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Radiative effects of long-range transported Saharan Air Layers as determined from airborne lidar measurements

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Mineral dust is one of the major contributors to the global tropospheric aerosol load and thus plays a key-role in the Earth's radiation budget. The Earth's greatest dust source is the Saharan desert. Every year huge amounts of desert dust particles get transported off the Western African coast across the Atlantic Ocean. Thus Saharan dust does not only influence the atmospheric radiation budget close to the source region but also over a distance of thousands of kilometers in the so called Saharan air layer (SAL). Therefore, it is important to investigate the properties and effects of long-range transported Saharan dust over the Atlantic Ocean. In August 2016 remote-sensing measurements onboard the German research aircraft HALO were performed in the context of the NARVAL-II experiment over the sub-tropical Western North Atlantic Ocean. Those measurements took place in the peak season of Saharan dust transport towards the Caribbean and are thus valuable to study long-range transported Saharan dust.

Simultaneous measurements of water vapor mixing ratio and aerosol properties with the DLR combined differential absorption and high spectral resolution lidar WALES showed increased amounts of water vapor within the SAL compared to the dry trade wind atmosphere. For a proper evaluation of SAL- radiative properties it is important to correctly include the water vapor mixing ratio profile in radiative transfer calculations. Due to a lack of measurements former studies that concentrated on radiative effects of Saharan dust made assumptions on the vertical water vapor profile using atmospheric standard profiles and focused on areas near source regions. We use our lidar data set of simultaneous measured water vapor mixing ratios and aerosol profiles over the Western North Atlantic Ocean to calculate the radiative effect of long-range transported Saharan dust employing the 'libRadtran' radiative transfer model. Our calculations show that enhanced amounts of water vapor within Saharan air layers strongly impact the radiative effect of those layers.

In our presentation we will give an overview of the performed measurements and the radiative transfer calculations, and we will show results of calculated heating rates and SAL radiative effects at surface level and at top of the atmosphere.