

#### Summary:

This paper presents the relationship between the 100 hPa temperature and the 68 hPa substances on the subseasonal and interannual timescales in order to estimate the upwelling speeds in the lower stratosphere. I think the evidence is weak in almost all of the results, especially in the estimations of upwelling speeds and causes. The authors should show the clear evidence.

I do not recommend the publication of the current form.

#### Comments:

1. Title is obscure. This paper tried to show the various causes of lower stratospheric upwelling, not only the cause due to the Rossby wave breaking.
2. Sect. 4.3 and Figure 8a: I found the weak evidence that the high coherence pattern between the 100hPa T and water vapor is due to the Rossby wave breaking. The MJO related Rossby wave occurs strongly over the western Pacific (Figure 8c), though the weaker Rossby wave may occur over the Indian Ocean.
3. Sect. 4.4: ENSO and QBO effects on the UTLS region are difficult to distinguish. Figs. 9 and 10 include both the effects. The interpretation of the multiyear timescale, therefore, seems to be not confidence.

#### Minor Comments:

1. l22,p19575: pahse -> phase
2. The sections written in "Paper Overview" do not correspond to them in this paper; there are seven sections.
3. l5, p19581: (15S-15N) -> 15S-15N
4. l7, p19581: H2O, CO, and N2O, and temperature,... -> H2O, CO, N2O, and temperature,...
5. l25, p19586: 150E -> 150W
6. l15, p19587: neccessarilly -> necessarily
7. Sect. 6: I understand the calculation of the time lag. However, I think, when using the band-pass-filtered data, the time lag would be calculated within the time window.