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Determination of Air Quality Index for Kota City Rajasthan

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ABSTRACT: Kota, previously known as Kotah, is a city situated in the south-eastern part of the northern Indian state of Rajasthan. It is located about 240 kilometres south of the state capital, Jaipur and is situated on the banks of the Chambal River. A census conducted in 2011 estimated the population to be approximately 1 million people.

Towards the middle of 2021, Kota was experiencing a period of air quality that can be classified as being “Unhealthy” with a US AQI figure. This is an internationally recognised system that can be used when comparing cities in different countries as it uses the same metrics when ascertaining the levels of pollution. There are usually six commonly found pollutants that are measured and used as a benchmark. However, not all six are available in every case so what information is available has to be used as a guide. The recorded concentrations for Kota were as follows: PM_{2.5} - 58.2 µg/m³, PM₁₀ - 95 µg/m³ and nitrogen dioxide (NO₂) - 21.6 µg/m³. With elevated levels such as this, the advice would be to stay inside and close all doors and windows to prevent more dirty air from entering the rooms. Those people of a sensitive disposition should avoid unnecessary outdoor activity until the air quality improves. The wearing of a good quality face mask is recommended for all, as is the use of an air purifier if one is available.

KEYWORDS: Kota, Rajasthan, Air Quality Index, Determination, Pollution, Mask, People

I. INTRODUCTION

Air quality can change very quickly because it depends on many variables such as the temperature, the speed and direction of the wind and the strength and availability of sunlight.

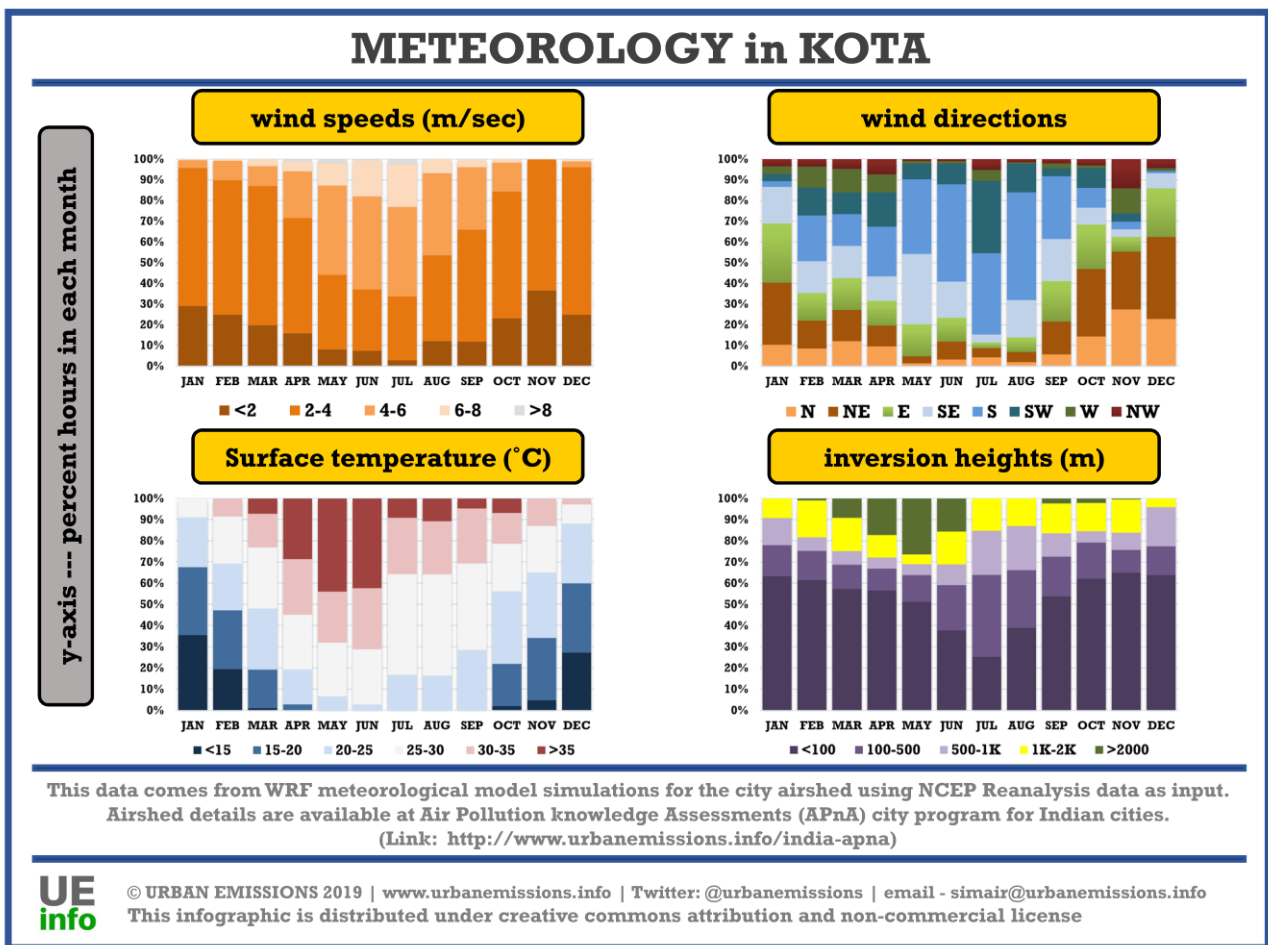
The figures for Kota for 2020, have now been published by IQAir.com and it can be seen that the best air quality was enjoyed in April, June, July and August when the figures were between 12.1 and 35.4 µg/m³ which classified it as “Moderate”. The previous months of January, February and March (as well as May) recorded levels that were classed as “Unhealthy for sensitive groups” with figures between 35.5 and 55.4 µg/m³. The late autumn/winter months of October through to the end of December were the worst with readings of 55.5 to 150.4 µg/m³, which firmly classified the air quality as “Unhealthy”. This was mainly due to the use of coal to provide heating for the homes and public spaces. Records were first noted in 2018 when the figure was 52.7 µg/m³ followed by 49.1 in 2019. 2020 returned the best figure of 42.1 µg/m³, but this could be artificially lower than average because of the restrictions put into place due to the COVID-19 pandemic. Because of the lockdown, [1,2] many vehicles were not used as their drivers were not required to go to work. There were also many factories that were told to suspend production in a bid to suppress the spread of the virus.

The major sources of pollution in Kota are ambient particulate matter, burning of domestic and commercial biomass, wind blowing mineral dust, burning of coal for energy production, industrial emissions and burning of agricultural waste. There are construction works, brick furnaces, traffic vehicles and diesel generators. Due to domestic pollution, solid fuels used for cooking include cow dung, agricultural residue and charcoal etc.

More than two-thirds of the country's total population generate carbon from cooking. India tops the list of countries that do not use clean fuel for cooking. The majority of rural households use dried cow dung as a cheap and convenient means of cooking and heating. Around 45 per cent of the rural population are not connected to an electricity supply so most households have no other choice than to use biomass as a source of energy. Medical experts say that due to not being a source of clean fuel, people use such cheap fuel which is seriously damaging to human health, especially women and children at home. Burning such solid fuel causes very high levels of internal air pollution. He says, since cooking is a daily routine and most people use solid fuel, the level of smoke particles emanating from it is much higher than the allowable annual limit for external air pollution.



Meteorology fields are important as they have a direct impact on air pollution concentrations. During periods of high precipitation or high speed winds, emissions from a city are swept away and do not have an impact on concentrations. On the other hand, during the winter months when temperatures and inversion heights are low, there is a greater impact of emissions on pollution concentrations. Low temperatures also affect behaviour through the need for space and water heating – which in turn has increases emissions. We processed the NCEP Reanalysis global meteorological fields from 2010 to 2018 through the 3D-WRF meteorological model. A summary of the data for one year, averaged for the city’s airshed is presented below by month. The processed data which includes information on year, month, day, hour, precipitation (mm/hour), mixing height (m), temperature (C), wind speed (m/sec), and wind direction (degrees) – key parameters which determine the intensity of dispersion of emissions.[3,4]

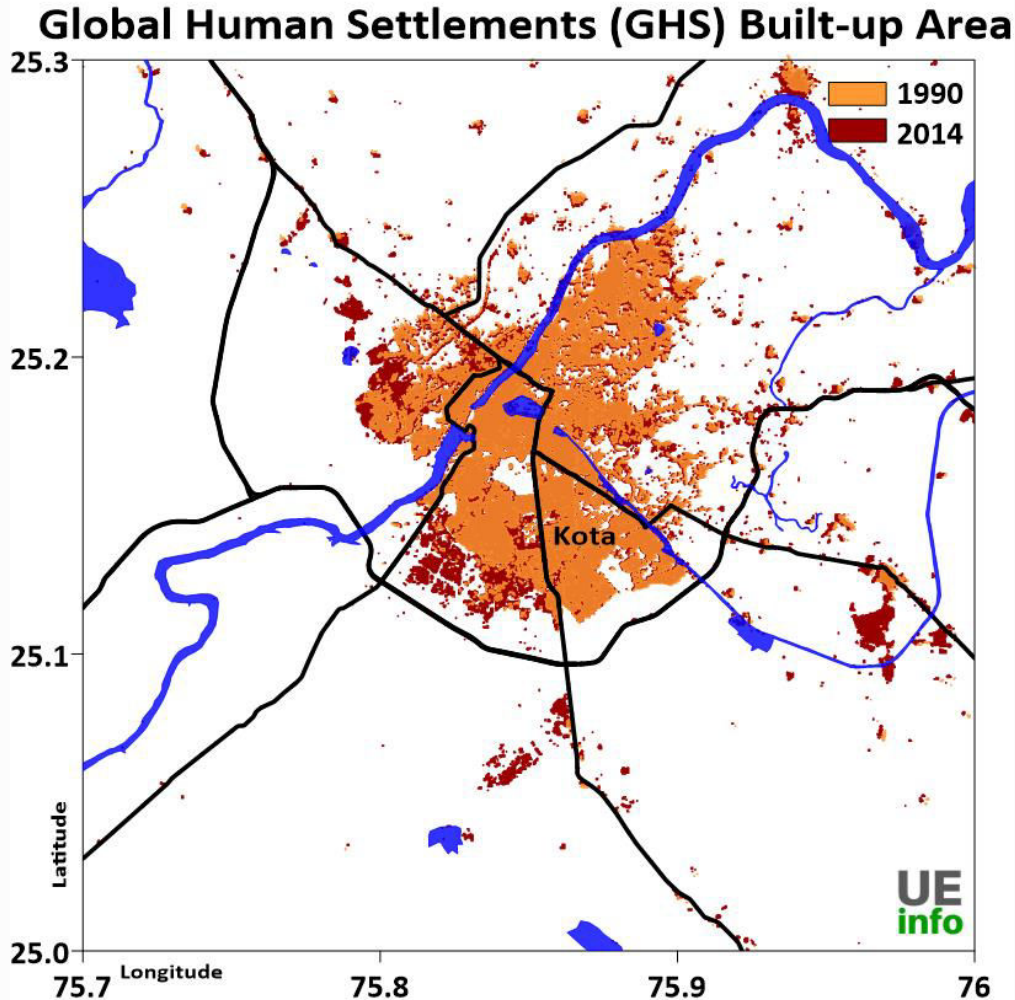


II. METHODOLOGY

We compiled an emissions inventory for the Kota region for the following pollutants – sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), carbon dioxide (CO₂); and particulate matter (PM) in four bins (a) coarse PM with size fraction between 2.5 and 10 µm (b) fine PM with size fraction less than 2.5 µm (c) black carbon (BC) and (d) organic carbon (OC), for year 2015 and projected to 2030. In Phase 1, base year for all the calculations was 2015. In Phase 2, all the calculations are updated for year 2018.

We customized the SIM-air family of tools to fit the base information collated from disparate sources. Apart from the official reports, resource material ranges from GIS databases of land use, land cover, roads and rail lines, water bodies, built up area (represented in the adjacent figure), commercial activities (such as hotels, hospitals, kiosks, restaurants, malls, cinema complexes, traffic intersections, worship points, industrial hubs, and telecom towers), to population density and meteorology at the finest spatial resolution possible (1-km). A detailed description of these resources is

published as a journal article in 2019, which also includes a summary of baselines and pollution analysis for 20 Indian cities.[5,6]



This emissions inventory is based on available local activity and fuel consumption estimates for the selected urban airshed. This information is collated from multiple agencies ranging from the central pollution control board, state pollution control board, census bureau, national sample survey office, ministry of road transport and highways, annual survey of industries, central electrical authority, ministry of heavy industries, and municipal waste management, and publications from academic and non-governmental institutions.

For the road transport emissions inventory, besides the total number of vehicles and their usage information, we also utilized vehicle speed information to spatially and temporally allocate the estimated emissions to the respective grids. This is a product of google maps services. For the city of Kota, we extracted the speed information for representative routes across the city for multiple days. [7,8]

III. DISCUSSION

Air pollution is the second largest cause of premature deaths in Rajasthan. This cost of health in the state is equal to 70 per cent of the state's GDP due to air pollution, which is much higher than the country as a whole. If the concentration of air pollution is low, the life expectancy in Rajasthan may increase by 2.5 years.



Most villagers believe that when cow dung is found easily and free, why should they spend money on buying an LPG connection and gas stove. Apart from this, since it is the job of women to cook food and collect fuel for it, men do not show any interest in investing money in it.

Some states now want to subsidise farmers to purchase machines to remove straw after harvest, or to process machinery after harvest to make it safer. An innovative approach could be to use climate change funds to convert agricultural residues into a resource, using technological options such as converting agricultural waste into biofuels and fertilisers. This solution is on trial in certain states where the government guarantee to buy all the briquettes made from straw and burn them in power stations in lieu of coal.

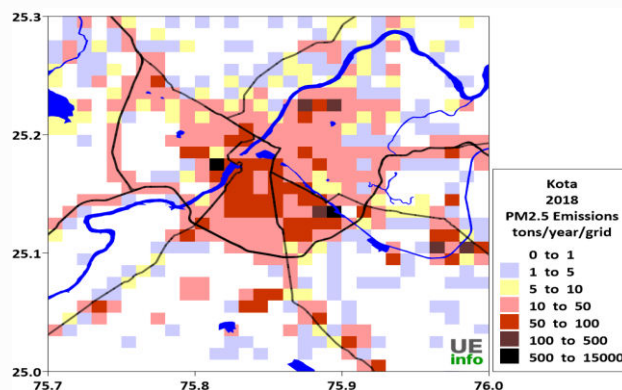
Epidemiological studies have clearly revealed that air pollution is directly related to heart diseases and heart attacks. Perhaps the most disturbing thing is that a person often becomes a victim of air pollution in their own home. The World Health Organisation Household Air Pollution and Health report, states that more than 50 per cent of untimely deaths in children under five are caused by pneumonia. The soot generated due to air pollution in the homes penetrates their lungs as they breathe this is the biggest cause of pneumonia.

IV. RESULTS

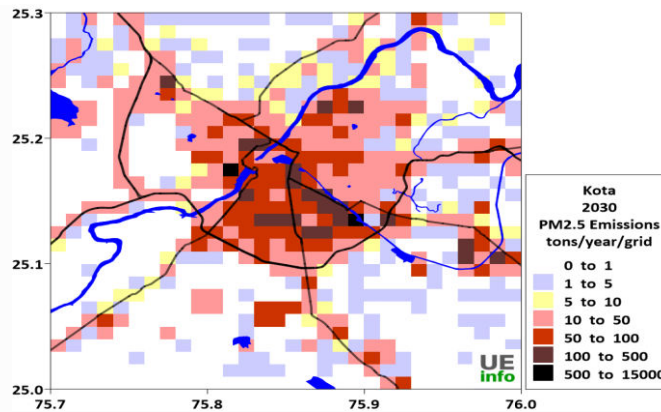
The summary for a city's emissions inventory does not include natural emission sources (like dust storms, lightning, and seasalt) and seasonal open (agricultural and forest) fires. However, these are included in the overall chemical transport modeling in the national scale simulations. These emission sources are accounted in the concentration calculation as an external (also known as boundary or long-range) contribution to the city's air quality.

Projections to 2030 under the business as usual scenario are influenced by the city's social, economic, landuse, urban, and industrial layout and hence the projected (increasing and decreasing) rates that we assume are an estimate only. We based the vehicle growth rate on the sales projection numbers; industrial growth on the gross domestic product of the state; domestic sector, construction activities, brick demand, diesel usage in the generator sets, and open waste burning on population growth rates and notes from the municipalities on plans to implement waste management programs. We used these estimates to evaluate the trend in the total emissions and their likely impact on ambient PM2.5 concentrations through 2030.

The emissions inventory was then spatially segregated at a 0.01° grid resolution in longitude and latitude (equivalent of 1 km) to create a spatial map of emissions for each pollutant (PM2.5, PM10, SO2, NOx, CO and VOCs). The gridded PM2.5 emissions and the total (shares by sector) emissions are presented below.[9]

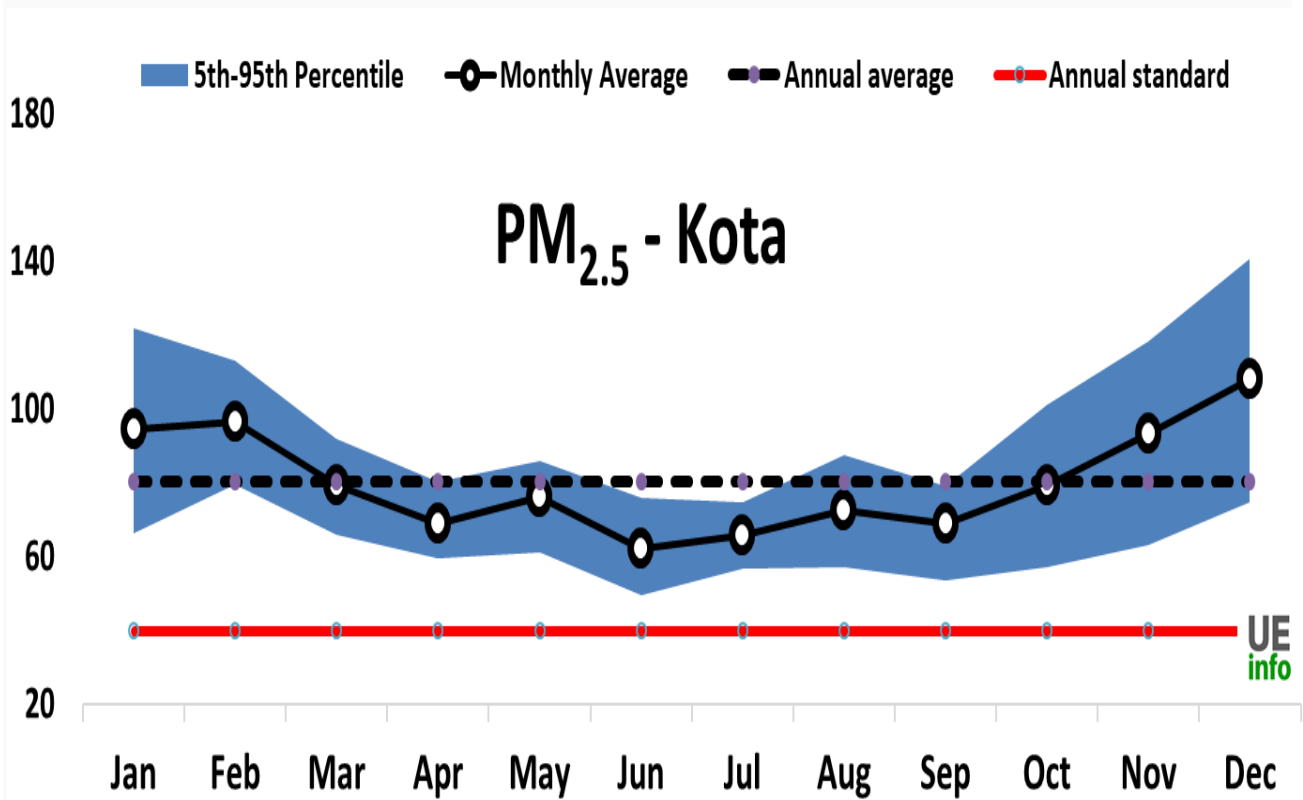


Gridded PM2.5 Emissions (2018 and 2030)



Gridded PM2.5 Emissions (2018 and 2030)

We calculated the ambient PM2.5 concentrations and the source contributions, using gridded emissions inventory, 3D meteorological data (from WRF), and the CAMx regional chemical transport model. The model simulates concentrations at 0.01° grid resolution and sector contributions for the urban area, which include contributions from primary emissions, secondary sources via chemical reactions, and long range transport via boundary conditions (represented as “boundary” in the pie graph below).



The ribbon graph shows the variation for average PM2.5 pollution by month. Due to precipitation during the monsoon, usually pollution levels dip and may fall within national air pollution standards, however most cities are unable to attain these standards at other times of the year.

The following is a map of annual average PM2.5 pollution for the city of Kota. The main sources contributing towards PM2.5 in 2018 are in the pie-chart on the left. The change in contributions in 2030 from different sources are shown on the right.



V. CONCLUSIONS

The results of satellite data derived concentrations are useful for evaluating annual trends in pollution levels and are not a proxy for on-ground monitoring networks. This data is estimated using satellite feeds and global chemical transport models. Satellites are not measuring one location all the time, instead, a combination of satellites provide a cache of measurements that are interpreted using global chemical transport models (GEOS-Chem) to represent the vertical mix of pollution and estimate ground-based concentrations with the help of previous ground-based measurements. The global transport models rely on gridded emission estimates for multiple sectors to establish a relationship with satellite observations over multiple years. These databases were also used to study the global burden of disease, which estimated air pollution as the top 10 causes of premature mortality and morbidity in India. [10]

REFERENCES

- 1) CPCB repository of continuous air monitoring data (Link)
- 2) Rajasthan State Pollution Control Board data under the National Air Quality Monitoring Programme (Link)
- 3) Kota Nagar Nigam (Kota Municipal Corporation) (Link)
- 4) Urban Improvement Trust Kota Master Plan 2031 (Link)
- 5) Kota Smart City Proposal (Link)
- 6) Report of the Comptroller and Auditor General of India on Economic Sector for the year ended 31 March 2017: Government of Rajasthan Report No. 5 of the year 2017. Pages 3-5, 11-47 (Link)
- 7) GAIL: Natural gas supply infrastructure in Kota (Link)
- 8) "Indian Railways and GAIL (India) Limited sign an MoU for Use of Natural Gas in Railway Workshops and Production Units", Press Information Bureau, GoI, Ministry of Railways. (2018) (Link)
- 9) Rajasthan Solar Energy Policy. (2014) (Link)
- 10) "Seasonal Variation of Selected Metals in Particulate Matter at an Industrial City Kota, India", Meena, M. et. al. (2016) (Journal Article Link)



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