

Interactive comment on “Effect of anthropogenic aerosol emissions on precipitation in warm conveyor belts in the western North Pacific in winter – a model study with ECHAM6-HAM” by Hanna Joos et al.

Anonymous Referee #1

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Review of “Effect of anthropogenic aerosol emissions on precipitation in warm conveyor belts in the western North Pacific in winter – a model study with ECHAM6-HAM” by H. Joos et al.

This is one of the first studies to investigate the impact of aerosols on precipitation in extratropical cyclones in global models and extends the results of two previous cloud-resolving model studies that simulated just one ETC. As such, it is an important contribution to the field. In agreement with these previous two studies, the authors find no systematic change in precipitation due to aerosols despite large changes to cloud

C1

droplet number concentration. The explanation for why there is no change in precipitation could be improved and a few inconsistencies exist in the discussion as detailed below. Overall this paper should be accepted with minor revisions.

Major Comments:

1. Lines 351-361. This paragraph does not seem to be well substantiated by the figures. “larger and fewer cloud droplets . . . lead to a fast removal of condensate from the atmosphere”. However Figure 4e shows that there is virtually no difference between the clean and polluted trajectories in terms of condensate. The PI trajectories have less condensate throughout, and the rate of removal (after the peak at 750 hPa) is actually slower than for the PD trajectories. Then, the authors state that more BC in the PD clean trajectories compared to the PI trajectories reduces the efficiency of precipitation formation, yet Figure 4f shows the precipitation production to be nearly the same.
2. It took me a long time to understand what was being shown in Figure 6 and discussed in Lines 362-370. This description of the figure needs to be improved. Up until this point, “WCB” and “WCB trajectory” are used almost interchangeably which makes the phrase “all WCBs have a large fraction of clean trajectories” very confusing. I finally understood that here WCB is used to mean a collection of trajectories that all start at the same time. Perhaps the y-axis could say “number of WCBs”? Also, by definition, only 10% of trajectories are “polluted.” So it is not surprising that a low fraction of the trajectories are polluted. I would expect that the corresponding plot for clean trajectories would look similar.
3. Line 386-388. These two sentences are unclear. Why does it follow that the precipitation is initialized first in the clean trajectories? Plus, as mentioned by the authors, even the clean PD trajectories are much more polluted than the PI trajectories. So why is there still such little difference in the precipitation? I don't think that this question has been addressed sufficiently.
4. A statement of data availability is missing.

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Minor Comments:

5. In the abstract, the authors state, “We conclude that while polluted warm conveyor belt trajectories start with 5-10 times higher black carbon concentrations, the overall amount of precipitation is comparable in pre-industrial and present-day conditions. Precipitation formation is however suppressed in the most polluted warm conveyor belt trajectories.” At first, these sentences seem contradictory. Without further information, one assumes that the present-day conditions are the same as the polluted WCBs. I recommend changing the first sentence to “While present-day conditions contain some polluted warm conveyor belts . . .” or something similar.

6. Line 362. The authors have not shown a difference in the onset of precipitation since all trajectories show precipitation occurring at the lowest levels.

7. Figure 4d. Does the mean really lay outside of the 25-75th percentile? It’s theoretically possible, but seems unlikely.

8. For me, Figure 5, particularly 5a, does not add much insight to the discussion since it shows the same information as in Figure 4, just plotted differently.

Typos:

1. Line 9: suppressed
2. Line 253: mountains
3. Line 329: concentration

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