Weather Clim. Dynam. Discuss., author comment AC1
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Reply on RC1

Lisa-Ann Kautz et al.

Author comment on "Atmospheric blocking and weather extremes over the Euro-Atlantic sector – a review" by Lisa-Ann Kautz et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-56-AC1, 2021

Reply on RC1

The manuscript by Lisa-Ann Kautz and co-authors presents an extensive review of the state of research on atmospheric blocking with a strong focus on their impacts. It starts with an overview of blocking types including the most important mechanisms during a blocking live-cycle. Then the impacts of blocking on several types of extreme events are addressed: temperature, hydrological, wind, and compound. For each extreme an overview is given, the involved dynamics are explored and some case studies are given. In the final part of the manuscript the predictability of blocking induced extremes events as well as their relationship in a changing climate is investigated. The manuscript ends with a summary of the most important open research questions in relation with blocking.

This review manuscript presents a timely and extensive overview of the manifold blocking impacts, that can sometimes seem contradictory at first glance (hot/cold and wet/dry extremes can both be caused by blocking). The topic it addresses is well motivated, it is well-written and -structured. Mostly, the authors manage to generalize and combine results from different studies to clear top-level messages (one exception is mentioned in my comments below). My only real point of critique are the first two figures: they are never mentioned in the text and the information I could extract from them was limited. I think both of them aim to address important topics (blocking locations and their naming as well as impacts depending on their relative position to the block) but fail to fully do so.

Apart from that I only have a few minor comments outlined below. Given that the authors address them my evaluation is that this manuscript should be published in Weather and Climate Dynamics.

Reply: We thank the reviewer for his/her generally positive feedback and are grateful that he/she supports a publication in WCD.

We understand the main criticism addressing the figures, especially Figure 1 and 2, and we agree they could be better explored and interlinked with the text. Regarding Figure 1, we agree that it could be replaced by a figure that includes even more aspects on the occurrence of atmospheric blocking over the Euro-Atlantic sector – for examples considering seasonal differences. Therefore, we will follow the suggestions of the reviewer and change the figure accordingly, and perform the according changes in the main text.

Regarding Figure 2, we aimed to provide a summary of the many influences blockings can have for different types of natural hazards. Therefore, we have opted to add everything into one figure as a synthesis instead of splitting the surface influences into several figures. As some of the processes shown in Figure 2 can occur simultaneously, we think this is the more adequate representation. Specifically, we rather want to show here where the extremes can occur relative to the blocking - using an omega block as the example. Nevertheless, we will enhance the text to provide a better connection between the figure and the text and make the statements clearer.

Minor Comments

Figure 1: I personally find this figure to be too schematic. What is the authors aim with it? If it is only in the paper to indicate the names of the different areas in use it should be stated so. Otherwise, it might be better to use some figure which gives more realistic representation of blocking regions, potentially also distinguishing between winter and summer (such as figure 1a/e in Davini et al. 2020) In any case, if the authors show the figure is should be discussed and referenced in the text.

Reply: We agree with the reviewer that Figure 1 could be improved and better connected with the text. Please refer to our reply to the main comment above.

Figure 2: Basically the same comment as for figure 1: It is not discussed at all and I am unsure what to take away from it. What are the different impact areas based on? Does a single block have all these effects or are these merely all the potential effects that have been observed/reported at some point? Are they only valid for an omega block in the exact region as indicated or is this to be understood more generally?

Reply: Figure 2 is about "phasing", i.e. where relative to the blocking certain surface extremes occur. This is exemplified by an omega block. So when an omega block is present, these extremes can occur at the marked locations. A good example of this is the case in the summer 2010. There was a heat wave below the blocking ridge (i.e. over Russia/Eastern Europe) and flooding in Pakistan, i.e. associated with the eastern trough (eastern flank of the block). There were also some extreme rainfall events below the western trough (western flank of the block). However, as pointed out by the reviewer, these explanations are missing in the text and need to be added. Please see also our reply to the main comment above.

Some of the shaded areas are quite small (e.g., high IVT and heavy precip to the north), how can they be interpreted? Are there physical mechanisms that can lead to heavy precip only in that area or is it rather that it has just been reported in this area for a specific case?

Reply: We thank the reviewer for the specific questions regarding Figure 2. We will address these questions in the revision and enhance both the figure and the text.

I think it could even be helpful to have several figures with blocks at different locations and their impacts in a more general sense. These could then be referenced in the relevant sections in the text.

Reply: In the previous replies, we have already tried to clarify what our intention was with this figure. We have chosen the omega block as it can be used to explain the different influences very well. In general, dividing the figure into different panels is a good idea. However, we estimate that it is hardly possible to clearly distinguish the impacts of different blocking types based on the existing literature. This is related to the variety of different indices and definitions. Therefore, we think it is not feasible to provide this distinction in the figure. However, we will split the figure in terms of seasonal differences,

which was suggested by Anonymous Referee #2. Therefore, please also look at the responses to Anonymous Referee #2.

section 2.3: Could the authors try to better distinguish the different datasets used to investigate blocking here and in section 2 in general? (or explicitly state whenever statements are valid for simulating blocking in general)

E.g., it is mentioned that blocking representation is a concern in numerical models (line 147) is this referring to global climate models (as discussed in the rest of the paragraph) or also to NWP models? It is further stated that blocking is underestimated but relative to what?

Conversely, are the considerations discussed from line 154 for weather forecast systems also valid for climate models?

Reply: We agree that we should clearly state which statements are based on reanalysis data and which references analyzed NWP or GCM model data. We will improve the text in the manuscript.

216 "separately form each"

Reply: We will implement the suggested change in the manuscript.

Figure 3: Please make clear that temperature is indicated as shading and gp as lines. Please make clear that dots refer to significance of the temperature anomalies (as I assume).

Reply: We will enhance the figure as suggested.

323: Not sure if the * should be removed from Kautz*?

Reply: Thanks for pointing this out. It will be removed.

421: "surface negative temperature anomalies" should be "negative surface temperature anomalies"?

Reply: This will be changed.

435: I acknowledge that the dynamics of precipitation are more complex but I find this paragraph a bit convoluted (in particular compared to, e.g., the one about temperature extremes). Could the authors try to extract clearer high-level impacts here? E.g., it seems a bit strange to me to separately explain the effect of blocking between 0-40E and 0-30E or to switch between clearly defined areas (0-40E) to more general geographical terms ('Central Europe', 'several regions in Europe')

Reply: Thanks for the suggestion, we will enhance the text as suggested to enhance clarity and consistency.

508: "We next move to blocking related flood cases in Europe" This first example was also about flood in Europe?

Reply: We chose this formulation because a thunderstorm case was introduced in the previous paragraph and because we wanted to say that we are now continuing with flooding cases. However, flash floods also occurred in the thunderstorm case, thus, we will remove this sentence.

525: “In October 2000 a feedback between heavy precipitation events could be identified.” between heavy precip and blocking?

Reply: Yes, this will be changed in the manuscript.

Figure 4a: The last category is a precipitation anomaly exceeding -100% of the climatology and it seems to exist on the map. This should not be possible, right?

Reply: We agree with the reviewer that there cannot be less than -100% here. The very dark red color is -100%. We will adjust the color bar so that it no longer looks as if -100% is exceeded somewhere.

572: “low wind conditions” weak wind? or low wind speed conditions?

Reply: We mean “low wind speed conditions”, this will be changed in the revised manuscript.

702 “changes blocking occurrence”

Reply: This will be changed.