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Modeling heterogeneous ice nucleation due to mineral dust using Dust Regional Atmospheric Model (DREAM-NMME)

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Modeling of atmospheric aerosol transport and interaction with the atmosphere has been challenge for decades because of complexity of the process, insufficient knowledge about sources of different aerosol types, their composition and role in cloud microphysics processes. Many studies have identified mineral dust particles as a very efficient ice nuclei, which glatiate supercooled cloud water through a process of heterogeneous ice nucleation even in regions distant from the desert sources. During last years mineral dust parameterization, as a prerequisite for connecting it to cloud processes, has become one of the priorities in the atmospheric modeling community.
A new generation of ice nucleation parameterization schemes, including dust as ice nucleation agent, along with increasing number of laboratory studies, ambient aerosol/cloud measurements, satellite aerosol observations and model evaluation studies, significantly improved treatment of cold cloud formation and aerosol-cloud-atmosphere radiative forcing.
The Republic Hydrometeorological Service of Serbia, under the activities of the South East European Virtual Climate Change Center, in cooperation with the Environmental Physics Laboratory at the Institute of Physics Belgrade is working on the research, focusing on atmospheric dust cycle modeling and aerosol remote sensing. Dust Regional Atmospheric Model (DREAM) was developed to predict the atmospheric dust cycle, including dust emission, horizontal and vertical turbulent mixing, long-range transport and dust deposition. Our recent study has demonstrated that the number of the ice nuclei due to dust (IN), can be successfully predicted on a routine basis.
In this study, we use DREAM-NMME model to calculate the IN and compare the results with corresponding observations performed at the ACTRIS in-situ and remote sensing station Jungfraujoch over a period of about one month ("Ice Nucleating Particles (INP) measurement by FRIDGE at Jungfraujoch during CLACE 2017, FRIDGE@CLACE2017").
The calculation of the number of ice nuclei in the DREAM model is based on atmospheric parameters (temperature and relative humidity) and on dust concentration. For the different temperature intervals, immersion (-36°C; -5°C) and deposition (-55°C; -36°C) ice nucleation parameterizations have been implemented. Both measurement data at Jungfraujoch, and model data were used for assessing agreement between two methods of representation of activated IN due to dust.
In addition, several sites with ground-based remote sensing instruments and collocated cloud radars and lidars, along with MSG/SEVIRI ice water path satellite observations have been used to evaluate horizontal and vertical distribution of modeled IN respectively.
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