J. Ind. Geophys. Union (May 2016)
v.20, no.3, pp: 362-364

- A TECHNICAL REPORT

Unusual lightning activity over Andhra Pradesh and Telangana on 6 September, 2015: A Report

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INTRODUCTION

Lightning is an electrical discharge caused when static electricity builds up between thunderclouds, or thunderclouds and the ground. Lightning strokes carry up to 100 million volts of electricity and leap from cloud to cloud, or cloud to ground and vice versa. In India, lack of central database as a record of past disasters is a major constraint for compilation of disaster history in the country. Different sources of data have different figures of casualties and impacts, thereby hindering an objective assessment. However, data compiled by the ministry of Home Affairs suggests lightning, a natural calamity, can injure/ kill fauna and humanbeingswww.undp.org/content/dam/india/.../disaster_management_in_india.pdf). Lightning is always associated with thunder cloud. Thunder is a direct result of lightning. Thunder is the noise caused by the explosive expansion of air due to the heat generated by a lightning discharge. However, it is possible not to hear the thunder on some occasions if it is too far away. Lightning strokes can produce severe injuries and death. The injuries may be caused by thermal burns. However, usually the nerves and muscles may be directly damaged by the high voltage current.

Severe convective activity with lightning occurred over many parts of Andhra Pradesh and Telangana on 6 September, 2015 leading to a number of deaths. As per news paper reports by The Hindustan Times dated 07 September, 2015 (http://www.hindustantimes.com/india-news/20-killed-by-lightning-as-heavy-rains-lashed-andhra-pradesh/article1-1388237.aspx) lightning caused twenty deaths in the two states. The number was 23 as per The Deccan Chronicle and BBC News (http://www.deccanchronicle.com/150907/nation-current-affairs/article/lightning-rain-kill-23-andhra-pradesh, http://www.bbc.com/news/world-asia-india-34171362). Deaths were reported in Nellore, Prakasam, Krishna, East Godavari, Cuddapah & Guntur districts of Andhra Pradesh and Mahbubnagar district of Telangana. A brief analysis of the meteorological conditions leading to the event is given below.

Key words: Lightning, thunder cloud, high voltage current, meteorological conditions, Andhra Pradesh, Telangana.

Meteorological Conditions:

Streamline analysis 0000 UTC of 06 September (Figure 1) shows a trough extended upto 1.5 km above mean sea level from Marathawada to Lakshadweep across interior Karnataka. Streamline convergence over Andhra Pradesh and Telangana is clearly seen in the figure. Relative humidity (RH) analysis over the region (Figure 2a&b) shows that very high RH (>75%) in the lower levels (925 hPa) with a relatively drier atmosphere in the middle (500 hPa). This kind of distribution of moisture coupled with convergence provided a potentially convective atmosphere. Convective available potential energy (CAPE) values were 1500 - 2000 J/kg at 0000 UTC on 6 September (Figure 1a). These conditions led to widespread thunderstorm activity over the region (Table 1) associated with lightning. Convective clouds with cloud top temperature (CTT) < -40°C were seen in satellite imagery from 0800 UTC (1330 IST) to 1600 UTC (2130 IST) of 6 September over Telangana and Andhra Pradesh (Figure 3a-d). Sequence of clouds in Figure 3 shows eastward movement of convection under influence of easterly winds in the upper troposphere (not shown here). Time of occurrence of thunderstorms in Table 1 also shows that the thunderstorms started earlier in eastern parts of the region. This thunderstorm activity was associated with an eastward moving strong lightning activity over the regions from 0800 to 1600 UTC (Figure 4-d).

Most of the persons who died due to lightening on 6 September were working outdoors. Statistics, worldwide, suggest that persons working outdoors are the worst hit. The U.S. National Lightning Safety Institute advises to have a plan for their safety when a thunderstorm occurs and to commence it as soon as the first lightning or thunder is observed. This is important as lightning can strike without rain actually falling. If a thunder is heard or lightning is seen, then there is a risk of lightning. The F-B (flash to boom) method is used to gauge distance to a lightning strike. The flash of a lightning strike and resulting thunder occur at roughly the same time. But light travels 300,000 kilometres in a second, almost a million times the speed of sound (344 m/s). So the flash of lightning is seen before thunder is heard. To use the method, count the seconds between the lightning flash and thunder. Divide by three to determine

Table 1. Thunderstorms reported over Andhra Pradesh and Telangana

Station Name	Thunderstorm duration on 6th September, 2015 (Time in IST)	Rainfall reported in mm
Nizamabad	1705-1800, 2030-2230	0.9
Ramagundam	2100-2400	0.0
Kalingapatnam	1100-1300, 1400-1820	59.2
Hyderabad	1545-1930	0.4
Tuni	1315-1445, 1800-2115.	19.6
Visakhapatnam	1440-1700	22.5
Vijayawada, AP	1250-1540,1755-2230	20.2
Masulipatnam	1310-1550, 1905-2205	30.0
Narsapur	1400-1450, 1715-2100	0.3
Kakinada	1450-1650	15.8
Kurnool	1715-1745, 1845-2100	12
Bapatla	1350-1915	3.7
Ongole	1245-1820	0.0
Anantapur	2100-2215, 2335-0045	18
Kavali	1100-1330	12.2
Nellore	1315 -1430 ,1430 -1445	36.8
Tirupathi AP	1200-1445	11.2

the distance in kilometres. Immediate precautions against lightning should be taken if the F-B time is 25 seconds or less, that is, if the lightning is closer than 8 km. The safest place is inside a building or a vehicle. Risk remains for up to 30 minutes after the last observed lightning or thunder. The US National Weather Service (http://www.lightningsafety.noaa.gov/tips.shtml) and the US Centres for Disease Control and Prevention (http://www.cdc.gov/features/lightning-safety/) provides the following tips about lightning safety.

SAFETY NORMS

Indoor Lightning Safety

- Stay off corded phones, computers and other electrical equipment that put you in direct contact with electricity.
- Avoid plumbing, including sinks and baths.
- Stay away from windows and doors, and stay off porches.
- Do not lie on concrete floors, and do not lean against concrete walls.
- Stay in safe shelter at least 30 minutes after you hear the last sound of thunder.

Outdoor Risk Reduction Tips

If caught outside with no safe shelter anywhere nearby, the following actions may reduce risk:

If you hear thunder, lightning is close enough to strike you. Suspend or postpone the outdoor activity and go indoors. Find a safe, enclosed shelter.

- Immediately get off elevated areas such as hills, mountain ridges or peaks
- Never lie flat on the ground
- Never shelter under an isolated tree or a cliff or rocky overhang for shelter
- Immediately get out and away from ponds, lakes and other bodies of water
- Stay away from objects that conduct electricity (barbed wire fences, power lines, windmills, etc.)
- As of now no regulated safety guidelines are available specifically for India. However, if above precautions are followed, deaths and injuries due to lightning can be avoided.

ACKNOWLEDGEMENTS

We thank various organisations for usage of web links. We place on record our thanks to IMD officials for their support. We thank Chief Editor of JIGU for inviting us to present this report.

Compliance with Ethical Standards

The authors declare that they have no conflict of interest and adhere to copyright norms.

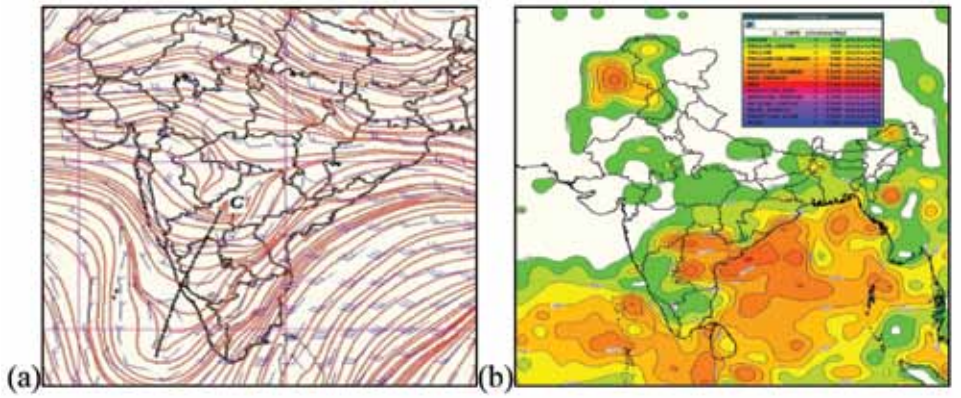

Figure 1. Streamline analysis at 925 hPa (a) and CAPE (b) at 0000 UTC of 6 September, 2015.

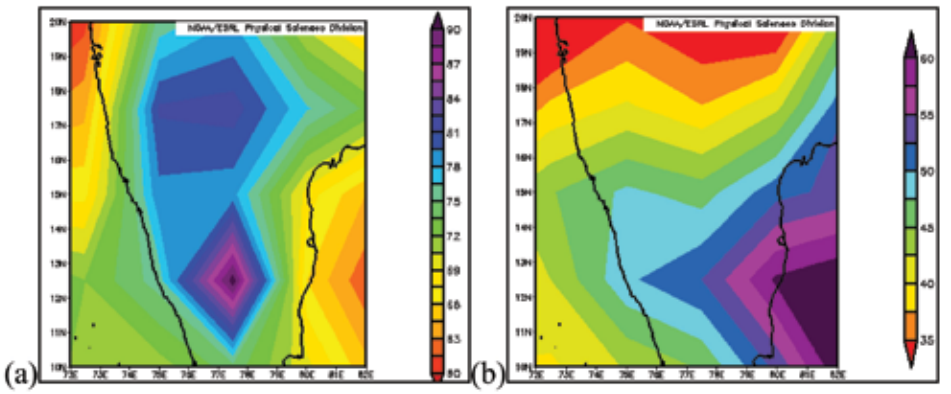

Figure 2. Relative Humidity (%) at 925 hPa (a) and 500 hPa (b) on 6 September, 2015.

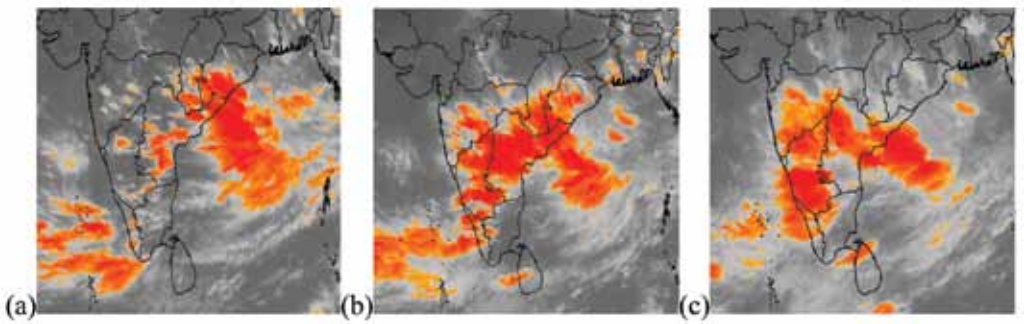

Figure 3. Satellite Imagery at 1330 (a), 1730 (b) and 2130 IST (c). Red colour shows area with CTT <-40° C.

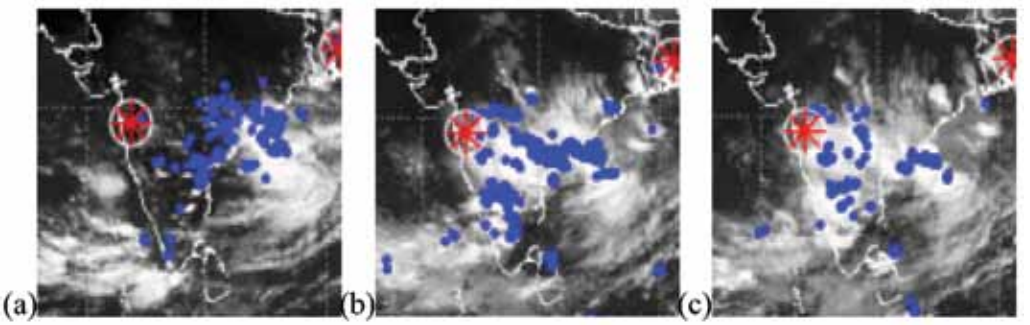

Figure 4. Lightning (blue dots) on 6 September, 2015 during 1230-1330 IST (a), 1830-1930 IST (b) and 2030-2130 IST (c). (http://wwlln.net/WWLLN_movies/Movie_of_Lightning_over_Indian_Ocean_BIG.gif).