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Detection of Shallow Marine Cumulus Convection with airborne and spaceborne Lidar-Systems over the tropical North Atlantic Ocean

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Recent modeling and theoretical studies have shown that the vertical and horizontal distribution of cloudiness in the trades has a large impact on the results of cloud feedback calculations. In particular, feedbacks from marine cumulus convection in the boundary layer with maximum cloud top heights of 4 km introduce large uncertainties in climate sensitivity. Characterizing shallow marine cumulus clouds using passive satellite measurements is difficult. The small size of these clouds and the low horizontal resolution of passive satellite sensors as well as the influence of solar background noise on measurements lead to inevitable errors. Airborne lidar instruments allow measurements with high temporal and spatial resolution and are therefore suitable for the investigation of small scale shallow marine cumulus clouds. During the field campaigns NARVAL-I and –II (Next-generation Aircraft Remote-sensing for VALidation studies) in December 2013 and August 2016 over the North Atlantic Ocean measurements with the DLR high spectral resolution and differential absorption lidar system WALES onboard the German research aircraft HALO were performed. Those measurements provide the opportunity to study the horizontal and vertical distribution of shallow marine cumulus convection. Since measurements during NARVAL-I in December 2013 were conducted during the dry season and measurements during NARVAL-II in August 2016 were conducted during the wet season, they can furthermore be used to study seasonal differences in cloud size and cloud top height distributions. During both campaigns sets of A-Train underpasses were flown, that allow to examine the benefit of spaceborne lidar measurements to study shallow marine cumulus convection.

In our presentation we will give an overview of the measurements and we will show first results of derived shallow marine cumulus cloud statistics over the subtropical North Atlantic Ocean. In particular, we present statistical quantities such as cloud top height distributions, horizontal cloud extent and cloud gap lengths obtained during NARVAL-I and –II. Moreover, we show a comparison of those quantities to derived cloud statistics from the spaceborne lidar instrument CALIOP.