



Earth and Life

Volcanoes: eruptions and climatic effects

Voice Over

The Philippines, June 15th 1991 – Mt. Pinatubo erupts after 600 years lying dormant. The climate effect that an eruption will have will depend on how large the aerosol particles are and how long they remain in suspension. High-flying research aircraft have collected volcanic aerosol particles such as these, seen with an electron microscope. They're about 0.1 microns in diameter.

Caption: Alan Robock, University of Maryland

Pinatubo put a tremendous amount of sulphate aerosols up into the stratosphere which lasted for a couple of years and it cooled off the Earth so the year 1992 was much cooler than 1991. The amount of cooling from Pinatubo was as large as the effect of all the greenhouse gases we've put in the atmosphere up until then so the net effect was cooling, it was worked against the greenhouse effect.

Voice Over

Following the Pinatubo eruption the evolving cloud of water vapour, sulphurous gases and aerosol moved westward and circled the globe in approximately twenty-two days, but the effect on the temperature wasn't the straightforward cooling predicted. The world map shows temperature anomalies in the winter of 1991-92. Blue areas correspond to a temperate increase by 1-2, sometimes 3 degrees Celsius. Yellow corresponds to anomalous warming, and the red areas temperatures as high as 4.3 degrees Celsius above normal. The sulphate aerosols from the volcano went up into the stratosphere. In the Tropics they heated it. This produced a larger gradient of temperature between the Equator and the Poles. It made the jet stream stronger and that produced a novel pattern of atmospheric circulation so that more winds came from the south than usual, and that produced a much warmer winter in Europe and over North America.

Alan Robock

So this dynamical effect, this effect on the atmospheric circulation, is sort of counterintuitive 'cos in addition to blocking out the sunlight and cooling a little bit the change of the atmospheric circulation, the change of the wind direction, was a stronger effect and it produced warming.

Male Voice Over

One effect that occurs when you have a sort of a slow emission of the lava rather than an explosive event is that the sulphurous gases tend to be, you made it into the lower part of the atmosphere, and mainly into the troposphere, which is where we have weather, we have clouds, we have precipitation and so the aerosols tend to have a considerably shorter lifetime or residence time in the atmosphere. It might typically be a week to several weeks. And then an explosive volcanic eruption of a large enough size that injects the aerosols into the stratosphere, then the aerosols that form the sulphuric acid aerosols can have resinous times of several years, and that makes considerable difference in the climatic impact because it's not just the density of the aerosols that you have but it's also the length of time that they're producing a net energy deficit of the surface.