Atmos. Chem. Phys. Discuss., 13, C5924–C5926, 2013
www.atmos-chem-phys-discuss.net/13/C5924/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Increased absorption by giant aerosol particles over the Gangetic–Himalayan region" *by* V. S. Manoharan et al.

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Received and published: 16 August 2013

We thank Dr. Ghan for his comments and suggestions on our paper titled "Increased absorption by giant aerosol particles over the Gangetic-Himalayan region". We have incorporated the suggestions into the paper as follows:

Major comments: "...Such a distinction was heavily relied on in the bounding black carbon paper by Bond et al. JGR, 2013. The implications of this work for bounding the contribution of black carbon to direct radiative forcing should be discussed in this manuscript. The authors might also discuss the Bahadur et al. PNAS (2012) and

Chung et al. PNAS (2012)."

We have included the references, Bond et al., (2013), Bahadur et al. PNAS (2012) and Chung et al., (2012) in the Introduction. The following discussions are added in the first paragraph of the Introduction:

Several observational and modeling studies have addressed the optical properties of absorbing aerosols in this region and their impact on monsoon rainfall in southern Asia [Costabile et al., 2012; Russell et al., 2010; Bergstrom et al., 2002; Dubovik et al., 2002]. Most climate models attribute the atmospheric absorption of solar radiation mainly to black carbon and mineral dust. Absorption by organic aerosols is considered by a number of studies particularly at ultraviolet wavelengths, and it is much weaker on a per gram basis than black carbon in the visible band (Jacobson, 2001; Kirchstetter et al., 2004; Feng et al., 2013). However, the complexity associated with the wavelength dependent absorption by aerosols leads to increased uncertainty in the estimation of global aerosol direct radiative forcing and bounding the contribution of black carbon to direct radiative forcing [Chung et al., 2012; Bahadur et al., 2012]. A recent study by Bond et al., 2013 addresses the need for inclusion and quantification of the associated physical and radiative processes of black-carbon aerosols in climate forcing to improve future climate forcing estimates.

Added references:

Feng, Y., Ramanathan, V., and Kotamarthi, V. R., Brown Carbon: a Significant Atmospheric Absorber of Solar Radiation?, Atmos. Chem. Phys. Discuss., 13, 2795-2833, doi:10.5194/acpd-13-2795-2013, 2013 (accepted in Atmos. Chem. Phys.)

Jacobson, M. Z.: Global direct radiative forcing due to multicomponent anthropogenic and natural aerosols, J. Geophys. Res. 106:1551–1568, 2001.

Kirchstetter, T.W., Novakov T., and Hobbs P. V.: Evidence that the spectral dependence of light absorption by aerosols is affected by organic carbon. J. Geophys. Res., 109,

D21208, 2004.

Minor Comments: 1. Changed the lines 3-4 in the abstract. – Climate models treat black carbon as the main light absorbing component of carbonaceous atmospheric aerosols, while absorption by some organic aerosols is also considered, particularly at ultraviolet wavelengths.

2. Changed as per the referee's suggestion – To investigate the impact of aerosols on radiative transfer and cloud processes in this region, the Ganges Valley Aerosol Experiment (GVAX) was conducted from June 2011 to March 2013 at Manora Peak, Nanital, India.

3. Deleted the lines 19-20 in page 19841 as per the referee's suggestion.

4. Changed the line 24-25 at page 19841 as – This feature is consistent with the presence of larger particles.

5. Included the comparison of total atmospheric heating by the two aerosol ranges in the first paragraph of page 19845 - The atmospheric forcing by aerosols is +5.2 and +3.8 W/m2 for D10μm and D1μm particles, respectively, during this 3-week time period. The super-micron particles (D10μm - D1μm) contribute about 27% (1.4 W/m2) of the aerosol heating in the atmosphere.

6. Changed as per the referee's suggestion – D10μm particles exhibit markedly higher measured absorption values (by roughly 30%) than the D1μm particles during several segments of the post-monsoon period. The differences between D10μm and D1μm suggest a significant contribution to total aerosol absorption due to super-micron coarse particles (D10μm - D1μm).

7. Changed "small" to "low" while talking about negative values in point 2 at page 19845 as per the referee's suggestion.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 19837, 2013.