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Frequency of large volcanic eruptions over the past 200,000 years

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Volcanic eruptions play an important role in climate forcing, and over longer periods they are an essential component of the budget of carbon dioxide in the atmosphere. Eruptions of different magnitudes pose hazards at different scales to society and ecosystems. However, establishing the past frequency of eruptions of various magnitudes is challenging. Antarctic ice cores, through their record of episodic sulfate deposition, offer the opportunity to establish such frequencies, at least in those cases where sulfur is injected into the stratosphere and deposited globally. A number of difficulties have to be overcome however. Here, we build on recent work that has used large eruption spikes to synchronise records back to 200,000 years, in particular between the East Antarctic sites of Dome C, Dome Fuji and Vostok. In each record, and for each volcano, we can estimate the amount of sulfate deposited above the background across the years following an eruption; in some cases we will use electrical conductivity data as a surrogate for sulfate. By using the three records together we can place uncertainty estimates on the amount of sulfate deposited for each eruption. We will then test methods for assessing the frequency of eruptions above a given magnitude (in terms of sulfate deposition). We will check these methods using synthetic records which can be applied on top of different backgrounds and snowfall rates, and after appropriate diffusion, to confirm that our methods are robust against such differences through 200,000 years. We will finally establish the frequency of large eruptions through two glacial cycles to assess the validity of suggestions that the rate is higher during periods of deglaciation.