

**Interactive comment on “Synoptic-scale conditions and convection-permitting hindcast experiments of a cold-season derecho on 3 January 2014 in Western Europe”**

By Luca Mathias et al.

**Anonymous Referee #2**

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This paper presents a series of high-resolution simulations of a high-impact winter severe weather event in Europe. This event was poorly represented in the operational FC and the paper addresses the question of why this was the case. The results very nicely shows that very high temporal resolution boundary condition input is required to capture the event with high resolution simulations. The main findings are clearly communicated and well documented and I have only minor questions and requests for changes.

A: We would like to thank the reviewer for his/her time spent on the manuscript and his/her thoughtful comments that helped to improve the manuscript. Point-to-point responses to each comment can be found below (marked in red). We have included a careful justification for those points where we did not fully follow the suggestions by the reviewer.

L22 endure last

A: We replaced “endure” with “last”.

L23 for a broader readership consider to define the term derecho

A: We have now included a complete definition of the term “derecho” in the introduction.

L24 might may

A: We replaced “might” with “may”.

L29. Please define straight-line wind damage

A: We replaced “straight-line wind damage” with “non-tornadic wind damage”.

L33/34 under suspicion of being produced by were likely affected by tornados.

A: We deleted that part of the sentence.

L43 It is unclear what is meant by “these specific characteristics”

A: We replaced “These” with “All the above-mentioned” to make this statement clearer.

L46 Please define strongly forced

A: “Strongly forced” is a term which is generally used in the literature to describe synoptic situations with strong large-scale/QG forcing for ascent.

L51 with regard to for

A: We replaced “with regard to” with “for”.

L101 the statement “which in the end leads to two additional distinct input datasets” is unclear

A: We removed that statement.

L133 What do you mean by the statement “while the ECAN boundary conditions remain unchanged”?

A: It means that the wind and moisture fields of the ECAN boundary conditions were not changed, in contrast to the wind and moisture fields in the initial conditions.

L144 discontinuity of what?

A: We deleted the term “discontinuity” to avoid confusion.

L153 I am more familiar with the term anticyclonically tilted

A: “Negatively tilted” means that the trough axis has a NW-SE-orientation.

L162ff Why was the event not recognized by the forecasters if all the ingredients were so clearly present?

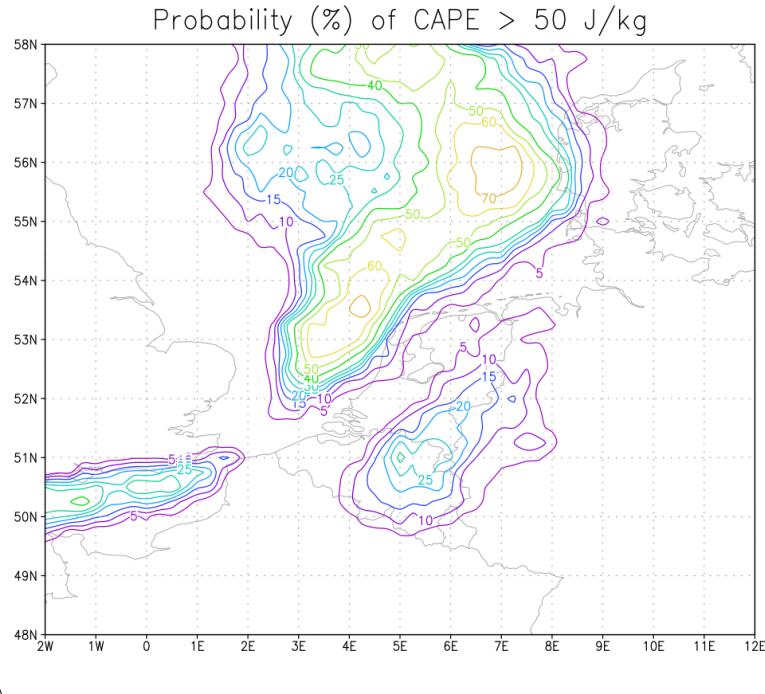
A: Two important ingredients - the lifting mechanism (surface trough) and the latent instability over Benelux - were not fully anticipated in the forecasts of the event.

L185 The high shear values are of course related to the fact that Kyrill was one of the strongest storms in this area in the last decades, maybe add a comment.

A: We added “in a highly baroclinic environment”.

L194ff: Could you in addition to the surface wind signature briefly comment on how the env. Conditions for convection (shear, stability etc.) were represented in the fc?

A: We added a sentence mentioning that the ECMWF-EPS underestimated the latent instability over Benelux (see figure below).



**Figure R1.** Probability of CAPE being larger than 50 J/kg at 1800 UTC on 3 January 2014.

L209 Do you know why the trough was missing in the simulations? Were dry or moist dynamics responsible for this failure? L225 Related to the previous point, how exactly did the trough form?

A: The formation of the surface trough associated with the DMCS was likely linked to another surface trough moving to Ireland. We have shown that with the different update frequencies of LBCs in the CCLM-ERA5 simulations.

L240 Please define low-end CAPE

A: It is defined as CAPE  $< 150 \text{ J/kg}$ , which is indicated in the brackets.

L252 Could you add the observations to figure 13, going back and forth to figure 1 makes the comparison quite cumbersome.

A: Our intention is not that the reader should compare every point in situ observations with the model fields. We only wanted to provide a general comparison of the overall gust strength, and hence we chose to use the same colorbar.

L265 Please define linear upscale growth

A: Formation of a more or less closed convective line based on initially scattered convective cells.

L267 Can you really call a trough a boundary?

A: We changed the term to “convection-initiating convergence zone”.

Figures: The line labels are in most figures difficult to read and I recommend increasing their size

A: We increased the size of the line labels in Figure 4 and removed the contour lines in Figure 6. We removed Figure 5 entirely. Overall, we enhanced the readability of our figures.

Figure 1: can you highlight the location of the Larkhill sounding more prominently?

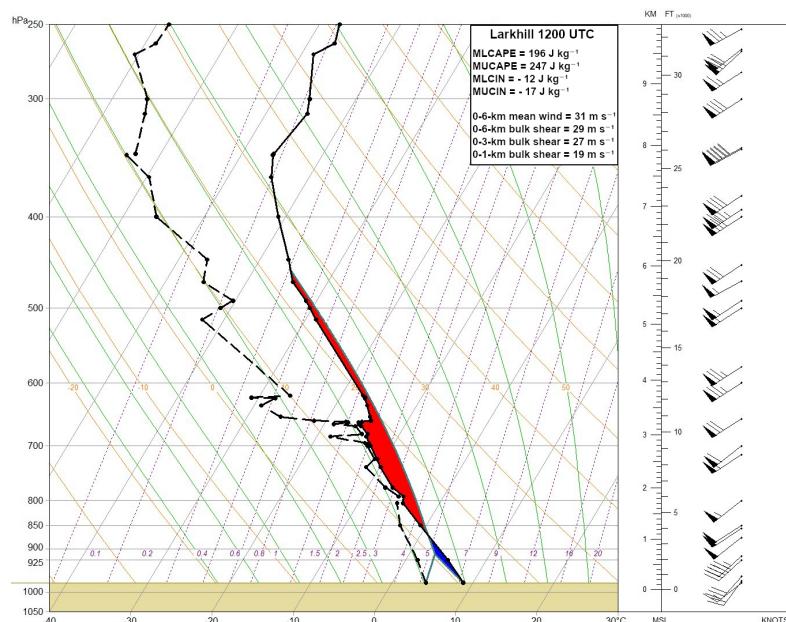
A: Larkhill is now highlighted more prominently with a dark blue dot.

Figure 4f: Do you have an indication if the upward motion is mainly in response to diabatic heating or due to qg forcing?

A: Mainly in response to QG forcing, as it was associated with an amplifying/digging upper-level trough.

Figure 7: I am not familiar with this graphical representation of the MU cape. Are the unit values really around 1 J/kg? How do the values add up to 202 J/kg?

A: We changed the graphical representation of MUCAPE and MUCIN (see Fig. R2). It should be clearer now.



**Figure R2.** Updated Fig. 6 (old Fig. 7). MUCAPE (MUCIN) is denoted by the red (blue) area between the temperature profile and the parcel ascent curve.