Recent Research in Science and Technology 2010, 2(3): 28–31
ISSN: 2076-5061
www.recent-science.com

PHYSICS

VARIATION OF CO COLUMN OVER NORTH KERALA BY EXPLORING MOPITT DATA

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Abstract
Carbon Monoxide (CO) is one of the prominent pollutant species mainly produced from of fossil fuel burning and motor vehicles. Being a toxic trace gas, it can considerably affect human health. The rapid increase in CO enhances the production of surface ozone which contributes to global warming. This is the first attempt to retrieve the increase in CO over a column of atmosphere up to 100 mb pressure from the surface using MOPITT version 3 of level 2 data. The increase in column abundance of CO observed is correlated with the increase in vehicles in this region and it gives a positive correlation for the four years of observation from 2004. The prominence of this location of north Kerala is that no major industries are sited within this region and the increase in pollution is solely due to anthropogenic activities.

Key Words: CO, MOPITT, Air Pollution, Vehicles.

Introduction
Atmospheric CO is an important trace constituent as it plays a critical role in determining the oxidizing capacity of the atmosphere through its reaction with the OH radical. It is a primary component of biomass burning products and is also emitted by various anthropological activities.CO has been measured at a network of ground stations as well as from aircraft [Novelli et al., 1998]. In the last few years, global measurements of CO have been carried out by the MOPITT mission [Drummond and Mand, 1996]. With its lifetime of a few weeks to 2 months, CO is a good tracer of vertical transport. Increase of CO in the troposphere will lead to the enhancement of ozone concentration in the troposphere and this will further contribute to global warming and climate change. The variation of CO is vital because its budget provides a fingerprint of anthropogenic activities like biomass burning and increase in motor vehicles. Thus the trend of CO is a vital element in retrieving the chemistry of the atmosphere. The data retrieved from MOPITT are of good quality and extensive amount of research programmes are being pursued globally.

Here we make an attempt to study the variation of CO over the northern part of Kerala by retrieving the MOPITT data obtained from NCAR, USA for a span of five years from 2004. The increasing trend of CO is reported for the first time over this region which could be correlated with the increase in vehicles during this period.

Method
MOPITT is on board the Terra spacecraft and is flying in a sun synchronous polar orbit with an altitude of 705 km. Measurements of upwelling infra red radiation are performed in nadir view with a near global coverage within three days. CO vertical profiles (on 7 altitude levels) and total columns are retrieved from the radiance data with a horizontal resolution of 22 x 22 km^2.

MOPITT is equipped with gas correlation radiometers incorporating both length modulation and pressure modulation cells operating in two distinct spectral bands: the near-infrared (NIR) CO overtone band near 2.3 μm and the thermal-infrared (TIR) fundamental band near 4.7 μm. Conceptually, the NIR observations sense the attenuation (by CO molecules) of solar radiation reflected from the Earth's surface to the MOPITT instrument, whereas the TIR observations detect CO signatures in thermally emitted radiation from the Earth's surface and atmosphere. In principle, the NIR radiances provide information with respect to the CO total column with very weak sensitivity to the vertical distribution of CO whereas the TIR radiances are sensitive to differences in CO concentrations over broad layers in the troposphere. Over land, where the surface reflectance and hence NIR radiances are relatively high, the NIR radiances should provide more consistent sensitivity to CO in the lower troposphere than the TIR radiances, which are sensitive to lower tropospheric CO only in favorable thermal contrast conditions.

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The column (1000mb-100mb) abundance of CO is over North Kerala comprising of Kasaragod and Kannur districts retrieved from MOPITT data for a period of five years from 2004 to November 2009 and its monthly variations are recorded from the website (http://eosweb.larc.nasa.gov/PRODOCS /mopitt/table_mopitt.) and depicted in Fig.1. It is observed from the graph that the column abundances show an increase over the years.

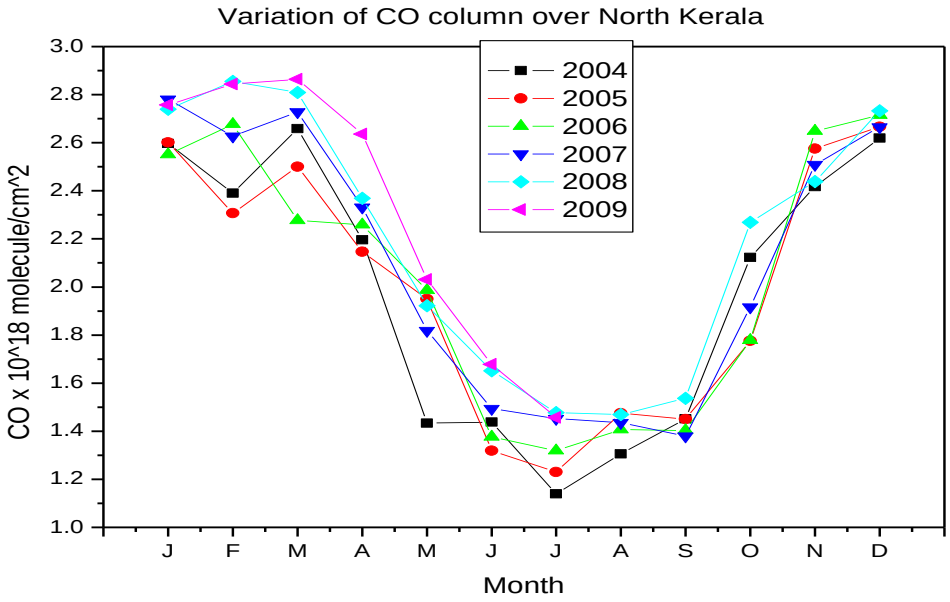

Figure 1. MOPPTT retrieval of CO column variations over North Kerala

It is further observed that the CO column abundance becomes maximum during January-March and November-December and minimum during June-September at all years of observation. The increase in CO is mainly attributed to the emissions from motor vehicles and enhanced industrial activities. The fall of CO abundance is mainly due to the intense south-west monsoon rainfall at this location. The rain fall produces OH radicals in plenty which clean the atmosphere to decrease the amount of CO. Since the humidity in the atmosphere is found to be less during November-December, as shown in Fig. 2, the amount of OH radicals also will be decreased.

This reduction in the abundance of OH radicals in the atmosphere would increase the CO column. The most remarkable feature of the observation is that the CO column abundance has an increasing trend over the years. Table 1 shows the cross sectional concentrations retrieved from the MOPITT data and the increase in number of vehicles during these years.

Table 1. Year wise increase of vehicles and CO in this location

Year	Percentage of increase in number of vehicles	Increase in CO column (10^{18}molecules/cm^2)	Percentage of increase in CO column
2004	9.4	1.980	0.95
2005	11.82	1.999	1.70
2006	12.06	2.033	3.07
2007	13	2.094	4.54
2008	10.4	2.189	

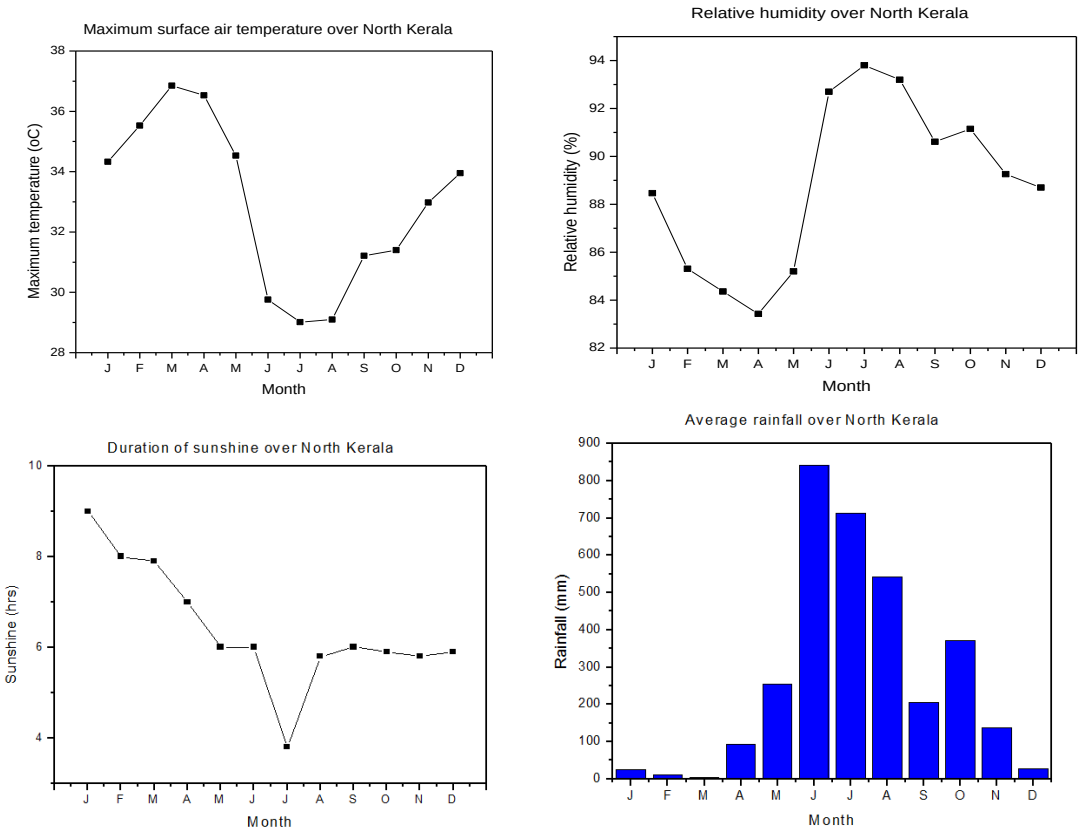

Figure 2. Average monthly variations of maximum surface temperature, sunshine, relative humidity and rainfall recorded in North Kerala.

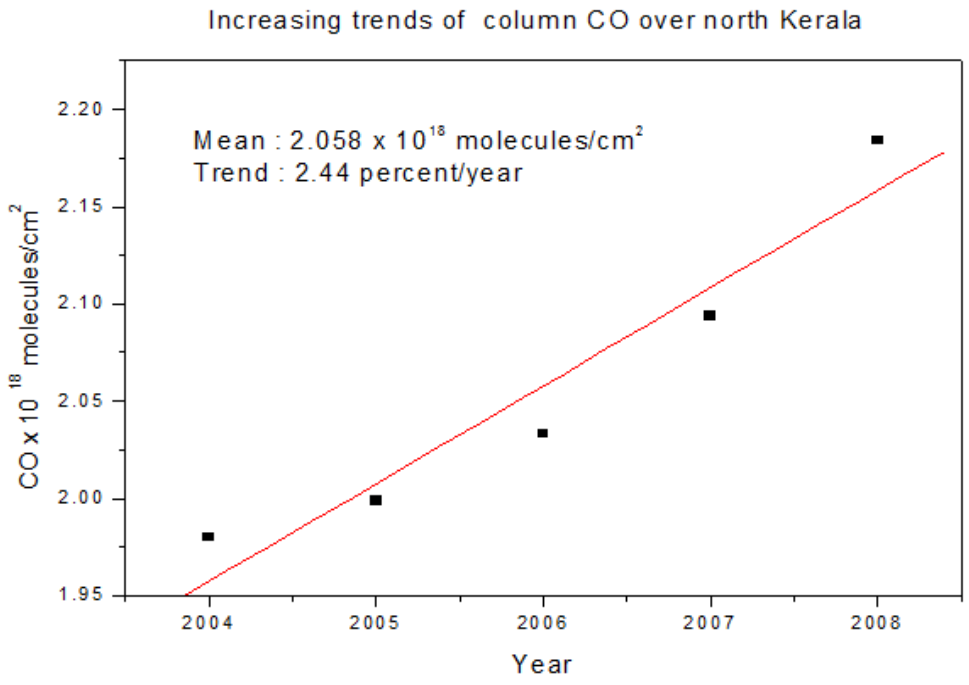

Figure 3. Increasing trend of CO column over North Kerala

Thus the increase in CO is mainly attributed to the increase in the motor vehicles during this period of time and this data is collected from the Motor Vehicles Department of Kerala at this location because the industrial activities are more or less the same (Satheesh Kumar, 2009). The trend of CO is calculated by incorporating a data fit and it is shown in Fig.3.

Conclusion

CO column abundance over North Kerala is recorded for the past few years and it is observed that CO column has an increasing trend over the past few years. From the analysis it is evaluated an increasing trend of 2.44 percentage per year which is in good agreement with the increased number of vehicles (KVS Badarinath, 2009, R P Singh, 2007). Being CO is a strong greenhouse gas, this rapid increase in the amount of CO would certainly contribute to elevate the surface temperature in the days to come.

Acknowledgement

This programme is carried out under the consistent financial support of ISRO-GBP through their AT-CTM programme. The authors express their thanks to Kannur University for providing all support to materialise this work. They wish to register their thanks to NCAR, USA for their valuable advice in providing the retrieval algorithm for MOPITT data. The authors express their sincere gratitude to Motor Vehicle Department of Kerala for providing the statistics of vehicles registration. One of authors (MKS) is highly indebted to Department of Higher Education, Govt. of Kerala for granting a deputation to Kannur University to carry out this work.

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