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Multi-sensor approach to retrieving water cloud physical properties and drizzle fraction

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Accurately representing clouds and their interaction with the surrounding matter and radiation are one of the most important factors in climate modeling. In particular, feedback processes involving low level water clouds play a significant role in determining the net effect of cloud climate forcing. An accurate description of cloud physical properties is therefore necessary to quantify these processes and their implications. To this end, measurements combined from a variety of remote sensing instruments at different wavelengths provide crucial information about the clouds. To exploit this, building upon previous work in this field, we have developed a ground-based multi-sensor retrieval algorithm within an optimal estimation framework. The inverse problem of 'translating' the radar, lidar, and microwave radiometer measurements into retrieval products is formulated in a physically consistent manner, without relying on approximate empirical proxies (such as explicit liquid water content vs radar reflectivity factor relationships). We apply the algorithm to synthetic signals based on the output of large eddy simulation model runs and present here the preliminary results. Given temperature, humidity profiles, information from the measurements, and apriori contraints, we derive the liquid water content profile. Assuming a monomodal gamma droplet size distribution, the number concentration, effective size of the cloud droplets and the extinction coefficient are computed. The retrieved profiles provide a good fit to the true ones. The algorithm is being improved to take into account the presence of drizzle, an important aspect that affects cloud lifetime. Quantifying the amount of drizzle would enable the proper use of the radar reflectivity. Further development to allow retrieval of temperature and humidity profiles as well is anticipated.