

## ***Interactive comment on “Recommendations on benchmarks for photochemical grid model applications in China: Part I – PM<sub>2.5</sub> and chemical species” by Ling Huang et al.***

### **Anonymous Referee #1**

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Air pollution is a major environment problem and a hot scientific topic in China. Air quality model is a crucial kit to perform mechanism study, source apportionment study, strategy study and policy consultant. The usage of different air quality models increased exponentially over the past years. This work compiles studies during 2006-2019 using air quality models over China comprehensively, and analyses the accuracy of these studies over different regions with different models. Although the performance of some model results are compiled and evaluated in this work and the language presentation is good, however, I find this evaluation failed to follow the suggestion made by authors themselves and may be not based on a thoroughly review of previous modelling works. Furthermore, I find little improvement in this new reversion, it failed address my major

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concerns in the quick review. I could not suggest for publishing the current version, unless the following concerns are well addressed.

1) A quick search on Web of Science tells me that there are about 74 papers published 2006-2019 using Geos-Chem to study air quality in China. This figure is much more than the other 3 models analysed in this study, CAMx, CMAQ, NAQPMS. Without include GEOS-Chem, I can not agree this samples used in this can represent the air quality modelling study in China and lead to a benchmark suggestion. Furthermore, I use the key word WRF-Chem, China and air quality, Web of Science gives me a result of 174 publications during 2006-2019. This figure is 3 times higher than the number of samples used in this study, which is only 56 samples. Authors need to fully justify the criteria them used for selecting samples.

2) The title does not reflect the present work. This work mainly focuses on PM, but the title highlights photochemical model. I feel more discussion about ozone pollution need to be included, given that ozone is the key secondary pollution of photochemistry and is becoming more and more important for air quality in China. Without including ozone, this study is far from any recommendation on benchmarks for photochemical models.

3) Authors need to include the evaluation of meteorology performs in this study, instead of “will be discussed as a future work”. As suggested by authors themselves in the conclusion part: “It is always good practise to present model performance results of meteorological field. . . Performance results of meteorological model could also help explain potential causes of unsatisfactory PGM simulated results.” Analyse the air quality performance in conjunction with meteorological performance will certainly improve the value of this work. Separating a nice and comprehensive work to individual pieces is not a good practise and also not good for a prestigious journal such as ACP.

4) As suggested by authors themselves in the conclusion part: “In addition to providing numerical values of statistical metrics for model performance evaluation, graphs/plots are strongly recommended to further support model validation. To give a few examples,

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visualizing data via time series plots of modelled and observed data could help illustrate periods with better or poorer performances.” I believe audiences are also expecting to see a time series plots of model performance over 2006-2019. Did we improve the ability of air quality simulation over past decades? If yes, what is the critical step we have improved; if no, where is key problem we should focus on in future? These are the key questions/suggestions we are keen to know from this comprehensive review study, and will add great value to this work and large help for the modelling community. However, this information is absent. I would like to suggest some further discuss in this direction, in addition to the summary of performance in previous works.

5) As suggested by authors themselves in the conclusion part: “Provide as much details as possible with respect to how observation and modelling results are used to obtain the statistical results.” However, I feel very limited details are provided for some statistical analyses of this work. At lease, for me, it is difficult to understand or reproduce the Fig. 9. What does x-axis mean? “Sample fraction”, fraction of what? Why the sum of fractions is larger than 100%, are they integrated values? Here is just an example, more details need to be provided in captions.

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