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AIR POLLUTION TRACKING IN MANGALORE USING GIS AND RS

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ABSTRACT: Environmental pollution of urban areas is one of key factors that state authorities and local agencies have to consider in the decision-making processAir quality is deteriorated in Mangalore due to the release of toxic smoke from vehicles. Petrochemical industries at Baikampady and Padubidri release large amount of smoke day and night. Trash burning is observed in many places' day and night. Road repairs are left incomplete and dust circulates everywhere. Plastic wrappers, containers are found scattered here and there in public places. The vehicles are also increasing; all these factors along with the petrochemical industries contribute to rising air pollution. Many places within the city of Mangalore need plenty of improvement, as far as cleanliness and sanitation are concerned. All riversides and localities such as Bunder, Central Market, Alake, Hampankatta and Urva ferry point need to be cleansed up.An attempt has been made to Identify major air pollutants, Zoning of air pollution areas, Effects of air polluted areas, Mapping of air polluted areas.

INTRODUCTION

Air is a basic requirement for the survival and development of all lives on Earth. The air quality remains one of the major environmental issues in modern society. Quality of air affects the entire human race as well as plant and animal populations on the earth. Air pollution is made up of a mixture of gases and particles in harmful amounts that are released into the atmosphere due to either natural or human activities such as due to the development of industrialization, the increase in the number of private cars, economic development, the burning of fossil fuels as well as living standards. There are many pollutants in the atmosphere, such as SO_2, NO_2, CO_2, NO, CO, PM $_{2.5}$ and PM_{10}

With an objective to address the above concerns, concept of air quality index (AQI) has been developed and used effectively in many industrialized countries for over last three decades AQI is defined as an overall scheme that transforms the weighted values of individual air pollution related parameters such as sulphur dioxide (SO2), nitrogen dioxide (NO_2) and particulate matter < 10µm (PM_{10}), etc., into a single number or set of numbers.

Mangalore in Dakshina Kannada is one of the most polluted industrial centres in the country. The pollution level at the centre have touched "critical level", says the study which covered 83 of the most polluted industrial hubs in the country. As a municipal entity, the city spans 170 Km^2 (65.64 sq. mi). The Netravali and Gurupura rivers encircle the city. The Gurupura flows around the north and the Netravati flows around the south of the city. The rivers form an estuary in the south-western region of the city, from where they flow into the Arabian Sea. Coconut, palm trees and Ashoka comprise the primary vegetation of the city. The city's topography consists of a plain that stretches up to 30 KM (18.64 m) from the coast and undulating, hilly terrain towards the east near the Western Ghats. The local geology is characterised by hard laterite in hilly tracts and sandy soil along the seashore.

Air quality is very bad nowadays in Mangalore. Automobile pollution has been increased Petrochemical industries at Baikampady and Padubidri release large amount of smoke day and night. Trash burning is observed in many places' day and night. Road repairs are left incomplete and dust circulates everywhere. Plastic wrappers, containers are found scattered here and there in public places. The vehicles are also increasing, all these factors along with the petrochemical industries contribute to rising air pollution. Many places within the city of Mangalore need plenty of improvement, as far as cleanliness and sanitation are concerned. All riversides and localities such as Bunder, Central Market, Alake, Hampankatta and Urva ferry point need to be cleansed up

Fig.1: Satellite Imagery of the study area (Source: GoogleEarth Pro)

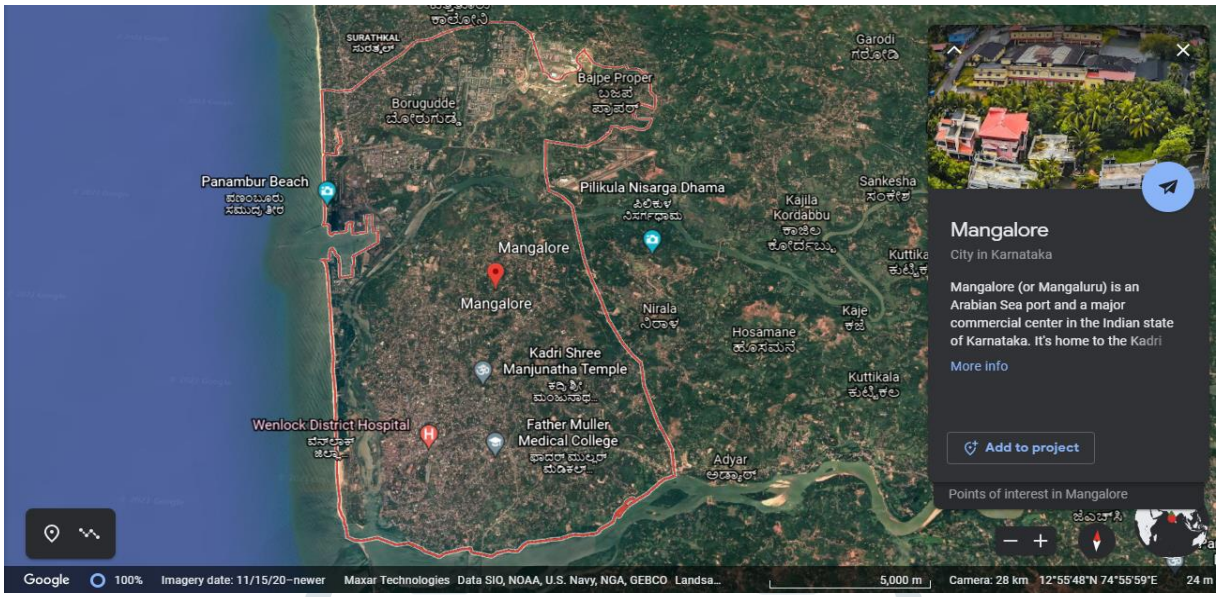

Table 1: Human health effects of common air pollutants

Pollutants	*Quantifiable Effects*	*Unquantifiable Effects*
Ozone	Mortality minor RADs respiratory Hospital admissions asthma attacks Changes in pulmonary function	Increased airway responsiveness to stimuli Centroclinal fibrosis Inflammation in the lung
Particulate matter / TSP/ Sulphates	Mortality, chronic and acute bronchitis Hospital admissions and lower respiratory illness Upper respiratory illness, Chest illness, Respiratory symptoms Minor RADs, Days of work loss Moderate or worse asthma status	Changes in pulmonary function
Carbon monoxide	Mortality, Hospital admissions, Congestive heart failure, Decreased time to onset of angina	Behavioural effects other hospital admissions
Nitrogen oxides	Respiratory illness	Increased airway responsiveness
Sulphur dioxide	Morbidity in exercising asthmatics Changes in pulmonary function Respiratory symptoms	
Lead	Mortality, Hypertension Nonfatal coronary heart disease Nonfatal strokes Intelligence quotient (IQ) loss	Neurobehavioral function other cardiovascular diseases Reproductive effects Fatal effects from maternal exposure Delinquent and antisocial behaviour in children

INDUSTRY IN MANGALORE	**PRODUCTS**	**POLLUTANTS**
Primacy	Candles, Home fragrance Sector	CO_2, PM
Kyra	Glass Industry	SO_2,CO_2, Nitrogen Oxide, PM
Achal	Cashew nut	Urushiol toxin, CO_2

New Tech	Coffee processing Machine, Grain, Cashew nut, Coconut	CO_2
Gurucharan	Plastic processing, Single Screw extrusion plants	Benzene, Vinyl hydrochloride, main source of dioxin
Delta	Fabrication services	None
SK	Oil scale	Benzene, Toulene, ethyl benzene, Xylene toxic pollutants
Roadricks	Truck body & Truck Components	None

Table 2: Major air pollutants from industries, Mangalore

The emission from diesel engines of the regulated pollutants - carbon monoxide, hydrocarbons and oxides of nitrogen - is lower compared to vehicles using petrol without a catalytic converter, but diesel engines do emit oxides of nitrogen and sulphur and particulate matter in greater amounts. From the table 2, six major substances are taken into consideration for analysis, namely Carbon monoxide(CO),Ozone (O3), Sulphur dioxide (SO_2), PM 2.5, Nitrogen oxide (NO_X), Ammonia (NH_3)

MATERIALS AND METHODOLOGY

- Air quality, meteorology and emissions data analysis
- Air pollution exposure assessment
- Health impact assessment
- Economic impact assessment
- Preventive policy assessment

Software used

- QGIS
- Google Earth Pro
-

Sources of Data

The sources of data used for this study include:

1. Administrative Map of the study area showing local boundaries, obtained from the KSRSAC (Karnataka State Remote Sensing Applications Centre).

2. Pollution data and survey information were sourced from CPCB (Central pollution control board).

3. Additional information was gleaned from other sources such as academic journals, gazettes, brochures, Internet and statistical publications of the Environmental Protection Agency (EPA).

Monitoring of Mangalore Air Pollution

Three monitoring sites have been selected for the analysis of Mangalore air pollution. The first site, Mangalore, is located in the north-western part of the city.. The data obtained from the the monitoring site consist of Carbon monoxide(CO),Ozone (O_3), Sulphur dioxide (SO_2), $PM_{2.5}$(mostly dust of road caused by vehicles and other sources), Nitrogen oxide (NO_X), Ammonia (NH_3) is available only for Mangalore and not for other monitoring stations. The data are recorded at 24 hour (one averaged measurement per day). The data collected at Mangalore, Hassan, Chikmangalore, Udupi and Shivmoga as monitoring sites in and around Mangalore district are used to perform a count, distance analysis, and summary statistics based on the feature attributes of the data.

RESULTS AND DISCUSSION

Long-term exposure to air pollution is one of the causes for asthma and other respiratory diseases. or not. This is because the concentrations of the sulphur dioxide, particulate matter, or nitrogen dioxide & other pollutants.

Concentration and trend of following pollutants:

Carbon Monoxide,Ozone,SO_2, Particulate Matter ($PM_{2.5}$), Nitrogen Dioxide (NOx) and Ammonia (NH_3).These pollutants mean monthly data is taken from CPCB website, and with the help of Inverse Weightage distance method the following maps were extracted and demonstrated pollutants trend in different parts of Mangalore

Concentration and Trend of Carbon Monoxide (CO)

Carbon monoxide is a colourless and odourless gas produced by incomplete combustion of fossil fuels like petroleum and coal

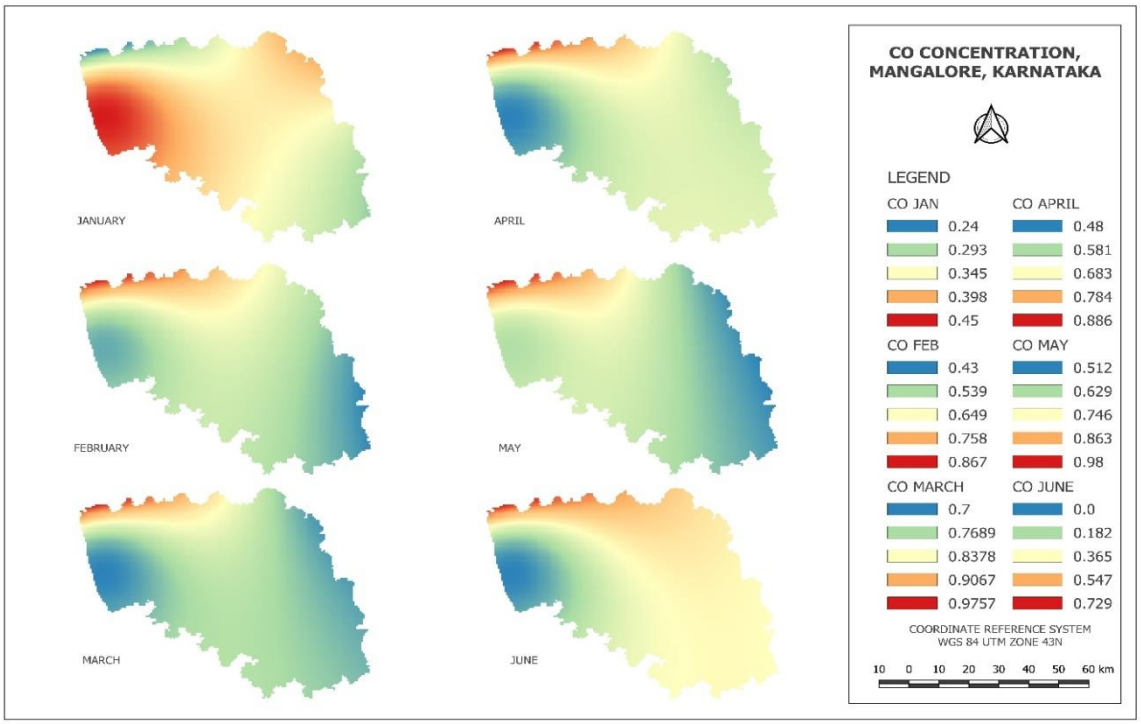

Fig. 1.1: Monitoring results: mean month CO concentration, Mangalore

It affects the delivery of oxygen to the body's organs and tissues. This causes serious problems for people with respiratory/cardiovascular disease. Eastern part of Mangalore having low concentration of CO and comparatively CO concentration is less in the city. The monitoring of carbon monoxide started later than that of the dioxides of nitrogen and sulphur. Fig 1.4 shows the concentration of carbon monoxide and its trend. Except for the maximum and the second highest concentrations, a clearly declining trend has been revealed, which is probably due to the adoption of emission control measures in the automobile sector. Moreover, the advent of hybrid cars and alternative energy sources are factors that have contributed significantly in lowering CO emissions.

The Concentration and Trend of Ozone (O_3):

Ozone, or tri oxygen, is an inorganic molecule with the chemical formula O_3. It is a pale blue gas with a distinctively pungent smell.

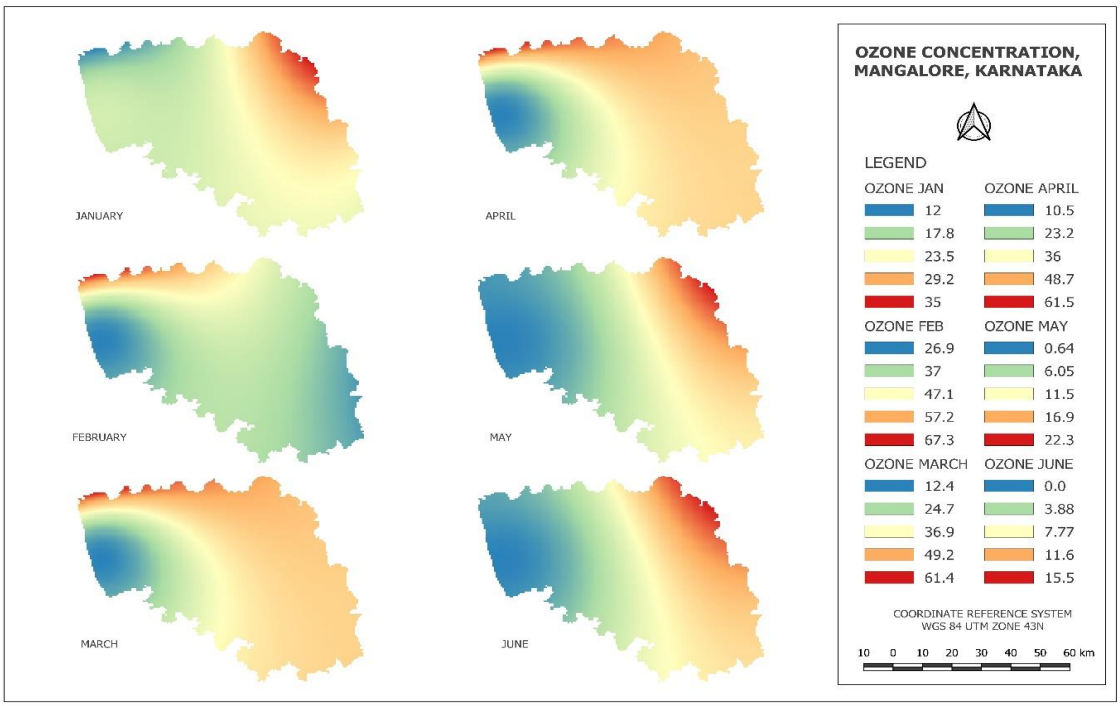

Fig 1.2: Monitoring results: mean month O3 concentration, Mangalore

Photochemical smog or oxidants are a composite concoction of gaseous chemicals formed in the atmosphere under the sunlight; Ozone (O3) is one such gas. The high concentration and low concentration of ozone is at northern part and western part of Mangalore respectively**.** Relatively low amounts of ozone can cause chest pain, coughing, shortness of breath and, throat irritation.

The Concentration and Trend of Sulphur Dioxide (SO_2)

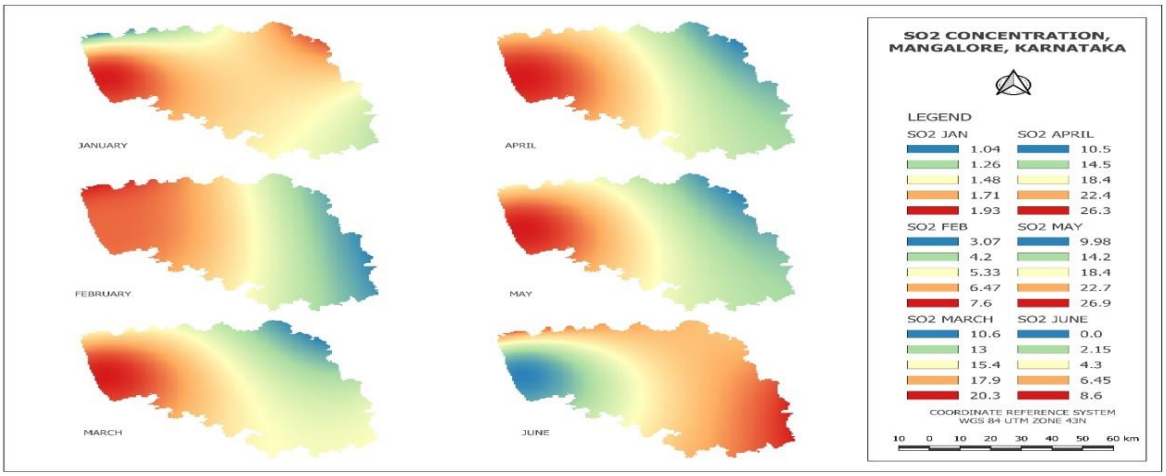

Fig 1.3: *Monitoring results: mean month SO_2 concentration, Mangalore*

Sulphur dioxide (SO_2) is a strong and irritating gas without colour; an anthropogenic formed by burning fossil fuels like sulphur-containing coal, oil or gas. In India, SO2 is not a major concern. Figure 6.3 shows the level of concentration of the sulphur dioxide at 24 hr average for the period of different months in the year 2021.

The trend lines for the Mangalore city do show an high level of SO2 in Figure 6.3. The understanding of Sulphur dioxide (SO2), as a colourless gas with a prickly, irritating odour further explains the basic reason for some of the result of the research. Sulphur dioxide (SO2) is formed in combustion processes burning fossil fuels containing sulphur (mostly coal and oil), in refining petroleum, or in smelting mineral ores. Sulphur dioxide is transformed by upper atmospheric processes into sulphuric acid, which contributes the dilute acid deposition known as acid rain. Low level sulphur dioxide affects human health by causing respiratory irritation and disease, including chronic bronchitis. Sulphur dioxide and its aerosols (sulphates in water droplets containing dissolved sulphur dioxide) also damage vegetation and other parts of the ecosystems.

The Concentration and Trend of Particulate Matter (PM 2.5)

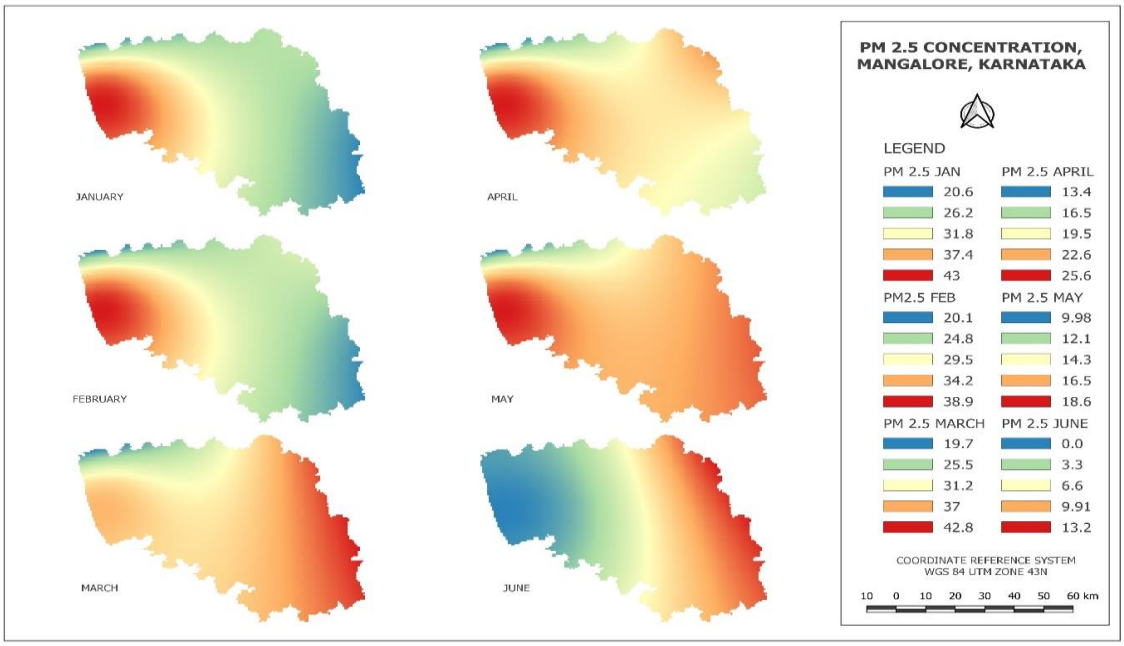

Fig1.4: Monitoring results: mean month PM2.5 concentration Mangalore

PM stands for "Particulate Matter". PM 10 particles (particles less than 10 microns in size) can irritate your nose and eyes, but fewer of these particles penetrate deep into your lungs, so they do not cause the same health problems that smaller micron

particles can, although they do increase rates of respiratory disease**.** The high concentration and low concentration of PM 2.5 are in western part and south-east part of Mangalore district.

The Concentration and Trend of Nitrogen Dioxide (NOx) Motor vehicle emissions are the major source of the secondary pollutant NOx in urban areas. Nitric oxide (NO) does not considerably affect human health, because it so readily oxidises to NOx. The high concentration and low concentration of NOx is at south-east part and western part of Mangalore respectively**.** It has been observed that there is a decreasing trend of concentration of nitrogen dioxide at the Eagle Farm and Springwood sites but an increasing trend has been found at the CBD site. There are several factors that possibly contribute to the increasing trend at CBD such as its central location with the junction of major roads and a cluster of minor roads. The Eagle Farm site is located far from the city centre although it is in proximity to a major road. According to DEH (2005), governmental policies and public awareness about the environment seem to be the factors that have played an important role in curbing the level of NO_2 concentration. As regards the Springwood site, it is located on the outskirts of the city and thus has a smaller number of local vehicles as compared to CBD. Moreover, the data levels of nitrogen dioxide are consistently below the EPP air quality goal in the (overall) study region. Ozone concentration at the urban location based on socio-economic properties is one hypothesis for increasing NO2 concentrations at CBD site, despite general country reductions of emissions. The original nitric oxide (NO) gas is produced in high temperature combustion processes like those of motor vehicle engines and industrial boilers of power stations and other industries, by oxidation of elemental nitrogen (N) formed at high temperatures from atmospheric nitrogen (N2).

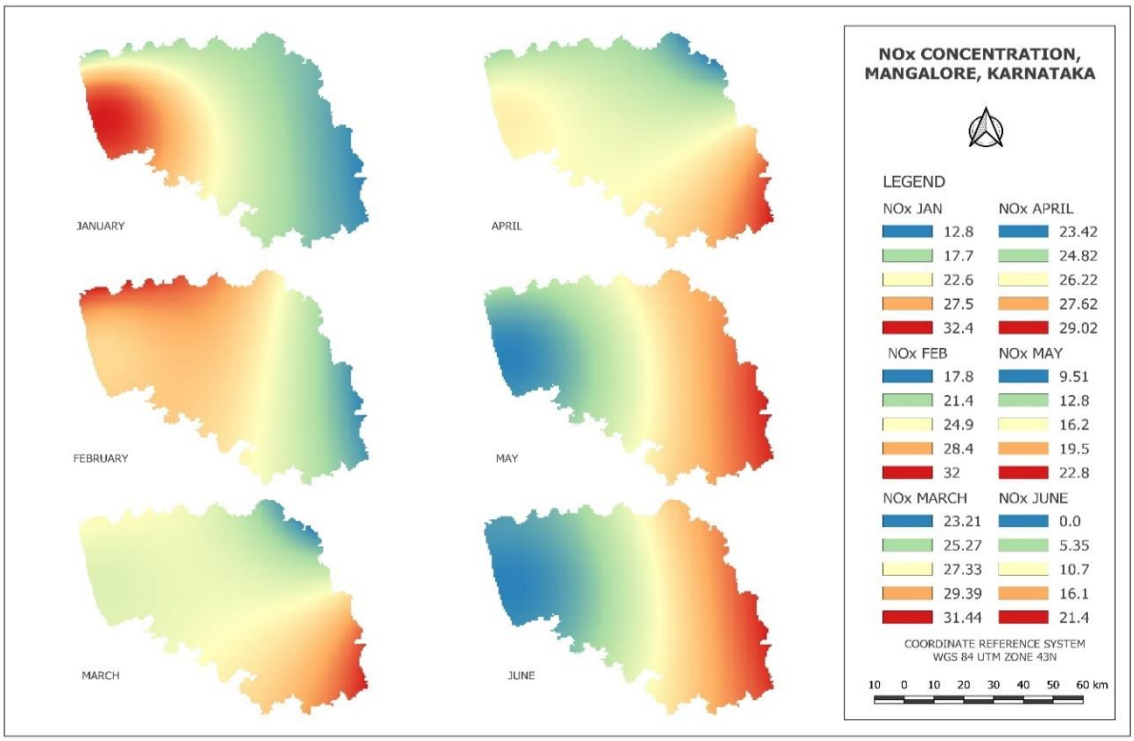

Fig. 1.5 Monitoring results: mean month NO_X concentration Mangalore

Concentration and Trend of Ammonia (NH_3) Ammonia is a compound of nitrogen and hydrogen with the formula NH_3. The high concentration and low concentration of NH_3 is at north-east part and western part of Mangalore respectively

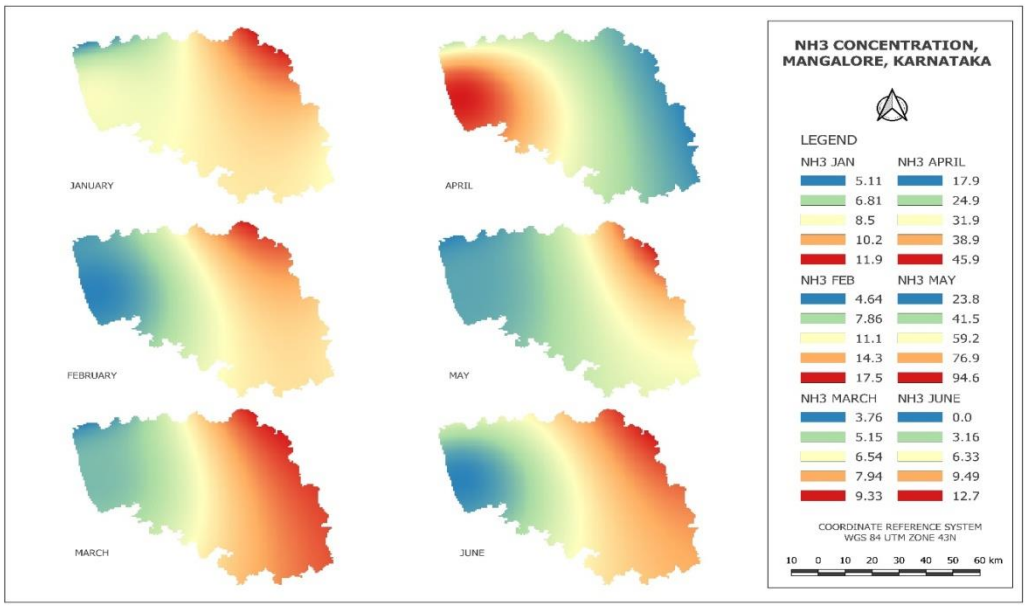

Fig. 1.6 Monitoring results: mean month NH_3 concentration Mangalore

A strong relationship between intrinsic vehicle characteristics and number of deaths from air pollution related to the distribution of respiratory disease (RD), cardiovascular diseases (CVD) and Cardiorespiratory Diseases (CRD) has reported. This study produced results which corroborate the findings of a great deal of the previous work in this field. The results of this study show and indicate that high concentration of air pollutants in Mangalore. Hence, there is need to practically identify environmental, social and physical values and guidelines to protect air quality; this could be in addition to provision of a framework to manage managing environmental impacts by development appropriate Environmental Impact Assessment.The findings of this work about Sulphur dioxide (SO_2) cannot be extrapolated to all regions, and an important reason for the increase trend in Mangalore could be attributed to action of anaerobic bacteria in farming related activities that aid the formation of hydrogen sulphide. Also, due to paucity of available data used in the research, no direct comparison with related studies within the study area could be made. There are similarities between observed increase is as a result of human activities, principally the burning of fossil fuels.More adverse reaction will occur if emissions result in high unburned methane and CO_2, which are greenhouse gases. Heat, noise and soot are the other expected pollutants, considering the role transportation has played in the understanding of the research theme in the study area.

CONCLUSION AND SUGGESTION

The results reveal that the association between air pollution (exposure to the oxides of nitrogen, sulphur and carbon) and number of deaths vary across different geographic areas in Mangalore city and this relationship emerges to be stronger in areas with heavy or busy traffic. The effects seem to be age specific as the highest number of air pollution-related deaths was recorded for people over 75 years of age and a positive correlation for infants and children was also observed between a moderate concentration of air pollution and the mortality from air pollution. However, the project was limited in several ways. First, the project used a convenience sample that do not consider age distribution difference, and it is recommended that further undertaken in this area and take into consideration this age difference distribution.

The results of this study indicate that it is important to evaluate the spatial features of air pollutants before modelling the air pollution-health relationships. This is because spatial distribution will enable in finding the important indicators that should be considered for further analysis. Thus, reducing analysis efforts. The research demonstrates the spatial variability of pollutants across Mangalore. This analysis was performed to estimate the specific effects of different sources of pollution emitted by vehicles running on the major roads as the monitoring sites are located on the major roads

The overall vehicular transportation pollution situation in the study area is high,

The control of air pollution through transportation can be achieved by:

Installation of pollution control devices on all diesel generation sets and pumps, Hydrocarbon vapor control devices at all vulnerable regions, Minimizing venting during production of activities that could be a source of pollution and Prohibit or restrict bottom-disturbing activities in vicinity of ecologically sensitive habitats.

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