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Modelling concentrations of volcanic ash encountered by aircraft in past eruptions

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During the eruption of Eyjafjallajokull in April/May 2010, pressure mounted on the London VAAC to estimate the volcanic ash concentrations within the plume. Ash concentrations were desired in order that the UK Civil Aviation Authority (CAA) could consider allowing aircraft to fly within regions of the plume where concentrations were below hazardous levels. An important step in determining a safe concentration limit is to understand the ash concentrations that aircraft are predicted to have flown through in historic encounters. Dispersion model simulations of six volcanic eruptions associated with aircraft ash encounters from 1982 to 2006 have been conducted using the atmospheric dispersion model NAME. NAME is the operational model of the London VAAC and was used during the 2010 Eyjafjallajokull eruption. The simulations conducted for this study use the same operational set-up, but different meteorological data of a lower resolution due to the historical nature of the case-studies.

The results for the past eruptions will be presented in this talk. In many cases, discrepancies exist between modelled ash concentrations at the aircraft locations and the concentrations that might be expected based on reports of the aircraft damage. Five key factors have been identified as contributing to ash concentration modelling accuracy:
1. The level of information on the volcanic eruption, e.g. timing, height, etc
2. The need to model multiple eruptive episodes
3. The precision of information on aircraft locations and flight paths
4. Uncertainties in the driving meteorological data
5. Sophistication, or lack there of, of eruption plume dynamics within operational atmospheric dispersion models.

These factors demonstrate some of the problems that need to be addressed going forwards if we are to improve volcanic ash plume model simulations. To invoke a process that allows aircraft to fly in regions where ash concentrations are below a certain limit, it is critical to be able to predict ash concentrations to an adequate degree of accuracy. The challenges for predicting ash concentrations for both past and future eruptions will be highlighted and discussed.