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Atmospheric Chemistry and Physics Discussions

Interactive comment on "High resolution mapping of combustion processes and implications for CO_2 emissions" *by* R. Wang et al.

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Point-to-point rsponses to comments from Schulze (C6351)

Comment 1:

Abstract line 11: you present a total of 11.2 PgC yr-1. Was this total different from the "official" record? In the results section (page 21220 line 15 you present 7.87 PgC yr-1 reported by IEA). Does this mean that your approach leads to 42% higher estimated total global emissions? Also in section 3.2 you only mention the reduction in uncertainties but not changes in the total average. I think you should compare the averages in the Abstract and in Section 3.2.

Response:

The 11.2 Pg C yr-1 in abstract is the emission of CO2 from all combustion sources, including fossil fuel, biomass, and solid wastes, while the 7.87 Pg C yr-1 was reported by IEA only for the emission from fossil fuel combustions. To make it clear, the sentence on line 12 in ABSTRACT was revised as follows accordingly: "It's estimated that total CO2 emission from all combustion sources including fossil fuel, biomass, and solid wastes in 2007 was 11.2 Pg C yr-1 (9.1 Pg C yr-1and 13.3 Pg C yr-1 as 5th and 95th percentiles). Of this, the total emission from fossil fuel combustion was 7.83 Pg C yr-1, which is very close to that estimated by IEA (7.87 Pg C yr-1)." In Section 3.2, we compare the difference in spatial patterns between PKU-CO2 and NAT-CO2 to show the improvement from sub-national data disaggregation. The total emissions of the two inventories are identical. The comparisons between our result (total) and those reported in the literature are presented in Section 3.1.

Comment 2:

Abstract line 19-20: you interpret the difference between rural and urban areas by urbanization. In chapter 4.1, you discuss also migration. This interpretation may be true for China, but may not hold for industrialized regions, where highways pass through rural areas, heavy machinery is used in agriculture, and most country people work in town and sleep in the farm. This is not urbanization, but daily long-distance travel to reach the city. I think this interpretation may be removed from the Abstract or it needs more explanation.

Response:

We did not interpret the differences between urban and rural areas in developing countries by urbanization. Instead, we meant that because of these differences diagnosed from our data, future urbanization will lead to significant increases in fuel consumption and CO2 emission in the future. The term "suggesting" should be replaced with "implying" and "potential influence in the future" was not clearly presented. To clarify it, the sentence in ABSTRACT (line 19-20) was revised as follows accordingly: "Significant difference in per-capita CO_2 emissions between urban and rural areas was found in developing nations (2.09 vs. 0.600 Mg C cap-1yr-1), but not in developed ones (3.57 vs. 3.42 Mg C cap-1yr-1), implying potentially strong influence of the rapid urbanization of these developing countries on the carbon emission in the future." This is also presented in the statements in Section 4.1: "The large urban-rural Ecap difference in developing countries is due to disparities in socioeconomic development (Dhakal, 2010; Satterthwaite, 2009). Such a difference is a key driver of future emission trends and should be addressed when formulating carbon mitigation policy."

Comment 3:

Introduction page 21213, line 5: you promise to quantify emissions from diesel used by industry and vehicles. I agree that this information would be nice to know, but I do not see that you provide this information. Maybe I have overseen it.

Response:

The emissions from diesel consumptions by industry and vehicles were distinguished in PKU-FUEL and PKU-CO2. The result is shown in Table S1, instead of in main text due to space limitation.

Comment 4:

Chapter 2.1 Combustion sources: page 21215 line 2: Why did you omit Russia? Russia has become member of the WTO, and it should provide the necessary information, and Russia is important with its large scale forest fires. In Fig. 1b you show high emissions near the arctic ocean, in Fig. 2 Russia is missing, and in Fig 3b Russia sticks out as big red area. It would be great if you could include Russia, or make clear why you did not include Russia

Response:

Russia is INCLUDED in the inventories. When we searched for available sub-national data, we found detailed sub-national data for European Russia (in the EMEP database)

but not for Asian Russia. Consequently, Russia was separated into two regions in the study and both are listed in Table S2. This is one reason that we used 223 "countries/territories" instead of "countries". To make it clear, the following sentence was added before "Due to difference in data sources and data processing methods, ..." in Section 2.1: "Russia was divided into two territories (European Russia and Asian Russia) and sub-national fuel consumption data were only available for European Russia". In Figure 2, only territories with sub-national data available are presented to show the improvement of using sub-national disaggregation method. Therefore, the Asian Russia territory was not included in Figure 2. For the same reason, the relatively uncertainties for European Russia and Asian Russia are remarkably different, as shown in Figure 3b.

Comment 5:

Results page 21220: I think you should avoid enumerations using "respectively". This is reader-unfriendly. You should use each number with its descriptor.

Response:

The sentences were revised as follows accordingly: "According to PKU-FUEL, oil (154 EJ yr-1), coal (133 EJ yr-1), and natural gas (124 EJ yr-1) dominated global fuel consumption, followed by biomass (11.4 EJ yr-1) and solid waste (3.59 EJ yr-1) fuels. Globally, Fcap was 0.0733 TJ cap-1 yr-1, which was primarily fossil fuel (0.0650 TJ cap-1 yr-1, anthropogenic biomass (0.00829 TJ cap-1ïČŮyr-1) and solid waste (0.000611 TJ cap-1 yr-1 fuels contributed relatively small fractions."

Comment 6:

Page 21220 line 24: In Fig. 1 you contrast land based emissions and aviation and shipping, but you do not present numbers on C-emissions from aviation and shipping. It would be nice if you could do so. In Fig. 4 you exclude again shipping and aviation.

Response:

The detailed data on carbon emissions from various sources including aviation and shipping are listed in Table S5. According to the comment, the following sentence was added to the end of the sentence “Fig. 1 shows the geographical distributions of ... as labeled pies”: “The emissions from aviation (91 Tg CïČŮyr-1) and shipping (181 Tg CïČŮyr-1) are not included in the regional pies.” Fig. 4 shows the difference between PKU-BC to the ODIAC inventories. The shipping and aviation are not included because these two sources were not included in the published ODIAC inventory.

Comment 7:

Chapter 4.2: I am happy to see the map of the terrestrial carbon sink, but I recommend that you make crystal clear that the GHG-balance is different. The sink across Europe and maybe in other industrialized countries is equilibrated by N2O and CH4 emissions. Can you include these emissions? I am afraid that this sink-map may be misinterpreted.

Response:

Thanks for the comments. PKU-FUEL and PKU-CO2 are the databases focusing on combustion sources. We added a sentence at the end of section 4.2 to recall that the CO2 sink is different from the GHG-balance: “It should be noted that the result presented is only for terrestrial CO2, excluding other GHGs such as N2O and CH4.”

Comment 8:

Fig. 7: what are the red dots in this map? Are this the cities? I think it would be worth it to mention this, because there was a lot of discussion whether city trees and parks would make also cities a carbon sink.

Response:

The red dots are grid points with extremely high CO2 emissions and most of them are not cities. Many of them are large wildfires and deforestation fires. Only a small number of red grid points are megacities, including Beijing-Tianjin area, Nagoya area,

Los Angeles area, and New York. Unfortunately, detailed carbon fluxes of most cities are not able to be located at $1^{\circ}\times1^{\circ}$ resolution used in the inversion model.

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