Research Paper Environment

A Study on the Pre-monsoon Thunderstorm Spells over Kolkata

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ABSTRACT

Pre-monsoon thunderstorms are common in Kolkata. A study has been carried out on the number of Pre-monsoon thunderstorm spells over Kolkata. The obtained trend and concerned probable causes are very significant. Further physical study is also proposed.

KEYWORDS Lightning, Thunder, Thunderstorm, Pre-monsoon, Electric field, Induced magnetism.

Introduction:-

Thunderstorms are meso-scale phenomena. These are violent convective systems in atmosphere. Thunderstorm is well grown Cumulonimbus (CB) cloud producing lightning and thunder. The base of CB cloud over Kolkata is generally at about 450 m above ground level. Thunderstorm may extend up to the tropopause. Thunderstorm may or may not be associated with precipitation. Hail, Squall may also be associated with thunderstorm. Entire lifespan of a CB is only a few hours at most.Pre-monsoon (March to May) or Summer thunderstorms over Kolkata are generally "Nor'westers". Pre-monsoon thunderstorms over Kolkata are not isolated local storms, these are more like line squalls. Flow of moisture from Bay of Bengal, low level inversion and low level convergence are the root causes of these thunderstorms.

Discussion:-

Lightning and thunder are caused due to massive electrostatic discharge between the electrically charged portions within CB clouds or between that in a CB cloud and the surface of the earth. For such electrostatic discharge to occur, the necessary conditions are:- (i) high electric potential difference, (ii) high resistance medium. Cloud to cloud and intra-cloud lightnings are dangerous for aircrafts. Cloud to ground and ground to cloud lightnings are dangerous for life and property. Physical manifestation of lightning is lightning induced magnetism. Different causes produce lightning friendly conditions. High energy cosmic rays and solar particles from solar wind electrify the air on entry into the earth's atmosphere and accordingly create pathways of lightning bolts. Silent electric discharge causes production of Ozone from Oxygen. According to some Scientists, this Ozone rich atmosphere (medium) promotes further such discharge. However, propagation of electromagnetic waves through the atmosphere may be very important in this regard. Wireless communication, detection and ranging as well as remote sensing- all these require electromagnetic wave propagation through the atmosphere. The earth surface can modify electromagnetic wave propagation. Power is radiated uniformly in all directions from a transmitter. At large distance, the field may be assumed to be a plane wave having an electrical strength inversely proportional to the distance from the transmitter and proportional to square root of power transmitted. Combination of direct wave, reflected wave and surface wave is called ground wave (when those are present simultaneously). Ionospheric or sky wave is not relevant in this regard, as the ionosphere lies between 50 – 400 km above ground level. The troposphere is confined to about 10 km above ground level and it accounts for tropospheric propagation. Electric field produced by transmitter may promote electrostatic discharge in / through the atmosphere.

Source of data and methodology of study:-

Pre-monsoon thunderstorm data of Kolkata were available in the free and open-access website of the Regional Meteorological Centre, Kolkata (Project Data/ STORM: Weather & Forecast).We have considered such data of Dum Dum (North Kolkata) and Alipore (South Kolkata). Total numbers of Pre-monsoon (March to May) thunderstorm spells observed at Dum Dum and Alipore have been computed. Data of last five years (2009 – 2013) have been plotted in graphs and trend lines have been drawn accordingly.

Conclusion:-

The trend lines exhibit rise in number of pre-monsoon thunderstorm spells over Kolkata during the period from 2009 to 2013. The matter is of a great concern. Necessary steps are required so as to enhance general awareness and adoption of safety measures.

Proposal for further work:-

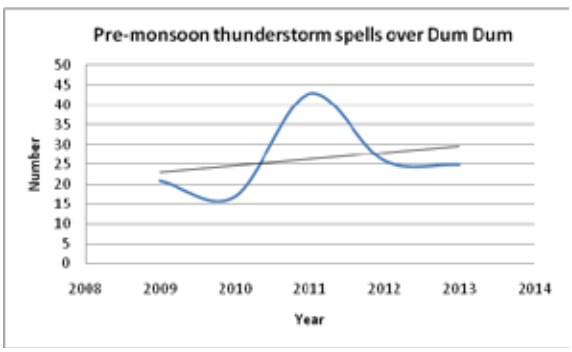
In view of the existing awareness and safety measures, account of loss of property and life may not be significant in this regard. Duration and intensity of thunderstorm spells may be a subject of further work. But most important study may be on lightning-induced magnetism. In the ground, we can map the lightning-induced magnetic anomalies, Analysis of magnetised materials will confirm lightning as the source of magnetisation and also its frequency, track and strength as we can make an estimate of the peak current of the electrostatic discharge (lightning discharge).

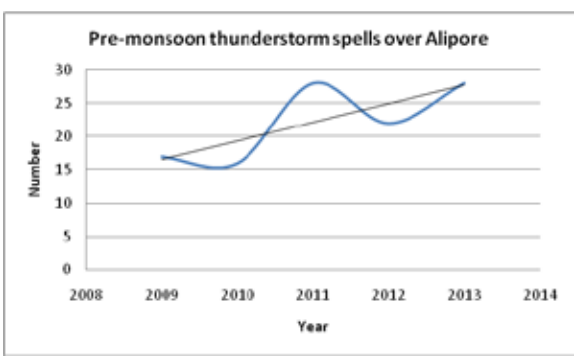
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Table: Number of thunderstorm spells

Month	Dum Dum					Alipore				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
March	7	2	13	1	3	6	2	8	1	5
April	0	1	7	17	11	0	3	8	15	12
May	14	14	23	8	11	11	11	12	6	11
Pre-Monsoon Total	21	17	43	26	25	17	16	28	22	28





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