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Impact of Holuhraun volcano aerosols on clouds in cloud-system resolving simulations

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Increased anthropogenic aerosols result in an enhancement in cloud droplet number concentration $N_{d,}$ which consequently modifies cloud and precipitation process. It is unclear how exactly cloud liquid water path (LWP) and cloud fraction respond to aerosol perturbations. A volcanic eruption may help to better understand and quantify the cloud response to external perturbations, with a focus on the short-term cloud adjustments. The goal of the present study is to understand and quantify the response of clouds to a selected volcanic eruption and to thereby advance the fundamental understanding of the cloud response to external forcing. In this study we used the ICON (ICOsahedral Non-hydrostatic) model at numerical weather prediction setup at a cloud-system-resolving resolution of 2.5 km horizontally, to simulate the region around the Holuhraun volcano for the duration of one week (1 – 7 September 2014). A pair of simulations, with and without the volcanic aerosol plume, allowed us to assess the simulated effective radiative forcing and its mechanisms, as well as its impact on adjustments of LWP and cloud fraction to the perturbations of $N_{d.}$ In comparison to MODIS (Moderate Resolution Imaging Spectroradiometer) satellite retrievals, a clear enhancement of N_d due to the volcanic aerosol is detected and attributed. In contrast, no changes in either LWP or cloud fraction could be attributed. The on average almost unchanged LWP is a result of some LWP enhancement for thick, and decrease for thin clouds.