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Dust aerosol radiation effects over the Tibetan Plateau and its surroundings based on CALIPSO observations and radiative transfer model

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Dust aerosol modulates the Earth's radiative budget by the interaction with the solar and thermal radiation, which can enhance cloud evaporation and cause large reducing snow and ice albedo that often exert a great melting potential on glaciers. The Tibet Plateau and its surroundings (TPS), which exhibits unique thermal and dynamic forcings, make the dust over it becoming a very important part of global dust cycle, and having an important impact on regional and global climate. Therefore, it is of great scientific significance to understand dust aerosol radiation effects over the TPS.
Based on 10 years (2007-2016) datasets from CALIPSO V4.10 L2 aerosol profile products, the dust aerosol extinction coefficient profiles over TPS are gridded at 2*2 degree spatial resolution by using the revised averaging method for single aerosol species. In order to evaluate dust aerosol radiation effects accurately and completely, dust in the polluted dust is extracted according to the aerosol particle depolarization ratio. Finally the dust aerosol radiation effects over TPS are estimated with the assumption of transported dust optical properties from OPAC and the constraint of surface albedo from MODIS and water vapor and ozone density from ERA-interim and MERRA-2. Statistical analysis of a large number of dust samples show that the simulated TOA fluxes assuming transported dust optical propertes agree well with those from CERES. The column dust shortwave heating in the Taklimakan desert reaches its maximum ($\sim$ 6.2 k/day) during spring and minimum ($\sim$ 2.5 k/day) during winter. In the southern of TP, the column dust shortwave heating rate of dust aerosol reaches maximum values ($\sim$3.9 k/day) during spring, and minimum values ($\sim$ 1.29 k/day) during the winter. However the column heating rate over the TP is very small, its maximum value appears in spring (only 1.3 k/day).The uncertainties of dust radiation effects associating with the dust optical properties are also discussed in this study.