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Mapping Spatial Distribution of Carbonmonoxide Emission in Surabaya – Malang Road

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Abstract:- Air is one of the important elements of life because it is needed by every living creature. Air pollution is a reliable thing for human life given the important needs for every living thing. One sector of dissemination is the transportation sector. The research location taken was Sidoarjo Regency. The purpose of this study is mapping spatial distribution of street level of service - co emission correlation. The research method in this study was carried out in three stages: firts stage is characterizing CO pollution using CO Probe equipment spatially by using eulerian grid with an area of 500 x 500 m^2 which was then adjusted according to the CO pollution threshold value. The second stage of this study is measurement of CO levels in the air use a measuring instrument CO probe. The last stage of this study is mapping using raster interpolation analysis using the IDW (Inverse Distance Weighted) model. Based on the results of CO level tests, there is one observation point that has a value exceeding the threshold located at point 2 during the day (12:00 - 14:00) in Surabaya direction at 35,500 µg / Nm^3.

Keyword:- *Mapping-Distribution-Carbonmonoxide, Eulerian-Grid, Air-pollution, Threshold, Pollution, CO-Probe.*

I. INTRODUCTION

Air is an environmental component that is very important for life, therefore it is necessary to maintain and improve air quality[1,2]. Population growth, industrial and economic expansion and a surge in the number and use of motorized vehicles are factors responsible for the emergence of air pollution in urban areas[3]. One of the biggest contributors to urban air pollution is the transportation sector, namely an increase in the number of motorized vehicles[4]. Vehicle use in Indonesia has increased very rapidly, especially in urban areas. This resulted in many large cities experiencing a decrease in air quality due to the concentration of exhaust gas that exceeds the threshold so that disrupting comfort has even caused health problems[5]. The movement of motorized vehicles in the transportation network is a major cause of air pollution which is 60 to 90% of total emissions[6].

The movement of motorized vehicles produces major pollutants in the form of gases including carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons (HC), Sulfur dioxide (SO2), lead (Pb) and carbon dioxide (CO2) (3). Carbon monoxide (CO) is an important factor of the troposphere because of its role in air quality, atmospheric chemistry and global climate, therefore it is very important to maintain carbon monoxide within the normal threshold as stipulated by PER.13 / MEN / X / 2011 that is 25ppm. CO can cause cellular hypoxia, oxidative stress and inflammation, neurological, cerebrovascular, or cardiovascular disorders, including encephalopathy, ischemia, and peripheral nerve injury[7;8]. Carbon monoxide is known as a silent killer because it is colorless, odorless, and does not cause irritation but is a very toxic gas[9].

Based on data from the world health organization, the World Health Organization, more than 80% of people living in urban areas breathe in poor quality air. CO poisoning causes around 1000-2000 deaths per year in the United States[10], with visits of 50,000 visits[11]. As many as 4000 visits and 40 deaths are recorded annually in the United Kingdom[8]. Whereas in Indonesia, there is no exact number of deaths due to CO gas poisoning.

Jalan Raya Surabaya - Malang Section Sidoarjo Regency, is the main road that connects Sidoarjo Regency and Surabaya City. The movement on the Surabaya - Malang road segment is classified as dynamic because of the variety of uses of land along the road and the intersection of the eastern ring and baypass Pasuruan. With the existence of the east ring road and paspass baypass, the Surabaya - Malang Highway Road has a high volume of traffic.

The increasing number of motorized vehicles will result in a decrease in the quality of clean air due to emissions from the results of combustion of vehicle fuels[12]. With the presence of high air pollution caused by a high level of movement it is necessary to conduct research on measuring the concentration of CO pollution in the Jalan Raya Surabaya - Malang Section of Sidoarjo Regency. In this study the

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Surabaya-Malang road was used starting from the Buduran Highway to Ahmad Yani Street.

II. METHODS

The type of research used in the study of the measurement of CO pollution concentrations in the Surabaya - Malang Highway Section of Sidoarjo Regency was evaluative descriptive research. the method used in this study consist of:

A. Eurelian Grid Method

Eurelian Grid Method is used to divide Sidoarjo Regency into a grid with an area of 500 x 500 m^2. Based on the results of the Eurelian Grid Method there are 10 measurement points for CO pollution concentration in Sidoarjo regency. Measurement of CO Pollution is done at points that have been determined based on the Eurelian Grid Method. The equipment used is CO Probe for 5 minutes at each point.

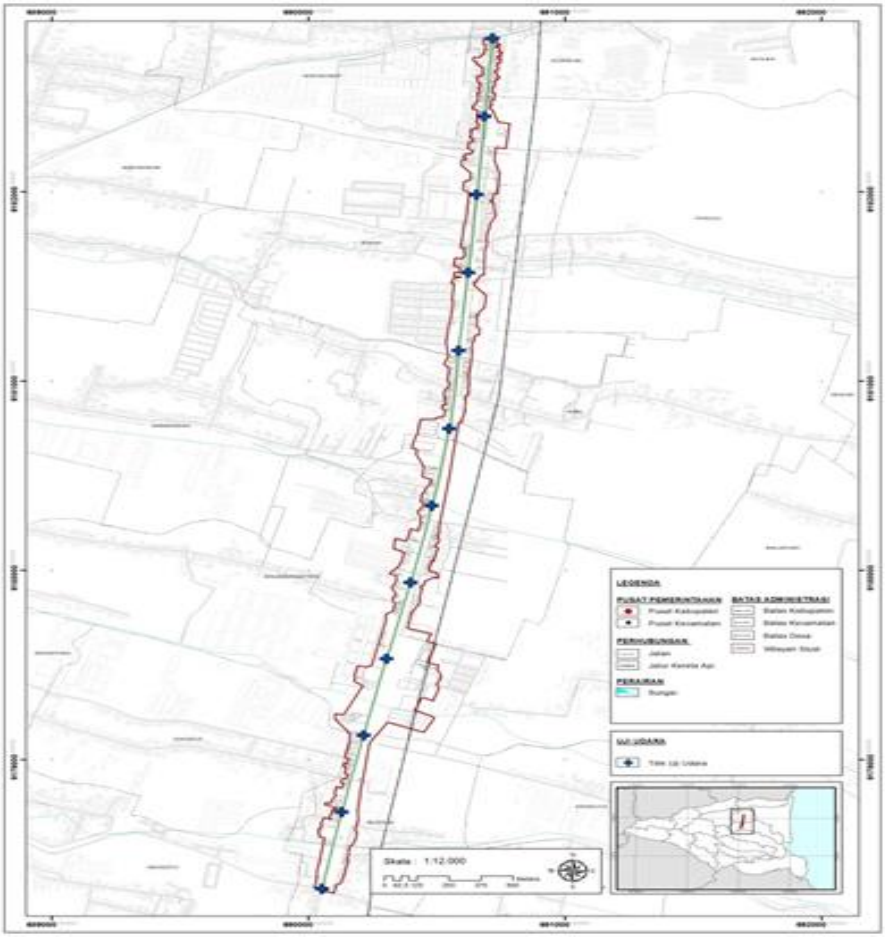

Fig 1 :- Location Of Sample Measurement of CO

B. Measurement of CO Levels

The measurement of CO levels in the air in this study was carried out using CO measuring instruments with type Multinorm Instrument MI 6201 which is a tool used to measure air parameters such as CO that is connected with CO probes that have a standard unit of parts per million (ppm). The following are the steps to measure CO using CO Probe:

- Install the CO probe tool in the Multinorm Instrument.
- Turn on the multinorm instrument.
- Place or hold the tool in the area to be analyzed for the CO level.
- Select the "Measurement" menu on the main menu by pressing the "ENTER" button.
- Wait for a maximum of 5 minutes then press the "ENTER" button to start the measurement. If the measurement is in a quiet area (there is no wind), as long as the measurement takes place it is agreed to move the CO Inquiry to the right and left for better results.
- After approximately 30 seconds, press the "ENTER" button to stop the measurement.
- Note the CO value indicated on the screen.

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Fig. 2:- Measuring CO levels (CO Probe)

C. Raster Interpolation Analysis

The function of raster interpolation is to create the surface (or estimate) of the sample point values. The interpolation function is to make predictions from sample measurements for all locations in the layout data (Figure 1). As for some models found in raster interpolation, what is used in this study is IDW (Inverse Distance Weighted).

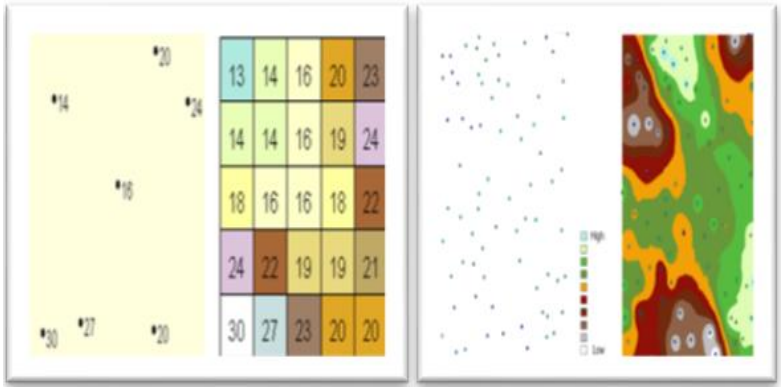

Fig. 3:- Interpolasi and Raster Analysis

- The output value for a cell using IDW is limited to the range of values used for interpolation. Because IDW is a weighted average distance, the average cannot be greater than the highest or less than the lowest input. Therefore, it cannot create mountain valleys or if the extreme sample does not run[(13)].
- The best results from IDW are obtained when sampling is quite dense with respect to the variations that will be tried to be simulated. If sampling input points is sparse or uneven, the results may not adequately represent the desired surface[(13)].
- The effect of input on the interpolation value is isotropic. Because the influence of the input on the interpolation value is related to distance, IDW does not "produce a hillside"[(13)].

III. RESULT

CO gas emission levels on Surabaya - Malang Highway were measured using CO Probe test equipment. In this study there were 20 measurement points for CO levels where 10 points were located along the road to Surabaya City and 10 points were located along the road leading to the direction of Sidoarjo Regency.

The time to measure CO levels using a tool is carried out from morning to night from 06:00 to 20:00. In this study, the measurement results of CO levels will be converted from ppm units to µg / Nm^3 so that CO levels in the study area can be compared with BMUA standards.

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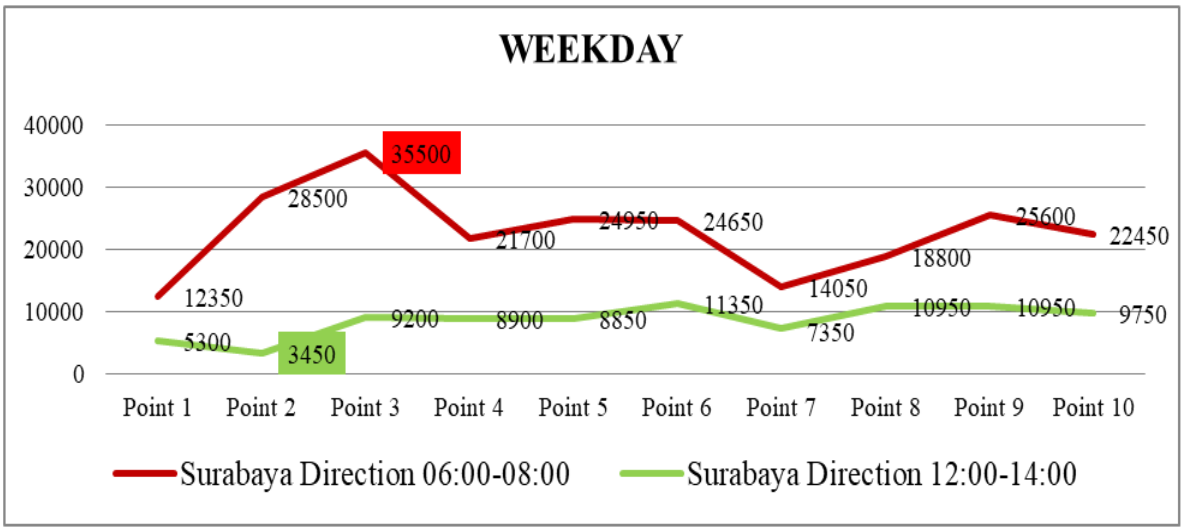

Fig. 4:- Highest And Lowest Value Charts on Weekday

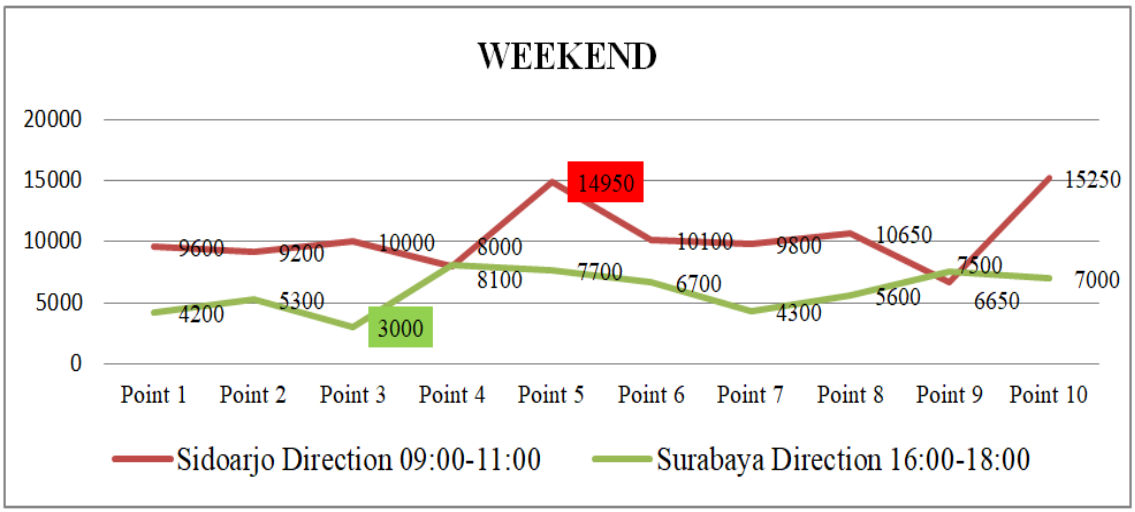

Fig. 5:- Highest And Lowest Value Charts On Weekend

The results of the measurement of CO air pollution can be seen in table 1 and table 2. Based on table 1 and table 2 the highest and lowest CO levels on Jalan Raya Surabaya - Malang for weekday are at point 3 in the morning (6:00 - 8:00) in Surabaya and point 2 in the afternoon (12:00 - 14:00) Surabaya direction is 35,500 µg/Nm^3 and 3,450 µg/Nm^3. While the highest and lowest CO levels on Jalan Raya Surabaya - Malang for weekends are at point 5 during the day (09:00 - 11:00) Sidoarjo direction and point 3 in the afternoon (16:00 - 18:00) direction Surabaya at 14,950 µg/Nm^3 and 3,000 µg/Nm^3.

CO levels in the air on Jalan Raya Surabaya - Malang which have the highest CO level values are 35,500 µg/Nm^3. This CO value has exceeded the normal national air quality standard threshold with a standard value of CO 30,000µg/Nm^3. The high CO level is due to the high flow of traffic at that point. In addition to the high traffic flow, CO air measurement using the CO Probe tool can also be affected by wind direction and speed when taking air test samples.

Based on the results of CO air pollution tests with CO Probe on Surabaya-Malang road, then the stages of CO air pollution interpretation will be carried out by using mapping raster interpolation analysis. Then mapping images can be seen in the Fig. 6.

The color degradation found in Fig. 6 means that the darker the color degradation that is owned, the higher the level of pollution at that point. The highest level of pollution is in figure 6 (G) in red. This point is located at point 2 during the day (12:00 - 14:00) the direction of Surabaya is equal to the CO pollution value of 35,500 µg / Nm^3. The value found at point 2 has exceeded the national threshold with a value of 30,000 µg / Nm^3. While the lowest level of CO value is found at point 3 in the afternoon (16:00 - 18:00) in the direction of Surabaya with a value of CO 3000 µg / Nm^3 (Fig. 6-K).

Fig. 6:- Mapping Spatial Distribution Of Carbonmonoxide Emission In Surabaya – Malang Road

IV. CONCLUSION

Based on the results of CO level tests using the CO Probe tool on the Jalan Raya Surabaya - Malang Section in Sidoarjo Regency, there is one observation point that has a value exceeding the threshold located at point 2 during the day (12:00 - 14:00) Surabaya direction is 35,500 µg / Nm3. While some points have a value almost close to the CO pollution threshold of which are located at point 2 of the observation direction in Surabaya at 06:00 to 08:00 with a value of 28,500 µg / Nm3 and at point 9 in Surabaya at 06:00 to 08:00. While the lowest level of CO value is found at point 3 in the afternoon (16:00 - 18:00) in the direction of Surabaya with a value of CO 3000 µg / Nm3.

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APPENDIX

No.	Lokasi	Jam											
		06:00 - 08:00		09:00 - 11:00		12:00 - 14:00		14:00 - 16:00		16:00 - 18:00		19:00 - 21:00	
		Arah Sby	Arah Sda	Arah Sby	Arah Sda	Arah Sby	Arah Sda	Arah Sby	Arah Sda	Arah Sby	Arah Sda	Arah Sby	Arah Sda
1	Titik 1	12350	16300	9900	9000	5300	7600	7800	9600	9150	15200	10450	8700
2	Titik 2	28500	13250	13200	9600	3450	7350	8450	8700	9200	15400	9350	10450
3	Titik 3	35500	18200	13450	8100	9200	5900	10350	9350	12500	14400	17250	7650
4	Titik 4	21700	16950	8600	8550	8900	5000	9400	9450	12300	13050	12900	5300
5	Titik 5	24950	19550	12250	12700	8850	3950	12700	11250	14000	15600	14750	6850
6	Titik 6	24650	15600	14700	13600	11350	3850	9600	8750	12150	12050	15500	7400
7	Titik 7	14050	14800	9850	15400	7350	3900	8250	6350	11800	9900	13000	7250
8	Titik 8	18800	26400	15350	10700	10950	3800	10150	11600	14400	12400	17350	7400
9	Titik 9	25600	15750	13100	9750	10950	5750	8800	6950	14250	18500	15650	11000
10	Titik 10	22450	18950	13900	14950	9750	12400	10550	13000	11000	21000	13350	14650

Table 1:- CO Value on Jalan Raya Surabaya - Malang Section (Weekday)

No.	Lokasi	Jam											
		06:00 - 08:00		09:00 - 11:00		12:00 - 14:00		14:00 - 16:00		16:00 - 18:00		19:00 - 21:00	
		Arah Sby	Arah Sda	Arah Sby	Arah Sda	Arah Sby	Arah Sda	Arah Sby	Arah Sda	Arah Sby	Arah Sda	Arah Sby	Arah Sda
1	Titik 1	6800	14050	7500	9600	5250	8000	5900	7050	4200	6600	6750	10550
2	Titik 2	10100	8650	8500	9200	5850	7350	7350	8750	5300	4600	7150	6600
3	Titik 3	5250	13850	5450	10000	3050	12200	7750	5400	3000	8500	9500	12050
4	Titik 4	5350	7100	5650	8000	3250	9400	5800	3850	8100	11200	10550	8800
5	Titik 5	10550	13500	9250	14950	5800	12050	9850	4050	7700	8900	9550	8450
6	Titik 6	12500	10700	12350	10100	9050	7100	9900	3950	6700	6500	10700	6850
7	Titik 7	8050	10450	7950	9800	11150	7100	6550	3850	4300	4600	9500	8900
8	Titik 8	12450	10100	16000	10650	13250	9700	8650	6600	5600	14200	12150	10250
9	Titik 9	12600	10450	12800	6650	10700	8050	9750	7350	7500	5100	12050	8300
10	Titik 10	13400	12450	9450	15250	11750	14800	9450	14450	7000	7900	7800	14400

Table 2:- CO Value on Jalan Raya Surabaya - Malang Section (Weekend)