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RESEARCH ARTICLE

Spatial-Temporal Analysis of Air Pollutant Concentrations in Relation to Land Use and School Environment

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ABSTRACT

Excessive exposure schoolchildren to air pollution can lead to long-lasting health problems, allergies and respiratory disease. It is well known that the major factors contributing to increase of air pollution are motor vehicles and industries. Thus, it is important to analyze the spatial temporal air pollutant concentrations and its relation with school location as the location of schools and its surrounding can increase their exposure. In this study, six schools in Johor were selected and the land use surrounding the schools were updated using ArcGIS. The Inverse Distance Weighting (IDW) interpolation technique was used to identify which schools' area in Johor has a higher range of air pollutant concentration. There are four air pollution parameters obtained from the Department of Environment (DOE) which are PM2.5, CO, O3 and SO2. Hourly air pollutant concentration reading was obtained from the DOE in order to analyze air pollutant concentration during school period. The results obtained from the IDW technique showed that Sekolah Menengah Pasir Gudang (2) located in Pasir Gudang, Malaysia has reached a very unhealthy and hazardous level as compared to other schools in Johor. On the other hand, Sekolah Menengah Kebangsaan Tanjung Pengelih, Pengerang, Malaysia showed good to unhealthy range as compared to other schools in Johor. The spatial autocorrelation tool was used to analyze the relationship between the air pollution concentration and the school's location in Johor. The results showed that the Moran's Indices is positive showing a strong relationship that is clustering. It can be stated that there is a relationship between air pollutant concentrations with the school locations.

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Introduction

Air pollution can be well-defined as the term that contains a combination of thousands of components from a wide range of various sources. Air pollution has appeared as one of the main factors that lead to problem health especially in urban areas.

Theoretically, air pollution for both industrial processes and vehicles maintain a high correlation with energy consumption. For example, the main source of many main pollutants which include sulphur dioxide (SO_2) and carbon monoxide (CO) are due to the combustion of fossil fuel [1]. Hence, the major pollutants that have caused a serious effect on human physical condition include airborne

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particulate matter (PM) and other gaseous pollutants which include nitrogen monoxide (NO), ozone (O_3), SO_2 and CO [2]. There are two types of air pollution which are indoor and outdoor air pollution. Indoor pollution is defined as the presence of pollutants such as particulate matter, inflammable organic compounds, mineral, biological, physical and chemical factors in the indoor air of non-industrial buildings. Basically, children are very vulnerable to environmental exposures since most of them are still growing up [3].

It has been stated that the main factor that increases the level of pollution is due to the rapid growth of motor vehicle traffic and immediate growth of industrialization, especially in the urban area. It has been proved that the main sources of air pollutants that affect the environment include the emissions from the automobile, current generators and factories activities, road and building construction activities such as mining. Moreover, the main source of fine and ultrafine particles is mainly due to motor vehicles which brings a negative effect especially on urban air quality and human health [4]. The most concerning major of air pollutants include carbon monoxide, carbon dioxide, nitrogen oxide, sulfur oxide, noise, particulate matter and volatile organic compounds such as benzene, polycyclic hydrocarbons and formaldehyde [5]. Moreover, it stated that air pollution is intensely influenced by socioeconomic aspects which have been established to maintain a high correlation with air pollution.

Various pollutants can affect the health of humans, especially to schoolchildren during their important development phases. Based on [6], the location of schools can increase their exposure. Exposing students to pollutants will result in a serious health problem such as breathing problems, cancers, allergies, respiratory disease and cardiovascular issues especially when the pollutant reaches the permissible limits [7]. According to [8], the most susceptible to the effects of air pollution are usually children and adolescents compared to adults. Exposure to air pollution at an early stage especially children will cause a serious effect thus generate the environmental allergies [9].

Therefore, immediate action is required in order to protect students from being exposed to air pollution hence a strategy or plan to reduce the air pollution must be taken, reduce the number of students being exposed with the pollutant and monitor the pollutant. Monitoring air quality is necessary in order to control the air pollution. It is significant to measure air pollution in order to understand the risk of exposure around the school environment since all the pollutants from different sources affect the human health, comfort and student presentation and workers in a negative way because it brings harm and negative impact especially on memory and concentration of student [10]. Next, it has been recognized that the Air Pollution Index (API) is one of the air pollution fundamental indicators that used to record the interface between air pollution and human health [11].

In this study, GIS is used to analyze the air pollution in accordance with the selected schools located in Johor. Generally, the spatial-temporal and interpolation method has been applied in this study. Studying and analyzing the current status of air quality is important to assist in identifying the main air pollution issues thus through this identification, an awareness about the air pollution can be raised among the society especially among students. It is stated that different levels of sub-indexes signify different effects on human health [11]. The aim of this study is to analyze the air pollutant concentration in relation to the location of the selected schools in Johor from January 2018 to December 2018.

Methodology

The flowchart in Figure 1.0 shows the research methodology from data collection to map production. The first phase is data collection where air pollution parameters were obtained from the Department of Environment (DOE) Malaysia and the land use of Johor area were obtained from BBBike open street map (OSM) and Google Earth. In this research, the air pollution parameters obtained are particulate matter ($PM_{2.5}$), carbon monoxide (CO), Oxides (O_3) and Sulphur dioxide ($S0_2$). The next phase is data cleaning which has been performed for the air pollution dataset in order to remove outlier and unwanted data. The data processing phase involves two methods which are Inverse Distance Weight (IDW) spatial interpolation and Spatial Autocorrelation. The result analysis for these two methods will be presented on map.

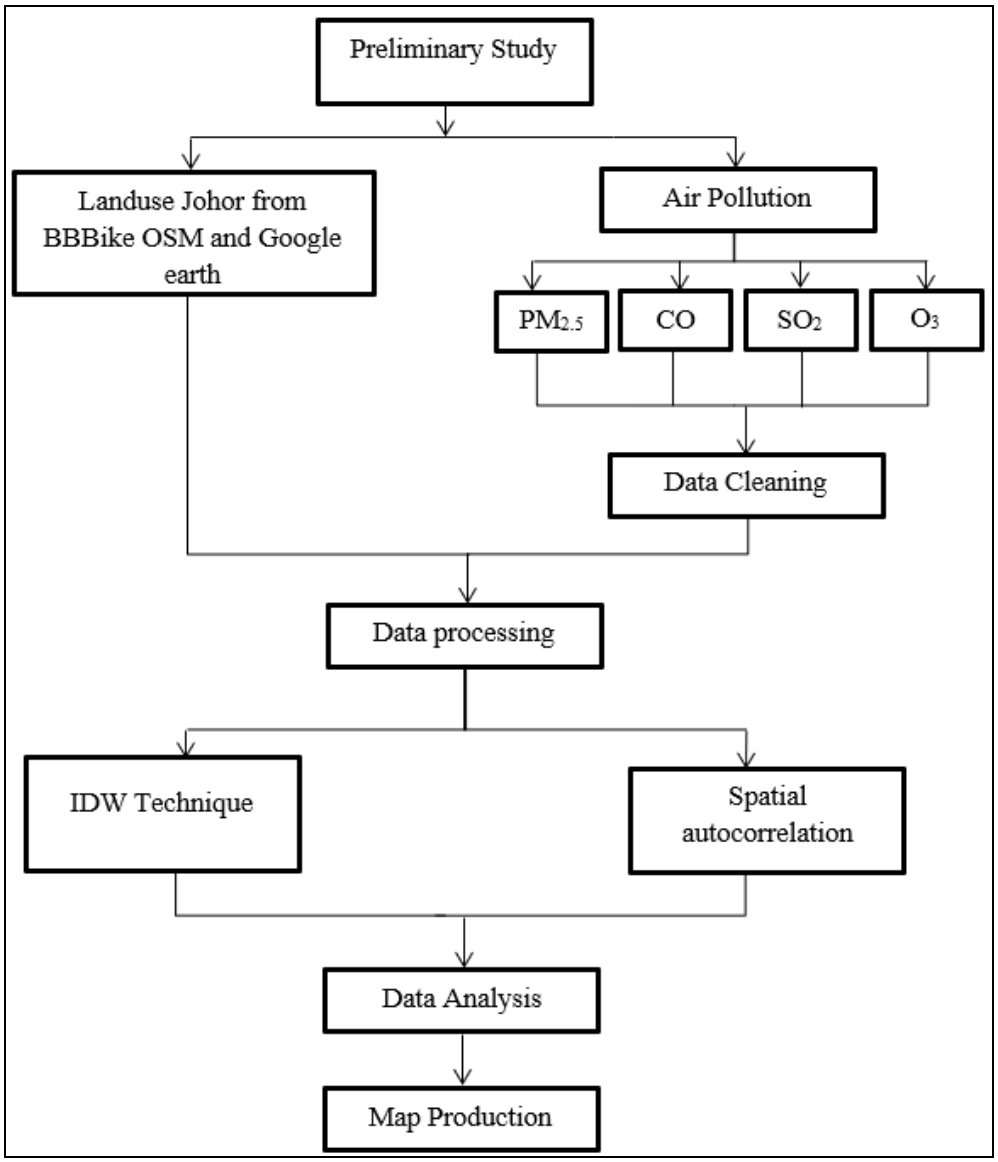

Figure 1. Research Methodology

Data Collection

The air pollution parameters were obtained from the Department of Environment (DOE), Malaysia. Generally, the air pollution index is calculated according to 24 hours data retrieved from the Air Quality Monitoring network from all over the country. Moreover, the air pollution index is updated hourly and the data retrieval process requires a complete cycle of one hour before the Air Pollution Index reading can be acquired. Through DOE references, due to the major existence of air pollutants the selected pollutants were measured, which is correlated with the criteria pollutants from other countries and the WHO [12]. The hourly data parameter obtained includes $PM_{2.5}$, CO, O_3 and SO_2 and the selected schools in this research includes Sekolah Kebangsaan Pasir Gudang (2), Pasir Gudang, Sekolah Menengah Kebangsaan Bandar Putra, Segamat, Sekolah Menengah Kebangsaan Bandar Penawar, Kota Tinggi, Sekolah Menengah Kebangsaan Tanjung Pengelih, Pengerang, Sekolah Menengah Teknik Johor Bahru, Larkin and Sekolah Kebangsaan Seri Separap, Batu Pahat. The hourly data obtained are starting from 7am until 5pm based on the selected six school locations.

Land use from BBBike OSM and Google Earth

The school location and its surrounding land use were taken from BBBike OSM which is one of the open sources that provide a basemap of Johor and the details of the school surrounding are digitized from Google earth. The BBBike open source provides a layer of points, places, waterways, road, railways, natural, land use and building of the entire Johor. Figure 2 shows the land use of Johor downloaded from the BBBike Open street map. Since not all features are available in this open street map, therefore other features were digitized from Google earth with various layers that represent the tree, path for the road and polygon for the building. The location of the school and its surrounding are identified then further analysis was performed corresponding to the air pollutant concentration reading.

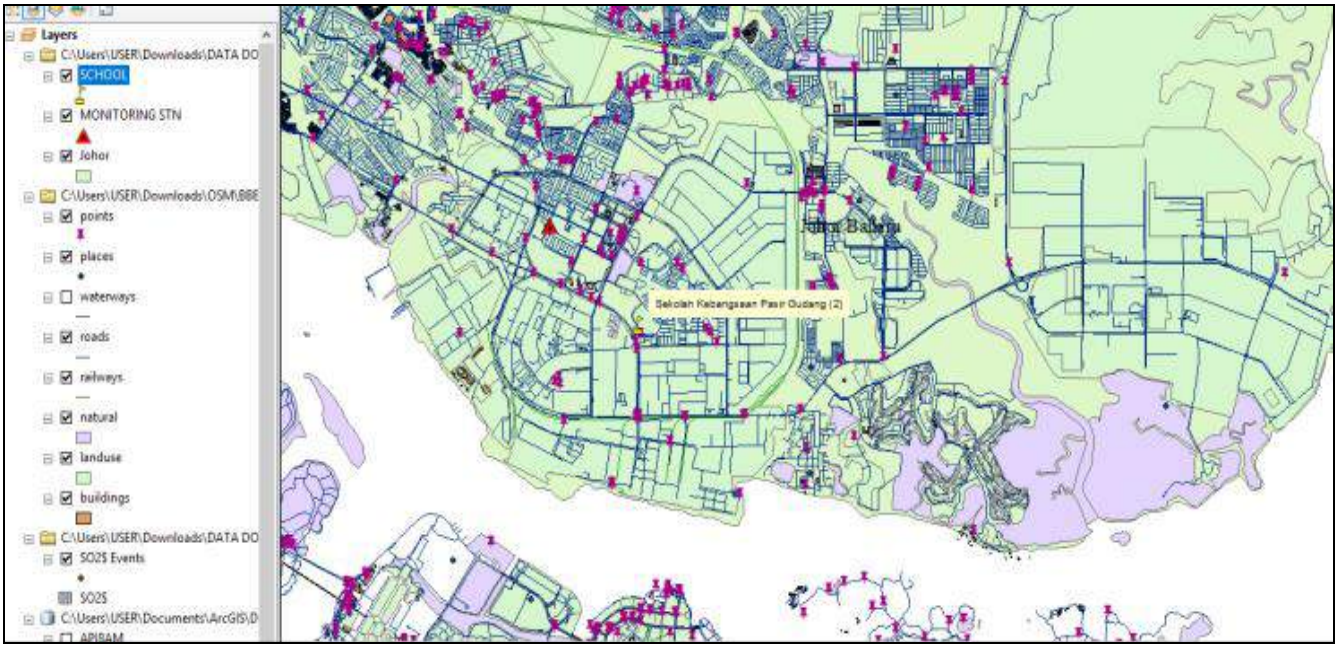

Figure 2. Land use of Johor

Data Cleaning

Data cleaning is done to remove the unavailable and unwanted data. The final output of this process is getting the daily data for six monitoring stations in Johor from 7am to 5pm.

Data Processing using Geography Information System (GIS)

The data is processed using interpolation geostatistical methods and the software used is ArcGIS 10.6. Interpolation method assumes the value for the cells in a raster by using a limited number of sample point's data points that assist in predicting the unknown values for any geographic station [13]. In this research, Inverse Distance Weighted (IDW) was chosen to estimate the concentration of air pollution at the unknown location. Moreover, this method of GIS has been used to perform interpolation with the help of concentration data on air quality at school locations in Johor. Through this method, the relationship between the air pollutant concentration and the school location can be analyzed and justified. Hence, the most polluted school area can be identified. The final output can be seen once the interpolation technique is performed and displayed on the map.

1. Inverse Distance Weighted (IDW)

The data is processed using interpolation geostatistical methods which are one of the GIS components. The main software used in this research is ArcGIS10.6. Interpolation method assumes the value for cells in a raster by using a limited number of sample point data points that assist in predicting the unknown values for any geographic station [13]. Furthermore, interpolation geostatistical methods allow the construction of a map that displays the variability continuously of an analyzed feature. Various applications of interpolation methods will result in different valuations of parameter values at interpolation points and thus to the creation of different maps that present changes in the values of the analyzed parameter. In this task, Inverse Distance Weighted (IDW) was chosen to estimate the concentration of air pollution at the unknown station. In addition, the technique IDW of GIS has been used in this study to perform interpolation with the help of concentration data on air quality at school locations in Johor. Through this method used, the relationship between the air pollutant concentration and the school location can be analyzed and justified. Hence, the most polluted school area can be identified. Finally, the final output can be seen once the interpolation technique is performed and displayed on the map.

2. Spatial Autocorrelation

In this study, spatial autocorrelation method was used to identify the relationship between the readings of the air pollution parameter obtained from the monitoring station with the school surrounding. Spatial autocorrelation is used to analyze the spatial distribution pattern of air pollution. Moreover, positive spatial autocorrelation shows the same similar neighboring values whereas negative spatial autocorrelation shows the different values. Moran's I statistic and other measurement such as Geary's C are commonly used to measure the spatial autocorrelation. Global Moran's I statistics is used to test the present of spatial autocorrelation by using Moran's I statistic [14].

The analysis was done by analyzing the school location and its surrounding either it is located near a busy road, residential area, industrial area or vice versa. In addition, the identification was done by analyzing the selected duration which is from 7am until 5pm. The relationship

between time and its surrounding can be seen according to the reading of the air pollutant concentration result based on interpolation method results. Therefore, spatial autocorrelation is used and this identification can be performed by using Global Moran's I tool in ArcMap whether the result is disposal, random or clustered. The spatial distribution of pollutants is observed to limit to 1km radius based on the digitized features in Google earth.

In addition, the identification was done by analyzing the selected time duration which is from 7am until 5pm. Generally, spatial autocorrelation can identify the pattern and hotspots. The relationship between time and the surrounding can be seen according to the reading of the air pollutant concentration result based on the interpolation method result. Therefore, spatial autocorrelation is used and this identification can be performed by using Global Moran's I technique in ArcMap whether the result is disposal, random or clustered. According to [15], applying global Moran's I estimated vehicle emissions for main traffic routes and evaluated spatial patterns. The spatial distribution of pollutants is observed to limit to 1km radius based on the digitized features in Google earth.

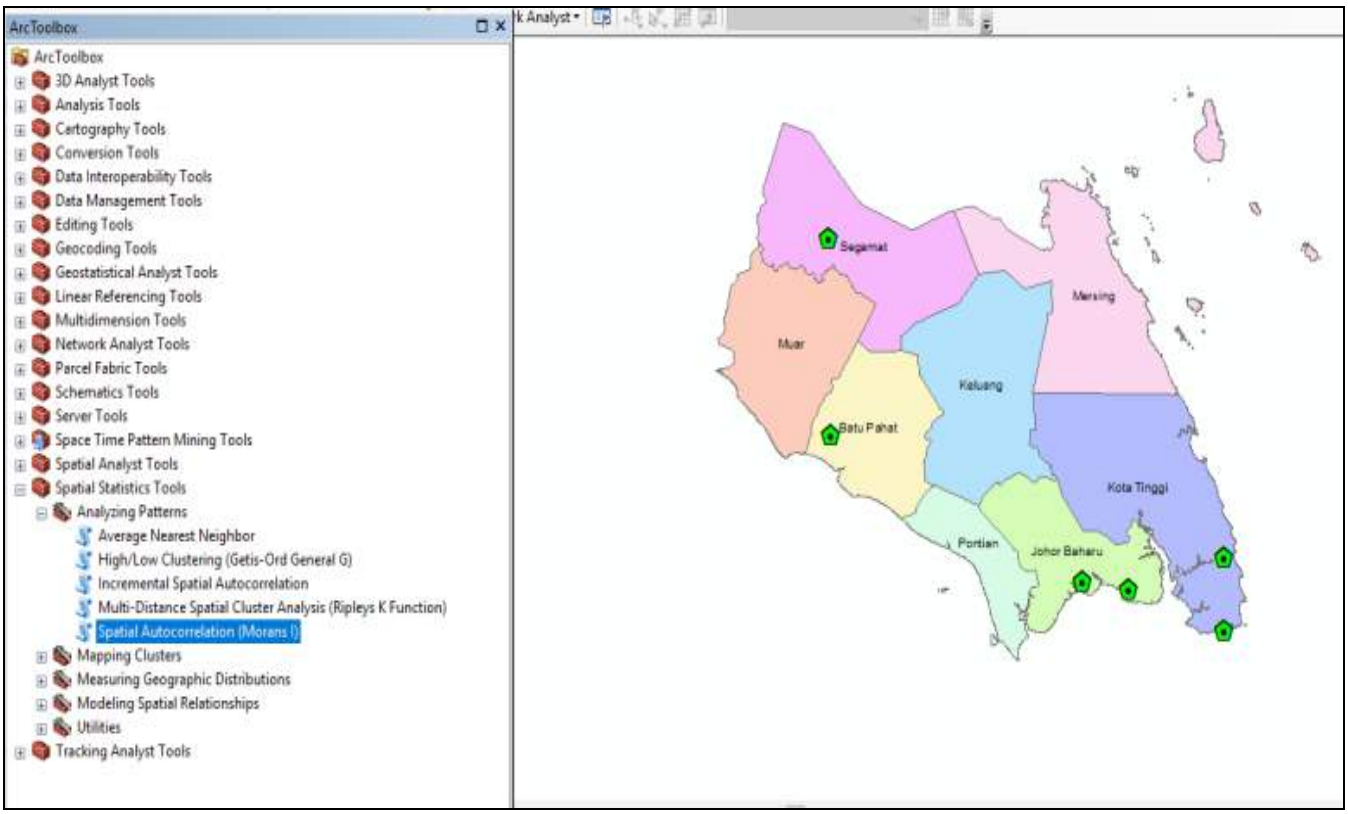

Figure 3. Spatial autocorrelation (Morans I) tools

Figure 3 shows the spatial autocorrelation process where it observed how well an object correlates with other nearby objects across a spatial area. In this study, Inverse distance was selected which enabled nearby neighboring features to have a larger influence on the computations for a target feature than features that are far away. Global Moran's statistics are applied for the spatial autocorrelation analysis in ArcGIS. Moran's I with p-value and Z-score are calculated to test the spatially clustered tendency between the air pollution and the surrounding school area.

Result and Discussion

Digitization of Land Use from Google Earth

In this study, the digitization is used to trace features on Google Earth which involve school building, commercial and industrial building. The selected schools in Johor includes Sekolah Menengah Teknik Johor Bahru Larkin, Sekolah Kebangsaan Pasir Gudang (2), Sekolah Kebangsaan Separap Batu Pahat, Sekolah Menengah Kebangsaan Bandar Putra Segamat, Sekolah Menengah Kebangsaan Tanjung Pengelih Pengerang and Sekolah Menengah Kebangsaan Bandar Penawar Kota Tinggi. The digitization process covers one kilometer radius from school area as shown in figure 4.

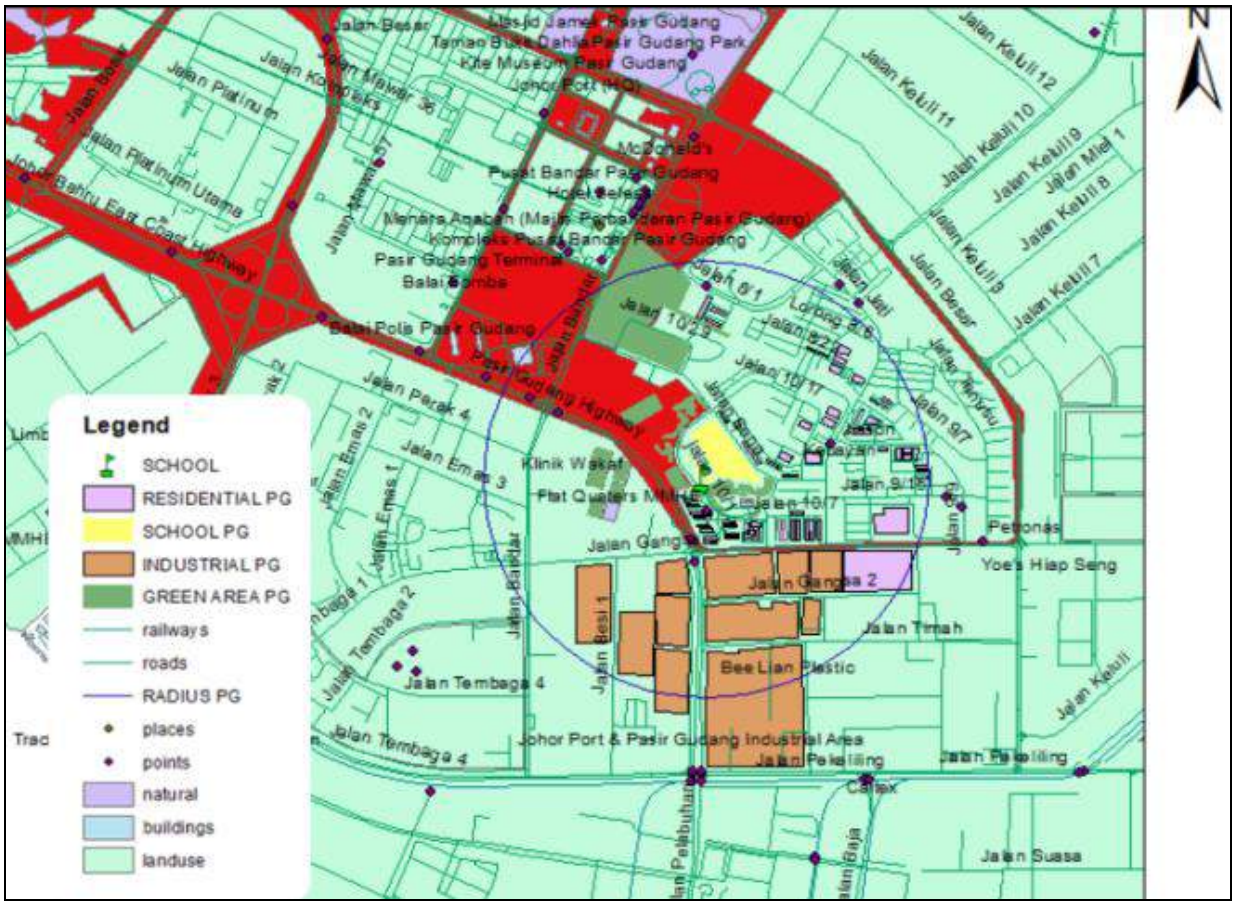

Figure 4 Updating the land use area in Pasir Gudang

Results of IDW Interpolation

The IDW interpolation results show variation of air pollution level for each hour. Referring to Figure 5, the air pollutant concentration status. Based on [1], the API is the model used to gauge the level of ambient air pollution.

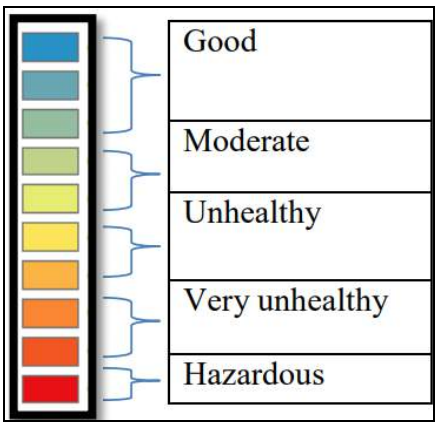

Figure 5 API indicator

IDW is a deterministic assumption method where values at unmeasured points are determined by a linear combination of values at nearby measured points. The derived results for each parameter show different color ranges from good to hazardous status.

1. IDW Interpolation of Particulate Matter 2.5 ($PM_{2.5}$)

Figure 6 shows the IDW mapping for $PM_{2.5}$ concentration reading for each hour. It can be observed that the most polluted area is located at Pasir Gudang and Larkin area since it reaches the hazardous status most of the time starting from 7am until 5pm. On the other hand, Pengerang and Kota Tinggi areas maintain their good status by showing lower air pollutant concentration reading. It can be concluded that the $PM_{2.5}$ is mostly released in Sekolah Kebangsaan Pasir Gudang (2) and Sekolah Menengah Teknik Johor Bahru, Larkin area in 2018.

$PM_{2.5}$ concentration at Sekolah Menengah Kebangsaan Bandar Putra, Segamat starts to increase from 10 am until 2pm and slowly decreases. Whereas, $PM_{2.5}$ concentration at Sekolah Kebangsaan Seri Separap, Batu Pahat starts to rise early at 7am until 8am slowly decreasing and rises again at 10am but slowly reduces again onwards. It can be concluded that the range of the $PM_{2.5}$ concentration is affected by the operating hour of the school especially when involving two sessions which are morning and evening sessions. Basically, $PM_{2.5}$ primarily from combustion sources which include exhaust gas from traffic that occur during operating hours and when exposed to children will cause a serious effect thus generate the environmental allergies and bring harm to human health.

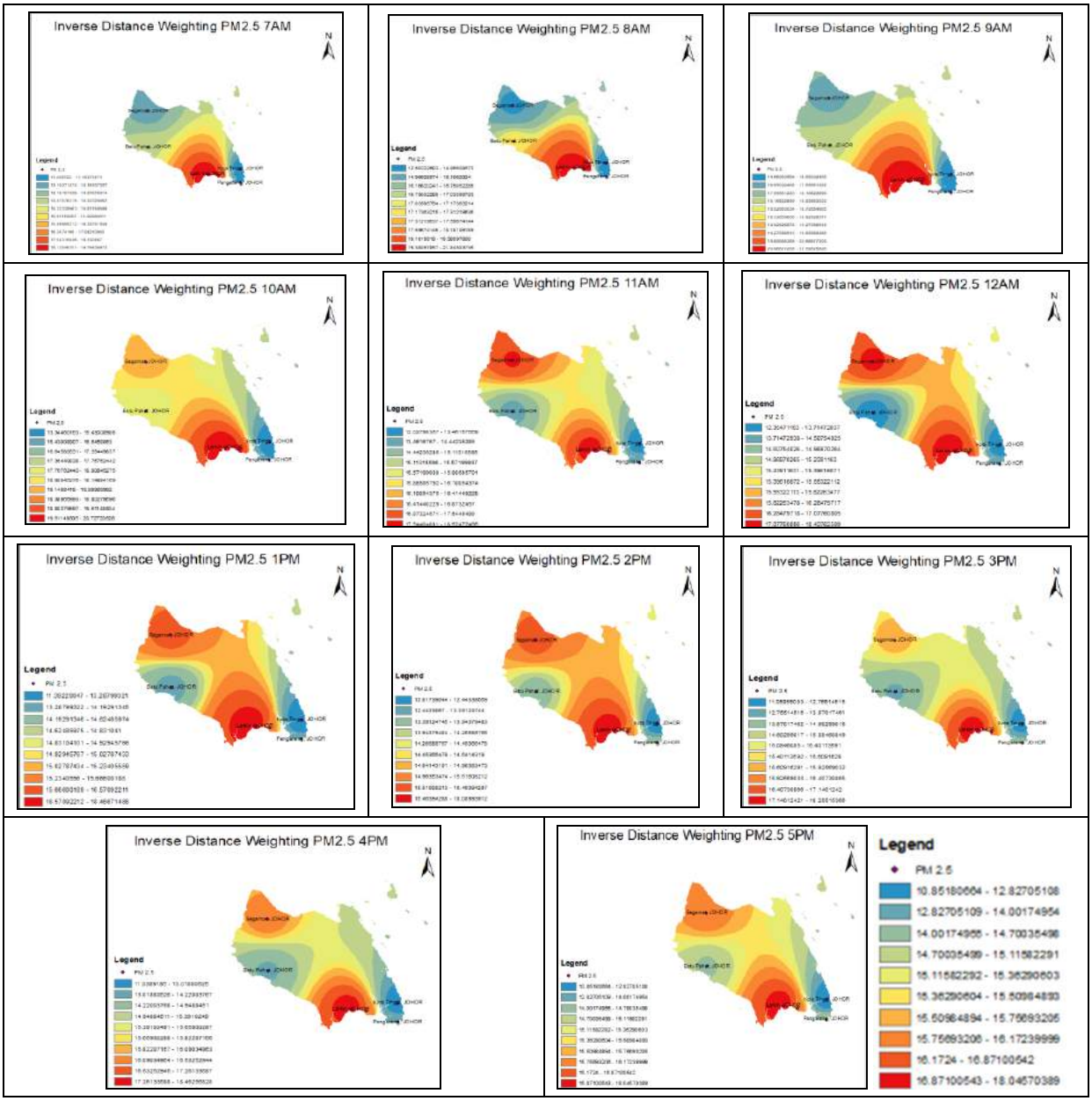

Figure 6. IDW mapping of $PM_{2.5}$

2. IDW Interpolation of Oxides (O_3)

Based on the O_3 observation, Sekolah Menengah Kebangsaan Bandar Putra, Segamat and Sekolah Kebangsaan Pasir Gudang (2), Pasir Gudang has the highest range value of air pollutant concentration from 7am until 5pm where it reaches hazardous level the entire operation hours compare to other school in Johor. Next, for Sekolah Kebangsaan Seri Separap Batu Pahat, the O_3 concentration started to increase at 7am until 5pm where it reached an unhealthy level during operation hours. As for O_3 concentration level at Sekolah Menengah Teknik Johor Bahru Larkin shows increasing levels until it reaches unhealthy and hazardous levels and slowly starts to reduce after 2pm. Meanwhile, the O_3 concentration in the Kota Tinggi school area started to increase from 7 am until 10am and slowly reduced from 11am until 5pm.

The increasing value of API is due to increasing of ozone concentrations which resulting solar radiation, study has been made where concentration of O_3 gradually increase after sunrise, coinciding with the increasing solar radiation from 7am onward and the result show that the API value is high at 10am until 5pm equivalent with the study made by [16]. The lowest O_3 concentration can be seen at Sekolah Menengah Kebangsaan Tanjung Pengelih, Pengerang. According to [2], O_3 concentration in outdoor air depends on the exchange between upper and lower layers of atmosphere and involves nitrogen oxides and VOCs for the photochemical reactions. Besides traffic, O_3 source also comes from indoors where O3 is released into the air through some office equipment such as laser printers and other electrostatic air cleaners. Significantly, short-term exposure to O_3 associated with increased hospitalization in children. A high level of O_3 has been shown to not only contribute to the exacerbation of asthma but also be a cause in the development of asthma.

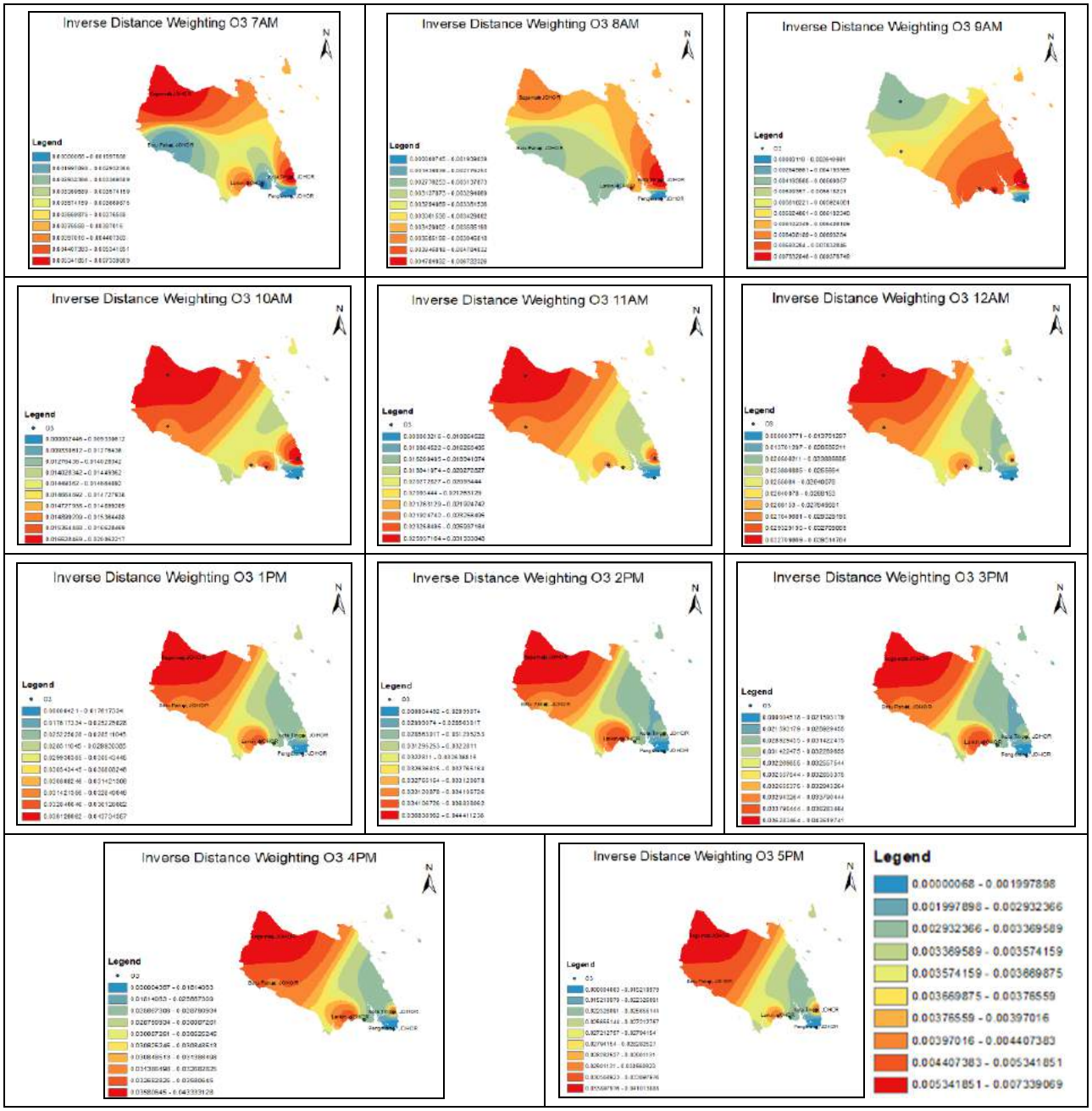

Figure 7. IDW interpolation of O_3

3. IDW Interpolation of Carbon Monoxide (CO)

As for the IDW interpolation of CO results show that the concentration of CO started to increase at 7am in Sekolah Kebangsaan Pasir Gudang (2), Sekolah Kebangsaan Separap Batu Pahat and Sekolah Menengah Kebangsaan Bandar Putra Segamat compare to other school area. The CO concentration continues to increase for SMK Bandar Putra Segamat area and reach hazardous levels most of the time. Whereas for Sekolah Kebangsaan Pasir Gudang (2), the CO concentration shows very unhealthy range level and at am reach hazardous level but start to decrease slowly and rise again in the afternoon. On the other hand, SMK Tanjung Pengelih Pengerang and SMK Bandar Penawar Kota Tinggi show lower concentration of CO compared to other school area. However, CO concentrations start to increase at SMK Bandar Penawar Kota Tinggi area at 10am and maintain an unhealthy level according to API indicators.

According to range level of CO concentration, the increase of range value is due to the busy road since carbon monoxide is a vehicular pollutant, therefore vehicle exhaust from the roads and parking areas that existed nearby school buildings represents the most important contributor to CO indoor exposure. Excessive exposure to this pollutant concentration can cause acute intoxication since this compound can combine with the haemoglobin in human blood which then produce carboxyl-haemoglobin hence disrupts the transfer of oxygen to human tissues. Early precautions should be taken in order to prevent students from being affected by this pollutant concentration.

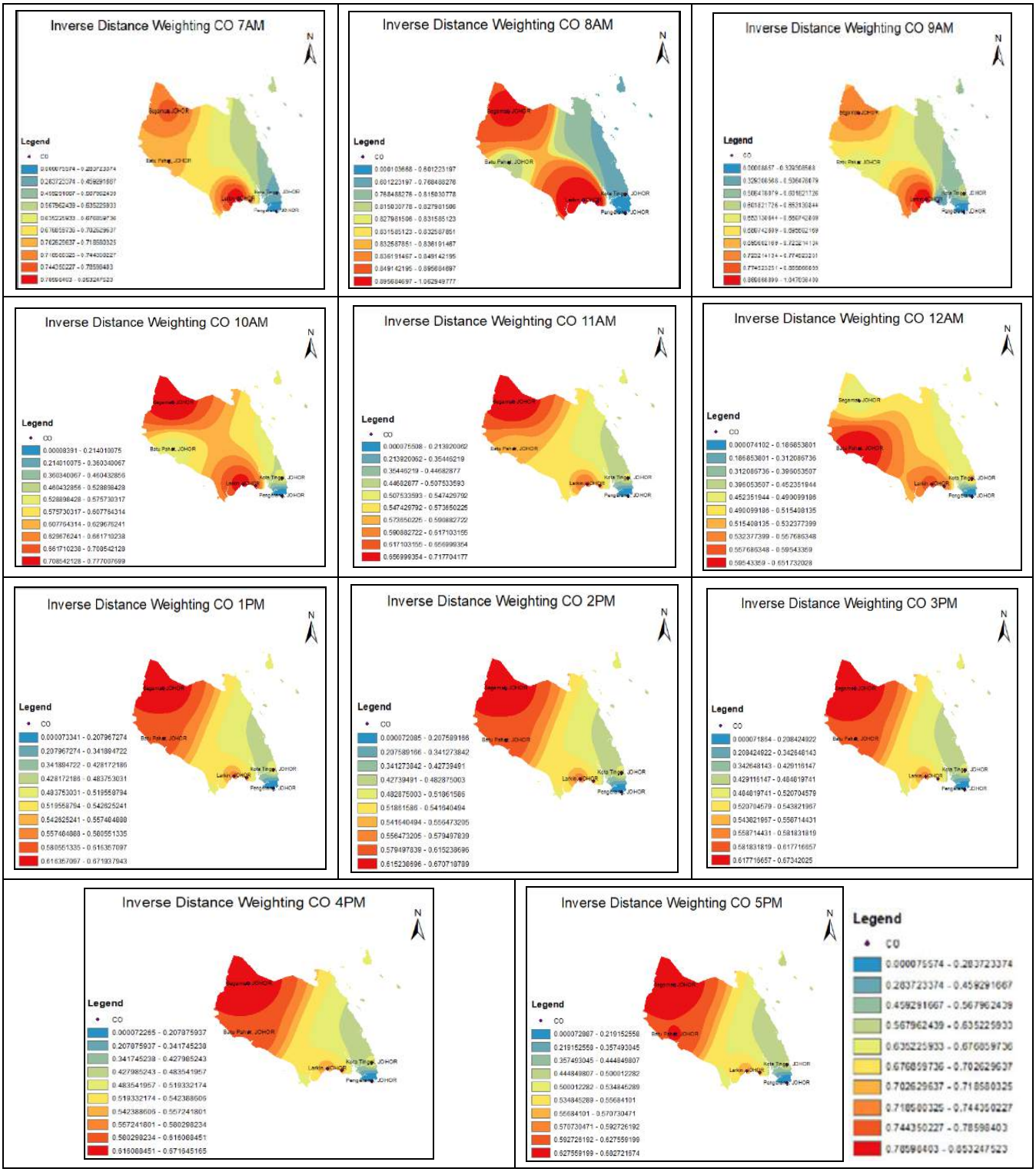

Figure 8. IDW interpolation of CO

4. IDW Interpolation of Sulphur Dioxide (SO_2)

Based on the results in figure 9, Kota Tinggi shows high concentration of SO_2 early at 7am and slowly reduces until 11m and maintains unhealthy status until 5pm. While for the Pasir Gudang, the SO_2 concentration started to increase from 7am until 5pm at the school area. As for Pengerang, the SO_2 concentration starts to increase at 8am until 11am and slowly reduces from 11am until 5pm. In this analysis, the Segamat area shows good status early in 7am until 5pm except during 10am where it is slowly increasing until 11am but reduces again until 5pm. It can be concluded that the location of the schools is one of the main factors that increase the SO_2 concentration in school areas such as the schools is located in close proximity to industrial areas, close to major roads and residential areas.

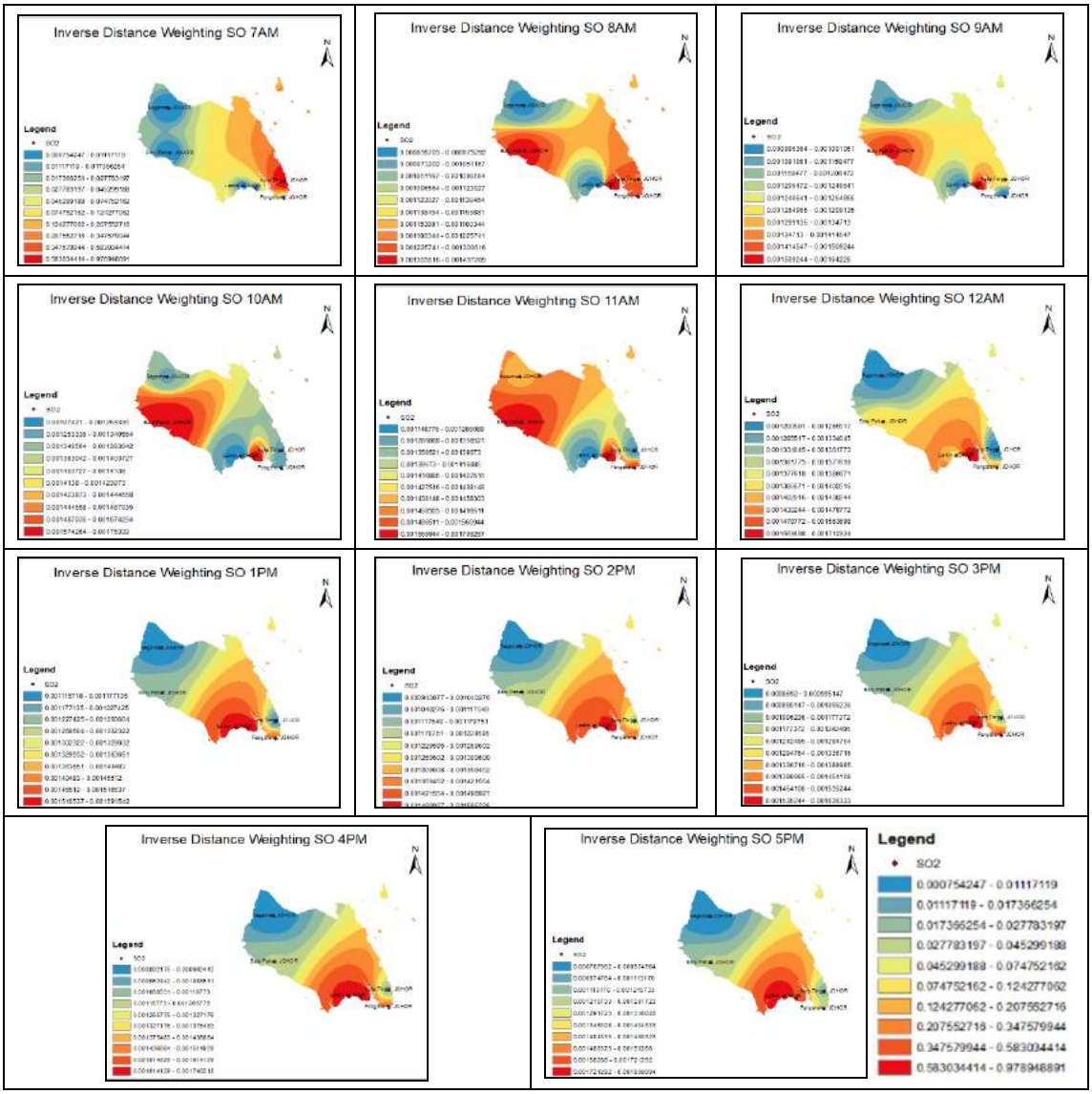

Figure 9. IDW interpolation of SO_2

The main source of SO_2 in the air is through industrial activity that processes materials that contain sulphur. Furthermore, industrial activities also involve burning fossil fuels containing sulphur that is one of the important sources of SO_2. Moreover, motor vehicle emission involves fuel combustion since school is located with major roads, this can be seen when there is a heavy traffic occurrence near the school area. Excessive breath in of SO_2 can affect human health and it irritates the nose, throat and the airways which leads to coughing, wheezing, shortness of breath or a tight feeling around the chest.

Comparison of Air Pollution Level

Based on the derived results of $PM_{2.5}$, CO, SO and O_3, it can be concluded that air pollutant concentration increases during peak hour of the school operation hour especially at 7am until 10am and 2pm until 5pm. In addition, changing between morning and evening sessions are one of the factors that increase the air pollutant concentration range due to the increase of traffic where students come and leave the school. Based on the results, Sekolah Menengah Pasir Gudang (2) located in Pasir Gudang shows frequent results of air pollutant concentration reaching between very unhealthy and hazardous levels compared to other schools in Johor. On the other hand, Sekolah Menengah Kebangsaan Tanjung Pengelih, Pengerang shows frequent results of air pollutant concentration at good until unhealthy range as compared to other schools in Johor.

Spatial Autocorrelation

The relationship of air pollutant concentration and the schools surrounding based on the spatial autocorrelation Global Moran's results. The derived spatial autocorrelation Global Moran's I results are in the HTML report. In this analysis, if the Moran's Indices are positive meaning that it rejected the null hypothesis similar to rejecting the spatial autocorrelation and the p values is lower than 0.05. Spatial autocorrelation measures the air pollutant concentration in relation to school location in Johor. It is truly known that everything is related to everything else, but near things are

more related than distant things. The reading of air pollution index at selected schools in Johor which obtained from DOE can be explained according to the school surrounding.

Study was conducted to justify the relations between the school location and air pollutant concentration. Global Moran's I statistics was used to test the present of spatial autocorrelation by using Moran's I statistic. Seven layers which include industrial, residential, school, commercial, green area, road and agriculture area has been digitized from Google Earth to show the surrounding area of school.

1. Spatial Autocorrelation Results

Figure 10 shows the air pollutant concentration derived from spatial autocorrelation at 7am. The results show that the Moran's Indices is positive showing a strong relationship that is clustering. All the spatial autocorrelation results show positive clustered and positive Moran's Indices. Based on the result, it can be stated that there is a relationship between air pollutant concentrations with the school locations.

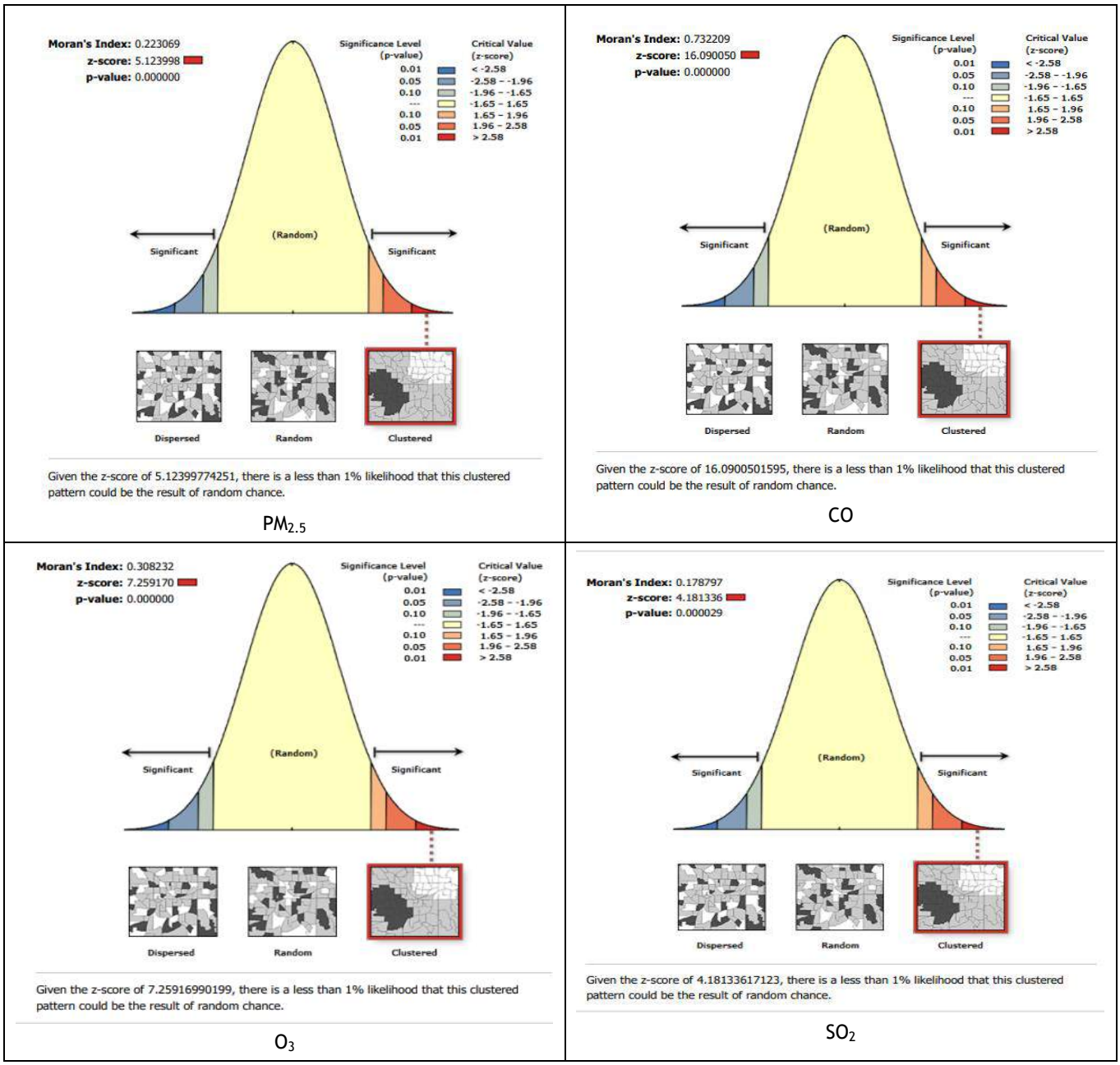

Figure 10. Spatial autocorrelation 7am HTML results

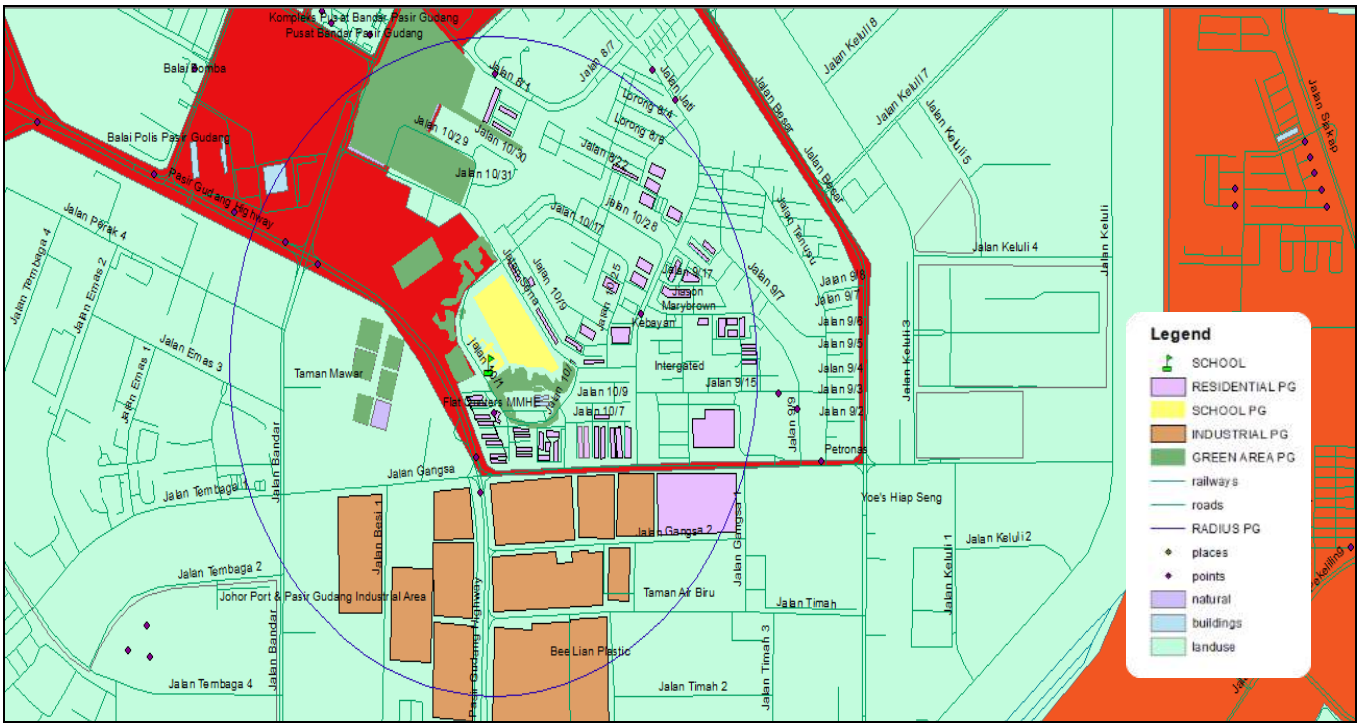

Figure 11. Land use surrounding Sekolah Kebangsaan Pasir Gudang (2)

Land use surrounding Sekolah Kebangsaan Pasir Gudang (2) in figure 11. Referring to the interpolation results, schools located in Segamat and Pasir Gudang have the highest air pollutant concentration reading and this can be justified based on the location of the school area. Sekolah Kebangsaan Pasir Gudang (2) is located in close proximity to industrial areas and low number of green areas which act as a buffer nearby the school area thus resulting in higher value of air pollutant concentration. It can be seen that the industrial area took out about 50% coverage, much larger compared to residential area which is about 20%, 15% of roads and commercial area and 15% of green area which is not enough to act a buffer to reduce the range of air pollution. Majority, Sekolah Kebangsaan Pasir Gudang (2) is surrounded with industrial areas which then increases the air pollutant concentration range value every single hour especially during school operation hours.

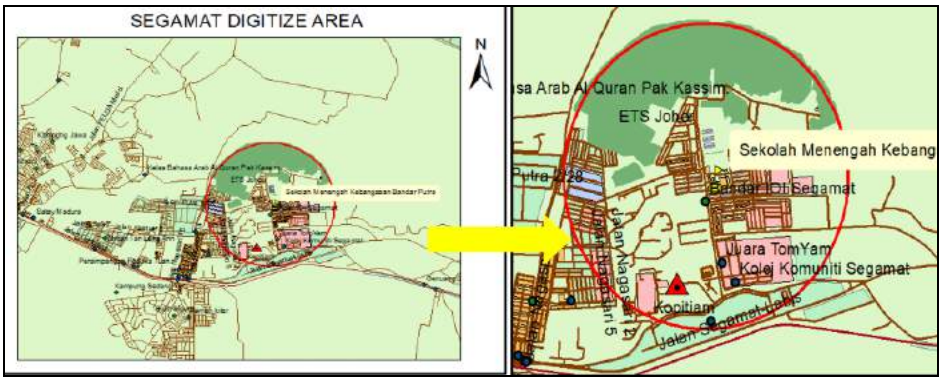

Figure 12. Land use surrounding Sekolah Menengah Kebangsaan Bandar Putra Segamat

Based on figure 12, this school located in the Segamat area shows a higher level of air pollutant concentration along with school in Pasir Gudang since the school is located near an industrial, residential and commercial area. Therefore, it can be concluded that there is a relationship between the school surroundings and the air pollutant concentration. Residential and commercial areas trigger the traffic activities and industrial areas that release smoke into the atmosphere thus more pollutant concentration such as $PM_{2.5}$, SO_2, O_3 and CO are released into the atmosphere which is then breathed in by students. Based on the results, the school was covered with 40% of commercial area, 6% of industrial area, 25% of residential area, 6% of roads and 20% of green area. It can be concluded that, school located near residential and commercial areas triggered the value of air pollution due to crowded situations which then leads to traffic, smoke release from the vehicle and from the nearest industrial increase the range value of air pollutant concentration hence affects the students' health.

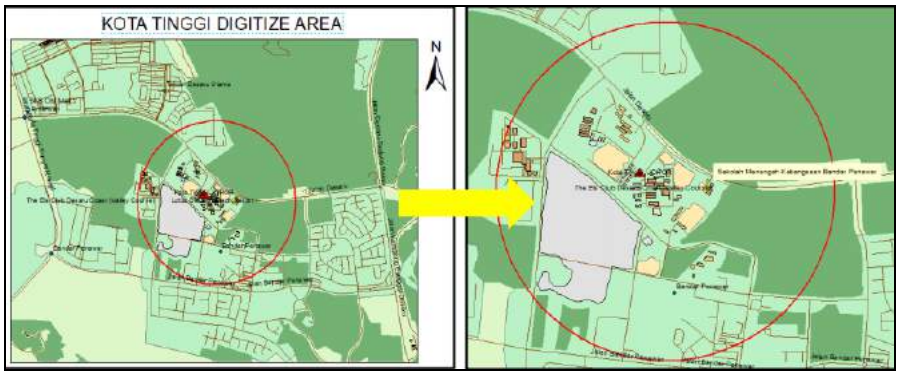

Figure 13. Land use surrounding Sekolah Menengah Bandar Penawar, Kota Tinggi

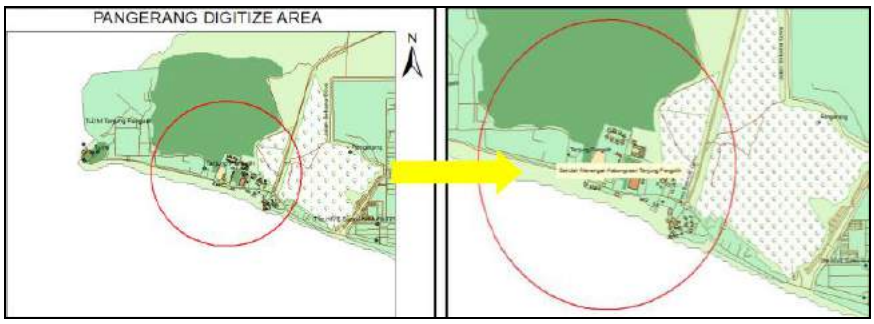

Figure 14. Land use surrounding Sekolah Menengah Kebangsaan Tanjung Pengelih, Pengerang

Figures 13 and 14 show the land use for schools in Pengerang and Kota Tinggi. Despite these schools located near residential areas which cover about 30% of the area and commercial areas that cover about 20% of the area, both areas are surrounded by large green areas thus contributing to low levels of air pollution concentration. This can be explained through the observation made where both school areas are covered with green area or vegetation which covers about 50% among the radius. As for Sekolah Menengah Kebangsaan Tanjung Pengelih located in Pengerang, the school area is located near with oil palm vegetation which covers about 20% and 30% of green area coverage furthermore it is near the sea area.

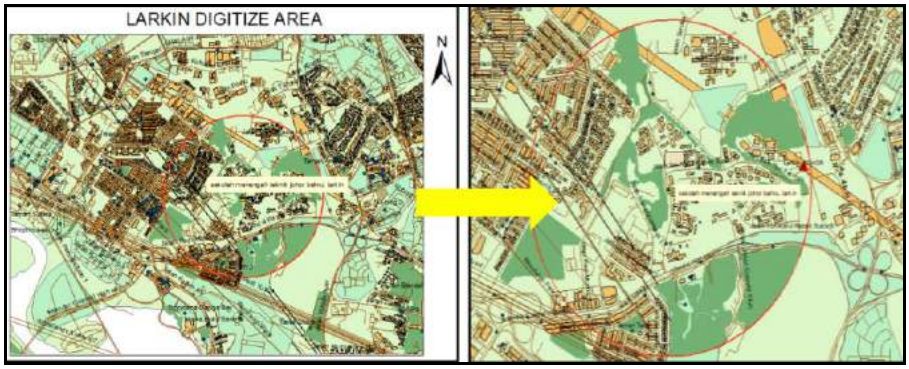

Figure 15 Land use surrounding Sekolah Menengah Teknik Johor Bahru, Larkin

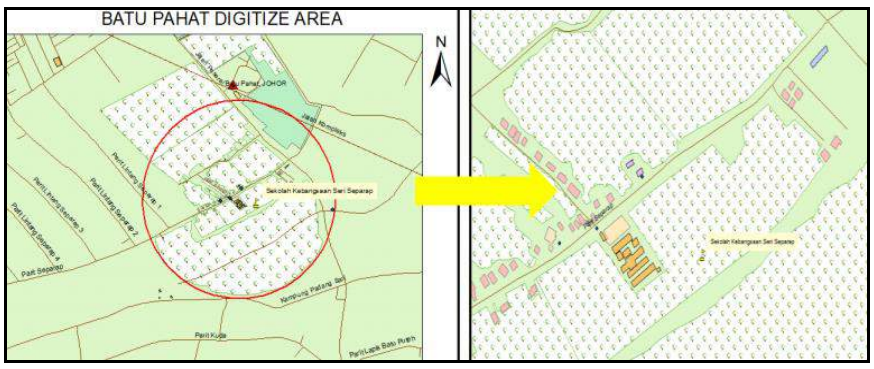

Figure 16. Land use surrounding Sekolah Kebangsaan Seri Separap, Batu Pahat

Figures 15 and 16 show the land use surrounding schools in Larkin and Batu Pahat. The school in Larkin is located in an urban area consisting of residential area and commercial area. Despite the school location is in urban area, the air pollution index show that this area is less polluted as compared to Pasir Gudang due to present of green area which cover about 40% of the coverage area and stabilize the pollutant concentrations compare to Pasir Gudang area where the building is arranged very close to each other. As for figure 16, Sekolah Kebangsaan Seri Separap in Batu Pahat is surrounded by the oil palm plantation which covers about 50% of the coverage area. Meanwhile, there is only 20% of commercial area, 10% of roads coverage and 20% for residential coverage area.

Conclusion

Air pollution is a momentous global issue and it is the most environmental hazard to human health and it is a particular concern in urban areas where elevated pollutant concentration and high risk in getting health problems. Based on the results and analyses of the air pollutant concentration map using IDW interpolation and spatial autocorrelation methods, the most polluted school area is located at Sekolah Kebangsaan Pasir Gudang (2) since the school located nearest with industrial area hence, waste smoke release from the industrial area affects the air pollutant concentration level. Therefore, higher volumes of air pollutant concentrations are released such as $PM_{2.5}$, CO, O_3 and SO_2 into the atmosphere which is then breathed in by the students in that nearby area. Besides industrial areas, other sources such as higher traffic activity, residential area and commercial area are one of the factors that lead to rising air pollutant concentration. Transport emissions constitute a dominant source of urban air pollution. On the other hand, schools located at Pengerang and Kota Tinggi have lower air pollutant concentration as compared to other selected schools in Johor due to their location where it is covered with green area despite it is located near industrial, residential and commercial areas. In addition, green areas act as a buffer which prevents the air pollution from being directly reached the schools area. Sekolah Menengah Kebangsaan Bandar Penawar located and Kota Tinggi and Sekolah Menengah Kebangsaan Tanjung Pengelih located at Pengerang which contain larger area of green area which is about 40% to 50% of the coverage area. Therefore, it can be concluded that the air pollutant concentration is related with the schools surrounding based on the result analysis made. Therefore, it is important to take early precautions in order to prevent children from getting health problems especially when they are studying in the most polluted area or areas with high air pollutant emissions. Thus, identification of the major air pollution problem and raise public awareness of the environmental protection including informing an air pollution abatement policy.

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