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The prediction and observation of volcanic ash clouds during the Eyjafjallajökull eruption

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The Eyjafjallajökull volcano in Iceland erupted on 14 April 2010 emitting a plume of ash into the atmosphere. The ash was transported from Iceland towards Europe where cloud-free skies allowed ground-based lidars at Chilbolton in England and Leipzig in Germany to estimate the mass concentration in the ash plume as it passed overhead. The UK Met Office's Numerical Atmospheric-dispersion Modelling Environment, NAME, has been used to simulate the evolution of the ash plume from the Eyjafjallajökull volcano during the initial phase of the ash emissions, 14-16 April 2010.

NAME captures the timing and sloped structure of the ash layer observed over Leipzig, close to the centre of the plume. Failure of the driving meteorology to represent the complex situation along a decaying cold front traveling southwards over the UK results in a timing error at distances far from the centre of the plume, although the spatial error is small. Taking the timing error into account, NAME is able to capture the sloped ash layer over the UK.

Comparison of the lidar observations and NAME simulations has allowed reconstruction of the plume height time-series during the initial phase of the eruption. It is necessary to represent the large, short-term fluctuations in plume height in order to accurately predict ash plume structure at long range. Quantitative comparison with the mass concentrations at Leipzig and Chilbolton suggest that between 3 and 4% of the total emitted mass flux is transported as far as these sites by small ($< 100\mu$m diameter) ash particles.