

Impact Assessment of Ambient Air Quality at Enyimba Dumpsite Aba, Abia State Nigeria

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Abstract: Air pollution has continued to be a great concern all over the world due to the negative impact it imposes on human health and welfare. Unless controlled, regulations should be enforced by Abia State Environmental Protection Agency (EPA) to ensure compliance of scavengers dumping refuse in the region of our study to standard rules, else they would deteriorate the fine air quality and thus, threaten the ecosystem of the study area. This Paper characterizes air quality prediction (H_2S , NO_2 , CH_4) over the dumpsite at Enyimba, Aba, Abia State Nigeria and its environs by retrieving meteorological parameters (Temperature, Wind speed, Relative humidity) using Non Dispersive infra red (NDIR) analyzer AZ 77535 with the atmospheric pollutants and the results were compared. The study area covered Lat. $5^{\circ} 6' 50.5''N$ - $5^{\circ} 6' 59''N$ and Long. $7^{\circ} 19' 42.5''E$ - $7^{\circ} 19' 37.7''E$. Our findings indicate that concentrations of air pollutant within the surroundings of the dumpsite are found to be above standards of ambient air quality. The retrieval first present the preliminary stage and maintains diurnal pattern.

Keywords: Air quality, Biomass burning, Dumpsite, EPA, Environment, Pollution.

1. INTRODUCTION

Air pollution has been a major problem in our modern society. This can be attributed to high level of industrialization that is always found in cities and also unlawful conversion of land to dumpsites. [1] reported that there exist significant correlations between polluted environment and certain diseases like lungs cancer, chest pain, nausea and shortness of breath. [2] estimated that 2.4million people die each year from causes attributed to air pollution. Adding to its negative impacts, pollutant air is known to cause injuries to animals, vegetation, metal structures by causing cracks and deterioration [3]. Improper management of solid waste is one of the main causes of environmental pollution and degradation in many cities, especially in developing countries. Many of these cities lack solid waste regulations and proper disposal facilities, including for harmful waste. Such waste may be infectious, toxic or radioactive. Municipal waste dumping sites are designated places set aside for waste disposal. Depending on a city's level of waste management, such waste may be dumped in an uncontrolled manner, segregated for recycling purposes, or simply burnt. Poor waste management poses a great challenge to the well-being of city residents, particularly those living adjacent the dumpsites due to the potential of the waste to pollute water, food sources, land, air and vegetation. The poor disposal and handling of waste thus leads to environmental degradation, destruction of the ecosystem and poses great risks to public health.

[4] and [5] quoted that extreme effects of air pollution include cardiovascular problems and high blood pressure. This can also result to climate change. It became increasingly clear that the observed climate changes are mostly anthropogenic as a result of the enhanced atmospheric greenhouse gas concentrations caused in fossil fuel burning, increase in agricultural and industrial production due to fast growth in human population (eg [6], [7], [8]). [9] assessed the radiation emission from two cities of Lagos State in Nigeria using RADALERT 50. Five sampling stations were monitored and the results obtained recorded a higher emission of $29.80\mu S\text{nh}r^{-1}$. Diurnal measurement of atmospheric pollutants and meteorological datasets were used to quantify Enyimba dumpsite emission rate, using AZ 77535 analyzer and GARMIN GPsmap 76CSX to retrieve its altitude and Coordinates. The objectives of this experiment are to (i) address air quality impact from the

dumpsite. (ii) to identify the possible impact the dumpsite have posed on its surroundings. (iii) to recommend appropriate mitigation measures which could assist people staying around to comply with Nigerian Ambient Air Quality Standards (NAAQS).

Aba located at (5.52°N, 7.49°E) has climate characterized by extreme heat during the day, rapid cooling at night and regular rainfall. Temperatures from observation may rise above 40°C during dry season. And from our assessment, this dumpsite poses all these characteristics to its environs.

From our observations, smoke generated from the dumpsite are being transported to the main road by wind. The impact of such activities would cause road accident and restrict vehicular movement on the road. This might affect business activities within the state. The arial extent of the dumpsite is an indicator of the seriousness of the pollution. Although, environmental factors such as atmospheric pollution from biomass burning, household cooking and water availability may also bias the relationship between pollution and dumpsite emission. It is obvious that the large diversity of dumpsite morphology, climatology, level of activity and economic and social factors complicate a comprehensive comparison between the state urban areas.

2. MATERIALS AND METHODS

Field campaign observations of atmospheric H₂S, CH₄, NO₂ and meteorological dataset of temperature, relative humidity, wind speed, and dew point were carried out at 10 sites in Aba (5.52°N, 7.35°E) with an elevation of 148m for just one day as indicated in table 1. Aba is situated on the South-East region of Nigeria (4.15°N - 7.17°N, 5.05°E - 8.68°E). These meteorological in-situ measurements exhibit large diurnal (Morning, Afternoon and Evening) periods. To measure polluted air samples at the selected stations, we used a Non Dispersive Infra red Radiation meter P.R.O.C AZ77535 for long term continuous retrieval. The measurement obtained from these sites can provide essential information on sources and sink within the city.

3. RESULTS OF ANALYSIS AND DISCUSSION

Analysis performed in this experiment were used to characterize air quality prediction involving H₂S, NO₂, and CH₄ over the dumpsite and its environs by retrieving meteorological parameters (Temperature, Wind speed, Relative humidity) using Non Dispersive infra red (NDIR) analyzer (AZ 77535) with the atmospheric pollutants and the results were compared. Our findings indicate that concentrations of air pollutant are found to be above standards of ambient air quality. Although, this retrieval first present the preliminary stage and maintains diurnal pattern. Further research is still needed to develop reliable emission estimates over the dumpsite.

From results obtained in table 2, we use statistical analyses to observe that locations 3, 5 and 6 have more H₂S emission influence. The same were also observed for CH₄ in table 3. Figures 1 and 2 were used to depict the trends. Although, this bi-variant plot captured the elevations of the locations with pollutants, elevation is simply the angle made from the tropopause to adjacent of the Earths boundary layer. So, using the elevation of locations 3, 5, and 6, it can clearly show the influence.

Table 4 shows location 10 as NO₂ emission zone which also show high temperature in table 5. Figures 3 shows a peak trend despite having a high wind speed and dew point as shown in tables 6 and 7. And the relative humidity analysis using variance captured the water content of location 10. Figures 8 clearly show wind speed influence towards emission transport. Figure 9 shows the comparison between hydrogen sulfide and nitrous oxide emission when checked with elevation. It could be observed from the graph that these pollutants are of higher emission, which indicates dumpsite polluting its environment, mostly when there is lower continental air mass. The results obtained from the analysis are used to characterize the dumpsite and its surroundings.

4. CONCLUSION

Our findings indicate that concentrations of air pollutant are found to be above standards of ambient air quality. From the environmental evaluation conducted, it is obvious that the dumpsite will exposes the residents around it to unacceptable levels of environmental pollutants with adverse health impacts. A high number of children and adolescents living around the dumping site had illnesses related to the respiratory, gastrointestinal and dermatological systems such as upper respiratory tract infections, chronic bronchitis, asthma, fungal infections, allergic and unspecified dermatitis/pruritis –

inflammation and itchiness of the skin. Although, this retrieval first present the preliminary stage and maintains diurnal pattern. Further research is still needed to develop reliable emission estimates over the dumpsite. Regulations should be enforced by Abia State Environmental Protection Agency (EPA) to ensure compliance of scavengers dumping refuse in the region may deteriorate the fine air quality and thus, threaten the ecosystem of the study area.

Table 9 shows the correlation coefficient between the morning and evening measurement. Where temperature and wind speed shows positive relationship.

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APPENDICES-A

Table 1: Summary of the study locations and description

S/N	Station	Latitude (N)	Longitude (E)	Altitude (m)
1.	Alaba village borrowpit	05°06'50.5''	007°19'42.5''	59
2.	Mechanic workshop	05°06'50.3''	007°19'40.8''	70
3.	2 Ubani street	05°05'06''	007°19'37.0''	61
4.	14 Ubani street	05°06'48.8''	007°19'37.0''	61
5.	Behind Salvation Ministry	05°06'50.7''	007°19'37.0''	59
6.	Behind Grace to Grace Church	05°06'52.3''	007°19'35.6''	61
7.	Borrow pit park	05°06'57.0''	007°19'42.9''	67
8.	Behind borrow pit	05°06'58.6''	007°19'40.8''	62
9.	Adjacent borrow pit	05°06'59.0''	007°19'37.7''	63
10.	Akwu Akokwa street	05°06'59.0''	007°19'37.7''	64

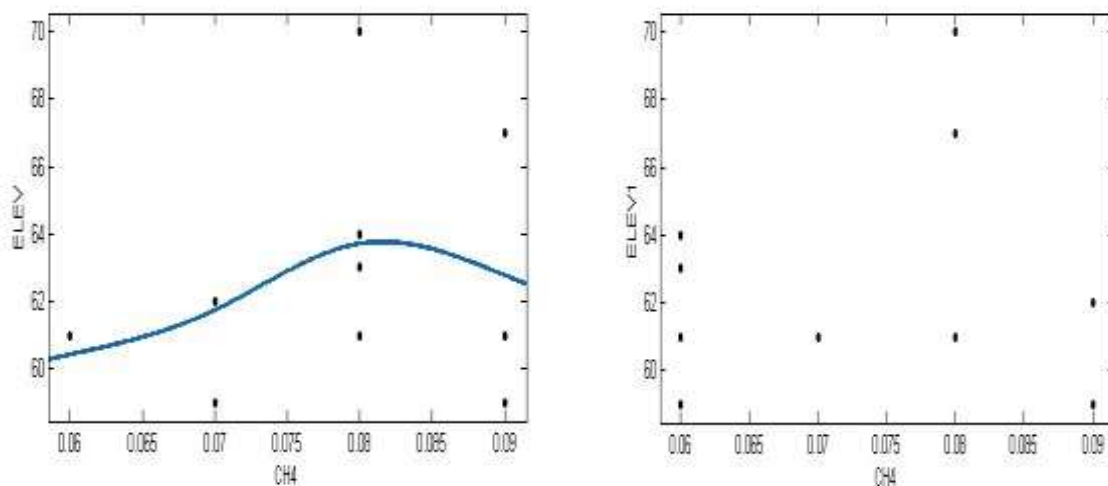
Table 2: Statistical characteristics of observed H₂S over selected stations

Station	A_o	σ_o	$S_{\bar{X}}^2$
1. Alaba villege borrowpit	19.82	2.15	4.62
2. Mechanic workshop	19.07	4.34	18.84
3. 2 Ubani street	21.20	2.82	7.96
4. 14 Ubani street	19.99	0.01	0.00
5. Behind Salvation Ministry	21.40	0.15	0.02
6. Behind Grace to Grace Ch.	21.25	2.71	0.13
7. Borrow pit park	20.64	0.93	0.87
8. Behind borrow pit	18.66	3.77	14.20
9. Adjacent borrow pit	19.61	0.56	0.32
10. Akwu Akokwa street	20.88	1.25	1.56

Note: A_o = average, σ_o = standard deviation, $S_{\bar{X}}^2$ = variance,

Table 3: Statistical characteristics of observed CH₄ over selected stations

Station	A_o	σ_o	$S_{\bar{X}}^2$
1. Alaba villege borrowpit	0.08	0.02	0.00
2. Mechanic workshop	0.08	0.00	0.00
3. 2 Ubani street	0.07	0.00	0.00
4. 14 Ubani street	0.07	0.00	0.00
5. Behind Salvation Ministry	0.09	0.01	0.02
6. Behind Grace to Grace Ch.	0.08	0.01	0.00
7. Borrow pit park	0.09	0.00	0.00
8. Behind borrow pit	0.08	0.01	0.00
9. Adjacent borrow pit	0.07	0.01	0.00
10. Akwu Akokwa street	0.07	0.01	0.00

**Figure 1: Diurnal distribution of methane over dumpsite elevation.**

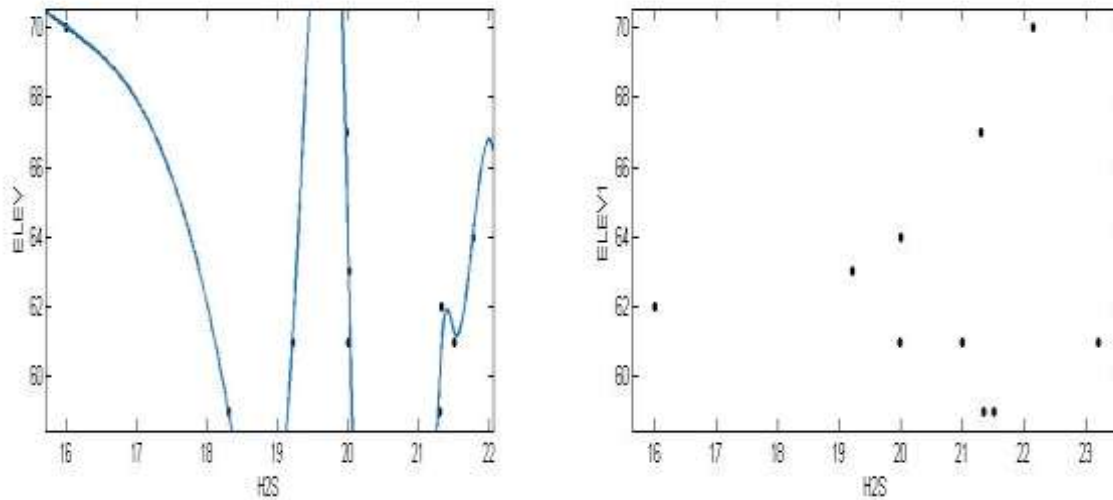


Figure 2: Variations of hydrogen sulphide with dumpsite.

Table 4: Statistical characteristics of observed NO₂ over selected stations

Station	A_o	σ_o	$S_{\bar{X}}^2$
1. Alaba villege borrowpit	3.91	0.13	0.01
2. Mechanic workshop	3.76	0.01	0.13
3. 2 Ubani street	3.69	0.02	0.04
4. 14 Ubani street	3.83	0.44	0.19
5. Behind Salvation Ministry	3.52	0.35	0.12
6. Behind Grace to Grace Ch.	3.75	0.30	0.09
7. Borrow pit park	3.79	0.40	0.16
8. Behind borrow pit	3.79	0.26	0.07
9. Adjacent borrow pit	3.93	0.10	0.00
10. Akwu Akokwa street	4.01	0.02	0.00

Table 5: Statistical characteristics of observed Temperature over selected stations

Station	A_o	σ_o	$S_{\bar{X}}^2$
1. Alaba villege borrowpit	29.60	0.85	0.72
2. Mechanic workshop	29.65	0.92	0.85
3. 2 Ubani street	30.05	0.92	0.85
4. 14 Ubani street	29.40	0.85	0.72
5. Behind Salvation Ministry	30.20	0.14	0.98
6. Behind Grace to Grace Ch.	30.70	0.00	0.00
7. Borrow pit park	27.55	1.34	1.81
8. Behind borrow pit	28.00	2.12	4.50
9. Adjacent borrow pit	30.30	1.41	2.00
10. Akwu Akokwa street	32.30	4.53	20.48

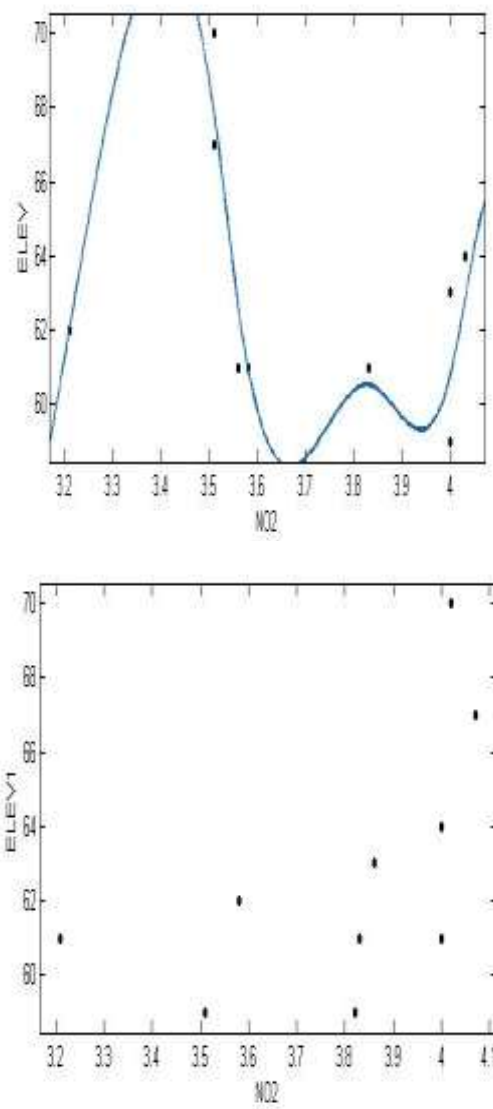
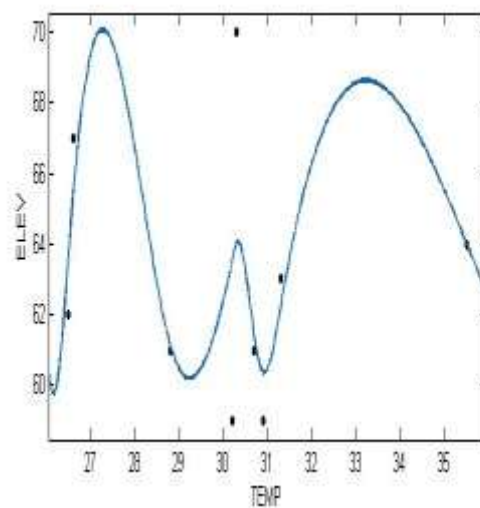


Figure 3: variation of Nitrogen oxide with elevation.



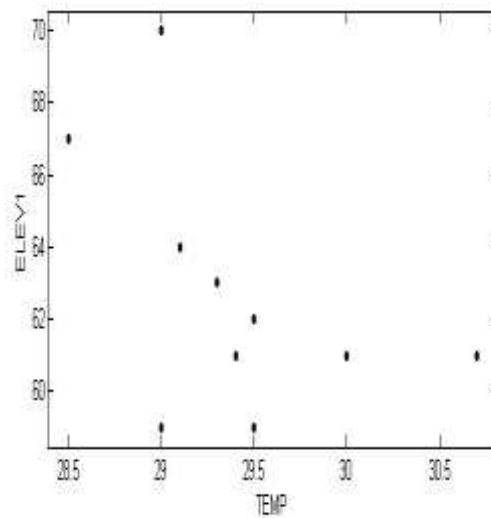


Figure 4: Temperature variation with elevation.

Table 6: Statistical characteristics of observed Wind Speed over selected stations

Station	A_o	σ_o	$S_{\bar{x}}^2$
1. Alaba villege borrowpit	1.00	0.28	0.08
2. Mechanic workshop	0.90	0.14	0.02
3. 2 Ubani street	1.00	0.00	0.00
4. 14 Ubani street	1.00	0.14	0.02
5. Behind Salvation Ministry	0.80	0.14	0.02
6. Behind Grace to Grace Ch.	0.90	0.35	0.13
7. Borrow pit park	1.15	0.21	0.05
8. Behind borrow pit	1.20	0.14	0.02
9. Adjacent borrow pit	1.30	0.00	0.00
10. Akwu Akokwa street	1.25	0.07	0.00

Table 7: Statistical characteristics of observed Dew Point over selected stations

Station	A_o	σ_o	$S_{\bar{x}}^2$
1. Alaba villege borrowpit	27.65	0.77	0.61
2. Mechanic workshop	27.60	0.00	0.00
3. 2 Ubani street	27.25	0.35	0.13
4. 14 Ubani street	26.10	0.57	0.32
5. Behind Salvation Ministry	28.55	1.77	3.13
6. Behind Grace to Grace Ch.	28.25	0.35	0.13
7. Borrow pit park	26.95	0.21	0.05
8. Behind borrow pit	27.40	0.57	0.32
9. Adjacent borrow pit	26.95	0.77	0.61
10. Akwu Akokwa street	27.90	1.84	3.38

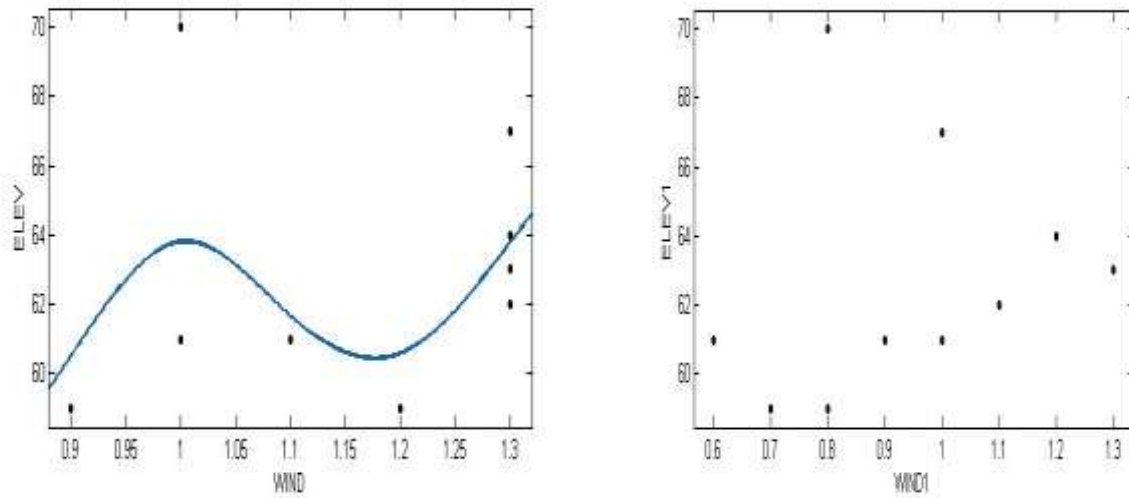


Figure 5: Wind speed variation over dumpsite elevations.

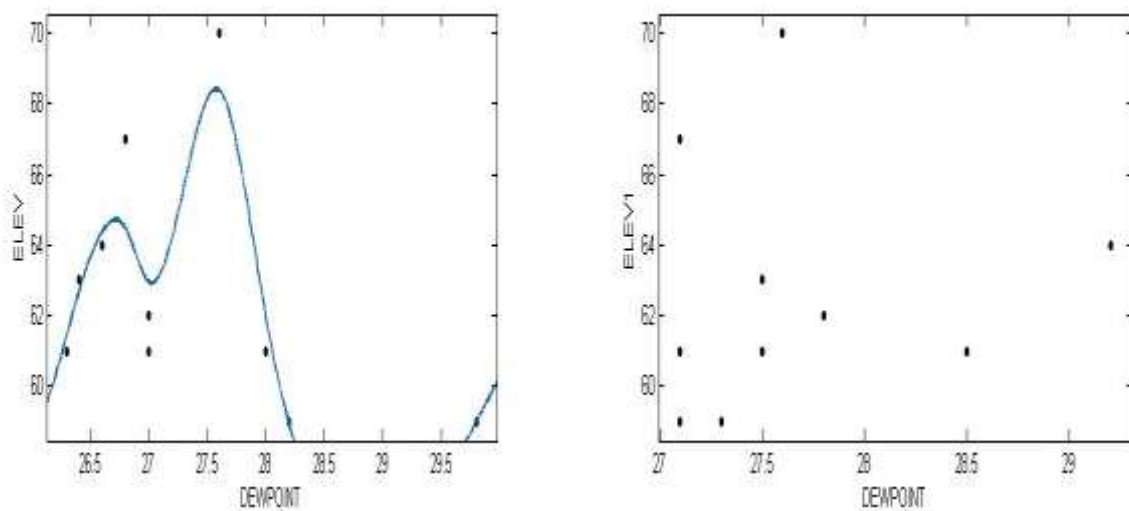


Figure 6: Dew point variations with elevation

Table 8: Statistical characteristics of observed Relative Humidity over selected stations

Station	A_o	σ_o	S_x^2
1. Alaba villege borrowpit	89.10	0.28	0.08
2. Mechanic workshop	89.10	4.66	21.78
3. 2 Ubani street	88.25	3.89	15.13
4. 14 Ubani street	89.50	7.21	52.02
5. Behind Salvation Ministry	88.90	0.42	0.18
6. Behind Grace to Grace Ch.	87.80	1.84	3.38
7. Borrow pit park	85.40	6.51	42.32
8. Behind borrow pit	84.60	6.65	44.18
9. Adjacent borrow pit	86.80	6.36	40.50
10. Akwu Akokwa street	87.90	10.75	115.52

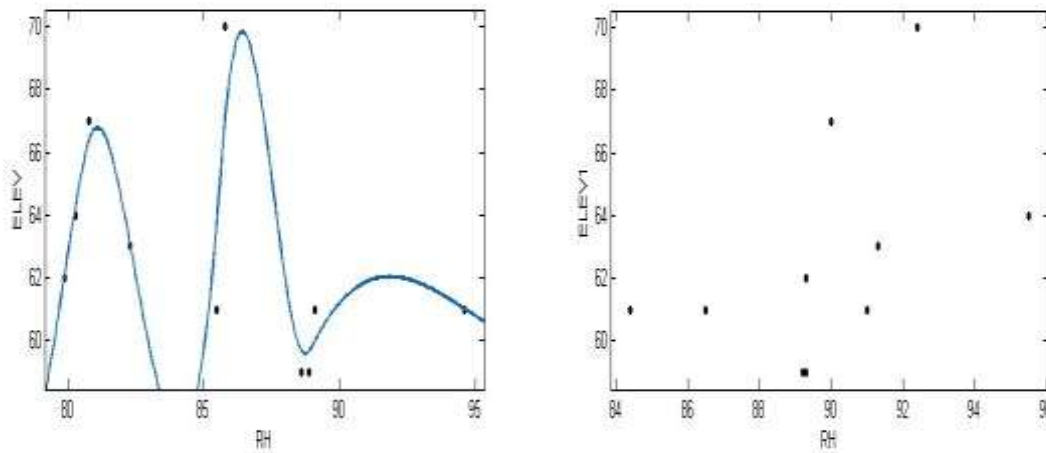


Figure 7: Relative humidity variation with dumpsite.

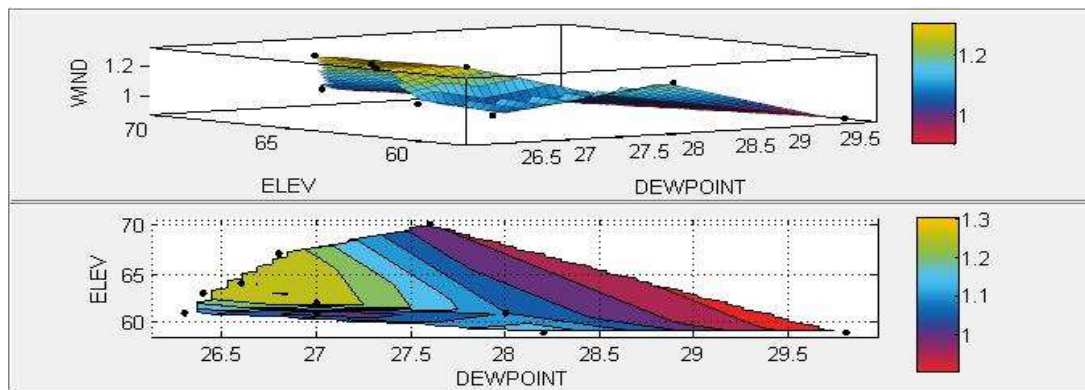


Figure 8: A 3D capture indicating that wind speed transports emission to surroundings.

Table 9: Correlation coefficient of the diurnal observed measurement

Parameter	R
1. H ₂ S	-0.47
2. CH ₄	-0.15
3. NO ₂	-0.11
4. Temperature	0.07
5. Wind speed	0.69
6. Dew point	-0.14
7. Relative humidity	-0.73

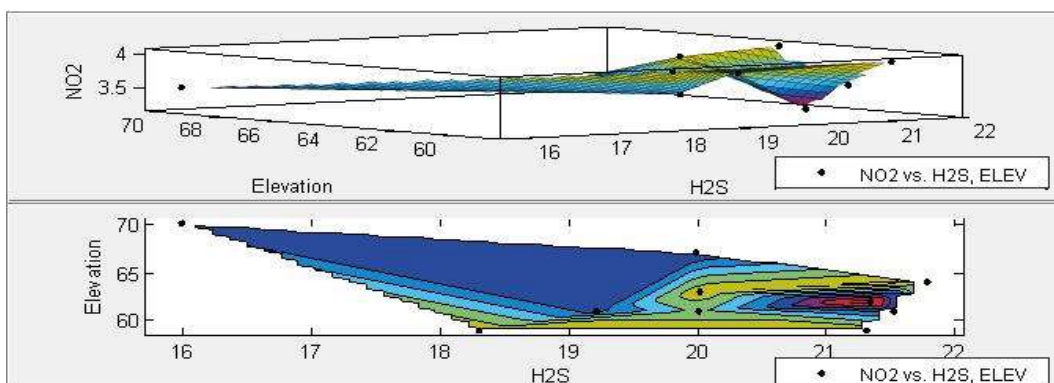


Figure 9: 3 Dimension display of pollutants with elevation.