Referee #1:

Reply: We thank the support for the reviewer, and thanks for the helpful comments prior to the ACP Discussion online.

Referee #2:

"This is a nice study that analyzes the effect of seesaw transport and stagnation days on local $PM_{2.5}$ pollution in several regions of China and the health impact of $PM_{2.5}$ pollution. The authors should have spent great efforts on presenting comprehensive results. This paper is well-written, and I recommend it for publication after consideration of the points below."

Reply: We are grateful for the helpful comments from the reviewer to improve the manuscript. Please see the detailed responses to your comments below.

Comments

1. "L149-150 The authors should clarify if they are simulating only DJF or all 2014-2019 period. Related to WRF, would be a nice addition to know if they are using nudging or daily initialization of meteorology and what's the length of the spinup period."

Reply: In this study, the simulation time for WRF and CMAQ is six full years from 2014 to 2019. The simulations are conducted continuously for each year, with December in the previous year as the spin-up time. Moreover, the grid nudging technique is applied to improve the meteorological simulation to enhance the simulation capability of the air quality model. Only U and V nudging above the boundary layer is applied, with a nudging coefficient of 0.0003. All the information has been added to the revised manuscript.

2. "Throughout the manuscript, please make clear that you are referring to the DJF period. Sometimes, in the manuscript it is written "2014-2019" and Figure's caption refers to winter 2014-2019."

Reply: We thank the reviewer for the helpful suggestions, and in the revised manuscript, winter 2014-2019 is used for consistency.

3. "At times difficult to read, i.e. L270-287. Please explain if "day 1" represents the mean of all days considered as the first day of all 24 events or if the authors are referring to a specific event. If the authors are talking about the mean, have they verified the dominant wind direction for each event?"

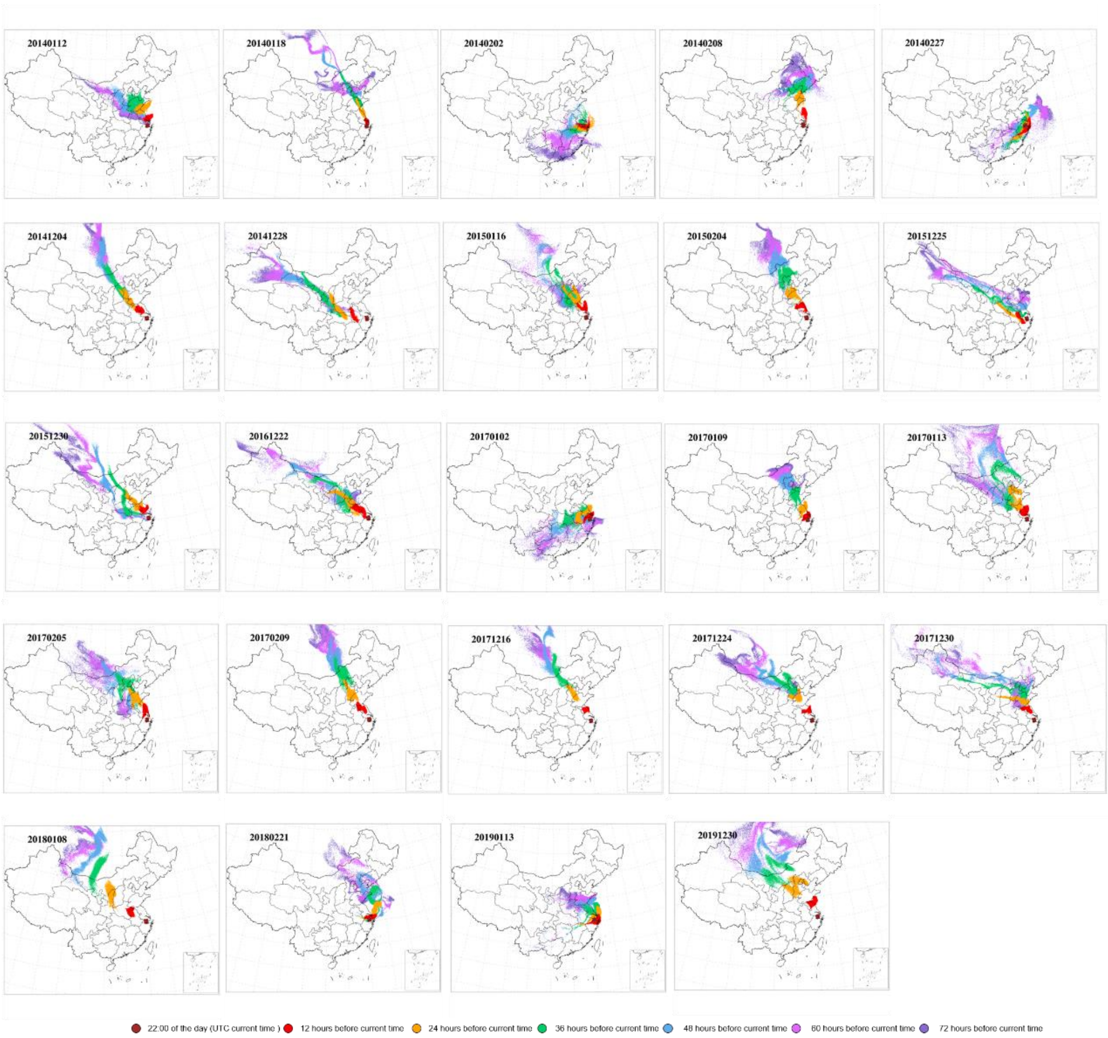
Reply: "Day 1" represents the mean of all the first days for each type of event, e.g., 24 events for type I, and 32 events for type II.

To identify the dominant wind direction for each event, the Lagrangian particle dispersion model FLEPART working with WRF (FLEXPART-WRF) is employed for all events in types I and II, with the target regions of YRD and NCP, respectively. A total of 72 hours, with an interval of 12 hours, from the end of each event (e.g., 22:00) are backward tracked to identify the transport pathway, yielding a total of 7 trajectories marked in different colors for each event.

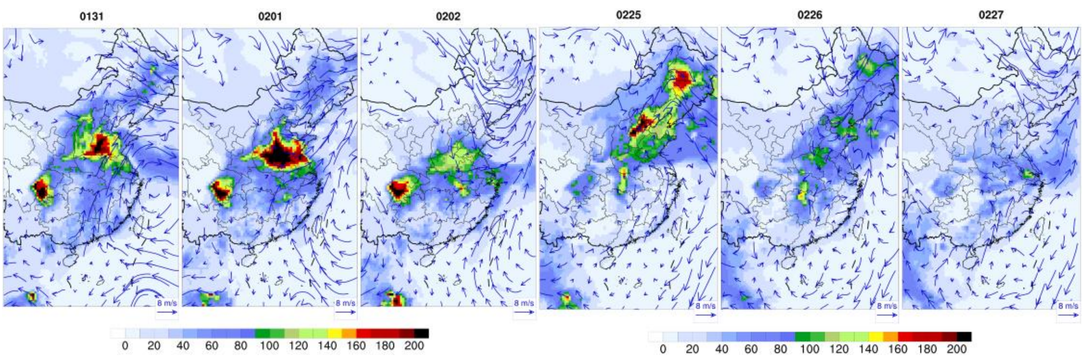
For type I, as shown in Supplementary Figure 1, most of the “seesaw” episodes are driven by northwesterly winds, leading to high $PM_{2.5}$ concentrations in the SWLY region. Note that there are a few exceptions. For instance, on February 2 and 27 2014, the wind direction 72-hour prior to the event may be quite different from the other two days (e.g., 24 hours and 48 hours), which in general favors the northwesterly transport, indicating that the wind pattern closer to the end of the event may play a larger role fostering the accumulation of high $PM_{2.5}$ concentrations downwind the pollution area.

For type II, on day 1, strong northwesterly wind in northern China is concomitant with low $PM_{2.5}$ concentrations over NCP, while the $PM_{2.5}$ in southern China such as YRD and the adjacent areas is relatively high. In the following two days, the northwesterly wind retreats further north, and weak southerly wind dominates the majority of North China, stimulating the accumulation of $PM_{2.5}$ in SWLY and NCP. This phenomenon is in general supported by the results derived from FLEXPART-WRF.

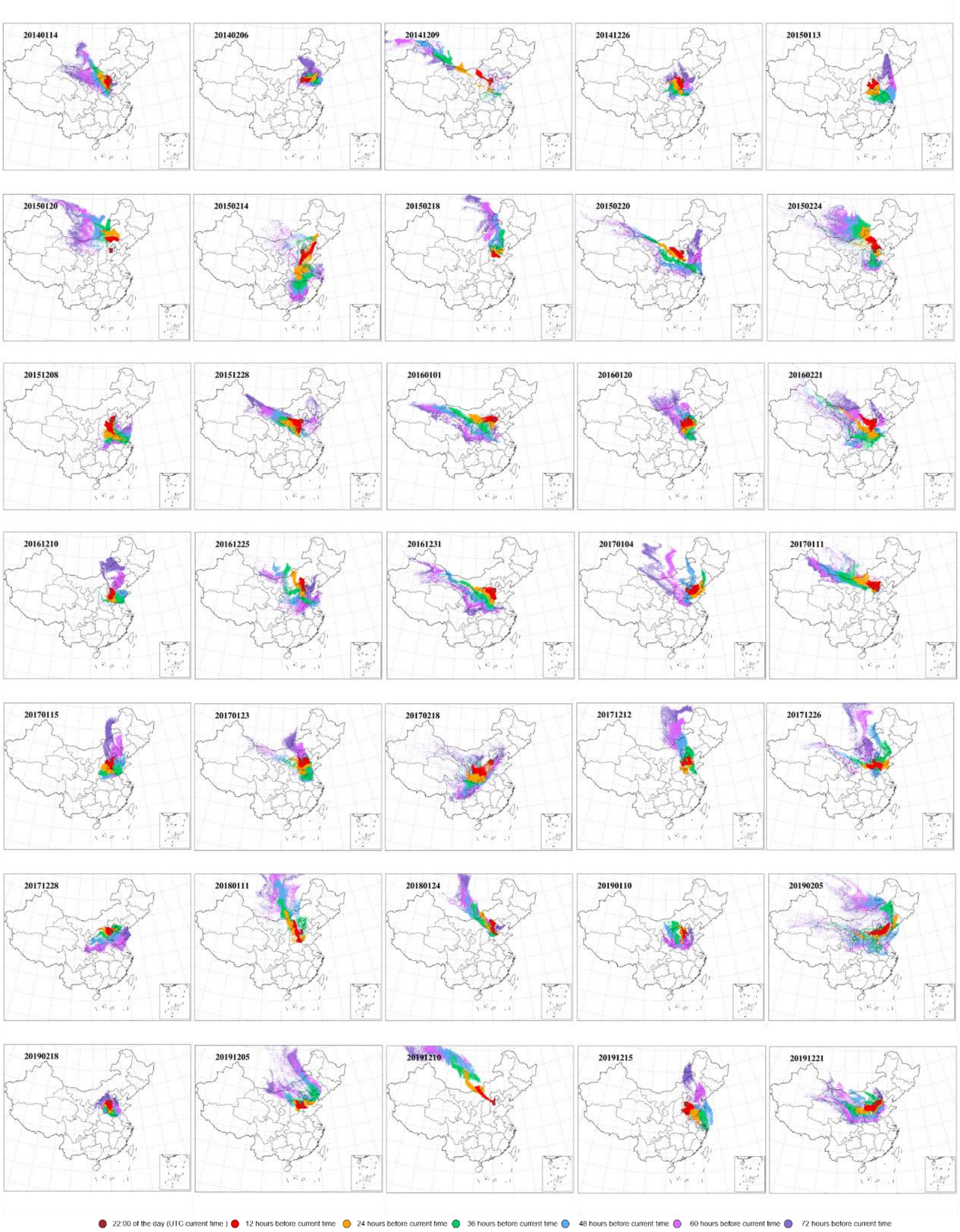
The information above has been added to the revised manuscript and supporting information (Fig. S6-7).




Supplementary Fig. 1 Trajectories from FLEXPART-WRF in YRD for episodes of Type I, with different colors indicating the number of hours prior to the end of the event (e.g., 22:00 UTC), including 12, 24, 36, 48, 60, and 72 hours in red, orange, green, blue, magenta and purple, respectively.




Supplementary Fig. 2 The spatial distribution of the surface mean $PM_{2.5}$ concentrations and wind vector during three days from January 31 to February 2 and from February 25 to February 27, 2014 in type I, respectively.




Supplementary Fig. 3 Trajectories from FLEXPART-WRF in NCP for episodes of Type II, with different colors indicating the number of hours prior to the end of the event (e.g., 22:00 UTC), including 12, 24, 36, 48, 60, and 72 hours in red, orange, green, blue, magenta and purple, respectively.

4. “L363 Fig 6a doesn’t show a clear positive trend for $PM_{2.5}$ and HSR.”

Reply: From Fig. 6a, there is a high correlation (positive R = 0.92) between the $PM_{2.5}$ concentrations (red line) and HSR (blue line).