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Geoscientific Model Development Discussions

Interactive comment on "Using Radar Observations to Evaluate 3D Radar Echo Structure Simulated by a Global Model" *by* Jingyu Wang et al.

Anonymous Referee #1

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This is a nice paper testing the performance of the NCAR climate model against observations from the US weather radar network. My view is this is important and that more climate models need to be tested against observations, both for current and recent climate but also studies such as this focusing on representation of key processes.

Note the large scale circulation in this model is being nudged towards observations, so that the performance being discussed represents an upper bound. It would be interesting to also compare the output from an extended period of the model in free running mode as for CMIP and looking at the latter part of 20th Century and early 21st century runs so that the forcings are consistent with current observations. I suspect the

key limitations outlined in the nudged runs will be at least as large and possibly greater.

The analysis looks at a few metrics including the overall spatial distribution and the vertical profiles of reflectivity. This is OK as far as it goes, but I feel further and deeper analysis will yield more information on the process limitations in the model. For example, further insights would be gained by examining the mean diurnal cycle of convection and how that compares with observations over the great Plains. Does the model reproduce the night-time maxima over the eastern plains and as a difficult test are propagating modes observed modulating the diurnal convective activity (cf. Carbone and Tuttle, J Clim., 2008). Is the spatial distribution of time of peak convection at all captured or is it dominated by a morning maxima as convection triggers too early in daily heating as occurs in many simulations in the tropics. The diurnal cycle of convection is also important for the resulting cloud and radiation climatology of the model.

In Sect 3.1, where there is a mean difference in reflectivity. Noting these are linear averages over a 100 km area, do you have a feel how much of this is associated with differing convective fractions within the grid points, differing fractions of precipitation or differences in the PDF of the reflectivities not associated with the convective/precipitating fraction? Have you compared convective fraction from the model paramaterisations with observations? Diagnostics looking at fractional cover can also aid interpretation and diagnose issues.

In Section 3.3, comparing NEXRAD and subscale distributions – testing maybe could be earlier in the paper and is there is a degree of circularity in your argument since you are adjusting the sub-grid scale distributions with the observed NEXRAD data and so naturally there is increased agreement. Note that the bimodality in the original distributions shown in Fig 4 are not generally observed in nature.

As a minor point, on line L130, using NEXRAD also simplifies the radar scattering calculations compared with GPM and TRMM with the 10 cm wavelength radar being close to Rayleigh scatter most of the time although the scattering calculations are still

complex for ice habits

Overall, I think this is a useful study, but would benefit from being taken further. It is clearly addressing important issues with climate models and as noted these kind of studies are sorely needed. The methods are clearly articulated.

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