Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-858-AC1, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Benzene and Toluene in the surface air of North Eurasia from TROICA-12 campaign along the Trans-Siberian railway" *by* Andrey I. Skorokhod et al.

Andrey I. Skorokhod et al.

e_berezina_83@mail.ru

Received and published: 26 January 2017

The authors thank the anonymous referee #1 for the constructive comments and corrections. They helped us to improve our paper.

1. In the manuscript the sources of benzene and toluene along the Trans-Siberian railway were investigated mainly using the T/B ratios, and propene-equivalents and OFPs were also discussed. As emission sources of benzene and toluene include not only motor vehicle exhaust and industry emission, but also biomass burning, coal burning and gasoline evaporation, the source attribution need consider contributions from sources other than vehicle exhaust and industry emission.

Printer-friendly version

Discussion paper

Reply: The referee is certainly right. Biomass burning, coal burning and gasoline evaporation are very important sources of benzene and toluene emissions in the atmosphere. However, taking into account the measurements on a mobile platform, it is difficult to separate the data corresponding to the emissions from different sources (we will be very grateful for more exact recommendations). Therefore, taking into account the fact that vehicle exhaust is one of the main sources of benzene and toluene in anthropogenically polluted atmosphere, we use the well known criteria and the simultaneous measurements of CO, NOx, SO2 and NMHC in the campaign to distinguish the impact of vehicle emissions as well as other local and regional-scale sources (including industrial emissions, coal burning and evaporative emissions) on benzene and toluene levels. This information is also very important for the immense Russian territory. It should be noted, however, that in TROICA-12 experiment no significant biomass burning along the Tran-Siberian railway was observed, so this emission source is not expected to impact significantly on benzene and toluene levels (see corrections at page 9, lines 1-3, and page 12, lines 16-17).

2. For the comparisons of the ozone formation rate from aromatics relative to that due to isoprene in the rural and urban areas, it should be noted that aromatic hydrocarbons are quite different from isoprene in reactivity and atmospheric lifetimes, and in their source regions and emission patterns. Therefore, it is important to figure out new understandings and new findings other than somewhat common senses like larger contributions of benzene and toluene to ozone formations in the urban areas.

Reply: It is well known that aromatic VOCs differ from isoprene by reactivity and sources. However, isoprene is one of the main biogenic VOCs forming ozone in the polluted surface air. So, it was important to reveal a significance of the benzene and toluene impact in ozone formation along the Trans-Siberian railway in contrast to isoprene. These estimations are very important because of a lack of such information for Russian regions. Although some new understandings are certainly necessary.

Details

1. Page 3, the authors should give more details about where the mobile laboratory was located, in the front of the train or in the end or elsewhere? How to eliminate the interferences from emission inside the train or human activities in the train?

Reply: The location of the laboratory is described in the section 2.1 TROICA experiments, page 3, lines 2-3. To reduce a possible influence of emission from human activities in the train, all conveniences were placed at the end part of the train. Thus, their impact is expected to be generally non-significant (Panin et al., 2001). This information was added to the text (page 3, lines 8-12).

2. Page 4, the calibration method and frequencies for measuring VOCs by PTR-MS and APHA- 360 should be stated.

Reply: Agreed. We provide more information about the instruments in the final version of the paper (see the sections 2.2 VOC measurements, page 4, lines 10-20 and 2.3 Other components and meteorology, page 5, lines 8-10).

3. Page 8, lines 17 -20 were repeating lines 13-16 Reply: Agreed. Lines 13-16 are removed from the text.

4. Page 8, reference Karl et al., 2009 was not listed in the reference.

Reply: Agreed. The reference is added to the paper, page 14, line 32.

5. Page 8, section 3.2, as the benzene and toluene data were measured along the Trans-Siberian railway instead of at a fixed station, the discussions about diurnal variations of benzene and toluene should be careful. It is difficult to say whether emission sources, photochemistry or meteorological conditions had led to the variations. I'd like to suggest deleting this section.

Reply: The referee is certainly right about the influence of wide range of factors on the diurnal variations of benzene and toluene obtained from the measurements on a mobile laboratory. However, the statistics calculated for hourly mean values and presented in Fig. 4 allows some differentiating among these factors. Furthermore, the study of

diurnal variations of benzene and toluene in the campaign is necessary to determine their contribution to spatial variability. The absence of significant diurnal variations of benzene and toluene allows us to neglect them and summarize the data in different spatial scales (for different regions and cities of Russia), as pointed out at page 9 lines 16-18.

6. Page 9, The correlations coefficients (R) between benzene, toluene, NMHC, CO, NOx, and SO2 were all less than 0.6, that means their R2 were all lower than 0.36. I don't think these can suggest the high or significant correlations between them. Section 3.3 should be rearranged.

Reply: As we know, the significance of the correlation coefficients is determined by t-test. According to our statistical calculations, all coefficients presented in Table 6 and shown by asterisks are statistically significant including the relationships between benzene, toluene, NMHC, CO, NOx, and SO2. Some of the coefficients are a little bit less than 0.5. It means that the strength of correlation is moderate (R= 0.3 to 0.5). The correlation coefficients for the relationships between benzene and toluene and CO and benzene in urban areas are > 0.5. The latter may evidence for (potentially) strong relationship (R= 0.5 to 1.0) between these compounds. Thus, the correlation analysis presented in section 3.3 allows us to see a relation between some compounds in urban atmosphere determining by their common pollution sources even in the large spatial scale. Furthermore, we noted that in rural areas correlation between all the species studied is very poor except for that between benzene and toluene. Some terminological corrections are included in the section 3.3 (page 9, lines 28-31).

7. Table 5 and Table 6, I think the authors wanted to list C7H8 (Toluene) instead of C5H8 (isoprene) as they discussed in section 3.3.

Reply: The referee is right. It is corrected.

8. Figures 3a, 3b and 8 in the manuscripts are really hard to read. I suggest plotting them in a different way.

Reply: The experience of previous presentations of a big TROICA dataset showed that it is rather difficult to present the data in a lot better way, however, we tried to improve the quality of the figures.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/acp-2016-858/acp-2016-858-AC1-supplement.pdf

---

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-858, 2016.

Printer-friendly version

Discussion paper

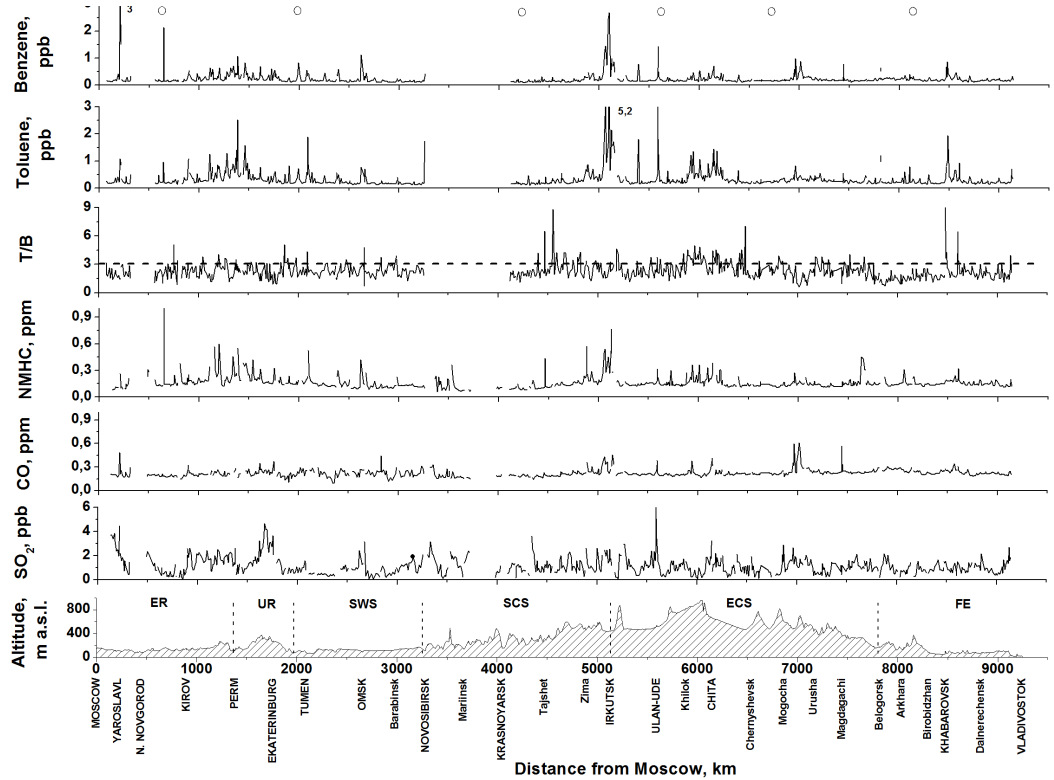

Fig. 1.

Printer-friendly version

Discussion paper

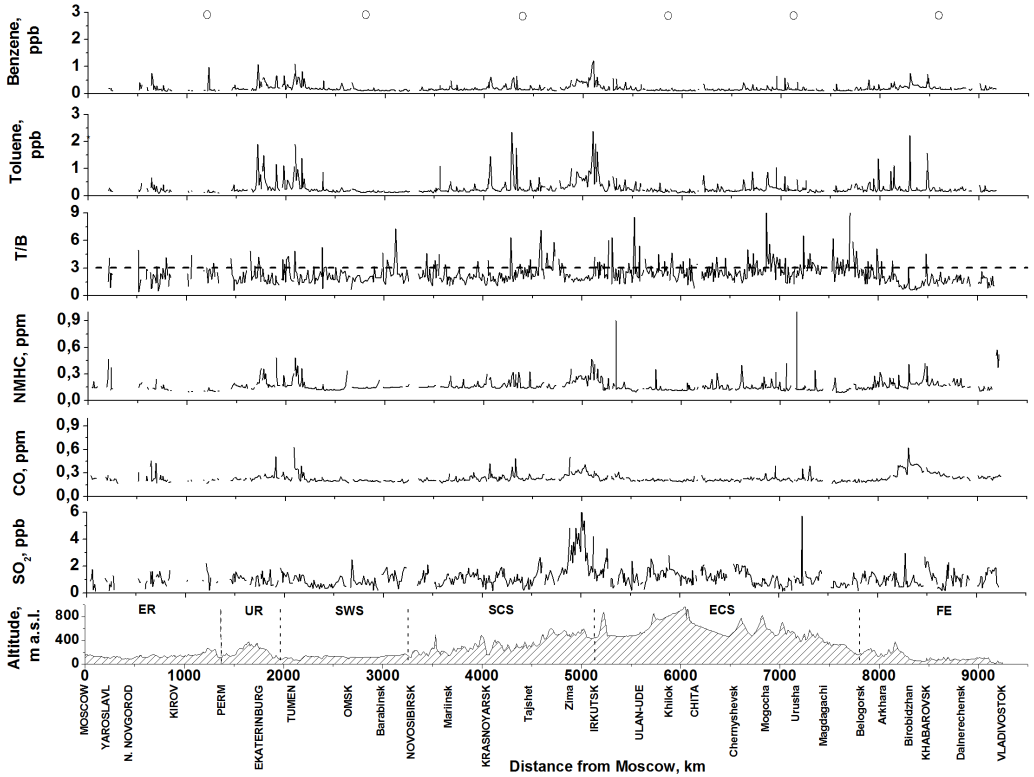

Fig. 2.

Printer-friendly version

Discussion paper

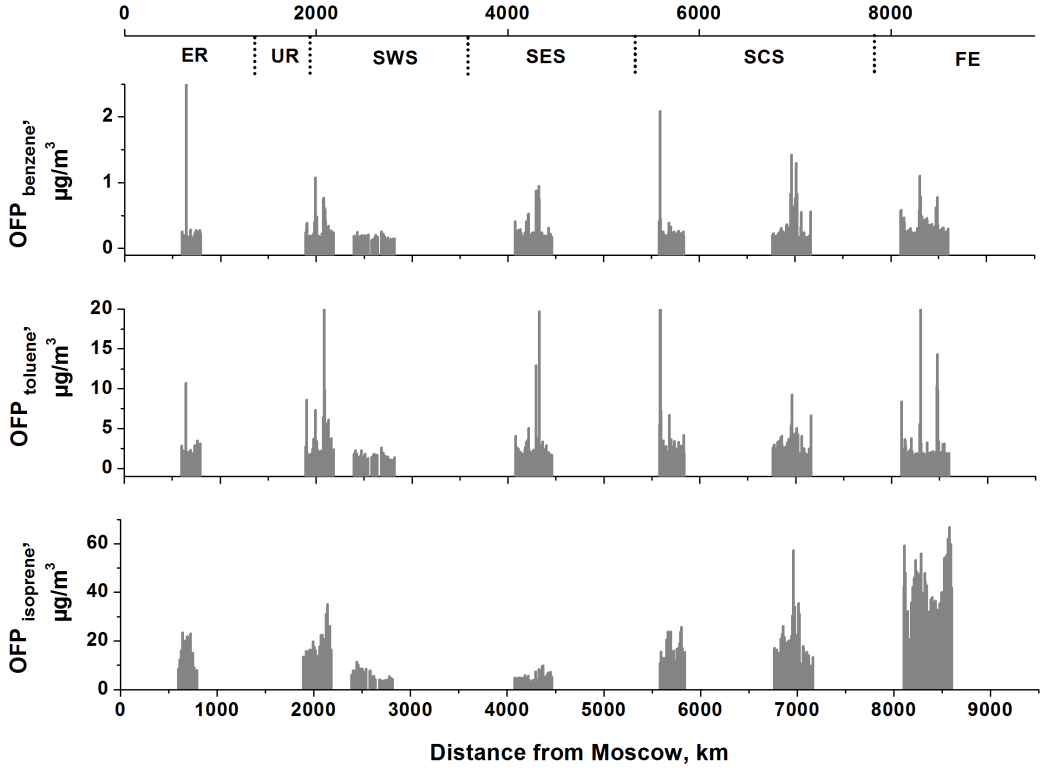
0
2000
4000
6000
8000
ER
UR
SWS
SES
SCS
FE
OFP benzene' µg/m3
OFP toluene' µg/m3
OFP isoprene' µg/m3
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Distance from Moscow, km

Fig. 3.