to aviation. (Krishna Rao, 1961). Southeast Asia between 30°N and 10°S is the one of the principal maximum thunderstorms area over land. Main areas of thunderstorm shift northwards and southwards practically following the Sun. The area of largest frequency shifts slightly to the north of Equator in March-May and a bit more in quarter June-August. (Ramakrishnan and Rao, 1955). Meteorologists are interested physical and dynamical structure of Cumulonimbus clouds which generate thunderstorms. In India, annual highest thunderstorms activity occurs over Assam, Bengal, parts of South Bihar and Orissa. The annual average thunderstorms days in these areas exceed (75) days. Northeast Assam, the most thundery area in India has an average thunderstorms days exceeding (100) days. (Rao & Raman 1961). A study of the distribution of Thunderstorm occurrences in Assam during different hours of day and night has shown that a large majority of them occur during night and

early morning hours. (Sen & Basu, 1961). Thunderstorms Days (TSD) in tropical continents are observed to be (140) and show pronounced diurnal variation with their duration of activity are about one hour or less. (Atkinson, 1971). A thunderstorm days (TSD) is defined as a local calendar day on which thunder is heard (WMO,1953). In South/ Southeast Asia, during the 1997–98 ENSO event, the number of flashes and average flash rate increase by 12% and 36%, respectively, during the El Nino period and during the La Nina period decrease by 22% and 5%, respectively, as compared to the corresponding normal periods. (Kumar & Kamra, 2012). Annual variation of lightning activity showed semiannual variation. Latitudinal variation of lightning flashes shows a prominent peak at the northeast part of India at latitude of 26°N which is the most prone area of lightning activity. (Kulkarni et al., 2015). The frequency of thunderstorm over central parts of country is between 30 and 50 days. The frequency increases eastwards and is between 50 and 80 days over Bihar, east Madhya Pradesh, Chhattisgarh, Telangana and coastal Andhra Pradesh and Orissa. The frequency increases to 80 to 100 days over Gangetic West Bengal and Bangladesh and between 100 and 120 days over Sub-Himalayan West Bengal, Assam and adjoining northeastern states. (Tyagi, 2007). Myanmar also experienced the impacts of thunderstorms associated squally weather events

especially in the Major Airports, Coastal and Inland Transport. Frequency, diurnal variation of formation and duration of thunderstorms activity are useful for Aviation, Electricity Supply, Disaster Management, Agriculture, etc. More research activity for thunderstorms with NWP, Radar and Upper Air Observation is required in further study. Thunderstorms are very frequent during pre-monsoon season and post-monsoon season. Convective thunderstorms are most prominent with localized squally weather phenomenon including aviation hazardous weather elements. Nyunt (1969) has attempted the forecasting methods for thunderstorms with stability index (Showalter's method) for the Yangon (KabaAye) Station with April, May, October and November of 1961, 1962, 1964 and 1965 Upper Air Observation Data. Thunderstorms occurred in afternoon and evening and thunderstorm formed with 67% likelihood in April-May and 71% likelihood in October-November if Stability Index is less than (-3) and mean relative humidity is greater than (60%). Mon (2016) studied thunder storm frequency at Yangon for period 1971-2015. Increasing trend and above normal annual thunderstorms days, (948) thundery days were observed during 2001-2015 at Yangon (KabaAye). Phyu et al. (2018) has studied thunderstorm and lightning days and frequency in Yangon (KabaAye) and neighboring two stations during (2008-2017). Lightning activities were more active during the month of May, June and October, thunderstorms activities were more active in 15:30hrs Local Time, highest thundery days were observed during May and September.

2. Thunderstorm Days in Yangon

Thunderstorm day frequency analysis for monthly, seasonal and annual, diurnal variation and duration of that thundery days at Yangon (KabaAye) Stations were analyzed. A total of 1566 Thunderstorm days were observed and mean annual TSD over Yangon during the period of 1971-2000 is 52.2 days. The lowest annual thunderstorm days was 26 in the year 1982 and the highest thunderstorm days was 79 in 1999. Linear trend of annual thunderstorm days showed slight increase (Figure 2). Monthly variation of TSD shows a double peak. The first peak appears at the time of

Thunderstorms Study Areas

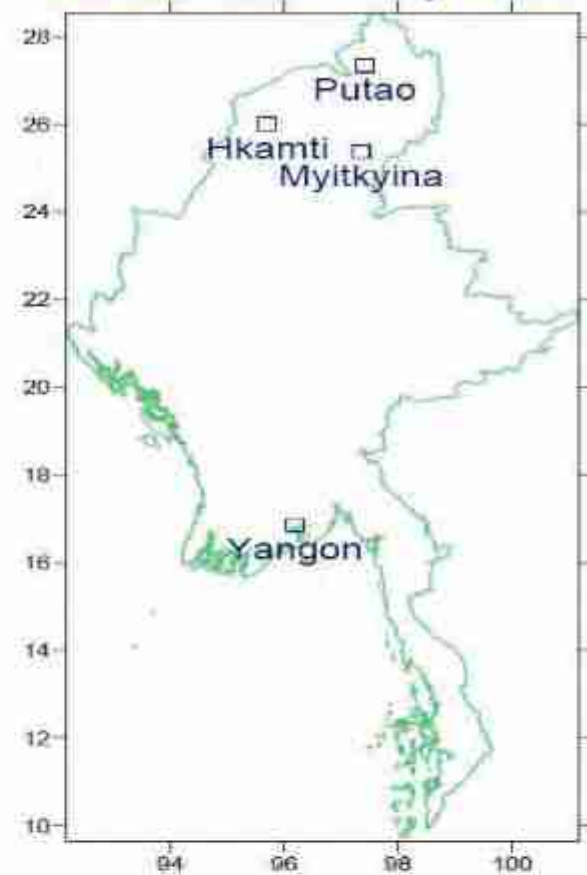


Figure 1: Map of thunderstorm study areas.

onset (May) and the other at the time of withdrawal (September) of summer monsoon in Deltaic area of Myanmar. 22.5% of annual Thunderstorm days occur in the month of May and 14.6% in September (Figure 3). Most of thunderstorms in Yangon occurs in the afternoon and evening hours. During the study period, 511 thundery days occurred with less than one hour duration and 88 days were with more than 5 hours duration (Figure 4). 59% and/or 927 thundery days were found during afternoon and evening time interval 12:31–18:30 Local Time (Figure 5).

3. Thunderstorm Days in Northern Myanmar

Thunderstorm days in Hkamti (26.00 °N, 95.69°E), Putao (27.33°N, 97.42°E) and Myitkyina (25.38°N, 97.40°E) are studied during the period of 1991-2000. Stations are located in Northern Myanmar area (Figure 1). 10-year average of annual TSDs are observed as 72.9 days in Myitkyina, 78.2 days in Hkamti and 57.2 days in Putao. Monthly frequency of thunderstorm days in each station



Figure 2: Annual Thunderstorm Days in Yangon (1971 – 2000).



Figure 3: Percent of Monthly Mean Thunderstorm Days in Yangon (1971-2000).
Numbers 1 to 12 indicate months January to December.

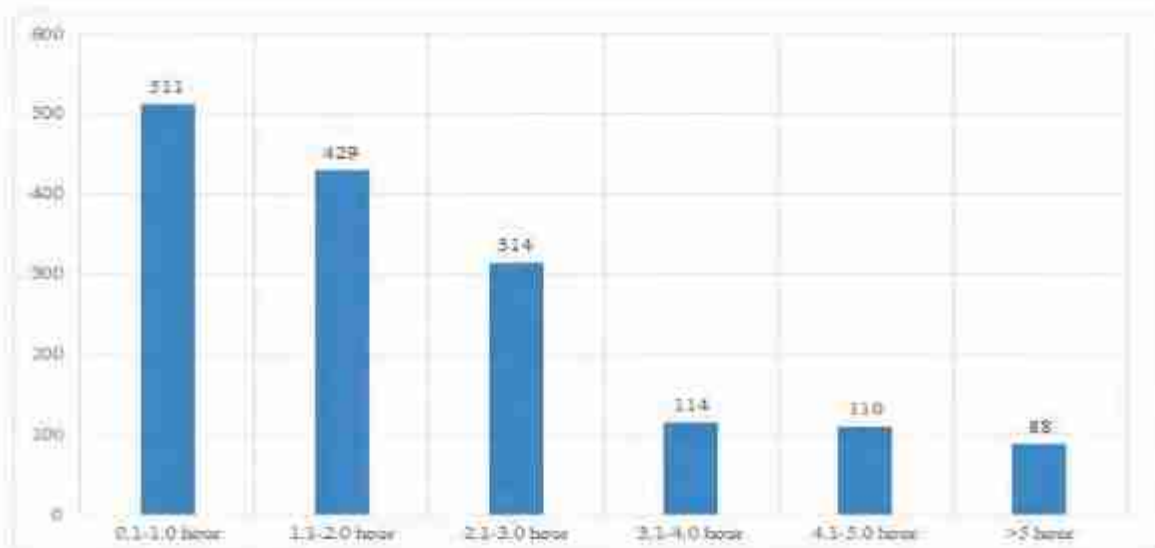


Figure 4: Duration of Thunderstorm days in Yangon (1971-2000).

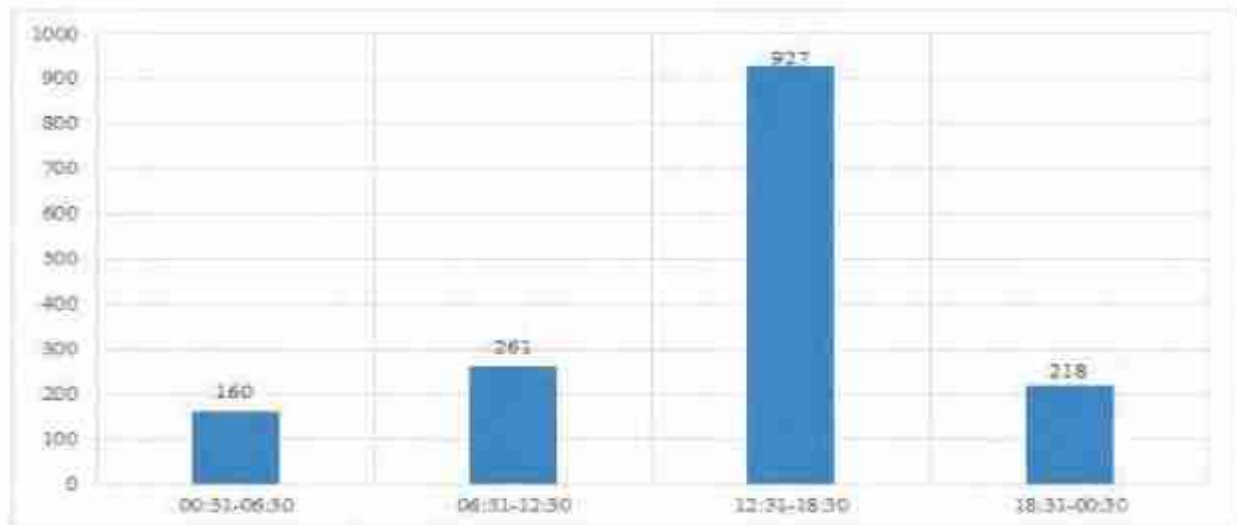


Figure 5: Diurnal Variation of Thunderstorm days in Yangon (1971-2000).

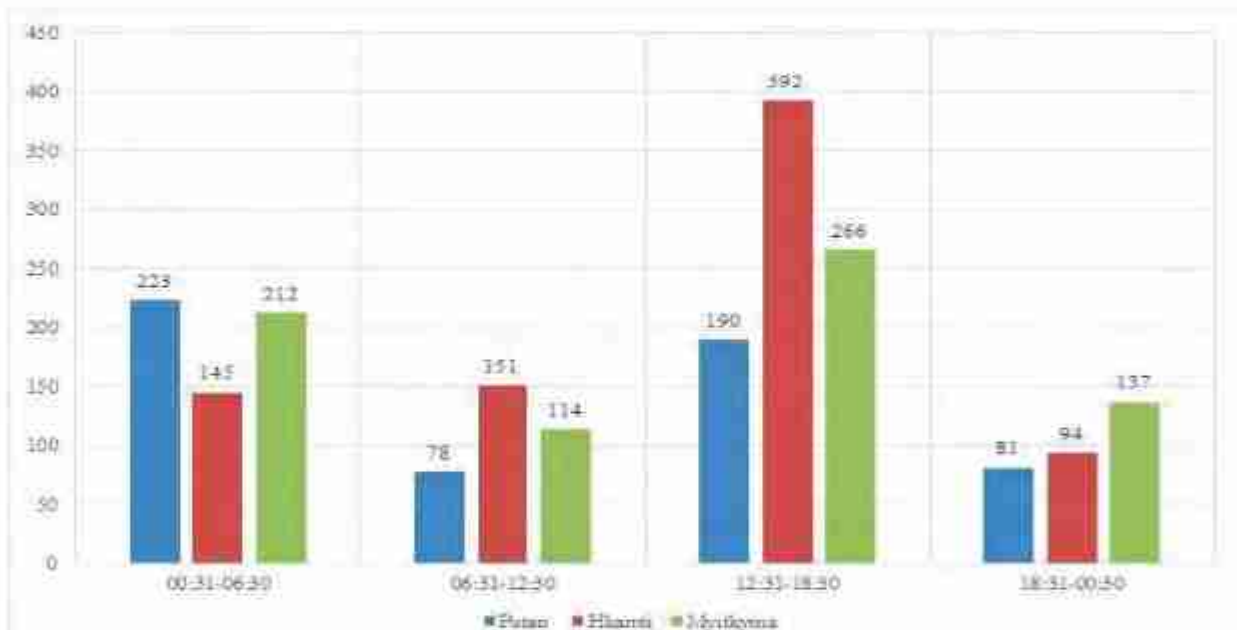


Figure 6: Diurnal Variation of Thunderstorm days in Northern Myanmar (1991-2000).

shows first peak in June and secondary peak appear in September, coinciding with the onset and retreat of southwest monsoon over that area while Putao station shows flat maximum. Thunderstorms are generally less frequent during the month of November to February but the frequency rapidly increase during the period of pre-monsoon months of March, April and May. The period of 12:31-18:30 (Local Time) hours is generally the most dominant period of thunderstorms activity with more than 36% in Myitkyina, 50% in Hkamti and 33% in Putao (10 years TSD Figure 6). During the 10-year period, the highest frequencies of durations

in all the stations were observed in less than two hours and the second highest duration was 2-4 hours (Figure 7).

4. Discussion

Thunderstorm activities in Myanmar are reviewed in some stations in Lower Myanmar and Northern Myanmar areas in this study. Typical characteristics of thunderstorms frequency, duration, and diurnal variation were observed including higher frequency in May, June and September, afternoon and evening and short duration of convective thunder storms.



Figure 7: Duration of Thunderstorm days in Northern Myanmar (1991-2000).

Advanced observation and forecasting technique, research activities, capacity building and technical cooperation program should be continued to reduce the risks by thunderstorms related hazards and damages.

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