Forecasts of methane concentration at the outlet of the longwall with caving area - case study

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Abstract. This paper presents the characteristics of methane hazard and prevention undertaken in the N-6 longwall of seam 330/2 in “Krupiński” coal mine. On the basis of methane concentration measurements conducted with the use of telemetric system, time series of the average and maximum methane concentration at the outlet of the longwall area were generated. It was ascertained that they exhibit a strong autocorrelation. Based on a series of the average methane concentration, a time series of ventilation methane content was created and a total methane content was calculated with the use of methane flow rate measurements in the demethanization system. It was ascertained that dependence between methane concentration and output on the examined day and on the previous day is weak and also that the dependence between methane concentration and air flow rate is very weak. Dependencies between ventilation methane content, total methane content and demethanization efficiency were also investigated. Based on forecasting models [1] developed earlier by H. Badura, forecasts have been made to predict the average and maximum methane concentrations. The measured values of methane concentration show a high level of accordance with forecasted ones.

1. Introduction

The existing mining regulations [2] require performing forecasts of methane content in longwalls prior to the commencement of mining exploitation. The relevance of these forecasts depends on the accuracy of geological reconnaissance of deposit conditions, the degree of recognition of methane volume in the exploited seam and seams lying above and below it as well as methane volume in gangue, especially in sandstones occurring in the roof and floor rocks [3, 4, 5, 6]. The recognition of methane volume based on measurements is usually limited to seams in which the exploitation was or is conducted. Methane volume in seams occurring between the ones in which methane volume was determined is performed by interpolation. Methane volume of seams occurring below the exploited one is determined by extrapolation of methane volume indications in seams occurring higher or interpolated from measurements made in geological test boreholes. It also happens to be assumed by the forecaster basing on his experience. Also methane volume in sandstones is most often set down on the basis of the experience of a person performing forecast.

Methane contained in rock mass occurs in free and sorbed form (adsorbed and absorbed). In coal seams the largest amount of methane is present as sorbed. Free methane usually does not exceed 10% of the total methane content. Sorbed methane is also present in coal-containing mineral layers. The largest amount of free gas occurs in gravels, sandstones - especially coarse grained ones, and in conglomerates, because these rocks exhibit the highest porosity.
Methods used to forecast the total methane content in the longwall area assume that degassing of rocks that occur in the roof and floor of the exploited part of seam takes place in the so-called desorption zone, the shape and range of which is differently determined by the authors of forecasting methods [7, 4, 8, 5, 9, 10]. In Poland at the present time the most often used theory is the one proposed in papers [6, 7]. It is also assumed that the degree of degassing of layers depends on the distance of the investigated layer from the exploited seam [4, 5, 6, 8]. In Poland, the most commonly used method is the one developed at the Central Mining Institute – ‘Barbara’ Experimental Mine by B. Kozłowski [5, 6]. Forecasts of total methane content in longwall areas also take into account the predicted output size of the longwall.

In the light of the above forecasted value of methane content in the longwall is determined by many factors, the influence of which cannot be fully predicted. Every methane content forecast is therefore burdened with a certain error, the actual value of which can only be determined by comparison with methane content that was present during the mining exploitation.

Forecasted ventilation methane content is calculated as the product of forecasted total methane content and methane removal efficiency achieved or assumed in the given mine.

Ventilation methane content of the longwall area is calculated as the product of methane concentration and the flow rate of air in the longwall area. Upon forecasting the average methane concentration and knowing or assuming the value of the air flow rate, one can calculate the forecasted ventilation methane content value for the designed longwall.

This paper presents the results of an one-day forecast of the average and maximum methane concentration at the outlet of the N-6 longwall in seam 330/2 of the "B" coal mine and the assessment of forecasts errors.

2. Natural and mining conditions of the N-6 longwall area in seam 330/2

Occurring conditions of part of seam 330/2 exploited by the N-6 longwall were identified by five boreholes of which two were drilled from the surface (BS-30/1981, BS-3/1972) and three from underground excavations (G-23/2005, G-24/2005 and G-17/2007) as well as from preparatory excavations made for the N-6 longwall [11]. Fragments of geological profiles from BS-3/1972 and G-23/2000 boreholes are shown in figure 1. Figure 2 presents geological cross-section of seam parallel to the face of the N-6 longwall.

The analysis of geological profiles shows that geological conditions of seam occurrence were very variable. For example, the BS-3/1972 borehole drilled directly above seam revealed dark gray claystone, cracked, 1.80 m thick, light gray sandstone, cracked, 1.60 m thick and gray claystone, strongly sandy, 9.8 m thick. Over these layers occurs the first layer of coal and coal with claystone with a total thickness of 0.8 m. Due to the total thickness of rock layers, one can conclude that coal layer occurs over seam 330/2 at a distance of 13.20 m.

In the G-23/2000 borehole above seam 330/2 occurs claystone, 0.30 m thick, the layer of sandy claystone with intercalations of sandstone, 6.10 m thick, sandstone, 2.20 m thick and the layer of sandy claystone with the thickness of 5.70 m. Over the mentioned layers, i.e. at a distance of 13.0 m, occurs the coal layer with a thickness of 1.00 m.

It follows from the foregoing that rock layers between seam 330/2 and an unnamed carbon layer differ in mineralogical composition, petrographic composition and thickness. Also the carbon layer has a different thickness and the degree of impurity caused by gangue.

Profiles in figures 1 and 2 show that seam 330/2 is divided into layers by gangue partings. The number of layers and their thicknesses vary in dependence of coordinates of the studied geological profile. In BS-3/1972 borehole (figure 1) the seam has a thickness of 3.50 m, with carbon layers accounting for 54% of this thickness. In G-23/2000 borehole (figure 1) coal has a thickness of 1.10 m and forms one layer with high content of claystones in the roof section.

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Figure 1. Fragments of geological profiles from BS-31/1972 borehole (left) and G-23/2000 borehole (right).

Figure 2. Geological cross-section through seam 330/2 parallel to the longwall face.

In the longwall face profile, in place of the beginning of exploitation with longwall (figure 2) near the N-6 gate, seam has a thickness of 2.66 m and coal layers account for 64% of this thickness (1.69 m). At the point located about 90 m from the N-6 gate, seam thickness is 2.48 m, and the
thickness of carbon layers – 1.48 m (60% of seam thickness). At the point located about 210 m from the N-6 gate, seam thickness is 2.85 m and the thickness of carbon layers –1.77 m (62%).

The strength of roof rocks, determined by testing core samples, ranged from 53.5 MPa to 75.1 MPa, the strength of floor rocks ranged from 22.0 MPa to 41.2 MPa. The strength of coal in seam 330/2 ranges from 14.0 MPa to 16.0 MPa.

On the basis of geological profiles, it can be stated that in close proximities to seam 330/2 occur several non-recoverable seams. The deposit also contains mineral layers with considerable content of coal. As mentioned above, such layers are the source of sorbed methane.

The distance of adjacent recoverable seams located over seam 330/2 is variable. The closest earlier exploited seam 329/1, 329/1-2 is located at the distance of 35 m to 75 m.

Forecasted total methane content of the N-6 longwall was 30.14 m$^3$/min for the planned output of 4000.00 Mg/day. Forecast predicted that approximately 48.6% of total methane content would come from overlying rocks, 26.5% from the exploited seam, and 24.9% from layers occurring below seam 330/2.

The G-6 longwall (figure 3) was characterized by the following geometric parameters:
- longwall length about 225 m,
- panel length about 1100 m,
- height from 2.80 m to 2.96 m.

In order to prepare the N-6 longwall exploitation area, the following preparatory excavations were made. The N-6 gate was drilled from ramp N-4 in seam 330/2. From the N-4 gate, a bottom gate for the N-4 longwall, the N-6 top gate was drilled, separated from the N-4 gate by a narrow coal pillar. The N-6 gate and the N-6 top gate were connected by the N-6 raise.

Fresh air from the N-4 ramp in seam 330/2 entered the N-6 longwall through the N-6 gate. After ventilating the longwall, the exhausted air was drained along the N-6 top gate to the N-4 gate. Along the N-4 gate exhausted air flowed into the intersection with the N-4 ventilation cross-cut. Here it merged with fresh air flowing from the N-4 ramp in seam 330/2, sealed by a section of the N-4 gate. From the intersection, the flow of exhaust air was drained by the N-4 ventilation cross-cut to the subsequent excavations towards the ventilation shaft.

In the initial period, at the panel length of about 220 m, the exploitation with the N-6 longwall was carried out under an unexploited part of the deposit. In the remaining part of the exploitation area the

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**Figure 3.** Diagram of workings of the N-6 longwall area in seam 330/2.
The longwall entered under the mined out part of seam 329/1, 329/1-2, which is depicted in figure 3 in the form of beige hatched surfaces. As the distance between seams 330/2 and 329/1, 329/1-2 ranged from 35 m to 70 m, the exploitation in seam 329/2, 329/1-2 caused partial demethanization of seam 330/2 and rock layers between these seams. As the exploitation progressed, the length of longwall underneath workings in seam 329/1, 329/1-2 increased.

The average monthly longwall advance was 105 m, i.e. about 5 m per working day.

3. Measurement data
Forecasts of methane concentration were based on telemetric measurements. Methane concentration sensor was located in the exhaust air current in the N-4 gate, in front of the intersection with the N-6 ventilation cross-cut (figure 3). Measurement error of the methane concentration sensor was 0.1% CH₄. Measurements used to create and verify forecasts were conducted in the period from 23.05.2013 to 04.02.2014, i.e. 257 days, including 175 working days. The first day of the observation period was also the first day of the N-6 longwall exploitation.

Measurement data were processed with the use of PROGMET program, developed at the Institute of Mining of Silesian University of Technology [1]. The results of calculations include among others the average values of methane concentration as well as the maximum and minimum values. The average methane concentration values were calculated for twenty-four hour periods, from 6:00:00 on the current day to 5:59:59 the following day. The maximum and minimum methane concentration values were determined in the same periods.

Figure 4 shows the average, maximum and minimum daily methane concentration throughout the observation period.

![Figure 4](image.png)

**Figure 4.** The average, minimum and maximum methane concentration during the observation period.

Figure 4 shows long-term changes in methane concentration and fluctuations associated with the five-day working week (mining was conducted from Monday to Friday). In weekly fluctuations, the highest concentrations of methane occurred from Wednesday to Friday, while the lowest concentrations were generally observed on Sundays.

The average methane concentration at the outlet of the N-6 longwall ventilation area increased steadily from the beginning of the exploitation (from 23.05.2013) to 09.07.2013. The increase in methane concentration was certainly due to the formation of the complete methane desorption zone both in the roof layers and in the floor ones. In the discussed period big differences between the highest and the lowest concentration of methane in weekly periods are visible.

From 09.07.2013, the methane concentration level was constantly decreasing, initially (from 25.08.2013) slowly and then faster. With the increase of exploitation time, differences between the
minimum and maximum methane concentrations also decrease. This is a period of exploitation during which an increasing length of the longwall enters under the mined-out part of seam 329/2, 329/1-2.

After 09.12.2013, there was a short period of the average methane concentration increase, followed by its stabilization. This fact is related to a reduction of the air flow rate by about 500 m$^3$/min (figure 6).

Figure 5 shows graphs of methane concentration and output on respective days of the observation period.

**Figure 5.** Changes in average methane concentration and daily output during the observation period.

Graphs suggest that the dependence between presented values is not high. This is confirmed by the value of linear determination coefficient between the average methane concentration and output, which amounts to $R^2 = 0.179$, between daily output and minimum concentration $R^2 = 0.115$ and between daily output and maximum methane concentration $R^2 = 0.169$. This means that the variability in the average methane concentration can be explained by the variability of output only in 17.9%, the variability of the minimum methane concentration in about 11.5%, and the variability of the maximum methane concentration in about 16.9%.

Figure 6 shows graphs of air flow rate and the average methane concentration.

**Figure 6.** Changes in air flow rate and the average methane concentration.
The value of determination coefficient between air flow rate and the average methane concentration is \( R^2 = 0.072 \), between air flow rate and the minimum methane concentration \( R^2 = 0.065 \) and between air flow rate and the maximum methane concentration \( R^2 = 0.068 \). Values of determination coefficients indicate a very weak dependence of methane concentration from air flow rate. The reason for such low dependence is relatively small variability of air flow rate and at the same time quite significant variability of methane emission to the longwall area.

Based on the above analyses it may be concluded that fluctuations of methane concentration were the effect of several factors (measurable and non-measurable) at the same time, and roles of particular factors in shaping the methane concentration in the longwall area are difficult to quantify unequivocally.

In paper [1] it was found that the average methane concentration on the current day can be described by a linear function of methane concentration on the previous day. It was also ascertained that there exist linear dependencies of the maximum methane concentration from the average methane concentration on the previous day and of the maximum methane concentration from the maximum concentration on the previous day.

Based on statistical analysis of ten longwalls data set in Jastrzebska Coal Company, covering a total of 2239 days, the parameters of linear predictive models were determined for each day of the week (i.e. Monday, Tuesday, etc.) for the average methane concentration in dependence of the average methane concentration on the previous day, the maximum methane concentration in dependence of the average methane concentration on the previous day as well as the maximum methane concentration in dependence of the maximum methane concentration on the previous day. Using the above forecasting models, on the basis of measurement data collected at the outlet of the N-6 longwall in seam 330/2 in the ‘B’ mine, the one-day ex post forecasts were carried out and then errors of these forecasts were examined.

4. Forecast of the average methane concentration
The average methane concentration forecast was made for all days of the observation period except for the first one, for which there is no descriptive variable (independent variable), i.e. methane concentration on the previous day. Graphs of the average methane concentrations for measured and forecasted values are shown in figure 7. The comparison of both graphs shows that forecasts exhibit a significant consistency with measurement data.

Figure 8 shows the linear correlation between the average forecasted concentration and the average measured concentration of methane.

In the case of ideal compliance of forecast with measurements, the values of the gradient of a straight line and the determination coefficient are 1.

The equation of the straight line shown in figure 8 leads to a conclusion that the gradient of a straight line adopts the approximate value of \( a = 0.97 \) and therefore is close to one. On the other hand, the value of determination coefficient is \( R^2 = 0.87 \), indicating a very strong coherence between forecasted methane concentration and the measured one [12].

For each day of forecast, absolute error was calculated with the accuracy of 0.01% \( \text{CH}_4 \), i.e. with the accuracy of the average methane concentration value calculation. A summary of the average methane concentration forecast absolute errors is shown in figure 9.
Figure 7. Graphs of the average methane concentration, measured and forecasted.

Figure 8. Linear correlation between the average measured and forecasted methane concentration.
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The horizontal axis specifies the upper limits of absolute errors values intervals, computed with an accuracy of 0.01% of CH₄. For example, the value of 0.1 refers to the left-half open interval of absolute errors (0.09; 0.1). The number of absolute errors is indicated on the vertical axis, and the number of absolute errors in the given interval is shown over individual columns in the graph.

The figure shows that errors above the value of 0.15% CH₄ are accidental errors caused by excessive disturbances in methane inflow into the longwall area or ventilation problems on the day for which forecast was made or on the previous day. The above statement shows an example of the average methane concentrations on 26.11.2013 and 27.11.2013.

Table 1. Exemplary results of measurements, forecasts and forecasts errors of the average methane concentration.

| Date        | Methane concentration measured (%CH₄) | Methane concentration forecasted (%CH₄) | Difference (%CH₄) | Absolute error (%CH₄) |
|-------------|---------------------------------------|----------------------------------------|-------------------|-----------------------|
| 24.11.2013  | 0.35                                  | 0.36                                   | -0.01             | 0.01                  |
| 25.11.2013  | 0.34                                  | 0.43                                   | -0.09             | 0.09                  |
| 26.11.2013  | 0.70                                  | 0.45                                   | 0.25              | 0.25                  |
| 27.11.2013  | 0.32                                  | 0.73                                   | -0.41             | 0.41                  |
| 28.11.2013  | 0.37                                  | 0.35                                   | 0.02              | 0.02                  |
| 29.11.2013  | 0.37                                  | 0.04                                   | -0.03             | 0.03                  |

On November 24th and 25th, 2013, the average measured methane concentration amounted to 0.35% CH₄ and 0.34% CH₄ respectively, and forecasted methane concentration amounted to 0.36% CH₄ and 0.43% CH₄. Absolute errors amounted to 0.01% CH₄ and 0.09% CH₄. On 26.11.2013, the average methane concentration suddenly increased to 0.70% CH₄. Since forecast for that day uses the measured concentration of the previous day, forecasted value amounts to 0.45% CH₄. Therefore, absolute error of forecast is large and amounts to 0.25% CH₄. On the next day (27th November) the measured methane concentration was reduced to 0.32% CH₄. Forecast for this day amounts to 0.73% CH₄ and is significantly overstated because it bases on the value of methane concentration from the previous day (0.70% CH₄), much higher than on the few days before. Hence the absolute error of
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The forecast for this day amounts to 0.41% CH₄. On the next two days the disturbances in methane concentration are relatively small, which makes absolute errors of forecast also small.

Figure 10 shows the total percentage of absolute errors from 0.00% to the value specified on the horizontal axis.

Figure 10. Histogram of the cumulated percentage of absolute errors of the average methane concentration forecast.

The graph in figure 10 shows that in the interval of 0.00% CH₄ to 0.10% CH₄ there are 18% of absolute errors of forecast, in the interval of 0.00 CH₄ to 0.10% CH₄ there are 86% of absolute errors of forecast, and in the interval of 0 to 0.15% CH₄ there are as many as 95% of absolute errors of forecast. The remaining 5% of forecast errors is due to accidental, large disturbances in methane concentration.

Analyzes performed in paper [12] have shown that residuals of prognostic models do not have a normal distribution. Accordingly, the theoretically calculated forecasts errors that are correct in the event of a normal distribution of residuals of the model would be burdened. Therefore, the expected accuracy of the proposed prognostic method will be possible to assess only after performing numerous forecasts and evaluating their errors.

For engineers of mine ventilation divisions who make use of forecast, the important issue is a relative error of forecast with a predetermined value, which they consider acceptable. In the following part of this paper it was assumed that this error amounts to 20% of forecasted average value of methane concentration.

Figure 11. Location of measurement values of the average methane concentration in relation to the 20% deviation interval from forecasted average methane concentration.
In Figure 11, the green line (the lower limit of forecast) represents 80% of forecasted average methane concentration and the red line - 120% of this value (the upper limit of forecast). The black line connects the measurement values of the average methane concentration.

Calculations have shown that in the forecast interval there are 232 of the total 256 values of the average measured concentration, which is approximately 90.3% of all values.

For safety reasons it is important to know the number of exceedances of the upper forecast limit by the average methane concentration. The calculations show that such relationship occurred in only 10 cases, which accounts for 3.9% of cases.

The above analysis makes it clear that the accuracy of the average methane concentration forecasts is very good.

5. Forecast of the maximum methane concentration

Based on prognostic equations in paper [1], two types of the maximum methane concentration forecasts were performed. The independent variable in forecast 1 is the average methane concentration on the previous day, and in forecast 2 it is the maximum methane concentration on the previous day.

Graphical comparison of the maximum methane concentration measurement values with values of forecast 1 is shown in Figure 12, and with values of forecast 2 - in Figure 13.

**Figure 12.** The values of maximum methane concentration measured and forecasted on the basis of the average methane concentration on the previous day (forecast 1).

Comparison of Figures 12 and 13 shows that the maximum methane concentration values obtained from forecast 1 are slightly higher than from forecast 2. This observation may be confirmed by the fact that the sum of forecasted values for the whole analyzed period is 231 according to forecast 1, and 216 according to forecast 2, while the sum of the maximum concentration measurement values amounts to 221. The obtained maximum methane concentration values according to forecast 1 are underestimated in 88 cases and overestimated in 168 cases, while according to forecast 2 forecasted values are underestimated in 129 cases and overestimated in 127.
Figure 13. The values of maximum methane concentration measured and forecasted on the basis of the maximum methane concentration on the previous day (forecast 2).

Figure 14 shows the distribution of absolute errors of the maximum methane concentration forecast 1, and Figure 15— the distribution of absolute errors of forecast 2.

Figure 14. Histogram of absolute errors quantity for the maximum methane concentration forecast 1.
Figure 15. Histogram of absolute errors quantity for the maximum methane concentration forecast 2.

Forecast 1 is characterized by a lower number of absolute errors to the value of 0.1% CH$_4$ than forecast 2. In forecast 1, absolute errors do not exceed the value of 0.9% CH$_4$, while in forecast 2 they reach the value of 1.2% CH$_4$.

Figures 16 and 17 show that absolute errors till the value of 0.1% represent 52% of all errors of forecast 1 and 54.7% of all errors of forecast 2. On the other hand, absolute errors from an interval of 0 to 0.3% represent 96.1% of all errors of forecast 1 and 92.2% of errors in case of forecast 2. This means that absolute errors greater than 0.3% CH$_4$ represent 3.9% of the total number of errors in case of forecast 1 and 7.8% of all errors in case of forecast 2.

Figure 16. Histogram of the cumulated percentage of absolute errors of the maximum methane concentration forecast 1.
Figure 17. Histogram of the cumulated percentage of absolute errors of the maximum methane concentration forecast 2.

Figures 18 and 19 show forecast interval $[0.8S_{\text{max}}, 1.2S_{\text{max}}]$, where $S_{\text{max}}$ represents forecasted maximum methane concentration. The value of $0.8S_{\text{max}}$ is called the lower limit of forecast, and the value of $1.2S_{\text{max}}$ is the upper limit of forecast. Figure 18 refers to forecast 1 and figure 19 - to forecast 2.

Figure 18. Location of measurement values of the maximum methane concentration in relation to the 20% deviation interval from forecast 1 of maximum methane concentration.
Within the limits of forecast 1 there are 188 cases of the maximum methane concentration measurement values, and within the limits of 2-interval forecast - 182 cases, corresponding to respectively 73.4% and 71.1% of the total number of 256 cases.

For security reasons, underestimation of forecast is more unwelcome than its overestimation. Over the upper limit of the 1-interval forecast occurred 15 cases of the maximum methane concentration measurement values, and over the upper limit of 2-interval forecast occurred 42 cases. This represents 5.9% and 16.4% of the total number of cases, respectively.

The above specification shows that the maximum methane concentration forecast that uses the average methane concentration on the previous day (forecast 1) is in case of the N-6 longwall more accurate than forecast that uses the maximum methane concentration on the previous day.

6. Recapitulation and conclusions

Exploitation of the N-6 longwall in seam 330/2 in the ‘B’ coal mine owned by Jastrzebska Coal Company was conducted in complex geological conditions. The roof and floor layers of seam had variable thickness as well as mineralogical and petrographic composition. In seam 330/2 there were four layers of gangue.

In the initial phase of exploitation, the longwall was situated under the unexploited part of seam 329/1, 329/1-2. The longwall advance revealed the rising trend of methane concentration at the outlet of the longwall area. That trend was connected with the expansion of methane desorption zones in rocks above and below the exploited seam. After mining out about 220 m of panel length, the longwall was gradually entering under the abandoned workings in seam 329/1, 329/1-2, which changed the trend of methane concentration to descending. Due to exploitation works conducted five days a week, over the whole period appeared fluctuations in methane concentration.

This paper presents the application of methods developed in paper [1] for forecasting the average and maximum methane concentration at the outlet of the N-6 longwall area in seam 330/2.

Methane concentrations were analyzed by continuous measurements performed by methane concentration sensor located at the outlet of the longwall ventilation area, which is an element of the ‘B’ mine telemetric system. On the basis of these measurements, the average methane values for 24 hours (from 06:00:00 to 06:59:59 the following day) were calculated and the maximum and minimum methane concentrations were determined. Measurement error of methane concentration amounted to 0.1% CH₄. Forecasts covered a 256 day period of the longwall exploitation.

Analysis of forecasts results allowed for the following conclusions:
The average forecasted concentrations in 86% cases of the total number of forecasts (256) differed from the measured value by no more than 0.01% CH₄ and in 95% cases by no more than 0.15% CH₄.

In the interval of 80% to 120% of the average methane concentration forecasted value occurred 90.3% of the measured average methane concentration cases. In 3.9% of cases the average measured concentration was higher than 120% of the average forecasted concentration.

The results of forecast lead to the conclusion that forecasts for the average values of methane concentration show a very good accordance with the average methane concentration measured values.

The maximum forecasted methane concentrations on the basis of the measured average values of methane concentration on the previous day (forecast 1) differ in 52% of cases from the measured values by not more than 0.1% CH₄, which corresponds with the measurement error. In 85.5% of cases the forecast error is no greater than 0.2% CH₄, and in 96.1% of cases this error amounts to no more than 0.3% CH₄.

In the interval of 80% to 120% of the maximum methane concentration values, calculated according to forecast 1, occurred 73.4% of the measured maximum methane concentration cases. In 5.9% of cases the maximum measured concentration was higher than 120% of forecasted values.

The maximum forecasted methane concentrations on the basis of the measured maximum values of methane concentration on the previous day (forecast 2) differ from the measured values by not more than 0.1% CH₄ in 54% of cases. In 79.3% of cases absolute error of forecast is no greater than 0.2% CH₄, and in 92.3% of cases this error amounts to no more than 0.3% CH₄.

In the interval of 80% to 120% of the maximum methane concentration value calculated according to forecast 2 occurred 71.1% of the measured methane concentration cases. In 16.4% of cases the measured maximum methane concentration took higher values than 120% of the maximum methane concentration calculated according to forecast 2.

Both the results of forecast 1 and forecast 2 of the maximum methane concentration can be assessed as good. Comparison of the results of forecast 1 and forecast 2 showed that forecast 1 was slightly more accurate.

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