Review for

Subseasonal prediction of springtime Pacific-North American transport using upper-level wind forecasts

by Albers et al.

Synopsis:

In their study, Albers et al. look at subseasonal prediction of stratosphere-to-troposphere transport (STT) and tropical moisture exports (TME). In contrast to previous attempts in this direction, they rely on the upper-level wind forecasts, i.e., on the location and intensity of the jet streams in the Pacific-American sector, which they characterize by the leading three components in an EOF analysis. First, the approach is considered in a retrospective perspective, based on ERA-Interim reanalysis data. Then, hindcast simulations are used to apply it to forecasts at different lead times. The relevance of the research topic is clearly motivated in the introduction, the text is very well written and follows a very clear storyline, and the number and quality of the figures and tables well supports the scientific findings. There is no doubt that the study will be of interest to the readership of Weather and Climate Dynamics. In summary, I can recommend the publication of the study with minor changes, which are listed below. The only aspect that serves a little more attention is the specific role that is attributed to tropopause folds and PV streamers, as proxies for Rossby wave breaking events. It would be nice if the text gets more specific (lee speculative) and possibly also incorporates some feature based analysis.

Major concerns:

1. Not a concern, but a thank you for a very concise and very clear introduction! It is a little long, but provides a very introduction into the topic and reads very fluently.

2. Tropopause folds, Rossby wave breaking and PV streamers are mentioned at several places in the text. Their role, however, remains somewhat unclear: Some examples are:

> *-L187-190: "While the EOF patterns likely combine jet variability due to both the subtropical and polar front jets (Koch et al. 2006), a strong jet stream of either type will act as a waveguide for Rossby waves (e.g., Schwierz et al. 2004; Rivière 2010 and references therein) with an increased frequency of STT and TME (e.g., Shapiro and Keyser 1990, Koch et al. 2006)"*
> *-L200-202: "STTPBL on the other hand (Fig. 3 middle row), have maxima slightly downstream of the 500 hPa maxima, which reflects the fact that deep STT tends to occur as maturing Rossby waves amplify and tropopause folds and potential vorticity streamers extend downwards towards the surface (Wernli and Bourqui 2002; Sprenger et al. 2003, Appenzeller et a. 1996, Wernli and Sprenger 2007, Škerlak et al. 2015)."*
> *-L207-210: "*That the STTPBL is weaker is not entirely surprising because while a high percentage of upper level breaking waves extend downwards to the mid- to upper troposphere, subsequently causing associated STT500 and TME, only a small subset of these waves will achieve the needed amplitude and depth to extend all the way to the PBL"

My specific concerns/questions in this context are: What does it mean that a PV streamer extends down to the surface? Are TMEs are really mentioned in Shapiro and Keyer (1990) and Kock et al. 2006) to be linked to Rossby waveguides? Furthermore, the feature-based

dataset presented in Sprenger et al. (2017) also includes tropopause folds and PV streamers (as proxies for Rossby wave breaking); would it, therefore, be worthile to support the statements in this section by the corresponding composites of these features, as they are shown for TME and STT. I think that the physical argument given by the authors is essentially correct, but it would be nice to support it by the corresponding composites, if they can 'easily' be calculated.

3. Whereas the signals for STT-500hPa and TME are rather clear, it is much more difficult to see the signal of STT-PBL. For instance, in Figure 7 it is really difficult to see the signal in the west-American box for the hindcast simulations. The same applies, to a lesser degree, to the retrospective analysis in Figure 3. I wonder whether this would become somewhat clearer if (especially in Figure 7) the colorbar is adjusted. Overall, I have have the impression the link between the jet structures, as expressed in PC1-3, is clearly discernible in for STT-500hPA and TME, but rather weak for STT-PBL. Actually, Figure 10 shows that there is some skill, but it is difficult to get it from the Figure 7.In summary, I see that the authors are aware of this fact and argue by means of Rossby waves not extending to the surface (see point 2 above) and PBL effects (altitude) to explain this weak signal of STT-PBL compared to STT-500hPA and TME, but the explanation is not fully convincing. Please add, at least, some references supporting the argument..

Minor comments:

-L48: As a more recent study linking STT and PV streamers, the authors might want to add the following reference:

> *Sprenger, M., Wernli, H., & Bourqui, M. (2007). Stratosphere–Troposphere Exchange and Its Relation to Potential Vorticity Streamers and Cutoffs near the Extratropical Tropopause,* Journal of the Atmospheric Sciences*,* 64*(5), 1587-1602.*

- L51: "extratropical transport related to local frontal dynamics" This is a little too narrow, also given the references given in brackets; the references actually refer to warm conveyor belts (WCB) and, therefore, it might be appropriate to bring up this term and explain also in one, two sentences how WCBs, TMEs and atmospheric rivers are related. A possible reference could be:

> *Sodemann H. et al. (2020) Structure, Process, and Mechanism. In: Ralph F., Dettinger M., Rutz J., Waliser D. (eds) Atmospheric Rivers. Springer, Cham. https://doi.org/10.1007/978-3-030-28906-5_2*

- L60: "deep STT is limited" -> "deep STT into the PBL is limited"; to make very clear that 'deep' refers to PBL-reaching trajectories

- L103: The retrospective (1979-206) and hindcast (1997-2016) analysis periods are introduced here, which is fine. But at first reading, I wondered a little why these time periods are chosen and what exactly are the underlying datasets. This becomes very clear only in section 2.1, but would have 'helped' me already at this place.

- Figure 1: I am somewhat confused how I have to link the two color bars to the different panels. This should be mentioned, at least, in the figure caption. Furthermore, I wonder whether the unit 'events/6-hourly time step' could be replaced by an equivalent, but more intuitive 'frequency per month'?

- Figure 2: The jet variability is expressed by the first three components of an EOF analysis. This is fine, and the three EOF patterns in Figure 2 clearly show distinct jet signatures (structures). Just to be sure: Would it be correct to name EOF1 a 'double-jet structure', EOF a 'single jet structure and EOF3 a 'transitional structure'? The patterns are OK, but it would be nice to attribute them to a somewhat less abstract (EOF loadings) picture.

-L136: "is very little amplitude remaining"; What does 'amplitude' mean in this context? Would 'skill' be the better word?

- L152-153: "units of number of mass exchange events per 6-hourly time step"; It might be worthwhile in one sentence more clearly what this unit means. How is a 'mass exchange event' defined?

-L218: "in terms of both correlation and amplitude"; really 'correlation', or should it be 'location'?