Response to the review of "Impact of Eastern and Central Pacific El Niño on Lower Tropospheric Ozone in China":

We thank the referee for the detailed and constructive comments. We respond to each specific comment below. The referee's original comments are shown in blue. Our replies are shown in black. The corresponding changes in the manuscript are shown in *Italic black*.

Anonymous Referee #1:

Review of "Impact of Eastern and Central Pacific El Niño on Lower Tropospheric Ozone in China"

In this manuscript, the authors gave a very details study of middle to lower tropospheric ozone column (LTO) interannual variations induced individually by Eastern Pacific (EP) and Central Pacific (CP) El Niño. Due to the climatic factors (temperature, relative humidity, general circulations etc.) impact by CP&EP ENSO are varied much in regions of mid-latitude and uncertainties in extent, this kind of topic is of much difficulty to get solid conclusions. While this kind discussion is necessary. The analysis of the manuscript is mostly sound, but the scientific significance and basis of this study need emphasize and restate, and some details need clarify. My specific comments and suggestions listed below.

Specific comments:

1. I suggest to give an introduction on the relative accumulative variance (in percentage) that contribute to the climatic factors (T, RH, circulations etc.) impacted by CP&EP ENSO on the basis of previous studies. It's the scientific basis of this study.

Thanks for this suggestion. We have investigated previous studies on the impact of EP and CP ENSO on the climate factors in China. Most of them discussed precipitation, temperature, and water vapor transport, and they generally focused on the EP type and a specific variable. A few of them consider several variables in one study. For example, Li and Chen (2014) discussed the impact of ENSO on monthly means of daily maximum temperature (Tmax), minimum temperature (Tmin), precipitation, and relative humidity (RH). They found that South China will experience warmer temperatures, more precipitation, and higher humidity in El Niño years than in normal years. However, they did not distinguish between the different types of El Niño. These studies generally qualitatively describe the relationship between these variables and El Niño, so it's not easy to provide a quantitative evaluation of the relative accumulative variance on

different climate factors impacted by EP and CP ENSO. Moreover, their impacts vary with seasons and spatial location. As a result, we expanded our discussion in the introduction to provide a better basis for our research.

[Main text, Lines 69-83]:

The impact of ENSO on East Asia climate is known as the "Pacific-East Asia teleconnection", including the central Pacific cyclone, western North Pacific anticyclone, and the northeastern Asian cyclone (Wang et al., 2000; Zhang et al., 2011). During the developing autumn, the anomalous atmospheric circulation over the western North Pacific is nearly opposite in response to EP and CP El Niño. EP El Niño is generally accompanied by an anticyclone, while CP type usually has a cyclone over the western North Pacific. Yu and Sun (2018) found that East Asia winter monsoon is strong for EP ENSO but weak for CP ENSO. During the decaying phases of El Niño, Feng et al. (2011) showed that the EP type generally corresponds to the anomalous western Pacific anticyclone and brings ample moisture to southern China, contributing to the increased rainfall over these regions. However, the CP type generally has a weak western Pacific anticyclone and thus corresponds to the drier condition over southern China. Except for the rainfall patterns, other studies also show that different types of El Niño can induce different changes in tropical cyclone genesis and water vapor transport over China (Feng et al., 2011; Li et al., 2014; Wang and Wang, 2013). Accompanied by these meteorological changes, the two types of El Niño are also likely to exert different impacts on pollution conditions.

2. In line 236, "over the west Pacific retreats"?

Sorry for this lack of clarity. As this is not an important information, we deleted this sentence to avoid confusion for the readers. This will not affect the presentation of the main point in this section.

3. In line 303, I suggest "suppressed " replace "exceeded".

Thanks. We replaced it according to your suggestion.

4. In line 313, why is "chemistry still contributes positively over eastern China (Figure 6c)" oppositely corresponding to "reduction of SR in spring" in line 307.

In general, the reduction of solar radiation does contribute to the decrease of the chemical production of ozone. However, in our case, the temperature increase during the spring over most regions of eastern China (Figure 3o) counteracts the effect of SR reduction. We added the following discussion in the text:

[Main text, Lines 353-361] :

In EP condition, with the slight westward shift of the anticyclone center from winter to spring, the wind anomalies also shift from southwesterly to southerly, bringing more moisture, and further enhancing TP in higher latitudes where RH increases and SR decreases coherently. Although these changes are generally unfavorable to the local ozone production, the chemistry process still contributes positively to eastern China (Figure 6c). We attribute this pattern to the large-scale increase in temperature related to the warm south winds (Figure 3o&s). As the climate warms from winter to spring, the role of temperature becomes increasingly important and may compensate or even exceed the impact of SR reduction.

5. In line 338, "the western Pacific warm pool begins to shrink with the building of La Niña (Johnson and Birnbaum, 2017)." is opposite to the reference in title "As El Niño builds, Pacific Warm Pool expands, ocean gains more heat".

This is because La Niña generally shows opposite characteristics to El Niño, according to Johnson and Birnbaum (2017). We revise the sentences here to avoid confusion.

[Main text, Lines 384-389] :

According to a previous study, the western tropical Pacific warm pool spreads eastward near the surface as El Niño builds (Johnson and Birnbaum, 2017). As La Niña generally shows opposite characteristics to El Niño, the western tropical Pacific warm pool under the former condition will shrink. Associated with the SST drop, SLP increases over the northwestern Pacific (Figure 4t), resulting in the enhanced western Pacific subtropical high(WPSH), a typical feature of CP El Niño (Chen et al., 2019).

6. In around line 343, related to ozone transport, please denote the upwind regions were in high ozone or low?

Thank you for pointing out this lack of clarity. We had a typo here (Figure 6g should be Figure 6p), and we now revised this sentence and also added an explanation.

[Main text, Lines 389-394] :

Controlled more by the local Pacific than the Indian Ocean, the SLP center shifts eastward during CP El Niño compared to the anomalous anticyclone during EP El Niño, and the positive LTO anomalies also move eastward accordingly (Figure S5h). Thus, the enhancement of LTO concentration in the SLP center cannot reach the southeast coastal line of China. Regional transport (Figure 6p) by the southwest wind anomalies surrounding the anomalous anticyclone (Figure 4t) brings air with low ozone content

from the ocean and exerts a consistent negative contribution to LTO in southern China (Figure 2h; Jiang et al., 2021).

References

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