Volcanic impact on cirrus clouds

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Cirrus clouds have a net warming effect on climate due to their high altitude and low optical thickness. Small changes in their properties may however shift this to a stronger warming or a cooling. Aerosol particles can strongly affect cirrus cloud properties since they can act as ice nuclei (IN) for the ice crystals. How downwelling sulfate aerosols from the stratosphere affect cirrus clouds is highly unknown but important both in terms of volcanic impact on climate and possible geoengineering through sulfate injections in the stratosphere. In this study we investigate how the microphysical properties of cirrus clouds change with aerosol loading in the lowermost stratosphere (LMS). The study is focused on the midlatitudes where the descending air motion in the stratosphere result in aerosol downwelling from the stratosphere to the troposphere. The study is conducted during 11 years (2006 - 2016) when the stratosphere had varying levels of aerosol load due to volcanic eruptions.

The cirrus clouds are studied using the satellite dataset DARDAR (raDAR/HiDAR) which combines data from the CloudSat radar and CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation) lidar. Also the aerosol loading in the LMS is retrieved using a satellite dataset, from CALIPSO (Friberg2018). The first results show that the ice water content of the cirrus clouds decrease when the aerosol loading in the LMS increase. This change occur mainly during spring and autumn for homogeneously frozen cirrus clouds. The results regarding the effective radius of the ice crystals are more uncertain but the effective radius also seem to decrease with increased aerosol loading in the LMS. However, this is mainly seen in the northern hemisphere which has experienced the largest changes in aerosol load due to volcanic eruptions during this period. Also data of ice crystal number concentration are being processed and will be studied to better understand the impact on the cirrus clouds from the downwelling stratospheric aerosol.

References