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Comparison of airborne lidar configurations in a radar-lidar retrieval technique as a preparation for the future EarthCARE mission

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Remote sensing measurements and more particularly synergies of active remote sensing instruments have shown considerable potential for the documentation of cloud climatology, especially since the development of space missions. The Cloudsat-CALIPSO tandem mission, from NASA's A-Train constellation, has been successfully providing insights of cloud microphysical mechanisms for more than 10 years. The upcoming ESA/JAXA EarthCare (Earth Cloud Aerosol Radiation Explorer) satellite is expected to play a major role in the future of Earth observing space missions as it will provide simultaneous profiles of clouds, aerosols and precipitation from state-of-the-art remote sensing instruments mounted on the same platform.

Such information can be completed with airborne measurements for more specific and lower-scaled cloud processes. Moreover, airborne instruments can also be used for data validation and instrument calibration when the aircraft takes concurrent measurements under the satellite track. In this context, a field campaign took place in Iceland, Keflavik in October 2016, taking advantage of 2 research aircraft, French F20 and HALO (High Altitude and Long-range) being operated within the NAWDEX (North Atlantic Waveguide Downstream Experiment) campaign. Both aircraft were boarding active and passive remote sensing instrumentation perfectly in line with the A-Train and EarthCARE payloads. For instance, the RALI platform, on board the French SAFIRE Falcon 20, consists in a radar-lidar platform combining the measurement of the 95GHz multiple-beam Doppler cloud radar RASTA and the high spectral resolution (HSR) LNG lidar with two simple backscatter measurements at 532 nm and 1064 nm and HSR and depolarization channel at 355nm. This payload offers several options from the Cloudsat-CALIPSO-like configuration to one similar to the upcoming EarthCARE project (a 94GHz Doppler radar and a high spectral resolution lidar at 355nm on the same platform). Similarly, the payload on board the HALO operated by DLR, consisting in the MIRA 35GHz
Doppler dual-polarization radar combined to the WALES HSR
Lidar with a high spectral
resolution channel at 532nm, also allows for EarthCARE-like measurements and provides an independent remote sensing measurement dataset for comparisons with RALI during conjoined flights.

Both RALI and HALO measurements can be implemented in a variational scheme that retrieves ice cloud properties such as Ice Water Content and effective radius from the combination of radar and lidar observations. The presented work will focus on the comparison of the different lidar instrumental configurations made available by both aircraft during the NAWDEX campaign: we will show what the HSRL channel can provide us with as additional information and how to make the best of it in our radar-lidar variational algorithm.