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Interactive comment on "Influence of ENSO on North American subseasonal surface air temperature variability" *by* Patrick Martineau et al.

Anonymous Referee #2

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This study is interested in the influence of ENSO on subseasonal variability in North American SAT during the winter season. Previous studies found that La Nina conditions are associated with enhanced subseasonal SAT variability (SSV) over western North America. Here, the authors use SVD, regression/correlation and composite analyses to investigate how ENSO affects subseasonal variability through modulation of subseasonal eddies - specifically, via changes to the vertical structure of the eddies which have bearing on the amount of baroclinic energy conversion that occurs.

The subject is interesting and relevant to improving our understanding of climate dynamics, as improving near-term climate predictions, and better understanding the large-scale conditions for extreme events. I feel this manuscript could represent a valuable contribution to these areas of research, but would first require substantial revisions

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to address a number of scientific and methodological issues that are a bit unclear. First and foremost, while the abstract sounds nicely focused, the rest of the paper seems to mix together a number of different research questions without quite giving the reader enough guidance to connect them (see especially comment #1). The presentation is generally fine, and figures are of good quality, although the captions should include more details so that the reader need not go back to the text to look up information, abbreviations, etc.

MAJOR COMMENTS

1. The setup of a clear, motivating question in the introduction is not quite there. There seem to be several trains of thought, including the influence of ENSO on SSV, the link from SSV to extremes, and the mechanisms by which ENSO affects SSV, but they are not well connected and in some cases, we seem to be missing some background information needed to make this connection. Some specific comments:

- Is the ENSO-related SSV signal just part of the PNA-related SSV? if not, how is it different?

- How important is the portion of extratropical SSV related to ENSO? It seems key to establish this up-front, since later on in Fig. 10, you show an SSV signal unrelated to your ENSO index (SVD1) that is both substantial in amplitude and very similar to the ENSO-related signal. It would also be nice to show the SSV climatology for reference, perhaps early on in the results section, since this is a field many readers will not be so familiar with.

- And perhaps even one step before this, how important is SAT variability in the 10-60 day band?

- The paragraph starting on L42 seems to be off-topic - if this is meant to relate to the issue of extremes, the connection needs to be made better. In general, the parts of the manuscript dealing with extremes seems like somewhat of an afterthought - it probably

should be either expanded or de-emphasized. Also, the topic sentence seems to say there is a clear association between ENSO and blocking, while later in the paragraph, we see that the association is not clear.

- The paragraph starting on L60 - I'm having some trouble with the logical flow in the first few sentences.

- I'm not sure how familiar most readers are with the term "subseasonal eddies".

2. The title and abstract talk about ENSO's influence on SSV, but the "first step" (L73) is identifying the dominant mode of covariability between North Pacific SST and SSV. Why not use an ENSO index - either one of the standard ones in Table 1, or an EOF-based index of tropical Pacific SST (Takahashi et al., Cai et al.)? I see that the SVD1 produces indices that are well correlated with ENSO, but I don't understand the point of using this over using actual ENSO indices (perhaps there is a good reason but I've missed it, in which case it should be better explained). Even if one were to use an SVD, would it not be better to choose a tropical Pacific box for the SST field? It's been shown that including the North Pacific mixes frequencies and forcing source regions (Wills et al.).

- Cai et al. (2018): Increased variability of eastern Pacific El Niño under greenhouse warming. Nature, 564

- Takahashi et al. (2011): ENSO regimes: Reinterpreting the canonical and Modoki El Niño. Geophys. Res. Lett., 38, L10704

- https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL076327

3. I like the dynamical line of investigation regarding why subseasonal eddies may be more "active" during La Nina. I think the argumentation could be made more convincing, and this would really strengthen the paper as a whole. First, the connection from subseasonal SAT variability to the subseasonal eddies should be made clearer in the text (just a few lines of explanation to help the reader interpret the figures). Second,

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Fig. 8 is not so compelling as a demonstration that differences in the vertical structure of the eddies are key. Some suggestions: (a) show a larger longitudinal range that include all the positive/negative centres of action seen in Fig. 7, so we see the change in vertical structure systematically with each one, (b) show barotropic energy conversion with height, so we see the big increases where the temperature and Z fields are most offset.

4. Some of the analysis choices seem rather arbitrary, and need to be better explained. Also the analysis itself. Some examples, but not exhaustive:

- regions for the SVD (the SSV box is probably related to target area and climatological field, but what about SST? see comment #2)

- locations for temperature regressions in Fig. 7

- location for Z regressions in Fig. 8. Presumably, we want to look at the eddies responsible for SAT variability such as that seen in Fig. 7? It would be helpful to justify this point and mark it on one of the maps.

- what frequency data is used for the various analyses? Presumably daily or 6-hourly for SSV that is then band-pass filtered? The SVD looks to be using monthly or seasonal averages? What about in the regressions for vertical structures?

- how are warm/cold extremes identified?

- how are u", v", T" defined?

- Fig. 7: is the SAT index using the 10-60 day filtered field? Is Z filtered?

5. The composites need some measure of significance, either via comparison to the total variability, or via comparison to the inter-composite spread, or via some boostrapping, etc. This is especially important in light of the fact that internal variability seems to play an important role in shaping extratropical ENSO teleconnections. Also, how many "samples" (days, months, seasons?) make up each com-

posite? https://journals.ametsoc.org/jcli/article/31/13/4991/92604/How-Well-Do-We-Know-ENSO-s-Climate-Impacts-over

OTHER POINTS

- Fig. 1: show SSV climatology?

- Fig. 2, 3, 4: please define abbreviations in caption

- L257: "an important asymmetry" - isn't this just a consequence of L252-254?

- L262: "which significantly widens the probability distribution..." I don't understand this explanation. Are you suggesting that a wider distribution mean that you "lose" extremes on one end but not the other, and if so, why?

- L286: EN and LN flipped?

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