Geophysical Research Abstracts
Vol. 19, EGU2017-15950-1, 2017
EGU General Assembly 2017

Comparative Characterisation of Maritime Clouds between Dry and Wet Season Over the Tropical North Atlantic by Airborne Observations

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Trade wind clouds are a major uncertainty in climate models. The observation of these clouds by satellites is limited by the satellite resolution and detailed ground-based observations are lacking. Therefore, the series of Next-Generation Aircraft Remote-Sensing for Validation campaigns (NARVAL) using the High Altitude LOng range research aircraft (HALO) was initiated to assess North Atlantic trade clouds on an appropriate scale. In this presentation, we take the advantage of the synergy of the HALO active and passive Microwave Package (HAMP) in combination with the solar radiation measured by the Spectral Modular Airborne Radiation measurement system (SMART) to characterize shallow clouds in the Caribbean. The two NARVAL campaigns in December 2013 and August 2016 offer the opportunity to study clouds during dry and wet season, respectively.

Based on a cloud mask derived from SMART spectral solar measurements, about 12 000 cloudy profiles describing 4100 individual clouds could be detected during the dry season (NARVAL-I) with about 70 % of the clouds having a length of less than 2 km. Corresponding retrieval of the liquid water path (LWP) using passive microwave measurements reveals that these small clouds contain little water with a third of the clouds having a LWP of less than $50\,\mathrm{g\,m^{-2}}$. Such small clouds are difficult to measure by the spaceborne Special Sensor Microwave Imager/Sounder (SSMIS) due to its coarse resolution while precipitable water vapor agrees rather well between airborne and satellite measurements. Using a simple reflectivity threshold, 7 % of the clouds were identified as precipitating. Precipitation did not show a strong dependence on LWP and there were also precipitating clouds showing a LWP lower than $100\,\mathrm{g\,m^{-2}}$. While the Moderate Imaging Spectroradiometer (MODIS) is able to identify smaller clouds (~ 1 km), it shows deficits in terms of LWP for drizzling clouds.

This presentation addresses differences in cloud characteristics between the tropical dry and wet seasons as revealed based on measurements of 70 flight hours during the dry season and 85 flight hours during the wet season.