$PM_{2.5}$ concentrations based on near-surface visibility in the Northern Hemisphere from 1959 to 2022

We thank the referees for the comment and carefully thought about the comment.

Response to Anonymous Referee #2

Comment. *I am curious why the test results sorted by time (in the reviewed version) are only slightly lower than the random test results (in the first submission) (0.80 to 0.79), and even the test results on a site scale are better in China and India. Typically, test results divided by time are significantly lower than those divided randomly. For example, Yang et al. (2022) developed a model to estimate PM2.5 concentrations and showed that sample-based cross-validation (CV) and date-based CV yielded R2 of 0.92 and 0.63, respectively. (Reference: "Geographical and temporal encoding for improving the estimation of PM2.5 concentrations in China using end-to-end gradient boosting," Remote Sensing of Environment, 2022).*

- **Response:**

(1) This study is based on the time series of the site for modeling and prediction (not based on spatial distribution prediction), which will capture the historical variation easily at site scale, avoiding the influence of similar environments (the similar values of variables) in different location due to the strong spatial variability of $PM_{2.5}$ concentration.

(2) The dependence of variables shows that visibility is the most important variable, indicating that it is an indicator of $PM_{2.5}$ concentration. Especially in China, the contribution is even greater than 90%. In addition, we also discussed the differences in visibility-based and AOD-based $PM_{2.5}$ concentrations in section 4.3.

(3) C**ompared to the previous version, the main reason for the better performance in China and India is that more visibility stations were added, greatly reducing the errors caused by spatial distance between visibility station and $PM_{2.5}$ site.**