

ABSTRACT

The impact of weather conditions and emissions from a coal-fired power plant on the concentration of PM₁₀ dust in Katowice and Dąbrowa Górnicza against the background of climate change

The aim of the dissertation is to develop interrelationships, interactions and relations between selected elements of the natural environment such as weather conditions characterized by more important meteorological elements and synoptic situations, and environmental disturbances understood as PM₁₀ dust pollution. An equal aim is to present high and low emission issues while implementing legal regulations related to the occurring and expected climate changes and air pollution. Proposals of adaptation measures necessary for the operation of the nearby Łagisza coal-fired power plant as well as significant from the point of view of the functioning of Katowice and Dąbrowa Górnicza cities were also presented as an area of research in the conditions of progressing climate change.

Data showing daily PM₁₀ dust concentrations in 2011-2015 were obtained from stations of the air quality monitoring system in Katowice and in Dąbrowa Górnicza. The values characterizing high emission comprised daily emissions of dust from the TAURON Wytwarzanie S.A. - Branch of Łagisza Power Plant in Będzin (for the needs of work called the Łagisza Power Plant) in 2013-2015. Data showing daily values of air temperature, total rainfall, wind speed in 2011-2015 in Katowice were obtained from IMGW.

The dependence of PM₁₀ concentration on emissions from the Łagisza Power Plant, as well as selected meteorological elements, was analyzed using the Spearman's rank correlation at the significance level equal to $\alpha = 0.05$. By using the calendar of atmosphere circulation types proposed by Niedźwiedź, the types of circulatory situations were divided into four groups of threats depending on the frequency of occurrence of a given synoptic situation and the accompanying concentration of the average PM₁₀. The subject of the adaptation to climate change was discussed in relation to the examined cities and the Łagisza Power Plant using the matrix method.

The quality of atmospheric air in Katowice and Dąbrowa Górnicza over the years 2011-2015 should be considered variable seasonally and bad in the months of the heating season. The number of days exceeding the permissible level of PM₁₀ in the analyzed years was in the range of 71-136, with an acceptable level of 35 days.

In 2013, the dependence between the emissions from the Łagisza Power Plant and the concentration of PM₁₀ in cities was the strongest. A more detailed analysis of this year shows that in the case of Katowice, the Spearman's rank correlation coefficient for the whole year was 23.23%. For the heating season, it reached 22.02%. These were statistically significant values

at the significance level of $\alpha = 0.05$. Spearman's rank correlation coefficient of 6.30% for the non-heating season proved to be statistically insignificant. In the case of Dąbrowa Górnicza, the Spearman rank correlation coefficient of 29.29% characterized the dependence for the whole of 2013. For the heating season, this ratio reached 30.09%. Both values were statistically significant. The Spearman rank correlation coefficient of 3.25% for the non-heating season was not statistically significant. Obtained Spearman's rank correlation coefficients, even statistically significant, do not reach high values, which indicates that the concentration of PM₁₀ in cities only slightly depends on high emissions.

The air temperature has the greatest influence on the level of PM₁₀ in Katowice and Dąbrowa Górnicza in the analyzed period. Negative Spearman's rank correlation coefficients, which were -42.88% and -47.60% respectively, suggest that the PM₁₀ concentration decreases with increasing air temperature. The second meteorological element that has the strongest impact on air quality in PM₁₀ is the sum of rainfall. Spearman's rank correlation coefficients were -28.08% for Katowice and -21.90% for Dąbrowa Górnicza. In the case of wind speed, Spearman's rank correlation coefficients amounted to -27.02% and -10.66% for Dąbrowa Górnicza.

Synoptic situations with the highest risk of exceeding the admissible levels of PM₁₀ are the anticyclonic wedge (Ka), anticyclonal advection from the south-east (SEa) and cyclonal advection from the south-west (SWc), anticyclonal advection from south-west (SWa) and anticyclonal advection from the west (Wa).

There are mechanisms in the European Union to reduce the impact on the climate, but the legal gap exists in the aspect of adaptation to the effects of climate change. It will be necessary to deal with the effects of climate change such as raising the temperature of the water, changing the sums of precipitation, heat waves and fires, urban heat island, bad air quality. Adaptation measures for industrial plants may be standby cooling systems, procedures in the event of climatic conditions, for cities, and increasing the amount of urban greenery, taking into account shaded places during the spatial planning stage. The cities of Katowice and Dąbrowa Górnicza, implementing measures to improve air quality and adaptation to climate change, will be closer to the assumptions of the idea of sustainable development.

Key words: air pollution, weather conditions, climate change, adaptation, urban area

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