**Response to Reviewer #2’s comments for the manuscript (CLDY-21-00295)**

**We would like to thank Reviewer#2 for his/her helpful comments that helped us to improve the manuscript. We have addressed the comments and revised the manuscript based on the suggestions. Please see our point-by-point response below. In the following, the black texts are original comments, and the blue texts are our responses.**

**Reviewer #2:** Reviewer comments: "Impact of the El Nino type and PDO on the winter sub-seasonal North American zonal temperature dipole via positive PNA changes" (CLDY-D-21-00295-R1)  
  
This is my third time reviewing this article. I appreciate the authors' effort to improve the manuscript and answer all my questions. However, I have found the manuscript is still not in a good shape for publishing. I would suggest to encourage the authors to rewrite and resubmit. Below are my major comments:

**Response to major comments:**

**Question 1:**1. The main message/result of the manuscript is that during a CP-type El Nino winter, PNA+ would prefer a WWCE SAT pattern over North America on sub-seasonal time scale. The manuscript includes some superfluous materials. For example:  
(1) The 2013/14 and 2014/15 winters were served as motivation, but there's a long analysis about how the SAT pattern related to the PNA+ events contribute to the seasonal mean. The clarification of how these two winters served as motivation is necessary, but should be concise.

**Response:**

Thank you for your useful suggestions. Based on your comments, we have shortened the discussions about the two winters to make it more concise and clearer. Please see **lines 192-201** in our new manuscript.

(2) In L298-299, the authors already excluded other clustering regimes, focusing on C3 and C4 which have distinct WWCE SAT pattern. But in the next subsection, the authors discussed the SST anomalies for all the six clustering regimes, which seems redundant to me.

**Response:**

Thank you for your suggestion. Here, we show the SST anomalies for all the six clustering regimes to compare the SST anomaly differences among the regimes. Based on your comments, we have mainly focused on C3 and C4 and removed some discussions about other clustering regimes in subsection. Please see **lines 314-321** in our new manuscript.

(3) Also, I am not sure that Figure 12 and its discussion are necessary. Figure 13 seems to be enough, for the purpose of this manuscript.

**Response:**

Thank you for your valuable comments. According to your suggestion, we have removed Figure 12 and the relevant discussions.

**Question 2:**2. I am confused with the definition of WWCE SAT pattern. My understanding from the introduction is that it is when western North America is anomalously warm AND eastern North America is anomalously cold. But the remaining analyses, sometimes the pattern shows normal SAT anomalies over western NA and cold eastern NA. When the authors defined T\_we index, did they set any limitation that T\_w has to be positive and T\_e has to be negative? L163 & L233-235 seems to be inconsistent (also, L233-235 needs to be rephrased.)

**Response:**

Thank you for your useful suggestions. In this study, the TWE index is defined as the SAT anomaly difference over the west and east parts of the North America. When we define the TWE index, we don’t require the limitation that TW is positive and TE is negative to guarantee that the TWE index is continuous. We have pointed out it in **lines 173-175 in our revised manuscript**. When we define a WWCE dipole event, we require a limitation that TW is positive and TE is negative so that thewestern North America is anomalously warm and the eastern North America is anomalously cold. Moreover, we have modified the definition of the WWCE pattern **in lines** **221-224** so that a consistent TWE index definition can be maintained in the whole paper.

**Question 3:**  
3. That's said, more clarification about the WWCE SAT pattern/features should be included in the manuscript. Sometimes, the more prominent feature is the strong warm anomalies and ridge anomaly located at Northwest North America, poleward of the box the authors used to calculate the T\_we index, the SAT anomalies over the western US, instead, are more or less normal (or it's an illusion caused by the colorbar scale?).

**Response:**

Thank you for your valuable comments. Indeed, the warm anomalies in the west part of North America are located at higher latitude than the eastern cold anomalies, thus we have used TW and TE averaged over the northwest (35°N-65°N, 125°W-100°W) and east (TE: 25–55°N, 100°W–65°W) parts of North America to define the WWCE dipole index in our new manuscript. The definition of TW and TE has been given **in lines 166-173.** Figure B1a-c show the time-mean fields of composite daily Z500 and SAT anomalies averaged from lag -5 to 5 days of PNA+ events for the combination of PDO+ with the different types of El Niño and their difference. The daily variation of TWE=TW-TE shows that a relatively stronger WWCE pattern occurs during the mature and decay of PNA+ (lag-1 to 7) events during the PDO+ and CP-type El Niño combination than during the PDO and CP-type El Niño combination (Fig. B1d).



**Figure B1.** (a, b, c) Time-mean fields of composite daily Z500 and SAT anomalies averaged from lag -5 to 5 days of PNA+ events (a) PDO+ and CP-type El Niño combination, (b) PDO- and CP-type El Niño combination and (c) their difference. (d, e, f) Temporal variations (5-days running means) of composite daily (d) TWE=TW-TE (e) TW (red box: 35°N-65°N, 125°W-100°W) (f) TE (blue box: 25°N-55°N, 100°W-65°W) from lag-10 to 10 days of PNA+ events for PDO+ and CP-type El Niño combination (red line) and PDO- and CP-type El Niño combination (blue line). The gray shading denotes the difference between the two curves being significant above the 90% confidence level based on 5000 Monte Carlo simulations. In panels a-c the region with the 95% confidence level based on a two- sided Student’s t-test is plotted with color shading.

**Question 4:**  
4. The manuscript includes at least two time scales in their analyses and discussion. One is PNA+ resulting in WWCE SAT pattern on sub-seasonal time scale. Another one is seasonal time scale. The distinction should be clarified throughout the manuscript. Also, in the Introduction, L60-83, it should be clarified about which studies are case study and which focus more on the general feature of WWCE SAT pattern.  
**Response:**

Thank you for your useful suggestions. According to your suggestion, we added more description about time scales to make it clearer throughout the new manuscript. Please see **lines 190-191, 463-466, 481-485** of the new manuscript. To explore the relationship of sub-seasonal WWCE and the winter-mean WWCE pattern, we show the time series of the winter frequency of daily WWCE events and the composite SAT and Z500 anomaly fields for all days of daily WWCE events during the winters from 1950 to 2018 (Figs. B2a-b). And the composite Z500 and SAT anomalies for the winters with high WWCE days show a winter WWCE pattern (Fig. B2c). In contrast, the winter WWCE dipole cannot be seen during winters with low WWCE days (Fig. B2d). Thus, the winter WWCE pattern is mainly related to the frequency of the sub-seasonal WWCE dipole. In Figs. B2c-d, the winter with high (low) WWCE days is defined as the normalized time series of the winter frequency of daily WWCE events being above 1.0 STDs (below -1.0 STDs). The discussion is added in **lines 218-236** of new manuscript.

On the other hand, we clarified the studies about two winters in **lines 61-73** and general WWCE pattern in **lines 74-81** according to your suggestion.



**Figure B2.** (a) Time series of the winter frequency (the number of total days) of daily WWCE events and (c) composite daily Z500 (contours, contour interval is 20gpm) and SAT (color shading and unit: K) anomaly fields for all days of North American WWCE dipole events during 1950-2018 winters, The composite DJF mean Z500 (contours, contour interval is 10gpm) and SAT anomaly for the winters of with (c) high WWCE days and (d) low WWCE days. The winter with high (low) WWCE days is defined that the normalized time series of the winter frequency of daily WWCE events is above (low) 1.0STDs. The region of the SAT anomaly (color shading) with the 95% confidence level based on a two-sided Student’s t-test is plotted.   
**Question 5:**  
5. On minor comment, the acronym "CI" for contour interval is really unnecessary. It only served convenience for writers, not at all for readers. I am not sure why the authors dropped this acronym in the last version, but decided to bring it back in this version.  
**Response:**

Thank you for your insightful comments. We apologize that we made this mistake in the former manuscript. Based on your suggestion, we have changed the acronym “CI” into “contour interval” to make it easier for readers to understand in the new manuscript.