

Three dominant synoptic atmospheric circulation patterns influencing severe winter haze in eastern China

The synoptic atmospheric circulation patterns influence haze pollution. This study employed the Hierarchical clustering classification algorithm to track haze days in the cool season over eastern China under three atmospheric circulation patterns. This manuscript also analyzed the possible mechanisms of each circulation pattern. The paper is well written, but the methods seems to be flawed. The following concerns are addressed.

**General comments:**

1. In the introduction section, the authors only introduced weather conditions and circulation system favoring haze pollution, and further pointed out “there is still a lack of research on the dominant circulation patterns of severe HD<sub>EC</sub>”. However, there are many previous studies on circulation patterns conducive to air pollution in China. The authors did not introduce previous related studies and clear clarify the difference and the novel of the current study.

References:

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2. The HD<sub>EC</sub> definition (PM<sub>2.5</sub> ≥ 150 μg m<sup>-3</sup>) would lead to underestimation of the role

of circulation pattern in recent years. Considering the implementation of the Air Pollution Prevention and Control Action Plan since 2013, there is a decreasing rate of 7% in  $PM_{2.5}$  concentrations in eastern China. The impact of emission change on  $PM_{2.5}$  should be removed before the  $HD_{EC}$  definition.

3. The process about classification of circulation does not seem convincing. The circulation patterns are identified not in fixed region, but a rectangular region of 30 degree with each station as the center. However, China is a vast country with a diverse climate, and uneven spatial patterns of meteorological conditions and air pollutants. The classification may be not reliable. For example, Figure 2(c) shows that the stations with severe haze are located in the southwestern parts of the anticyclonic anomaly center. But the locations of anticyclonic anomaly are different for stations in north and south China. It is recommended to first divide eastern China into four subregions like Figure 12 (a), and then begin to classify key circulation patterns in each region.

4. The authors only cluster the circulation anomalies of days with severe  $HD_{EC}$ . Would such data processing be robust? It is recommended to add box plots of the daily  $PM_{2.5}$  concentrations under each circulation type. Please add the frequency of occurrences for each type in Figure 2 also.