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Volcanic aerosol layers observed with multi-wavelength Raman lidar over Europe since summer 2008

Ina Mattis, Patric Seifert, Detlef Müller, Matthias Tesche, Anja Hiebsch, Thomas Kanitz, Jörg Schmidt, and Fanny Finger

Leibniz Institute for Tropospheric Research, Physics, Leipzig, Germany (ina@tropos.de)

Regular multiwavelength Raman lidar observations of the vertical aerosol distribution have been performed at Leipzig (51.4°N, 12.4°E), Germany, since 1996 in the framework of the European Aerosol Research Lidar Network (EARLINET). Our measurements in the past 12 years do not show any major event of volcanic aerosol pollution in the upper troposphere–lower stratosphere (UTLS) region. The situation changed since summer of 2008 due to a series of strong eruptions of volcanoes on the Aleutian Islands, Kamchatka, Alaska, and on the Kuril Islands. We observed aerosol layers in the upper troposphere above 5 km height and lower stratosphere below 25 km height. FLEXPART transport simulations show that volcanic aerosol is advected from Alaska to central Europe within about 7 days. The optical depths of the volcanic aerosol layers are mostly between 0.004 and 0.025 at 532 nm. The wavelength dependence of the backscatter and extinction coefficients indicate Ångström exponents from 1.0–2.0. Lidar ratios are found in the range from 30–80 sr (355 nm) and 30–50 sr (532 nm). The estimation of the effective radius, surface–area, and mass concentrations of a volcanic aerosol layer, observed well within the stratosphere end of August 2009, reveals values of 0.1–0.2 μm, 5–10 μm^2 cm^{-3}, and 0.3–0.5 μg m^{-3}, respectively. The surface–area and mass concentrations are thus about a factor of 10–20 lower than the respective values observed after the Mt. Pinatubo eruption in the years 1992 and 1993.