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Time- and height-resolved fine ash emissions from the Eyjafjallajoekull eruption

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The April-May, 2010 volcanic eruptions of Eyjafjallajökull, Iceland caused significant economic and social disruption in Europe and the capabilities to forecast volcanic ash dispersion were criticized by the aviation industry. Here we demonstrate for the first time that dramatic improvements can be made in quantitative predictions of the fate of volcanic ash emissions, by using an inversion scheme that couples the output of a Lagrangian dispersion model with satellite data to estimate the volcanic source strength in space and time.

We evaluate the model results based on the optimized emissions using plume heights derived from web-camera observations, data from a space-borne lidar, and in-situ aircraft measurements and also present sensitivity studies (e.g., changes of satellite data set used, particle size distribution). We then present metrics for the exceedance of various ash concentration thresholds over Europe.

Our results have important ramifications for determining air space closures and for real-time quantitative estimations of ash concentrations. Furthermore, the general nature of our method allows much better constraints on the distribution and fate of volcanic ash in the Earth system.