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Simulating the influence of aerosol feedback effects with WRF-Chem on surface- and vertical distributions of wind speed and temperature during the Eyjafjallajökull 2010 eruption

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Explosive volcanic eruptions can inject large amount of volcanic ash and other gases into the atmosphere, even up the stratosphere. These volcanic aerosols have the potential to have a significant impact on the surrounding atmosphere and there is a need to evaluate the impact that these events have on the local, regional, and even continental meteorology. Here, the on-line coupled chemical transport model WRF-Chem is used to simulate the dispersion of the volcanic ash cloud emitted during the Eyjafjallajökull volcanic eruption in 2010 and to investigate the influence of the aerosol radiative feedback effects on meteorological parameters.
A meteorology-only model simulation, without chemistry, provides the base case scenario and is compared to the results obtained from a WRF-Chem model run considering gas- and aerosol chemistry and direct- and semi-direct aerosol feedbacks. Comparisons with satellite- lidar- and ground observation data shows that the model can predict the distribution of the ash cloud. Furthermore, the model performance of both runs is evaluated using meteorological observations at ground level as well as from vertical profiles data.
Although the modeling of the dispersion of volcanic ash clouds is subject to uncertainties (e.g. source concentration, composition and geometry, changing aerosol properties during eruption phases, and transport processes over long distances) we have shown that the WRF-Chem model performs very well against different observations of aerosol- and meteorological parameters both at surface levels and for vertical profiles. Furthermore including chemistry and radiative feedbacks can improve the meteorological forecasts.