Response to the comments by Referee #2

We greatly appreciate the reviewer for his/her thorough review and constructive comments. We have revised our manuscript as much as possible following his/her comments. Our point-to-point response to them is described as follows:

(1) P.16970, L.16: The phrase "while temperatures in the Arctic is" should be "while temperatures in the Arctic are".
(2) P.16975, L.2: The word "accurate" should be "accurately".

The expressions have been revised following the reviewer's comments.

(3) P.16977, L.1-7: For the difference in the propagation speed of the high frequency regions of PSCs (20ms-1) and the zonal-mean zonal wind (35ms-1), the authors should make more discussions for the "wave modulation". The estimated traveling period of the former seems to be 5-6 days, if the anomalous field has a wavenumber-2 structure as seen in Fig.3b-d. Or can be seen the feature that the isolated cold pool (not wavy structure) travels eastward?

The anomalies with zonal wavenumbers of 1-3 are observed along with the propagation of high frequency regions, and all these anomalies are defined as atmospheric waves in this study. We have added the 4th para. in Section 3 to describe the behaviors of the high frequency regions and associated temperature fields.

*(4) P.16978, L.5-9: From Fig.4, the TSTS-based PSC frequency is generally lower than the frequency from the CALIPSO observations. This may be due to the failed estimation of HNO3 and H2O mixing ratios. However, if the CALIPSO observations *underestimate* PSC areal extent, the latter frequency may be higher and result in larger difference of the two than in Fig.4.*

We have revised the 2nd last sentences in the 7th para. of Section 3:
'Optically thin PSCs may not be detectable by CALIOP (Pitts et al., 2007). It should be also noted that the estimated PSCs based on temperature thresholds ignore detailed cloud microphysics (e.g., the rate of formation and evaporation of PSC particles differ) and sedimentation of particles (Section 2.5).'

(5) P.16979, L.15: "V" should be "PV".

The expression has been revised following the comment.

(6) P.16983, L.6-8: Fig. 10b shows positive impact on PSCs at altitudes of 16-25 km in spite of little temperature variance from synoptic-scale waves there. This feature is interesting; hence some discussions on this point are to be

helpful.

In the Northern Hemisphere, negative impacts of synoptic-scale waves are observed (Fig. 15d). However, this may come from synoptic-scale distribution of HNO_3 and H_2O rather than synoptic-scale waves. Similarly, this feature in the Southern Hemisphere may come from the synoptic-scale distribution of HNO_3 and H_2O. Following this comment, we have newly added Section 7.

(7) P.16985, L.20-25: In Fig.14, the TSTS-based PSC frequency overestimates the CALIPSO observations. However, the difference of the two is very small in the Southern Hemisphere (Figs.3 and 8). The authors should discuss such a discrepancy.

Optically thin clouds are considered to appear more frequently in the Northern Hemisphere than in the Southern Hemisphere because the average temperature through the winter is higher in the polar regions of Northern Hemisphere. Because CALIPSO may fail to detect such optically thin clouds, the proportion of clouds undetectable by CALIPSO to the actual clouds can be larger in the Northern Hemisphere. We have added this possible explanation to the 3rd para. of Section 3.