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RESEARCH ARTICLE

THE EXAMPLE OF THE VERIFICATION OF THE SO_2 DISPERSION MODEL FROM INDUSTRIAL SOURCES AND SMALL HOUSE STOWS IN THE CITY OF ZENICA

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Abstract

The quality of air in the Zenica area has been disturbed for many years, which causes justified concern for the citizens of Zenica. Monitoring shows that air is more polluted, that polluters are ever more numerous and that their impact on the health of the population and the environment is increasingly pronounced. Since monitoring of air quality is a costly and demanding job, dispersion modeling is increasingly used to determine the distribution of pollution or concentration at all points of the observed domain. Validation and calibration of the dispersion model is performed using air quality monitoring stations. Once the model is verified the number of air quality monitoring stations in the area covered by the model can be reduced to the minimum number of smart stations used only for calibration of the model. Therefore, the models can save considerable resources, because they allow reduction of the number of stations for measuring air quality. The paper describes the verification of SO_2 dispersion patterns from industrial plants and home furnaces in the area of the City of Zenica. The validation results show a good correlation of the concentration of SO_2 concentration obtained by modeling and measurement at the station for air quality measurement "Crkvice".

Introduction:-

Sulphur dioxide can affect both health and the environment. Exposures to SO_2 can harm the human respiratory system and obstruct breathing, and children and elderly are particularly sensitive to effects of SO_2. Sulphur oxides (SO_x), can react with other compounds in the atmosphere to form small particles, thus contribute to particulate matter (PM) pollution causing additional health problems. At high concentrations, gaseous SO_x can contribute to acid rain that can harm sensitive ecosystems [1]. In the Zenica Valley, almost 12.874 tons of SO_2 is emitted from industrial plants alone [2]. The contribution of small house stoves is still unknown, and contribution of traffic on the SO_2 concentration is not significant. This model of SO_2 dispersion is made as an effort to determine the impact of boilers on air quality in the Zenica Valley.

The paper deals with an example of verification of sulfur dioxide dispersion model from 20 stationary sources in the City of Zenica and from three industrial sources (primary point sources of metallurgical plants of the Arcelor Mittal Zenica). The height of the chimneys of stationary sources is less than 80 m high, and in period of appearance of the inverse layer, they significantly pollute the ground layer of the atmosphere [3]. The modeling was carried out for

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2010 due to the existence of all necessary input data such as air quality data, relevant emission measurements of pollutants from all sources, meteorological data of the atmosphere and fuel consumption data for each pollution source. The measurements of SO_2 emissions from 20 stationary sources was carried out by the Institute "Kemal Kapetanović" Zenica [4]. The data for three industrial sources are taken over from the Federal Ministry of Environment and Tourism. Table 1 gives the characteristics of the air pollution sources, the amount of fuel consumed and the type of fuel and the total SO_2 emissions. Annual production was also given for industrial sources. The position of the source in the Zenica Basin and domain within which modeling was performedis given in Figure 1.

Table 1:- Stationary sources of pollutants into the air included in the dispersion model.

Point source (Boilers in Zenica)	Fuel Type	Chimney height (m)	Chimney diameter (cm)	Chimney daylight size (m^2)	The amount of flue gas (Nm^3/h)	Average fuel consumption (t/6 months)	Total SO_2 emission (t/year)
1. "Almy" d.o.o	coal	12	70	0,38	2145	260	13,520
2. "Selecta" d.o.o	coal	14	40	0,13	221	50	2,600
3. "Ekor" d.o.o	coal	16	40	0,13	169	50	2,600
4. O.Š "Alija. N	heating oil	12	30	0,07	154	10	0,0012
5."Mljekara"d.o.o	coal	20	60	0,28	3362	550	28,600
6."Metalno"d.o.o	coal	15	70	0,38	6271	510	26,520
7. "Al-ex" d.o.o	biomass	10	60	0,28	8261	432	-
8. "Inpek" d.o.o	coal	12	40	0,13	1268	151	0,018
9. "Hotel Rudar"	coal	20	60	0,28	786	90	4,680
10. „Stara Jama“1	coal	15	60	0,28	285	50	2,600
11. „Stara Jama“2	coal	15	60	0,28	643	90	4,680
12. "Raspotočje"	coal	15	60	0,28	786	50	2,600
13."Kantonalna Bolnica"	coal	60	200	3,14	25864	3182,4	165,480
14. "Džananović"	coal	10	60	0,28	259	50	2,600
15.O.Š„Hasan.K“	coal	12	50	0,20	765	150	7,800
16. "KPZ" Zenica	heating oil	15	50	0,20	2318	372	0,044
17. „RM-LH“	coal	12	40	0,13	260	45	2,340
18. „Edel- Holz“	biomass	14	40	0,13	250	70	-
19. „Bingo“ 1	coal	12	50	0,20	320	100	5,200
20. „Bingo“2	coal	12	50	0,20	320	100	5,200
Industrial facilities	Row material / Fuel type	Chimney height (m)	Chimney diameter (m)	Chimney daylight size (m^2)	The amount of flue gas (Nm^3/h)	Average fuel consumption (t/6 months)	Total SO_2 emission (t/year)
21. Coke Oven Plant AMZ Zenica	coal/coke	105	5	19,63	166427	367365	2203,2
22. Palletization plant AMZ Zenica	agglomera te	150	5	19,63	658858	850640	2086,9
23. Heating plant AMZ Zenica	coal, COG and BFG/ steam	120	5	19,63	278549	171328	7785,8

In addition to this data, the meteorological parameters which were obtained on the basis of the measured values at the meteorological station “Brist”, which define atmospheric conditions, are also entered into the model. Validation of the dispersion model was performed at the stationary source in the area of "Cantonal Hospital of Zenica" because it is the only source that works continuously throughout the year and for which exist reliable data needed for verification of the model. In addition, near this stationary source there is air quality monitoring station "Crkvice" for continuous monitoring of sulfur dioxide concentrations in the air. Verification was performed by comparing the results of the model with the measured values obtained from previously mentioned monitoring station, for the summer and winter measurement periods. The summer period was chosen because during the summer there are no other active pollution sources in the area of the stationary source "Cantonal Hospital". Verification during the winter period was performed in order to see the contribution of small house stoves and traffic to the observed site, because to the lack of reliable data on emission of polluting substances for these sources.

The verification of the model gives the right way for estimating the influence of the pollutant source on air quality in the specific geo-urban and industrial conditions of the Zenica valley. Applying such a verified mathematical model to the emission simulation of sulfur dioxide in the given space can significantly reduce costs that require the assessment of air quality by continuous measurement. In addition, modeling can give much more data than those gained by the network of air quality monitoring stations.

Methodology:-

The measurement of SO_2 concentration in flue gases was performed by the portable TESTO 350 XL flue gas analyzer. The TESTO 350 XL is device for analysis of the composition of gases generated by fuel combustion, pressure measurement, gas flow rate and the efficiency of the combustion process. The measurement is performed with built-in electrochemical cells. Dry flue gases flow through cells from which was previously removed moisture in the dryer that is an integral part of the device. The measurements also included the total flow rate through which the sulfur dioxide emission into the air was calculated.

Dispersion modeling was performed using the AERMOD program package. The model is applicable in rural and urban areas, plain and complex field, for point and surface sources. Using relatively easy approach AERMOD combines current concepts of flow and dispersion in the complex field. Where it is appropriate, it can be modeled that the plume fly or collide with the terrain or to track it. This approach is designed to be physically realistic thus avoiding the need to pre-define the terrain types. The measurement of sulfur dioxide concentration in the ambient air for the observed period was carried out at the air quality monitoring station "Crkvice".

When determining the boundaries of the model in a specific geo-urban area with respect to the configuration of the terrain and wind rose, a uniform network of receptors has been defined in order to obtain a map of ground-level concentration of pollutants.

Figure 1 shows the domain within which modeling was done, with the plot of 100x100 m raster and the positions of polluting sources**.**

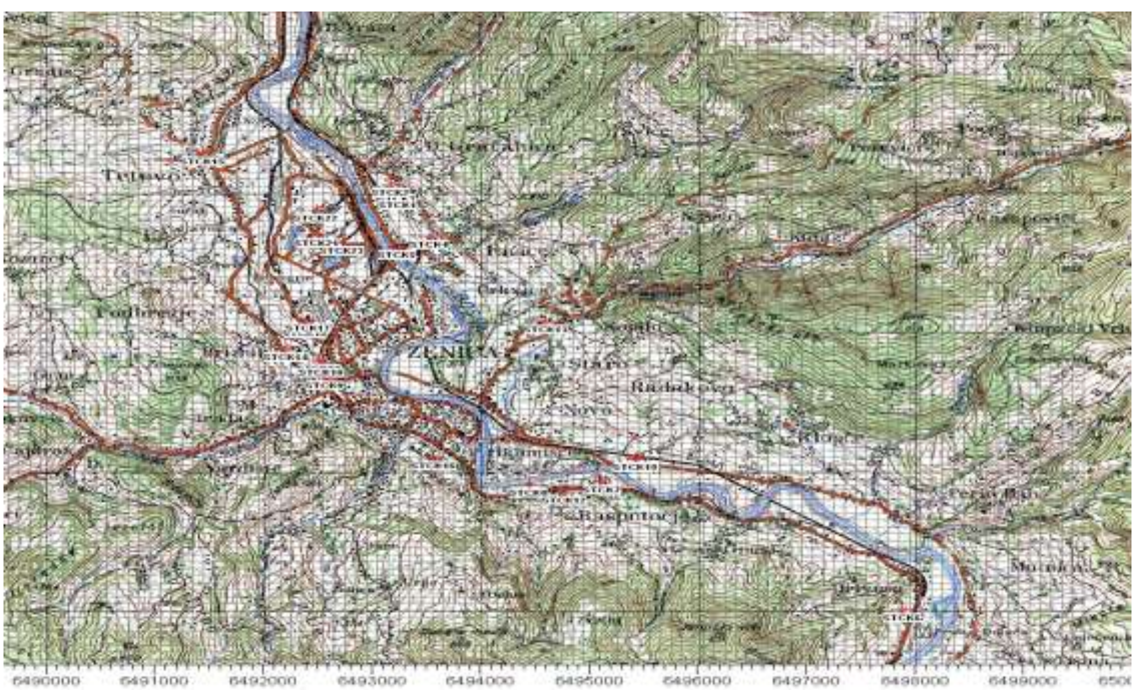


Figure 1:- Domain within which modeling was performed, raster network 100 x100 m and positions of polluting source.

The required input data for the modeling process are obtained on the basis of the measurements of sulfur dioxide concentrations in waste flue gases and flue gas flow. The data of the measured emissions of SO_2 emitted into the atmosphere through the chimney of the observed stationary sources for the given time period are entered in the AERMOD dispersion modeling software. The meteorological parameters, which define the atmospheric conditions, obtained based on measured values at the meteorological station were also entered in the AERMOD. The data about terrain configuration are entered in the form of digitized maps, referring to the shape of the terrain (altitude), the type or purpose of the land and other characteristics of the terrain. Output of the modeling process can be presented in different forms.

It should be mentioned that the obtained ground level sulfur dioxide concentrations are not the total concentration, but only the result of concentrations from the emissions from the chimney of the observed stationary sources. Thus, the presented dispersion modeling results do not contain the influence of any other sources of polluting or the natural concentration of pollutants in the atmosphere. Figures 2 and 3 show the results of the dispersion modeling of annual emissions of sulfur dioxide from the observed sources for the year 2010.

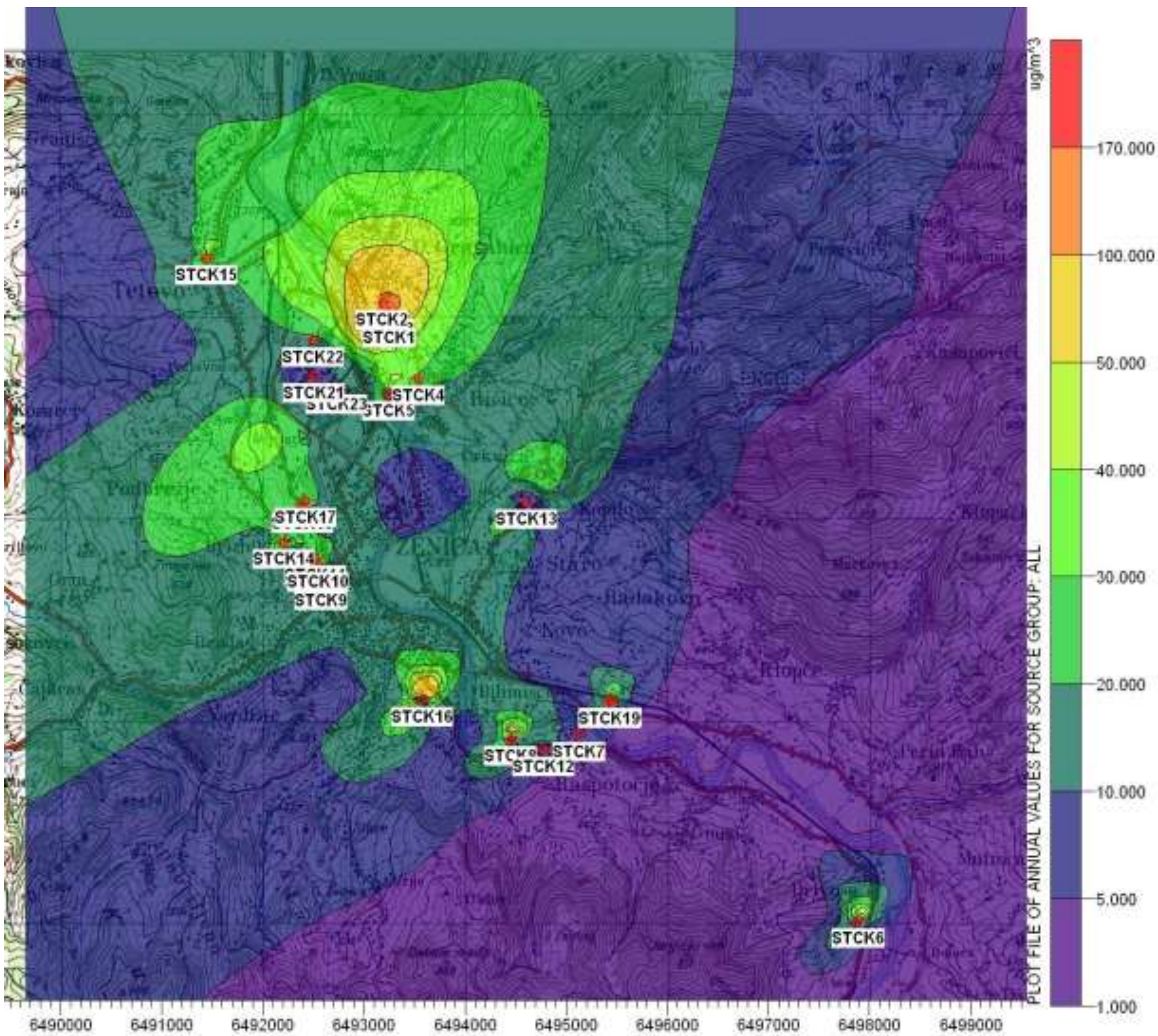


Figure 2:- Graphic representation of the sulfur dioxide concentrations (average annual value) obtained using SO_2 dispersion model from observed polluting sources for 2010.

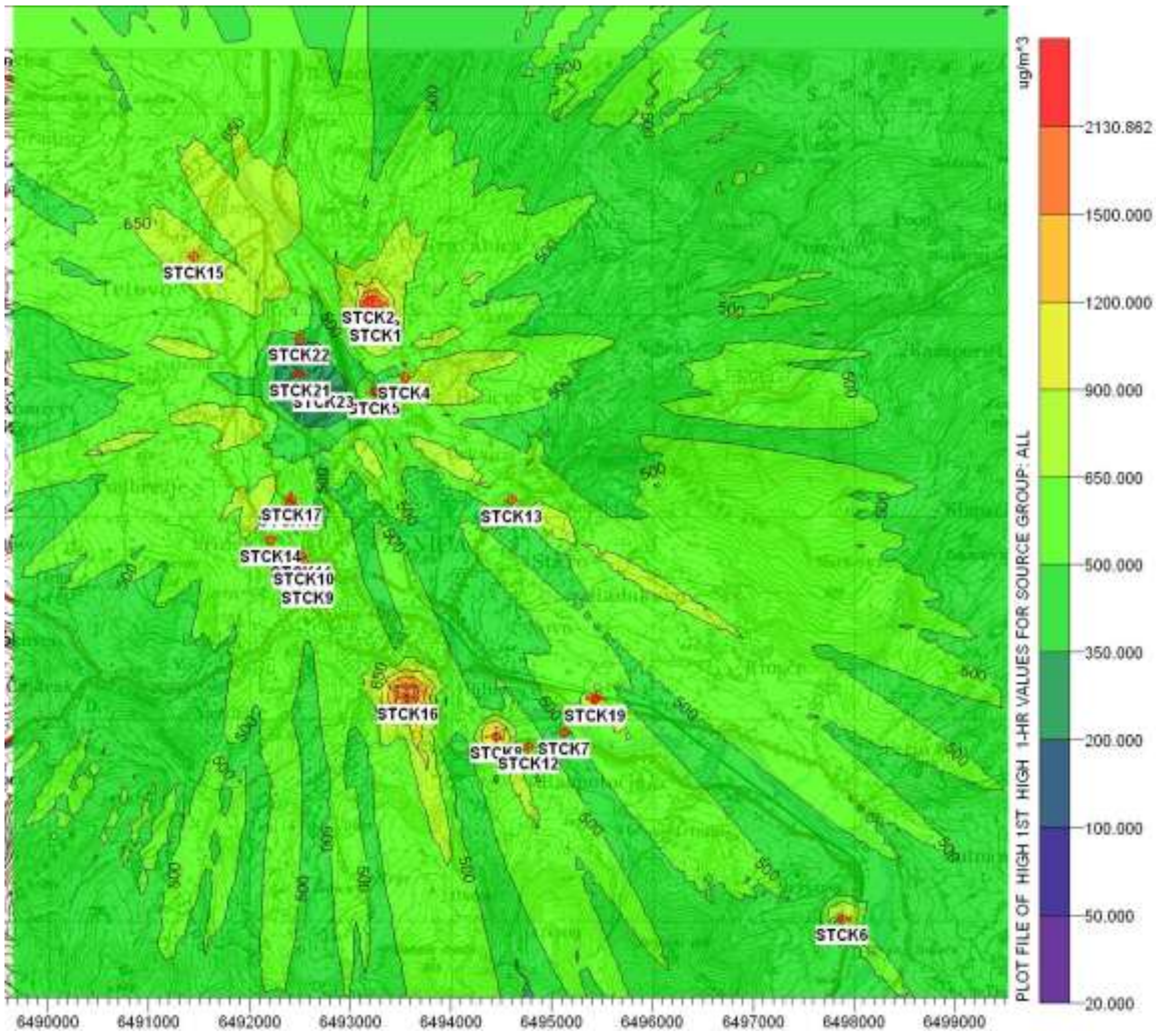


Figure 3:- Graphic representation of sulfur dioxide concentrations (maximum hourly value) obtained using SO_2 dispersion model from the observed polluting sources for 2010.

As can be seen from the results of dispersion modeling of sulfur dioxide concentrations over the observed period, air quality limit values were exceeded due to the influence of pollutants emissions from stationary sources (according to the Rulebook on air quality limit values "Official Gazette of FBiH" No. 05 /12)

Verification of the model:
In order to make the data obtained as a result of modeling comparable to the measured concentrations of pollutants at the control points, the calculation of average daily sulfur dioxide concentrations for the selected summer and winter seasons, as a dominant influence on the air quality within the model boundaries, was performed.

It is especially important to analyze sulfur dioxide concentrations from the dispersion modeling process from the aspect of the hospital's chimney impact on the environment, as it is located near the air quality station "Crkvice" and is the only large source of pollution active throughout the year. Therefore, the emphasis in further analyzes is on monitoring changes in ambient sulfur dioxide concentrations from the "Crkvice" measuring site.

By analyzing the matching of the modeling and measurement results, it is possible to evaluate the applicability of the SO_2 dispersion model used. For the validation process, it is necessary to find a set of measurement data from the field and to extract the pollutants that can be connected to a specific source of pollution in the modeled space in a certain part of the modeled period.

The choice of the representative period for validation of the model was done on the basis of the following criteria:

1. Select a period for which there are sufficient quality data of air quality measurement (more than 60% of quality measurements),
2. Select a period in which there are no significant, dominant impacts of other pollutants (during the observed period there is no in function a larger number of small house stoves that would contribute more to the increase of ground concentrations in the immediate vicinity of the control metering point where the air quality monitoring station is located) .
3. Select period with stable atmospheric conditions affecting reduced horizontal dispersion and lack of convective air mixing,
4. The time period must be long enough (3-10 days) to allow sufficient time to transport polluting substances to all edges of the defined area or network of receptors, and thus to the location of the metering stations

Verification of the model for the summer period:

As the most optimal period of the year for the validation of the dispersion model, the summer period was taken, due to the absence of other low height polluting sources, that is, domestic fireplaces which are not in use during the summer period. The most suitable stationary source of contamination was the chimney of the Zenica Cantonal Hospitals boiler, because boiler works continuously throughout the year. The boiler in the winter period due to the heating period is in higher capacity that was accounted for during modeling. Validation of the model was done with regard to sulfur dioxide due to its uniform dispersion and relatively known behavior in the atmosphere, i.e. stability and distances of dispersion. Table 2 provides the basic input data of the stationary source "Cantonal Hospital of Zenica" used for validation.

Table 2:- Stationary source data used for model verification in the summer period.

Stationary Source	Cantonal Hospital Zenica
Chimney height (m)	60
Diameter of the chimney (m)	2
Surface of the chimney (m^2)	3,14
Flue gas velocity (m/s)	2,2
Estimated flue gas flow Nm^3/h	8621,30
Total quantity of flue gas in summer period (Nm^3/6 months.)	5428106,50
Average fuel consumption (t/6 months)	795,6
SO_2 kg/6 months	41371,2
Geographic longitude / latitude	44° 12' 36.70 N / 17° 55' 40.11 E

For the verification of the model the period from 01. June until 31. August 2010 was taken from the summer season of the year 2010, for which most of the criteria mentioned above were met. During the observed period, 98% of the measured values, which were relevant to the modeling process and validation of the obtained results, were correct and usable. This refers to data on the measurement of sulfur dioxide concentrations from the "Crkvice" measuring site, the measurements of the emissions from the Zenica Cantonal Hospital Boiler and other data required for modeling. Graphic representation of daily averages of sulfur dioxide concentrations for the selected summer period of the model verification is given a Figure 4. As it can be seen in the Figure 4 certain parts of the selected summer season have increased concentrations of the sulfur dioxide. This means that certain pollutants have an impact on air quality throughout the year i.e. high concentrations of the sulfur dioxide in the periods when the influence of local pollution sources is reduced to a minimum.

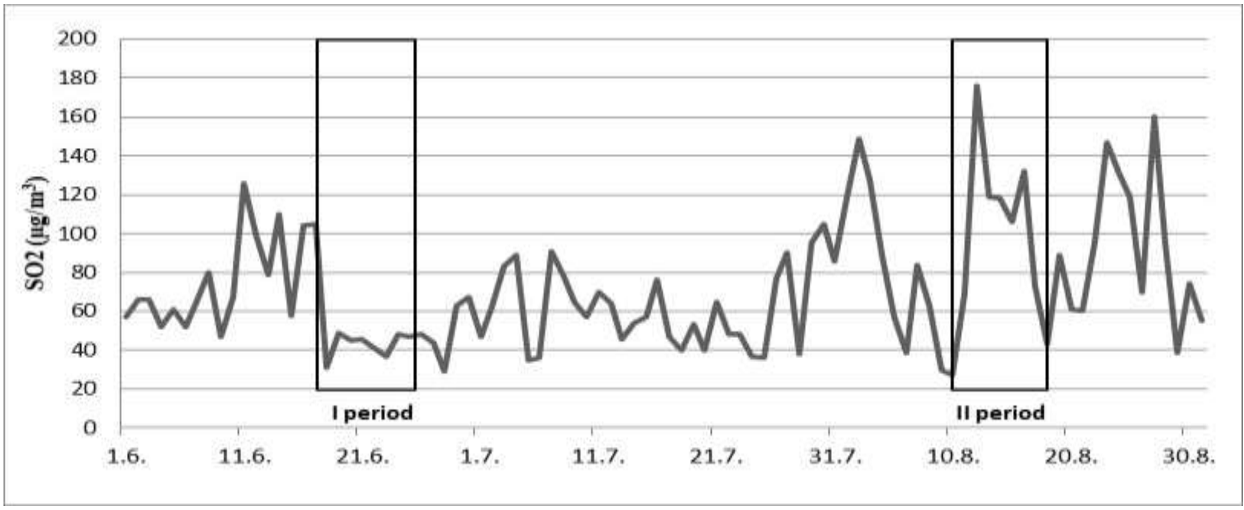
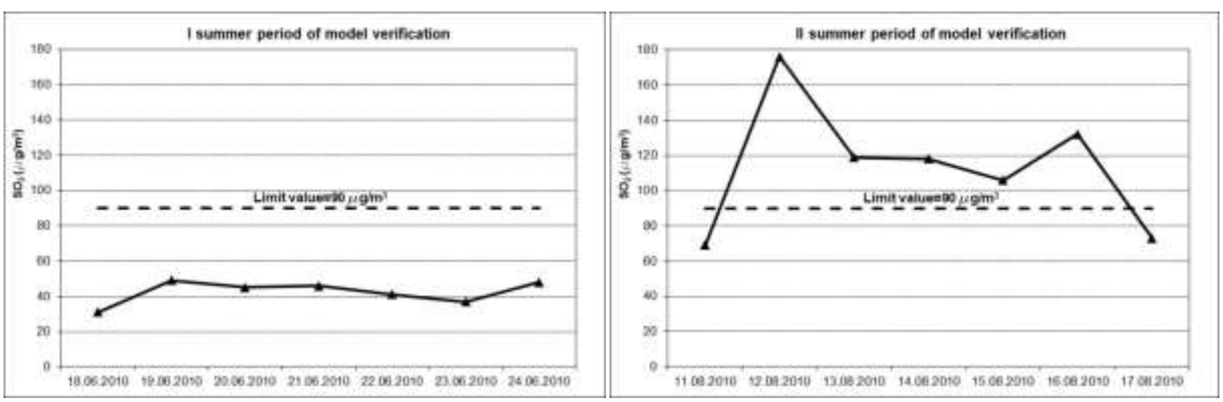


Figure 4:- Daily average of sulfur dioxide concentrations for the summer period of the model verification.

From the selected summer period, two shorter periods (episodes) with low and elevated concentrations of sulfur dioxide were selected. First period with low concentrations from 18. June to 24. June and second period with elevated concentrations from 11. August to 17. August. Daily average sulfur dioxide concentrations for selected periods are given In Table 3, and graphical interpretation of the data from table 3. is given in Figure 5.

Table 3:- Daily average of sulfur dioxide concentration for selected summer validation periods.

I summer period Date	Daily average of SO_2 concentration (µg/m3)	II summer period Date	Daily average of SO_2 concentration (µg/m3)
18/6/2010	31	11/8/2010	69
19/6/2010	49	12/8/2010	176
20/6/2010	45	13/8/2010	119
21/6/2010	46	14/8/2010	118
22/6/2010	41	15/8/2010	106
23/6/2010	37	16/8/2010	132
24/6/2010	48	17/8/2010	73



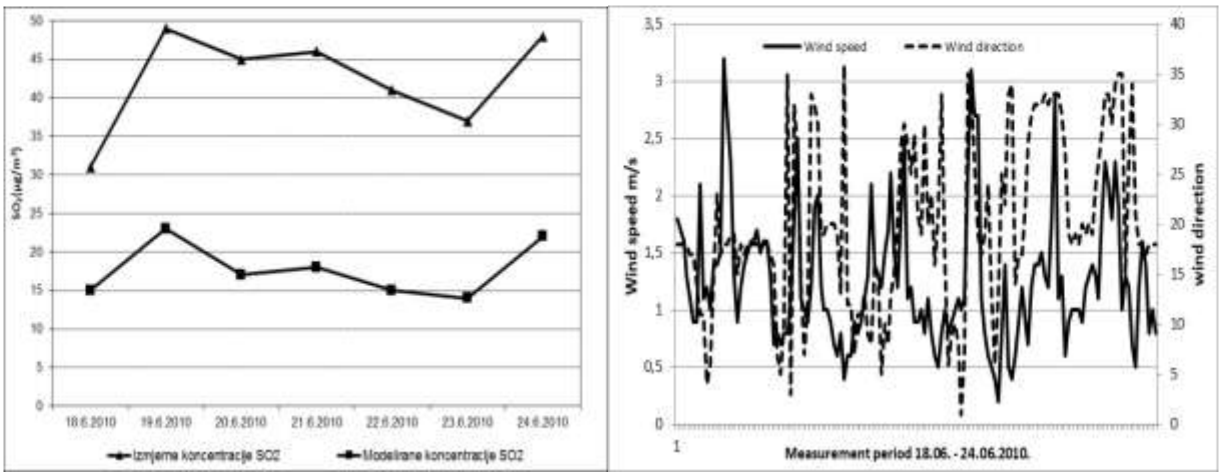
a) b)

Figure 5:- Daily average of sulfur dioxide concentration for the I summer period (a) and (b) for the II summer period of the model verification at the measurement site "Crkvice".

For both summer verification periods, Average daily values calculated using the dispersion model, and these values are given in Table 4. The table shows the measured and modeled values and percentage of matches of modeled and measured values. Graphical representation of data from table 4 is given in Figure 6a. Figure 6b shows wind speed and direction diagrams for the first summer period of model verification.

Table 4:- Overview of modeled and measured concentrations of SO_2 for the summer verification period.

Date (I period)	Daily average concentration of SO_2		Match percentage between modeled and measured values (%)
	Measured (µg/m3)	Modeled (µg/m3)	
18/06/2010	31	15	**48**
19/06/2010	49	23	**47**
20/06/2010	45	17	**38**
21/06/2010	46	18	**39**
22/06/2010	41	15	**37**
23/06/2010	37	14	**38**
24/06/2010	48	22	**46**
Average	**42,43**	**17,71**	**41,88**



a) b)

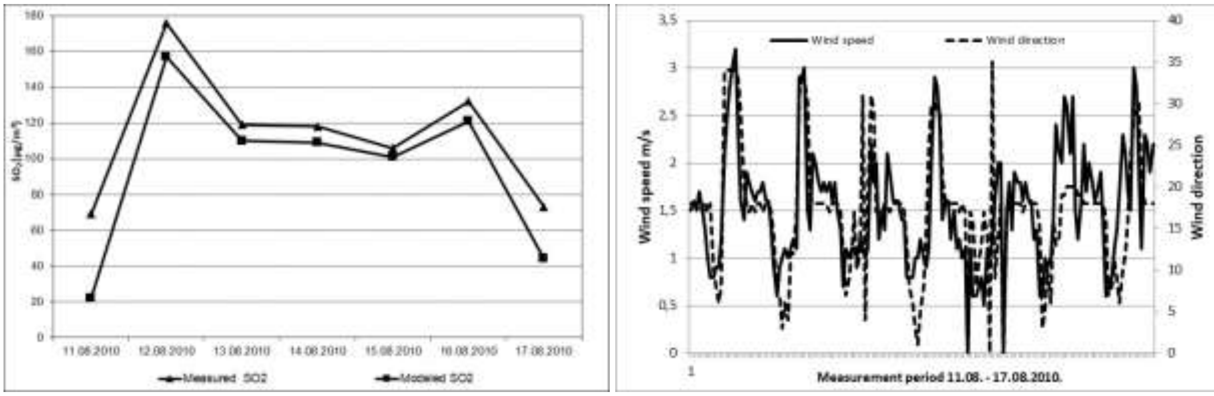
Figure 6:- Diagram of the daily average values of sulfur dioxide obtained by measuring and modeling (a), and (b) diagram of the wind speed and wind direction for the first summer period of model verification.

As it can be seen from the figure 6a) during the first episode of lower concentration of pollutants, results of the model follow the trend of the measured concentrations, but the percentage of correlation of these results is low. The model results are significantly smaller than the measured values. From the Figure 6b it is obvious that wind direction cannot be dominant influence factor for this deviation.

Modeled and measured values of SO_2 concentrations for the II summer verification period are given in Table 5. The table also shows percentage match of modeled and measured values. Graphical representation of data from table 5 is given in Figure 7a. Figure7 shows wind speed and direction diagrams for the second summer period of model verification.

Table 5:- An overview of modeled and measured concentrations of SO_2 for the second summer verification period.

Date (II period)	Daily average concentration of SO_2		Match percentage between modeled and measured values (%)
	Measured (µg/m3)	Modeled (µg/m3)	
11/08/2010	69	22	**32**
12/08/2010	176	157	**89**
13/08/2010	119	110	**92**
14/08/2010	118	109	**92**
15/08/2010	106	101	**95**
16/08/2010	132	121	**92**
17/08/2010	73	44	**60**
Average	**113,29**	**94,86**	**79,02**



a) b)

Figure 7:- Daily averages of sulfur dioxide obtained by measuring and modeling (a) and (b) wind direction and wind speed diagram for the second summer period of model verification.

As it can be seen from the figure 7a) during the second episode of lower concentration of pollutants, results of the model follow the trend of the measured concentrations and the percentage of correlation of these results is high. The model results are significantly smaller than the measured values only at the beginning and at the end of the observed period. The wind direction during the observed period, shown in figure 7b very unstable and cannot be taken as a dominant influence factor on the deviation of the modeled and measured values at the beginning and at the end of the observed period.

Analysis of the Verification Results for Summer Period:

Analysis of the data for the summer verification period has shown that the application of the given dispersion model for this kind of pollutant sources and pollutants into the air is adequate, with the provision of a sufficient data set for the purpose of quality verification and the design of the model itself. Matching trends of measured and modeled values pollutants in the air is one of the first indicators of the correctness of the applied dispersion model. In the case mismatching trends of measured and modeled data, it is necessary to carry out additional checks of the wind roses and polluters and check the times of data we have at our disposal. In some cases, it might come to delay in the comparison of measured data with emission data from emission sources, which may be due to terrain configuration, ground winds and distances between sources of pollutants and measurement stations. During the process of designing this model, the trends of the model and the quality of air quality have matched which means that model was properly set. However, there was a deviation of the modeled and measured values at the end of the verification intervals. Such errors are most often due to insufficient precision of the data averaging periods. In the case of this model, average annual energy consumption data, average daily air quality values and hourly wind data were used, hence the deviations that appeared were expected. Deviation of the value at the end of verification intervals does not have a significant impact on the final results when yearly average values are modeled. In that case, deviations that occur during the verification process should be taken with the caution, and considered as expected.

Verification of the model for the winter period:

High concentrations of sulfur dioxide in the ambient air were recorded at Crkvice measurement station during the whole observed period. In addition to the chimney of the cantonal hospital, small house stoves are a significant source of pollution in this period. But, this source of pollution is not taken into account since its influence is unknown and cannot be estimated.

Verification of the model for the summer period showed a very good correlation with high concentrations at the Crkvice measurement station in periods when atmospheric conditions were favorable for such transport of pollutants from the emission source of the Cantonal Hospital. Concerning this, it is possible to estimate the influence of other sources in the Zenica valley, on an annual basis, by comparing the influence of the Cantonal Hospital on the Crkvice measurement station in the summer period and influence of all sources in the winter period. Data used for SO_2 dispersion model verification in the winter period is showed in table 6.

Table 6:- Input data used for model verification in the winter period.

Stationary source name	Cantonal Hospital Zenica

Chimney height (m)	60
Dimensions of chimney (m)	2
Surface of the chimney (m^2)	3,14
Flue gas velocity (m/s)	2,2
Amount of flue gas (Nm^3/h)	25864
Total quantity of flue gas during the winter period (Nm^3/6 months)	21712425,6
Average fuel consumption (tones/ 6 months)	3182,4
SO_2 kg/6 months	165484,8
Geographic length / width of chimney loca	44°12'36.70N / 17°55'40.11E

For the purpose of model verification, the period from 01. December to 31. December of the year 2010 was taken for the winter season. This period during the winter season is selected because sulfur dioxide concentrations are much more pronounced in this period, and it is assumed that the sources in the surrounding of the measurement station have greatest influence on the air quality. Graphical representation of daily averages of sulfur dioxide concentrations for the selected winter period of the model verification is given a Figure 8.

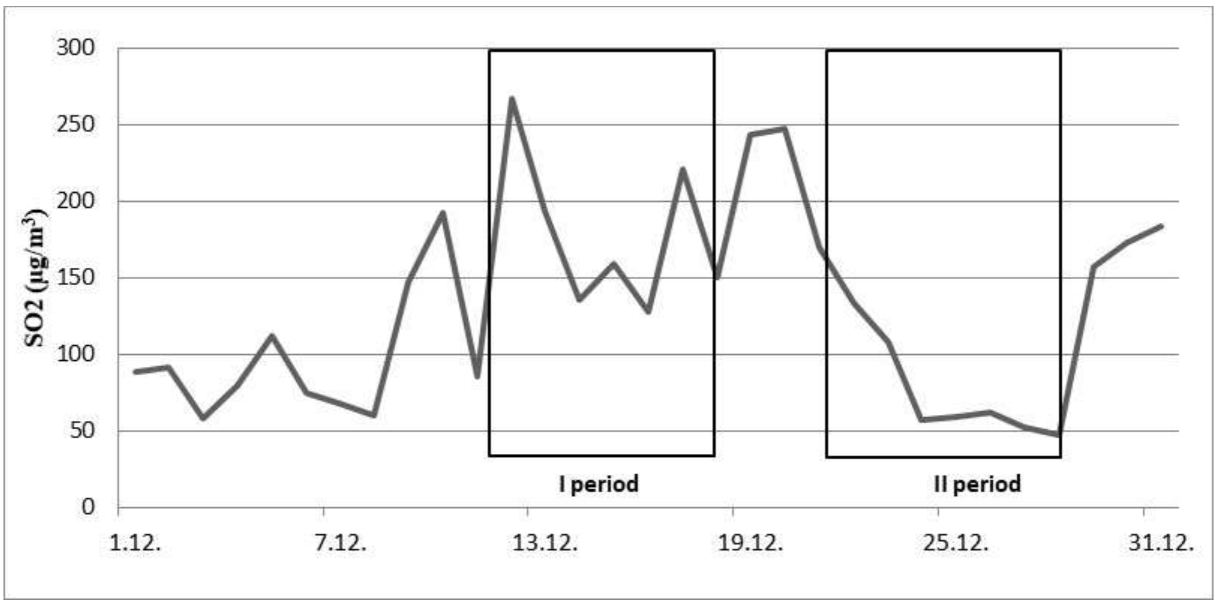


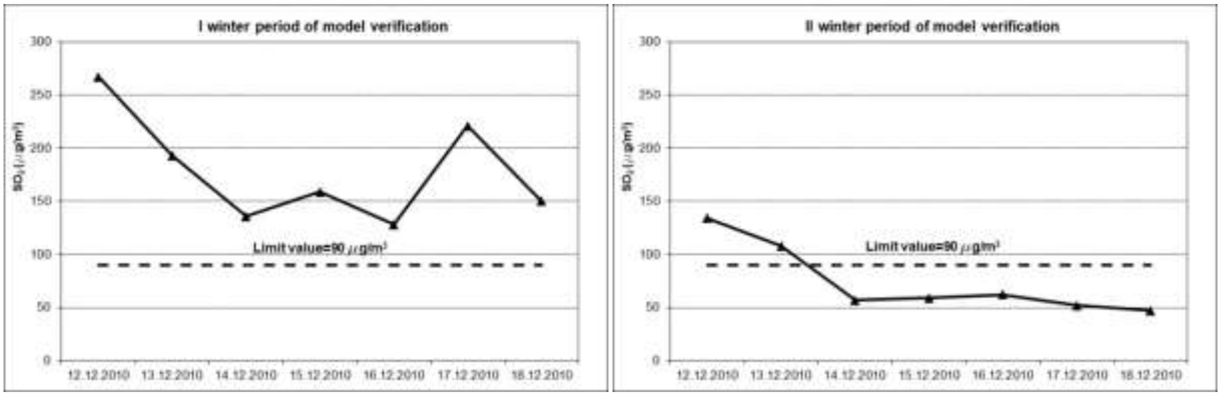
Figure 8:- Daily averages of sulfur dioxide concentration for the winter validation period of the model.

From the selected period, two shorter periods (episodes of low and high concentrations of sulfur dioxide), were chosen. The period from 12. December to 18. December 2010 with high SO_2 concentration and period from 22. December to 28. December of 2010 with low SO_2 concentrations, as shown in Figure 7.

Daily average sulfur dioxide concentrations for the periods of low and high sulfur dioxide concentration periods are shown in Table 7. Graphical representation of data from table 7 is given in Figure 8.

Table 7:- Daily average sulfur dioxide concentration for selected winter verification periods.

I winter period Date	Daily average concentration of SO_2 ($\mu g/m^3$)	II winter period Date	Daily average concentration of SO_2 ($\mu g/m^3$)
12/12/2010	**267**	22/12/2010	**134**
13/12/2010	**193**	23/12/2010	**108**
14/12/2010	**136**	24/12/2010	**57**
15/12/2010	**159**	25/12/2010	**59**
16/12/2010	**128**	26/12/2010	**62**
17/12/2010	**221**	27/12/2010	**52**
18/12/2010	**150**	28/12/2010	**47**



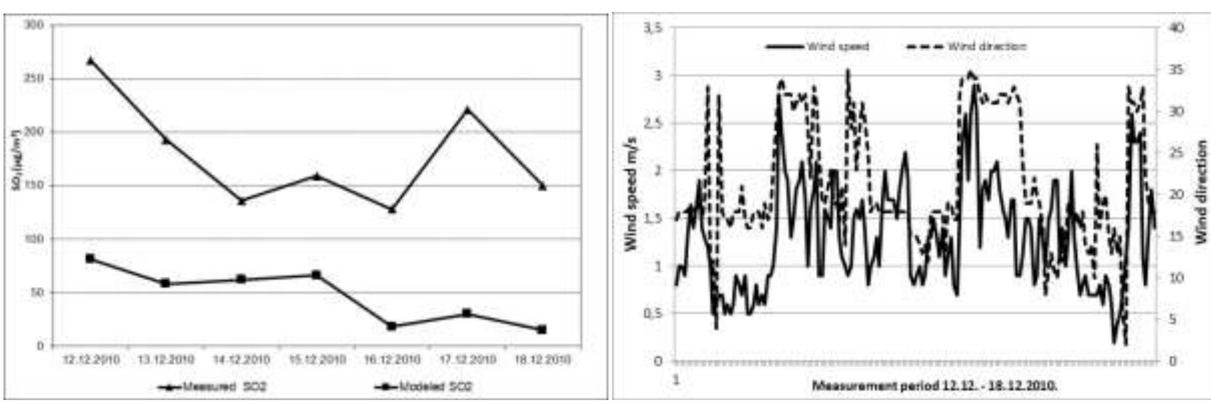
a) b)

Figure 9:- Daily average of sulfur dioxide concentrations for the first winter period (a) and (b) daily average of sulfur dioxide concentrations for the second winter period of model verification recorded at the measurement site Crkvice.

Modeled and measured values of SO_2 concentrations (daily averages) for the first winter verification period are given in Table 8. The table also shows match percentage between modeled and measured values. Graphical representation of data from table 8 is given in Figure 10a. Figure 10b shows wind speed and direction diagrams for the first winter period of model verification.

Table 8:- An overview of the modeled and measured of SO_2 concentrations for the winter period of the model verification.

Date (I period)	Daily average concentration of SO_2		Match percentage between modeled and measured values (%)
	Measured (μg/m3)	Modeled (μg/m3)	
12/12/2010	267	81	**30**
13/12/2010	193	58	**30**
14/12/2010	136	62	**46**
15/12/2010	159	66	**42**
16/12/2010	128	18	**14**
17/12/2010	221	30	**14**
18/12/2010	150	15	**90**
Average	**179,14**	**47,14**	**26,45**



a) b)

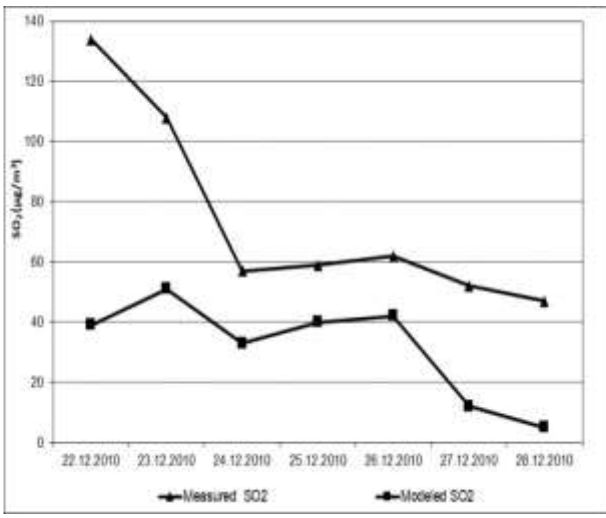
Figure 10:- Daily averages of sulfur dioxide obtained by measuring and modeling (a) and (b) the wind direction and wind speed diagram for the first winter period of the model verification.

As it can be seen from the figure 10a) during the first winter episode of high concentration of pollutants, results of the model do not follow the trend of the measured concentrations. Percentage of correlation of these results is very low (Table 8). The model results are significantly smaller than the measured values.

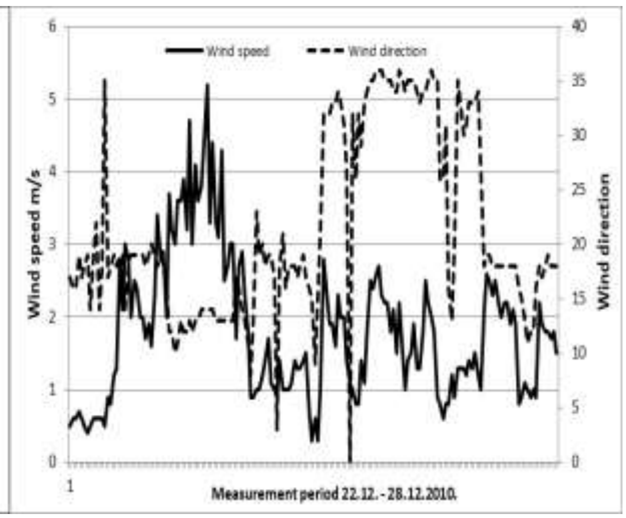
Modeled and measured values of SO_2 concentrations for the II summer verification period are given in Table 9. The table also shows match percentage of modeled and measured values. Graphical representation of data from table 9 is given in Figure 11a. Figure 11b shows wind speed and direction diagrams for the second winter period of model verification.

Table 9:- An overview of the modeled and measured concentrations of SO2 for the I winter period of the model validation.

Date (II period)	Daily average concentration SO_2		Match percentage between modeled and measured values (%)
	Measured (µg/m3)	Modeled (µg/m3)	
22/12/2010	134	39	**29**
23/12/2010	108	51	**47**
24/12/2010	57	33	**48**
25/12/2010	59	40	**68**
26/12/2010	62	42	**68**
27/12/2010	52	12	**23**
28/12/2010	47	5	**11**
Average	74,14	31,71	43,35



a)



b)

Figure 11:- Daily averages of sulfur dioxide obtained by measuring and modeling (a) and (b) the wind direction and wind speed diagram for the second winter period of the model verification.

As it can be seen from the figure 10a) during the second winter episode of lower concentration of pollutants, results of the model follow the trend of the measured concentrations. Percentage of correlation of these results is low (Table 9).

Analysis of the Verification Results for the Winter Period:

On the base of presented data for the winter period of model verification, it is clear that the verification of the model cannot be carried out during the winter period and that it is necessary to select the period of the year when there are no other sources of pollution. Only then can the real impact of the emission source on air quality be assessed. In order to verify the model and in the winter period it is necessary to include other pollution sources in the environment into the model and to consider the overall influence of the surrounding sources on the air quality condition. This kind of verification cannot be carried out without the good register of pollution sources, greater the data volume of the pollution sources, long-term data of the condition of atmosphere and correct data about ground winds at micro location.

The apparent presence of other sources of pollution, which could not be accounted for, could be the reason for huge mismatch between modeled and measured values in the winter period of the model verification. The wind direction during the observed period, shown in figures 10b and 11b was very unstable and cannot be taken as a dominant influence factor on the deviation of the modeled and measured values.

It is also necessary to mention that in the periods of temperature inversions the data from one meteorological station are not enough and additional meteorological conditions must be included because Zenica has a complex orography that affects the wind's character on micro location of the sources of pollution, especially in periods of temperature inversions. In addition, it would be useful to perform a recording of the atmosphere profile in these periods to analyze height of the inversion layer, its permeability, and its movement during the day. Model verification in temperature inversion periods, i.e. in short episodes of elevated values of air quality, is a very complex process that requires the processing of large amounts of data that is currently unavailable.

Conclusions:-

Applying the dispersion model depends on its verification. The SO_2 dispersion model verification method from 20 stationary sources in Zenica City and from 3 industrial sources (sources of sulfur dioxide pollution from the primary metallurgical plants of Arcelor Mittal Zenica) presented in this paper showed a small percentage of matching the concentration between SO_2 concentration obtained by modeling and measurement at the control point. However, verification has shown that the dispersion model for this type of pollutant in the air is well established because there is a good correlation between the trend of increasing and decreasing SO_2 values in the air obtained by modeling and measuring, which is one of the first indicators of the correct model.

A small matching of model results and measurement results can be attributed to the lack of high quality data required for modeling. Accordingly, in order to use the described dispersion model, it is necessary to make its improvement. Since improvement is primarily due to the quality of data used for modeling, it is necessary to:

1. consolidate all data on the air quality condition in the Zenica valley,
2. increase amount of valid air quality data,
3. increase the number of locations to collect meteorological data,
4. adequately enforce the quality control of air quality data,
5. perform a high-quality recording of City area configuration.

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