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Temporal development of the Eyjafjallajökull volcanic plume observed over Leipzig by Raman lidar and AERONET sun photometer

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After the eruption of the Eyjafjallajökull volcano in Iceland in April and May 2010 we observed the evolution of the emitted plume over Leipzig with two Raman lidars, with an AERONET sun photometer, and with a spectral aerosol extinction monitoring system (SAEMS). Our data set continuously describes the temperal development of the volcanic plumes over Leipzig during the whole period from April 16 to May 18.

With the multiwavelength Raman lidar MARTHA we determined 1-hour-mean vertical profiles of the particle backscatter coefficient at 355, 532, and 1064 nm, of the particle extinction coefficient at 355 and 532 nm and profiles of the particle depolarization ratio at 532 nm. Profiles of the backscatter-related-Ångström exponent and of the particle depolarization indicate the vertical position of the volcanic layers. Gaps in the MARTHA time series were filled with measurements of the 532-nm-backscatter profile from the automated Raman lidar Polly. Our AERONET system was used to study the temporal development of the fine-mode and coarse-mode fractions of the optical depth and of the volume-to-extinction coefficient. It is equipped with an additional channel at 1640nm that allows for a better characterization of very large particles like volcanic ash.

The volcanic plume of the first eruption on April 14, 2010 arrived over Leipzig in the morning of April 16 at about 6-7 km height. The optical depth of this plume was about 0.7 at 500 nm. The height of this optically thick layer rapidly decreased to 3 km before it vanished at about 18 UT. Spectra of AERONET observations indicate that the coarse-mode effective radius may have been as large as 2-3 μm. During the following days we observed thin ash layers in the free troposphere up to 8km height. On April 19 the major volcanic plume returned to Leipzig and then was mixed into the planetary boundary layer. SAEMS measurements at ground level show a decrease in the Ångström exponent and an increase in the particle extinction coefficient at the same time. Fresh volcanic aerosol originating from eruptions on April 19, 2010 and on the following days reached our site on 21 April 2010. Volcanic layers were detected up to 10 km height for many hours. The ash-related optical depth at 532 nm decreased from 0.04 on April 21 to 0.01 on April 22.