

The retrieval of dust optical depth and particle size distribution based on the combined MODIS Dark Target and thermal infrared algorithms

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Mineral dust aerosol impacts the radiation budget of Earth, cloud formations, ocean and terrestrial biogeochemical processes, visibility, and human health. The quantification of each impact relies on understanding the spatiotemporal variation of dust physicochemical properties, such as dust loading, optically represented by dust aerosol optical depth (DAOD) and dust particle size distribution.

In this study, we developed a novel joint retrieval algorithm for DAOD at both visible (e.g., 550 nm) and thermal infrared (e.g., 10 μm) and the dust lognormal size distribution over oceans based on observations from the combined long-term MODIS and CALIOP observations. The algorithm inherits the Dark-Target algorithm for non-spherical dust particles [1,2] and integrates with the recently developed thermal infrared algorithm that relies on the CALIOP-observed dust vertical distributions [3,4]. As the TIR retrieval is sensitive to coarse mode dust, the joint retrieval is able to retrieve the full range of dust size distribution, which is also inherently consistent with the DAOD ratio between VIS and TIR, which could help reduce the uncertainty of dust net direct radiative effect estimation.

The retrieval will be validated through the comparison with AERONET observations and retrieval products from MODIS, CALIOP, MISIR and IASI. The long-term climatology of both VIS and TIR DAOD and dust size distributions will also be presented.

References

- [1] Zhou, Y. et al. Dust Aerosol Retrieval Over the Oceans With the MODIS/VIIRS Dark-Target Algorithm: 1. Dust Detection. *Earth Space Sci* 7, (2020).
- [2] Zhou, Y., Levy, R. C., Remer, L. A., Mattoo, S. & Espinosa, W. R. Dust Aerosol Retrieval Over the Oceans With the MODIS/VIIRS Dark Target Algorithm: 2. Nonspherical Dust Model. *Earth Space Sci* 7, (2020).
- [3] Zheng, J. et al. The thermal infrared optical depth of mineral dust retrieved from integrated CALIOP and IIR observations. *Remote Sens Environ* 270, 112841 (2022).
- [4] Zheng, J. et al. Thermal infrared dust optical depth and coarse-mode effective diameter over oceans retrieved from collocated MODIS and CALIOP observations. *Atmos. Chem. Phys.* 23, 8271–8304 (2023).

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