Aerosol Trends Over South Asia as Detected by MODIS in the Last Decade

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Atmospheric aerosols impact both the regional and global climate through different mechanisms (direct and indirect effects), which are not yet understood and quantified well due to the aerosol short lifetimes, their different types, optical and physico-chemical properties and the mixture processes (external or internal) in the atmosphere. Nowadays, the general belief is that the only way to reduce uncertainties in climate forcing of aerosols is through concerned regional focus. In this perspective the South Asia region with its natural diversity, large population density and complex and seasonally changed climate interactions assumes importance. The present study uses the Moderate Resolution Imaging spectroradiometer's (MODIS) Aerosol Optical Depth at 550 nm (AOD_{550}) data on-board Terra satellite in the period 2000-2009 covering the whole South Asia region (0-30^o N, 58-95^o E) including the Indian sub-continent, Arabian Sea, Bay of Bengal and northern tropical Indian Ocean. The highest aerosol load over the area is observed in the summer monsoon, June to August, exhibiting a mean value of about 0.4, or even more. On the other hand, the local winter, December to February, exhibits the lowest AOD_{550} values, around 0.24. The aerosol load shows an increasing trend over nearly the whole area in the last decade, with the most pronounced increase to be situated in winter where the area averaged AOD_{550} shows an increase of the order of 23% to 40%. On the other hand, in the summer monsoon the AOD_{550} trend is negligible. Large variations are also found regarding the spatial distribution of the aerosol trends. The concurrent influence of natural and anthropogenic aerosols on the aerosol load, the black carbon emissions over the densely populated areas as well as the long-range transport of the continental aerosols over the adjoining oceanic areas constitute the main problems in understanding the anthropogenic impact on the increased aerosol trends. However, more detailed analysis of the trends of aerosols over main source regions (e.g. Indo-Gangetic Plains) and over the downwind oceanic areas would reveal the anthropogenic influence, which highly differentiates depending on season, emission strengths and removal, mainly wet deposition, processes.