**Response to Anonymous Referee #2**

**We thank Referee #2 for their helpful comments. In our reply below, referee comments are reproduced in black text whereas our corresponding responses are shown in *red italics*.**

*Summary:*

In this manuscript the challenge to characterize the severe weather potential in synoptically weakly forced convective environments is tackled. Various convective variables and indices are computed using proxy-soundings of hourly model analyses representing the environment. As observational data base for benign convection the authors' own dataset of radar reflectivities is blended with 'subjective' severe weather reports from Storm Data. The odds ratio is used to measure the conditional likelihood. In essence, the authors find the surprising result (their own wording) that only two convective parameters based on temperatures at two pressure levels (850 and 500 hPa) are able to differentiate between severe and nonsevere convection during such difficult to forecast weather regimes. It is suggested that prominent, heavily moisture-weighted parameters and indices broadly used in severe storm forecasting suffer from inaccuracies in the RAP analysis data.

The manuscript is well-written and merits publication given that the comments below are taken into account.

> *Thank you reviewing our paper, and providing valuable feedback. Please see our responses to your individual comments below.*

*Major Points:*

1) My main criticism is the use of the RAP analyses providing proxy-soundings to calculate convective variables and indices. Subtle model inaccuracies (or errors) can impede the accurate calculation of convective parameters. The key question is the suitability of the RAP system with dx=13km using presumably a convective parameterization scheme for deep convection for such calculations. I suggest to use proxy-soundings from the convection permitting model HRRR analyses (at least for a subset) and confront your results with those. This extension would considerably broaden the relevance of the manuscript.

> *At the outset of this project, we considered employing the HRRR analysis for the reasons you described. However, NCEI does not maintain a publicly accessible repository of historical HRRR output, likely to due to the enormous storage burden it would pose. The University of Utah does host an independent HRRR archive, but as an ad hoc effort, it does not support FTP downloads, and is designed for smaller-scale projects. Their nascent effort only overlaps with our study period for one year (2015), which is problematic because this may not be an appropriate year for comparison. Ideally, we would perform a subset comparison using a random sample of soundings across the 4-yr period (or at least more than a single year), which unfortunately is not possible given the current state of the HRRR archives.*
>
> *The HRRR is largely a higher-resolution nest of the RAP with the same physical parameterization configuration, except for deep convection (which, as you mentioned, is not parameterized). We would expect the HRRR to resolve similar temperature and moisture fields as the RAP, except near areas of convection (which the HRRR would depict with greater fidelity). Thus, proxy soundings from the HRRR would improve upon the RAP insofar as it reduces convective contamination, which relates to your Major Comment*

*#3. We will add text describing the potential of the HRRR to reduce convective contamination in the same addition proposed in our response to Major Comment #3.*

2) (line 117ff) More detail is needed describing the data assimilation of RAP. What data is how assimilated in RAP? Any radar reflectivities?

*We will supplement the current description of the RAP with more information about its data assimilation from Benjamin et al. (2016), particularly regarding the observational data sources that are assimilated (radar, lightning, aircraft, GOES cloud tops, etc).*

3) (line 128ff) Is the proxy-sounding representative for a storm environment if there is no storm in the model analysis? What happens if there is a shift in space or/and time between observation and model?

*The goal of the proxy sounding is to capture a snapshot of the pre-convective environment as close as possible to the time of convective initiation. It is possible that some soundings experience contamination from convection within the model. However, because the soundings are based on the 0-hr RAP analysis fields, any such influence is likely limited. Because the RAP assimilates radar reflectivity and lightning observations (Benjamin et al. 2016), areas of convection in the 0-hr analysis will typically mimic the radar-observed areas of convection. Further, any instances where convective overturning was a source of contamination would be smoothed out by aggregating all storms by day. Nonetheless, we will alert the reader to this possibility in Section 2.2 when we discuss the accuracy of the RAP soundings and the potential of the HRRR to improve upon this limitation.*

*Minor Points:*

1) (line 59) The term signal-to-noise ratio is awkward in this respect. Is there any reference? Is model error a noise source, too?

*This term is common in climate variability contexts; however, we have not identified any regular forecasting applications in contexts smaller than the seasonal scale. Yes, model error does qualify as noise because it is not a process considered by the OR analysis (i.e., convective parameters are taken at face value). We will add references supporting its use in climate forecasting such as:*

*Sutton, R. T., and D. L. R. Hodson, 2007: Climate response to basin-scale warming and cooling of the North Atlantic Ocean. J. Climate,* ***20,*** *891-907, doi:10.1175/JCLI4038.1.*

*Hamlington, B. D., R. R. Leben, R. S. Nerem, and K. Y. Kim, 2010: The effect of signal-to-noise ratio on the study of sea level trends. J. Climate,* ***24,*** *1396-1408, doi:10.1175/2010JCLI3531.1.*

*Trenberth, K. E., 1984: Signal versus noise in the Southern Oscillation. Mon. Wea. Rev.,* ***112,*** *326-332, doi:10.1175/1520-0493(1984)112<0326:SVNITS>2.0.CO;2.*

2) (line95) Although a brief explanation of the indices used in this study are given in the appendix, key 'tools' should be explained in the main text. What is SWEAT?

*We will add brief descriptions of the vertical totals and total totals near line 270 at first mention as effective differentiating parameters. Meanwhile, MLCAPE and MLLCL are both employed with enough frequency in the atmospheric sciences to be interpreted without further explanation.*

3) (line 108) More detail is needed on the authors' own dataset of radar reflectivities for benign convection that is still under review at the time of this review.

> *The Miller and Mote (2017) paper describing the development of the WFT dataset is now available in print (https://doi.org/10.1175/JAMC-D-17-0005.1). The current text will be supplemented with more detail describing the radar-based identification of storms; statistical clustering into morphologically similar groups; characterization each group's composite convective environment; and the final designation of each group as WFT/non-WFT. In response to Reviewer #1, we will also be adding a new table better characterizing the convective environments that hosted WFTs.*

**Changes NOT in response to reviewers:**

After submission, we learned it is more appropriate to describe the odds ratio (OR) as indicating that "the odds of an event are X times greater…" rather than "an event is X times more likely…" (e.g., line 223). The revised manuscript will standardize the language describing ORs to reflect the latter.