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Sensor synergy to detect clouds and precipitation: results of the first HALO-HAMP flight campaign.

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Clouds and precipitation play an important role in the atmospheric water cycle and radiation budget. Unfortunately, the understanding of the processes involved in cloud and precipitation formation and their description in global and regional models are still poor. Not only models poorly describe such processes, also satellites retrievals often show discrepancies in surface precipitation estimates. To improve our understanding of these processes and to reduce model and retrieval uncertainties, new observation and retrieval techniques exploiting the synergy between active and passive sensors are needed.
In this respect HAMP (Microwave Package for HALO, the High Altitude Long Range aircraft), consisting of a 36 GHz Doppler cloud radar and a 26-channel radiometer, is an ideal test-bed. HAMP radiometers have frequencies along absorption lines (22, 60, 118 and 183 GHz) and in window regions, overlapping with those of AMSUA and MHS. HAMP will participate in winter 2014 in the dedicated remote sensing HALO mission NARVAL (Next-generation Aircraft Remote-sensing for VALidation studies). During NARVAL, the HALO payload will include a water vapor lidar and dropsondes in addition to HAMP. The campaign consists of two parts: NARVAL South, which will take place over the subtropical Atlantic Ocean, with the aim of investigating shallow convection in the trade wind region; NARVAL North, focusing on post-frontal lows over the North Atlantic Ocean.
In this work we present measurements collected during three test flights conducted over Germany during summer 2013 as well as those that will be collected during the NARVAL campaign. Preliminary data analysis will be illustrated, and examples of the synergistic use of active and passive sensors to detect, categorize and quantify hydrometeors will be given. The analysis will focus on precipitation forming west of cold fronts crossing the North Atlantic Ocean, where different satellite retrieval algorithms show discrepancies in surface precipitation, and on precipitation produced by shallow cumuli in the trade wind region, often underestimated because close to the detection limits of the current satellite sensors.