

Review: Tropospheric Links to Uncertainty in Stratospheric Subseasonal Predictions

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Summary

This analysis identified and examined the uncertainty in the stratospheric predictions tracking its origins and attempting to establish a link to the subsequent tropospheric uncertainties. The authors constructed two groups of ECMWF hindcasts with large and small spread in the zonal mean zonal wind at 60N 10hPa averaged over the whole length of the forecast. The results of the group comparison show that the main regions of the uncertainty source in the stratosphere are associated with the precursor regions in the troposphere: North Pacific and Northern Europe. This suggests that the tropospheric uncertainty is linked to the stratospheric one. Moreover, the authors studied the SSW that took place in February 2018 in more detail to identify the tropospheric responses and establish the two-way propagation of uncertainty. They show that the ensemble members that predicted the SSW correctly also better predicted its downward impacts. In my opinion this is a very compact, yet somewhat conclusive study that proves existing hypotheses and provides new insights into the stratospheric-tropospheric coupling. Therefore, I recommend this manuscript for publication, but I also suggest a few comments below.

Major comments

- Averaging of the uncertainty over all 46-day integration period seems too broad and may filter out information. As the study focuses on the extended-range predictions it makes sense to average over week 3 and 4, for example. The authors may perform some sensitivity studies on that.
- The section which addresses the downward coupling and study of the SSW event seems to be not very well connected and lacking evidence. For example, the regions of the upward wave propagation could be discussed in this case. Also, as the authors argue that the SSW cluster better predicted the downward impacts, it would be helpful to add some comparison to reanalysis to prove that point.
- The OLR analysis does not seem to explain the difference between the clusters in wave-2 activity. I suggest the authors add some more explanation of the link to the tropics.

Minor comments

L34 I struggle to understand the part ‘..stationary waves, which interact with wave anomalies to determine the upward wave flux.’ Please rewrite the sentence to make it clearer.

L48 Please consider adding ‘often resulting in better simulation of SSWs’, as it is not always the case.

L52 Please consider adding (Statnaia and Karpechko, 2024) : a study investigating the overconfidence of the forecasts and its connection to the strength of the polar vortex.

L65 A new run for the 2018 SSW event is a very interesting addition to the study, but why you did not use the actual forecast issued on that date? Also, did you make only one run initialized on that date

or several to choose from? It is very interesting that quite a few ensemble members predicted the event well in advance.

L102 Do you have the explanation for the significant u1060 weakening after day 37 for the large u1060 spread composite?

Figure 1 Only the ensemble mean for the 2018 SSW events seems to be plotted (purple dash line). Please correct the figure caption.

References:

Statnaia, I. and Karpechko, A. Y. (2024) 'Factors influencing subseasonal predictability of northern Eurasian cold spells', *Quarterly Journal of the Royal Meteorological Society*, pp. 1–21. doi: 10.1002/qj.4744.