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Volcanic ash transport integrated in the WRF-Chem model: a description of the application and verification results from the 2010 Eyjafjallajökull eruption.

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Regional volcanic ash dispersion models are usually offline decoupled from the numerical weather prediction model. Here we describe a new functionality using an integrated modeling system that allows simulating emission, transport, and sedimentation of pollutants released during volcanic activities. A volcanic preprocessor tool has been developed to initialize the Weather Research Forecasting model with coupled Chemistry (WRF-Chem) with volcanic ash and sulphur dioxide emissions. Volcanic ash variables were added into WRF-Chem, and the model was applied to study the 2010 eruption of Eyjafjallajökull. We evaluate our results using WRF-Chem with available ash detection data from satellite and airborne sensors, and from ground based Lidar measurements made available through the AeroCom project. The volcanic ash was distributed into 10 different bins according to the particle size ranging from 2 mm to less than 3.9 μm; different particle size distributions derived from historic eruptions were tested. An umbrella shaped initial ash cloud and an empirical relationship between mass eruption rates and eruption heights were used to initialize WRF-Chem.
We show WRF-Chem model verification for the Eyjafjallajökull eruptions, which occurred during the months of April and May 2010. The volcanic ash plume dispersed extensively over Europe. Comparisons with satellite remote sensing volcanic ash retrievals showed good agreement during the events, also ground-based LIDAR compared well to the model simulations. The model sensitivity analysis of the Eyjafjallajökull event showed a considerable bias of ass mass concentrations afar from the volcano depending on initial ash size and eruption rate assumptions. However the WRF-Chem model initialized with reliable eruption source parameters produced good quality forecasts, and will be tested for operational volcanic ash transport predictions.