

## **Review of «ICON simulations of cloud diabatic processes in the warm conveyor belt of North Atlantic cyclone Vladiana” by A. Choudhary and A. Voigt**

In this paper, the representation of the warm conveyor belt (WCB) which is associated with the extratropical cyclone Vladiana in ICON simulations is discussed. The authors compare in detail the characteristics of the WCB in 18 simulations with 6 different horizontal resolutions, ranging from 80km to 2.5 km, parameterized and explicit convection, as well as 1 and 2-moment cloud microphysical parameterizations. The presented analysis is a valuable contribution to the existing literature as it is not well understood how the representation of WCBs and their impact on cyclone evolution, precipitation, the upper tropospheric flow structure and the downstream flow evolution will change with increasing resolution and the explicit treatment of convection in future weather and climate models.

Although the authors do not discuss all of these implications but focus on cyclone intensification, I would recommend to accept this publication with minor revisions.

### Minor comments:

- For all model resolutions you use offline trajectories which are calculated based on 1-hourly output fields. While I see the reason for that I think it would be good if you included some more critical discussion about this fact. In line 221 you say that the slower ascent is caused by the fact that you use offline instead of online trajectories (in comparison to Oertel et al., 2019). However I'm not so convinced that this is necessarily the case. By using the instantaneous value of the vertical velocity every hour in your offline trajectories it could also be that you overestimate the ascent. In case the trajectory at this point in time sees very high convective updrafts which might be relatively short lived, you assume that this high velocity lasts for one hour. This might not be so important when going to coarser resolutions but for the high resolution simulations I think it could happen. Or maybe this effects cancels in the mean over all trajectories as some of them also assume “unrealistic small updrafts speeds” over one hour? Could you add some more thoughts on this to your text?
- I think it is interesting to see that the number of trajectories in the trajectory 2 cluster strongly increases whereas this increase is less pronounced for the other ones. I wonder what the reason for this is? Do you know where these trajectories originate in comparison to the others? Are they especially convective? Are there special mesoscale substructures e.g. in moisture and or theta values in the higher resolution simulations where these trajectories originate? Or what is the evolution of different parameters like, p, theta, q, ....along this cluster compared to the others? Maybe this is out of the scope of your study but maybe you have thoughts on this which you could include?
- Lines 115 ff: The synoptic description could be a little bit more precise, e.g. in line 118 you say that there are low PV values north of the British Isles, however they are low over the whole Island including Ireland....and in Line 118: you state that the cyclone is decaying in the next 24h, however the minimum presses in Fig. 1c is still at 985 hPa → please adapt the description of the synoptic evolution.
- End of chapter 4: You show that the deepening of Vladiana is not due to diabatic processes and that in this case the WCB does not contribute to the cyclone intensification. However is it possible that the WCB contributes e.g. to the formation or strengthening of PV anomalies at the cyclone's warm and cold front and that there is a

difference between the different resolutions? Could a better representation of fronts and the diabatic processes in there in the higher resolution datasets lead to changed mesoscale weather phenomena, like enhanced precipitation or different precipitation patterns, changed PV anomalies associated with also differences in the wind speed?

Style comments:

- Line 91: ..with analysis and forecast data from the ECMWF.....why do you use forecast data here and not only analysis data ?
- E.g. line 105: make sure that the date formats are the same everywhere
- Line 158 end: "... to be be..." → remove one be
- Figure 2 caption: trajectory 3 (red) , should be "yellow" ?
- Figure 5 caption, 2. Line: ...,with given by the right x-axis → right y-axis.
- Figure 5: Panels a and b should be horizontally aligned, or maybe even remove panel b as not much is changing and only mention it in the text
- Figure 6: Aling as 2X2 figure, not all 4 in a column
- Line 262: Section title: "4 Synoptic evolution of cyclone Vladiana ....." → "4 Pressure evolution of ...."
- Figure 8: align panels horizontally and vertically.
- Line 293: intergral → integral
- In the reference list there are still many typos (e.g. capital letters, "" signs.....), please correct