Review of “Effects of Model Grid Spacing for Warm Conveyor Belt (WCB) Moisture Transport into the Upper Troposphere and Lower Stratosphere (UTLS) - Part I: Lagrangian”

by Schwenk and Miltenberger

General comments:

In this study, the authors explore the effect of changing horizontal resolution on the representation of warm conveyor belt moisture transport in the ICON model. By employing Lagrangian trajectories, they show that the convection-permitting, finer resolved model simulation results in higher vertical velocities within the WCB. This results in altered cloud microphysical processes and properties compared to the convection-parameterizing simulation.

The manuscript is logically structured and well written. I have some minor technical concerns regarding the setup and the intercomparison of the simulations. Nevertheless, this manuscript merits publication provided that the following comments are addressed.

Specific comments:

- P5, L149-151: The choice of two-way coupling introduces a significant challenge for attribution. Because the nested grid feeds back into the global domain, the “nested” setup will naturally diverge from the “global” control, eventually resulting in different synoptic states, in particular towards the end of the simulation period. Consequently, it is intricate to tell whether the reported differences are a direct result of increased resolution or simply a byproduct of this dynamical divergence. I would like the authors to clarify their rationale for this setup, as this could be avoided by employing a one-way coupling where the synoptical state in the global domain is identical between “nested” and “global” setup.
- A potential concern regarding the comparison between the “nested” and “global” simulations is that the trajectories are evaluated at different horizontal resolutions. Without a scale-aware framework, it is difficult to determine if the reported differences are due to resolving finer-scale or merely methodological. To isolate the added value of the finer resolution, I recommend that the authors coarse-grain the nested trajectories by averaging them within the spatial footprint of the global grid boxes. If the discrepancies persist after this upscaling, they can be more confidently attributed to the non-linear effects of resolving finer-scale processes.

Minor Remarks:

- P11, L281: *“… at one …”;* I assume you mean “… are on …“

- P12, L290-292: Here, the authors state that the underlying distributions are different between the two setups, but you nevertheless report mean values. As the mean is a parametric quantity that is dependent on the underlying distribution, using means to

compare the quantities is only valid if the underlying distributions are equal. I would therefore refer to reporting mean values, but rather median values, as they are independent of the underlying distribution. Please check for further occurrences in the manuscript.

- P15, L362-363: *"… increasing …";* change to "…increases…"

- P19, L472-473: I would also see a second effect that might cause the stronger graupel production. Due to the higher vertical velocities, saturation with respect to water can be more easily sustained, which might to some extent compensate for the depleting effect of the Wegener-Bergeron-Findeisen process for liquid hydrometeors, thereby causing higher graupel production.

- P26, Fig. A1: For better orientation, I would ask the authors to unify the geographical extent and add coastlines.

- P22, L516: *"… below pressures of above 500 hPa …"*; It is not fully clear to me what the authors mean here.