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Evaluation of the capability of Lidar and Radar measurements to reduce uncertainty in Cloud Resolving Model cirrus simulations

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The characteristics and the persistence of cirrus clouds strongly depend on key dynamical and microphysical processes as well as interactions between clouds and radiation and dynamic. There are currently numerous parameterizations connecting the size of the particles to the mass, the fall velocity and their optical properties. We show that the diversity of available parameterizations generates strong uncertainties on the properties of the cirrus simulated by a Cloud Resolving Model (CRM). Previous studies show the lidar and Doppler cloud radar measurements abilities to derive ice density and particle fall speed parameterizations. The aim of this study is to evaluate these parameterizations in a CRM. Radar and lidar observations are sensitive to size, shape and concentration of cloud particles. In our simulations, concentration and size of the particles are prognostic variables, while the shape is prescribed. In this way, we are able to calculate synthetic lidar and radar observations from the output fields of the model without additional hypotheses, which are directly compared to the observations. From several sets of synthetic observations, we have also derived new parameterizations and compared them with the parameterizations currently used in the CRM. Ice microphysical properties retrieved from the observations are also compared to those simulated from the CRM. We finally analyze the ability of lidar and radar techniques to reduce uncertainty in CRM cirrus cloud simulations.