RESEARCH REVIEW International Journal of Multidisciplinary 2021; 6(4):62-68
ISSN: 2455-3085 (Online)
https://doi.org/10.31305/rrijm.2021.v06.i04.011
Double Blind Peer Reviewed/Refereed Journal
https://www.rrjournals.com/

Research Paper

PM10, PM2.5, SO_2 AND NO_2 concentrations at different locations in East-Godavari District, Andhra Pradesh, India

[1]Radha Krishna Reddy. T, [2]T. Byragi Reddy & [*3]Ch. Venkata Ramana

[1]*Reaserch Scholar, Environmental Sciences and Andhra University, Visakhapatnam & India*
[2]*Professor, Environmental Sciences and Andhra University, Visakhapatnam & India*
[3]*Reaserch Scholar, Environmental Sciences and Andhra University, Visakhapatnam & India*

ABSTRACT

Air pollution is one of the most persistent environmental issues in local and global scale and its increasing day by day due to population growth, urbanization and industrialization. Present study, aim to determine the air quality of particularly four parameters like PM2.5, PM10, sulphur dioxide (SO2) and Nitrogen Dioxide (NO2) at three different locations in Visakhapatnam city and analysis done during three monsoon period in covering two calendar years of 2018 and 2019. In the present study, maximum concentrations were recorded during winter seasons when compared to rainy and winter while the minimum concentrations were recorded at during winter seasons and decreasing in the rainy season and gradually increasing during winter to summer when compared to 2019 and 2020. Sulphur dioxide (SO2) and Nitrogen Dioxide (NO2) concentration below the permissible limits in all the sampling locations as well as during all the seasons except PM2.5 and PM10. Present study reveals that in terms particulate matter, the air quality is very poor when compared gaseous pollutants.

Keywords: *air pollution, Particulate matter and Visakhapatnam*

Article Publication

Published Online: 15-Apr-2021

*Author's Correspondence

Ch. Venkata Ramana

Research Scholar, Environmental Sciences and Andhra University, Visakhapatnam & India

chintagunti_venki[at]yahoo.com

1. Introduction

Air pollution is a serious concern across the globe, fueled by rapid population growth, continuous urbanization, increases in industrialization, continuous rises in energy demand, deforestation, and increases in vehicle density, especially in major cities (Du et al., 2014; Cheng et al., 2014) has triggered the deterioration of environmental quality throughout the world (Sateesh and Desai, 2013). Urban and sub-urban area in India air pollution is rapidly increasing in recently developing cities (Nagendra et al., 2013; Ren and Tong, 2008). The ambient air quality is a well-known problem for big cities with dense population and high traffic volume (Samad and Vogt, 2020; Sun and Zhu, 2019). Many studies have shown association between exposure of the population to air pollutants and its adverse health impact (William et al., 2013; American Thoracic Society, 2000; WHO, 2017; Herman Autrup, 2010; Andrew et al., 2019; Manisalidis et al., 2020). To provide the public, information for air pollution dangers, several governmental and municipal agencies developed air quality indices, as a timely information about the potential changes in air quality. Public interest in the health effects of PM2.5 exposure is increasing worldwide; each country is focusing on the management of PM2.5 sources and exposure (Apte et al., 2018). Exposure assessment is important for providing accurate information on PM2.5 to the public (Randall et al., 2019). The traditional way for monitoring air quality is using stationary measurement stations. Present study focused on the air quality of three different locations in East-Godavari district, Andhra Pradesh.

2. Methodology

Followed by the Central Pollution Control Board air monitoring procedure, manual procedure was used analyze four parameters like PM2.5, PM10, SO_2 and NO_2 were analyzed. PM2.5 and PM10 parameters were analyzed by using gravimetric method while SO_2 and NO_2 gases parameters were analyzed by using wet-chemical methods for all the three seasons for the period of 2018 - 2019 in East-Godavari district at different air quality monitoring stations. For the investigation of the seasonal variation, the year was divided into three seasons: winter (November to February), summer (March to June) and monsoon (July to October) as per the regional meteorological considerations. All collected data was analyzed using the Microsoft Excel was also used for data presentation as well as for making tables and graphs.

Figure. 1: showing air sampling locations in the present study

3. Results and Discussion

Table. 1: Concentration of PM2.5, PM10, SO_2 and NO_2 at Annavaram

Seasons	Month & Year`	PM2.5	PM10	SO_2	NO_2
Rainy Season	**Jul-18**	68.1	85.6	4.5	10.3
	Aug-18	77.8	94.4	4.9	11.8
	Sep-18	69.4	95.8	4.2	11.1
	Oct-18	84	102.1	4.9	13.2
Winter Season	**Nov-18**	78.3	96.2	4.3	10.3
	Dec-18	68.4	86.3	4.2	12.6
	Jan-19	64.2	95.2	4.8	10.2
	Feb-19	77.8	108.3	5.6	11.8
Summer Season	**Mar-19**	72.2	125	6.9	12.5
	Apr-19	75.7	111.1	5.6	13.9
	May-19	57.1	79.3	4.3	9.8
	Jun-19	57.4	75.8	5.3	13.2
	Min.	**57.1**	**75.8**	**4.2**	**9.8**
	Max.	**84**	**125**	**6.9**	**13.9**
	Mean	**70.9**	**96.3**	**5**	**11.7**
NAAQ Standards		**60**	**100**	**60**	**60**

All values are expressed in $\mu g/m^3$

Table. 2: Concentration of PM2.5, PM10, SO_2 and NO_2 at Tuni

Season	Month & Year`	PM2.5	PM10	SO_2	NO_2
Rainy Season	**Jul-18**	65.3	111.2	5.9	13.6
	Aug-18	88.9	129.2	6.3	15.3
	Sep-18	93.1	118.8	6.9	14.6
	Oct-18	105.6	129.9	5.6	14.6
Winter Season	**Nov-18**	81.5	102.7	4.9	16.8
	Dec-18	80	101.6	4.2	17.4
	Jan-19	76	112.3	4.9	12.1
	Feb-19	100.7	129.9	6.3	11.8
Summer Season	**Mar-19**	89.6	121.5	6.3	13.9
	Apr-19	88.9	116.7	6.3	13.2
	May-19	60.9	81.5	5.4	11.4
	Jun-19	57.9	80.5	5.8	18.4
	Min.	**57.9**	**80.5**	**4.2**	**11.4**
	Max.	**105.6**	**129.9**	**6.9**	**18.4**
	Mean	**82.4**	**111.3**	**5.7**	**14.4**
NAAQ Standards		**60**	**100**	**60**	**60**

All values are expressed in $\mu g/m^3$

Table. 3: Concentration of PM2.5, PM10, SO_2 and NO_2 at Jaggampeta

Season	Month & Year`	PM2.5	PM10	SO_2	NO_2
Rainy Season	**Jul-18**	43.9	78.3	4.9	10.2
	Aug-18	38.2	70.1	8.3	5.6
	Sep-18	48.6	152.1	6.9	18.8
	Oct-18	73.6	100	5.6	15.3
Winter Season	**Nov-18**	91.8	119.6	6.5	15.2
	Dec-18	90.5	122.6	6.3	16.8
	Jan-19	96.3	102.3	5.2	11.2
	Feb-19	101.4	147.9	8.3	21.5
Summer Season	**Mar-19**	99.3	143.8	7.6	21.5
	Apr-19	93.8	138.2	8.3	22.2
	May-19	69	100	6.5	14.7
	Jun-19	71.1	100.5	6.8	15.3
	Min	**38.2**	**70.1**	**4.9**	**5.6**
	Max.	**101.4**	**152.1**	**8.3**	**22.2**
	Mean	**76.5**	**114.6**	**6.8**	**15.7**
NAAQ Standards		**60**	**100**	**60**	**60**

PM2.5 concentration:

PM2.5 is generally considered as fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller and high priority for particularly deadly, with a 36% increase in lung cancer per 10 $\mu g/m^3$ as it can penetrate deeper into the lungs (Ole et al., 2013).

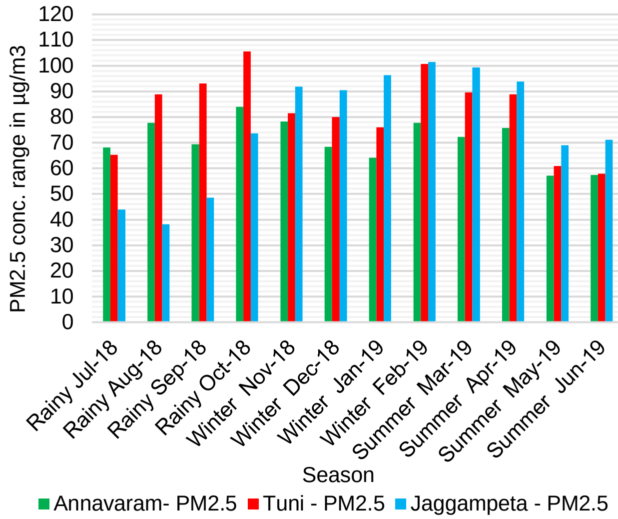

Figure. 2; Showing PM2.5 concentrations during the three seasons in the study

PM2.5 concentration ranges 57.1 to 84µg/m^3 with mean of 70.9µg/m^3 at Annavaram 57.9 to 105.6µg/m^3 with mean of 82.4µg/m^3 at Tuni, 38.2 to 101.4µg/m^3 with mean 76.5 µg/m^3 at Jaggampeta during three seasons in the years of 2018 to 2019. The maximum concentration observed at Tuni (105.6µg/m^3) during the rainy season in the month October due to particulate matter can be natural or anthropogenic (Plainiotis et al., 2010) and its contributed to deaths from heart disease and stroke, lung cancer, chronic lung disease, and respiratory infections in 2016 (State of Global Air, 2018). While minimum PM2.5 concentration is observed at Jaggampeta (38.2µg/m^3) in rainy season (August) during the year of 2018 and 90% of the sampling locations were exceeded the National Ambient Air Quality Standards (NAAQS) is 60 µg/m^3 and this result indicates that the PM2.5 concentration originated from local sources, and the rest of the PM2.5 mass from transportation (Ojanen et al. 1998).

PM10 concentration:

PM10 describes inhalable particles, with diameters that are generally 10 micro meters and smaller (Srimuruganandam and Shiva Nagendra, 2010). The issue of urban air quality in particular particulate matter (PM) concentrations receiving more attention as an increasing share of the world's population lives in urban centers (UN, 2004).

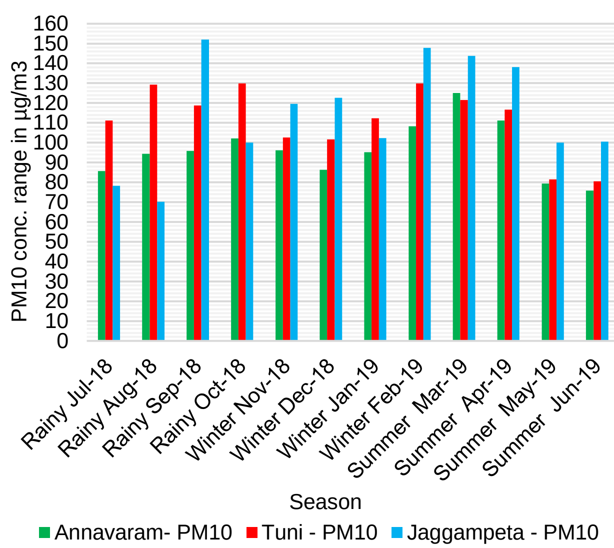

Figure. 2; Showing PM10 concentrations during the three seasons in the study

The concentrations of PM10 ranges from 75.8 to 125µg/m^3 with mean of 96.3µg/m^3 at Annavaram, 80.5 to 129.9µg/m^3 with mean of 111.3µg/m^3 at Tuni and 70.1 to 152.1µg/m^3 with mean of 114.6µg/m^3 at Jaggampeta during the all the seasons in the years of 2018 – 2019. All the seasons maximum concentrations were observed at were typically higher during winter and rainy seasons due to prevailing inversion conditions trapping the pollutants. In particular, PM10 concentrations were significantly higher during winter periods (Srimuruganandam and Nagendra Saragur, 2010). Elevated PM10 concentrations observed in urban environments are linked with increased cardiovascular and pulmonary mortality and morbidity (Grivas et al., 2004) and other studies with PM10 levels of comparable magnitude (Houthuijs et al., 2001; Vega et al., 2002; Hujia et al., 2013).

SO_2

Sulfur Dioxide is one of a group of gases called sulfur oxides (SOx) and the gases in the group are much less common in the atmosphere (Pan, 2011; Abdelrahman et al., 2016).

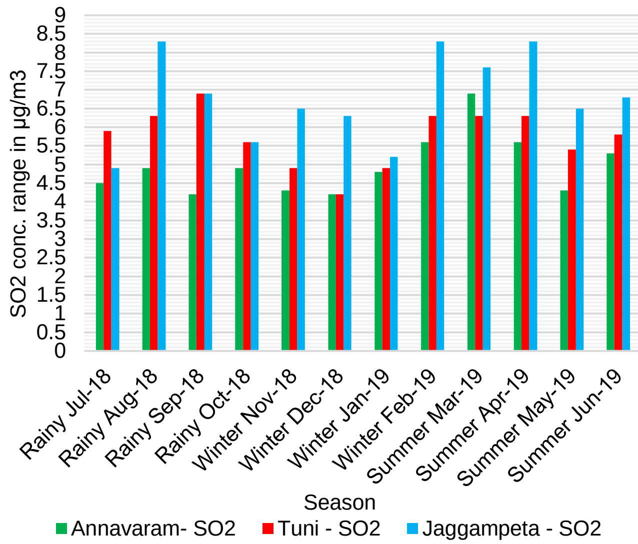

Figure. 2; Showing SO2 concentrations during the three seasons in the study

In the present study, concentration of SO2 ranges from 4.2 to 6.9µg/m^3 with mean of 5.0µg/m^3 at Annavaram, 4.0 to 6.9µg/m^3 with mean of 5.7µg/m^3 at Tuni and 4.9 to 8.3µg/m^3 with mean of 6.8 µg/m^3 at Jaggampeta were observed for all the seasons during the years of 2018-2019. All the sampling location and all the seasons were observed below the National Ambient Quality Standards (NAAQS) for SO2 is 60µg/m^3.

NO_2

Most predominant sources of NO2 are internal combustion engines burning fossil fuels (USEPA, 2016) Outdoors, it can be a result of traffic from motor vehicles. The concentrations of NO2, the present study, ranges from 9.8 to 13.9 µg/m^3 with mean of 11.7µg/m^3 at Annavaram, 11.4 to 18.4µg/m^3 with mean of 14.4 µg/m^3 at Tuni and 5.6 to 22.2µg/m^3 with mean of 15.7µg/m^3 at Jaggampeta were observed for all the seasons during the years of 2018-2019. All the sampling location and all the seasons were observed below the National Ambient Quality Standards (NAAQS) for NO2 is 60µg/m^3.

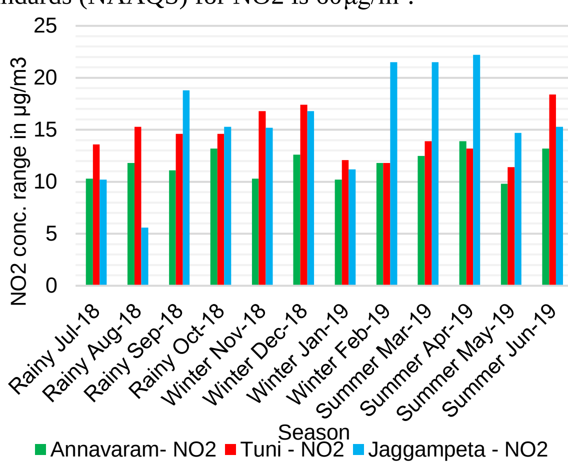

Figure. 2; Showing NO2 concentrations during the three seasons in the study

4. Summary and conclusion

Air quality is deteriorating now-a-days due to increasing transportation sector, urbanization and over population. Mainly sub-urban areas converted into urban areas due to migration of people due employment or habitual problems. In the present study, monitor air quality, in three different locations and analysed four air quality parameters. Results shows that PM2.5 and PM10 concentrations were exceeded the National ambient air quality in the during present study. NO2 and SO2 concentrations were observed as below the standards and it considered as negligible levels. Unusually, rainy and summer seasons particulate matter decreased and winter seasons increased when compared to other seasons were increased and exceeded during study period when compared to location one to another location according to standards. Present works reveals, air quality provided making it difficult to take action for critical air pollution and exposed to poor air quality in the study area. It is expected that government or related agencies should be preventing health impacts on communities.

References

1. Abdelrahman H. Hegazi, Jan T. Andersson, (2016); In Standard Handbook Oil Spill Environmental Forensics, 2nd Edition.
2. American Thoracic Society. What constitutes an adverse health effect of air pollution? Official statement of the American Thoracic Society. Am J Respir Crit Care Med 2000;161: 665 - 673.
3. Andrew Caplin, Masoud Ghandehari, Chris Lim, Paul Glimcher & George Thurston, (2019); Advancing environmental exposure assessment science to benefit society, Nature Communications, 10:1236.
4. Apte, Joshua &Brauer, Michael & Cohen, Aaron &Ezzati, Majid & Pope, C., (2018). Ambient PM 2.5 Reduces Global and Regional Life Expectancy. Environmental Science & Technology Letters. 5.
5. Grivas, G., A. Chaloulakou, C. Samara and N. Spyrellis, (2004); Spatial and temporal variation of pm10 mass concentrations within the greater area of Athens, Greece, Water, Air, and Soil Pollution, 158, pp: 357–371.
6. Hairong Cheng, Wei Gong, Zuwu Wang, Fan Zhang, Xinming Wang, XiaopuLv, *et al. (2014);* Ionic composition of submicron particles (PM1.0) during the long-lasting haze period in January 2013 in Wuhan, Central China, J. Environ. Sci., 26 (4) (2014), pp. 810-817,
7. Harini Nagendra, H. S. Sudhira, Madhusudan Katti, and Maria Schewenius, (2013); Sub-regional Assessment of India: Effects of Urbanization on Land Use, Biodiversity and Ecosystem Services, Ashoka Trust for Research in Ecology and the Environment (ATREE), Karnataka, India.
8. Herman Autrup, (2010); Ambient Air Pollution and Adverse Health Effects, Procedia Social and Behavioral Sciences, Vol. (2); 7333–7338.
9. Houthuijs, D., Bruegelmans, O., Hoek, G., Vaskovi, E., Mihalikova, E., Pastuszka, J. S., Jirik, V., Sachelarescu, S., Lolova, D., Meliefste, K., Uzunova, E., Marinescu, C., Volf, J., de Leeuw, F., v.d.Wiel, H., Fletcher, T., Lebret, E. and Brunekreef, B.: (2001); 'PM10 and PM2.5 concentrations in Central and Eastern Europe: Results from the Cesar study', Atmos. Environ. 35, 2757–2771.
10. Hujia Zhao, Huizheng Che, Xiaoye Zhang, Yanjun Ma, Yangfeng Wang, Hong Wang, Yaqiang Wang, (); Characteristics of visibility and particulate matter (PM) in an urban area of Northeast China, Atmospheric Pollution Research, 4, pp; 427 – 434.
11. Manisalidis Ioannis, Stavropoulou Elisavet, Stavropoulos Agathangelos, Bezirtzoglou Eugenia, (2020); Environmental and Health Impacts of Air Pollution: A Review, Frontiers in Public Health, Vol. 8, (14), pp; 1-14.
12. Marchwinska-Wyrwal, E., G. Dziubanek, I. Hajok, M. Rusin, K. Oleksiuk and M. Kubasiak., (2011); Impacts of Air Pollution on Public Health, The Impact the of air pollution on health, economy, environment and agricultural sources.
13. *Ole Raaschou-Nielsen; et al. (2013).* "Air pollution and lung cancer incidence in 17 European cohorts: prospective analyses from the European Study of Cohorts for Air Pollution Effects (ESCAPE)". *The Lancet Oncology. 14 (9): 813–22.*
14. Pan, X., (2011); Sulfur Oxides: Sources, Exposures and Health Effects in Encyclopedia of Environmental Health.
15. Plainiotis, S.; Pericleous, K.A.; Fisher, B.E.A.; Shier, L., (2010); "Application of Lagrangian particle dispersion models to air quality assessment in the Trans-Manche region of Nord-Pas-de-Calais (France) and Kent (Great Britain)" . International Journal of Environment and Pollution. 40 (1/2/3): 160–174.
16. Randall V. Martin, Michael Brauer, Aaron van Donkelaar, Gavin Shaddick, Urvashi Narain, Sagnik Dey, (2019); No one knows which city has the highest concentration of fine particulate matter, Atmospheric Environment: 3, pp; 1-5.
17. Ren, C., Tong, S. Health effects of ambient air pollution – recent research development and contemporary methodological challenges. Environ Health 7, 56, pp; 1-10.
18. Samad. A., and U. Vogt., (2020): Investigation of urban air quality by performing mobile measurements using a bicycle (MOBAIR), Urban Climate, Vol. 33.
19. Sateesh. N. Hosamane, G. P. Desai, (2013); Urban air pollution trend in India - present scenario, International Journal of Innovative Research in Science, Engineering and Technology (ISO 3297: 2007 Certified Organization) Vol. 2, Issue 8.
20. Srimuruganandam Bathmanabhan, Shiva Nagendra Saragur Madanayak, (2010); Analysis and interpretation of particulate matter – PM10, PM2.5 and PM1 emissions from the heterogeneous traffic near an urban roadway, Atmospheric Pollution Research, 1, pp; 184-194.
21. State of Global Air, (2018); A Special Report on Global Exposure to Air Pollution and Its Disease Burden". *Health Effects Institute. 2018.*
22. Sun., Z and Zhu. D., (2019); Exposure to outdoor air pollution and its human health outcomes: A scoping review. PLoS ONE, Vol. 14(5): pp; 1-18.

23. United Nations (UN), (2004); World Urbanization Prospects: The 2003 Revision, ST/ESA/SER.A/237. Department of Economic and Social Affairs, Population Division, New York.
24. USEPA (United States Environmental Protection Agency), (2016); "Nitrogen dioxide". *United States Environmental Protection Agency.*
25. Vega, E., Reyes, E., Sanchez, G., Ortiz, E., Ruiz, M., Chow, J., Watson, J. and Edgerton, E.: (2002); ‘Basic statistics of PM10 and PM2.5 in the atmosphere of Mexico City’, Sci. Total Environ. 287, 167–176.
26. WHO, (World Health Organisation), (2017); Department of Public Health, Environmental and Social Determinants of Health (PHE), World Health Organization, Avenue, 1211 Geneva, Switzerland.
27. william n. rom, homer boushey and arthur caplan., (2013); experimental human exposure to air pollutants is essential to understand adverse health effects,american journal of respiratory and cell molecular biology, vol. 49(5): 691–696.
28. Zhenyu Du, Kebin He, Yuan Cheng, Fengkui Duan, Yongliang Ma, Jiumeng Liu, *et al.*, (2014); A yearlong study of water-soluble organic carbon in Beijing I: sources and its primary vs. secondary nature, Atmos. Environ., 92, pp. 514-521.