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Cloud radar and lidar assimilation at ECMWF

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Cloud related observations, such as those from microwave radiances, have been at the forefront of recent developments in assimilation, but contain limited information on the vertical structure of clouds. Active observations from profiling instruments such as cloud radar or lidar contain a wealth of information on the structure of clouds and precipitation, providing the much-needed vertical context of clouds, but have never been assimilated in global NWP models. Inspired by the success of previous experiments, in which CloudSat radar reflectivity and Calipso attenuated backscatter profiles were indirectly assimilated via pseudo-observations of temperature and humidity, the European Centre for Medium-range Weather Forecasts (ECMWF) 4D-Var system
has been adapted to allow their direct assimilation.

In this presentation, several important developments required to prepare the data assimilation system for the new observations of cloud radar reflectivity and lidar backscatter will be summarized. This includes the specification of sufficiently accurate observation operators, i.e. models providing equivalent model fields to observations. Another important aspect is observation error definition; the observation error of cloud observations is highly situation dependent, so a flow-dependent error model will be presented that accounts for both the spatial representativity error and the uncertainty in the microphysical assumptions. In addition, for the proper handling of observations in the context of an assimilation system, an appropriate quality control strategy and bias correction scheme are required and will also be discussed. Finally, the potential of EarthCARE data for directly improving weather forecasts by assimilating cloud radar and lidar observations into a global NWP model will be demonstrated. Prospects for increasing the direct benefit of cloud radar and lidar assimilation will also be discussed.

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