Authors' comments on Review #2

RC C676: 'Review comments on "Black carbon emissions from Russian diesel sources" by M. Evans', Anonymous Referee #1, 12 Mar 2015

Black carbon emissions from Russian diesel sources: case study of Murmansk

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MAJOR COMMENTS

Comment 1. **The analysis does not include emissions associated to military and commercial ships saying that this is sensitive data. I can understand this for military ships but I do not believe that data of commercial and passenger ships are very sensitive. There are several emissions inventories for harbors in different parts of the world. Therefore, I believe that on this aspect something more could be actually done also for Murmansk region.**

Based on consultations with Russian and Murmansk officials in the early stage of the project, we understood that there were sensitivities regarding commercial activity at the port and around the Kola Peninsula. As a result, we decided to not include the emissions from commercial ships in the inventory.

However, information about port calls is publicly available and not sensitive. Therefore, per the reviewer's request, we analyzed information about five wide categories of ships called into the Murmansk port in 2012: 1) fishing; 2) cargo ships (general cargo, bulk and container ships), 3) tankers; 4) passenger ships and 5) support ships (tugs, research ships and other vessels).

We have changed the text as follows:

"The Murmansk Port is the largest Russian port in the Arctic. We analyzed emissions from fishing vessels, various cargo ships, tankers, passenger ships and support ships. The activity data for ships are based on the Russian Information System on State Port Control (Murmansk Port, 2014)."

Other categories of ships called into the Murmansk port include various cargo ships (general cargo, bulk and container ships), tankers, passenger ships and support ships (tugs, research ships and other vessels). We used the same methodology for emission calculations as for fishing ships.

We assumed that passenger and support ships use diesel. However, cargo ships and tankers use both heavy marine oil and diesel. We assumed that these ships use diesel only for one hour per call while in the port. Table 5 shows the number of port calls and emissions from different ship types.

Table 5. PM and BC emissions from ships

Type	*Number of port calls*	*PM emissions, t*	*BC emissions, t*	*OC emissions t*
Fishing	*1713*	*3.7*	*1.1*	*0.2*
Small fishing boats	*n/a*	*0.7*	*0.2*	*0.0*
Cargo, all	*604*	*3.1*	*1.0*	*0.2*
Tankers	*420*	*2.7*	*0.8*	*0.2*
Support	*203*	*2.2*	*0.7*	*0.1*
Passenger	*83*	*1.0*	*0.3*	*0.1*
Total	*3 042*	*13.4*	*4.2*	*0.8*

The Supplement provides additional details about the ships in Murmansk Region.

We have added the following information t the Supplement:

The distribution of gross tonnage

Table S17. Tankers

Gross tonnage, t	*Number of calls*	*Share, %*
< 2000	*27*	*6%*
2000-4000	*47*	*11%*
4000-10000	*7*	*2%*
10000-20000	*37*	*9%*
20000-30000	*108*	*26%*
30000-40000	*7*	*2%*
40000-50000	*171*	*41%*
> 50000	*16*	*4%*
Total	*420*	*100%*

(Murmansk Port, 2014)

Table S18. Cargo ships

Gross tonnage, t	*Number of calls*	*Share, %*
< 2000	*38*	*6.3%*
2 000-4 000	*128*	*21.2%*
4 000-10 000	*85*	*14.1%*
10 000-20 000	*120*	*19.9%*
20 000-30 000	*26*	*4.3%*
30 000-40 000	*87*	*14.4%*
40 000-50 000	*103*	*17.1%*
> 50 000	*17*	*2.8%*
Total	*604*	*100.0%*

(Murmansk Port, 2014)

Table S19 Passenger ships

Gross tonnage, t	*Number of calls*	*Share, %*
< 3000	*7*	*8%*
4000-5000	*64*	*77%*
5000-10 000	*3*	*4%*
10 000 -15000	*3*	*4%*
15 000-20 000	*2*	*2%*
>20 000	*4*	*5%*
Total	*83*	*100%*

(Murmansk Port, 2014)

Comment 2. The emissions of road-transport calculated from the surveys are significantly different from those calculated by the registry of vehicles. It is reported that the registry has been somewhat corrected. Do you mean in terms of the total number of vehicles or in the fractions associated with the different categories (Cars, LDV, etc.) or in the emission quality (Euro 0, Euro 1 and so on). Probably it would be better to include this info in Table S5 (and/or S6) of the supplementary material.

We adjusted the registry in *two ways:*

1) *We applied the distribution by Euro class we found in the city to registered vehicles in the region.*
2) *We applied the ratio between registered and observed vehicles to estimate how much to adjust the total registry for actively emitting vehicles*

We have added the following text to the Supplement:

"The starting point in emission calculations is the analysis of the vehicle registry. Traffic police are responsible for registering all on-road vehicles in Russia. However, vehicle registries, particularly in countries where registries are out of date, are inadequate for emission calculations.

As a result, we decided to use a video survey method developed for IVE to study the traffic flows in Murmansk. The registry is outdated and shows many vehicles that are not in use anymore, mostly old, heavy-duty truck and buses. We compared data from the parking lot surveys with the vehicle registry and found that the differences are very significant. For example, the share of vehicles without emission controls (Euro 0) on the roads is much lower than is shown in the registry.

We adjusted the vehicles registry to correct the information about vehicle distribution by Euro class. For cars and LDV, we adjusted the information on Euro class distribution based on the parking lot surveys and data from a vehicle inspection station. For trucks and buses, we adjusted the numbers based on data from the largest bus company and other commercial vehicle companies."

Comment 3. It is not clear if these corrections were also applied to road-transport in Murmansk region (Table 5) because I believe that a similar overestimation will be present also at this level. Will it be possible to use the same correction factors for all the region?

We used the correction factors both in the city and the region.

We have added the following text to the Supplement 1.

"For emission calculations of vehicular emissions in Murmansk Region, we adjusted vehicle registry in two ways:

1) *We applied the distribution by Euro class that we found in the city to the registered vehicles in the region.*
2) *We applied the ratio between registered and observed vehicles to estimate how much to adjust the total registry for actively emitting vehicles."*

Comment 4. In table 3, the first three columns are from the surveys and the last one from the uncorrected registry. Is this right?

This is correct. We show the emission calculations using data from video surveys; they represent real emission in the city. We also show emissions calculations from uncorrected registry to show the discrepancy between emission estimates from different methods. Using unadjusted registry could significantly overestimate the emissions (by a factor of five). Researchers should be aware of this discrepancy to avoid overestimation of emissions from on-road vehicles.

To clarify in this in the text, we have adjusted the column headings:
added "based on surveys" to the first three columns and "uncorrected registry" to the last one.

5) Page 3274 (line 5 in Section 10). Please correct "form" with "from".

Thanks!