Atmos. Chem. Phys. Discuss., 5, S5070–S5075, 2005
www.atmos-chem-phys.org/acpd/5/S5070/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relative humidity impact on aerosol parameters in a Paris suburban area" *by* H. Randriamiarisoa et al.

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Received and published: 14 January 2006

1) While I think the approach the authors take is interesting, I think it would be more useful to go beyond 'coherence' and take the data they have one step further. It would be great if they could actually try to achieve closure i.e., how does scattering calculated from Mie theory (using the measured size and chemistry) compare to the measured scattering. There are a variety of Mie codes which can easily be downloaded from the web to do these calculations or one can do them using a spread sheet. These closure calculations have been done by other groups but not necessarily at ambient RH (e.g., Wex et al., JGR, 2002; Quinn and Coffman 1998).

Mie scattering theory has been use to crosscheck the parameterisations, see the section 5.1.3: Coherence between fscatt(RH) and fr(RH) parameterisations. This is a type

of closure approach. We have a Mie code that has been use to assess the contribution of each mode to the total scattering cross section. We have added the references.

2) Page 8093 since diameter growth is discussed as a function of f(RH) using TDMA type instruments, the authors should also reference some of the large body of humidified nephelometer work (e.g., work by Carrico, Covert, Ogren, Rood to name a few)

We have added the references to Covert et al., 1979, Carrico et al., 2000, 2003 in the introduction. The reference to Rood et al. was already given.

3) Page 8095 radius ranging from 0.05 to 1.5 um how get 100% efficiency for 0.1 um?

The value of 0.05 has been replaced by the true value of 0.005 μm

4) Page 8097 what are the precision/uncertainties inherent in the size distribution measurements? Optical particle sizers are typically calibrated for particles of one refractive index which is usually quite different than the refractive index of ambient aerosol particles. This can lead to uncertainties in the sizing of the particles. See papers by Baumgardner for general discussion of this for some specific OPCs and also papers by Hand and Kreidenweis.

Yes, the particles sizers are calibrated with particles of refractive index quite different that the one of aerosols over Paris area. We have included precisions and the reference to Hand and Kreidenweis.

5) Page 8097 at what RH were the size distribution measurements made? Note: if at ambient conditions the refractive index will be significantly lower than for dry conditions and will lead to further uncertainties in the size measurements.

Yes, we agree with this point. Nevertheless, the whole of measurements was led in ambient atmosphere as that is specified in the text. The refractive index was selected for dry particles and one considered its evolution with RH according to Hänel (1967, 1976).

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6) Page 8097 Give the size cuts for each of the chemistry measurements (or say that there was no size cut.

The size cut is given in the text and equals to 1 μm in radius.

7) Page 8097 contribution of 0.1 um particles to mass is typically small so can caveat comment about losses for dp$<$0.1 um increasing rapidly (this comment is made later in the paper, but should be made now) This would also be a good use of the Mie code and measured size distributions to estimate what the contribution dp$<$0.1 um particles to scattering are.

Indeed, this comment is given later in the paper when the optical aerosol properties are discussed. The impact of small particles on the extinction coefficient is not the exact scoop of this paper and has been well described in Chazette et al. (2005). Over the Paris area, the accumulation mode is the more important contributor to the total extinction and it corresponds to aerosols of ˜0.1 μm in radius. The nucleation mode contribution is weaker (less than 5%, see Table 3).

8) Page 8099 using Nt to normalize neph scattering for changes in aerosol amount can bias the normalization towards smaller particles which are less likely to scatter light. With the number concentration and scattering data that I am familiar with any relationship between Nt and scattering is the exception not the rule! It might be better to use KC18 data which will encompass most of the particles which scatter light (i.e., dp $>$ 0.1 um).

Yes, we indeed thought of that and we carried out tests. The results are very similar; one observes the same laws of variation against RH with higher cross sections.

9) Page 8102 I agree that the nucleation mode particles are hygrophobic, but perhaps should mention this could be a chemistry or size effect as these are the particles that won't pick up water because of the curvature term in the Kohler equation.

Yes, we agree and this point has been added.

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Interactive Comment

10) Page 8103 what is meant by occupation rate?

This point has been clarified.

11) Page 8103 The authors spend some time discussing coarse aerosol mass size distribution and the need to know it and then suggest that aerosol emissions are probably mainly due to automobiles. Automobile emission is more likely to be in the fine mode while coarse mode aerosol tends to be 'natural' such as sea salt or dust. Page 8104 Say in the text what elements make up most of the mass of the coarse mode and hypothesize on what the source of this aerosol might be (e.g., dust) (see following comment)

Yes, the traffic emission is more likely to be in the nucleation and accumulation modes. Nevertheless, the cars inject also particles towards the atmosphere by friction on surface. We have added complementary informations about the coarse mode to identify its source.

12) Page 8104 the authors suggest a mode radius for the dust particles in the coarse mode. This is the first mention of dust. They should explain why they are assuming dust (and not, for example, sea salt since the airmasses also pass over the ocean)

The coarse mode is not only composed of dust, we rather created a class " residual". More precise information was added on the composition of the third mode but it remains still much of unspecified matter. Sea salts contribute little because the weak concentration of chlorine. Additional information was added.

13) Page 8105 I'm not sure why the authors state that they are going to focus on water soluble particles with dp$<$1um in this section. The nephelometer was presumably measuring all aerosol not just sub-um aerosol. The other chemical measurements don't have a size cut (at least there is not one noted in the text). One can probably safely assume that most of the POM and BC are in the sub-um mode. However, the residual appears to mainly be in the coarse mode based on figure 6. If the residual is

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dust it may be hygrophobic and may strongly affect the total aerosol water content. I suggest that the authors (a) get rid of the sentence saying they are focusing on sub-um water soluble and (b) add the total water soluble mass concentration to Figure 6.

The coarse mode contributes much less to the cross section than the accumulation mode. Moreover, it represents less than 30% of the total contents in WS which must especially found in the form of calcium nitrate. These various points are now given in the text. One can thus actually suppose that the accumulation mode is that which drives the hydroscopic properties of the aerosol on Paris.

14) Page 8107 The authors assume that the POMs and BC are hygrophobic. This is a fine assumption but should be supported by some references.

The references were done in section 3.3. We have again given some references in this section.

15) Page 8111 give references for where you say fscatt is typically reported in the literature for RH=80%

The references have been added in the text.

16) Table 4 include fscatt measurements by Covert et al 1972 for urban aerosol (Seattle, Altadena, Denver) and Covert et al 1980 (Pasadena Pomona and Fresno). These sites should be fairly comparable to f(RH) measurements in a Paris suburb.

The sites are comparable but the aerosol composition is different because the authors have shown a specific component of the aerosol. In this work, the aerosol is taken in the ambient atmosphere. Nevertheless, the values of fscatt(80%) stay comparable.

17) Figure 2 the differing scales for these plots was a little deceiving. I would recommend using 10-10 for all y-axes so that P4 would standout. It would have values up to 12 instead of 1.2.

We have made a remark in the figure caption for the specific case of P4.

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Interactive comment on Atmos. Chem. Phys. Discuss., 5, 8091, 2005.