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How accurate are volcanic ash simulations of the 2010 Eyjafjallajökull eruption?

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In the event of a volcanic eruption the decision to close airspace is based on forecast ash maps, produced using volcanic ash transport and dispersion models. In this paper we quantitatively evaluate the spatial skill of volcanic ash simulations using satellite retrievals of ash from the Eyjafjallajökull eruption during the period from 7-16 May 2010. We find that at the start of this period, 7-10 May, the model (FLEXPART) has excellent skill and can predict the spatial distribution of the satellite retrieved ash to within $0.5^\circ \times 0.5^\circ$ lat/lon. However, on the 10 May there is a decrease in the spatial accuracy of the model, to $2.5^\circ \times 2.5^\circ$ lat/lon, and between 11-12 May the simulated ash location errors grow rapidly. On the 11 May ash is located close to a bifurcation point in the atmosphere, resulting in a rapid divergence in the modeled and satellite ash locations. In general, the model skill reduces as the residence time of ash increases. However, the error growth is not always steady. Rapid increases in error growth are linked to critical points in the ash trajectories. Ensemble modeling using perturbed meteorological data would help to represent this uncertainty and assimilation of satellite ash data would help to reduce uncertainty in volcanic ash forecasts.