

Thunderstorm



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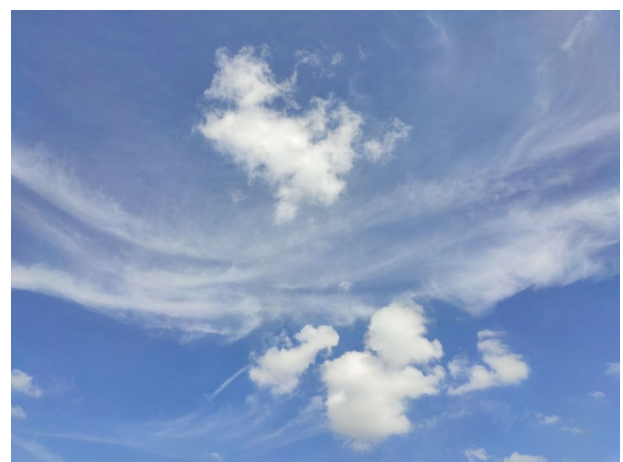
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In our busy schedules, we miss noticing many amazing phenomena happening in nature. One such phenomenon is thunderstorms. Thunderstorms are associated mostly with unseasonal rains or pre-monsoon rains in India. Thunderstorms bring hail, strong gusty winds, flash flooding, etc. with them, so they play an important role in agriculture crop management. The goal of this article is to explain different stages in the life cycle of a thunderstorm: the developing stage (images 1-7), the mature stage (images 8-9), and the dissipating stage (images 10-12).

To understand thunderstorms, let us first understand the formation of clouds which is a highly non-linear process depending on many factors such as temperature, amount of radiation, relative humidity, air pressure, aerosol concentration, etc. In the morning, when the ground starts to heat up due to the sun's radiation, air near to ground also heats up. This warm air is less dense than colder air in the upper atmosphere. Hence, warm air parcel starts to move up in the atmosphere. As it rises, it encounters less air pressure and expands adiabatically. In the process, it cools. If the air parcel contains a sufficient amount of moisture and aerosol concentration is just right, moisture condenses on aerosols and we see clouds. As more and more moisture condenses, the cumulus cloud forms. When conditions are favorable, thunderstorm formation begins as explained with the help of the following images.



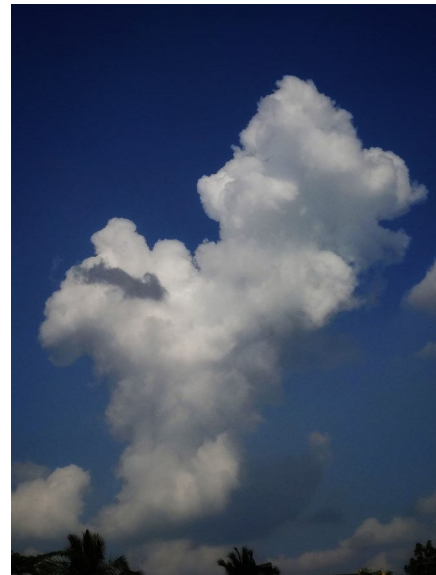
1) Cumulus cloud formation; 10 - 11 AM



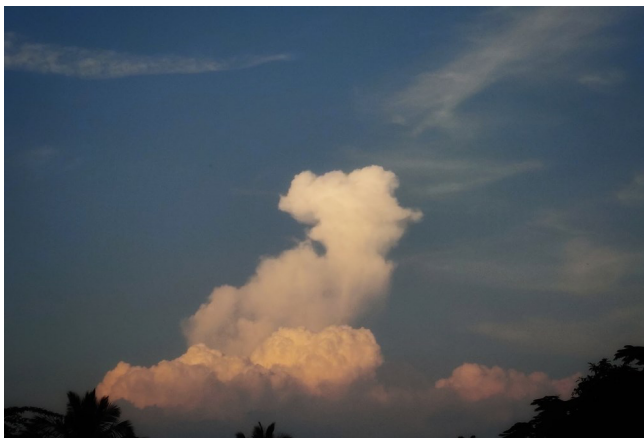
2) Many cumulus clouds start to form; 11 AM - 1 PM.



3) Nearby cumulus clouds merge together to form a single bigger cumulus cloud; 12 - 2 PM.



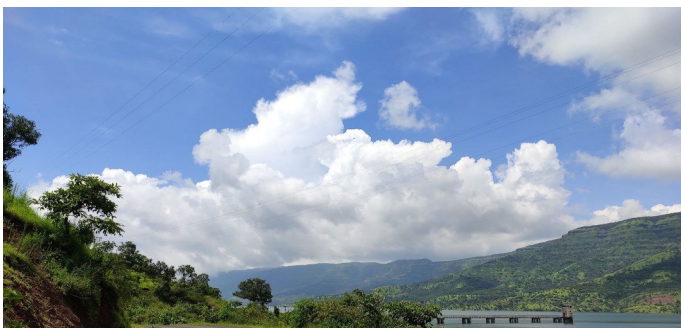
4) Cumulus clouds are being pushed upward by the rising column of warm moist air called updraft; mid-afternoon.



5) Rising cumulus clouds look like a tower, so known as towering cumulus and cumulonimbus clouds begin to form; late afternoon.



6) Typical turbulent convecting cauliflower structure when cumulus converts into cumulonimbus cloud; evening.



7) Moist surface air is being pushed upward due to mountains resulting in cumulonimbus cloud formation; in the afternoon.



8) Updraft continues to feed the storm and precipitation (rain) begins to fall, and the storm enters the mature stage; evening.



9) Rain creates the downdraft - a column of cold air moving downwards - which causes gusty winds on the ground; evening.

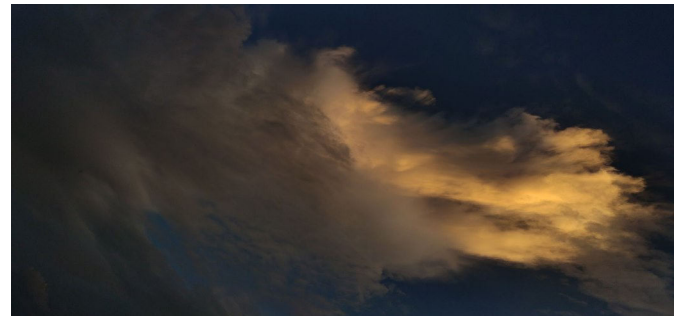


10) Eventually, due to the large amount of rain, updraft is overcome by downdraft and storm enters dissipating stage.



11) Lightning bolt from cloud to ground creating sound waves that we hear as thunder hence the storm is called the thunderstorm.

(Image Credit: Omkar Bankar, used with permission)



12) Strong downdraft cuts off the supply of moist warm air and rainfall decreases. Cloud growth abruptly stops and the storm ends.

Thunderstorm got its name due to thunder caused by lightning during the storm which in itself is a partially understood phenomenon. The whole process lasts for about 10 to 12 hours. The initial stage of a thunderstorm takes 8 to 9 hours and within 1 to 2 hours the thunderstorm reaches a mature stage and dissipates. Why the storm dissipates so rapidly is still not well understood. Intuitively, it feels that as the amount of moisture decreases in the air due to rain, the storm dies. But complex physics is involved in it, at microscale as well as at macroscale and the answer is not so simple!