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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Integrated impacts of synoptic forcing and aerosol radiative effect on boundary layer and pollution in the Beijing-Tianjin-Hebei region, China" *by* Yucong Miao et al.

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This work tried to understand integrated impacts of synoptic forcing and aerosol radiative effect on boundary layer and pollution in the BTH region based on weather typing as well as chemistry-meteorology coupled regional model. I think it is an interesting topic of great importance. By combining observed data together with simulations, the author analyzed the impact of different synoptic patterns and aerosol radiative effect on heavy haze pollution in BTH. The influence of the primary synoptic type and aerosols' feedback are displayed very well separately, while the joint effect of these two processes are not very clear. For example, which synoptic type is more conducive for

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the feedback formation and why? Are the differences of pollution level under different synoptic patterns due primarily to regional circulation or intensity of aerosol radiative impact and even more secondary aerosol formation? Overall, more in-depth analysis ought to be provided. Here are some issues that need to be addressed for further improving this work.

Major comments:

This study used T-PCA method to identify main synoptic weather in Section 3.1. I wonder if the sample size is too small to get the representative results. Usually, years of GPH data was utilized for weather classification (Zhang et al.,2016). Another, the domain of used FNL data is not very clear. Did the author just use the FNL data in BTH region as shown in Fig. 3? Can this region well capture the various spatial-scale circulation systems, especially large-scale ones? At last, it seems that Type 4 is more polluted than Type 2 and occurred during 28-31 Dec. in the following case discussed in 3.2, why the synoptic type 2 can be regarded as the representative polluted pattern (Line 133-135)?

One strength of this work is comprehensive observational data. Here, modeled meteorological conditions like air temperature wind speed and RH was validated in detail. However, the modeled air pollution, especially aerosol reproduction, ought to be evaluated since that this work mainly focused on aerosols' impact on meteorology. Thus, the WRF-Chem simulation with/without aerosol radiative effects is suggested to be compared with observed temperature, RH and hourly PM2.5 concentration.

Many previous studies on aerosols' impact on PBL have highlighted the important role of absorbing aerosol (Huang et al.,2018), did it also hold true in these two typical pollution events discussed here? Furthermore, the vertical profile of aerosol, which is highly dependent on synoptic condition, has been proven to play a vital role in aerosols' impacts on PBL development (Wang et al., 2018). It is a very crucial feature related to both synoptic weather and also PBL evolution. Thus, this work could be greatly

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improved by drilling down further into the link among synoptic condition, aerosol vertical structure and its impact on PBL, and in turn,air pollution itself.

Minor corrections:

Line 63: In the sentence "... leading to lower the BLH and deteriorate the pollution", "to" is a preposition and should be followed by substantive expressions instead of the root form of a verb.

Line 66: "...meteorological driving for..." should be "...meteorological driving factor for ...".

Line 77: "green triangle" should be in plural form.

Line 85: "... has been widely to ..." should be "...has been widely applied to ...".

Line 88: The same problem as Line 63, "in consideration of" should be followed by substantive expressions not an independent sentence.

Line 116: According to Fig2, it seems that not all the warming of upper air leads to a pollution aggravation (such as the time period at the end of November). Are there any other factors to be mentioned that control the variations of particulate matter in BTH? Besides, the author only gives the variations of potential temperature, while the definition of inversion is more concerned about air temperature. The vertical structure of air temperature may also worth attention.

Line 128: The total occurrence of type 1 and type 2 synoptic pattern is about 70% (Line 123), it's a little confusing why the rate of other synoptic types is no more than 12.5%. Shouldn't they be summed up to 100%?

Line 133: The author may intend to mention "Fig. 4b" instead of "Fig. 3b" since Fig 4 gives the difference of potential temperature.

Line 155: "resulting to" should be corrected to "resulting in".

Figure 1 caption: “green triangle” should be in plurality, i.e. “green triangles”.

Section 3.3 is too short to be a subsection

Reference:

Zhang Y, Ding A, Mao H, et al. Impact of synoptic weather patterns and inter-decadal climate variability on air quality in the North China Plain during 1980–2013[J]. Atmospheric environment, 2016, 124: 119-128.

Huang X, Wang Z, Ding A. Impact of AerosolâĂŘPBL Interaction on Haze Pollution: Multiyear Observational Evidences in North China[J]. Geophysical Research Letters, 2018, 45(16): 8596-8603.

Wang Z, Huang X, Ding A. Dome effect of black carbon and its key influencing factors: a one-dimensional modelling study[J]. Atmospheric Chemistry and Physics, 2018, 18(4): 2821-2834.

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