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Multi-year evaluations of a cloud model using ARM data

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The advent of multi-scale models, wherein cloud system resolving models(csrm) is embedded in each large-scale grid column a model, make increased demands of the csrm. Spatially coarse configurations of these csrms are used to reduce computational cost, but while higher resolution versions are known to out-perform parametric models in case studies, little is known about the performance of coarse configurations over a wide-range of atmospheric states. This work exploits long-term lidar and radar retrievals of the vertical structure of cloud, at the Atmospheric Radiation Measurement (arm) programs Southern Great Plains (sgp) site, to evaluate cloud occurrence in 3-year model runs of three csrm configurations of varying resolutions and sophistications. To make the modeled and observed fields more comparable, we use the definition of cloud occurrence according to sensitivity of the observing instruments and map this to the model. As well traditional performance measures that assume ergodicity, probabilistic measures, used in ensemble forecast verification, are also applied, which do not require any temporal averaging of the observations.

When thermodynamics is constrained, the overall bias in modeled cloud occurrence is relatively small in all model runs, suggesting this field is relatively well calibrated in all of the model configurations considered. The Brier scores attained by all configurations also suggest considerable model skill. Greater difeerences in performance are found between seasons than between model configurations during the same season, despite substantial di?erences between the computational costs of the configurations. Several signi?cant seasonal dependencies are identified, most notably: greater conditional bias, but better timing, of boundary-layer cloud in winter, and substantially less conditional bias in high cloud during summer.