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The impact of meteorological conditions on PM10 and PM2.5 concentrations in Poland - assessment of selected machine learning tools in short term forecasting

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There is a high spatial variability of PM10 and PM2.5 concentrations in Poland. The best air quality conditions occur in the north of Poland and this situation deteriorates southward. There are many agents which determined air conditions: emission sources, location, topography and meteorological conditions. Kraków is one of the most polluted cities in Poland due to its high low emission sources (coal combustion in small residential units, transport), location in the concave landform with close neighbourhood of huge industry of Upper Silesian Industrial District (long-range transport). The worst air quality conditions occur in the cold half of the year when the meteorological conditions such as stable atmosphere, temperature inversion, low wind speed and temperature play a vital role in high PMs concentrations.

The aim of the research was to evaluate selected possible forecasting approaches of daily PM10 and PM2.5 concentrations. Daily concentrations were calculated as means from hourly values from the period 2006-2016. Meteorological variables used in the research as covariates comprised of: daily average air temperature, wind velocity, pressure, precipitation totals as well as minimum daily temperature acquired from the nearest stations of the Polish Institute of Meteorology and Water Management - National Research Institute. Forecasting models comprised of: ordinary multiple regression model, random forest, as well as neural networks allowing the recognition of non-linear relations between the analysed variables. Also, the modelling was performed on a seasonal basis (cold/warm period) taking into account the possible meteorological as well as the economical activity features selection schemes. The analysis allowed the calibration and validation of several forecasting models (1 or 2 days lead time) with varying set of covariates via the utilisation of standard model quality measures.