Interactive Comments on "Inferring absorbing organic carbon content from AERONET data" by Arola et al., v. 10, p. 18365-18388, 2010

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Arola et al. (2010) retrieved columnar mass concentrations of absorbing organic carbon and organic/black carbon ratio using AERONET Level-2 data and presented their characteristics in biomass burning regions of South-America, urban areas in US and Europe and over other locations in China and India. The main aim of this comment is to clarify findings of the higher absorbing organic content over Kanpur, India which is largely influenced by the emissions from a major coal-fired power plant (Figure 1) located close to Kanpur AERONET site, and not because of the very high biomass burning as suggested by the authors. Infact such biomass burning is not observed at Kanpur and Gandhi College AERONET sites.

Kanpur AERONET station in the Indo-Gangetic Plains is operational as of 22 January 2001 and provides valuable set of data which has been used by Indian and International scientists for deriving local atmospheric aerosol parameters and characteristics and also for comparing aerosol properties with other parts of the world. Kanpur AERONET sunphotometer is located around the outskirts of Kanpur, about 16 km from the main city. Arola et al. (2010) used AERONET data and derived amount of black carbon and amount of light absorbing organic carbon and found higher absorbing organic carbon at Kanpur site with peak values up to 30-35 mg/m^2 during winter season. They further compared their results with the modeled organic carbon by global Oslo CTM for several sites including Kanpur AERONET. Model results were found to be higher than that from AERONET over biomass burning sites while opposite was found in urban sites in India and China. The opposite trend is obvious since Kanpur and China AERONET sites are totally different than the sites close to biomass burning. In the conclusions, Arola et al. (2010) mentioned that the higher OC over northern India, at Kanpur and Gandhi College, is due to very high biomass burning. This conclusion is NOT true, especially for Kanpur which is an industrialized region and not greatly influenced by biomass burning. In northern India, biomass burning (in the form of agricultural crop burning) mostly prevails in the northwestern Indian state of Punjab (Badrinath et al. 2009). This comment is written in order to help Arola et al., (2010) to re-interpret their findings of absorbing OC over Kanpur.

In an earlier paper, Tripathi et al. (2005) first time reported BC measurements over Kanpur from Aethalometer (co-located with AERONET CIMEL sunphotometer) and the higher BC values observed were ascribed to transport of BC from Kanpur city and also due to vehicular emissions. In fact, the BC values measured by Tripathi et al. (2005) at Kanpur AERONET site is largely

influenced by the large emissions from a major Coal-fired thermal power plant which is about 3 km aerial distance from the Kanpur AERONET site (located in Panki). The Panki coal-fired thermal power plant has generation capacity of 210 MW and consumes 2000 tons of coal per day. The coal contains 0.4% Sulphur as an impurity (http://www.cleanairnet.org/caiasia/1412/article-70602.html). Additionally, few brick kilns are also located in the surroundings of the AERONET station. One can see Figure 1 which shows thick smoke plumes emitted from Panki power plant and the brick kilns close to AERONET site, these photographs are taken from AERONET site located at Indian Institute of Technology Kanpur. In our GRL paper (Prasad et al., 2006), we found that the density of power plants is very high in Indo-Gangetic basin and the higher aerosol optical depth over some of the very high capacity power plants is comparable to the major urban cities.

It is difficult to comment about China, but the significant absorbing OC estimated by Arola et al. (2010) from model in Kanpur is very obvious since measured value of BC is found to be higher during winter season (December and January) due to a major power plant in the vicinity of Kanpur site. Especially during winter season, the near-surface wind direction is westerly-south-westerly and as a result the BC measurements are influenced by the Panki power plant emission source. For reference about the wind direction, one can see Tripathi et al., (2006) where they reported predominately westerly-south-westerly near-surface windfield. The OC for Gandhi College is not shown in the paper, it is not clear how they mentioned about OC concentrations over Gandhi College. A plot is needed to support their findings. Again, biomass burning is also not active over Gandhi College during this period. Here authors did not mention the year they considered data for OC retrieval. Number of data points used in the retrieval of OC for the month of October to December should also be mentioned. During winter season (December-January), due to extremely dense foggy conditions, not many data points from AERONET are available in many years.

Singh et al. (2004) reported real and imaginary parts of refractive index and found generally higher imaginary part of refractive index during winter season compared to other seasons. Arola et al (2010) may like to consider refractive indices month to month rather than considering averaged seasonal values. Higher BC concentrations measured in Kanpur which is reported by Tripathi et al., (2005) is mainly due to emissions from Panki coal based thermal plant rather than attributing to biomass burning. Again, agricultural biomass burning is very heavy in the northwestern state of Punjab which is a highly agriculturally productive region (Badarinath et al. 2009). Such biomass burning in Kanpur city is low during winter season. The present comments will help Arola et al. (2010) to rewrite their paper regarding absorbing OC content, particularly over the two sites in India, in the right perspective rather than providing incorrect interpretations associated with biomass burning. Authors are highly recommended to carefully read the work of Singh et al. (2004) and Prasad et al. (2006), and discuss their findings of higher absorbing organic carbon in view of the emissions from the existing Power plant which is close to the

AERONET site rather than giving wrong impression of huge biomass burning in an unrealistic way.

Further, the conclusion drawn by Arola et al. (2010) is only based on the retrieval of OC and OC/BC(or EC) for the month of January, February, September, October, November and December over Kanpur. The OC values vary approximately in the range 7-11mgo/m^2 and OC/BC ratio in the range 2.8 – 3.5 for the months January, February, September and December, only in the month of October and November ratio is found to be 6-7. In a recent paper, (Ram et al., 2010), the authors have found higher OC, EC and OC/BC(or EC) ratio, which are higher in the month of December. As shown by Ram et al. (2010) the OC, EC and OC/EC are quite variable and show complementary nature. Ram and Sarin (2010) have found a strong dependence of EC and OC with significant correlation ($R^2 = 0.72$) at eastern parts of Indo-Gangetic locations (Kanpur and Allahabad) indicating their co-genetic source. For the co-genetic sources of EC and OC they have referred to our GRL paper (Prasad et al. 2006) i.e. coal based emissions that is mainly from Coal based thermal power plants which are highly localized in eastern parts of the Indo-Gangetic plains. The Panki power plant is located very close to Kanpur AERONET station which is the main source for OC and EC (or BC).

Arola et al. (2010) must include detailed analysis of OC and EC and compare their AERONET retrievals with the observed OC and EC values for an entire year, at least for Kanpur AERONET site, since such data are available with one of the coauthors (Tripathi) to support their conclusions about Kanpur and Gandhi College AERONET sites. The main conclusions of Arola et al. (2010) paper is drawn for Kanpur and Gandhi College based on limited observations seem to be rather "unrealistic".

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Figure 1: Figure shows AERONET site and BC measurement site, Panki Coal based thermal power plant and brick kiln close to Kanpur AERONET site is seen. Black enhanced layer is seen clearly during winter time. During winter season higher BC measurement is reported by Tripathi et al. (2005).