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

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https://environment.uw.edu

Impact of volcanic eruption on clouds

tropospheric aerosols (SO_4)

↓

natural laboratory

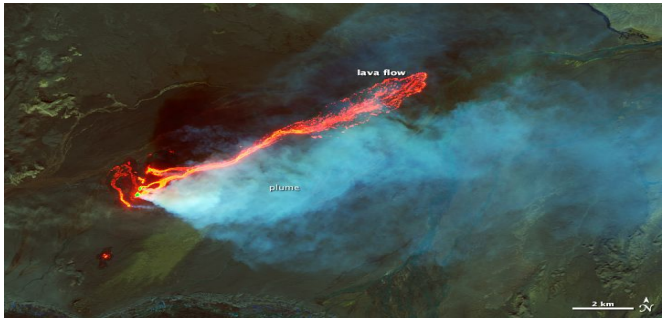
↓

the impact of additional CCN (cloud condensation nuclei) on liquid-water clouds

Model and Data

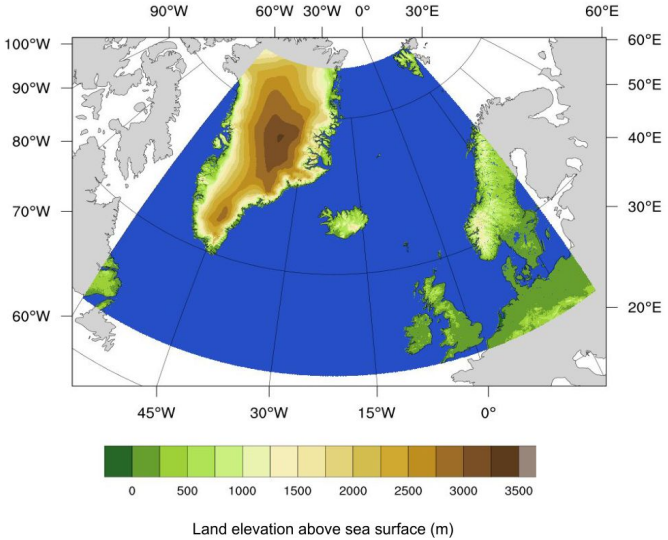
Holuhraun Volcano:

- the ICON-NWP model
- satellite observations



Holuhraun Lava Field in Iceland
(https://earthobservatory.nasa.gov)

General setup of ICON-NWP simulation of Holuhraun volcano

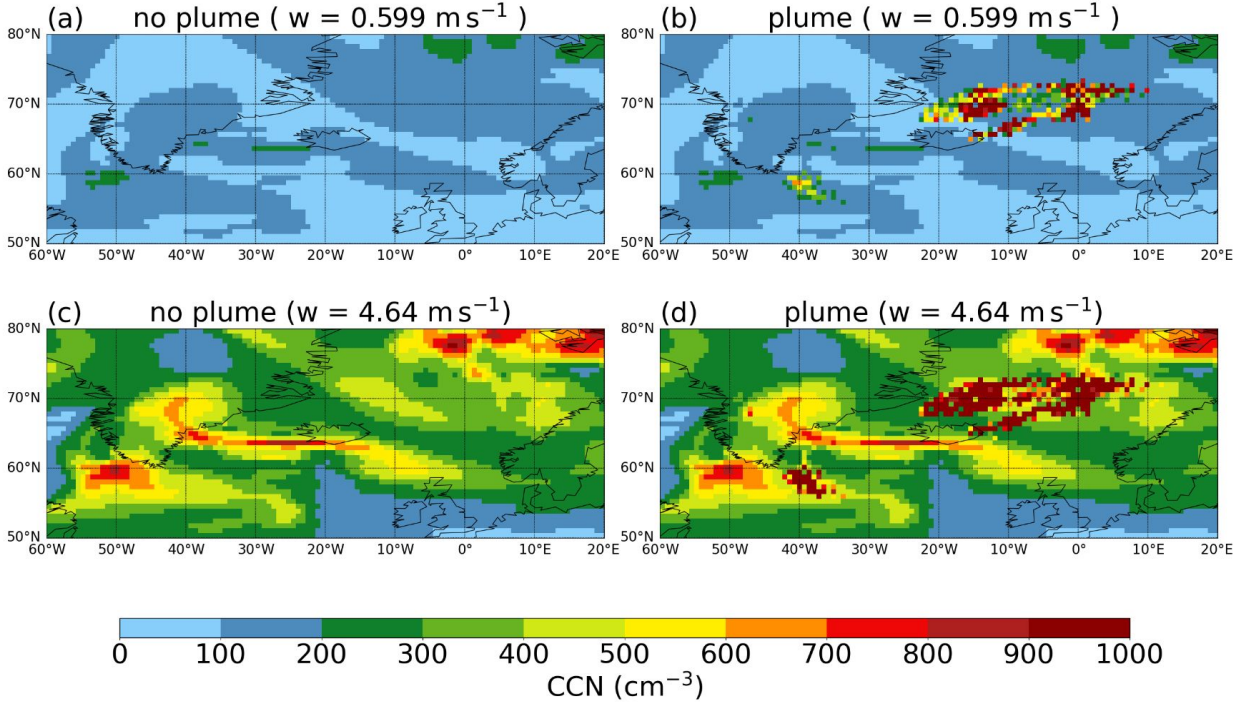


- regional domain 2.5 km horizontal resolution
- double-moment cloud liquid and ice microphysical scheme (Seifert and Beheng, 2006)
- ECMWF analysis (IFS) data as an initial and boundary condition
- simulation 1-7 September 2014
- COSP satellite simulator

Model and Data

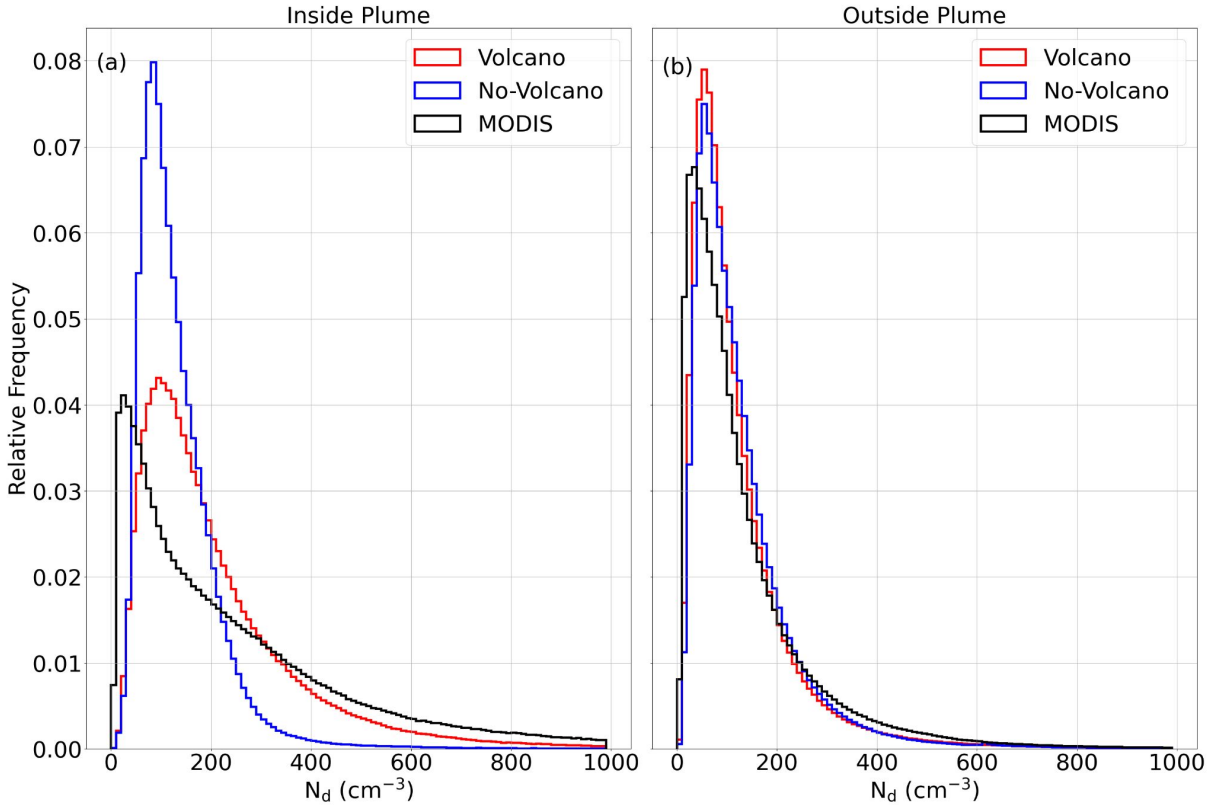
- Look-up tables that contain the number of activated CCN as a function vertical velocity as an input for the ICON simulation.
- Scaling sulfate aerosol in CAMS based on enhancement of So2 in OMPS retrievals in lower troposphere

2 September 2014



Results

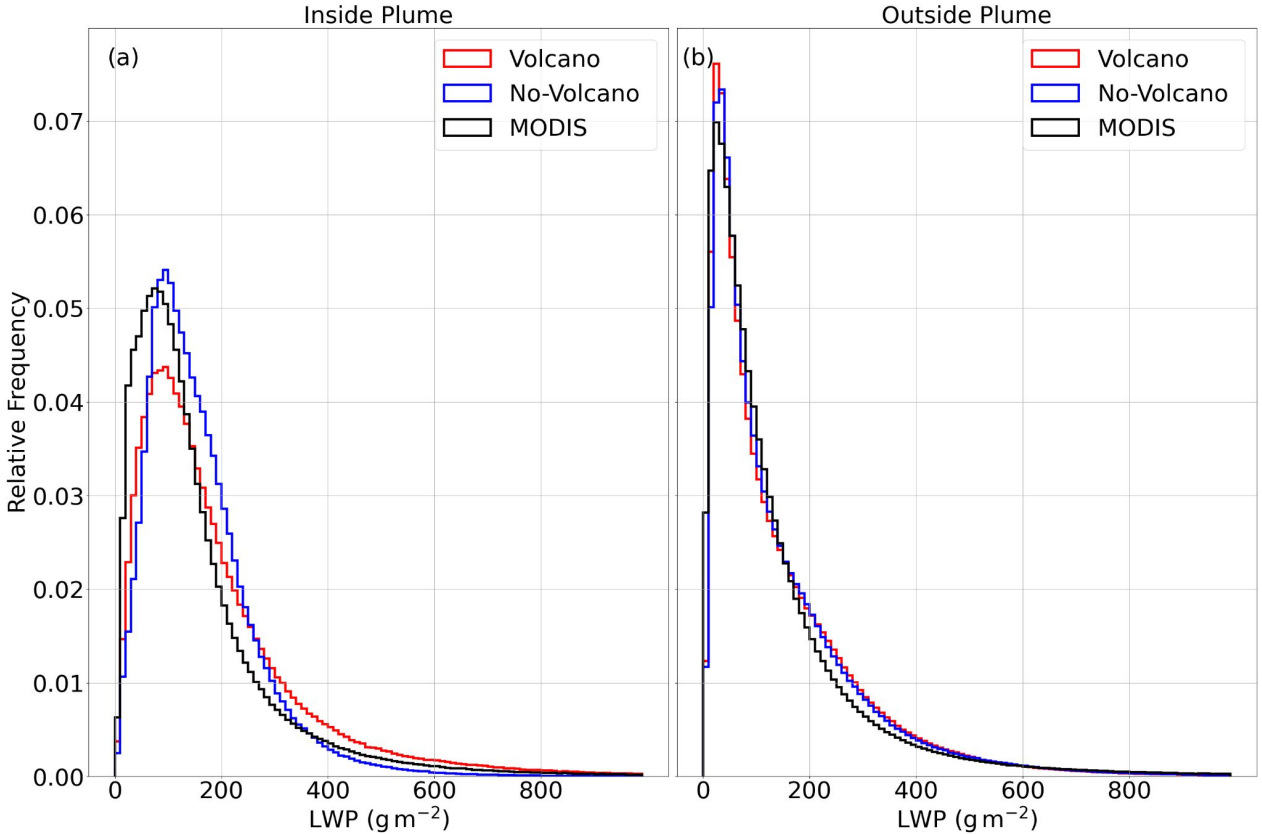
Compare cloud droplet number concentration in simulations and Modis-Aqua



$N_d(cm^{-3})$	
MODIS outside plume	135
MODIS plume enhancement	78%
no-vol outside plume	134
no-vol plume enhancement	0%
vol outside plume	128
vol plume enhancement	77%

Results

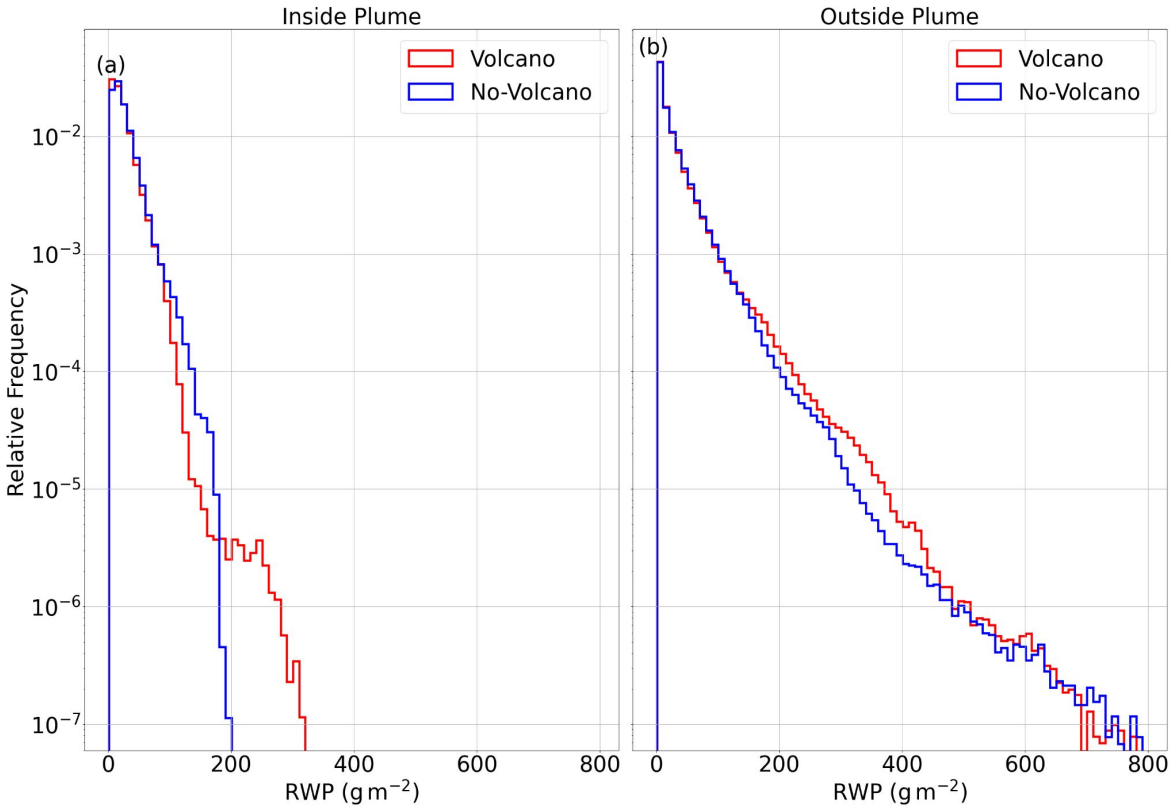
Compare LWP in simulations and Modis-Aqua



LWP(g m^{-2})	
MODIS outside plume	149
MODIS plume enhancement	7%
no-vol outside plume	151
no-vol plume enhancement	6%
vol outside plume	151
vol plume enhancement	30%

Results

Compare rain water path and cloud fraction in simulations and Modis-Aqua



RWP($g\ m^{-2}$)	
MODIS outside plume	-
MODIS plume enhancement	-
no-vol outside plume	13
no-vol plume enhancement	53%
vol outside plume	13
vol plume enhancement	38%

Summary

- ICON-NWP to Cloud-resolving simulation of Holuhraun volcano
- developing a new method in ICON-NWP microphysics scheme to read and interpolate number of activated CCN
- using COSP MODIS simulator in ICON
- determine the SO2 Plume from OMPS satellite retrieval to scale activated CCN as model input
- enhancement in Nd in simulation and MODIS
- shift in the LWP distribution to the higher values