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Comment

# ***Interactive comment on “Light extinction by Secondary Organic Aerosol: an intercomparison of three broadband cavity spectrometers” by R. M. Varma et al.***

**Anonymous Referee #2**

Received and published: 16 September 2013

Review of: Light extinction by secondary organic aerosols: An intercomparison of three broadband cavity spectrometer by Varma et al.

This paper presents the results of the inter-comparison of three different types of cavity spectrometers and their application to the determination of real part of refractive index (RI) of secondary organic aerosols (SOAs) generated in smog chamber. Although I think there are some difficulties in reasonable estimation of the accuracy of these instruments especially the evaluations of the baseline drift, this study provide valuable information on the applicability (and also limitation) of these instruments for the measurement of optical properties, such as extinction coefficient, refractive index, single

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scattering albedo, in laboratory and field studies. In addition, this paper reports the RI of SOA generated from NO<sub>3</sub> oxidation. The results will contribute to understanding of the impacts of SOA generated during night time on radiation balance. Especially the discussions on higher real part of RI for SOAs generated from NO<sub>3</sub> oxidation of  $\alpha$ -pinene reported in this study compared to literature studies for SOA generated from ozonolysis and photooxidation (OH oxidations) of monoterpenes in the absence or presence of NO<sub>x</sub> are interesting. This manuscript includes sufficient originality and novelty, and the topic seems to fit the journal. I therefore recommend publication once the comments and questions below are addressed.

#### Major Comments:

1) In this study, it is suggested that organic nitrates are likely cause for the high SOA refractive index (Page 6709, lines 7-9). Nakayama et al. (2012) reported smaller real part of RI at 532 and 781 nm for the SOAs generated in the photooxidations of  $\alpha$ -pinene in the presence of NO<sub>x</sub>. They reported the nitrate to organic (HRNO<sub>3</sub>/HROrg) and oxygen atom to carbon atom (O/C) ratios of the SOAs were 0.036  $\pm$  0.006 and 0.47  $\pm$  0.01, respectively (Table 1 of their paper). Lambe et al. (2013) recently reported that the real part of RI value at 405 (as well as 532 nm) decrease with O/C ratio for SOAs generated in the photooxidations of  $\alpha$ -pinene in the absence of NO<sub>x</sub> (Fig. 6 of their paper). I think it will be valuable if the authors can add the HRNO<sub>3</sub>/HROrg and O/C ratio for the SOAs generated in this work and compared with their results.

2) The mass of SOA in Fig. 2 seems to show non-negligible generations of SOAs from around 9:00 before the additions of ozone at 10:30. It might be nice if the authors would add possible explanations.

3) It is important to show the reliability of the calculations of real part of RI. It would be better if the authors could add temporal variations of mass (or total volume/surface) concentration and mode (or average/mean) diameter of SOAs in Fig.3(a) and 4(a).

#### Minor Comments:

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- 1) Page 6693, lines 13-14: How was the interval of zero air measurement?
- 2) Page 6693, eq. (1) and page 6696, eq. (3): How did authors determine the Lf and Ls values?
- 2) Page 6694, line 9: 400 m => 400 micro meters?
- 3) Page 6695, line 14-17: How did authors measure wavelength dependence of L0 values?
- 4) Page 6723, Table 5 One of the Kim (2010) should be Kim (2012). Nakayama et al (2012) also reported the RI values at 532 and 781 nm for SOAs generated from ozonolysis and photooxidation of a-pinene.

Reference Lambe et al., Relationship between oxidation level and optical properties of secondary organic aerosol, *Environ. Sci. Technol.*, 47, 6349-6357 (2013). Nakayama et al., Wavelength dependence of refractive index of secondary organic aerosols generated in during the ozonolysis and photooxidation of a-pinene, *SOLA*, 8, 119-123 (2012).

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