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Environmental and climatic effects of volcanic aerosol: past, present and future

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Volcanic eruptions have a significant potential to affect the climate system, the environment and society. I will summarize my work on volcanic sulfur emissions from volcanic eruptions of different styles, magnitudes, and durations. I will first discuss how volcanic emissions into the troposphere and effusive Icelandic volcanism can alter the microphysical properties of low-level clouds and serve as a "natural lab" to better understand and quantify aerosol-cloud interactions. A prime example is the most recent Icelandic eruption at Holuhraun (Bárðarbunga volcano). Starting in August 2014, Holuhraun erupted effusively for six months and emitted up to nine times as much sulfur dioxide per day as all European industry combined, which led to a measureable episodic degradation of air quality across Northern Europe in September and October 2014. Holuhraun was the first so-called flood lava eruption in Iceland since the much bigger 1783-1784 CE Laki eruption. Laki had substantial effects on northern hemisphere climate and the environment across Europe. Using a global aerosol microphysics model to simulate the effects of a future Laki-type eruption, I show that such an eruption could have the potential to degrade air quality and affect human health in Europe. Lastly, I will present results from CESM(WACCM) model simulations of volcanic eruptions and their radiative effects since the year 1990.