Influence of Aerosol Pollution of Atmosphere in Tbilisi on Air Electric Conductivity in Dusheti

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ABSTRACT: The results of investigations of the influence of aerosol pollution of atmosphere in Tbilisi (the capital of the Georgia, city with the greatest level of air pollution) on the total air electric conductivity in Dusheti (the small city, located in 40-45 km to the north of Tbilisi) are represented. As the level of aerosol pollution of atmosphere in Tbilisi the aerosol optical depth of atmosphere is used (AOD). The measurements of air electric conductivity in Dusheti were conducted by the Gerdien type instrument (AEC). An observation period makes 25 years, from 1966 to 1990. On the basis of data about the trend + background and random components of time-series of the mean half year and annual values of investigations parameters the linear integral regression equations of relation AEC with AOD are obtained. In particular it is shown that the long-term negative trend of the AEC in Dusheti (year and warm period) is mainly connected with an increase of anthropogenic component of the AOD in Tbilisi and practically it does not depend on its random component. The linear correlations analysis of the daily values of AOD with AEC for different series of measurements independently of weather type is carried out also. The negative correlation between the indicated values are observed, which also confirms the representativeness of AOD values as the parameter, which characterizes the level of the surface boundary layer pollution not only in Tbilisi, but at least at the distances to Dusheti.

1. INTRODUCTION

The atmospheric aerosol optical depth (AOD) is the integral characteristic of the aerosol pollution of the entire thickness of the atmosphere. At the same time it is important to know, as value of AOD is connected with the surface air pollution. In the works [Sztyler A., 1992; Amiranashvili et al., 2007a] the direct connection of AOD with the concentration of surface aerosol was indicated.

Results of statistical analysis of mean six month and yearly values of total air electric conductivity (AEC) in Dusheti (in latitude 42.08 degrees, in longitude 44.7 degrees, 900 m altitude a.s.l., about 40-45 km northern from Tbilisi - the capital of Georgia) showed, that a negative trends of AEC take place in 1966-1990. One of the reasons for this trend it was explained by an increase in the aerosol pollution of the atmosphere in Tbilisi [Amiranashvili et al., 2003]. This work is the continuation of the foregoing studies about the influence of the aerosol pollution of the atmosphere in Tbilisi city on the AEC on the surrounding territories.

2. METHOD AND DATA DESCRIPTION

We have used data from Dusheti Atmospheric Electricity Station of AEC. The measurements were conducted by the Gerdien type instrument. A measurement unit is given in 10^{-15}/ohm·m, omitted further to be more convenient. The value of AOD in Tbilisi determined by the method [Tavartkiladze, 1989]. An observation

period makes 25 years, from 1966 to 1990. On the basis of data about the trend + background and random components of time-series of the mean half year and annual values of investigations parameters [Amiranashvili et al., 2005, 2007b] the linear integral regression equations of relation AEC with AOD are obtained [Vensel, 1983]. The linear correlations analysis of the daily values of AOD with AEC for different series of measurements independently of weather type is carried out also.

The following designations will be used below (besides those pointed out above): α - the level of significance; R^2 - coefficient of determination.

3. RESULTS

The results of the analysis in table 1 and in figures 1-2 are represented.

Table 1 The equations of the multiple linear regression of summary air electrical conductivity in Dusheti (Y) with anthropogenic (X1) and random (X2) components of the atmospheric aerosol optical depth in Tbilisi

Coefficient	Year		Cold period		Warm period	
	Y = a+b·X1+c·X2					
	Value	95% (+/-)	Value	95% (+/-)	Value	95% (+/-)
a	52.717	7.593	39.418	6.088	70.323	12.719
b	-164.217	66.263	-115.092	71.870	-235.444	91.094
c	19.540	70.622	57.001	60.559	10.512	78.968
R^2 multiple	0.549		0.404		0.607	
α	0.01		0.01		0.01	
Share of X1, %	28.8		20.2		36.4	
Share of X2, %	4.2		16.8		1.9	

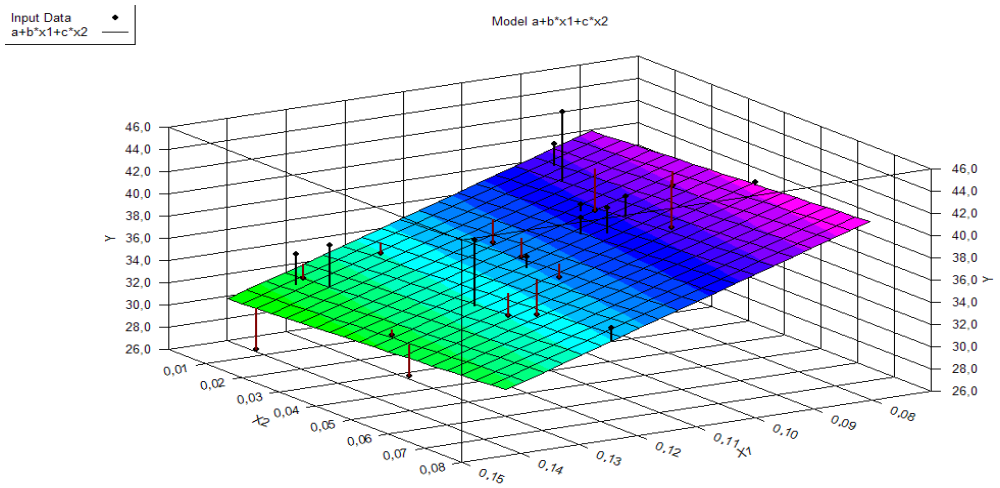

Fig. 1

Connection of the mean annum values of summary air electrical conductivity in Dusheti (Y) with anthropogenic (X1) and random (X2) components of the atmospheric aerosol optical depth in Tbilisi

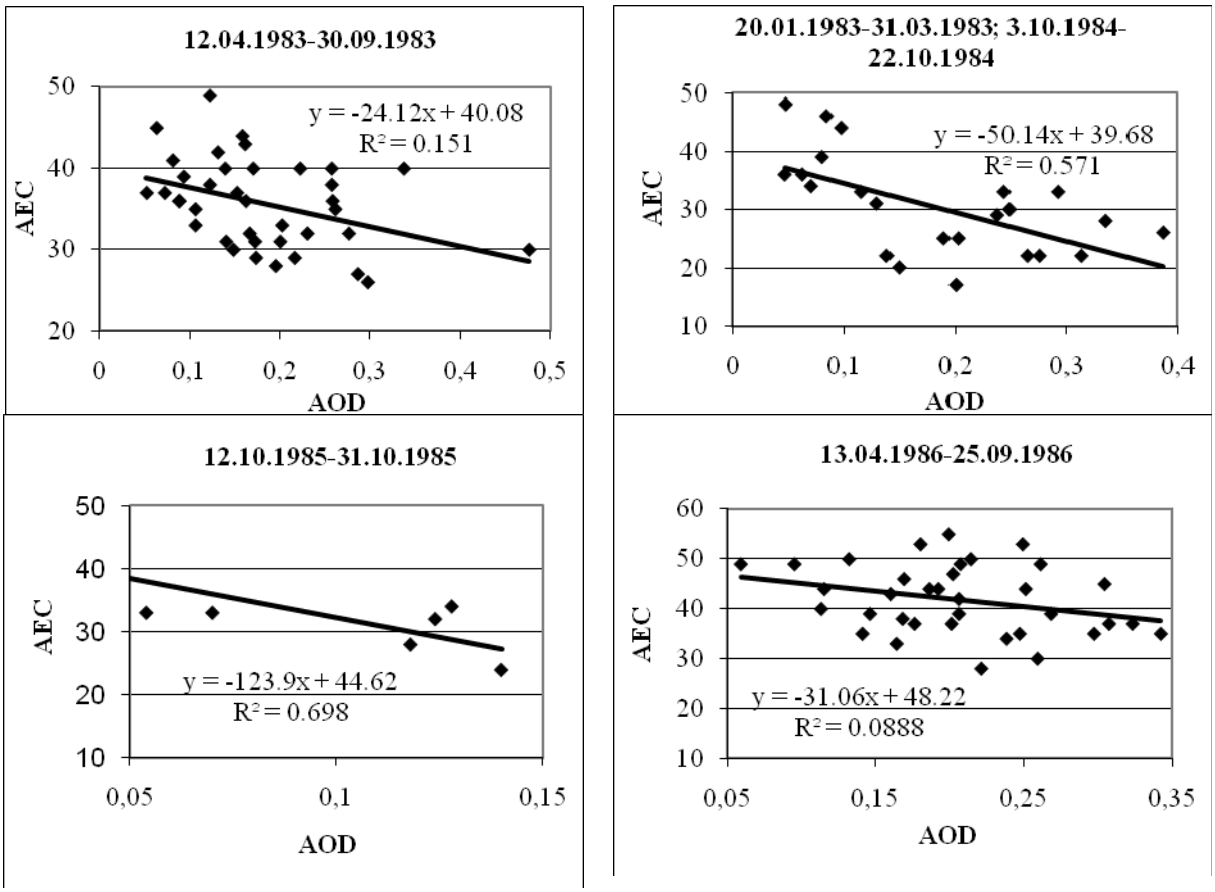

Fig. 2

Relationships between the daily values of aerosol optical depth of atmosphere in Tbilisi and summary air electrical conductivity in Dusheti for different series of measurements

In the table 1 the equations of the multiple linear regression of summary air electrical conductivity in Dusheti with anthropogenic and random components of atmospheric aerosol optical depth in Tbilisi are presented. In particular it is shown that the long-term negative trend of AEC in Dusheti (year and warm period) is mainly connected with an increase of anthropogenic component of AOD in Tbilisi and practically it does not depend on its random component. In cold period the share of anthropogenic and random components of AOD in Tbilisi in changeability of AEC in Dusheti is approximately equal (20% and 17% accordingly).

Example of connection of the mean annum values of AEC in Dusheti with anthropogenic and random components of AOD in Tbilisi in fig. 1 is represented.

Relationships between the daily values of aerosol optical depth of atmosphere in Tbilisi and summary air electrical conductivity in Dusheti for different series of measurements independently of weather type in fig. 2 are represented. As follows from this fig., the linear correlation between the indicated parameters is sufficiently high.

The negative correlation between the indicated values are shows the representativeness of AOD values as the parameter, which characterizes the level of the surface boundary layer pollution not only in Tbilisi, but at

least at the distances to Dusheti.

4. CONCLUSIONS

The long-term negative trend of summary air electrical conductivity in Dusheti in year and warm period is mainly connected with an increase of anthropogenic component of aerosol optical depth of atmosphere in Tbilisi and practically it does not depend on its random component. In cold period the share of anthropogenic and random components of aerosol optical depth of atmosphere in Tbilisi in changeability of summary air electrical conductivity in Dusheti is approximately equal.

Correlation between the daily values of aerosol optical depth of atmosphere in Tbilisi and summary air electrical conductivity in Dusheti for different series of measurements independently of weather type is sufficiently high.

The negative correlation between the indicated values are shows the representativeness of AOD values as the parameter, which characterizes the level of the surface boundary layer pollution not only in Tbilisi, but at least at the distances to Dusheti.

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