Abstract

Intercontinental transport of air pollution is a global issue as the air quality of a region can be highly influenced by long range transport from remote continents. Pollutants with longer atmospheric life times are important when assessing the impacts of long range transport, but shorter lived air pollutants that produce secondary pollutants are also important. Tropospheric ozone ($O_3$) is a secondary pollutant produced through a sequence of photochemical reactions involving nitrogen oxides ($NO_x$), carbon monoxide (CO), volatile organic compounds (VOCs) and $CH_4$. South Asia is not only one of the major developing industrial regions but also the most populated region in the world. The significance of intercontinental transport study is to achieve environmental policy objectives in the future due to variation in the magnitude and spatial distribution of emissions. There are several observation and model based studies which show the impact of foreign emission on countries at Northern mid-latitudes but detailed study of Intercontinental transport of pollutants over South Asia, its impact on other receptor regions and its seasonal variability is an open field of research which need to be explored further, This is the broad objective of this Ph.D. Thesis.

Chapter 1 contains a basic introduction of continental transport of pollution. Importance of ozone in the study of long range transport of pollution is included here. The major meteorological pathways of continental transport and the objective of the thesis are attained in this chapter.

Chapter 2 describes the methodology adopted with a detailed description of fourteen HTAP models. Beside the model outputs satellite data and surface observation over four Indian station are also used for this study. The population
density data from SocioEconomic Data And Application Centre (SEDAC) for the year 2000 is taken to study the population impact. NCEP/NCAR reanalysis, ECMWF/ERA-Interim reanalysis wind data is used to describe the meteorological conditions.

**Chapter 3** discuss about the inter-comparison of model simulation with satellite data and ground observations of ozone and its precursors over the South Asian region. The performance of the models also has been validated over four stations in India. The model simulations reproduce the seasonal cycle of surface $O_3$ concentration over the locations, but are substantially higher by 10-20 ppbv. The seasonal cycle of TTCO generated by the models over SA is comparable with satellite observations.

**Chapter 4** describes the seasonal variation of ozone and its precursors over South Asia due to reduction of its own emission under HTAP Emission Scenario phase 1. HTAP defined a set of emission perturbation experiment to compare model estimates of how emission changes in one region of world impact the air quality. When the emission over South Asia(source) is reduced, the maximum effect is seen at the surface. The variation in the magnitude and spatial distribution in surface ozone over south Asia due to emission reduction is mainly controlled by the concentrations of precursors.

**Chapter 5** deals with the effect of pollution transport between East Asia and south Asia. To find the foreign influence on regional air quality the difference between the control simulations and those with 20% emission reductions over a given source region is analyzed. The reduction in $O_3$ and its precursors over the receptor region shows how much emission from that source region influences it. The prevailing circulation patterns change its direction over the seasons in this region. So to explain the seasonal variation of foreign emission the wind fields are analyzed. To provide a more relevant assessment of the effects on human health, the population-weighted $O_3$ change over each of the receptor regions is also presented in this chapter.
Chapter 6 discuss the transport of pollutant between Europe and South Asia. The contribution of south Asian emission over the surface of Europe is effectively low. But the effect of south Asian pollutant can be seen at higher altitude over Europe due to convective activity over south Asian region. The transport of pollutant from Europe mainly occurs due to horizontal advection, so the effect of European pollution over South Asia is mainly along the surface. The pollution coming from European region joins the monsoonal flow in the Arabian Sea branch so there is an increase in European contribution over South Asia in monsoon season.

Chapter 7 Major finding of the thesis is summarized in this chapter. The scope of further research is also discussed in this chapter.