Anonymous Referee #1

On the basis of the CPED database, including the detailed information of over 7600 individual coal-fired power plants and supplements with aggregated data, the authors developed a comprehensive and high resolution emission inventory for SO_2, NO_x, $PM_{2.5}$ and CO_2 from China's coal-fired power plants during the period 1990 to 2010. Undoubtedly, emission inventories for SO_2, NO_x, $PM_{2.5}$ and CO_2 in this study, which are characterized by higher spatial resolution and more accurate temporal profile due to the extensive use of unit-based data, are necessary data for improvement the performances of regional air quality modelling by using chemical transport models (e.g., WRF-CMAQ, WRF-CHEM, etc.) and policymaking for their emission control. In general, the present manuscript is well written and presented with good quality, and I recommend the publication acceptance of the manuscript. However, some minor revision comments and suggestions should be addressed before the manuscript can be accepted for final publication.

Response: We thank Referee #1 for the encouraging comments. All comments and suggestions have been considered carefully and well addressed.

Specific comments:

(1) Compared to previous emission inventories, the values of emissions from China's coal-fired power plants estimated by authors are deemed to be much higher reliability on accounting of extensive use of underlying data at unit level. Nevertheless, the detailed activity data using in equation 1, 2 and 3 obtained from MEP-database is unpublished data. Therefore, in order to further convince the international readers of ACP, I recommend the authors supply some much more detailed information about parameters using in the emission calculation, especially for the data in 2010, such as provincial data of P, H, SCC, AC, etc.

Response: The provincial data of P, H, SCC and AC for the year 2010 are provided in Table S3 of the supplemental information. We also added a sentence to indicate the availability of the data in the Sect. 2.2 of the revised manuscript.

(2) With the replacement of small plants with large and high-efficiency units and the continuously increasing application rate of advanced technologies, dynamic emission factors are applied in this study to estimate the historical emission inventory for SO_2, NO_x, $PM_{2.5}$ and CO_2 during 1990-2010. The authors are recommended to make the verification for historical emissions by using of valid index, such as ground-level or satellite based ambient concentrations of above pollutants in China.

Response: Validation against to ground-level or satellite based observations provides a good way of evaluating emission inventories. Developing the relationship between power plant emissions and observations is a challenging task given that observations also contain information of other emitting sources. We believe this is beyond of the scope of this paper. In another paper (Liu et al., 2015), we developed a new approach to quantify NO_x emissions from OMI NO_2 observations for non-isolated sources, which addressed the questions raised by the referee. In the revised manuscript, we have added the citation to Liu et al. (2015) to support the validation of the CPED inventory.

(3) Presently, the research results about emissions from China's coal-fired power plants are one of the most comprehensive emission inventories in China. Based on the emission inventories, the authors are recommended to add some related discussion about integrated control suggestions for minimizing diminish the final stack discharges from coal-fired power plants of China, such as promotion of ultra-low emission units, which will be interesting to the international reader of ACP and policy makers.

Response: We thank the reviewer for the constructive suggestion. We added a paragraph in Sect. 5 to discuss the emission reduction potential in China's power plant sector, including promotion of ultra-low emission units, decommission of flue gas bypass system, and strengthening supervision and management, etc.

(4) With regard to $PM_{2.5}$ emissions, the spray slurry in scrubber of wet FGD system can scrubber part of PM, however, some of gym produced of SO_2 removal can be emitted as gym rain from the stack, which is a concern for many of units installed with limestone-gym FGD. I recommend this point should be properly addressed when considering the effects of FGD on $PM_{2.5}$ emissions.

Response: Thanks for pointing out this. We analyzed the influence of "gypsum rain" on $PM_{2.5}$ emissions in the Sect.4.1 of the revised manuscript. The assumption of $PM_{2.5}$ removal efficiency for wet FGD may have underestimated $PM_{2.5}$ emissions for wet limestone-gypsum FGD. Particulate matters in desulfurizers of the spray slurry from scrubbers of wet FGD are likely to exhaust from stacks along with plumes. These particulate matters would offset $PM_{2.5}$ emissions absorbed by scrubbers of wet FGD (Meij and te Winkel, 2004). In the revised manuscript, we conducted a sensitivity analysis to evaluate the effect of the assumption on $PM_{2.5}$ emissions. By assuming 10% changes of PM2.5 emissions are induced by gypsum spray (Meij and te Winkel, 2004), PM2.5 emissions could be increased by 0.3% in 2005 and 6.4% in 2010, depending on the penetrations of wet FGD.

(5) Line 10-12 on 18789: What are the sources of these air pollutant emissions? The references citation should be cited clearly.

Response: The reference of Y. Zhao et al. (2013) is added in the revised manuscript.

(6) Line 8 on Page 18792: how did the parameter "f" determine for each unit? It is critical for obtaining the monthly profiles of air pollutants for each unit, which should be clearly stated to make it more clarity.

Response: We further clarified the determination of the parameter "*f*" in the Sect. 2.1 of the revised manuscript, as follows:

The monthly fraction of annual electricity generation (*f*) is quantified by province, due to the lack of data at unit level. For 2003–2010, *f* was derived from the statistics (NBS, 2013) and was applied to each unit with adjustments if the unit was commissioned or decommissioned within that year, following Eq.(1). For the years prior to 2003, a monthly climatological profile of the 2003–2007 average was used.

$$f_m = \frac{\gamma_m F_m}{\sum_{m=1}^{12} \gamma_m F_m} \quad (1)$$

where *m* represents the month. *f* and *F* is the monthly fraction of annual electricity generation at unit and province level respectively. *γ* is the state factor for the unit; *γ*=1 when the unit has been commissioned and in operation, otherwise *γ*=0.

(7) Line 10-16 on Page 18795: it might be true that some of SCR were not put into operation before 2010 owing to poor inspection. However, since most of these units are built in Beijing, YRD, and PRD regions, to improve the regional air quality where some large-scale international activities have been hold, such as 2008 Beijing Olympic, 2010 Shanghai Expo and 2010 Guangzhou Asia Games. Thus, assuming all of these DE-NO_x devices are not put into operation may overestimate the emissions. This point is recommended to be considered for the uncertainties analysis.

Response: In the Sect. 4.1 of the revised manuscript, we quantified the uncertainties induced by the assumption that the de-NO_x devices were not in operation until 2010. By assuming that de-NO_x devices were put into operation in Beijing, Shanghai and Guangdong in 2010, NO_x emission estimates could be reduced by 67 Gg (1% of total), indicating our assumptions have small impacts on national total NO_x emission estimates.

(8) The uncertainties of historical emissions of these four species are recommended to give more detailed discussion.

Response: Thanks for the suggestion. We have strengthened the discussion of uncertainties in the Sect.4.1 of the revised manuscript, as follows.

The uncertainty ranges narrowed gradually from 1990 to 2010, representing the improved knowledge of the underlying data over time. The uncertainty ranges declined from −36~38%, −24~26%, −43~55%, −32~39% and −24~27% in 1990 to −22~23%, −15~15%, −31~38%, −26~30% and −15~16% in 2010 for SO_2, NO_x, $PM_{2.5}$, PM_{10} and CO_2 respectively. As discussed in Sect. 2, many of the input data in the CPED in 1990 were determined by extrapolations and assumptions associated with high uncertainty, whereas the uncertainty ranges for the 2010 emission estimates are significantly reduced because of the extensive use of unit-specific data. The unit-specific annual coal use in 2010 contributed to the improved accuracy for all four species. In addition, a better understanding of sulfur content and removal efficiency of FGD, coal type, ash content and heating value of coal for each unit in 2010, on which the accuracy of SO_2, NO_x, PM and CO_2 emission factors depend respectively, is the primary reason for the narrowed uncertainties for corresponding species.

Reference

Liu, F., Beirle, S., Zhang, Q., Dörner, S., He, K. B., and Wagner, T.: NO_x lifetimes and emissions of hotspots in polluted background estimated by satellite observations, Atmos. Chem. Phys. Discuss., 15, 24179–24215, doi:10.5194/acpd-15-24179-2015, 2015.

Meij, R., and te Winkel, B.: The emissions and environmental impact of PM10 and tra ce elements from a modern coal-fired power plant equipped with ESP and wet FGD, F uel Process. Technol., 85, 641–656, 2004.

National Development and Reform Commission (NDRC): Clean coal-fired power plants action plan (2014–2020), available at: http://www.sdpc.gov.cn/gzdt/201409/t20140919_626240.html (last access: September 10, 2015), 2014 (in Chinese).

Zhao, Y., Zhang, J., and Nielsen, C. P.: The effects of recent control policies on trends in emissions of anthropogenic atmospheric pollutants and CO_2 in China, Atmos. Chem. Phys., 13, 487–508, doi:10.5194/acp-13-487-2013, 2013.