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Atmospheric impact of the 1783–1784 Laki Eruption: Part II Climatic effect of sulphate aerosol

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Abstract. The long 1783-1784 eruption of Laki in southern Iceland, was one of the first eruptions to have been linked to an observed climate anomaly, having been held responsible for cold temperatures over much of the Northern Hemisphere in the period 1783-1785. Results from the first climate model simulation of the impact of a similar eruption to that of 1783-1784 are presented. Using sulphate aerosol fields produced in a companion chemical transport model simulation by Stevenson et al. (2003), the radiative forcing and climate response due to the aerosol are calculated here using the Reading Intermediate General Circulation Model (IGCM). The peak Northern Hemisphere mean direct radiative forcing is -5.5 Wm^{-2} in August 1783. The radiative forcing dies away quickly as the emissions from the volcano decrease; however, a small forcing remains over the Mediterranean until March 1784. There is little forcing in the Southern Hemisphere. There is shown to be an uncertainty of at least 50% in the direct radiative forcing due to assumptions concerning relative humidity and the sophistication of the radiative transfer code used. The indirect effects of the Laki aerosol are potentially large but essentially unquantifiable at the present time. In the IGCM at least, the aerosol from the eruption produces a climate response that is spatially very variable. The Northern Hemisphere mean temperature anomaly averaged over the whole of the calendar year containing most of the eruption is -0.21 K, statistically significant at the 95% level and in reasonable agreement with the available observations of the temperature during 1783.

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