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Estimating volcanic ash hazard in European airspace

Adam Dingwell and Anna Rutgersson
Department of Earth Sciences, Uppsala University, Uppsala, Sweden (adam.dingwell@geo.uu.se)

The wide spread disruption of European air traffic in late April 2010, during the eruption of Eyjafjallajökull, showed the importance of early assessment of volcanic hazard from explosive eruptions. In this study we look at the short term hazard of airborne ash through a climatological perspective, focusing on eruptions on Iceland. By studying eruptions of different magnitude and frequency we attempt to estimate the overall probability that ash concentrations considered hazardous to aviation are exceeded over different parts of Europe.

The method involves setting up a range of eruption scenarios based on the eruptive history of Icelandic volcanoes, and repeated simulation of these scenarios for several years' worth of weather data. Simulations are conducted using meteorological data from the ERA-Interim reanalysis set which is downscaled using the Weather Research and Forecasting (WRF) model. The weather data is then used to drive the Lagrangian particle dispersion model FLEXPART-WRF, which is set up appropriately for each eruption scenario.

We see that the dispersion of ash is highly dominated by the mid-latitude westerlies and mainly affect northern UK and the Scandinavian peninsula. The occurrence of high ash levels from Icelandic volcanoes is lower over continental Europe but should not be neglected for eruptions of volcanic explosivity index (VEI) 5 or greater, which have a recurrence interval of about 120-150 years.

There is a clear seasonal variation in the ash hazard. During the summer months there is no single dominating dispersion direction and high concentrations are restricted to a relatively small area around Iceland with some plumes extending to the northwest and Greenland. In contrast, during the winter months the strong westerly winds will transport most of the emissions eastwards. The affected area of a winter-time eruption will be larger as high concentrations can be found at a further distance downwind from the volcano, effectively increasing the probability of hazardous levels of ash reaching the European continent.