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The effects of heating by transported dust layers on cloud and precipitation: a numerical study

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Abstract. There have been numerous recent publications showing that mineral dust might be a good absorber for solar radiation in addition to its capability to act as cloud condensation nuclei (CCN) and ice forming nuclei (IFN), and could lead to reduced cloud cover and precipitation in the region where it is present. This effect is investigated using a dynamic cloud model with detailed microphysics of both warm and ice phase processes. The model is initialized using measured size distributions and concentrations of mineral dust particles. Our results show that when dust appears at the cloud-base height and below 3 km, where the temperature is warmer than −5°C, the heating induced by the presence of dust layers can inhibit the formation of cloud droplets and suppresses the development of precipitation, leading to lower cloud optical depth and albedo. On the other hand, when the dust layers are located at altitudes with temperature colder than −5°C, or above the −5°C level, mineral aerosols can act as effective ice nuclei, intensify the ice-forming processes, and may enhance the development of cloud and precipitation. It is also found that the heating effect is more pronounced in continental clouds than in maritime clouds.

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