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Impact of the Eyjafjallajökull plume on cloud formation

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After resting for 187 years the volcano Eyjafjallajökull, Island, woke up again at March 20th, 2010. Starting at April 14th massive emissions of volcanic ash occurred and finally lead to a shutdown of civil aviation over entire Europe. The emissions went on with variable strength until May 23rd, 2010. The volcanic eruption offers a unique field experiment for investigating atmospheric processes as transport, radiation and cloud formation on a large variety of scales applying both observations and numerical models.

To simulate the dispersion of the ash plume we used the comprehensive online coupled model system COSMO-ART in an operational forecast mode. COSMO-ART is the extension of the operational weather forecast model of at Deutscher Wetterdienst (German Weather Service, DWD). Six individual size distributions of the ash particles were simulated starting from 1 μm up to 30 μm. Deposition, sedimentation, and below cloud scavenging were taken into account. For the source heights we used data that were published by the volcanic ash advisory centre London (VAAC).

To simulate the impact of the various aerosol particles on the cloud microphysics and therefore on cloud properties COSMO-ART was coupled with the two-moment cloud microphysics scheme of Seifert and Beheng (2006) by using comprehensive parameterisations for aerosol activation and ice nucleation. The activation of the ash particles is based on FHH adsorption activation theory and measurements of the activation behaviour of ash samples of the Eyjafjallajökull. Simulations were carried out taking into account the anthropogenic and natural emissions of gases and particles to investigate the impact of the ash particles on cloud formation. The simulations show an increase in ice crystal number concentration and enhanced glaciation of mixed phase clouds (-38°C < T < 0°C). No significant impact on ice crystal number concentration in the homogeneous nucleation regime (T < -38°C) and on liquid water clouds was found.