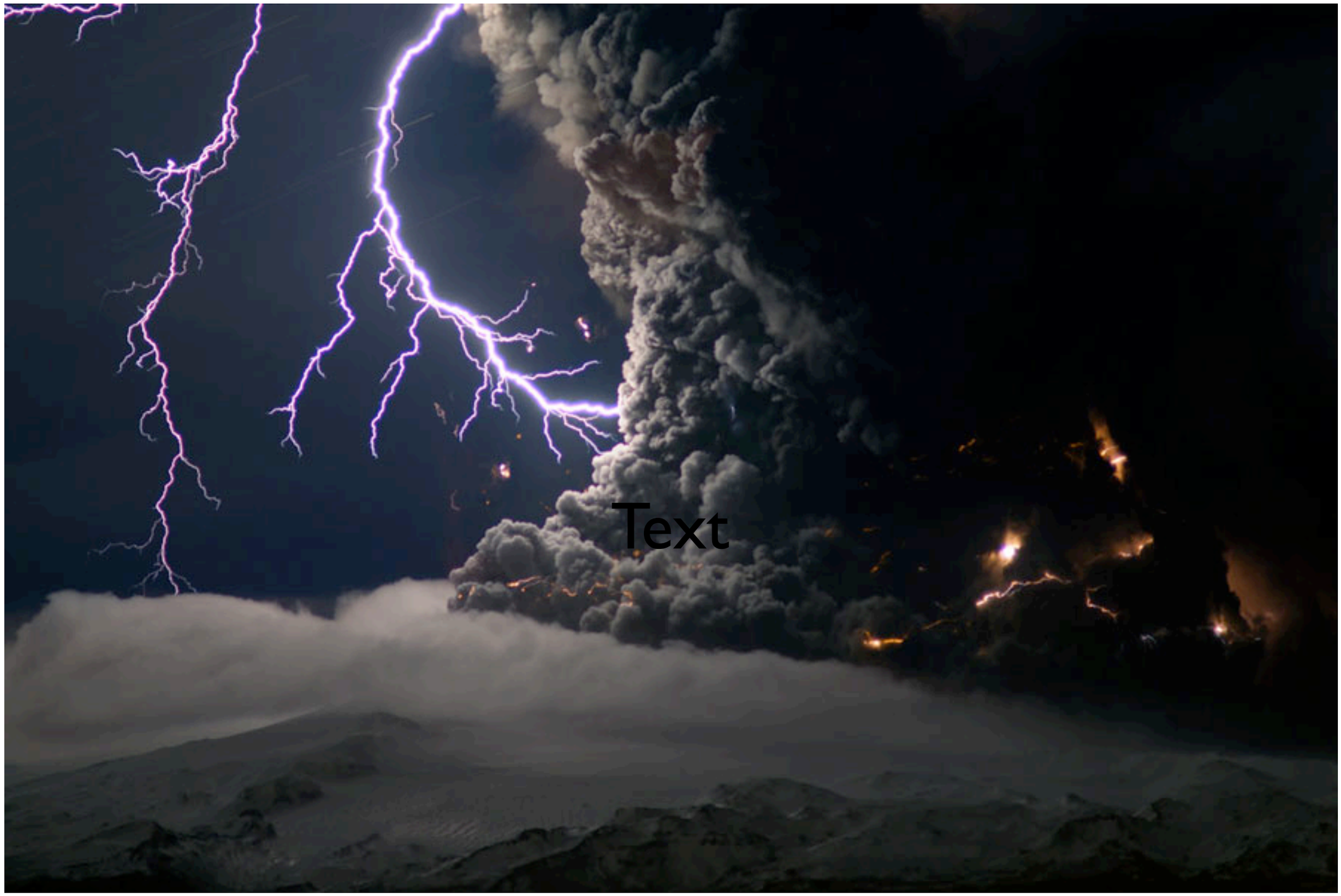
Volcano Lightning

Lightning storm around the Surtsey, Iceland volcanic eruption. Public domain image.

This photo was taken by Sigurgeir Jonasson.

The textbook example of lightning from volcanos is the Surtsey volcano in Iceland. Surtsey was an underwater volcano that ultimately created an island, Surtsey, in November 1963. If you are accustomed to seeing photographs of lightning, you will probably observe that this lightning has some very strange features except for the left most flash. Is the blurring produced by time exposure? Camera motion? Light scattering?

Astronomy Picture of the Day
2010 April 19

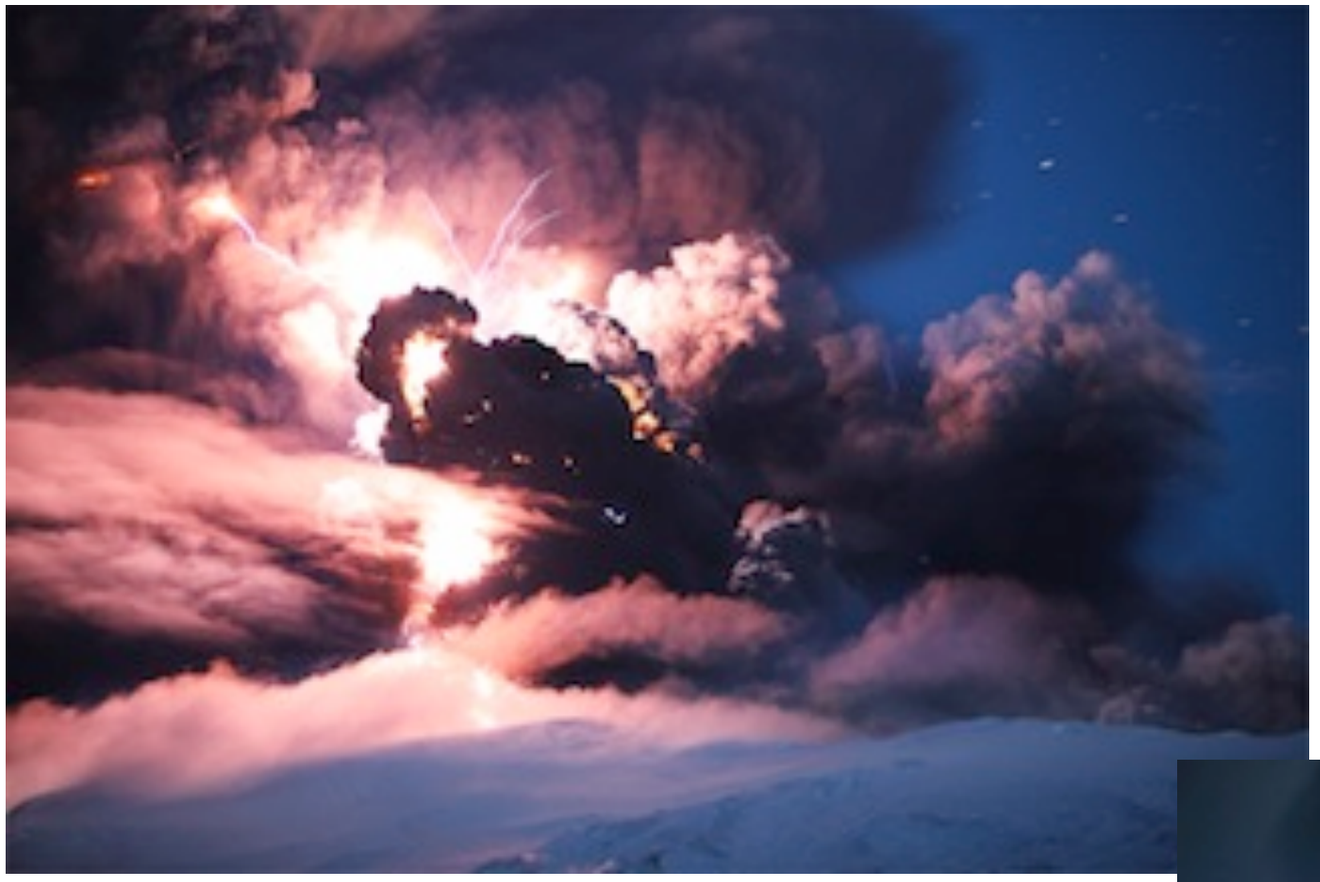


Photograph by Marko Fulle: Copyright information

The Surtsey volcano will very likely be replaced in future textbooks by the Eyjafjallajökull volcano (April 2010) for which there are many outstanding photos.

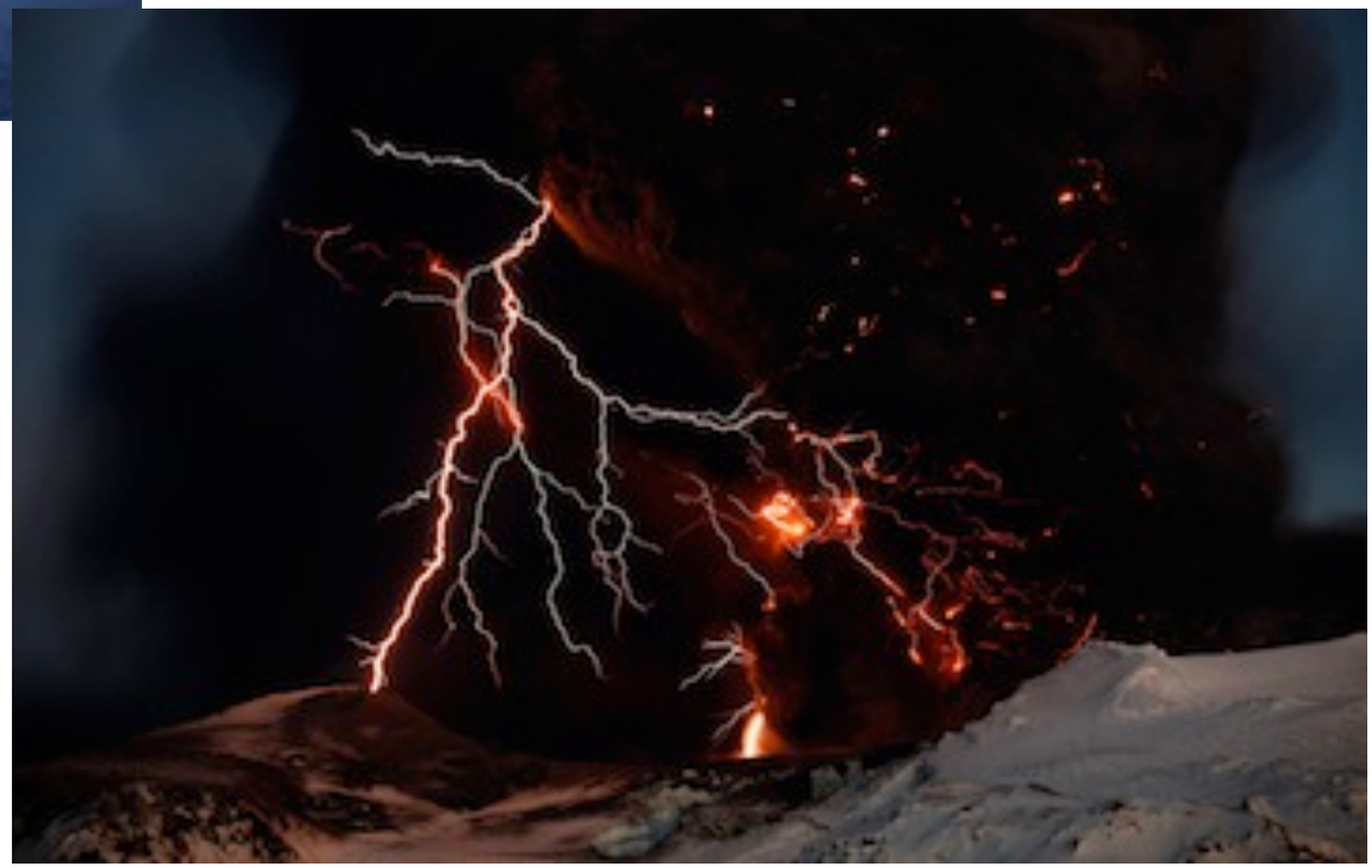
Eyjafjallajökull pronounced Aye yafa la yo kul

The Eyjafjallajökull volcano in southern Iceland began erupting on March 20, with a second eruption starting under the center of small glacier on April 14. Unlike the Surtsy photograph we can see two channels on the left that look like thunderstorm lightning. It is obvious that there are two different kinds of electrical discharges in this photo.



Left. Photograph by Skarphedinn Thrainsson.
Eyjafjallajökull volcano (April 2010)

In the center of the plume we see an upward branched flash that is typical of what we might see in a thunderstorm. If this were a thunderstorm this flash would be originating in the negative layer of the the cloud (~ -10 ºC) and terminating in the positively charged ice particles in the upper cloud.
There is a lot of discharge activity throughout the plume.



Right. Photograph by Lucas Jackson/Reuters.
Eyjafjallajökull volcano (April 2010)

The highly branched downward flash looks exactly like a negative cloud-to-ground flash from a thunderstorm.
We get a hint in the photograph that the blurred red discharges are probably produced by discharges on the edge of the plume.

Both of these photos are also of the Eyjafjallajökull volcano (April 2010). Are the reddened channels produced by: Scattering by ash? Channel cooling by dispersion of the current by plume constituents? Channel heating ash that reradiates red light. The channels are also thickened!

Icelandic volcanos are not the only volcanos that produce lightning.

Chalten, Chili, 2008

Note the widening of the channel entering the fog bank; this is normal water-drop scattering.

Icelandic volcanos are not the only volcanos that produce lightning.

Chalten, Chili, 2008

Green lightning! I've not seen this before. My guess is that this discharge contained a continuing current component and the channel charge produced a corona current around the channel, which excited oxygen that recombined to emit green light much like an aurora.

Another photo from the same position.

Chalten Volcano, Chili

It is difficult to figure this one out. My guess is it is cloud-to-ground from the cloud top with numerous branches entering the plume. What sort of charge structure produces this behavior? To the right we see a upward discharge exiting then reentering the plume.

Credit: Sakurajima Volcananological Observatory
Caption: Sakurajima volcanic lightning, May 18, 1991.

These appear to be discharges tracking along the surface of the plume. Confused discharge upper left. Good photo of volcanic bombs. We return to this photo in “View Second.”

Official U.S. Air Force Photo

Vesuvius in Eruption March 1944

Vesuvius is located in a highly populated region of the world and also a very literate populous. There are older records of observations of flashes and thunder associated with volcanos, but these earlier records are much less informed. More on the Vesuvius eruption of 79 AD in Vesuvius is located in a highly populated region of the world and also a very literate populous. There are older records of observations of flashes and thunder associated with volcanos, but these earlier records are much less informed. More on the Vesuvius eruption of 79 AD in the poster paper. “View Second.”

Before I launch into “View Second” of this presentation, I would like to tell you how I got involved with this project. I have a “citizen-science” web page on our Gold Hill town web site called Ask Arthur; neighbors are invited to submit questions about the sky and I answer them on the web. One of my friends submitted the question,”Why does the ash plume coming from the Icelandic volcano sometimes create lightning?” This document, “View First” site was my response. I was aware that there were scientist in the U.S., England, Iceland, Northern Europe, and Japan who had done serious research on this subject. I suggested to the American Geophysical Union that Volcano Lightning would make a good special session for the fall 2010 meeting. The response was “Great, now you are in charge. I became the session convenor and the session chair for both the oral and poster sessions.

Having started the ball rolling I felt obligated to prepare my own contribution to the session. The “View Second” is a decomposed and updated version of my poster paper “Ice in Volcanic Clouds.”