

Interactive comment on “A new method to determine the mixing state of light absorbing carbonaceous using the measured aerosol optical properties and number size distributions” by N. Ma et al.

Anonymous Referee #1

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General Remarks This work describes a new approach to estimate the mixing state of light absorbing carbonaceous (LAC) species based on optical and number size distribution data. The new algorithm was applied to the optical (hemispheric backscattering fractions) and number size distribution data obtained from a recent field campaign in the North China Plain. The model was carefully analyzed for possible error sources and the uncertainties in all the parameters were evaluated. A diurnal variation trend in the mixing state of LAC was observed and attributed to the evolution in the mixing layer. The method presented appears to be convincing and has the merit to determine

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the LAC mixing state with limited instruments and data, which may provide a better understanding on the impacts of LAC on global radiation budget. The manuscript is reasonably well written, addressed an important subject in atmospheric sciences, and can be considered for publication in ACP, provided that following issues are adequately addressed. Major comments: Atmospheric nanoparticles with diameter less than ~ 40 nm appear to contribute much less on the aerosol optical properties. As a result, when the fraction of these nanoparticles in number concentration is high, it may affect the cross section calculation. Is this factor considered in the model presented? Several recent papers on the subject (Pagels et al., *Aerosol Sci. Tech.* 43, 629, 2009; Xue et al., *Phys. Chem. Chem. Phys.* 11, 7865, DOI:10.1039/b700001a, 2009; Xue et al., *Environ. Sci. Technol.* 43, 2787, 2009; Khalizov et al., *J. Geophys. Res.* 114, D05208, doi:10.1029/2008JD010595, 2009; Khalizov et al., *J. Phys. Chem. A* 2009, 113, 1066; Zhang et al., *Proc. Natl. Acad. Sci. USA* 105, 10291, 2008) and books (e.g., Mishchenko, M. I.; Hovenier, J. W.; Travis, J. W. *Light Scattering by Nonspherical Particles: Theory, Measurements, and Applications*. Academic Press, 2000) will be helpful for the analysis in section 4.4 related to the LAC shape and cross sections. Other comments Page 27482 line 16-page 27483 line 5. It may be more appropriate to discuss the possible mixing state of LAC in the introduction part. Figure 6. What do the black dash lines stand for?

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