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Vertical distributions of aerosols and clouds over the greater Mediterranean basin using CALIOP observations

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The vertical distributions of aerosols and clouds are a key requirement in aerosol-cloud-radiation interaction schemes. Obtaining global vertical distribution of aerosols and clouds is necessary for more accurate assessments of the anthropogenic and natural radiative forcings and hence climate change. For example, the position of aerosols relative to clouds is of particular importance since it determines the magnitude or even the sign of the aerosol radiative effect, while also affecting microphysical and optical properties of clouds. Vertical distributions of these key atmospheric constituents have become possible in the last few years due to the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) instrument carried on the CALIPSO satellite, which has been obtaining global profiles since June 2006. The Mediterranean basin is one of the most interesting areas for making assessments of vertical distribution of aerosols and clouds because of the enhanced radiative and climatic effects of aerosols in this region and the vulnerability of the area to climatic change.

In the present study, vertically resolved data from version 3 CALIOP database are used to assess the vertical distribution of aerosols and clouds over the greater Mediterranean basin. The CALIOP data, specifically aerosol and cloud optical depths at 532 and 1064 nm, are available at the high resolution of 100m, from surface up to 16 km. They were originally available at 8 (10) layers for aerosols (clouds) and have been converted to the standard resolution of 100 m (160 layers) over the study region extending from 19˚E to 37˚E and from 30˚N to 41˚N. The derived data cover the period from July 2006 to July 2009, a period of three complete years. The vertically resolved aerosol optical depth over the study region allows one to examine the contribution of boundary layer and free tropospheric aerosols to the atmospheric columnar aerosol loading, while it offers the possibility to assess the identification of surface pollution from space measurements. Specific attention is given to the identification of spatio-temporal patterns of cases with airborne aerosols above clouds.

In addition, a comparison between CALIOP version 2 and version 3 data is also performed to assess the changes/improvements applied to the latest version 3 of CALIOP products. Furthermore, a detailed spectral radiative transfer model has been used with an accurate representation of the vertical distributions of aerosols and clouds, based on CALIOP. The purpose is to assess the effect of the vertical distributions of aerosols and clouds on the aerosol radiative effects at the top of atmosphere, within the atmosphere and at the surface.