Yang et al. investigate the role of Chaohu Lake in modulating surface $PM_{2.5}$ concentrations over the lake and the surrounding regions. They do so using high-resolution WRF-Chem simulations configured both with and without the presence of Chaohu Lake. The simulations indicate that the lake acts as a particle storage zone during the daytime due to suppressed boundary layer height and reduced dry deposition rates, leading to $PM_{2.5}$ accumulation and increased particle lifetime. During nighttime, $PM_{2.5}$ concentrations over land decrease substantially in the presence of the lake, driven by enhanced land-breeze circulation. The authors further examine aerosol sources (primary and secondary) and their contributions to $PM_{2.5}$. I found the methodology to be sound and the interpretation of the results convincing. Uncertainties related to the emission inventory are also documented in detail. Overall, the results highlight the importance of properly representing surface properties for improved air quality forecasting. I recommend publication in Atmospheric Chemistry and Physics after the authors address the following (mostly minor) comments.

Line 207: Instead of "Another type of option include...", I suggest using "Other model configurations include...".

Line 214: A brief explanation of why the first five days of the simulations was considered spin-up would be helpful. Additionally, why were the days between 5 and 20 March 2019 selected for this study? Does this period have any particular seasonal characteristics that make it relevant for lake-breeze development.

Line 220: The abbreviation "YRD" is not defined in the manuscript.

Line 260: How were the quasi-global WRF-Chem simulations on a 1° × 1° grid obtained for use as initial and boundary conditions for trace gases and different aerosol species?

Line 349 and Figure 3: Do the local times correspond to 10 March 2019? A reference date is missing in the manuscript. Alternatively, are these panels averaged over the simulations between 10 and 20 March 2019?

Figure S4: By "satellite-derived hourly 5 km resolution ground-level PM2.5 for Eastern China, 2018," do you mean that the satellite observations correspond to the year 2018? If so, this does not appear to match the simulation period used in this study.

Figure 3 caption: By surface, do you mean the vertical level nearest to the surface?

Several details regarding the observational data are missing. For example, Figure S4 in the Supplementary Material should be included in Figure 3, with same color map and limits, to qualitatively demonstrate that the simulated concentrations reasonably represent the observed spatial and temporal variations. In addition, it should be stated whether clouds

and associated precipitation occurred during the simulation period, as these factors can affect PM2.5 concentrations.

Line 374: Replace "reasonableness" with "reliability"

Figure 4 caption: Replace "...as a function of distance from point B" with "as a function of distance from point B toward A, as marked in Figs. 2 and 3."

Section 3.1.2 title: Replace "Component-dependent..." with "Aerosol-species-dependent...".

Section 3.2 title: Replace "The influence mechanism of..." with "Factors controlling the variations of...".

Lines 457–458: Although I understand that secondary $PM_{2.5}$ dominates the concentration differences, the phrase "secondary $PM_{2.5}$ plays a particularly prominent role" is somewhat unclear and could be rephrased for clarity.

Lines 459–462: It is not clear how this conclusion can be inferred from Figures 5 and 6. The color scale for the differences is limited to 2, and panel (d) in both figures appears nearly identical. I recommend merging Figures 5 and 6 into a single figure and adjusting the color bar limits to better highlight the differences.

Line 461: Replace "degree" with "extent".

Line 463: On what basis do the authors conclude that the differences between the lake and no-lake experiments stem from pollutant transport from the lake surface? It seems more appropriate to state "transport to the lake."

Line 472: Additionally, air masses transported over the lake may spend a longer time in the atmosphere, increasing the likelihood of secondary aerosol formation. This process could contribute to the larger differences between the lake and no-lake simulations for secondary aerosols.

Section 3.1.2: Could the authors comment on why secondary aerosols primarily contribute to the differences during daytime, while primary aerosols dominate during nighttime?

Figure 7 caption: Replace "wind speed" with "wind vectors," as the figure shows both speed and direction. Also correct "thier" to "their." Are the wind fields and boundary layer height interpolated along the AC track? I suggest reducing the spatial density of the wind vectors for improved visualization. Also, I suggest changing their color to something brighter like cyan that would be easy to read over dark red color. Additionally, the resolution of the figure is low, making the labels difficult to read.

Line 32: Replace "mechanisms which" with "mechanisms by which".

Line 38: It would be clearer to use "column dry deposition velocities" instead of "dry deposition velocities".