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Modelling the atmospheric impacts of the 1783-1784 Laki eruption in Iceland as a basis for modelling the impacts of continental flood basalt eruptions.

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The periodic eruption of continental flood basalts (CFBs), forming large igneous provinces (LIPs), has been a distinctive style of volcanic activity on Earth since Precambrian times, for which there are no direct modern analogues. CFBs have been the focus of numerous recent studies (e.g. Self et al., 2006, DOI: 10.1016/j.epsl.2006.05.041), providing information on their age and eruption style (e.g. the magma volume, the amount of volcanic gases emitted and the timing and duration of flow emplacement). It is well known that large volcanic eruptions perturb the Earth's climate system – however, the impact of the vast amounts of volcanic gases emitted during a CFB eruption on both regional and global climate, and the likely correspondence of CFBs (e.g. the Deccan Traps of India at 65 Ma) with mass extinctions are still poorly understood and a matter of great debate.

In order to make progress in predicting the atmospheric perturbations created by CFB eruptions, including better understanding of the formation of aerosols, their distribution and deposition, and the resulting perturbation of the climate system, we use observations of the 1783-1784 eruption of Laki in Iceland to develop an analogue model which will be scaled up to model CFB eruptions.

We attempt to model the 1783-1784 Laki eruption in more detail than ever before (cf Thordarson & Self, 1993, 2003, DOIs: 10.1007/BF00624353;

10.1029/2001JD002042) by employing the Leeds Global Model of Aerosol Processes (GLOMAP) implemented in the 3-D chemical transport model, TOMCAT. We compare our results with those gained from previous attempts at modelling the Laki eruption (e.g. Stevenson et al., 2003, www.atmos-chem-phys.org/acp/3/487/; Highwood & Stevenson, 2003, www.atmos-chem-phys.org/acp/3/1177/; Chenet et al., 2005, DOI: 10.1016/j.epsl.2005.04.046; Oman et al., 2006, DOI: 10.1029/2005JD006899). Our model for Laki will subsequently be employed to model the Early Tertiary flood basalt eruptions of the North Atlantic Igneous Province and the Deccan K-T boundary event in India, scaled up in duration and thus in the amount of sulphuric acid aerosol emitted into the Earth's atmosphere. This will allow us to represent a CFB eruption as realistically as possible in terms of eruption style, duration and amount of volcanic gases emitted. Our model codes allow investigation of the impact of these CFB eruptions within a "Late Cretaceous climate scenario" - i.e. with the palaeogeographical setting and the atmospheric composition (e.g. higher atmospheric CO_2 values than today) of the Late Cretaceous.

This is a frontier research area, crucial for making significant progress in climate modelling itself and improving our knowledge about the likely short-term and long-term climatic and environmental impacts of CFB volcanism throughout Earth's history.