# Application of factor analysis in the assessment of $PM_{10}$ enrichment of troposphere following precipitation

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In the papers concerned with the efficiency of $PM_{10}$ removal as a result of the effect of wet deposition, the authors focus on the process itself and its effects during the duration of the precipitation. There is a lack of information regarding the aerosanitary conditions that change just after the termination of the process.

The application of data derived from field measurements made in (Olszowski, 2016) applied factor analysis (Cooley, Lohnes, 1971) with the purpose of justifying weather conditions in the conditions following instances of precipitation. The analysis involved variables representing length of time following precipitation (LFP), total precipitation in time (TPT), temperature following precipitation (TFP), relative humidity (RH), force (WF) and wind direction (WD) after precipitation has ceased.

The Keiser criterion was applied as the principal test in the selection of all relevant parameters, i.e. factors with eigenvalues greater than 1 were the only ones retained for the purposed of a study (Kaiser, 1960). The selection of factors also was based on the scree test Cattell, 1966), whereas the ultimate verification was undertaken by application of analysis of residual correlations. The results of FA were presented for the summer season with classification of locations used as observation spots.

Table 1 contains a summary of principal data guiding the selection of the factors. The identification was based on the use of principal component analysis.

Table 1. Factor analysis results. Eigenvalues.

| No. of factor | Eigenvalues | % of the total variance | accumulated eigenvalues | cumulative % of explained variance |
|---|---|---|---|---|
| Urban area, warm season | | | | |
| 1 | 2.01 | 33.5 | 2.01 | 33.5 |
| 2 | 1.48 | 24.7 | 3.50 | 58.3 |
| 3 | 1.07 | 17.9 | 4.57 | **76.1** |
| Background area, warm season | | | | |
| 1 | 1.87 | 31.1 | 1.87 | 31.1 |
| 2 | 1.64 | 27.3 | 3.50 | 58.4 |
| 3 | 1.08 | 18.0 | 4.59 | **76.4** |

Both for the urban and background area, the selected factors account for around 76% of the variability in registered data. In the urban area, there is s considerable positive correlation between the features which affect the concentration of the examined PMs after precipitation as ceased, i.e. wind direction, total earlier precipitation and duration of the period following the precipitation (Fig. 1).

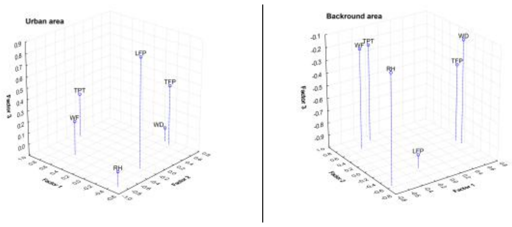


Fig. 1. Configuration of examined variables in the realm of selected factors.

Relative humidity is another attribute relevant in this respect (with a negative correlation). In the consideration of the season, it can be note that factors: regional and long-range transport (attribute WD) and dust resuspension from the ground (attribute RH) were the driving forces responsible for the increase of $PM_{10}$ concentrations. The scale of PM enrichment was also affected by the longer duration of the precipitation (attribute LFP), as it affects the efficiency of the impact of the transport and resuspension. The factor which prevented the increase in PM concentration was associated with the removal of particles from the atmosphere with the precipitation (attribute TPT). With regard to the results regarding the non-urban area, we need to add TFP to the list of attributes in the first group of factors (as it is correlated with WD). This statement indicates that along with the LFP, natural sources of emission become active sources associated with pollen emission from the surrounding fields and meadows. Generally, both the results derived from the work in (Olszowski, 2016) as well as the results of FA indicate that the rate of change in particulate matter concentration in the ground-level troposphere is relative to a considerable number of parameters which are difficult to identify and describe in a statistical manner.

Cattell, R. B. (1966) *Multivar. Behav. Res.* **1**, 245-276.

Cooley, W. W., Lohnes, P. R. (1971) *Multivariate data analysis*, New York Wiley.

Kaiser, H. F., *Educ.Psychol. Meas.* **20**, 141-151.

Olszowski, T. (2016) *Arab. J. Geosci.* 9:160.