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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud-system resolving model simulations of aerosol indirect effects on tropical deep convection and its thermodynamic environment" *by* H. Morrison and W. W. Grabowski

Anonymous Referee #2

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This paper studies the impact of aerosol particles on the properties of tropical deep convection and the corresponding anvil cirrus clouds. The authors present results of 240-member ensemble simulations using a two-dimensional nonhydrostatic anelastic fluid flow model with a 200 x 24 km model domain and a 1 km horizontal grid spacing. The aerosol indirect effects on clouds were investigated with a two-moment microphysical scheme. Simulations were conducted with pristine, polluted or highly polluted aerosol concentrations for a 6-day period during the TWP-ICE experiment of 2006.

The authors conclude that the domain-mean surface precipitation is not sensitive to the aerosol loading because the large-scale meteorological conditions govern the water

and energy budgets. On the other side, small fluctuations in the strength and timing of individual deep convective events for the same aerosol loading show a large spread in the top-of-the-atmosphere shortwave and longwave radiative fluxes. They also find that the cloud top heights and ice mixing ratios in the anvil are higher for polluted conditions. This is due to the fact that for higher aerosol concentrations more cloud droplets are able to freeze, leading to a higher concentration of smaller ice crystals with a smaller fall velocity.

In general this paper is very well written and presents interesting results, which matches the scope of Atmospheric Chemistry and Physics. I recommend this manuscript for publication after some minor revisions.

1) Discussion of Fig. 5 on page 15585/15586: Could the authors give an explanation why the signal of the precipitation flux of the ensemble members matches very good in time and amplitude with the measurements, while the other fluxes of sensible and latent heat are shifted in time. I understand that the difference in the sensible and latent heat flux is due to different representation of the ocean compared to the reality. But why does this have no influence on the precipitation signal?

2) P15592, line 18: The authors state that much of the impact of pollution on RSW is due to changes in the liquid microphysics. Therefore it would be nice to get more information about the cloud droplet activation (e.g. activated fraction), especially in the convective updrafts (w> 1 m/s). Fig. 13 only shows the horizontally averaged vertical profiles.

3) 6.2: Domain configuration tests: The authors show the large differences in the result when the grid spacing is changed from 2 to 4 km, but provide no explanation why this could be. Therefore, it would be nice if the authors could give some ideas.

4) It would be nice to have not only the three high- and low-OLR members in the figures, but also the median or mean.

5) p15584 equations: Definition of ω is missing.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 15573, 2011.