

Carbon Dioxide Estimation in Ambient Air of Udaipur Region

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ABSTRACT: Most of the cities across the world are considered as major anthropogenic sources of green house gases. Till now many efforts has been made to analyse ambient concentration of carbon dioxide in cities across the world, but a very few in developing country especially like India². In the present study, an attempt was made to monitor CO₂ level in ambient air of Udaipur city in the summer, winter and monsoon seasons during the year 2016. The sites taken for analysis were industrial area, institutional area, high traffic area and residential area. Other than these sites, the observations taken by Mauna Loa Observatory was taken for comparison of polluted sites in Udaipur. As the Mauna Loa Observatory is considered as a pollution free place and a representative of global average CO₂ concentration, it was taken as the control site. By this study it is concluded that the industrialization and vehicular emissions are playing a major role in contributing to the mounting concentrations of green house gas Carbon dioxide in Udaipur region. It is suggested to adapt certain CO₂ mitigation technologies such as Carbon Capture and Storage for reduction in emissions of green house gases.

KEYWORDS: Green House Gases, Anthropogenic sources, Ambient Air, CO₂ concentration, CO₂ mitigation.

I. INTRODUCTION

Carbon dioxide (CO₂) is an important trace gas in Earth's atmosphere currently constituting about 0.04%, i.e. 400 parts per million (ppm), of the atmosphere. In the Earth's atmosphere, CO₂ is a greenhouse gas, which means it traps heat. This "greenhouse effect" naturally helps to keep the Earth's temperature at a level that can support life on the planet. Despite it is present in very small concentration, it plays a vital role in regulating Earth's surface temperature through radiative forcing and the greenhouse effect. It is produced naturally when dead animals or plants decay, and it is used by plants during photosynthesis. People are adding carbon dioxide into the atmosphere, mostly by burning fossil fuels such as coal, oil, and natural gas. This extra carbon dioxide is the main cause of climate change. This extra CO₂ is being added to the atmosphere faster than natural processes can remove it, causing the atmosphere to trap more heat and causing the Earth's average temperature to rise. Scientists have found that the recent levels of CO₂ in the atmosphere are abnormally high compared with the long-term historical trend, and these levels are continuing to increase at an unprecedented rate. The current episode of global warming is attributed to increasing emissions of CO₂ and other greenhouse gases into Earth's atmosphere.

The Mauna Loa Observatory is one of the sites that have helped scientists determine that CO₂ levels in the atmosphere have increased significantly in recent decades and that these levels are continuing to rise at a rapid rate. CO₂ stays in the atmosphere for long enough that it is able to spread fairly evenly around the world, so even measurements from a single site (like Mauna Loa) can be the representative of global average CO₂ concentrations.

Paper is organized as follows. Section II describes materials and method under which, the study area is described and details of instrument is mentioned with the methodology used. In Section III experimental results are shown including table and graph showing peaks of different sites seasonally. Finally, Section V presents conclusion.

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II. MATERIALS AND METHOD

Study area

1. **Udaipur:** Udaipur district is situated over Aravali hills in the South eastern part of Rajasthan. Udaipur is located between latitude 24°35'N to 24°58'N and longitude 73°41'E to 73°68'E. It has an average elevation of 598 m above sea level. The city has witnessed considerable population growth in the last four decades while acting as a magnet city for the surrounding region. The growing economy and growing tourism sector have attracted both urban as well as rural populace. Udaipur has a semi-arid climate, which prevails over most of the year. It has a hot dry summer and bracing cold winter. The cold season is generally from November to February and is followed by the summer season from March to June. The southwest monsoon follows from last week of June to the mid September.
2. **Mauna Loa Observatory:** The Mauna Loa Observatory (MLO) is located at 19.54° latitude, -155.58° longitude and 3400 m above sea level. Carbon dioxide concentrations, in units of 'parts per million'.(ppm) have been measured daily and monthly averages reported, since 1958. The air at MLO is believed to be relatively free of pollutants, and assumed representative of air in the Northern Hemisphere. In the opinion of some, the general increase in CO₂ concentration to be due to the combustion of fossil fuels and deforestation.

Instruments

1. **Portable CO₂ monitor:** To assess the CO₂ concentration in ambient air , portable CO₂ monitor was used. Model CDM 901 was developed by Rave Innovations in Noida. This monitor is ideal for field use as it is small in size. The analyzer is provided with sensor probe, graphics LCD etc. It works on the principle of Non-Dispersive Infra-Red technology provided with range 0-10% and resolution 1% of the full scale. This instrument measures the concentration of CO₂ in the provided time period, for this purpose an option of recording is available from 1-30 minutes. It operates on battery and hence has a power port to connect the charger. It display concentration in % and ppm both. It also measures relative humidity and atmospheric temperature at the same time. This monitor can be connected to a computer and gives reading in excel sheet and hence consist of s a USB port also.

Method

The study was carried out for the year 2016. The data was collected for three seasons i.e winter (November, December, January); summer (April, May, June); monsoon (July, August September) from the selected sites of Udaipur city i.e industrial area, heavy traffic area, institutional area and residential area. The CO₂ monitor was brought to the sampling sites and the concentration was measured thrice per month to get the average reading of each month. Afterwards all the three months data were analysed and the average concentration for each month was given in result.

III. EXPERIMENTAL RESULTS

As shown in Table no.1 and fig no.1, if we compare all the sampling sites in one season, the maximum CO₂ concentration was observed in Industrial area i.e. 418 ppm, this may be due to high industrial emissions and heavy vehicle transport. There was heavy density of loading vehicles like trucks and huge vehicles in the area, it might be the reason for high CO₂ concentration. The lowest concentration was found to be in residential area 318 ppm as there was more vegetation than other sampling sites and less vehicular emissions. The institutional area and heavy traffic area was having 325 and 390 ppm respectively. If we see compare all of the concentrations from Mauna Loa Observatory observations it is clear that the Udaipur region has not much of the carbon dioxide concentration except industrial area. The difference in the locations, in respect of altitude, of both the area might be reason for the major variation in concentration¹².

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When we look at the seasonal readings, the maximum concentration was found in summer (e.g. for industrial site) 418 ppm as compared to winter 417 ppm and monsoon 415 ppm. According to similar findings by other scientists⁹, the maximum CO₂ concentration was found to be in winters than in warmer months due to increase in photosynthetic activities, but if we look at the CO₂ concentrations in Udaipur region, the maximum concentration was found to be in summer season than in monsoon and least in winters. The reason for this variation compared to other places must be the geographic location of Udaipur. As we know Udaipur is a semi-arid zone, during summers the maximum temperature in reaches to 47°C. Strong heat waves and high temperature of this region is a factor that reduces the density of vegetation during summer in comparison to other seasons. The loss of vegetation cover is the major factor for reduction in photosynthetic activity. Aravali hills in Udaipur region is rich in biodiversity mostly vegetation, but during summer seasons when the temperature reaches more than 45°C, the incidences of fire in vegetation is also increased which burns all the vegetation of one hill at a time. These activities are very frequent in summer season. When we observe monsoon and winter season the vegetation cover is increased due to availability of favorable conditions for plants to grow, increasing the average vegetation cover compared to summer. This can be a reason for more photosynthetic activity in monsoon and winter and low CO₂ concentration.

According to some authors, CO₂ in the atmosphere decreases during the growing season and increases during rest of the year, which leads to maximum buildup in April and May before photosynthesis begins to take over again. Photosynthesis, in which plants take up CO₂ from the atmosphere and release oxygen, dominates during the growing season (the warmer part of the year). Respiration, by which plants and animals take up oxygen and release CO₂, occurs all the time but dominates during the colder months of the year^{[1] [2] [4]}. But in this study we found the reverse CO₂ concentrations.

Table No.1

Sampling site	CO ₂ concentration in PPM		
	Summer	Winter	Monsoon
Institutional area	325	323	324
Heavy traffic area	390	387	389
Industrial area	418	415	417
Residential area	318	315	316
Mauna Loa Observatory	407	402	403

The above table describes the CO₂ concentration at all the sampling sites including the control site i.e. Mauna Loa Observatory of 3 seasons. It was observed that all the sites had highest concentration in summer season and least in winter.

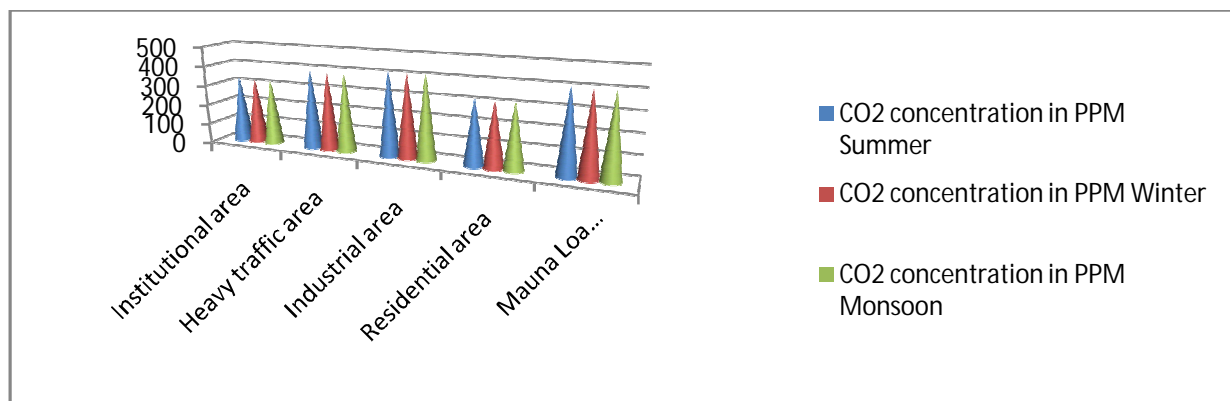


Fig No.1 Showing CO₂ concentrations in PPM at five sampling sites of Udaipur Region.

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The above graph shows the peaks of CO₂ concentration in industrial area and lowest at residential area. Mauna Loa observatory also has greater CO₂ concentration in comparison to residential, institutional and heavy traffic sampling sites.

IV. CONCLUSION

From the present study it has been concluded that CO₂ concentrations in the ambient air of Udaipur region varied seasonally, as compared to other regions of the world. The semi-arid type of climate and low vegetation cover in summer season was found to be the major factor for decrease in average photosynthetic activity and hence, the high CO₂ concentration than in other seasons. Only industrial site was observed to have high CO₂ concentration in all the seasons compared to other sites. It is suggested to adapt certain CO₂ mitigation technologies such as Carbon capture and storage (CCS) techniques and more plantations in the industrial area to reduce CO₂ concentration from atmosphere

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