Atmos. Chem. Phys. Discuss., 11, C2322–C2329, 2011
www.atmos-chem-phys-discuss.net/11/C2322/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variability of levels of PM, black carbon and particle number concentration in selected European cities" *by* C. Reche et al.

C. Reche et al.

cristina.reche@idaea.csic.es

Received and published: 27 April 2011

Interactive comment on "Variability of levels of PM, black carbon and particle number concentration in selected European cities" by C. Reche et al.

We agree with your comments and suggestions and we thank you for your contribution which helps us to improve the paper. We will try to answer all your questions in detail.

1. The title describes what is done: variability of air quality measures is shown. From the title a reader would however not guess the true contents and messages of the paper. Namely: a) BC is a consistent tracer that reflects the impact of road traffic on air quality and BC should therefore be measured in air quality monitoring networks. And

b) levels of N vary simultaneously with gasses related to traffic emissions in central and northern Europe but in southern Europe secondary aerosol is produced because of (a.o.) dilution and solar insolation. As a tracer for road traffic emissions, N may therefore not be useful everywhere. A title that contains information like: "new relevant indicator", "road traffic", and "air quality monitoring" would possibly trigger more readers

REPLY: The new title is "New considerations for PM, black carbon and particle number concentration for air quality monitoring across different European cities"

2. In the introduction the health impact of ultrafine particles is discussed, but the only conclusion (conclusion and abstract) related to UFP is that N variability does not always reflect the impact of road traffic on air quality. The reader may conclude that UFPs are not important (e.g. if not reading the whole paper). Perhaps the authors may find some room to discuss why monitoring UFP is relevant, despite is can not be used as traffic tracer.

REPLY: In abstract, page 8668, the second paragraph is now "Accordingly, it is clearly evidenced that N variability in different European urban environments is not equally influenced by the same emission sources and atmospheric processes. We conclude that N variability does not always reflect the impact of road traffic on air quality, whereas BC is a more consistent tracer of such an influence. However, N should be measured since ultrafine particles (<100nm) may have large impacts on human health." In the conclusion, page 8692, line 13, we have included "However, N should be measured since ultrafine particles (<100nm) may have large impacts on human health based on the very fine grain size that may reach the cardiovascular and cerebrovascular systems and the potential toxicity (Pérez et al., 2009)."

3. In the introduction the importance of BC is only discussed marginally but the articles main conclusion (BC should be measured in (urban) air quality monitoring networks) is related to BC. Moreover, in the 3rd para of the introduction it is mentioned that PM limit values are exceeded and that air quality plans seem not to reduce PM values.

ACPD

11, C2322–C2329, 2011

The question is raised: “is the efficiency of air quality plans overestimated?” The second question could be “or do traffic emissions not contribute to PM”. The need of a more specific metric to evaluate the impact of traffic emissions on the levels of urban aerosol, comes more or less out of the blue if the importance of traffic emissions on negative health outcomes remains undiscussed. Also in the conclusions (line 14-16) it is mentioned that BC is a relevant indicator for the impact of anthropogenic emissions, but the impact on what and why this is important, remains unmentioned. I suggest to include some text in the introduction that discusses the need of traffic tracer and why this tracer could be BC or N. This discussion should be related to the mentioned limit values for PM and health impacts (sometimes not captured by limit values).

REPLY: In the abstract, page 8667, line 8 and in the introduction, page 8669, line 9, the following question has been added: “Do the road traffic emissions contribute less than expected to ambient air PM levels in urban areas?” Later, in page 8669, after line 10, we have added “A number of studies have reported a strong association between BC and road traffic (Hamilton and Mansfield, 1991; Watson et al., 1994; Pakkanen et al., 2000) and biomass burning (Sandradewi et al., 2008) emissions. While BC aerosols are not the only cause of adverse health effects due to particles, they are a major factor, specially the ultrafine BC. Indeed, the recent WHO report concludes that “combustion-derived aerosols are particularly significant in terms of their health effects” (WHO, 2003).” In addition, the following statement have been included in page 8669, line 19: “since nowadays these parameters seem not to be properly controlled by air quality limit values.”

4. Abstract 1st para, see general remarks:

REPLY: See answer in question 2.

5. Abstract page 8667 line 24: morning traffic rush hours?

REPLY: Right, it has been changed.

ACPD

11, C2322–C2329, 2011

6. Section 2 Methodology. This section basically describes the sites and instrumentation. I suggest to replace the caption.

REPLY: The name of the caption is now Monitoring sites.

7. The description of the sites could be more harmonized (preferable). I suggest including the full city name in the captions. (e.g. 2.1 Barcelona, BCN, (urban backgr: : :.etc.) There are three caption for London (2.2-2.4) I suggest to list 2.2 London, Marylebone Road, MR (urban traffic: : :), 2.3 London North Kensin

REPLY:We have included the full name of the cities

8. Section 2, page 8677, line 6, Suggest to start new section: Instrumentation.

REPLY: We have split methodology in two sections, monitoring sites and instrumentation

9. Although a discussion of the measurement techniques falls out of the scope of this paper, I would like to see a bit more discussion here. 1) How do the different cut offs of the CPCs impact on the conclusions (mentioned several times as explanation).

REPLY: In page 8677, line 12, we have added the next statement: “The use of CPCs with different cut sizes is likely to influence the results somewhat, as a largest cut size can imply an underestimation of N, resulting in lowest N/BC ratios”

10. Last para (page 8678) How BC is converted to EC should be explained a bit more.

REPLY: We have complemented the explanation in that way: “Therefore, in order to perform an accurate comparison between sites, BC concentrations were determined using the experimental absorption coefficients (σ in m2g-1) according the equation by Petzold and Schönlinner (2004) (1): BC (μg/m-3) = σap (Mm-1) /σ (m2g-1) (1) where σap are the absorption coefficient measurements in Mm-1”

11. In the conclusions (page 8692) the influence of coatings is discussed, this discussion should not be placed in the conclusions (caption is not called discussions)

ACPD

11, C2322–C2329, 2011

REPLY: This discussion has been placed in the section instrumentation after the paragraph with the explanation to question 10.

12. Problems with Molybdenum could be discussed in this section, later these problems are used for a possible explanation (page 8680 line 25).

REPLY: These problems have been discussed at the end of the section instrumentation by adding the following paragraph: “Regarding gaseous pollutants instrumentation, it is important to mention that NO2 measurements can be overestimated because of interferences of oxidized nitrogen compounds in the conventional instruments equipped with molybdenum converters (Steinbacher et al., 2007).”

13. Section 3 page 8680 line 4-6. What is happening with BC, other than dilution like CO, at these (time) scales? Aging, deposition? please discuss

REPLY: In page 8680, line 6, the following statement has been included: “since more BC than CO is expected to have been eliminated from atmosphere by deposition when measuring at a distance of the emission sources”

14. Section 3.2 daily cycle of atmospheric pollution. Much more is discussed: weekly and seasonal. Suggestion use “temporal variability of atmospheric pollutants”

REPLY: We accept the suggestion, the caption has been changed.

15. Page 8681, line 21-23 second peak of BC earlier. What should be the mechanism that 150m introduces a timeshift, advection? Please discuss.

REPLY: We have discussed it by including this explanation: “except in the case of Bern, where the second peak of BC is produced earlier than expected possibly as a consequence of the different location of BC and gaseous pollutant instrumentation (around 150 m distant), being BC measurements done closer to road traffic and to a railway.”

16. Page 8681, line 27, “marked differences” I do not find this convincing: see p. 8679

ACPD

11, C2322–C2329, 2011

line 25 and p8680 line 4-6. Page 8682 top of page.

REPLY: It was not clear to see the different CO/BC ratios obtained for the different cities, so ratios have been calculated with CO in μg/m3 and values have been changed in Table 4b. In page 8681, line 27, this sentence have been included: "differences among sites in the ratios CO/BC (ranging from 90-235) and NO2/BC (ranging from 7-32) indicate that BC should be measured."

17. Page 8682 top of page. The referred Fig 2c does not support the statement on its own, a discussion is needed (what is changing and how).

REPLY: The first paragraph of page 8682 is now: "The combination of PM10 and BC in urban areas potentially constitutes a useful approach for air quality monitoring (Figure 2c). While BC daily cycle is mostly determined by vehicle exhaust emissions, PM10 concentrations at these sites are also governed by non-exhaust particulate emissions resuspended by traffic, by midday atmospheric dilution and by other non-traffic emissions (see LUG and NK patterns in Figure 2c)." This clarification has been also included in the abstract and in the conclusions.

18. Page 8683 line 5. The DAURE campaign is mention, and that no particle growth was seen. I do not see what conclusion is based on that remark. Is it necessary to include (no reference is given, and no supporting figure or number) If it should be included when was the period of the campaign?

REPLY: We have finally decided not to include this explanation.

19. Page 8685. To me it is not clear what defines S1. The single lowest N/BC measurement recorded or the lowest X% N/BC ratios. Please clarify. "S1 is described as: : : " continuing next page. Please look at sentence things are said twice. S1 should be interpreted as or really "described". "formed/emitted" = present?

REPLY: The definition of S1 in page 8685 have been changed to "S1 is described as the minimum number of primary particles arising from vehicle exhaust emissions per

ACPD

11, C2322–C2329, 2011

each nanogram of ambient air BC"

20. Page 8686 line 10etc., somewhere introduce reference to Table 5.

REPLY: A reference to Table 5 have been included in page 8686, line 10.

21. Page 8686, line 11. "derived" caused by/can be explained by/the result of?

REPLY: "Derived" has been changed by "caused by".

22. Page 8686 line 30 why are temperature lower at sunset than at sunrise?

REPLY: This discussion about temperature was not correct and has been removed. The sentence is now: "although values are slightly higher at 18-21 h at most of the sites, probably due to a major gas to particle transfer of matter by condensation and/or nucleation"

23. Page 8687 line 9, "mean annual hourly levels" all data or only S1?

REPLY: Only S1: "Figure 5 shows the correlations between the mean annual hourly levels of N and BC for the above S1 ratios (Table 5) during the periods 7-9, 11-14, 18-21 and 1-3 h (UTC) for the different sites."

24. Page 8687, line 25, "principally" ??

REPLY: "Mainly" has been used instead of "principally"

25. Page 8689, line 7, parallel cycles of N1 and N2 does not really hold for NK and MR, right?

REPLY: Right, the discussion has been replaced by: "Differences between sites are marked, observing two different patterns: stations with parallel cycles of N1 and N2 at midday (LUG and Bern) and stations with a clear decoupling of the two components, indicating no dependence on exhaust emissions of N2 at midday (BCN, HU, SCO, NK and MR)"

26. Page 8689, line 19 "progressive accumulation" Do the authors mean that aerosol

ACPD

11, C2322–C2329, 2011

accumulates in the cities or everywhere. Advection should be strong enough (on a yearly basis) that aerosol emitted will leave the city within a day.

REPLY: We mean the accumulation of pollutants in the city from Monday to Friday: "This tendency increases from Monday to Friday due to the progressive accumulation of atmospheric pollutants in the cities."

27. Conclusions page 8692, line 4-8, new discussion does not belong in this section

REPLY: This paragraph has been explained in the section "Instrumentation".

28. Conclusions page 8692, line 9-13, This conclusion only holds for southern Europe, it would be more fair to say that for northern and central Europe N can be used like BC

REPLY: It has been clarified as suggested.

29. I suggest the native English speaking authors to look at the paper once more.

REPLY: English is going to be corrected within a few days before submitting a new version.

The necessary references have been included.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 8665, 2011.