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# Dust aerosol optical depth above Sahara and Arabian Peninsula from CALIOP: comparison with MODIS Deep Blue and MISR

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Sahara is the biggest desert of the Earth contributing about half the global dust emissions. Dust aerosols emitted from Sahara are transported to Atlantic Ocean, Mediterranean Sea and Middle East, while they can reach Americas and Europe. The Arabian Peninsula is also an important dust source region. In situ systematic measurements of the aerosol optical depth AOD above desert areas are very sparse due to extreme meteorological conditions. At the same time, retrieving the AOD from space-borne instruments above deserts is less straightforward than over sea or land.
As an active instrument, the space-borne two-wavelength lidar CALIOP has the advantage to be far less affected by the desert high albedo in comparison to passive instruments measuring in the visible, while it is able to take measurements during nighttime. CALIOP was launched on board CALIPSO in April 2006 with principal aim to characterize aerosols and clouds vertical distribution on a global scale. Thanks to depolarisation at 532 nm, CALIOP is able to discriminate between dust and other types of aerosols, which generally do not depolarize light. However, being an elastic lidar in its retrieval of the AOD, a crucial assumption about the lidar ratio has to be done.

In order to assess the quality of the CALIOP-retrieved AOD (532 nm) above Sahara and Arabian Peninsula we compare it with retrievals from MODIS (Aqua) Deep Blue (550 nm) and MISR (555 nm). For this purpose, the L2 5 km aerosol layer product (version 3.01) is used for the 5-year period June 2006 – May 2011. Only nighttime data are taken into consideration due to better signal to noise ratio and only the aerosols layers with the best quality of discrimination from clouds. The aerosols classes “dust” and “polluted dust” from the L2 product are used and seasonal maps with 1 degree horizontal resolution are established. The choice of seasonal maps permits to overcome the difficulty of CALIOP’s low daily spatial coverage (beam diameter of 70 m at the earth’s surface), while making it possible to provide statistically meaningful results. Two options of aerosol layers with the abovementioned characteristics are examined by taking: i) all the available layers and ii) only the layers without vertical overlap (overwrite) in the same 5 km column (a result coming from their detection with different horizontal resolutions).
For the four seasons, results show that the option of CALIOP aerosol layers without vertical overlap is in better agreement with MODIS and MISR, both over Sahara and Arabian Peninsula, although CALIOP underestimates the AOD generally by 0.1-0.2 in comparison to the other satellite instruments. For the option without vertical overlap above Sahara (10°W-50°E and 10°N-30°N), the correlation coefficient of CALIOP with MODIS is 0.58 and with MISR is 0.72, while the correlation coefficient between MODIS and MISR is 0.76. Above Arabian Peninsula (39°E-58°E and 14°N-32°N) the agreement is better with the correlation coefficient of CALIOP with MODIS being 0.64 and with MISR is 0.79, while the correlation coefficient between MODIS and MISR is 0.63. Possible reasons (lidar ratio, vertical distribution, diurnal cycle) for the AOD underestimation from CALIOP are discussed.