Atmospheric aerosols are intricately linked to the earth's climate and it is now well recognized that they are crucial elements in "climate change". They perturb the radiative balance of the earth-atmosphere system by directly scattering and absorbing the solar short wave and the terrestrial long wave radiation and indirectly through modifying the optical properties and life span of clouds.

On a global basis, about 90% of the aerosol loading is caused primarily by the natural sources, mainly consisting of sea-salt and dust. The rest of the aerosol burden is contributed by anthropogenic activities such as industrial and vehicular emissions, forest fire, bio-mass burning, fossil fuel combustion etc. This diversity in the sources leads to pronounced variation in their physical and chemical properties. Large spatial heterogeneity of sources and their temporal non-uniformity along with the short residence time (typically few days in the troposphere), of aerosols leads to pronounced spatio-temporal variations in their distribution. Long-range transport is another important factor that influences the spatio-temporal variability. These heterogeneities in the aerosol distribution and properties challenge the quantification of their impact on the climate system.

Satellite remote sensing is an ideal tool for the regular monitoring of the global distribution of aerosols. Launch of new satellite-borne sensors with enhanced capabilities in the recent years brought a revolution in the understanding of global aerosol distribution and their long range transport. The multi-spectral satellite sensor, "MODIS" is a unique instrument capable of synoptic scale monitoring of aerosols with fine spatial resolution, on a daily basis. In order to assess the aerosol variations due to source and transport activities, NCEP reanalysis is a reliable source of prevailing meteorology and dynamics in the earth-atmosphere system.

In the present study, an attempt is made to investigate the transport dynamics of aerosols at different geographical environments over the Indian sub-
continent and the adjoining oceanic regions, mainly by using aerosol data from MODIS and reanalysis winds from NCEP. The study also aims to identify the sources of aerosols and estimate their strengths, using an aerosol flux continuity equation. This theme presented in the thesis opens up a distinct phase in the study of aerosols.

The thesis is organized in seven chapters. Chapter 1 outlines an overview on the atmospheric aerosols with emphasis on the importance of studies on aerosol transport. A review on the space-borne aerosol remote sensing and their advantage in addressing the transport dynamics of aerosols are discussed in this chapter. The specification details of MODIS sensor, a brief description on MODIS aerosol retrieval algorithm and a summary of the NCEP reanalysis data are presented in Chapter 2. This is followed by brief accounts on other instruments additionally used in the present study. The mathematical approaches adopted for the analysis of aerosol transport dynamics and for the estimation of aerosol source strength using the flux continuity equation are also detailed in this chapter.

Chapter 3 discusses the transport features of aerosols over the Ganga Basin in the winter period (December, 2004), when ISRO-GBP Land Campaign –II was conducted in this region. This study reveals the association between day-to-day changes in the spatial distribution of AOD and wind convergence at lower altitude (below 1 km) over the Ganga Basin. The aerosol flux continuity equation is used to identify the major sources prevailing in this region.

In Chapter 4 the aerosol transport dynamics over the South East Arabian Sea (SEAS) during the pre-monsoon period (ARMEX-II campaign, March 14-April 10, 2003) is presented. The observed day-to-day variation of AOD in the cruise is connected to the day-to-day changes in the spatial distribution of aerosols over the SEAS. AOD data from MODIS is used for this purpose. The role of atmospheric circulation variables and relative humidity in the spatio-temporal variations of aerosol distribution are examined in detail in this chapter.
The transport dynamics of aerosols over the Bay of Bengal (BoB) during the pre-monsoon period (first phase of ICARB, March 18 – April 12, 2006) is detailed in Chapter 5. Wind field variables at different altitudes are analysed to establish the transport mechanism of aerosols over the BoB during this period. The influence of flux convergence and flux vorticity in governing the day-to-day variation of mean AOD over the BoB especially through the higher altitudes winds (above 3 km), is brought out clearly in this chapter. Computations with the flux continuity equation show weak sources of aerosols over the BoB at the locations of moderately high surface wind speeds.

A detailed analysis of the aerosol transport over the Arabian Sea during the pre-monsoon period (second phase of ICARB, April 18 – May 11, 2006) is presented in Chapter 6. Wind field variables are examined to delineate the processes which are responsible for the observed spatial variation of AOD over the Arabian Sea. The mechanism governing an episodic event marked by the appearance of an aerosol cluster off the Maharashtra coast, its southward movement along the Indian west coast and its final dispersal after reaching the southern end of Indian peninsula, is studied in detail. This chapter also brings out the influence of flux convergence at an upper level (~ 3 km) on the day-to-day variations of AOD over the Arabian Sea.

The major findings in the work presented are summarized in Chapter 7. This chapter also outlines the future scope of research in the field of aerosol transport dynamics.