

Dear Editor and Reviewer #2,

We sincerely thank you and Reviewer #2 for once again taking the time to carefully read our manuscript and previous responses, and for providing constructive feedback that has helped us to further improve our work. With the reviewer's thoughtful and detailed suggestions, the overall quality of the paper has been substantially enhanced. We also wish to express our gratitude to the editor for the careful consideration and recognition of our manuscript. We have carefully addressed all comments and revised the manuscript accordingly. Below, we provide our point-by-point responses. *Italicized text represents the reviewer's comments*, while the regular text contains our responses. All specific revisions are highlighted in blue and have been marked consistently throughout the revised manuscript.

Sincerely,

Xiadong An

On behalf of all authors

Anonymous Referee #2

I suggest more care when it comes to referencing and more transparency when communicating the limitations of the analysis.

Response: We sincerely thank you for your constructive suggestions. You are right, and we agree that we should be more careful in the two aspects you mentioned. In response to your specific comments, we have made corresponding revisions and provide detailed explanations below.

- 1. My point on EP fluxes computation should be acknowledged in the text. Citing only paper (by the authors) using monthly data as justification is unconvincing, and the effects of noise/weather would anyway be reduced if averaging after the calculation. This choice of starting from monthly data likely leads to a smoothing of resulting fields, and it could easily be solved by using daily or sub-daily data (line 289). Perhaps only PM data is "lacking" at sub-monthly timescale. QBO and ENSO data can be computed also at daily scales, so this argument does not hold as well.*

Response: Thank you for your valuable suggestion. We have recalculated the EP fluxes using daily ERA5 data, and the results are shown in Fig. R1. Our method was as follows: we first computed the EP fluxes from daily reanalysis data, then calculated their monthly means, and finally composited the EP flux distributions for different QBO–ENSO phase combinations (as defined in Table 1 of the main text) using monthly EP flux anomalies with the climatology removed (Fig. R1). The results indicate that the EP fluxes based on daily data are overall consistent with those derived from monthly data. For instance, the propagation direction of planetary waves remains the same. Minor differences appear mainly in the stratosphere, while in the tropospheric regions of our interest—such as the subtropical and subpolar areas (Fig. R1 a and c)—the EP flux divergences are also consistent. This further demonstrates that our results are robust. We have added corresponding details in the main text and included the figure in the Supplementary Materials.

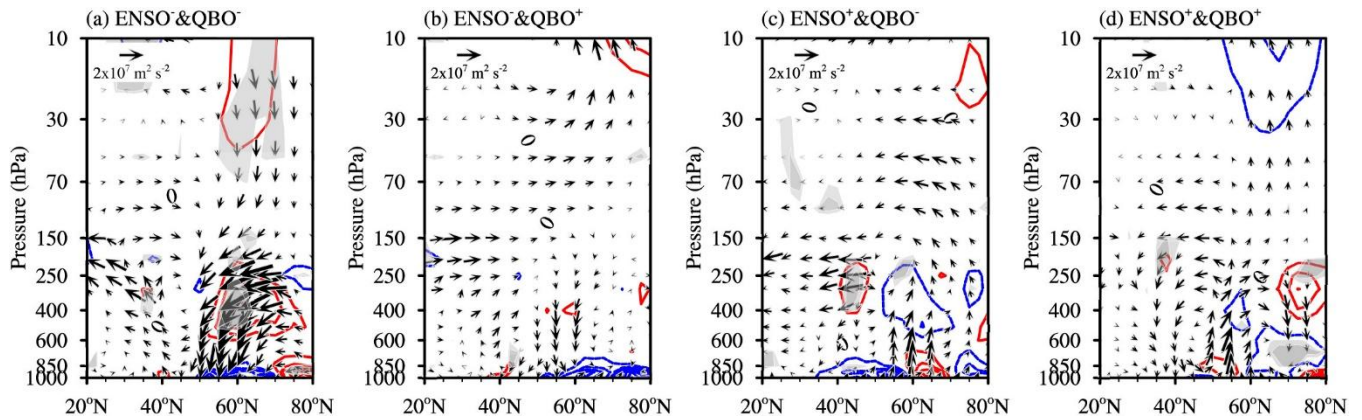


Figure R1: Cross-sections of the EP flux (vectors; unit: $\text{m}^2 \text{s}^{-2}$) based on daily ERA5 data for waves 1–2 and its divergence (contours, with red (blue) lines represent divergence (convergence); unit: $\text{m s}^{-1} \text{day}^{-1}$) for (a) La Niña and EQBO, (b) La Niña and WQBO, (c) El Niño and EQBO, and (d) El Niño and WQBO. Heavy and light shaded areas indicate significant values at the 95% and 90% confidence levels, respectively.

Lines 244–245: “To further ensure the robustness of our conclusions, we recalculated the EP fluxes using daily reanalysis data and found the results to be largely consistent (Fig. S12).”

2. I don't see the need for mentioning "WRF-Chem or GEOS-Chem" at line 286, without reference. The reader might be confused by this. I guess you just mean using atmospheric models with interactive chemistry. Please revise for clarity.

Response: We thank the reviewer for this helpful comment. To avoid confusion, we have revised the sentence at line 286 accordingly and removed the unnecessary model names.

Lines 287–288: “... the validation using atmospheric models with interactive chemistry are not included in the current manuscript, ...”

3. The authors need to use the ERA5 paper citation in the text, i.e. Hersbach et al. 2020 (<https://rmets.onlinelibrary.wiley.com/doi/10.1002/qj.3803>) and not Hersbach et al. 2018, which is a website and not a paper.

Response: Thank you for your careful checking. We have made the necessary revisions.

Line 87: “... (ECMWF) (Hersbach et al., 2020).”

Lines 371–372: “Hersbach, H., Bell, B., Berrisford, P., et al.: The ERA5 global reanalysis, Q. J. R. Meteorol. Soc., 146, 1999–2049, doi:10.1002/qj.3803, 2020.”

4. *The quality of Fig. S1 is poor. Please use different colors, and explain in the caption if these are regions, cities or else. The reader might not know the geography of the area.*

Response: We thank the reviewer for the suggestion. We have improved the quality of Fig. S1 by using more distinct colors and have clarified in the figure caption that the marked areas correspond to specific regions and cities. This should make the geographic information clearer for readers.

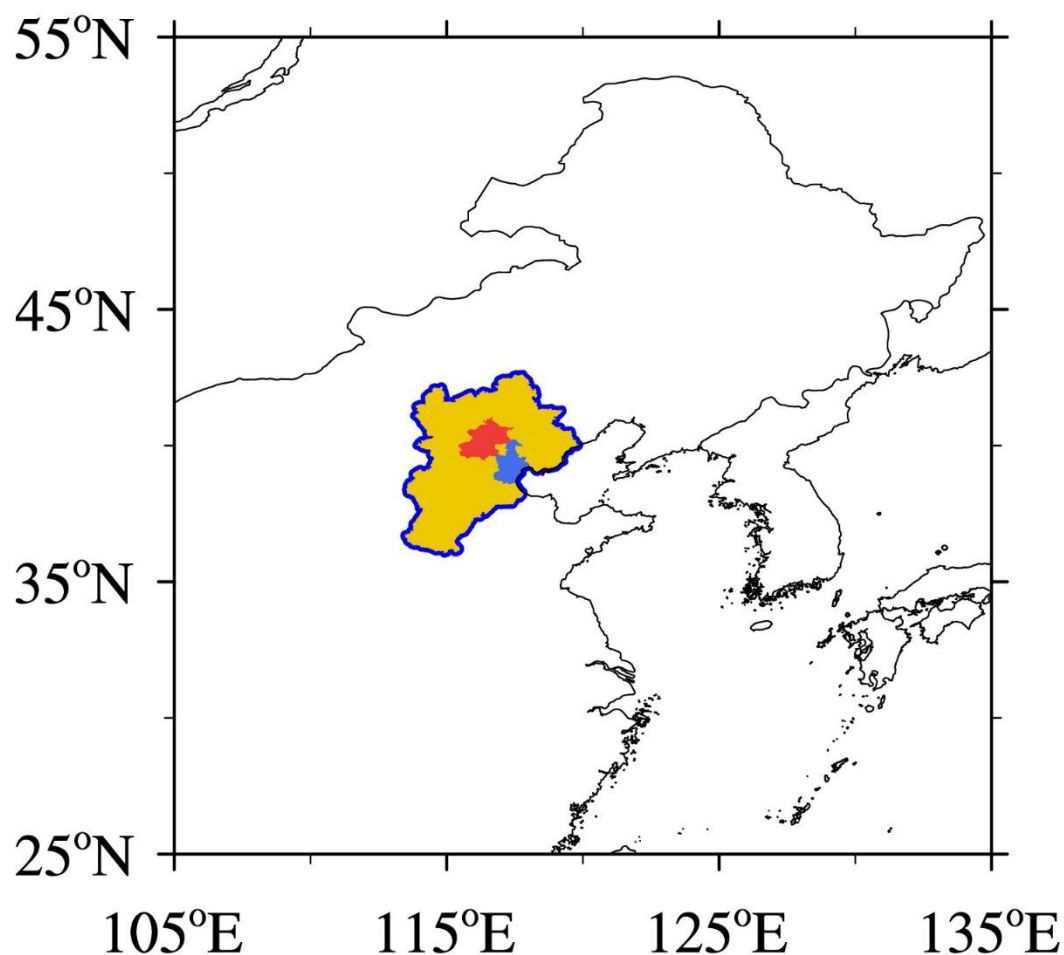


Figure S1: Map showing Hebei (yellow shading), Beijing (red shading), and Tianjin (blue shading), China. The area enclosed by the blue curve corresponds to the Beijing–Tianjin–Hebei region.

5. *In line 69 of the Supplement, you mention "ERA5 forecast data". I guess you are using the analysis, not the forecast. Please confirm this and adjust here and elsewhere accordingly. In Fig. S12, the explanation for the grey shading is missing.*

Response: We thank the reviewer for pointing this out. In line 69 of the Supplement, we indeed used the ERA5 seasonal forecast products (<https://cds.climate.copernicus.eu/datasets/seasonal-postprocessed-pressure-levels?tab=download>) provided by ECMWF, rather than the ERA5 analysis data. We have corrected the wording in the revised Supplement and carefully checked the manuscript to ensure consistency throughout. Regarding Fig. S12, we appreciate the reviewer's careful reading. We have now added the explanation that the grey shading indicates the period when hindcast experiments were conducted for verification.

Line 73 of the Supplement: "... based on ERA5 seasonal forecast products provided by ..."

Line 74 of the Supplement: "The gray shading indicates the period when hindcast experiments were carried out for verification."