We thank Dr. Gautam 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:

Comment 1: - The title of the paper contains "giant aerosol particles". Authors discuss their results based on measurements of aerosols in two size ranges (with the aerodynamic diameter <1 micron and <10 micron). It is probably true that coarse particles were present during the measurement period, and the authors in fact show the possibility of coarse particles based on spectral absorption/scattering coefficients. However, the 10 micron cutoff includes fine particles as well (<1 micron), and a significant absorption is reported in the paper specifically for fine particles. Moreover, there is no information provided regarding the aerosol size distribution (number or volume concentration). Unless authors show more quantitative information (e.g. size distribution), it is difficult to justify "giant aerosol" in the title. I think replacing "giant aerosol" with "coarse aerosol" reflects well the results presented in the paper.
Response: The reviewer is correct in identifying that the aerosol size bin information is not available in greater detail. We have no particular problem with changing the title from "giant aerosol" to "coarse aerosol".

Comment 2: - In the Introduction section and elsewhere, authors should refer to (and possibly compare their results with) previous studies in the literature that reported aerosol related measurements in the Himalaya, for example:
Pant et al. 2006, Dumka et al. 2010, Hegde-Kawamura 2012 (at Nainital),
Hyvarinen et al. 2008 (at nearby Himalayan site- Mukteshwar),
Marinoni et al. 2010 (at NCO-Pyramid site),
Gautam et al. 2011 (at several locations in the Gangetic-Himalayan region).
Response: As identified by the reviewer there are some measurements available from this region of various aerosol related properties. A detailed analysis has been performed and submitted for journal review by our collaborators (Dumka et al., 2013 and Sahai et al., 2013). Our focus in the paper is to highlight the absorption in the coarse particle range and not a detailed review of the GVAX study. A companion manuscript is being prepared that explores the aerosol data in more detail, corresponding meteorological conditions and comparison with other available data sets.

Comment 3: - The observed diurnal pattern in aerosol absorption shown in Figure 1 is quite interesting, especially during the post-monsoon period. But there is no explanation or discussions associated with the diurnal pattern, which has a significant amplitude (daytime absorption is twice as large as during nighttime). Similar observations are found
Response: The diurnal pattern observed is indeed quite interesting An evaluation of this process will require simulation of the local meteorology to generate a more accurate projection of the boundary layer height and local meteorology. We are in the process of conducting these very high resolution simulations and an evaluation of this and the diurnal observations are beyond the scope of this paper.

Comment 4: - Can the authors discuss the nature of the spectral absorption/scattering coefficients in terms of perhaps aerosol type, or atleast provide some insights into the aerosol composition and its seasonal variations? (there is not a lot of but some literature available for insitu/chemical analysis of aerosols that authors can refer to, see References).

Response: The scope of this paper is to show that super-micron-sized aerosol particles absorb more than sub-micron-sized particles. We have discussed some insights on the possible types of aerosols during the high absorption post-monsoon period. Details on aerosol absorption/scattering in terms of aerosol types will be studied and discussed in a paper as a follow up of this study.

Comment 5: - The aerosol absorption tends to have had weakened around January. In fact, there appears to be a dip during this period (around January) from the post-monsoon to pre- monsoon time series. Does the decrease in scattering and absorption efficiency around January indicate a seasonal shift in aerosols?, when aerosol loading in general reduces after the peak post-monsoon emission period (considering Nainital probably represents free-troposphere environment during winter as the PBL is shallow during peak winter months). Thereafter (February onwards) starts to build up again likely associated with enhanced convection during March (beginning of pre-monsoon period). Authors should discuss as to the seasonal variation of the aerosol extinction and the potential causes.

Response: A detailed description of the seasonal behavior of aerosols during the measurements is provided in Dumka et al., 2013. Again, to keep the subject matter of this paper focused on the coarse aerosol absorption we haven't dwelled into the description of the seasonal and diurnal behavior of the aerosols at this site.

Comment 6: - In addition, for better understanding of the observed seasonal and diurnal variations in aerosol scattering and absorption, I think it would be useful to show/discuss the corresponding data for RH, temperature (and PBL data if available).

Response: This is again focused on describing the climatology of the aerosols in the region and was addressed by Sahai et al., 2013 and Dumka et al., 2013 and hence not covered in this manuscript.

Comment 7: - It seems authors have not accounted for the humidity dependence of aerosol backscatter, i.e. the aerosol humidification factor - f(RH). At higher RH values, aerosol scattering, in particular, is strongly influenced by humidification leading to swelling of hygroscopic particulates. See for example, Kotchenruther et al. 1998. The aerosol humidification should be accounted for in the analysis shown in the paper.

Response: It should also be noted that both the coarse and fine aerosols experience the same humidity and hence should not be factor in obtaining increased absorption due to coarse aerosols compared to fine aerosols.

Comment 8: - Since the scattering and absorption coefficients are already shown in the paper. Why don't authors also show the corresponding single scattering albedo (SSA) for the entire period, and discuss their results in terms of spectral SSA as well? The SSA is a more direct quantity that can be readily compared with other studies/locations, as well as perhaps more useful for climate modelers for aerosol radiative forcing estimations.
Response: Again to keep the focus of the paper on increased absorption/scattering by super-micron aerosol particles and avoid deviation from the subject matter we have not dwelt in the SSA analysis.

Comment 9: - How do the measured aerosol scattering and absorption coefficients (and SSA) compare with other locations in the Himalaya and the Indo-Gangetic Plains (IGP)? It would be useful to have some comparative analyses of the results from this study over Nainital. For example, Hyvarinen et al. 2008 also showed aerosol surface measurements over Mukteshwar in the western Himalaya.
Response: As mentioned earlier the main objective of this study is to demonstrate the increased absorption by super-micron-sized particles. Comparison with other sites in the Indo-Gangetic region will be discussed in the follow up paper.

Comment 10: - In terms of the seasonal variations of spectral aerosol extinction, was any distinct pattern found suggesting variations in aerosol type? For instance, influx of dust has been observed over Nainital during pre-monsoon season (Ram et al. 2010). Does the March data indicate any influence of dust aerosols particularly in the D10 micron spectrum relative to the post-monsoon period when dust loading is, in general, lowest over the western Himalaya and the IGP.
Response: The D10 spectrum in general is higher than D1 during the entire period of observations indicating the D10 aerosol absorption is always higher in this region.

Comment 11: - Aerosol Radiative Forcing: Authors briefly mentioned in section 3.6 about Aerosol Optical Depth (AOD) and SSA without any details. Please also show/discuss the calculated and measured AOD/SSA here, so the reader has a better handle on the seasonal variation of AOD and SSA, and can conveniently associate the range/variations of AOD, SSA with the estimated aerosol radiative forcing.
Response: As discussed in section 3.6, we calculated aerosol direct radiative forcing for the three-week period in October to November 2011, in order to demonstrate the contribution to total aerosol forcing due to coarse particles. AODs and SSAs were derived from surface measurements of scattering and absorption coefficients by assuming aerosols were concentrated between the surface and 500 m above the ground. The figure below shows the daily variations in AOD (left) and SSA (right) in the forcing calculations for these three weeks. The time average of AOD estimated for D1-micro and D10-miron particles are 0.09 and 0.18, respectively, compared with the MFRSR AOD of 0.1, and the estimated SSA for the two size cuts are 0.91 and 0.93, respectively.

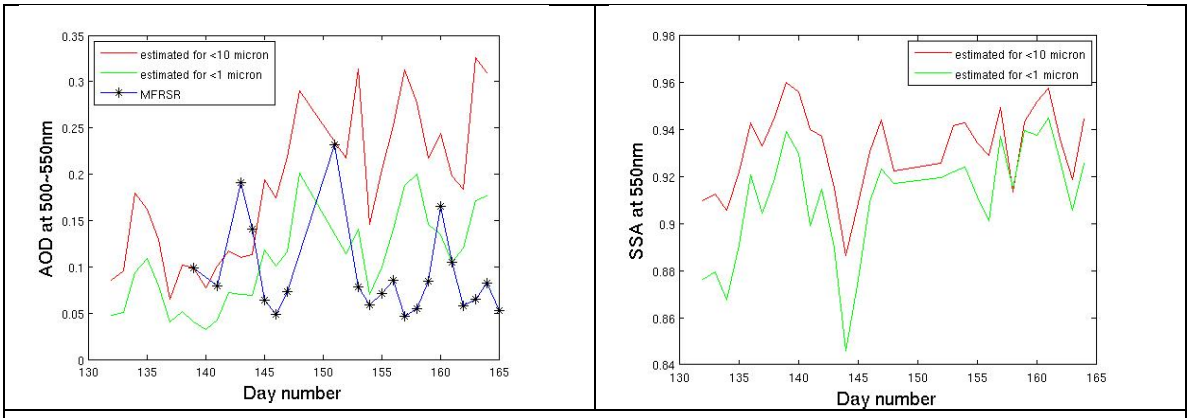

Figure. AOD and SSA derived from the surface measurements for the 3 weeks in October and November 2011. Also shown in the left panel is the Multifilter Rotating Shadowband Radiometer (MFRSR) AOD at 500nm

These observation-constrained forcing calculations indicated that super-micron particles could contribute to the total aerosol forcing by as much as by 44%. We didn't expand this calculation to a longer time period, because other assumptions, i.e., surface measurements are representative of the column aerosol properties and aerosols concentrated in the surface layer of 500 meters, might not hold any more. Nevertheless, seasonal variations of surface aerosol scattering and absorption coefficients have been shown in Figures 3a and 2a.

Comment 12: - In addition to the radiative forcing, I think it is also important to report the aerosol radiative forcing efficiency (Forcing per unit AOD). This would be particularly useful to infer the aerosol absorption (since the loading is probably small) and draw comparisons to other studies dealing with radiative forcing/forcing efficiency (e.g. Pant et al. 2006).

Response: The following discussions are now added in the end of the third paragraph of section 3.6,

"… for all aerosols. The estimated atmospheric forcing of total aerosols is 5.2 Wm^{-2} during October to November 2011, which is similar to other studies at this site (e.g., Pant et al., 2006). About 27% of this atmospheric heating by aerosols can be attributed to the super-micron particles. The calculated aerosol forcing efficiency is about 42 Wm^{-2} AOD^{-1} for sub-micron particles with a time averaged AOD of 0.09 and SSA of 0.91, and 29 Wm^{-2} AOD^{-1} for all aerosols with total AOD of 0.18 and SSA of 0.93."

Comment 13: - Was there a significant variation in the aerosol radiative forcing during the measured 10-month period? Most likely, Yes. It will be interesting to see the variations during monsoon, post-monsoon and winter periods.

Response: The main objective of the paper is to demonstrate (1) contribution of aerosol absorption by super-micron sized particles to total aerosol absorption; (2) seasonal variations in aerosol spectral absorption associated with different sources. In order to characterize season variation in aerosol forcing, further examinations are ongoing including aerosol vertical distribution, and cloud properties and it is

beyond the scope of this paper.

Comment 14: - Introduction section (last sentence on page 19838)- "Several observational and modeling studies have addressed the properties of aerosols in this region and their impact on monsoon rainfall in southern Asia (Bahadur et al., 2012; Costabile et al., 2012; Russell et al., 2010; Bergstrom et al., 2002; Dubovik et al., 2002)." It seems there is a mixup of references here, the appropriate references should be inserted here. None of the cited papers in the above sentence are related to the effects of aerosols on monsoon rainfall in southern Asia.

Response: We have included the appropriate references suggested by the reviewer.

References:

1. Sahai, S., M. Naja, N. Singh, D. V. Phanikumar, U. C. Dumka, V. Pant, A. Jefferson, P. Pant, R. Sagar, S. K. Satheesh, K. K. Moorthy, V. R. Kotamarthi, Evidence of perturbed aerosol physico-chemistry over Central Himalayas caused by post-harvest biomass burning in Punjab region during autumn season, *Environ. Sci. and Tech.*, in press, 2013.
2. Govardhan, G., R. S. Nanjundiah, S. K. Satheesh, K. K. Moorthy and V. R. Kotamarthi, Validation of the online chemistry transport model WRF-CHEM over Indian Region, *submitted to J. Goephys Res*., 2013. (response to review comments submitted)
3. *Dumka et al*., Aerosol Characterization at Nainital (1958 m AMSL) using the Atmospheric Radiation Measurement Mobile Facility (AMF-1), submitted.