UCP2019 - Understanding Clouds and Precipitation

Report of Abstracts

Abstract ID : **197**

Warm clouds over the tropical Atlantic - insights on liquid water path from synergistic airborne measurments

Content

Shallow maritime clouds have been identified as a major uncertainty factor in climate predictions. Advanced observations of key quantities such as the liquid water path (LWP) are a key to better understanding of changing climate. Different satellite LWP records differ by a factor up to two in the tropics. Microwave satellites provide the longest LWP record over ice-free oceans for several decades. However, they suffer from large footprints and superposing signals of clouds and precipitation. Therefore we use spatially highly resolved airborne microwave observations complemented by simultaneous radar and lidar measurements to better understand the LWP of warm clouds over the tropical North Atlantic.

The measurements were taken with the HALO research aircraft which was equipped with several remote sensing instruments, all mounted in nadir orientation. The measurements were collected during two campaigns in the dry (NARVAL-1-South) and wet (NARVAL-2) season. Microwave retrievals of the integrated water vapor (IWV) and LWP were developed using a unique database derived from 1.25 km-resolution ICON simulations. IWV comparisons with dropsondes and water vapor lidar shows good agreement with a relative accuracy better than 5 %. Ancillary measurements for the detection of clear sky conditions is important for the LWP retrieval as the microwave-only retrieval shows an error larger than 100 % for LWP below 20 g/m². Such sensor synergy is crucial as about 65 % of the time clouds with LWP below 20 g/m² were observed and the radiative impact of these clouds is high. The WALES lidar system is best suited for clear sky detection for both campaigns, as solar reflectance measurements frequently suffered from sun glint during NARVAL-2. A combination of passive microwave and active cloud radar observations allows to extend the application of LWP retrieval to drizzle and light precipitation. Rain detection shows significant skill (equitable skill score > 0.5) for rain water paths between 10 and 150 g/m².

Our analysis of both campaigns shows, that although clouds were more frequent in the dry season and have higher mean LWP of about 65 g/m² compared to 44 g/m² in the dry season, clouds with ice precipitation as identified by microwave scattering were more frequent in the wet season. As to be expected the IWV clearly shows that the wet season is more humid, but also reveals that the frequency distribution is strongly affected by the choice of the flight pattern. Therefore, the airborne measurements need to be combined with long-term ground and space-borne measurements to draw statistically sound conclusions.

Primary author(s) : Mr JACOB, Marek (University of Cologne)

Co-author(s) : Dr WIRTH, Martin (German Aerospace Center, Institute of Atmospheric Physics); Dr MECH, Mario (University of Cologne); Mr GUTLEBEN, Manuel (German Aerospace Center, Institute of Atmospheric Physics); KONOW, Heike (Universitaet Hamburg); AMENT, Felix (Universitaet Hamburg); Prof. CREWELL, Susanne (University of Cologne)

Presenter(s) : Mr JACOB, Marek (University of Cologne)

Track Classification : II - Insights from clouds and precipitation from recent and planned field studies

Contribution Type : Oral presentation

Submitted by **Mr JACOB, Marek** on **Wednesday 31 October 2018**