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Investigation of aerosol effects on shallow marine convection – Lidar measurements during NARVAL-I and NARVAL-II

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Clouds and aerosols have a large impact on the Earth's radiation budget by scattering and absorption of solar and terrestrial radiation. Furthermore aerosols can modify cloud properties and distribution. Up to now no sufficient understanding in aerosol-cloud interaction and in climate feedback of clouds is achieved. Especially shallow marine convection in the trade wind regions show large uncertainties in climate feedback. Thus a better understanding of these shallow marine convective clouds and how aerosols affect these clouds, e.g. by changing the cloud properties and distribution, is highly demanded. During NARVAL-I (Next-generation airborne remote-sensing for validation studies) and NARVAL-II a set of active and passive remote sensing instruments, i.e. a cloud radar, an aerosol and water vapor lidar system, microwave radiometer, a hyper spectral imager (NARVAL-II only) and radiation measurements, were installed on the German research aircraft HALO. Measurements were performed out of Barbados over the tropical North-Atlantic region in December 2013 and August 2016 to study shallow trade wind convection as well as its environment in the dry and wet season. While no or only few aerosol layers were observed above the marine boundary layer during the dry season in December 2013, part of the measurement area was influenced by high aerosol load caused by long-range transport of Saharan dust during the NARVAL-II measurements in August 2016. Measurement flights during NARVAL-II were conducted the way that we could probed aerosol influenced regions as well as areas with low aerosol load. Thus the measurements during both campaigns provide the opportunity to investigate if and how the transported aerosol layers change the distribution and formation of the shallow marine convection by altering their properties and environment.

In our presentation we will focus on the lidar measurements performed during NARVAL-I and NARVAL-II. We will give an overview of the measurements and of the general aerosol and cloud situation, and we will show first results how cloud properties and distribution of shallow marine convection change in the presence of lofted aerosol layers. In particular we will determine if aerosols modify horizontal cloud distribution and cloud top height distribution by looking on the correlations between aerosol load and cloud distribution, and we will investigate if and how the presence of the lofted aerosol layer changes the properties of the clouds, e.g. by acting as ice nuclei.