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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Wintertime Aerosol Optical and Radiative Properties in the Kathmandu Valley during the SusKat-ABC Field Campaign" *by* Chaeyoon Cho et al.

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Reply to Reviewer # 2 comments:

We appreciate your thoughtful and helpful comments. Our 'Reply' is embedded below. We hope we provide the appropriate answers, and if there are more questions, please let us know.

Best Regards, Authors

The paper presents surface and remote sensing aerosol optical measurements from an ABC campaign in Kathmandu from 2012 to 2014. Highlights from the study show

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diurnal and seasonal variation in the aerosol loading, AOD and intensive optical properties. Based on these measurements the authors calculate TOA and surface aerosol radiative forcing. Aerosol optical and forcing information from this study is important for tying the results from other ABC studies together to form a comprehensive model of Asian aerosol radiative forcing. I recommend the paper for publication after a few revisions. A comparison of the surface and remote sensing aerosol intensive properties, single scatter albedo, Angstrom and radiative forcing efficiency, as well as a comparison of AOD and extinction integrated to the top of the boundary layer would give insight on the vertical mixing of aerosol, response of aerosol mixing to transport and diurnal changes in the BLH, as well as provide an informal validation of the Aeronet retrieval of the aerosol intensive properties. The high aerosol loadings provide a good opportunity for a robust validation of the retrievals as well as provide information on mixing.

Thank you for your valuable comments and suggestions.

Do the surface extinction and AOD have different seasonal and diurnal responses?

Thank you for your interesting suggestion. We can analyze monthly/seasonal variations of AOD from AERONET Cimel skyradiometer measurements at Bode site during 2012-2016 (see Fig. 1 of this study). However, surface in-situ measurements of aerosol extinction (i.e., scattering and absorption) were not measured after SusKat experiment (December 2012 – February 2013). Therefore, we unfortunately cannot investigate the relationship between surface aerosol extinction and column-integrated aerosol optical properties at Kathmandu Valley.

Regarding to the variation of these two parameters during the daytime, surface in-situ data were decreased during the daytime with the development of mixing layer height and showed a minimum value in the afternoon (14-15 LST). However, columnar AOD increased during the daytime (see Figure 8 in the revised manuscript). We added this opposite variation in the revised manuscript (Section 4).

“On the other hand, it should be noted that AOD at 500 nm observed in the afternoon

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(14-18 LST) was about 1.5 $\sim$ 2 times higher than that observed before 14 LST. For example, AOD at 500 nm was distinctly increased from about 0.3 around 9-14 LST to 0.5 in the late afternoon (15-17 LST) on January 03, 2013 (Figure 8). An AOD increase in the afternoon (14-18 LST) can be attributable to enhanced vertical mixing within the developed MLH."

Insert [Figure 8] here

Figure 8. Variation of surface aerosol extinction coefficient (550 nm) and aerosol optical depth (500 nm) at the Bode site from January 02 to 04, 2013.

What fraction of the time (# of days during the campaign) was the Kathmandu Basin under cloudy conditions?

Unfortunately, we do not have cloudiness data at Kathmandu Valley during the campaign. Only temperature, wind direction and speed and RH data were available at the Bode site.

The changes in aerosol properties over three short time periods (Dec. 21-Feb 14) don't add pertinent information to the paper. Instead focus on segmenting the data to identify unique aerosol optical signatures (finger prints) for brick factory, cook stove and wood burning emissions. Quantification of the mass absorption efficiency, single scatter albedo, Angstrom/asymmetry parameter, forcing efficiency, mass scattering efficiency for each of these sources, separate from the other, is incredibly useful for climate models.

This is a really good suggestion. Thank you. However, unfortunately, we cannot distinguish aerosol optical properties for each aerosol type and/or sources. As reported by several papers (Kim et al., 2015; Sarkar et al., 2016, Panday and Prinn, 2009, and references therein), most aerosol emission sources are located at the bottom of the Kathmandu Valley, within a small area (about 300 km2). In addition, all aerosols emitted from various sources can be fully mixed in the Kathmandu Valley due to local

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circulations associated with bowl-shaped topography. Therefore, we cannot identify unique aerosol optical signatures (finger prints) for brick factory, cook stove and wood burning emissions under these environmental conditions. Aerosol chemical compositions from 24-h filter samples during the campaign made a difficulty in segmenting the data to each of these sources.

**Thank you again for your valuable comments and suggestions.

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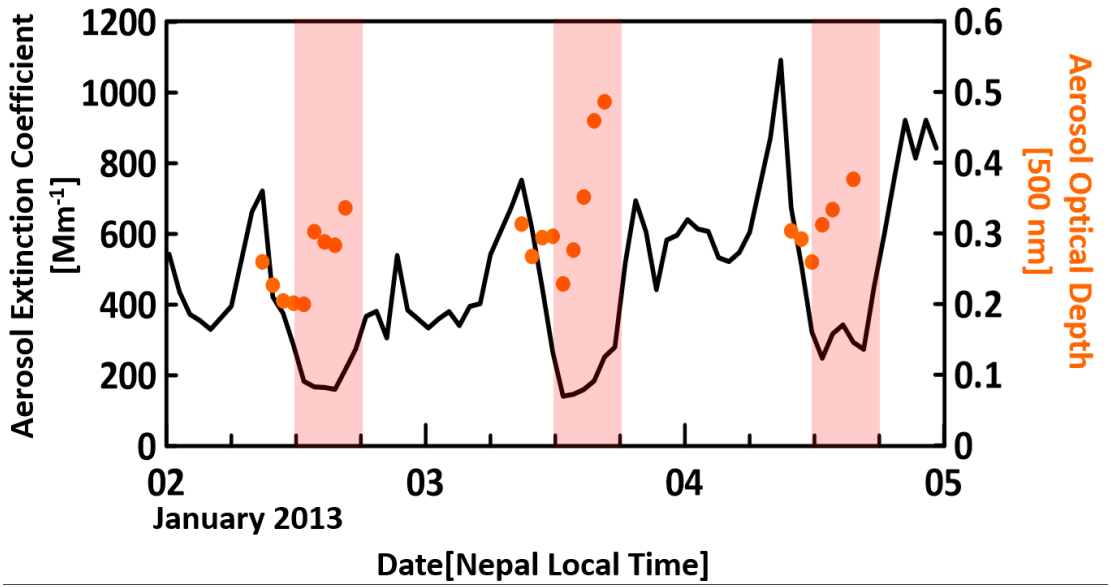

Fig. 1. Figure 8. Variation of surface aerosol extinction coefficient (550 nm) and aerosol optical depth (500 nm) at the Bode site from January 02 to 04, 2013.

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