Review of Gobbi et al. paper, Atmos. Chem. Phys. Discuss., 10, 1193-1220, 2010.

General Comments

The primary objective of this proposal is to present and discuss sun photometer measurements at a site high in the Himalaya (the NCO-P site) and a location on the Indo-Gangetic plain (Gandhi College). Overall, the data set is potentially important in that there have only been a handful of other studies that have looked at climate relevant aerosol properties in the Himalaya. But with that said, there are several weaknesses in the authors approach, that are discussed in detail below. In particular, the sun photometer data has clearly not been carefully screened for clouds and hence determining trends in aerosol optical depth (not including the contribution from clouds) is problematic. Overall, I think this paper is not suitable for publication in present form and the specific points below must be clearly addressed, and significant changes to the manuscript made before the paper can be considered for publication.

Specific Comments

1. Introduction. I would suggest referencing and discussing the paper by Carrico et al. (*Atmospheric Environment*, 2003) at several locations in the Introduction. The paper by Carrico et al. (2003) includes several key points about aerosols in Nepal discussed in this paper (i.e. AOD, black carbon, organic carbon, and dust annual variability with links to source regions via back trajectory analysis). The authors also need to discuss the relationship between their results and this past work where appropriate throughout the paper.
2. P. 1195, Line 25. It should be mentioned that direct radiative forcing also depends on aerosol phase function. The references discussing radiative forcing are not complete and exclude earlier work that set the stage for the references cite. I would suggest at least adding, and discussing the papers by Charlson et al. (*Science*, 1992) and Schwartz (*J. Aerosol Science*, 1996)
3. P. 1200, Section 3.2. A brief discussion on the cloud-screening process is necessary, since this is a critical factor in discerning general pollution, and dust aerosol particles from clouds
4. Section 3.2. It is not clear why the fine and coarse particle fractions are estimated and shown in Figure 4. These fractions are based on model estimates of the sun photometer data that have inherent uncertainty based on model assumptions. I would suggest the authors discuss the total AOD and plot the Angstrom Exponent for both stations (which allows for the qualitative discussion of aerosol size distribution) rather than presenting the problematic coarse and fine AOD fractions (note that the angstrom exponent for the NCO-P site is plotted in Figure 6b). Also, this would allow for better assessment of cloud contamination in the monsoon season AOD retrievals. Generally speaking, it is very hard to believe that the monsoon season measurements are not primarily of cloud droplets (i.e. aerosol particles that exist at RH > 100%). And in fact this point is supported by the authors. Given that particulates are readily removed by precipitation scavenging during the monsoon the AOD signal is very likely not from particulates related to dust, biomass burning, and other pollution sources but from condensed liquid water. I think plotting Angstrom Exponents will illuminate this issue. From a direct radiative forcing perspective it is additional light extinction due to the presence of anthropogenic pollutants that is the issue and given the high AOD's during the monsoon season I think the story about direct anthropogenic forcing during that time is misleading. In summary, I think it is critical that the data be looked at closely for cloud contamination, and the data impacted by clouds removed from the discussion. It is also worthwhile to add that the AOD measurements during the monsoon season are much less frequent and hence may not truly represent the average anthropogenic AOD's during that time. I suspect that at both stations the monsoon season AOD's represent primarily clouds and not RH < 100% aerosols. I would suggest a more rigorous, and clearly described cloud screening process be applied to the data before it is discussed.

5. Page 1202. Line 15. A more detailed explanation is needed of the assumptions made in the Mie Model. In particular, how can the refractive index of 1.5 – 0.001i be justified, particularly given the mix of aerosol sources (i.e biomass burning, dust, other anthropogenic sources) and varying complexity of the aerosol chemical composition and shape? How much uncertainty can be expected in the calculations?
6. Page 1202. The statement that the 'comparison provides information on the altitude dependence of the aerosol content' is incorrect. The AOD is the integral of the extinction with height and the assumption of a perfectly vertically mixed aerosol (i.e. constant extinction coefficient with height) must be made. This is rarely the case, and can not be justified particularly at such a high elevation site impacted by long range transport. The authors instead use an assumption of an exponential decrease in aerosol extinction with height which is also not justifiable. I suggest the authors remove figure 6a and the related discussion. It should be added that as the authors point out, a scale height of 100 km is at times estimated, which is totally unrealistic. This also goes back to another point, which is the data during the monsoon season is likely contaminated by clouds.
7. Figure 6a. As previously mentioned I suggest showing the plots of Angstrom Exponent for each station along with AOD plots. The low values of AE during the monsoon need to be more clearly discussed with respect to cloud contamination.
8. Page 1204. I think some additional explanation is needed with respect to what the authors mean by radiative forcing in light of the statement 'cirrus-like clouds appear to be more important than aerosols at determining the AOD and the consequent radiative forcing…'. I assume the authors do not mean *anthropogenic* radiative forcing? In general the forcing of interest with respect to aerosols is anthropogenic forcing and it is unclear what the link is between cirrus clouds and aerosols during the monsoon. Hence I am not sure of the utility of this finding.
9. Figure 7. The CALIOP data seems out of place in this paper. It does, once again, highlight the existence of clouds and their potential impact on AOD retrievals. I am not sure the analyses belong in this paper.