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Vertical characterization of the Saharan Air Layer using MPL and radiosondes at a subtropical site

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Eight years (2007-2014) of vertical atmospheric extinction profiles extracted from a Micropulse Lidar (MPL) at Tenerife (Canary Islands, Spain) have been analyzed in this work to characterize the Saharan Air Layer (SAL) structure over the subtropical North Atlantic. AErosol RObotic Network (AERONET) aerosol optical depth (AOD) and Angström exponent (AE) for two stations in Tenerife (Santa Cruz sea-level station and Izaña high-mountain station) have been used to define four different atmospheric scenarios, depending on the impact of mineral dust on the planetary boundary layer (PBL) and the free troposphere (FT). Information extracted from atmospheric soundings has also been used to characterize the meteorological parameters.

A relatively well-mixed PBL and significantly clean FT conditions are observed in the case of clean conditions. However, under dust influence at higher levels, predominantly in summer, SAL appears as a decoupled layer above the marine boundary layer (MBL), with an extinction peak at approximately 2.8 km. The Saharan air masses are more humid than clean FT conditions , with a peak of 47% relative humidity found at 5.6 km. The top of this dust-laden layer is observed between 6.4 and 6.6 km, and a decrease in the 0ºC level is also observed in the presence of dusty conditions. In wintertime dust is mainly confined to lower levels, and a similar two-decoupled layers are observed in the vertical but compressed in the first 2 km height. Clean FT conditions were found above this level.

Our results also indicate a reinforcement in the trade wind regime. A possible effect of the SAL on heterogeneous ice nucleation is also hypothesized as a consequence of a higher occurrence of modestly super-cooled altostratus clouds at mid-levels (5 - 7 km) near the SAL's top.