



Long Term Association of Tropospheric Trace gases over Pakistan by exploiting satellite observations and development of Econometric Regression based Model

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Air pollution is the expected key environmental issue of Pakistan as it is ranked among top polluted countries in the region. Ongoing rapid economic growth without any adequate measures is leading to worst air quality over time. The study aims to monitor long term atmospheric composition and association of trace gases over Pakistan. Tropospheric concentrations of CO, TOC, NO₂ and HCHO derived from multiple satellite instruments are used for study from year 2005 to 2014. The study will provide first database for tropospheric trace gases over Pakistan. Spatio-temporal assessment identified hotspots and possible sources of trace gases over the Pakistan. High concentrations of trace gases are mainly observed over Punjab region, which may be attributed to its metropolitan importance. It is the major agricultural, industrialized and urbanized (nearly 60 % of the Pakistan's population) sector of the country. The expected sources are the agricultural fires, biomass/fossil fuel burning for heating purposes, urbanization, industrialization and meteorological variations. Seasonal variability is observed to explore seasonal patterns over the decade. Well defined seasonal cycles of trace gases are observed over the whole study period. The observed seasonal patterns also showed some noteworthy association among trace gases, which is further explored by different statistical tests. Seasonal Mann Kendall test is applied to test the significance of trend in series whereas correlation is carried out to measure the strength of association among trace gases. Strong correlation is observed for trace gases especially between CO and TOC. Partial Mann Kendall test is used to ideally identify the impact of each covariate on long term trend of CO and TOC by partialling out each correlating trace gas (covariate). It is observed that TOC, NO₂ and HCHO has significant impact on long term trend of CO whereas, TOC critically depends on NO₂ concentrations for long term increase over the region. Furthermore to explore causal relation, regression analysis is employed to estimate model for CO and TOC. This model numerically estimated the long term association of trace gases over the region.