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Detection of absorbing aerosols from ground based observations of scattered sun light

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Absorption of solar radiation by atmospheric aerosols is an important heat source in the atmosphere. The absorption potential by aerosols (usually quantified by the co single scattering albedo) can vary strongly, depending on the aerosol composition. The absorption potential can be captured by in-situ sample analyses or retrieved by remote sensing techniques (e.g. by sun/sky photometry). For a global view, advanced satellite sensors with polarization and especially multi-viewing would be required (e.g. 3MI). However, sensor data at different UV wavelengths (e.g. TOMS) already inform qualitatively on the presence of (elevated) absorbing aerosol (i.e. from mineral dust, wildfires) via the so-called UV absorbing aerosol index (UVAI).

In this study, we propose an UVAI similar approach for ground-based observations of scattered sun light. We first performed radiative transfer simulations. Based on these simulations we found that absorbing aerosols can indeed be identified from ground-based measurements. We could in particular show that the detection of absorbing aerosols is possible in the presence of clouds (except optical very thick clouds), which will be of special importance, because existing remote sensing measurements of the aerosol absorption are only possible for clear sky conditions.

We also derived the UVAI from ground based measurements during a ship cruise in April and May 2019 over the tropical Atlantic. Clearly enhanced values of the UVAI could be detected when the ship crossed air masses which were contaminated by desert dust aerosols from the Sahara.

We present these early results and discuss possible future improvements.