Monitoring Of Carbon Dioxide (CO_2) and Methane (CH_4) From Four Locations in the Densely Populated Kuwait City in the State of Kuwait

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***Abstract*---**The hourly CO_2 and CH_4 concentration measured at four air monitoring stations (AL-Mansoria, Al-Reqqa, Um-Alheman, and AL-Jahra) of EPA-Kuwait for a period of two years (2008-2009) were analyzed. The objectives of this study were to investigate diurnal, seasonal, and annual variations, and indentify possible spatial and temporal trends in CO_2 and CH_4 concentrations. It was observed that the monthly average CO_2 concentration for the year 2009 is higher than that of 2008 for the months of January through June. As For CH_4, the data showed that, on average, 2008 was significantly greater than that of 2009. With respect to seasonal effect, we found that the CO_2 concentration is lower in summer season in most stations, as compared to winter season. The seasonal variations among locations for CH_4 did not show any notable trend except for Al-Jahra, where 2008 fall produced highest amount of CH_4. We speculate that the lower CO_2 during summer season may be due to the fact that large portion of the population go on vacation outside Kuwait, hence fewer vehicles are driven and in turn less CO_2 is released. The diurnal cycle for urban areas also demonstrates driving behavior and high level of CO_2 releases during times of congested traffic.

***Keywords*--** Carbon dioxide, climate change, methane, air quality, urban.

I. INTRODUCTION

Globally, climate change has become the most pressing environmental issue, and anthropogenic activities are believed to be the largest contributing factor. It is also widely accepted that many parts of the world, urban centers in particular, will be affected due to the increased level of greenhouse gases (GHGs) such as carbon dioxide (CO_2) and methane (CH_4). According to some estimates on a hot summer days, urban air can be 2-10°F (2-6°C) hotter than the surrounding countryside. The increased heat of our cities increases discomfort for everyone, requires an increase in the amount of energy used for cooling purposes, and increases pollution (Elsayed. 2012). As a result of this increase, the atmosphere's ability to trap and hold the heat increases more than required, leading to the average temperature of the earth surface to increase. According to available statistical data, the planet has witnessed a 35% rise in global CO_2emissions due to the burning of fossil fuels. The burning of fossil fuels leads to higher concentrations of CO_2, which constitutes about 76% of all the GHGs in the Earth's atmosphere. Most of the increase in CO_2has occurred in the last 50 years. Kuwait, being a major oil producer, is expected to be a big contributor to the GHGs emission.

The primary aim of this project is to analyze the recorded CO_2 and CH_4 concentration data that are measured by four air monitoring stations which can also represent the influence of urban, industrial, oil refineries, and power plants. Findings of this study will shed an important light on whether or not there is a statistical association between ambient CO_2 concentration and selected locations of monitoring station. This kind of finding will definitely help improve regulatory regime designed to address climate change issues. We speculate that the lower CO_2 during summer season may be due to the fact that large portion of the population go on vacation outside Kuwait, hence fewer vehicles are driven and in turn less CO_2 is released.

II. MATERIALS AND METHODS

Kuwait is situated in the northeastern part of the Arabian Peninsula, bordered on the north and west by Iraq, on the south and west by Saudi Arabia and on the east by the Persian Gulf. With respect to the size, Kuwait is one of the world's smallest countries in the world, occupying 17,818 km^{-2}. The greatest distance from north to south is 200 km and from east to west 170 km (110 mi), with several offshore islands. With regards to the climate, Kuwait has four distinct seasons: summer, winter, autumn, and spring. Weather in Kuwait varies greatly; the summer months (June, July, August, and part of September) are mostly dry, extremely hot (temperatures exceeding 48 ^oC) and dusty. During winter (December, January, February and part of March) temperatures decrease to as low as 0 ^oC at night, especially at the desert areas where can drop to even below zero 0 ^oC for days. Fig. 1 details Kuwait geographic map with the four locations selected for CO_2 and CH_4 emission assessments.

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Fig.1. Kuwait map showing the Kuwait Environmental Public Authority (K-EPA) monitoring stations selected to assess the concentration of CO_2 and CH_4.

III. Results and Conclusions

Two years hourly data (2008-2009) were obtained from Kuwait Environmental Public Authority (K-EPA) from four different monitoring stations located at different parts of the country (Fig. 1). The CO_2 and CH_4 concentrations were recorded and averaged on hourly bases. The monitoring stations where chosen such the recorded CO_2 and CH_4 concentration levels would reflect the influence of urban areas, industrial areas, refineries, and power plants. Fig. 2 and 3 respectively depict CO_2 and CH_4 emissions in 1998 and 1999 from strategically selected four locations described below in detail.

Mansoria (MN) station is located in AL-Monsoria district, bounded by first and second ring roads (main highways) and routes to highway 40. Measurements of CO_2 and CH_4 at this station reflect influence of traffic vehicles and urbanization. Al-Reqqa (RQ) station is located in is located near the oil refineries, and CO_2 and CH_4 records will definitely reflect the influence of oil refineries and oil fields. Similarly, Um-Alheman (UH) station is located in a district which is near oil refineries and a huge power plant. AL-Jahra (JH) station is located in AL-Jahra district, an urban and commercial area, also close to two power plants (East and West Doha plants). Thus the recorded CO_2 and CH_4 concentration data represent influence of urbanization and power plant, with little or no traffic influence.

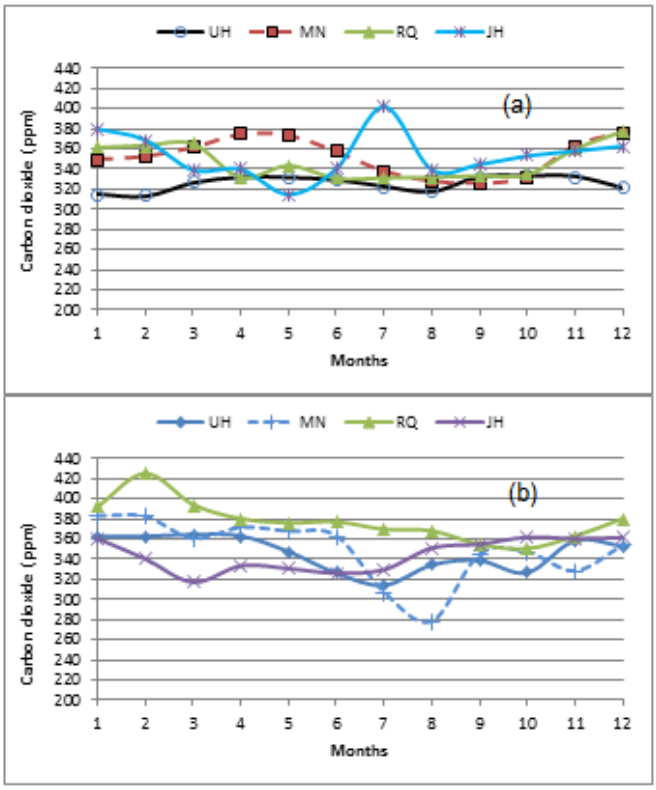

Fig. 2: Carbon dioxide emissions from four locations in the city of Kuwait during (a) 1998 and (b) 1999.

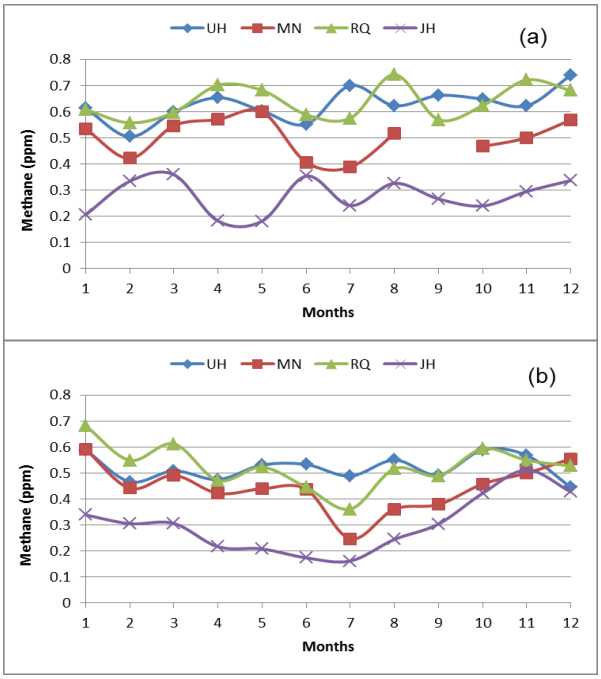

Fig. 3: Methane (CH_4) emissions from four locations in the city of Kuwait during (a) 1998 and (b) 1999.

References

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