Response to Reviewer #1 (ESSD-2023-477)

We Thank Reviewer for his/her constructive comments

Responses to the Specific comments

General comments: This is a valuable high-resolution emission dataset for China, and the paper is well-structured. However, I have some questions and suggestions:

Reply: The authors appreciate the reviewer for his/her constructive and up-to-point comments. We have carefully considered the comments and revised the manuscript accordingly. Please refer to our responses for more details given below.

Comment 1: In Figure 4, compared to other pollutants, NOx and VOC emissions still show distributions in the Tibet region of China. Could you provide more information about the sources of NOx and VOC in this region?

Reply: Thanks for this suggestion. Besides the anthropogenic emissions of NO_x and VOC which are mainly located over the urban areas of the Tibet region of China like the other pollutants, there are also distributions of natural sources distributed over there, for example, the soil NO_x emissions and the biogenic NMVOC emissions. Thus, the differences in the distributions of the emissions of NO_x, and VOC compared to other pollutants over the Tibet region of China could be mainly attributed to the natural sources of these two species, considering that the contributions of natural sources to the other pollutants are much smaller. Following the suggestions of the reviewer, we have added more information about the sources of NO_x and VOC in this region in the revised manuscript (please see lines 438–440)

Comment 2: Could you display the temporal trends in emissions from 2013 to 2020 for China and its sub-regions, comparing different inventories (multiple lines) to better illustrate the changes in emission patterns over time?

Reply: Thanks for this suggestion. we have added the temporal trends in the emissions of different air pollutants in China (Fig. R1) and its sub-regions (Fig. R2–R7) obtained from our inversion results and other emission inventories in the revised manuscript to better illustrate the changes in emission patterns over time. Please see Fig. 13 in the revised manuscript and Fig. S10–S15 in the revised supplement.

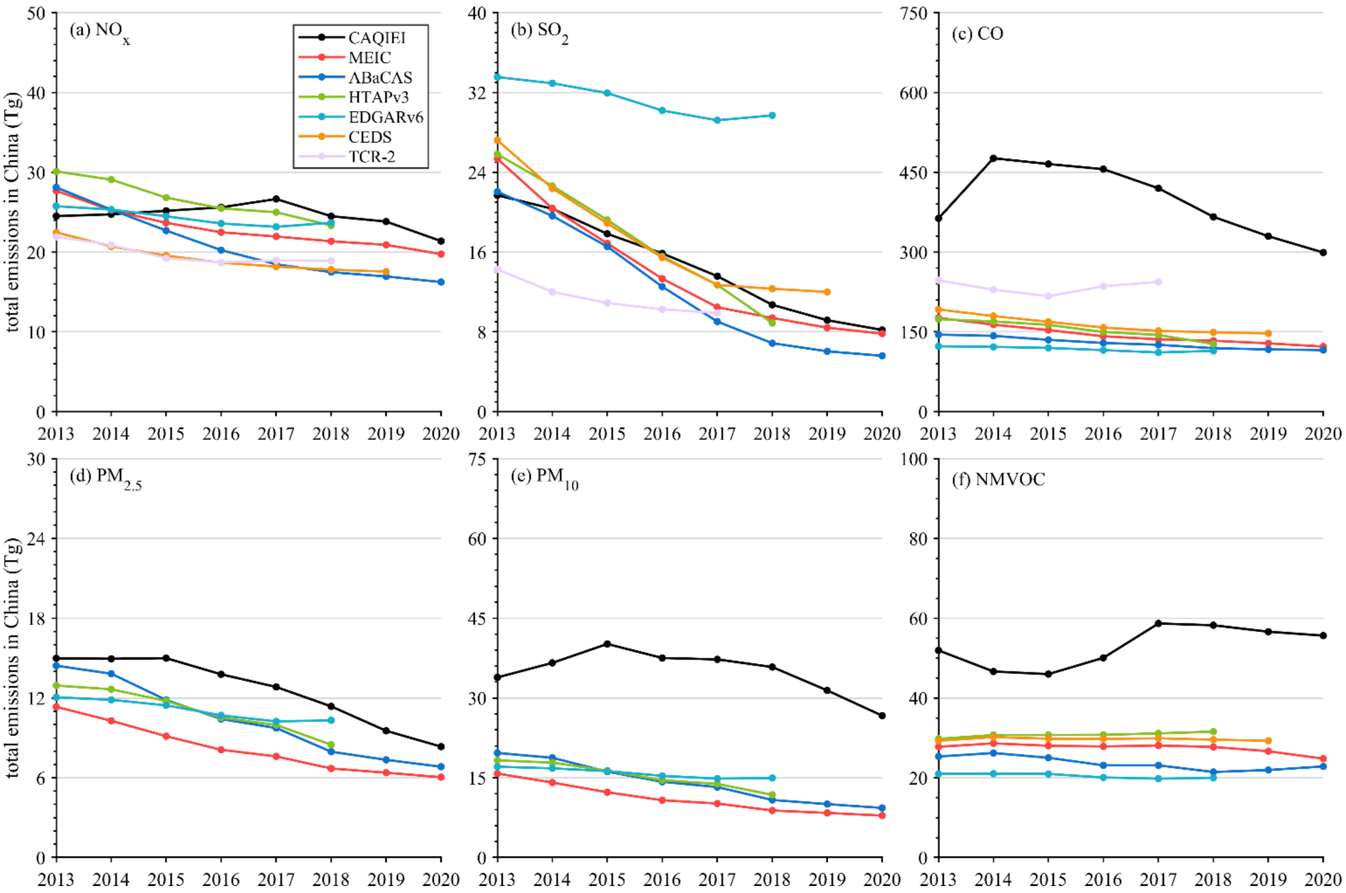

Figure R1: Time series of annual emissions of (a) NO_x, (b) SO_2, (c) CO, (d) $PM_{2.5}$, (e) PM_{10} and (f) NMVOC over China from 2013 to 2020 obtained from CAQIEI and previous inventories. Note that the natural sources were not included in the previous inventories in this figure.

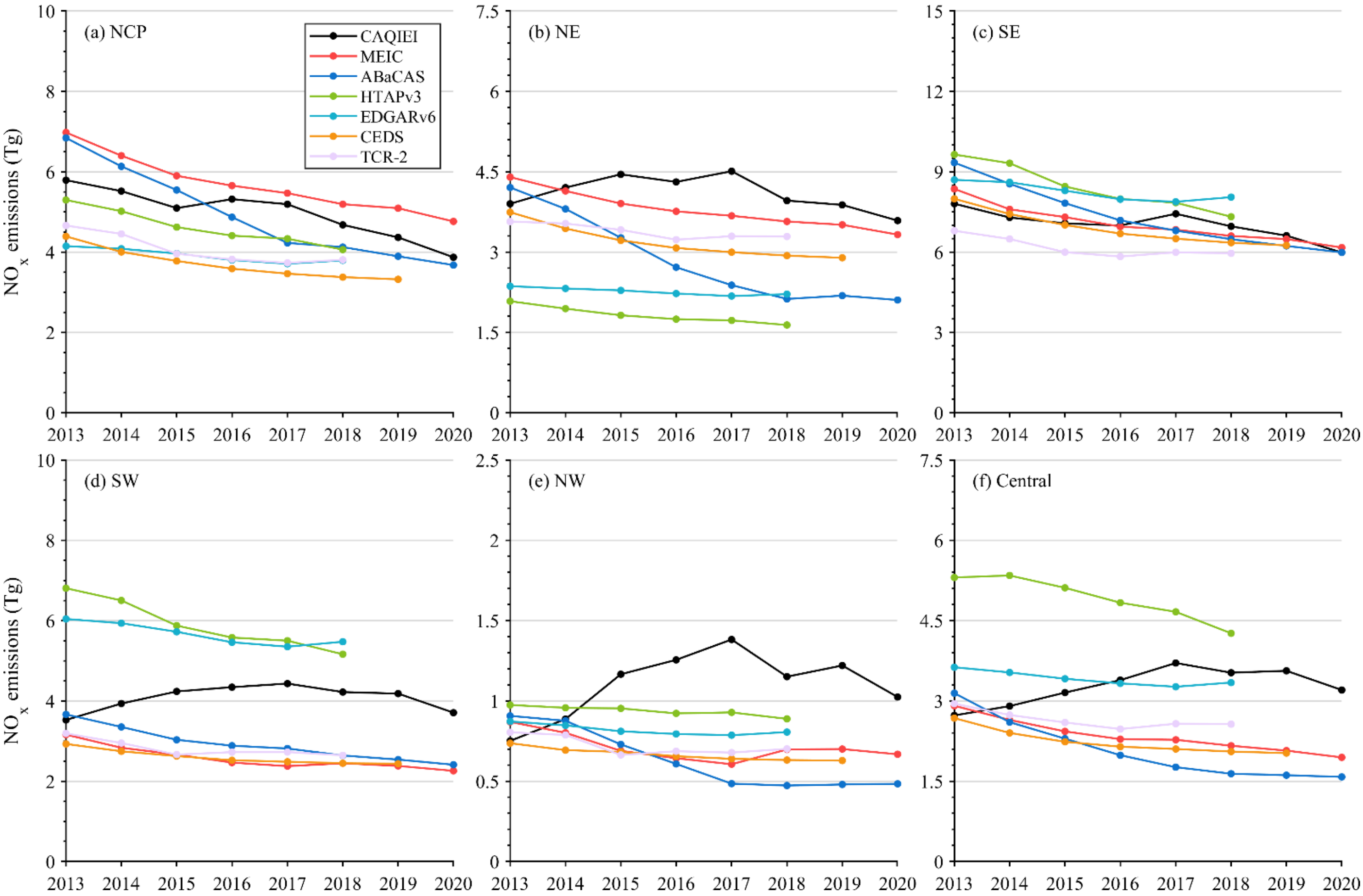

Figure R2: Time series of annual NOx emissions over of different regions of China: (a) NCP, (b) NE, (c) SE, (d) SW, (e) NW and (f) Central from 2013 to 2020 obtained from CAQIEI and previous inventories. Note that the natural sources were not included in the previous inventories in this figure.

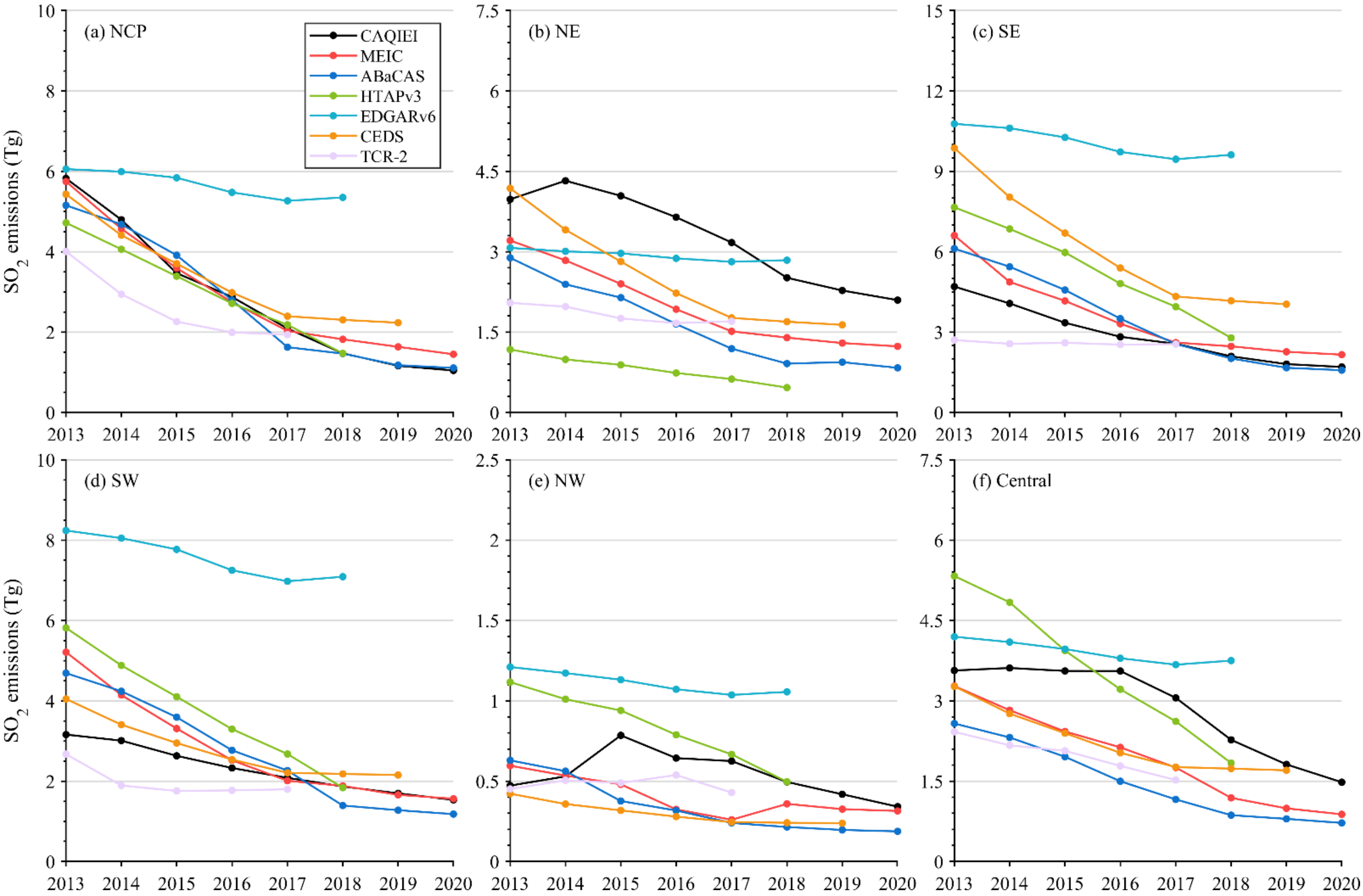

Figure R3: Same as Fig. R2 but for SO_2.

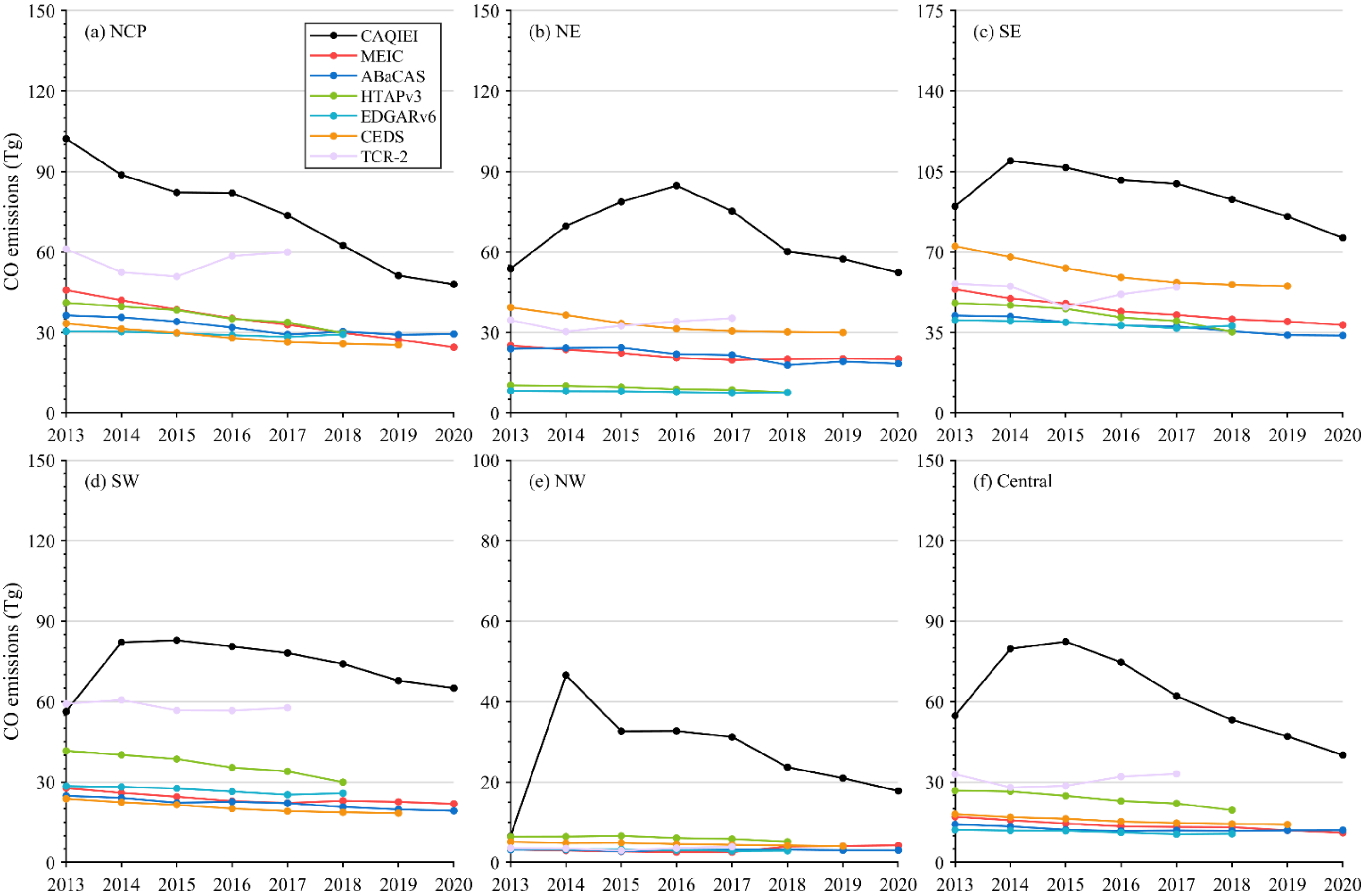

Figure R4: Same as Fig. R2 but for CO.

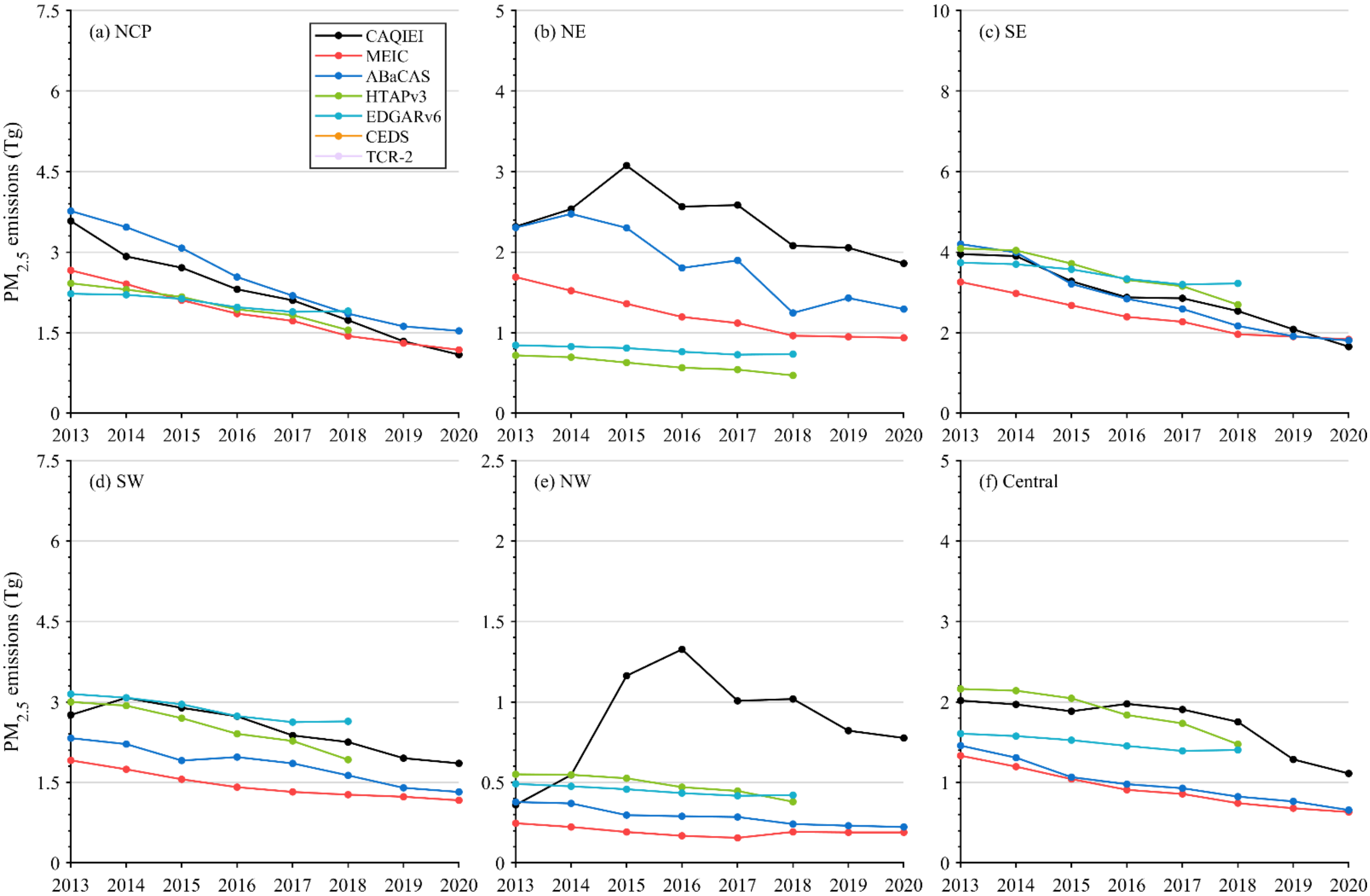

Figure R5: Same as Fig. R4 but for $PM_{2.5}$.

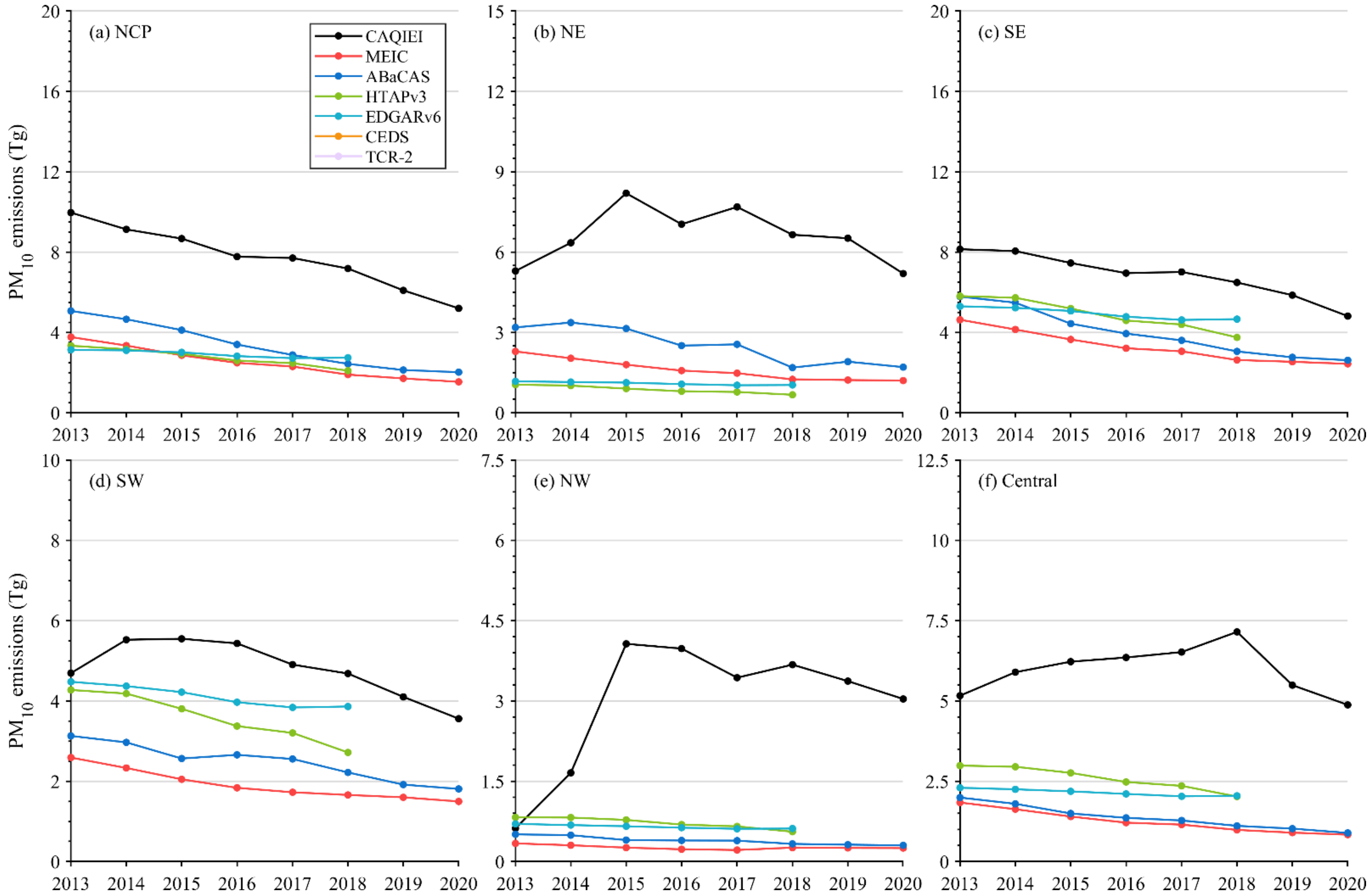

Figure R6: Same as Fig. R5 but for PM_{10}

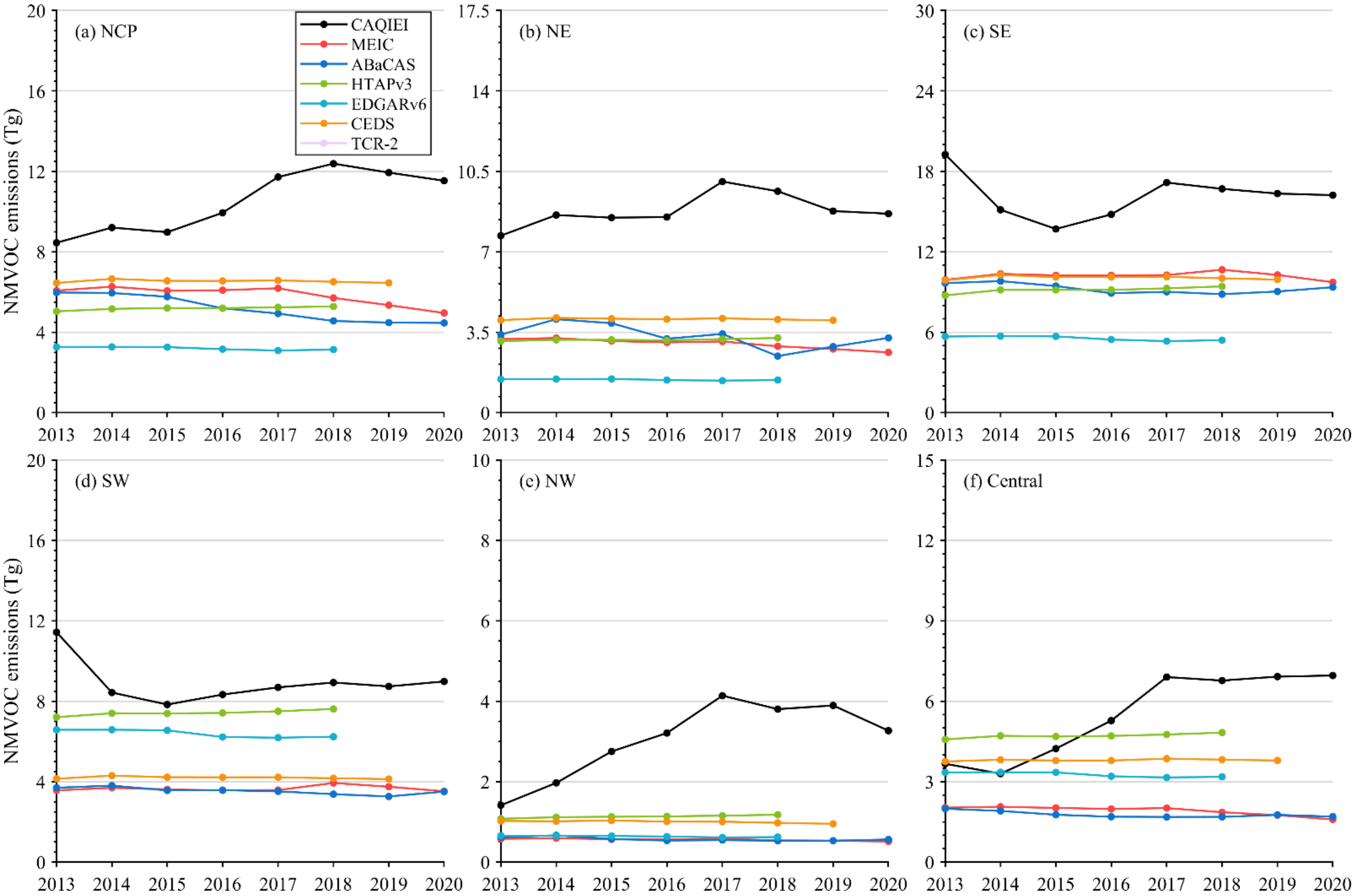

Figure R7: Same as Fig. R2 but for NMVOC

Comment 3: As a high-resolution grid product, is it possible to include a comparison at the grid scale with other inventories?

Reply: Thanks for this comment. We have added the comparisons of the inversion results with the other emission inventory at the grid scale in the revised manuscript by drawing the spatial distributions of the emissions of different pollutants obtained from different emission inventory (Fig. R8). Please see Fig. S9 in the revised supplement.

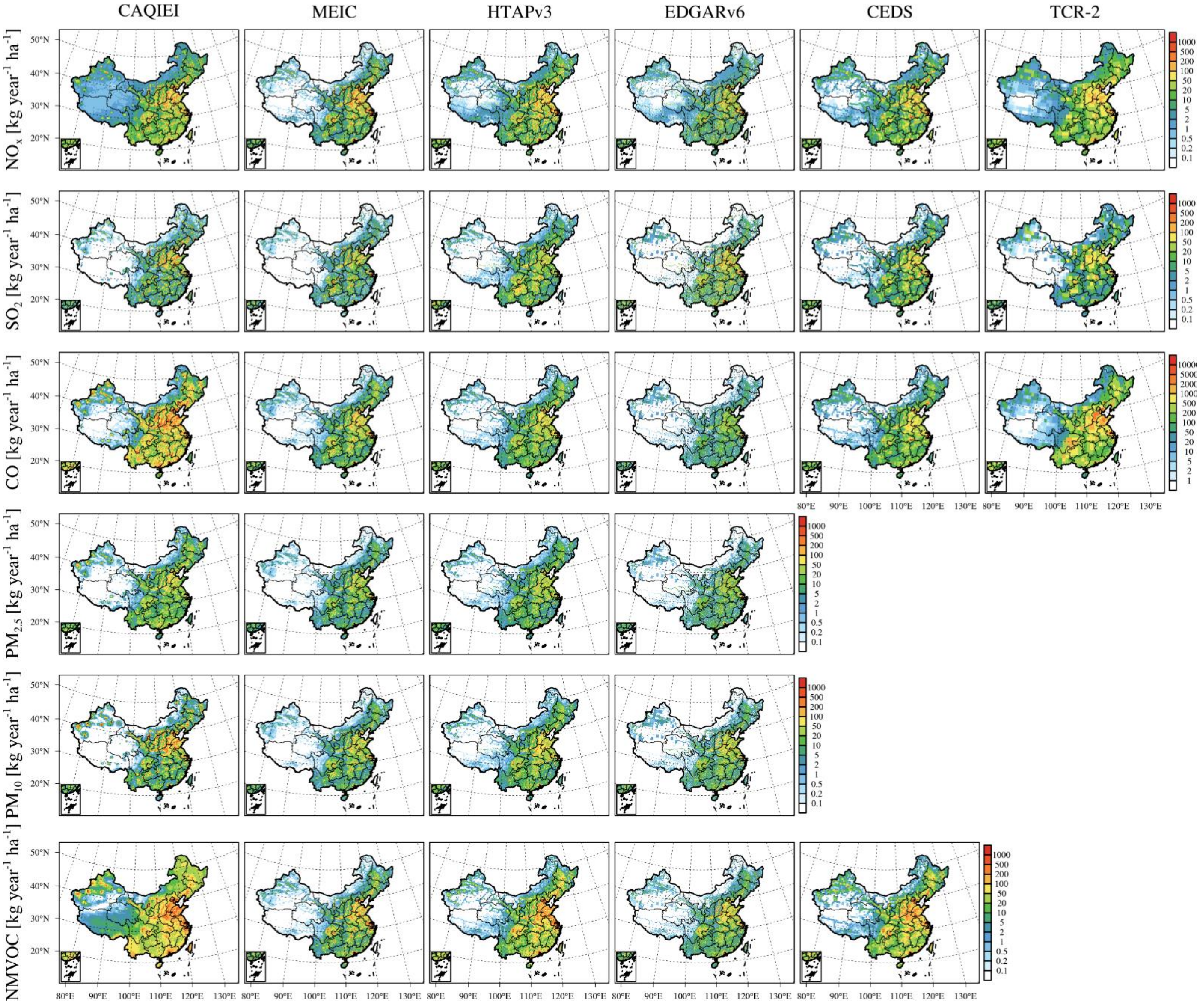

Figure R8: Spatial distributions of the averaged emissions of different air pollutants in China during 2015–2018 obtained from CAQIEI, MEIC, HTAPv3, EDGARv6, CEDS and TCR-2. Note the due to absence of gridded products of the ABaCAS inventory, we did not provide its spatial distributions. Also, the natural sources were not added to the previous emission inventories in this figure because of the different spatial resolutions among these inventories.

Comment 4: In Figure 12, the profiles presented in this study differ from previous research, especially for SO2 and PM10. Are the monthly simulation results for SO_2 and PM_{10} superior to the simulation results using other inventories?

Reply: Thanks for this comment. Since the monthly profiles of the a priori SO_2 and PM_{10} emissions are very similar to those of the other inventories (Fig. R9), the comparisons of the a priori and a posterior simulation could be used to investigate whether the monthly simulation results for SO_2 and PM_{10} are superior to the simulation results using other inventories. Figure R10 and Figure R11 then show the comparison of the a priori and a posterior monthly simulation of SO_2 and PM_{10} over different regions of China. It can be clearly seen that the performance of monthly simulations of SO_2 and PM_{10} are improved significantly by using the a posteriori simulation, suggesting that the monthly simulation results of SO_2 and PM_{10} would be superior to the simulation results using other inventories.

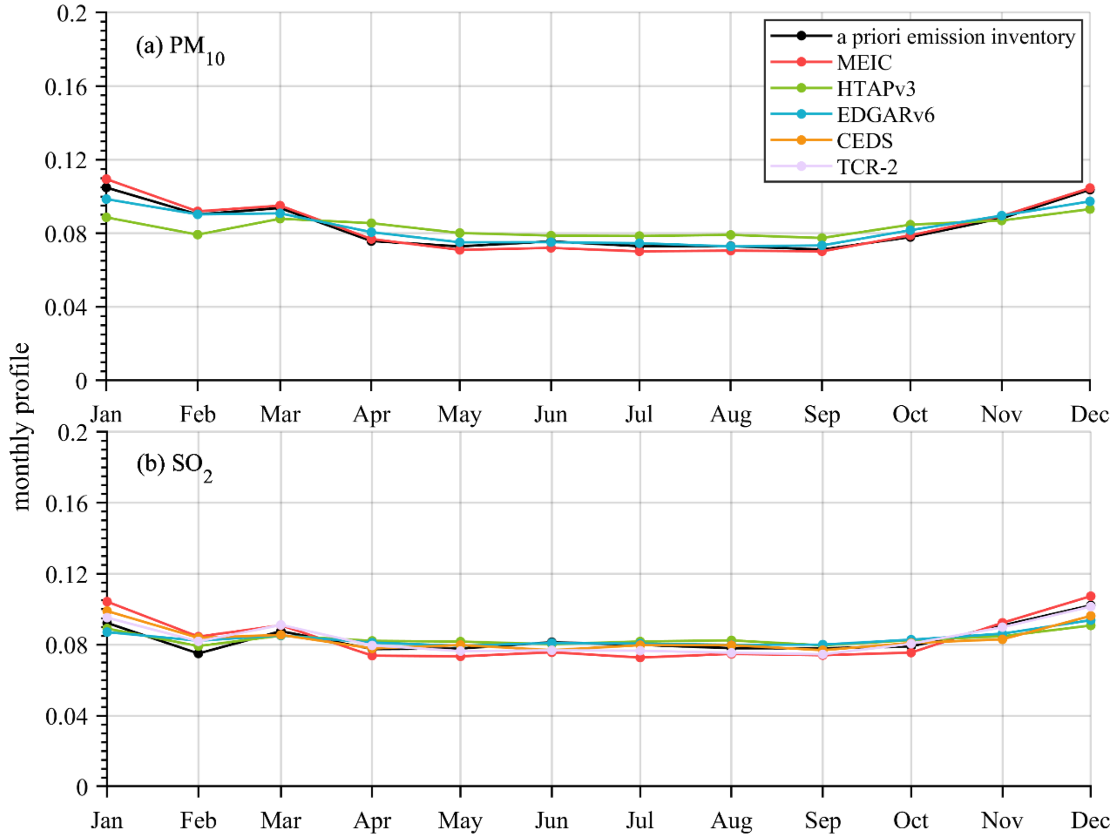

Figure R9: Comparisons of the monthly profiles of the a priori SO_2 and PM_{10} emissions with previous emission inventories.

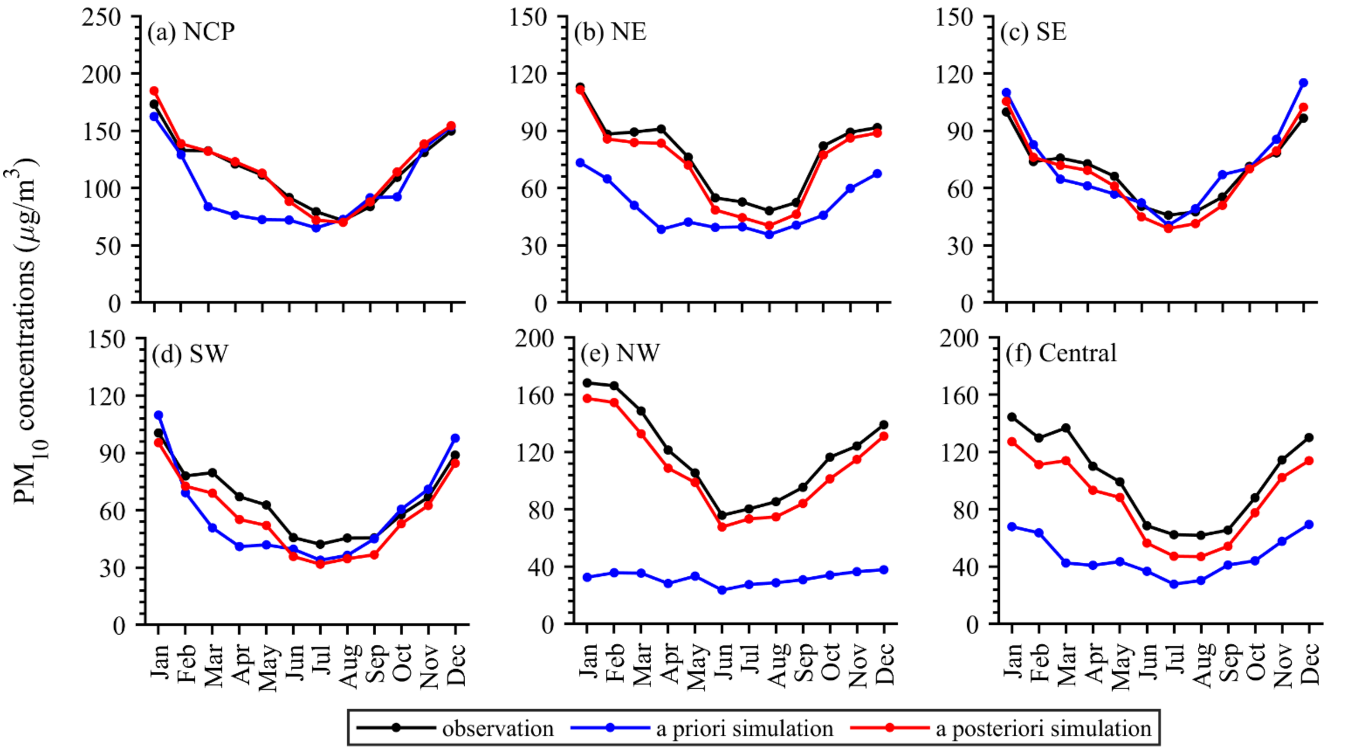

Figure R10: comparison of the a priori and a posterior monthly simulation of PM_{10} concentration over different regions of China.

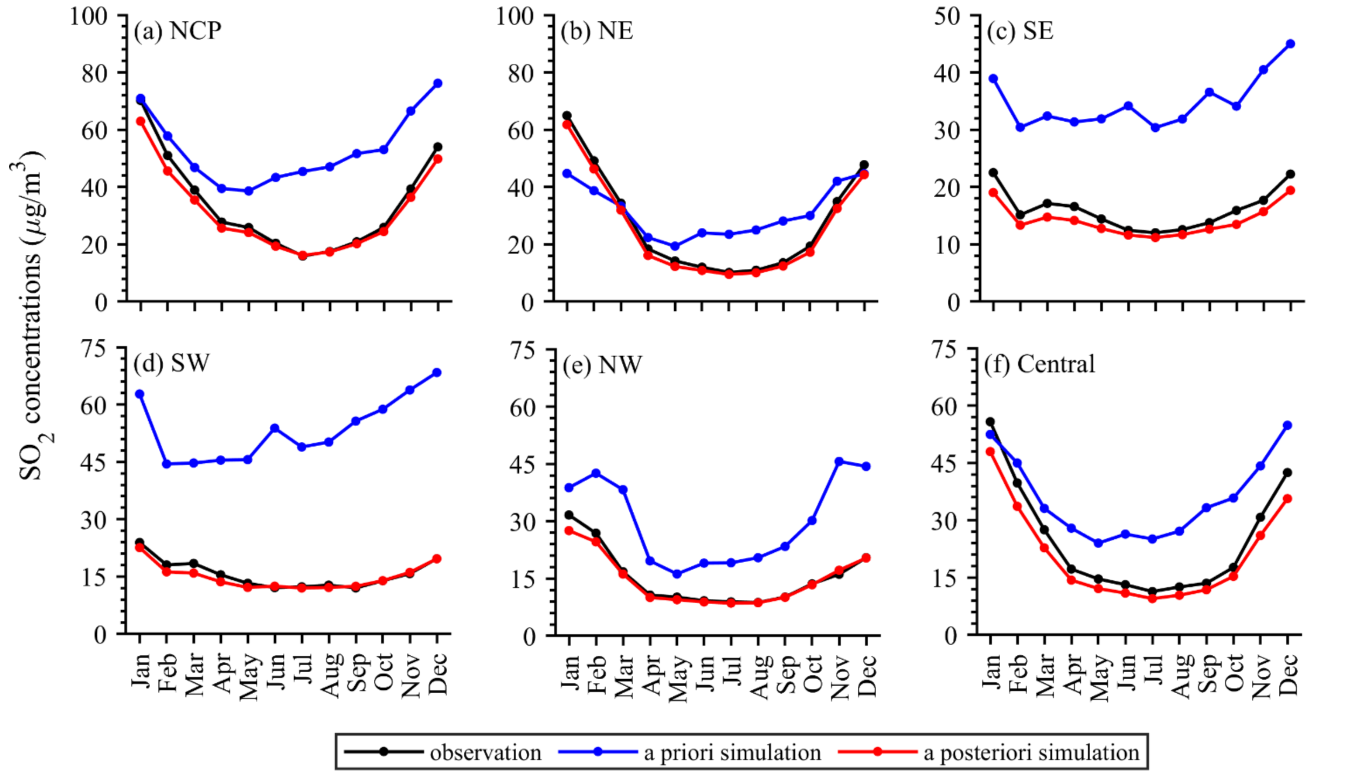

Figure R11: comparison of the a priori and a posterior monthly simulation of SO_2 concentration over different regions of China.

Comment 5: Additionally, it would be interesting to see further validation results from more models (e.g., WRF-CMAQ) using this dataset as input in the future.

Reply: Thanks for this suggestion. Using other models to validate the inversion inventory is a worthwhile endeavor because the results can better validate our inversion inventory and also provide us with interesting information about the impacts of model uncertainty on the emission inversions. As suggested by the reviewer, further validation results by using the other models would be analyzed and provided in the future which has been mentioned in the revised manuscript (please see lines 1015–1016).