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# Aerosol effect on atmospheric heating rates in the Mediterranean region using vertically resolved satellite aerosol data

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It is well known that the main direct effect of aerosols is the cooling of the surface and warming of the atmosphere, which impact atmospheric dynamics via the weakening of convection and the inhibition of cloud forming. In order to be able to fully understand and parameterize this throughout the atmosphere, a detailed vertical profile of the aerosol induced surface cooling and atmospheric heating is required. To get a vertical profile like this, detailed vertically resolved data on aerosol optical properties are required. Such data have now become available from CALIOP lidar onboard CALIPSO satellite. Its near-nadir viewing geometry allows for viewing curtains of the atmosphere, thereby defining with sufficient accuracy the vertical position of aerosols and clouds.
In this study, CALIOP Level 2-Version 3 Layer and Profile data for the Mediterranean region from January 2007 to December 2011 have been used. The Mediterranean region was chosen, as it is an area with a mixture of aerosol types, both natural and anthropogenic, where aerosol radiative effects take large values. Furthermore, it is in the proximity of Sahara desert dust, making the area one with large aerosol load. The original CALIOP data have been regridded at a 1°x1° latitude-longitude resolution and at 160 vertical layers. The use of both Layer and Profile data has enabled the derivation of useful 'climatological' products, like spatial properties of aerosol layers, as well as optical properties of them. A comparison with the recently distributed (December 2011) CALIOP Level 3 data, as well as with other satellite data, is presented. Initial results, in agreement with previous studies, reveal that CALIOP aerosol optical depth (AOD) is biased low by around 20%, when compared to other satellite products, such as MODIS.
The regridded data are subsequently used in a spectral radiative transfer model and the vertical profile of direct radiative effect is computed. From that, a vertical heating rate profile due to aerosols is derived for each model grid. The geographical and seasonal variability of these rates are investigated, in relation with the corresponding variability of aerosol optical properties. According to preliminary results, the determination of the cooling/heating rate above the surface and within the atmosphere is not affected by the aforementioned bias of CALIOP AOD. The findings of this study are expected to be particularly useful to future studies that deal with the modelling of the aerosol direct, indirect and semi-direct effects (e.g.. Monitoring Atmospheric Composition and Climate II) while the aerosol induced modification of atmospheric lapse rates will be the basis for further studies of aerosol effects on atmospheric dynamics.