

This paper aims to determine the processes that led to a long cold spell and heavy snowfall event in Spain in January 2021. The authors pose 3 key questions; (i) how unusual were these events; (ii) which processes led to the formation of extratropical cyclone Filomena; and (iii) which characteristics of Filomena facilitated the heavy snowfall. By comparison with climatology, they provide evidence to show that the events were rare. However, with respects to the development mechanisms of Filomena there are some conclusions that require more supporting evidence (see general comments 3 & 4 and specific comments 9 & 10).

General comments

1. Lines 131, 142, 172 and 242. In several places it is stated that the 'surface progressively cooled down'. However, I couldn't find any surface temperature observations in the paper to support this statement. Are the authors referring to the 2m temperatures? If so, these are not 'surface' temperatures. For clarity I also suggest using 'air frost' to avoid ambiguity with ground frosts.
2. Lines 147, 266 and 271. On several occasions reference is made to the 'uniqueness', 'unique feature' or 'special characteristics' of the event. However, I do not think that analysis of 2 events with different features confirms uniqueness. Have the authors looked for combination of 'long-lasting cold temperatures and high accumulations of snow' over their 40-year dataset to see if they occur during other periods?
3. Line 184 and elsewhere. I understand that anticyclonic outflow from warm conveyor belts have been shown to increase the amplitude of downstream ridges in previous studies, but I couldn't find any evidence in this paper to suggest this is what happened in this case study. Since this statement is repeated in the abstract and conclusions, I think there should be strong evidence to support this statement for the case study analysed.
4. Lines 186 and elsewhere. It is stated that the strong ridge contributes to anticyclonic wave breaking. Perhaps I missed this in the paper, but how are the authors defining anticyclonic wave breaking? Also, it is concluded that wave breaking is important for the re-intensification of the decaying low L1 and the cyclogenesis of Filomena. This is repeated in the abstract and conclusions, but it wasn't clear how the authors reached this conclusion.

Specific comments

1. Abstract. The authors include an example of 'up to 50 cm of snow fell in Madrid and the surrounding area in 4-days'. This has little context as motivation. In section 3 they state that this was the highest recorded 4-day snow accumulation event in the last 40 years. Perhaps this could be added to the abstract to provide context?
2. Line 25. What records were broken during this event? How long is the daily minimum temperature record?
3. Line 27. The motivation for this work could be broader. Currently, the motivation given is that 'it is worth analysing the processes that led to the long-lasting cold spell and heavy snowfall' because it is 'rather rare in the Mediterranean'. While I agree that it is scientifically interesting to analyse rare events when they occur, I wonder if there may be other reasons for performing the analysis. For example, the authors do not comment on the skill of the NWP forecast for this event. Was it poorly forecast or well forecast? What can we learn from a single extreme event?
4. Lines 46-47. In the text 'at least two essential ingredients' are given for large snow accumulations. I always understood that temperatures $< 2^{\circ}\text{C}$ throughout the depth of

the atmosphere through which snow was falling was also necessary criteria for snow to remain frozen? Also, it seems odd that a moderate precipitation rate is not included as a criterion since precipitation accumulation is the product of precipitation rate and duration.

5. Line 105. Is the ranking of this event sensitive to the choice of a 4-day window?
6. Line 129. It is 'presumed' that incoming solar radiation is reduced during the period 9-10 January 2021. This hypothesis should be relatively easy to test.
7. Lines 162 and 244. It is difficult to conclude from figure 5f that the airmass was drier than normal since there is significant overlap of the interquartile range over the 10-day back trajectories.
8. Line 183. How is the strength of the warm conveyor belt activity quantified? Is it the areal extent of the grey shading in figure 6?
9. Line 229. How do the authors know that the strong θ_e gradient did not have a large impact on the intensification of the cyclone? I could not find the argument leading to this conclusion.
10. Line 262. I was not convinced that the stated conditions are 'essential ingredients' for this extreme snowfall event since the counterfactual experiment has not been demonstrated using either numerical modelling, or at least similar events with 'missing' ingredients analysed.

Typographical errors

1. Line 208. Could 'nicely visible' simply be 'visible'?
2. Line 27. I think 'rather rarely' could simply be 'rarely'.