Are Climate Scientists Ready to Observe and Model the Next Big Volcanic Eruption?

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Large volcanic eruptions inject sulfur dioxide gas into the lower stratosphere, which over weeks converts to sulfate aerosols. In addition small tephra and sulfate may be in the initial plume. To initialize climate model simulations, the amount and location of this material are needed as soon as possible. Over time as the sulfur dioxide converts to sulfate, those processes need to be modeled and the observed resulting aerosol size distribution will then serve to evaluate initial model simulations, as initial conditions for further simulations, and as an analog for how stratospheric geoengineering might be implemented.

After the June 15, 1991 Mt. Pinatubo eruption in the Philippines, satellites were able to observe the initial sulfur dioxide injection. But the subsequent aerosol evolution and transport were not well observed. There were no lidars in the Tropics or in space, and the SAGE II solar occultation observations in the lower stratosphere in the Tropics were not possible because of the thick sulfate cloud. Balloons were not used until the cloud reached midlatitudes months later. And climate models did not have the ability to calculate the gas-to-particle conversion or the impacts on ozone.

We are more ready now than we were in 1991 to measure and model the next large volcanic eruption. Both NASA and the Stratospheric Sulfur and its Role in Climate (SSiRC) project have produced recent plans for observing from Earth's surface, balloons, aircraft, and satellites, but the frequency and precision of the resulting observations will depend somewhat on which equipment is available for early deployment. However, these plans need to be approved and enacted so that we are actually prepared to take the observations. Several climate modeling groups are ready to take observations of the initial sulfur dioxide measurements and predict the evolution and transport of sulfate aerosols, and the subsequent climate response.