

Response to Reviewer #3

This paper explored enhancements in PAN over the North China Plain at the Shangdianzi (SDZ) site for two October days. After meteorological analysis, the authors determined that direct PAN transport was impossible given the timing of prevailing southerlies and used CO as a tracer to confirm. Local enhancements in photochemistry were determined to be the source of enhanced PAN. Authors used observations of various precursor species to calculate respective contributions and found that oxidation of acetaldehyde by the hydroxyl radical was the main pathway for PAN formation at the SDZ site.

I recommend this paper for publication given the following minor edits:

We appreciate the positive feedback from the reviewer. All the concerns have been addressed in the following.

Specific comments:

- The title suggests generalizability to all cold-season haze events, though 3 October days were examined. Additional observation/analysis is necessary in order to determine generalizability to all cold-season pollution events with PAN enhancements. Revision to the wording of the title is suggested.

Thank you for the title suggested. The precedent version of the title has been replaced, becoming “Measurement report: Fast photochemical production of peroxyacetyl nitrate (PAN) over the rural North China Plain during haze events in autumn”.

- The authors concluded that conditions were anomalously warm and wet for days of study, though title suggests "cold-season". As a reader, I question whether results are generalizable to "cold-season" days when anomalously warm and wet conditions are not present.

As suggested by the reviewer, we have changed “cold-season” in the title as “in autumn”. The meteorological conditions during pollution days are anomalously warm and wet in comparison with clean days. It is not inconsistent with “cold season” or “autumn”.

- Figure 3b -- it is unclear as to what "clean days" refers to.

Thank you for pointing this out. The clean days refer to the days excluding three pollution days during the observation period. The Figure 3 caption now reads: “Wind at 925 hPa and sea level pressure (hPa) derived from ERA5 (a) averaged during 10/13–10/27, (b) clean days (10/13–10/19, 10/21–10/24) and on (c) 10/20 and (d) 10/25. The red asterisk in (a) shows the location of the SDZ site.” Similar changes have been made in captions of Figure 4, Figure 8 and Figure 10.

- Improvements in grammar and language are suggested.

Thanks for the reviewer's suggestion. We have carefully checked and improved the language throughout the full text.

Technical comments:

- Line 116 - listed chemical species naming is not consistent with respect to chemical formula and English name use.

Following the reviewer's suggestion, we have revised the sentence as "The proton transfer reaction-time of flight-mass spectrometer (PTR-ToF-MS) is used to measure concentrations of formaldehyde, acetaldehyde, acetone, propene and isoprene etc."

- Line 185 - lack of consistency in naming wind directions. "Southwesterly" should be used rather than "Northwestern". "Southwesterly" should be followed by "winds" to be complete (i.e. Southwesterly winds)

As suggested by the reviewer, we have changed "southwesterly" to "southwesterly winds" throughout the full text.

- Line 186 - sentence reads "...the SDZ site was **in** the south of a strong" should read "...the SDZ was **to** the south of a strong.."

Corrected. Thanks.

- Line 187 - sentence reads "The southwesterly on 10/25 was caused by a weak high-pressure system with anticyclone in the southeast" should read "the southwesterly **winds** on 10/25 **were** caused by a weak high-pressure system with **an** anticyclone in the southeast."

This sentence has been updated as suggested by the reviewer.

- Line 195 - "meridian" should be "meridional"

Corrected. Thanks.

- Line 217 - Wind direction naming consistency -- "southern wind" should be changed to "northerly wind" if this is what is meant.

To keep consistency, we have changed "southern wind" to "southerly wind".

- Lines 240-245 are not interpretable by the reader because the meaning of (Chem + Phys), (Chem), (Phys), were not clearly defined.

Thanks for your suggestion. We have added the sentence in Line 260 as: "Here, we define PAN change rates induced by chemical processes and physical processes as Chem and Phys, respectively."

- Line 335 - “while our results *was* based on” should be “while our results *were* based on”

Corrected. Thanks.

- Line 358, 395 - wind direction naming consistency needed.

We have changed “southern wind” to “southerly wind” throughout the full text.