

Crackle! Zap! Boom!

What is Lightning?

J. Carnathan, STC; S. Gallagher, STC; M. Martinez, Colorado Air Academy; N. Schuster, STC; R. Nishiyama, CIRES; and A. Bedard, NOAA

If you walk across a rug and then touch someone or something, you can often create a nice spark. Nature has ways of creating really nice “sparks”. Whereas gaps for carpet sparks are measured in millimeters, nature’s sparks (lightning) can be many kilometers in length. Charge differences between the earth and clouds or between different regions within a cloud can cause discharges over large distances. Since energy stored by weather’s electrical processes is so great compared with “carpet scuffing” energy, and we are so small compared with nature’s discharge gaps, lightning and its “voice” (thunder) have been a source of wonderment over the ages. Here we explore various processes producing lightning and thunder, examining ways of creating charge differences capable of producing surges of electric current that can harm people and structures. Two examples shown here (a Kelvin water drop apparatus and a Wahlen ion separator) demonstrate how weak processes operating over time can cause static charges to build up. These demonstrations, mere shadows of atmospheric processes, show how nature could manipulate small effects over time to produce a large outcome — a lightning bolt and thunder clap.



Lightning Strike Distance



Thunder Type

What produces lightning

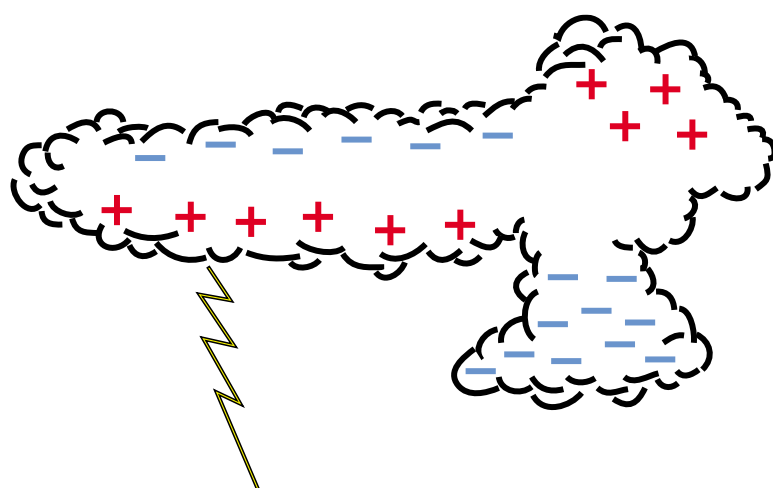
Models for Cloud Electrification



Close

Sharp crack

◆ Positive cloud to ground



ground

Particle charging by selective ion capture

Particle charging by thermoelectric effects

Particle charging by induction

Convection charging

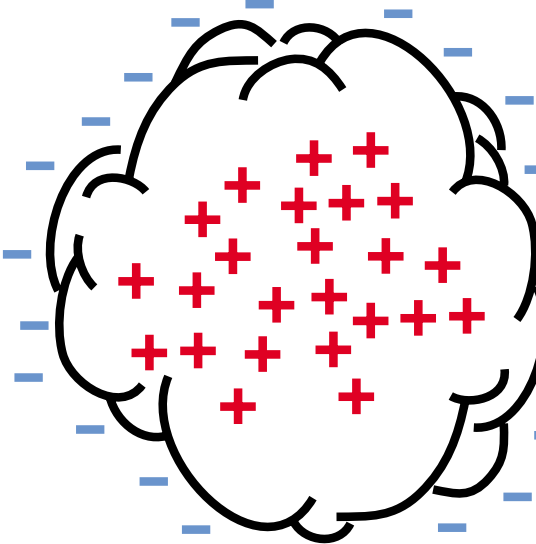
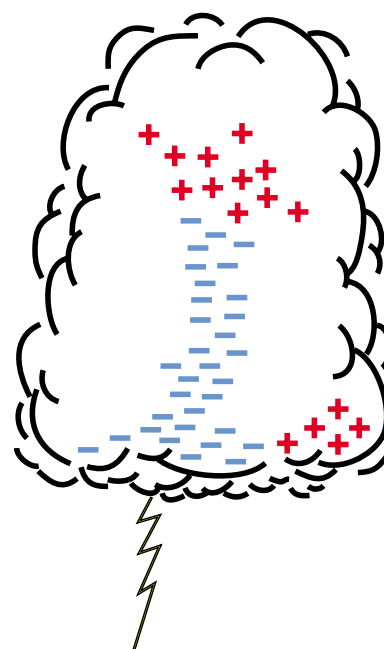
Initial updraft carrying positive ions upward



Medium

Bang and rumble with lowest sounds last

◆ Negative cloud to ground



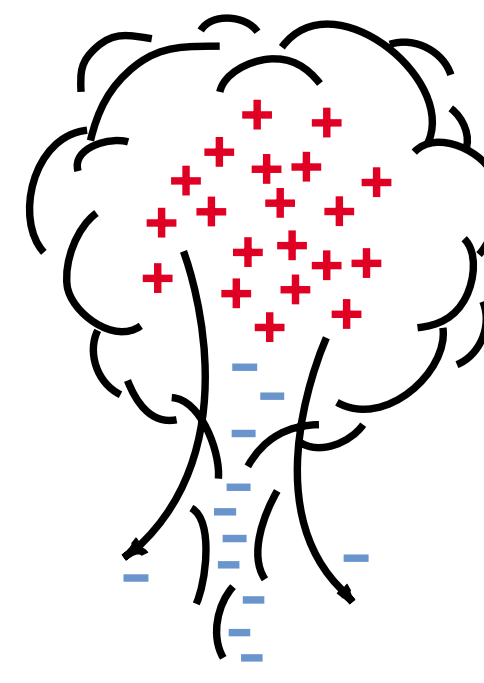
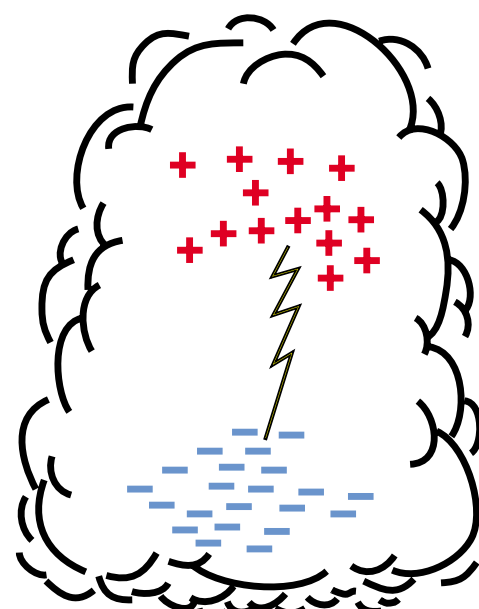
Screening negative charges from free air surround cloud



Distant

Low rumble

◆ Cloud to cloud



Downdrafts carry negative ions to the surface increasing the potential difference

