Observation of Multiple Narrow Bipolar Events in Tropical Thunderstorms

Intended for the Lightning Occurrence Relative to Meteorology Session Topic

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This paper reports a recent observation of multiple Narrow Bipolar Event (NBE) from tropical thunderstorms. Similar observation by Nag *et al.* (2010) has been reported from Florida thunderstorms. Electric field change measurement has been conducted in South Malaysia (latitude 1°N, longitude 103°S) during Northeastern monsoon season between November and December 2012. From the total 173 recorded NBEs, the majority (82.7%) appeared to occur as a single bipolar pulse event. The remaining 17.3% of NBEs have been observed to occur as a pair of bipolar pulses event. We observed the occurrence of multiple NBEs in both isolated NBEs and NBEs with CG flash. Nag *et al.* (2010) found them only in the case of isolated NBEs with 3 pairs of positive NBEs (+NBEs), 4% from the total examined NBEs. They estimated the range of time intervals between the +NBEs is from 43 ms to 181 ms. We discovered 12 pairs of NBEs in isolated case. The range of time intervals is between 19 and 341 ms. 7 out of 12 are pairs of +NBEs, 2 pairs of negative NBEs (-NBEs) and 3 pairs with mixed polarity. Interestingly, all the pairs with mixed polarity NBEs are initiated by –NBE and then followed by +NBE and the time interval between them is always larger than 100 ms. Further, we also discovered 3 pairs of NBEs occurrence as part of CG flash. 2 pairs were found to occur prior the first Return Stroke (RS) while the remaining pair was found to occur between RSs. The first pair prior the first RS consists 2 +NBEs with 6.5 ms time interval between them. The first pulse of PBP has followed the first +NBE after 5.8 ms. Interestingly; we found that the second +NBE has occurred in between PBP pulses. The time intervals between the second +NBE and the first RS is 16.4 ms. The ratios of the peak amplitudes of the first and second +NBEs to the first RS are 0.3 and 0.7 respectively. The second pair was initiated by +NBE and then followed by –NBE after 16 ms interval. The time intervals between the second –NBE and the first RS is 327.4 ms. The ratios of the peak amplitudes of the first +NBE and second –NBE to the first RS peak amplitude are 0.6 and 0.8 respectively. We can see that the time interval between NBEs of the second pair is longer than the first pair, perhaps due to the mixed polarity event. Also, the amplitudes of the second NBE of both pairs are more intense than the first NBE. A pair of –NBEs is found to occur between RS3 and RS4. The time interval between the NBEs is 3.4 ms and the first –NBE is observed to be more intense than the second –NBE with the ratio of peak amplitudes between them is 2.5. The second NBE is then followed by RS4 after about 32.2 ms. The ratios of the peak amplitudes between the first and second –NBEs to RS4 peak amplitude are 2.0 and 0.8 respectively.