

Interactive comment on “Contrasting aerosol trends over South Asia during the last decade based on MODIS observations” by D. G. Kaskaoutis et al.

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General Comments:

Trends in aerosol loading are gaining increased interest due to its importance to global climate change. However, I do not favour the use of satellite data to study trends in aerosols over land due to the large uncertainties involved in the satellite retrieval of aerosol optical depth (AOD) over land. These are attributable to the complex (seasonally and annually changing) surface reflectance patterns, cloud contamination, and aerosol models used in the retrieval methods. The space-based remote sensing of

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aerosols encounters difficulties in retrieving aerosol properties over land. Difficulty in accounting for the changes in surface reflectance as a consequence of land-use changes over a rapidly growing country like India poses another problem for retrieval of optical depths for trend analysis. Zhang et al., GRL, (2005), Kahn et al., JGR (2007), Shi et al., ACPD, (2010), Levy et al., ACPD, (2010) and several others have suggested that one must be wary of mistakenly interpreting noises and biases in satellite aerosol products as legitimate signals in long-term trends analysis. Such studies would also be inundated by calibration issues. Despite the increased proficiency and use of closer-to-realistic models in the retrieval algorithms, several studies have shown that discrepancies still exist between (sensor to sensor) retrieved aerosol optical depths even over ocean regions (see Jeong et al., JGR, 2005). In summary, retrieval of aerosol optical depth over land continues to be a challenge especially over complex terrains such as Himalayan region and plains having large surface heterogeneity (Indo-Gangetic Plains, for example). Ground-based sun photometers (preferably a network such as AERONET established by NASA) and/or in situ measurements of aerosol mass are best suited for such a study.

There have been several publications and reports on aerosol trends over India. A recent review paper by Lawrence and Lelieveld (2010) discusses a figure adapted from an Indian Ocean Experiment (INDOEX) publication (JGR, 2002, Fig. 10). They show that aerosol optical depths over India increase from 0.2 to 0.4 during 1986 to 1999 period based on ground-based sun photometer data. Recently, Moorthy et al., 2009 (WCC-3, Climate Sense, World Meteorological Organization, ISBN 978-92-63-11403-5, 2009) have shown an increasing trend in AOD using data over two decades based on data from a network of sun photometers from India. Zhang and Reid, JGR (2010) reported increasing trend in aerosols over oceanic regions adjacent to Indian subcontinent. Central Pollution Control Board (CPCB), Government of India is executing a nation-wide programme of ambient air quality monitoring known as National Air Quality Monitoring Programme (NAMP). The network consists of 342 monitoring stations covering 127 cities/towns in 26 States and 4 Union Territories of the country. A recent

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report by Ministry of Environment and Forests (MoEF), Government of India (State of Environment, Report, 2009; http://moef.nic.in/soer/2009/SoE%20Report_2009.pdf) using data from these monitoring sites have reported a decreasing trend in particulate mass contraction over several cities while no trend was observed over many other locations. Therefore, reports on decreasing trend in aerosols over India is not a new result.

I am skeptical about the applicability of GOCART data in trend analysis. First of all, comparison of Gocart data over India with measurements show large discrepancies. Secondly, trends in any model output depends on the input used.

In summary, this paper represents only a follow up study. There have been several publications and reports on aerosol trends over India. Large uncertainties involved in aerosol optical depth retrieval over land (which is seasonally changing as well as a function of location) without validation make the conclusions unconvincing.

Specific Comments:

Abstract: The authors state that "The present study shows an evidence of a decreasing AOD550 trend over the densely-populated Indo-Gangetic Plains (IGP) during the period April–September, which has never been reported before". This aspect is already well documented in several reports. See the CPCB report, 2009 (cited in general comments).

Aerosol Optical Depths: In this paper, authors have used MODIS-derived optical depth. Authors should validate the AOD product (2001-2009) using data from ground-based sun photometers, but not limited to just one AERONET site. Earlier studies have showed that difference between MODIS AOD with that measured by ground-based sun photometers over Indo-Gangetic basin is seasonally dependent and also vary from location to location. In this context authors may justify use of satellite data in trend analysis.

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