

Review: Stratospheric influence on the winter North Atlantic storm track in subseasonal reforecasts

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Summary

This analysis identified and examined the impact of stratospheric extremes on the extratropical storm track, cyclone frequency and cyclone life cycle characteristics at subseasonal time range. The results show that events with a canonical response after weak and strong stratospheric polar conditions are better predicted compared to the events without the canonical response. This possibly leads to over-prediction by the model as it tends to forecast the expected response. The predictability after SSW events is less uniform across events compared to the predictability of the surface response after SPV states. In my opinion, while the response analysis may be not very novel, it provides solid quantification. The most interesting part discusses the predictability of the response and provides new insights into the driving mechanisms. Therefore, I recommend this manuscript for publication, but I also suggest a few comments below.

Major comments

- Had you considered to split the 28 days period into, for example, two parts (week 1-2 and week 3-4) in the first part of the manuscript? It would probably be interesting to look at least at U850 and cyclone frequency anomalies especially having in mind the results of the predictability part.
- The box position choice does not seem well explained. You say that in this region the increase in cyclone frequency is biggest after SSW events (L185), but the anomalies are biggest only in reforecasts (Fig. 3a). Moreover, the anomalies are biggest and statistically significant over the Northern Europe in reanalysis (Fig. 3c), which can be also seen in reforecasts. Had you considered taking a box more to the north-east of its current position? Also, was your choice of the box position based only on the anomalies after the SSW events? I see that the biggest anomalies after the SPV cases are still concentrated inside the box (Fig. 3b), but maybe this can be pointed out in the text.

Minor comments

L32 “predication” -> prediction

L34 Add brackets to citation

L48-51 This sentence seems to repeat the information given above, please consider removing it or rephrasing the repetition

L88 As reforecasts are initialized in conjunction with real-time forecasts, could you provide here the dates/years of the real-time forecasts? You indicate below the model versions used, but this is potentially confusing, as, for example, the 46R1 version does not have reforecasts for December 2019

L97 Please consider adding "... in the ECMWF model and in reanalysis..." if you used the same algorithm

L100 Consider adding here a remark that the number of the cyclone tracks can be found in Fig.6

L104 DJF -> DJFM for consistency throughout the text

L108 Did you use cross validation when computing the anomalies for each ensemble member?

L108 While I understand the choice of 28 days, it could be better clarified here for better understanding

L117 I wonder if you checked if there is no difference indeed when using ERA-Interim or ERA-5?

L120 Please specify that the list given in (Butler and Domeisen, 2021) contains only final warming events, rather than all warming events. Or consider omitting this part of the sentence

L131 Please consider mentioning that the dates of the SSW and SPV can be found later in Figures 7 and 8. I wanted to suggest adding a table with dates, but it seems excessive, since the information appears later in the text.

Fig 1c The model bias spans from -4.5 to 4.5% while the frequency itself changes from 0 to 45%, do you think that the bias is statistically significant in this case?

L154-155 Repetition of "in ERA-5" in the sentence, please remove one of them

L155 Did you look at the individual events before constructing the composite? It would be interesting to know which events had stronger response. However, the washed-out signal in the reforecasts might show that the model underestimates the response, especially averaged over 28 days of forecast.

L196 "The statistical significance of *this* shift..." it is not clear whether you refer to the shift compared to all winter days, or the small shift of reforecasts compared to reanalysis

Fig. 4 As I understand, the figure shows cyclone frequency anomalies after the 14 events in each subplot, but in this case what does the height of the bars show? Counts on y-axis does not add up. If you used a somehow broader statistics, please clarify that in the caption.

Fig.5 and L212 Could you explain why there are more cyclone tracks (black lines) detected in reforecasts than in reanalysis? I suppose that you used each ensemble member separately rather than ensemble mean, which could be mentioned in text for easier understanding. Also, you mention in Data and Methods that in this part you use more reforecasts from three model versions, but could you explain more in detail why do you use other model versions. The temporal resolution increase to 6-hourly data is understandable here.

L248 Did you check this correspondence case-by-case here, rather than the overall ratio?

Fig.7b,d It would probably be better for understanding if you indicated in the figure that N=10 for enhanced cyclone frequency and N=4 for the reduced, etc.

L261 Did you have a look why the week-1 hit rate for 11 Feb 2005 was so low, especially considering that the skill is higher on the following weeks and the averaged skill is rather high (0.7 from Fig. 7c)?

L270 "...predicted a weakening of the cyclone frequency in the period that followed the SSW." As I understand the majority of ensemble members still predicted the increased cyclone frequency on week 1 and 2 in this case, so maybe you can specify that it is not about the period that directly follows the SSW.

L297 It could be worth specifying that in case of SSW it is about the reduced frequency

L308 Consider adding "after SSW events *in these cases.*" as temperatures are not always predicted poorly after SSWs.