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## Comment on acp-2020-1140

Anonymous Referee #3

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Referee comment on "“Warm cover”: precursory strong signals for haze pollution hidden in the middle troposphere" by Xiangde Xu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-1140-RC2>, 2021

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Anthropogenic pollutant emissions and unfavorable meteorological conditions are commonly regarded as two key factors for haze pollution. This study investigated whether the structure of atmospheric thermodynamics in the troposphere and its intensity variation could act as a ‘strong forewarning signal’ for surface PM<sub>2.5</sub> concentration variations. It is a very interesting topic and significant for air pollution control. However, I think the current analysis is not sufficient to support the conclusion. Thus, some quantitative estimation and mechanisms illustration is suggested before publication. The detailed reason and suggestions are listed below.

- Fig 1 and Fig 2 demonstrate the key role of “warm cover” in the haze process. However, the illustration of the connection of “warm cover” with the Tibetan Plateau has lacked. The “warm cover” shown in Figure S1 is below 900 hPa, which is similar to the height of the PBL top. It results in a very stable ABL and further improves the surface PM<sub>5</sub> concentration. However, the “warm cover” induced by Tibetan Plateau is about 600 hPa, which is 4 km. The mechanisms of the impact of “warm cover” in such altitude on PBL is needed to be illustrated in the manuscript.
- Fig 3 shows that the “upper warming and bottom cooling” vertical structure in Autumn and Winter favors haze formation. It is interesting. However, the analysis is on the seasonal scale and did not directly support the haze formation on the daily scale.
- Fig 4 compares the interdecadal change of thermal structure in EC and eastern TP with haze days. However, the anthropogenic emissions in EC have increased several times from 1961 to 2018. It is hard to attribute the increase of haze days to the change of TP thermal structure.
- I guess the impact of TP thermal structure on air pollution may cover a large part of EC. Maybe large-scale haze processes could be tried.

Therefore, I think more quantitative estimation and mechanisms should be added. Besides, the definition and calculations of air temperature anomalies are suggested to be supplemented.