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Vertical distribution of the Saharan Air Layer from 5 years of CALIPSO observations

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The Saharan Air Layer (SAL) forms as dry and hot air moves across the Sahara desert. SAL, containing substantial amounts of mineral dust, is a dominant feature that influences the large scale environment from West Africa to eastern tropical America, inhibiting tropical cyclogenesis and Atlantic hurricane formation. Furthermore, SAL dust aerosols have a strong impact on the energy budget through the so-called direct and indirect effects.
The SAL has been studied with dedicated campaigns at the two sides of the Atlantic or using space observations due to lack of systematic in situ measurements away from the continents. However the campaigns are restricted in time, while satellite observations of thermodynamic variables are affected by the presence of dust. Moreover, satellite measurements of aerosols, particularly in the visible, mostly provide column integrated properties like the optical depth, without information about the vertical distribution. On the other hand, new generation infrared sounders now bring reliable information on the dust layer mean altitude, but their new established results need further validation. However, the two-wavelength lidar CALIOP, launched on board CALIPSO in April 2006, permits an accurate determination of the aerosol 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. Here, the L2 5 km aerosol layer product (version 3.01) is used to calculate the vertical distribution of the dust aerosols above the Atlantic during the last 5 years (June 2006 – May 2011) with a horizontal resolution of 1 degree for the four seasons. More specifically, two classes of aerosols are used from the L2 product: dust and polluted dust, in order to take into account the change of dust aerosols optical properties with transport.
Results show the latitudinal displacement of the SAL between winter [-5, 15]°N and summer [10, 30]°N. Concerning the vertical distribution, the SAL during winter is between the surface and 3 km near Africa, while its top level drops to 2 km near South America. In summer, SAL is found in the range 1-5 km near Africa, while above the Caribbean Sea its southern part reaches the surface and its top drops to 4 km. During the seasonal cycle from winter to summer, the northern low part of SAL appears decoupled from the ocean surface, indicating the influence of the trade winds on the shape of the SAL. This is further examined by using the ECMWF ERA-Interim wind data for the same period.