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Estimation of volcanic ash emission profiles using ceilometer measurements and transport models

Ka Lok Chan (1), Alexander Geiß (1), Josef Gasteiger (1), Frank Wagner (2), and Matthias Wiegner (1)

(1) Ludwig-Maximilians-Universität München, Meteorological Institute, München, Germany, (2) Deutscher Wetterdienst, Meteorological Observatory Hohenpeißenberg, Germany

In recent years, the number of active remote sensing systems grows rapidly, since several national weather services initiated ceilometer networks. These networks are excellent tools to monitor the dispersion of volcanic ash clouds and to validate chemical transport models. Moreover, it is expected that the can be used to refine model calculations to better predict situations that might be dangerous for aviation. As a ceilometer can be considered as a simple single-wavelength backscatter lidar, quantitative aerosol profile information, i.e., the aerosol backscatter coefficient (β_p) profile, can be derived provided that the ceilometer is calibrated. Volcanic ash concentration profile can then be estimated by using prior optical properties of volcanic ash. These profiles are then used for the inverse calculation of the emission profile of the volcanic eruption, thus, improving one of the most critical parameters of the numerical simulation. In this study, the Lagrangian particle dispersion model FLEXPART (FLEXible PARTicle dispersion model) is used to simulate the dispersion of volcanic ash. We simulate the distribution of ash for a given time/height grid, in order to compute the sensitivity functions for each measurements. As an example we use ceilometer measurements of the German weather service to reconstruct the temporal and spatial emission profile of Eyjafjallajökull eruption in April 2010. We have also examined the sensitivity of the retrieved emission profiles to different measurement parameters, e.g., geolocation of the measurement sites, total number of measurement sites, temporal and vertical resolution of the measurements, etc. The first results show that ceilometer measurements in principle are feasible for the inversion of volcanic ash emission profiles.