EGU24-5430, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-5430
EGU General Assembly 2024

A near-global multiyear climate data record of the fine-mode and coarse-mode components of atmospheric pure-dust

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Dust aerosols play a key role in the Earth's radiation budget, in climate system, environmental conditions, and human health. However, the complex role of dust depends not only on the physical and chemical properties, but in addition to the particle size distribution, spanning from less than 0.1 μm to more than 100 μm in diameter. Larger mineral dust particles are more efficiently removed through dry deposition close to the source regions and act more efficiently as CCN and/or IN than fine-mode dust particles, whereas fine dust particles are more prominent to long-range transport, resulting to degradation of air-quality and induced negative disorders on human health.

Here, a new four-dimensional, multiyear, and near-global climate data record of the submicrometer and supermicrometer (in terms of diameter) components of atmospheric pure-dust, is presented. The separation of the two modes of dust is based on a combination of (1) the total pure-dust product provided by the ESA-LIVAS database and (2) the supermicrometer-mode component of pure-dust provided by the first-step of the two-step POLIPHON technique, developed in the framework of EARLINET. The submicrometer-mode component of pure-dust is extracted as the residual between the LIVAS total pure-dust and the supermicrometer-mode component of pure-dust. The decoupling scheme is applied to CALIPSO observations at 532nm. The final products consist of the submicrometer-mode and supermicrometer-mode of atmospheric pure-dust, of quality-assured profiles of backscatter coefficient at 532nm, extinction coefficient at 532nm, and mass concentration. The datasets are established primarily with the original L2 horizontal (5 km) and vertical (60 m) resolution of CALIOP along the CALIPSO orbit-path, and secondly in averaged profiles of seasonal-temporal resolution, $1^{o}\times1^{o}$ spatial resolution, and with the original vertical resolution of CALIPSO, between 70^{o}S and 70^{o}N and covering more than 15-years of Earth Observation (06/2006-12/2021).

The climate data record is unique with respect to a wide range of potential applications, including climatological, time-series, and trend analysis over extensive geographical domains and temporal periods, validation of atmospheric dust models and reanalysis datasets, assimilation activities, and investigation of the role of airborne dust on radiation and air quality.