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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Study of columnar aerosol size distribution in Hong Kong" *by* X. Yang and M. Wenig

Anonymous Referee #2

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The paper reports on an analysis of sun-sky radiometer measurements taken at City University in HK during May-November, 2002-2004 and 2008. This is good data and should be published in some form. The presentation needs polishing, the arguments need tightening, and much pruning is required. The arguments about the aerosol sources can be made more effectively if the analysis is carried out using in-situ (or coincident) relative humidity and wind data. Grammatical and typo errors are common and need to be corrected.

Comparison with MODIS and AERONET (October-November only) data was made. The data show a fine (<0.1μm radius) and coarse (>6μm radius) mode aerosols while a third mode ($\sim$2 μm radius) was evident in high AOD situations. The authors attributed aerosol growth and coagulation as the reason for the third mode. After growth

and coagulation, Aithen particles are transformed and are present in the so-called "accumulation mode" with radii range of 0.1-1 μm (Wallace and Hobbs, 1977). This corresponds to the fine mode in their analysis. While it is possible that the accumulation mode aerosols can grow to larger size (2 μm radius), no substantial evidence was presented in the paper to substantiate this other than monthly mean relative humidity (RH). All monthly RH values are above 60%, which is the required for growth and coagulation as suggested by other authors. However, there are large diurnal and day-to-day variations. To fully assess the RH effect, coincident RH values are necessary. Detail examination of their aerosol size distribution shows that this third mode may be present even in low AOD situations (their figures 9 and 10). It is not convincing from their analysis that the third mode is due to growth and coagulation.

The authors have suggested transported of aged aerosols that they ruled out as the main contributor. Previous analyses of HK air pollution and meteorological data have shown substantial cross border pollution transport in HK (Lau et al., 2006, Civic Exchange Report; Chiu and Lok, 2008, JGIS). The prevailing wind directions, as indicated by Waglan Island climatology show predominately easterly and southerly in May –September but a northerly component is present in October and November (Ng, 1997; HK Observatory TN 91). To rule out the cross border transport as a contributing factor in the third mode, analysis of the high AOD data with wind data can either support of refute this hypothesis. Another possibility for the third mode is the sea spray (2μm size), which is enhanced by surface wind from any direction except from the north for HK. Hence both of these hypotheses can be tested using wind data.

Specific comments (reference to 15 May 2009 version) Abstract. "Investigation of its variations . . .that it is mainly due to the fine aerosol hygroscopic growth and coagulation rather than the contribution from the coarse mode." More large -> larger Ageing -> aging

1. Introduction Be consistent with the use of terms, such as fine "mode" aerosol, instead of fine aerosol. 2nd paragraph. Aerosol size distributions are also useful indica-

tors of the sources and sinks. Line 8 from bottom. "...using the Angstrom exponent as (discrimination → a discriminator). Para 3. line 2. " ... Delta region, one of ..." -> "...Delta region. The PRD is one of ... " Line 4 from bottom, four years of seasonal data probably does not constitute "long-term" observations. I suggest simply to state the time period of analysis. Section 2.2 last paragraph. Line 13 from bottom. "...the error for ..." Please be more specific about what the error is. This is important for the distinction of the third mode.

Section 3.2 paragraph 2. Change (coinciding-> coincident) Change "...solely 25 coinciding..." -> "...a total of 25 coincident..." Similar changes in paragraph 3, line 9. Paragraph 3, line 10 "AERONET in July and September" change (and -> to) Line 11. ".. the relative humidity is (relatively drier -> lower) Line 25. "Therefore there are (a more limited number of -> less) ..."

Section 3.2 Add "and the subscript i denotes the aerosol type" after "geometric standard deviation," Line 6 from bottom of page. Change (symbolized change to denoted); Reverse order of the sentence, "volume concentration, volume median (radiuses -> radii)," change the second Cf -> Cc

Section 3.3 paragraph 1. last line. "...under more humid(ity)..." Paragraph 2. line 8 (denoted → noted); line 20 (accompanies with a low ..." Paragraph 3. "For instance, the fine (mode) fraction in 2002 increases from 49% to 63% when α > 1.4" Please explain what this change in percentage refers to.

Paragraph 5. line 10. "For instance, when AOD > 0.5 in 2008, the fine mode fraction and geometric standard deviation increasing from 52.76% to 57.61%..." Indicate what are the samples on which these numbers are computed, i.e. for AOD>0.5, what other discriminators are used to compute there numbers. End of the paragraph. It is not clear that there is a trend in the shifting of the fine mode median radius to smaller sizes while coarse mode median radius increases.

Paragraph 6. Please rephrase the last sentence.

Paragraph 7. Give a mean and SD instead of the range in discussing aerosol properties under high and low AOD conditions. Last sentence again please explain what those numbers (52.76%, 52.9%, 58.57%, 57.61%) refer to.

Paragraph 8. Add "the angstrom exponent" for the coarse mode is smaller than 0.04 ...Explain what is meant by "the increment of coarse (mode) aerosols..."

Section 4. paragraph 2. "Validation" means the comparison of a quantity with one of lower uncertainty, hence the use of the word is probably not appropriate here. In the abstract, the coarse mode is said to centered around 6 μm while a 2.7μm median radius is indicated in the conclusion. Paragraph 3. The discussion in paragraph 3 does not lead to the conclusion "that hygroscopic growth of aerosols is the main underlying mechanism for the observed shifting."

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 8341, 2009.