El Chichón Forebodes Climate Change

The cloud of debris lofted into the stratosphere in early April by the Mexican volcano El Chichón is huge. It is probably 20 times more massive than the cloud from Mount St. Helens, and might equal or exceed the size of Agung's cloud of 1963 or Katmai's of 1912. Like the Agung cloud, El Chichón's will in all likelihood temporarily cool the climate of the Northern Hemisphere. The immediate problem for researchers attempting to predict the magnitude of any climate effect is the cloud's failure to cooperate in their studies.

Since April, the El Chichón cloud has been circling the globe about every 10 days while smearing into a more or less continuous band, the bulk of the debris stretching between 0° and 30°N. Surprisingly, the main body of the cloud remained penned between the equator and the subtropics after the first few months of lateral spreading. While relatively stagnant latitudinally, the cloud's vertical mobility has startled researchers. The cloud started out between about 22 and 26 kilometers; the highest previously measured cloud reached about 22 kilometers. Then, unexpectedly, it spread even higher to about 32 kilometers, leaving its densest parts at about 26 kilometers, according to Charles Barth of the University of Colorado. Barth had been monitoring the water vapor content of the middle atmosphere, through the infrared detector of the Solar Mesospheric Explorer satellite, when the emissions of the cloud overwhelmed those of water vapor. Barth is not alone in having to watch the cloud blot out his intended object of study, but such serendipitous satellite data are proving helpful in mapping the cloud's motions as well as in determining its mass.

Although remote sensing from satellites, aircraft, and the ground are helping to characterize the cloud, penetrating the cloud and sampling the particles is viewed as crucial to the most direct approaches to climate prediction. Sampling in situ is important because the composition and size of cloud particles, in addition to the total cloud mass, determine what, if any, climatic effects there will be. Much of El Chichón's ash seems to have fallen out of the cloud, as expected, leaving sulfur dioxide gas and sulfuric acid droplets. The acid droplets, which are a few micrometers and less in size, form from the gas and will cause any surface cooling that occurs by scattering sunlight back into space. It was the dearth of sulfur dioxide gas in Mount St. Helens plume that relegated it to a negligible role as a perturber of climate (*Science*, 23 January 1981, p. 371).

So far, researchers have been able to sample only the fringes of the main cloud. The highest flying research aircraft, the U-2 operated by the National Aeronautics and Space Administration (NASA), reaches only 21 kilometers. The only balloon-borne instrument, the "dustsonde" flown by James Rosen and David Hofmann of the University of Wyoming, has sampled only the northern edge of the main cloud over southern Texas. Researchers expect that the situation will improve by fall, at least, when a seasonal shift in stratospheric circulation should spread the cloud farther north. In the meantime, continued surveillance, especially of the cloud's interaction with solar radiation, should sharpen estimates of the cloud's effects.

In view of the present uncertainties, researchers are reticent about predicting possible climatic effects, but preliminary observations indicate that the cloud is as large, and likely as influential, as those of Katmai and Agung, which are the largest of this century. The present cloud interacts with about the same proportion of incoming solar radiation as these earlier clouds did, according to James Pollack of NASA's Ames Research Center in Mountain View, California. Wayne Evans of Canada's Atmospheric Environment Service in Downsview, Ontario, has remotely measured total sulfur dioxide from planes crisscrossing beneath the cloud. He has found at least as much sulfur dioxide as Agung is thought to have put into the stratosphere.

If the El Chichón cloud were to cool the Northern Hemisphere by a few tenths of a degree centigrade, as Agung did, the result might not simply be an imperceptible chill in the air, says Pollack. Such an average hemispheric cooling could produce extremes of weather through changes in atmospheric circulation. Would Chicago have an unusually cold winter? Would Seattle have more sunshine? Prediction of such specific regional effects, even if hemispheric predictions prove accurate, will present a considerable challenge to climate modelers.

—Richard A. Kerr

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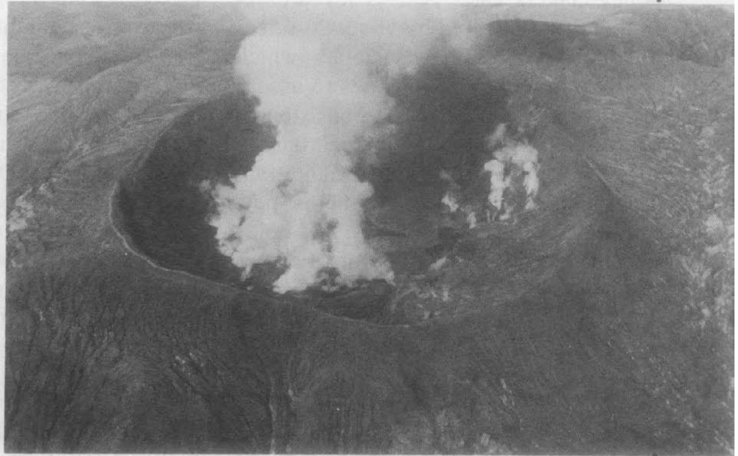
El Chichón: before . . .



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and after.

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