

The challenge of improving visibility in Beijing
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The authors use hourly observations of visibility, relative humidity RH, and wind speed and direction in 1999-2007 and daily observations of PM10 index, RH and visibility in 2005-2007, to study the trend in visibility and its diurnal and monthly variability in Beijing. They show a close association between the visibility variations and the changes in relative humidity and PM10 index, and also for different wind directions. The downward trend in visibility is explained by the increasing RH trend, despite reported decrease of PM10 index. For a August month (the month in which the 2008 Olympics were held in Beijing), the authors also look at the combined effect on visibility of PM10 index, RH, wind speed and direction for the period 2000–2008, demonstrating an improvement in visibility in the August 2008. Based on obtained results, the authors make a rough estimate of the value of PM10 index which should have been obtained in order to attain “good” visibility during 2008 Olympics (4-24 August). They conclude that both traffic and industrial emissions needed to be restrained for this purpose.

There are some aspects of the problem left out of the discussion in the paper, such as:

- rather different length of time-series of visibility and PM10 data the conclusions are based on; probably the authors could look closely at the period 2005-2007, for which both visibility and PM10 (and RH) data are available (besides PM10 variation in 2005-2007 is not presented).
- It could be advisable to show the variation of PM10 index, discussed in the manuscript. Furthermore, according to Andrews (Environ. Res. Lett., 2008), reported improvement in PM10 concentration in Beijing for 2006-2007 can be attributed partly to a shift of monitoring stations in 2006 to less polluted areas. Could the authors, please, comment on that.
- chemical composition of PM10 (as PM soluble components, namely SO₄, NO₄ and NH₄, determine the PM hygroscopic growth with increasing RH);
- the major sources of the soluble inorganic aerosols in Beijing, as limiting those may decrease the deterioration of visibility with increasing RH;
- PM10 size distribution (in particular the fraction of particles with sizes just below the visible wavelength, as their growth with RH contributes the most to visibility deterioration);
- the latter is also connected to the choice of PM10 mass as indicator of the amount of light scattering aerosol in air, which the authors explain that fine PM_{2.5} account for 99% of PM10 in Beijing (ref. Shi et al., 2003). But according to Shi et al. (2003), it applies to the number of fine PM, but not the mass, and the mass and number concentrations are not always correlated.
- representativeness (or its lack) of in-situ PM10 measurements for such a horizontally averaged parameter as visibility (see e.g. Bäumer et al., 2007). In fact, there is no what so ever description of PM10 monitoring sites used in the manuscript.

Specific comments:

Abstract (and else where):

Since 'decreasing PM10 trend' is not shown in the present work, please give the reference.

check on the use of tenses when referring to the past (e.g. 'should have been' instead of 'should'. 'returned' instead of etc. 'has returned'). Last sentence: explain 'the same period of 2009' and 'standard'.

1. Introduction:

line 20 and else where – change 'decreased trend' to 'decreasing trend' or downward trend'

line 27 – at Beijing.. airport

line 28 – it's not relevant to talk about 'respirable particles', but rather 'fine fraction'

line 29-30 – it should be pointed out that according to Shi (2003), fine PM contribute with 99% to PM10 number, not mass.

The details on measurements data used (l. 24-28) should be moved to section 2 'Data description'

2. Data description

The authors are advised to collect all spread details about measurements in this section and give a better structured data description, including details about PM10 monitoring network (e.g. number and type of the sites).

l. 9-10 – 'data on/for', or 'visibility data'

line 13 – explain 'PM10- a leading pollutant'

14 – 'presented' instead of 'measured'

3. Results and discussion

Please, check that the past tense is used when referring to the past

p.6203, 22 – suggested: The monthly variation of RH shown in Fig.3 reveals that the moisture abundance in summer....

27 – suggested 'in addition' instead of 'on the other hand'

p.6204, 2 – 'On average' instead of 'In general'

8 – increasing trend of RH

16- 'The days .. are excluded'. Also, could you please give a brief explanation why.

20-22- Suggested: The visibility varies between 2 km and 45 km when PM10 index is below 100, and most of the days with.... occur in summer.

23 – suggestion: combined frequency distribution of visibility ranges and RH

p.6205, 8 – increase light extinction

9 – “This explains' seems is too determined. What about 'We think it is a probable explanation'

14- characterize the transport

19 – remove 'also'

24 – 'visibility is associated'

25 - 'regional transport of less polluted and moist air from...'

3.3 Visibility in August

The discussion in this section is rather messy and needs better structure. It would also be nice to have a clear explanation why the authors specifically focus the discussion on the August month (and further 8 to 24 August in fig.8) in 2008.

p. 6206, 3 – remove the repeated 'observations', and explain 'as verification' (of what)?

8 – Its (?) PM10 – explain. Probably 'PM10 in the same period...'

10 – 'brought more challenge'

11 – 'was impossible' and correct for the past tense through the rest.

13-14- The sentence starting with “Improvements...” should be moved in Introduction.

15-16 – please, re-formulate/explain that “vehicle emissions contribute with 24% in a wet season'. Do people drive more in a wet season?

17 – what is 'secondary biomass burning'?

27-28 – 'decrease of PM10 and increase of visibility compared with other symbols' is an unfortunate formulation; “compared to observations in 2000-2007”?

4. Conclusions – advisable to be tidied up.

p.6207, 11-13 – the first sentence should be better formulated.

18 – elaborate the general statement 'Topography plays an important role in blocking pollutant dispersion'

24 – 'apparently due to the increase in RH'

26-27 - should probably be 'a good day would not have happened during Olympics 2008 even if all vehicle emissions were eliminated'

28 – what is 'secondary emission',.....'should have also been considered'

p.6208, 1 – 'The result was verified..' is a very unclear statement. Maybe it was more like 'some conclusions were confirmed'?

1. Does the paper address relevant scientific questions within the scope of ACP?

Definitely

2. Does the paper present novel concepts, ideas, tools, or data?

There is no much novelty in the ideas and tools, but according to the authors there has not been done comprehensive analyses of hourly visibility data for Beijing before. In this respect, the work contributes to the study of the variability of atmospheric visibility.

3. Are substantial conclusions reached?

Partly, the conclusions confirm the earlier research findings concerning the main factors affecting the visibility. The obtained results have also been applied to investigate the possibility of visibility improvement in Beijing during The Olympics in August 2008. The conclusions may have implications for designing the measures to improve visibility and thus air quality in Beijing.

4. Are the scientific methods and assumptions valid and clearly outlined?

A paragraph explaining main principle of visibility impairment by atmospheric aerosols, including the effect of relative humidity, could be recommended.

The description of data and methods used could be given more attention and documented in a better structured manner. Basically, the data is visualized in form of trend diagrams and various types of frequency distribution, while no quantitative statistical characterization of the data is provided.

5. Are the results sufficient to support the interpretations and conclusions?

Yes, in the sense that the conclusions are made directly from observing the figures.

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

As above, the observation data could be described more appropriately.

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

8. Does the title clearly reflect the contents of the paper?

Yes

9. Does the abstract provide a concise and complete summary?

The abstract does provide some of the main conclusions, but I feel it could be more focused. There are also several poorly formulated statements, obscuring the understanding.

10. Is the overall presentation well structured and clear?

It could be improved indeed as it is not always easy to follow. In particular, the data used in the work and measurement sites/network should be described properly in section 2.

11. Is the language fluent and precise?

Not always. May place it makes understanding of the text rather difficult. There are also quite a few inaccurate and imprecise formulations.