Review of:

Left- and right-moving supercell dynamics, environments and hazards — today and in future

Monika Feldmann, Sandro Beer, Aaron W. Zeeb, Killian P. Brennan, Lena Wilhelm, and Olivia Martius

General Comments:

This manuscript is of excellent scientific significance. It addresses an important gap in the literature for left and right moving supercells in Europe (but probably has broader applicability), and investigates a pressing issue as our warming climate impacts thunderstorm environments and characteristics around the world. The methods also appear to be robust and well suited for this endeavor.

The presentation quality needs additional work in some areas, in my opinion. I have included suggestions below for many of the figures. With respect to the writing, there are several grammatical issues throughout the manuscript that need to be addressed before publication (see below). There are also numerous instances of one and two sentence paragraphs throughout, which should be addressed.

Specific comments:

Title: European left- and right-moving supercell dynamics, environments and hazards — today and in the future
  - Not that the physics that result in supercells in Europe are different than anywhere else, but the way in which favorable environments and the hazards they support certainly could be. And, since the simulations are focused here, I think this is needed.

Fig 1: why have the right and left mover labels oriented differently than the subplot colorbars or labels? I find myself turning my head to try to read this, which is annoying. Also, it would be nice to show these same fields for the PGW simulations (not raw values, but as deltas vs present day). I think you can shrink the subplot size just a little and fit this all into one figure. If you made this figure the same format as you have in Figure 7, it would be much more readable.

Figure 2: I think you can show both present day and future hodographs on the same plot (use a different shade of the colors for present vs future, or use a different linestyle). It would be easier to visualize changes (or lack thereof). As it currently is, it's difficult to see what those are. You could make the plot bigger this way too. You do this in several of the other figures, why not here?

Figure 4: As with figure 2, changes between epochs don't stand out, and these plots have a lot going on. Would imagine most readers of this journal are familiar with the basics of skew-T's, so having all the adiabats/mixing ratio lines/LCL height dots/CAPE & CIN shading, and the notation

on the -10C isotherm aren't necessary and make the plot messy. Like with the hodographs, you could make this into a larger single figure, and then use solid lines for the present day and dashed lines for the future (again, considering the audience, don't think it's necessary to make the Td lines dashed - we all know which lines are which). At minimum, I'd move LM's to one subplot and RM's to the other. As it is, this seems like we're comparing those environments (which we already know are going to be different) vs changes between present and future.

Figure 5: I really like how the comparisons between both storm types and epochs on the same plots here, but I wonder what some of the parameters that the literature has shown to have statistical separation and can be helpful discriminators between RM/LM storm environments: 0-1, 0-3m or 1-3 km SRH like Bunkers 2002 used, along with some of the other parameters that have shown separation between supercell and nonsupercell environments, highlighted from Thompson et al. 2003 (https://journals.ametsoc.org/view/journals/wefo/18/6/1520-0434_2003_018_1243_cpswse_2_0_co_2.xml), e.g. LCL height, 0-1 and 0-6 km bulk wind difference, and supercell composite parameter.

I realize these are from the USA, but it would be very interesting to see what the separation (or overlap) might be between both storm types and between both epochs. I also think LCL height may be a better moisture parameter for you to test here, since it implicitly takes into account more than just moisture content. When you say "shear" in figure 5...what is that? Deep layer shear - and if so, between what vertical levels? 0-6 km? 0-8 km? I don't see this clarified anywhere in the text, unless I missed it, and I think it needs to be. Another suggestion for this figure - L165 mentions the typical synoptic location of most european severe storms, and the environmental schematic from Feldmann et al. 2025b indicates an EML is often present for these events. Perhaps it would also be helpful to look at lapse rates and/or RH in the mid-levels (e.g. 2-5 km AGL) - again, similarities or differences here would be an interesting thing to note (especially since Fig 8 shows updraft area increases in the PGW simulations, which would make the future storms more resistant to EML entrainment, which could have some feedbacks on other areas).

Figure 9 might need to be updated depending on what kind of changes you make here.

Figure 7: I really like the takeaway points from this figure, but the caption doesn't provide an adequate description, and I think it's confusing the way different colorbars are used for each peril and delta. I can see the validity of using a different colorbar for each peril to distinguish between them, but suggest using coolwarm, BWR, or seismic (diverging matplotlib cmaps, with negative values in blues, and positive values in red) for all of the delta plots (columns 2 and 4). If all delta values are positive, as appears to be the case for everything but 10m wind gusts, I think truncating the colorbar accordingly or just using the "Reds" colorbar is fine...point is, stick to the same color scheme.

Fig 11: I like this figure, and think it provides a nice overview of the RM/LM difference, but it may be wise to clarify more that these are composites from the simulations? Are the isohypses

average values? There is no comparison between contemporary and PGW simulations. Do you have comparisons between these that could be shown here?

Fig A1: Why make this a supplemental figure? Would suggest moving this up in the order (start of section 3.4?) and showing it before any regional breakdown information. Perhaps these are common distinctions in the European WX research space that much of the expected audience is familiar with, but someone like me from the US (and may still find relevance to this work) is not.

L10: The relative increase

L11 - 12: Rephrase to: A regional decomposition across Europe indicates LMs tend to occur in warmer, more unstable conditions than RMs, and that these regional differences are generally greater than the differences in storm environments between LMs and RMs

L16: Supercells rarely produce tornadoes? Most tornadoes are produced by supercells as far as I understand it...https://journals.ametsoc.org/view/journals/wefo/20/1/waf-835_1.xml. I know that paper is based in the US, but I find it hard to believe this claim. Don't think a citation is really needed here as most of your audience probably understands this, but I'd just maybe rephrase the sentence as "Their hazards include hail, torrential rainfall and flash flooding, lightning, tornadoes, and non-tornadic wind gusts." This eliminates some of the potentially misleading qualitative descriptors, and won't raise any eyebrows.

L18: Higher hazard intensity? Are you referring to the magnitude of the hazard...e.g., 1 vs 2 inch hail? Or the propensity of these storms to produce hazards. Clarify/Rephrase.

L19 - 25: I think there are a number of meaningful and relevant citations that are absent from the first paragraph of the introduction, especially when it pertains to left movers. I suggest reviewing the background sections of these: https://digitalcommons.unl.edu/geoscidiss/159/ and https://digitalcommons.unl.edu/geoscidiss/158/. I'm not suggesting there needs to be an overly deep dive into every single thing LM's have ever done, but there is a much more extensive body of literature on these storms than is acknowledged in the way this paragraph is currently written, and there are some fundamental citations in this area of research (e.g. Bunkers 2002, which is cited in the results) that isn't mentioned up front.

L35 - 39: Incomplete paragraph. Also, like with my comment above on LM research, probably could be some more meaningful details added about high-res severe storm simulations (and using PGW on these as well). There's been a lot of work done in this area, as I'm sure you're aware. Perhaps a brief overview on PGW would tie in well here, help round out this paragraph, and would flow nicely into your next paragraph.

L73: This comment is actually for instances the method is referred to later in the paper, but suggest not using "cookies"...just say 20 km radius.

L100: I think this figure shows composite storm structure. "Morphology" indicates a time evolution component.

L113/114: using "2h" and "one hour" in the same sentence.

L123: Instead of "A priori, we expect", go with "Prior research suggests" (or something like that).

L134: "do not exhibit large degrees of directional shear" could be somewhat confusing, since directional shear can also be characterized in degrees. Maybe just say "do not contain substantial directional shear"

L146: " different ~~systematic~~ relative locations ~~of~~ within the parent synoptic systems"

L152: statistically significant differences? Or is significant being used as an adjective similar to substantial? Clarify or reword.

L153: same as above

L172: "identified" instead of "decomposed"?

L196: instead of having "max .", type out "maximum

L303 and L346: rephrase "moister"

L348 - 350: I had to re-read this several times, and still am not sure I understand what you were going for here. Clarify/rephrase