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Study of columnar aerosol size distribution in Hong Kong

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Abstract. This paper presents studies on columnar aerosol optical properties in Hong Kong with focus on aerosol volume size distribution, which helps understand local aerosol properties, variation, hygroscopic growth and coagulation. Long-term ground measurements in the wet season in the years of 2002, 2003, 2004 and 2008 have been performed using a sun-sky radiometer. Data validation made using MODIS and local AERONET shows agreement. A bimodal size distribution is found with the fine mode centering at ~0.2 μm and coarse mode centering at ~3 μm respectively. The fine and coarse mode have close volume concentrations of nearly 50% fraction in composing local aerosols. Intercomparison of different years shows similar aerosol properties while a small increase of fine mode aerosol could be observed. A systematic shift of size distribution parameters is observed with different atmospheric conditions, where higher aerosol loadings and Angstrom exponent correspond to more fine mode aerosols. The fine mode is found to be more closely correlated with this shift than the coarse mode. A higher fine mode volume fraction and smaller median fine radius correspond to a larger Angstrom exponent. The fine mode aerosol hygroscopic growth is one of the main mechanisms for such systematic shifting. A third mode centering at ~1–2 μm could be discovered under high aerosol loading and high fine mode aerosol conditions. It becomes more pronounced with high aerosol optical depth and larger Angstrom exponent. Investigation of its variation with corresponding optical parameters and correlation with atmospheric conditions appears to support the hypothesis that it is mainly due to the fine mode aerosol hygroscopic growth and coagulation rather than the contribution from the coarse mode. While the very humid environment facilitates the aerosol hygroscopic growth, aerosol coagulation might further produce larger aerosols under high fine aerosol conditions. The continental outflow with transported aging aerosols and biomass burning might have also contributed to this additional mode.

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