EGU-2011, April 7, 2011, Vienna, Austria

Relationship between aerosol optical thickness trends and population growth in the Indian subcontinent

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Kishcha, P. , B. Starobinets, O. Kalashnikova, P. Alpert (2011)

AEROSOL OPTICAL THICKNESS TRENDS AND POPULATION GROWTH IN THE INDIAN SUBCONTINENT

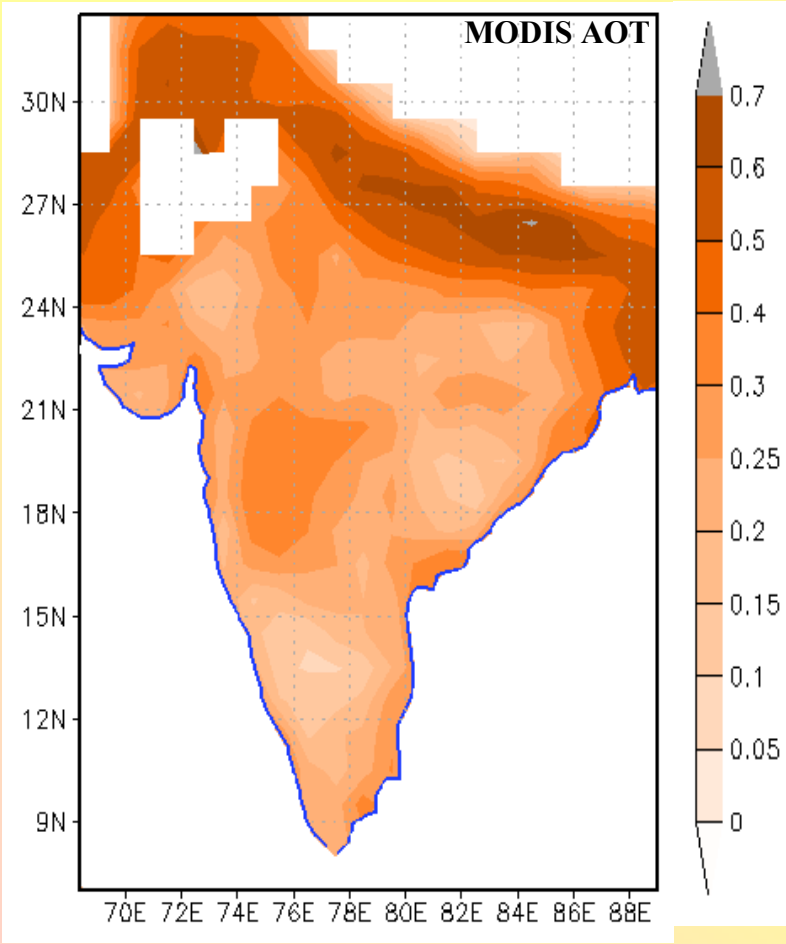
International Journal of Remote Sensing, 2011, in press.

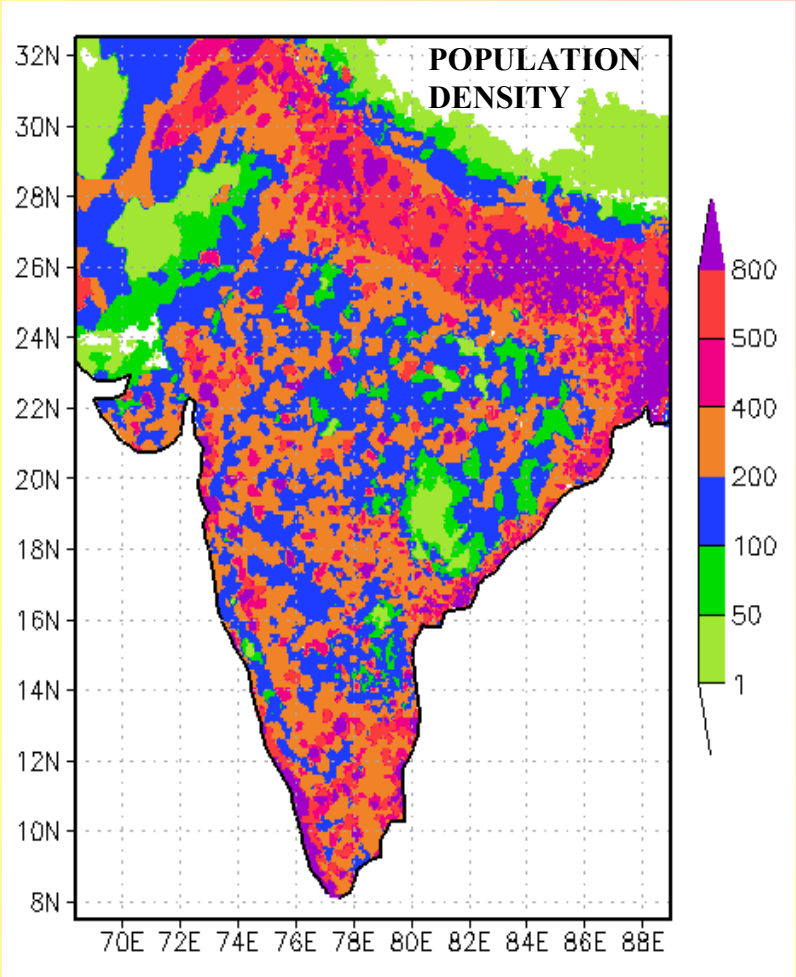
Our paper was aimed at quantifying the effects of urbanization on aerosol optical thickness, averaged separately over regions with differing population densities in the Indian subcontinent.

To estimate the effect of urbanization on aerosol optical thickness, we used AOT averaging over extensive territories of the Indian subcontinent with differing population densities.

Even though, there are some sites without correspondence between population and AOT, however, AOT averaging minimizes their effects on the total dependence of AOT on population density.

Comparison between the 8-year (2000 – 2008) mean distribution of MODIS AOT and that of population density for the months from October to February.





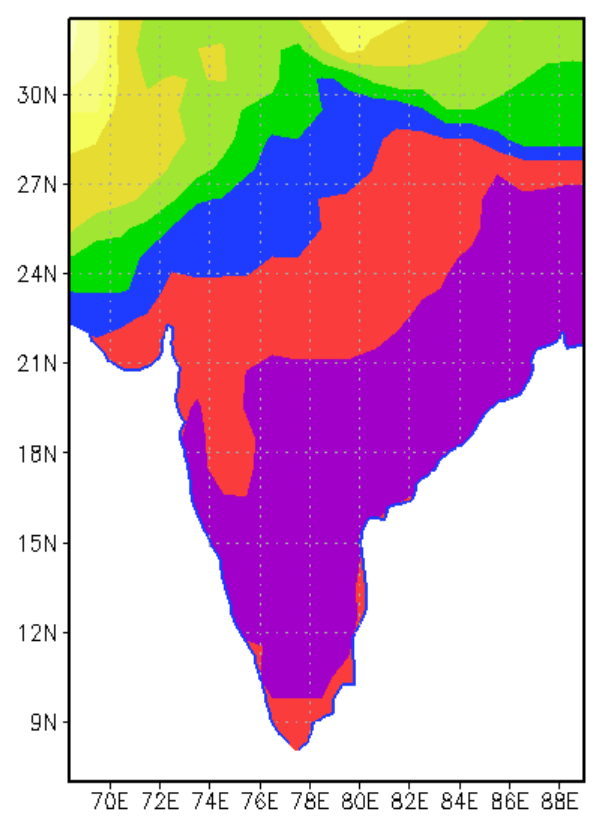
We removed the factors which influence AOT, but do not depend on population density:

These factors are natural aerosols (desert dust); the effects of cloudiness during the monsoon period; and the anomalous precipitation associated with increased wet removal of atmospheric aerosols.

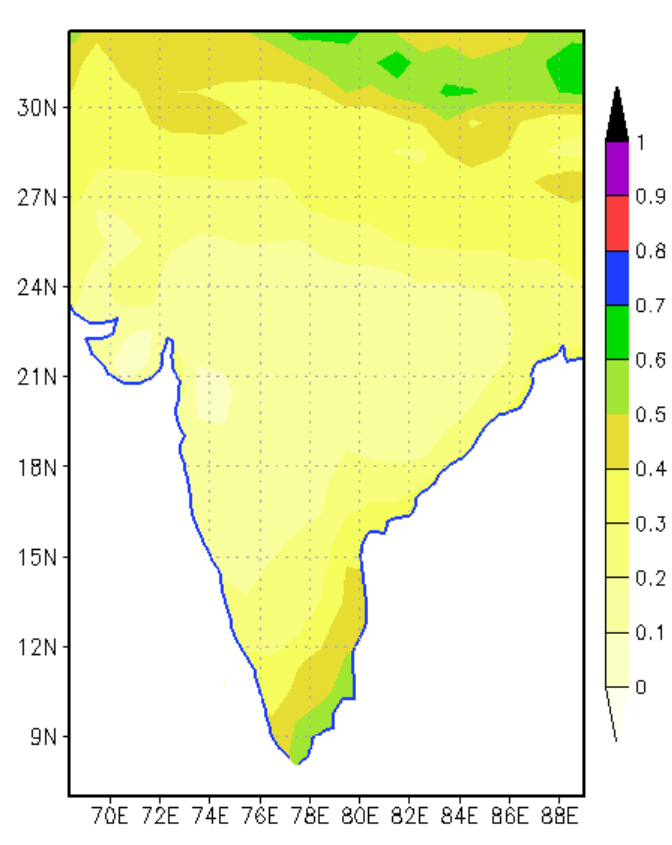
These factors interfere with determining the relationship between AOT associated with anthropogenic activities and population densities; and that between AOT trends and population growth.

The 8-year (2000 – 2008) mean distributions of MODIS cloud fraction

June - August

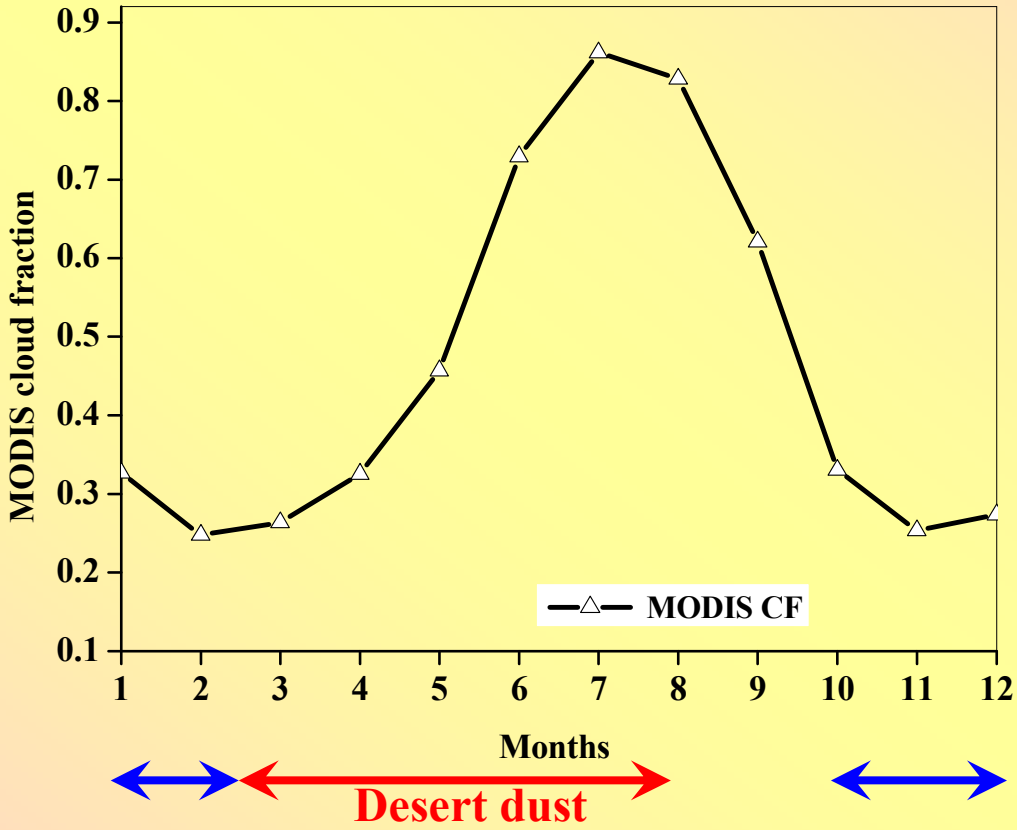


October - February



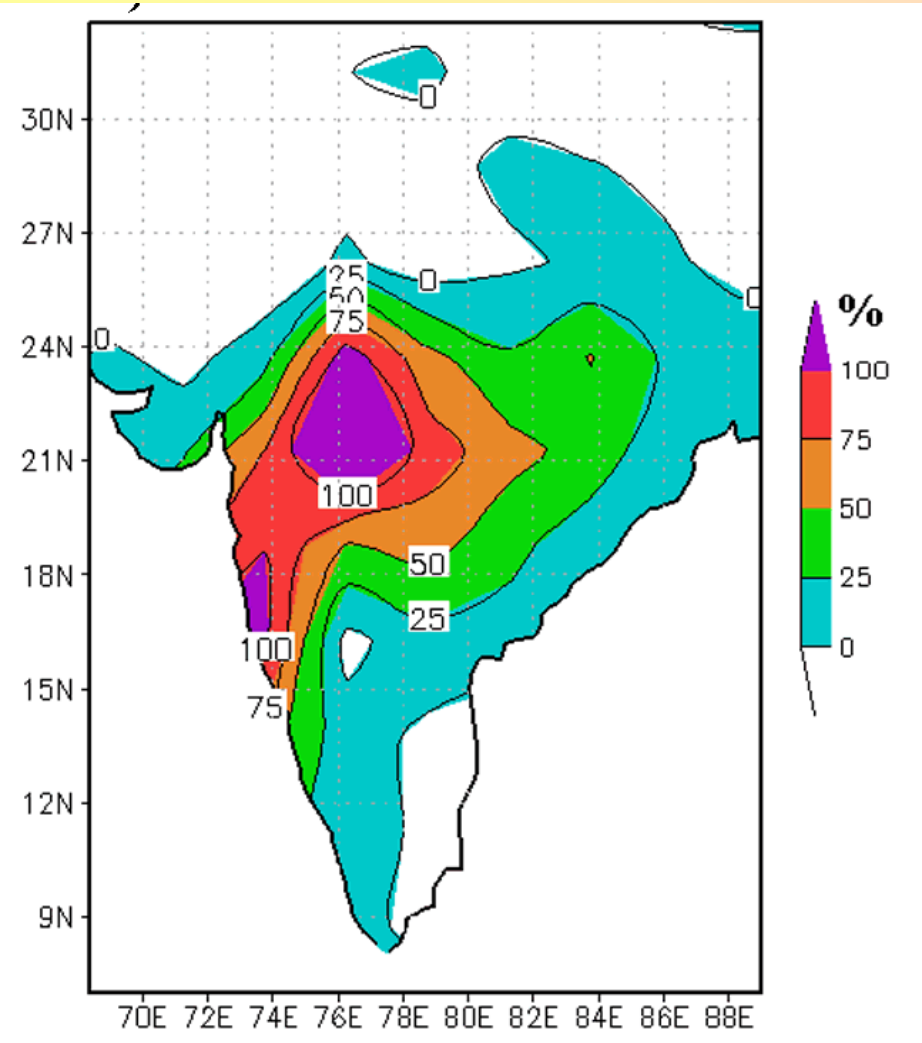
The monsoon season with high cloud presence is unfavorable for studying relationship between population figures and satellite-based AOT

The 8-year (2000 – 2008) average seasonal variation of MODIS cloud fraction over the Indian subcontinent

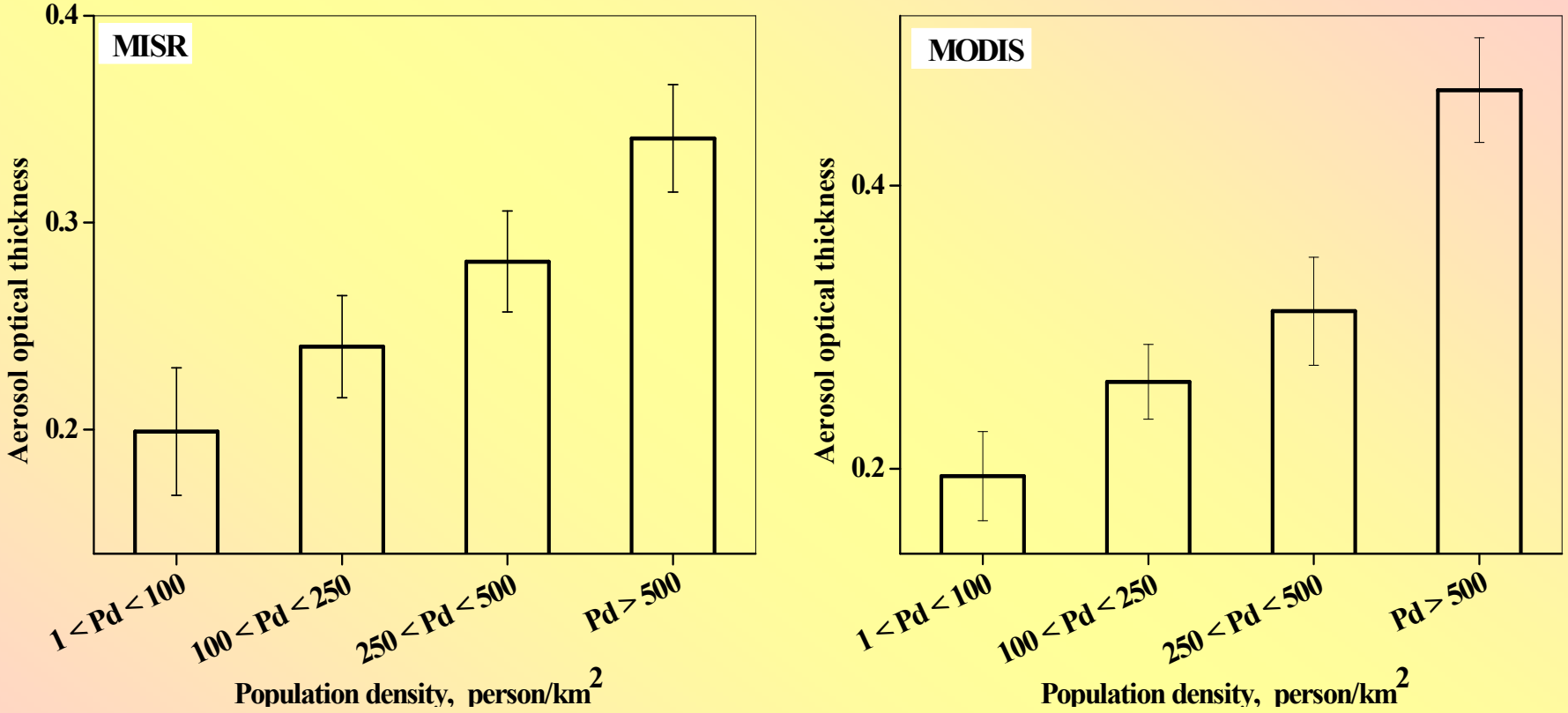


The period from October to February is the favorable season for our study – this is the season with minimal cloud fraction and minimal dust activity.

Spatial distribution of precipitation anomalies (in %) in winter 2005 – 2006, in relation to their corresponding eight-year mean.

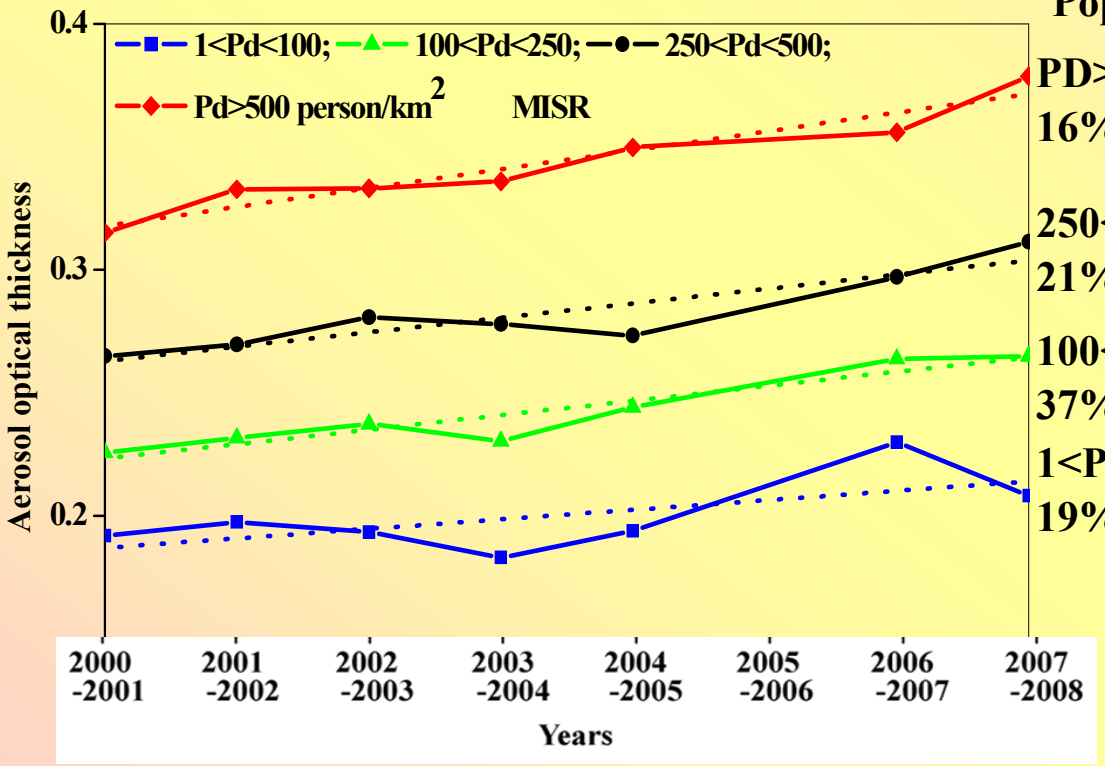


The eight-year (2000 – 2008) mean AOT averaged over the regions with differing population density from October to February



The dependence of AOT on population density is monotonic: an increase in population density is accompanied by an increase in AOT.

The time series of AOT averaged over the regions with differing population density, for the months from October to February – as an indication of the deterioration of air quality.



Pop. Den.	AOT trend	Pop. Den. trend
PD>500; 16% of the territory	2.3 % yr^{-1},	1.4% yr^{-1}
250<PD<500; 21%	2.1 % yr^{-1},	1.5% yr^{-1}
100<PD< 250; 37%	2.5 % yr^{-1},	1.7% yr^{-1}
1<PD<100; 19%	AOT trend is not significant	

Kishcha, P. , B. Starobinets, O. Kalashnikova, C. Long, P. Alpert (2009): VARIATIONS OF MERIDIONAL AEROSOL DISTRIBUTION AND SOLAR DIMMING. *JGR, **114, D00D14, doi:10.1029/2008JD010975***

Kishcha, P. , B. Starobinets, and P. Alpert (2007): LATITUDINAL VARIATIONS OF CLOUD AND AEROSOL OPTICAL THICKNESS TRENDS BASED ON MODIS SATELLITE DATA. *Geophys. Res. Letters*, ***L05810, doi:10.1029/2006GL028796***

Conclusions

1) Over the past decade, despite the significant increase in the world population and air pollution, there is no trend in natural and anthropogenic aerosols over the ocean and remote areas over the land.

2) Over the specified regions in the Indian subcontinent with differing population densities:

(a) the higher the averaged population density – the bigger the averaged AOT,

(b) over more than 70% of the Indian subcontinent, a population growth of ~1.5% yr^{-1} was accompanied by increasing AOT trends of over 2% yr^{-1}.