

The research conducted by Yang et al. investigated the impact of different grid resolutions on meteorology, especially turbulent mixing, as well as its subsequent influence on air pollution transport and dispersion. Although the topic is of interest, some flaws in model validation and interpretation would undermine the scientific validity and clarity of this work and should be properly addressed before its consideration in ACP.

My major concern about this work is the validation for the model. The current validation is limited to comparisons between simulations and meteorology/BC concentration data from a single surface station. To enhance the robustness of the validation, additional stations with meteorological or air quality data should be incorporated. Furthermore, it would be beneficial to include vertical observations such as PBL height or turbulent fluxes. Comparing these with the simulations could better illustrate the mixing processes in the boundary layer. Without such data, it remains unclear whether the mixing is more accurately captured at finer resolutions.

The model settings and the interpretation of model results should be further elaborated. The vertical level settings in all three domains should be further elaborated. Are these settings sufficient to capture boundary layer turbulence accurately? Given that hourly observations for meteorology and BC are available, why is the model output provided at 3-hour intervals? This discrepancy should be addressed. The authors claim that the PBL mixing coefficient is crucial for BC surface concentration, which is closely related to land-use type and terrain. Does this imply that high-resolution surface information is more important than high-resolution atmospheric grids? This point needs further clarification. Lastly, vertical grid resolution may play a more significant role in resolving eddies of different scales. The authors should discuss this aspect in more detail.

Minor:

Line 23-28: 'higher resolution' in key points, what resolution? Vertical or horizontal? Please be specific.

Line 418: what is the diurnal variation of BC emissions?

I noticed a few spelling errors, such as 'parametrized' (should be 'parameterized') on page 17, line 474. Please review the manuscript for similar issues.