General comments

- Paper would benefit from a more diverse collection of references, which place these heavy rainfall events into wider context and better draw upon literature from all across the world.
- A schematic diagram of typical synoptic setup during heavy precipitation event might be useful (you show a map in Figure 1, but as the reader, I want more information and detail). This kind of plot would really sell the paper to the reader.
- The detail in evaluating model performance against observations is impressive.
- The length of this paper could be reduced. The level of detail is commendable, but there are sections that are difficult to fully take in because of the consistent level of depth.
    - The text on the model setup in Section 3.1 is an example. The level of detail is impressive, but do you need to go into this much detail?
    - Along the same line, you could lose a couple of figures (and accompanying text) without reducing the quality of your writing. As an example, you could remove either Figure 7 or 8, Figure 10, and Figure 13 without impacting the quality of your analysis.
- Careful to use the same tense throughout your writing. In places you switch between present and past, which is confusing.
- When you introduce diagnostics such as water vapour mixing ratio and precipitable water in Section 2, it would be useful to know how large these values are relative to climatology (how unusual?).
- Splitting section 2 into two sub-sections, one focusing on the synoptic evolution and the other on the mesoscale details of the rainfall, could help to make the writing more streamlined and easier to follow. At the moment, there is too much information crammed in; the section is too long.
- You have confused ‘westwards’ and ‘eastwards’ in places throughout the text. Make sure that your descriptions are accurate and consistent.
- There are quite a few occasions where you describe details of the synoptic or mesoscale evolution without referring to figures. It is fine to do this on a few occasions (adding ‘not shown’), but not too much, or the reader will get confused.
- Some of the more technical information could be included in an Appendices section at the end of the paper, rather than in the main text (would help to streamline the text). The first paragraph in Section 4 is a good example (on REF_SP).
- Generally, there is too much description of results, and not enough interpretation and putting your results into wider context.
- When explaining to the reader why this study is important (Introduction), you should discuss the topic of interactions between tropical cyclones and the midlatitude flow, and how they can impact upon predictability. Papers by

Christian Grams and Florian Pantillon provide good examples of this type of work. This type of discussion will help to link the specifics of this event that you're discussing with larger-scale issues of interest in the meteorology community.

Specific comments

- Avoid vague language (a few replacements are suggested)
    - convective activity → convection
    - synoptic situation
    - seem to be maintained → maintained
    - density departures
    - thermal signature
    - more reflectivities are observed
    - precipitating activity → precipitation
- Standard and personal weather stations – please elaborate
- You introduce the concept of the stationarity of the cold front (L11) without any prior discussion – seems a bit rushed
- L15 to 17: 'the location of the exceptional precipitation appears to be driven primarily by the location of the quasi-stationary cold front…' seems like an obvious statement to make. Would like more insight here.
- Which dataset did Ricard et al. (2012) use for their climatology of heavy precipitation events over the northwest Mediterranean?
- 'Mediterranean Sea supplied up to 60% of the total air parcels moisture (Duffourg and Ducrocq, 2013; Duffourg et al. 2018), modulating the intensity of convective precipitation.' How did the authors calculate this value (60%)? More information on the method is needed here, even if brief.
- L46: don't start a new sentence with 'this'. Always refer directly to the part of the previous sentence that you're referencing (i.e. 'This combination of factors…').
- L52: need a sentence to tell the reader that you're introducing your case study here. Currently, you just start talking and the transition from the topic in the previous paragraph is not smooth enough.
- Paragraph on the event itself reads well (L52-62); you summarise the key points nicely.
- L68-69: 'Because of the heavy rain observed in the area, evaporative cooling processes may have played a role in the stationarity of the cold front.' Not sure I follow this argument. Evaporative cooling would be expected in conjunction with the rainfall, but why are you hypothesising that this cooling could play an important role in the movement of the front? You need to make this point more confidently here, and with more detail.
- L69-71: link between evaporative cooling and conditionally unstable air? Are you hypothesising that evaporative cooling occurred in the mid troposphere and destabilised the profile? Need to make these details clearer.

- L84-87: where is the evidence that the interaction between both lows seems to have strongly slowed the westward movement of the mid-level cut-off low? Or, do you mean eastward movement? This would make more sense.
- L88-92: which figure are you referring to in this discussion? Make the connection clearer and add detail to figure if necessary.
- L103-104: “A potential vorticity at upper levels is observed upstream of the low.” Where is the evidence for this feature? Need to relate all statements to figures, or add ‘(not shown)’.
- L104: “It may have helped to deepen it…”. A reference or two here on the interaction between surface cyclones and upper-level PV anomalies would be beneficial. Something like Hoskins et al. (1985), or a classic paper along those lines.
- Be as precise as possible in your discussion of figures. For example, in Figure 4 you plot the 925 hPa water vapour mixing ratio and geopotential height. In the accompanying text, make sure that you refer to the diagnostics in the figure (“925 hPa wind”), rather than using more vague descriptions (“near-surface wind”).
- Do the authors have any theory on why precipitation within the western band is overestimated by the model, or why the model overestimates precipitation over orography?
- Add latitude and longitude labels and tickmarks to Figures 2 to 6
- Overlay the position of key features such as CF1 and CF2 on the relevant figures. It would make the connection between text and figures much stronger.
- How do Leslie’s remnants contribute to the formation of the cold front CF2, behind which a Mediterranean low deepened rapidly?
- Mark the Albera Massif on Figure 5. Also mark the Aude and Pyrénées-Orientales departments. You refer to these features, but the reader won’t necessarily know where they are (without referring back to earlier figures).
- The convective lines that you mark on Figure 5 are not easy to see. The eastern line in Figs. 5a to c is fine, but the other two lines are much more difficult to pick out. Is there another way that you could annotate these figure panels?
- L229: do you mean downstream? Upstream suggests the windward (not lee) side of the ridges.
- L243-255: when justifying your investigation of evaporative cooling, it’s not immediately clear how evaporative cooling near the surface could modify the location of CF1 or change its stationarity. Could you describe how this could occur (maybe add a reference)?
- L248-255: in the NOCOOL simulation, did you turn evaporation off completely in the child domain, or just set the temperature tendency from evaporation to zero? Assuming the second – it wouldn’t make a difference to your results, but it’s best to be as precise as possible when discussing the changes you made to the model output.

- L277-286: you discuss the evolution of precipitation in your model simulation relative to observations, but don't show any of the plots required to do so (Figure 6 presents accumulated rainfall but gives no indication of how the structure of the rainfall evolves during the 24-h period).
- Figure 8: why have you used virtual potential temperature rather than potential temperature to diagnose the position of the front? Would be interesting to know what the pure temperature difference across the front looks like (potential temperature) as well as the moisture difference (virtual potential temperature). Don't change anything in the manuscript, it's just something to think about in future.
- Figure 10: the idea is good, but it's difficult to pick out the difference between the observations and the REF simulation, because as the reader you are drawn to the filled contours (REF winds) and it's hard to see the differences between the wind vectors in black and red. Given that the text accompanying this figure makes a similar point to that with Figure 9, I would recommend removing the figure. You could still make your point about the longer stationary period in the REF simulation (relative to observations) likely explaining some of the over-estimation in accumulated rainfall.
- L345-346: how does the Lagrangian trajectory tool of Gheusi and Stein (2002) differ from newer tools such as LAGRANTO?
- Discussion of Figure 11 (~L355): make it clearer in the figure panels and in the text that the trajectories in (b) correspond to the transect (A → D), etc. The reader will get confused otherwise. You have done this in your discussion of Figure 13 → please apply the same method to the discussion of Figure 11.
- Nice illustration of lifting along the cold front in Fig. 11c.
- Overlay the position of the cold fronts (CF1 and CF2) in Figures 11 and 12, and on Figures 14 and 15.
- L387-389: the claim that the trough over the Aude department may locally increase wind shear inland, based on Fig. 10a, is not based up strongly by the evidence.
- Do you need Figure 13? The results are similar to those in Figure 11, and you could just include a sentence to tell the reader that trajectories ending at 0400 UTC 15th October are qualitatively similar to those ending at 0000 UTC 15th October.
- L417-418: be careful when describing the motion of cold air 'as a density current'; you don't have enough evidence to make that specific claim. Instead you say something like 'in a similar manner to a density current' to be less specific.
- L418-420: not sure what you mean by equilibrium in this discussion. You need to be more specific here and describe the important physical processes. Also, language like '…tends to show that…' is too vague and should be avoided.
- L465: replace "probably" with "likely"
- L486-490: I don't follow the argument. You say that backward trajectory analysis demonstrates that an increasing number of low-level moist air

parcels that have **not** crossed the Albera Massif are found inside convective cells on the lee side of the mountain (i.e. originating on the lee side of the mountain, rather than further S-SE?). You then follow on from that point and say the supply of conditionally unstable air parcels (from the S-SE) along the line is continuous. Have I misunderstood, or do these two sentences contradict each other?

- I like the final paragraph of Section 5, in which you summarise the role of the Albera Massif. Follow-up question: is the topography of the Albera Massif only likely to play an important role when the wind direction is exactly as in this event? If the wind direction was slightly different, would you expect a different region of orography to play a more important role?
- Figure 19: confusing that the direction of the vertical cross section (A → B) in panels (c) and (d) is reversed from that in the virtual potential temperature plots in (a) and (b). It would make sense to reverse the orientation of the x-axis in (c) and (d).
- L530: replace “This probably” with “This difference possibly”
- Figure 20: change the colour scale so that you can more easily distinguish between values around 60 to 80% and those nearer 90% and above.
- The summary paragraph from L588-595 is well-written and nicely set out. However, I don’t think the statement that Leslie’s remnants are involved in the formation of the cold front CF2 is backed up strongly enough by your analysis. Modify the text to include more evidence supporting this statement, or remove it from the manuscript.

Technical corrections

- Model domain notation. Use parent + child rather than father / mother.
- L88: replace with “a small jet branch circumvented the cut-off low to the south”
- L100: “participated”? Not sure of its meaning here.
- L138: “more reflectivities are observed”. Change to something like “an extended region of reflectivity > 12 dBZ is observed…”
- Figure 11: equivalent potential temperature above the surface is normally shown in K, not in ºC.
- L452: replace “couples” with “couplets”
- Figure 15 is referenced in the text before Figure 14. Switch the order of the figures, or change the text.
- Brackets need editing in some of your time interval labels in Table 2
- L484-485: “…slightly directional vertical wind shear…” do you mean that there is only a slight change in wind direction with height? Replace “slightly” with “slight” if so.
- L597-598: “Accurately tracking and representing the life cycle…”