Review of revised version of "Dynamics of stratospheric wave reflection over the North Pacific" by Schutte et al.

The authors have addressed many of my comments and the paper reads tighter and the motivation is clearer now. However, there are a few points that are still unclear, and in some ways misleading, that should be improved before publication.

Main points:

1) The emphasis on the role of the stratosphere in the introduction and abstract is a bit misleading. The focus of the analysis is on understanding the tropospheric and lower stratospheric evolution of the positive-negative heat flux dipole.

The abstract refers to negative v'T' events as Stratospheric Wave Reflection events which *"involve the upward propagation of planetary waves, which are subsequently reflected downward by the stratospheric polar vortex."* (1st sentence of the abstract).

The first few paragraphs of the introduction discuss a downward effect of the stratosphere on the troposphere, specifically, via downward wave reflection, and including how to diagnose downward reflection events. I am not sure, however, that the negative v'T' events discussed here are classical downward reflection events in the sense of an upward wave pulse propagating to the stratosphere, then reflecting back down from a reflecting surface. At least, the data shown does not necessarily support this. Rather, it shows that the combination of a stratospheric wave 1 and a westward propagating tropospheric medium scale wave packet which is also developing downstream, combine to give a dynamical evolution of upward wave activity flux over Siberia and downward over Canada.

In addition some of the results do not fit this chain of events - for example the sentence on lines 281-282 : "*The overall Rossby wave activity mostly remains close to its climatological average and only increases in the stratosphere after the end of reflection events (Fig. 6 b).*" I would expect the wave activity to increase in the stratosphere before reflection events, and to increase in the troposphere after the waves are reflected downwards, if the secenario assumed apriori in the introduction is true. Rather, this result (though see comment on figure 6 below) maybe supports the notion that the negative v'T' is due to a superposition of stratospheric and tropospheric waves which have different sources and phase speeds.

The only suggestion for a classical evolution of upward propagation to the stratosphere followed by a downward propagation downstream is found, to my mind, in figure A8 which shows the stratospheric phase tilt changes from westward with height to vertical with height.

2) The discussion of the validity of the spectral diagnostics (lines 304-313) is convincing to some level but not for all the points it is used for. Specifically, it is not convincing enough to justify using it for figure 6.

More explicitly:

Line 145 refers to figures 5 and A2 but these figures do not really show the diagnostic is able to capture daily time scale variations. On the other hand, figure 3 shows the Hovmöller diagram alongside ISP_west, and it does seem like ISP captures the temporal evolution of phase speed, though maybe the change from stationary to westward phase speed is sharper in the Hovmöller diagram than in ISP. Figure 7 also makes such a comparison, and the spectral diagnostic captures the broad features but maybe not as nicely as in figure 3.

A better test maybe would be to look at specific events and compare the time evolving spectral diagnostics with a corresponding Hovmöller diagram (which is not a composite), and show that these match for a few events.

- Figure 6: I find the use of the diagnostic potentially problematic for this figure, especially conclusions about detailed daily-timescale evolution, c.f. comments like that made on line 297: "and in the stratosphere a few days later". I am not convinced the temporal resolution is good enough. Moreover, as fig A7 clearly shows, that stratosphere is dominated by smaller zonal wavenumbers than the troposphere, meaning that the significant ISP_west enhancement is occurring for larger frequencies in the troposphere than the stratosphere. Can't this, by itself, lead to differences in the timing of statistical significance of the signal?

I expect the spectral diagnostics can only point out changes on coarser time scales, thus it is more convincing to use for onset - end comparison plots like figure 5, given that the phase propagation lasts for quite a few days, as does the stationarity of the anomalies during the first part of the events.

Minor comments

line 188 - how do you deduce Rossby wave breaking from thr figures?

line 251 - I would check references by Randel and co-authors from the 1980s which studies medium scale waves in the southern hemisphere for a tropospheric example which is maybe more relevant to the case studies here. Specifically there is: Randel, W. J., and J. L.

Stanford, 1985: An Observational Study of Medium-Scale Wave Dynamics in the Southern Hemisphere Summer. Part II: Stationary-Transient Wave Interference. *J. Atmos. Sci.*, **42**, 1189–1197, https://doi.org/10.1175/1520-0469(1985)042<1189:AOSOMS>2.0.CO;2.

Figure 4- hard to see the green contours

line 268- the reference to waves 2-5 in figure 5c is confusing because there changes in these wavenumbers are not statistically significant

There are too many appendix figures - it is hard to follow the paper when the reader is referred to these figures so much. This impression is strengthened by the fact that the appendix figures are not referred to in the order of appearance. specifically, Fig A9, A16, A17 appear earlier than the reference to figures before them.

Line 281: the following statement -" *and only increases in the stratosphere after the end of reflection events (Fig. 6 b).*" I am puzzled by this- I would expect the wave activity to increase in the stratosphere before reflection events, and to increase in the troposphere after the waves are reflected downwards. This maybe supports the notion that the negative v'T' is due to a superposition of stratospheric and tropospheric waves and not wave activity actually going down from the stratosphere to the troposphere... see major comment 1

Figure 6, The discussion of this figure on lines 291-295 is confusing. Lines 291-295 took several re-reads for me to figure out what the authors are trying to say, specifically due to some of the implied causality words (can be understood by, a result of). Are you implying that the westward phase propagation in the lower stratosphere upper troposphere **is consistent with** the stratospheric waves vertical phase tilt changing from a westward to a vertical one (as is expected in downward wave reflection), with the phase of the wave not changing too much at 10mb?

In addition, the total ISP subplot (6b) does not seem to match the eastward and westward ISP plots 6c and 6d, especially at positive time lags - shouldn't it be some sort of sum of the two? At the same time, I am not sure how the information in figure 6 adds to the discussion, thus I would consider dropping this analysis altogether.

Section 3.2 - I think a plot like figures 4 or A17 for the PT-AKR transition would be useful to see.

Lines 342-343 - discussion of figures A11-A12 refers only to differences in the stratosphere, but I would say that also the tropospheric evolutions are different- there is essentially no westward phase speed for the regime transitions in these figures outside of reflection events (A12), and only a very weak westward phase propagation for those with a reflection event (A11).

Sentence starting at the end of line 343, to 345: I am confused. I assume the authors mean to point out the small region of significant difference in the region of 250mb waves 3-4 phase speeds that protrudes into the contoured region of phase space that dominates climatology in figure A14 which does not appear in A13? I would state this reference to A13 vs A14 explicitly, but this is contrary to what A11 vs A12 show for the 250mb level...

Discussion

The reasoning in the two sentences on lines 381-385 is not clear. Specifically the way this sentence is phrased implies that the westward propagation results from downward reflection. However, it is possible that the westward propagation results from internal tropospheric free Rossby wave dynamics, and its superposition with stratospheric stationary waves could give a signature of downward reflection.

I think maybe a schematic might help summarize the results more clearly.

Appendix figures:

Figure A7 - Title should be changed - this is not an evolution, rather a longitude height section breakup to different wavenumbers.

Figure A18 - I don't find the signal strong enough to be convincing. The variability is so much stronger...