We would like to thank the Editor and the reviewer for their comments on our paper. We appreciate the time that they have taken to read our manuscript and their comments and suggestions. Our replies to each of the referee comments are given below in blue.

Reviewer 2

This manuscript examines 5 existing inventories of anthropogenic gases and aerosol in China. It compares emissions (CO, NOx, SO2, and PM) over national, regional, and sector level over 2000 to 2008. It then uses WRF-Chem to evaluate how the differences in emissions inventory influences air quality modeling. Overall, this is an informative paper and adds to the larger research discussion about uncertainty in emission inventories. However, many (but not all) of the comparisons between inventories are called out with simple comparisons with little effort to decompose the reasons behind the differences. In many sections, a deeper dive into why there are differences in the inventories would be really useful, similar to the discussion in L316 – 32 or L360 - 64, rather than just pointing out where differences occur. This is not always possible, as transparency and methodological documentation in inventories is often lacking, which the authors allude to, but even a discussion of why you can't explain the differences would be helpful. Additionally, a discussion of how uncertainty varies over sectors and emission species would be helpful to put uncertainty in China inventories in context. I would recommend this paper for publication with revisions.

General Comments:

- In section 3, many of the sources sectors are compared across inventories as percent of total emissions. For example, (line 333) SO2 industry emissions have shares of 53,33,53,44, and 27% nationally for the 5 different inventories. This comparison is often somewhat misleading because the differences in other sectors, as well as aggregate totals, influence those percentages. For many of these comparisons, absolute emission values would be more informative.

We have changed the percentages to absolute emission values, based on the reviewer's suggestion. This sentence now reads as follows:
Nationally, it contributes 13 (53%), 17 (33%), 17 (53%), 14 (44%), and 9.3 (27%) Tg yr^{-1} of total SO_2 emissions in REAS, EDGAR, MEIC for 2008, ZHAO for 2007, and GAINS for 2005, respectively.

- Manusrcipt is organized nicely, but writing style is very wordy. More concise writing style would aid in comprehension.

We have revised the manuscript to make it more concise.

- Figure axes: many of the figure axes would benefit from formatting with commas or the use of Tg rather than Gg.

We have revised the figures to make the axes easier to read.

- This paper would benefit from a discussion or literature review of uncertainty in emissions inventories. Certain emissions species and sectors are more uncertain across the board in all countries. A discussion of how the differences in China inventories fit into that narrative (or don't) would be useful context.

We have inserted the discussion of uncertainty in emissions inventories as follows: The difference in global CO, SO_2, and NO_x emissions estimates among inventories is 28%, 42%, and 17% in 2000, respectively (Granier et al 2011). China's uncertainty is much larger for CO and NOx and 90% of global CO_2 emissions uncertainty stems from China.

- A summary discussion of the influence of activity data versus emissions factors in different sectors/regions would be helpful.

We have included the discussion of the influence of fuel use statistics and emission factors nationally per sector and we also discuss emission factors and vehicle categories in more detail for the road transport sector. We have changed the section 3 significantly and a part of 3.1 reads as follows:
"Fig. 2 illustrates China's national total emissions for the four air pollutant species of our interest (CO, SO_2, NOx, and PM_{10}) as well as CO_2 estimated by REAS, EDGAR, MEIC, ZHAO, and GAINS, between 2000 and 2008, along with other published study estimates. We also used one million Monte Carlo samples from all emissions inventories, sector by sector, to create a composite emissions estimates for each species. For the inventories that provided a standard deviation or uncertainty, we used the information and assumed either a normal or log-normal distribution based on the information provided. If such information was not available, we used the relative uncertainty percentage provided by REAS to estimate standard deviation and assumed normal distribution.

We find the largest difference, ranging 65-94 Tg/year (87-106%), between REAS and EDGAR emissions estimates for total CO in China with REAS exceeding EDGAR throughout the 2000-2008 time period (Fig. 2). We further find that the major sectors leading to the differences are industry and transport (Fig. 3). Indeed, between REAS and EDGAR, 38% of the difference in national total CO emissions stems from the industry sector in 2000. By 2008, the industry sector contributes 51% of the difference in their estimates.

What brings such a large difference from the industry sector? Coal combustion plays a large role in CO emissions from this sector in the REAS estimate and 98.6% of the combustible industrial emissions are due to coal in 2008. The comparison of fuel use statistics among REAS, EDGAR, and GAINS for 2000 (Fig. 4) and net emission factors per sector among REAS, EDGAR, GAINS, and MEIC (Fig. 5) are useful in understanding the reason behind the differences. The largest difference in fuel use is found for oil in the industry sector and a more than 9000 PJ/year difference exists between REAS and GAINS inventories. Coal use for industry also shows a more than 6000 PJ/year difference between REAS and GAINS (Fig. 4). However, considering that REAS and EDGAR show the largest difference and not REAS and GAINS for the

Industrial CO emissions, it is clear that the difference in emission factors for industrial CO between REAS (2.2 ton CO/TJ) and EDGAR (1.1 ton CO/TJ) is the major reason for this difference, rather than the fuel use. Because emission factors are related to each technology type, penetration of the technology, uncontrolled emission factor and the emission reduction efficiency of each technology type, these factors all contribute to discrepancies. Obtaining estimates for CO is particularly troublesome because of many technology types that exist for emissions reduction. For the transport sector, estimated emissions by EDGAR are still lower than those of REAS (Fig. 3) even with its higher fuel use and emission factor, most likely because the modeling of superemitters have been omitted in EDGAR."

Specific Comments:

- Table 1: it looks like there is a reference, in the "Coverage" column for GAINS inventory

Corrected. Thank you.

- Figure 1: The scale of the figure makes it difficult to see the differences between SO2, NOx, and PM10.

We changed the figure so that the differences are much more visible and we have also included other inventory values to make the comparison easier.

- The world "Total" in section title 3.1 and 3.2 is very misleading. The entire section is spent breaking down the national/regional TOTALS by sector.

We changed the subtitles to be National Level Comparisons and Regional Level Comparisons.

- Figure 9 – label units of y axis

Corrected. Thank you.

- L460 – 4: Why is Zhao estimate of off road estimates so much higher? – this is an example of where deeper discussion would be really useful.

Thank you for this question. We were unfortunately unable to compare the data to answer this specific question and we hope to do so in the future research.

- L153: please give a better discussion of figure 3

Thank you for your suggestion. We have changed the Fig. 3 to a new one, incorporating more inventories and over the whole time period to make our points come across better. We provide a better discussion of this revised Fig. 3 in the revised Section 3.

- L150: EDGAR doesn't "underestimate" CO emissions. It produces a smaller estimate than the other inventories. It may, infact underestimate CO emissions, but the analysis in this paper is not enough to assert that statement.

This is a very good point and we have revised the paper and changed to "For the transport sector, estimated emissions by EDGAR are still lower than those of REAS (Fig. 3)"

- L269-77: I'm not convinced that the ranking order of sectors "clearly illustrates" that emissions should be better constrained. Here (and elsewhere in the paper too) absolute differences (or percentages of sector totals) in inventory estimates would be more convincing than percent of total inventory value or ranks.

We have changed the sentence as follows:
At the national level, CO emissions are ranked first by industrial, next by residential, then by transport, and power. At the regional level, however, this ranking of source sectors does not always hold and also changes over time. For Northwest, emissions from the residential sector are estimated to be the largest in all years in all inventories. In Southwest, REAS estimates higher industrial emissions (6.6 Tg yr^{-1} in 2000 and 12.4 Tg yr^{-1} in 2008) than residential emissions (6.3 Tg yr^{-1} in 2000 and 9.9 Tg yr^{-1} in 2008) but EDGAR estimates higher transportation emissions (2.5 Tg yr^{-1}) than industrial (2.0 Tg yr^{-1}) in 2000. Similarly, in the South, REAS estimates industry to be the largest source sector (6.4 Tg yr^{-1}) followed by residential (5.3 Tg yr^{-1}) and transportation (4.5 Tg yr^{-1}) in 2008, whereas EDGAR estimates residential to be the largest (3.7 Tg yr^{-1}), followed by industry as a close second (3.4 Tg yr^{-1}) and transport (0.73 Tg yr^{-1}) with much lower emissions than the other two in the same year. This clearly illustrates the importance of constraining emissions at the disaggregated levels.