

**Inferring Aerosol-Cloud Interactions over the Indian subcontinent
during winter 2000-2005 using MODIS data**

Ritesh Gautam

Center for Earth Observing and Space Research
School of Computational Sciences
George Mason University
Fairfax, VA 22030

Mentor: Dr. N. Christina Hsu

Climate and Radiation Branch, Code 613.2
NASA/Goddard Space Flight Center
Greenbelt, MD 20771

Abstract

The pollution level in the South Asian region has increased considerably over the years due to the growing population, urbanization and industrialization with its pronounced effects on weather and climatic conditions around this region. In this paper, a detailed analysis of aerosol and cloud microphysical properties obtained from MODerate resolution Imaging Spectroradiometer (MODIS) data over the Indian subcontinent has been carried out for the period 2000-2005. High aerosol optical depth (AOD) persists over the northern part of India throughout the year with dust particles (coarse mode) dominating during summer season while urban/industrial emissions and other sources of pollutants (fine mode) present in other seasons. The Indo-Gangetic (IG) basin in the northern part of India is characterized by dense haze, fog and smog during winter months and builds the central theme of this paper. In order to detect the formation of fog, climatologies of different cloud microphysical properties were analyzed indicating the

presence of fog formation over the IG basin with distinct characteristics (Cloud effective radius <14 microns, Cloud Top Pressure ~900 mb, High Cloud Fraction). Diurnal variations from Terra and Aqua along with radiosonding observations further confirm the presence of fog. Significant changes in spatial variability of fog were found in direct accordance with changes in aerosol concentration and distribution of black carbon (BC) aerosol optical depth over the IG basin.

1. Introduction

The Asian continent is the world's largest living habitat with about 60% of the world's population. The South Asian region, especially, has been undergoing high transformations in the urban and industry sectors, due to the growing population and globalization. India and China are the two most populated and developing nations in the world and contribute heavily towards the pollution pool over Asia. *Guttikunda et al.* [2003] studied the contribution of megacities to sulfur emission and pollution in Asia over a 25-year period (1975–2000) and found that Asian megacities cover <2% of the land area, but emit ~16% of the total anthropogenic sulfur emission of Asia. Percentage increase in the SO₂ emissions in India has been reported to be 47% per decade during 1979-2000 and is attributed to the increased population over the years [*Massie et al.*, 2004]. A recent study has shown that the bio-fuel combustion is the largest source of black carbon emissions in India, and suggests that it needs to be addressed for climate change mitigation in the south Asian region [*Venkataraman et al.*, 2005]. Other major sources of aerosol in this region are smoke from biomass burning and severe dust storms that this region faces on a seasonal basis.