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METHOD OF DETERMINING THE INFORMATIVITY AND RATIONAL DISTRIBUTION GROUND STATIONS REMOTE OPTICAL MONITORING OF URBAN AIR

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Introduction. Now a lot of attention is given to a problem about reception of the operative, adequate and scale information on level of pollution of urban air. For the decision of this problem as on regional, and inter-regional level a lot of attention is given to remote optical sensing methods [1-3].

Remote sensing methods concern the most perspective directions of monitoring of the city environment. In the present work according to long-term measurements the sunlight component (direct and scattering radiation) in territory of a city of Baku is considered the quantitative approach to a problem of rational placing of a network of land informative points of optical monitoring of atmospheric air in city territory.

Methodical aspects of the decision of a problem

As initial measured parameters of monitoring we use the optical thickness τ and scattering function $f(\theta)$ of urban air, where θ is the scattering angle of light. These parameters are defined on measurements of the downwelling direct sunlight and brightness of the cloudless sky [2]:

$$f(\theta) = B(\theta) / \pi S_0 P^{m_0} m_0, \tag{1}$$

where $B(\theta)$ is the brightness of the sky in solar almucantar, where $F(\tau) = \pi S_0 P^{m_0}$ is the incident direct radiation flux of the Sun; πS_0 is the a solar constant, where $P=exp(\tau)$ is the transparency and m_0 is the optical weight of atmosphere.

Data of measurements of function (1) form the statistical sets [3]. We shall designate through $f_i(\theta_j)$ the i - th realization $(i = 1, 2, \cdots)$ of scattering function in directions $\theta_j (j = 1, 2, \cdots)$. We will carry out the statistical control of initial data for the analysis in them of defective data by a rule 4σ:

$$\left| f_i^j - \overline{f}^j \right| \geq 4\sigma, \tag{2}$$

where $\overline{f^j}$ is the averages and σ^j is the average quadratic deviations of realizations of scattering function.

Initial data are coded by introduction of the indicator of errors:

$$\omega_i^j = \begin{Bmatrix} 1, f_i^j \neq a \\ 0, f_i^j = a \end{Bmatrix}, \tag{3}$$

where a specifies in presence of the information or absence of defective data.

Statistical dependence between realizations $f_i(\theta_j)$ is defined by calculation of correlation function:

$$r_{jk} = \frac{1}{n_{jk}} \frac{\sum_i^n \left(f_i^j - \overline{f^{jk}} \right) \left(f_i^k - \overline{f^{jk}} \right) \omega_i^{jk}}{\sigma_j^{jk} \sigma_k^{jk}}, \tag{4}$$

where $\omega_i^{jk} = \omega_i^j \omega_i^k$ and $n_{jk} = \sum_i^n \omega_i^{jk}$.

The computing formulas (2) - (4) are used for calculation of the error of optimum interpolation ε in any direction θ_k [3]:

$$\varepsilon = 1 - \frac{2r^2(\rho)}{1+\eta^2+r(\theta_k-\theta_j)}, \tag{5}$$

where η^2 - a measure of the error of measurements, $\rho = \theta_k - \theta_j$ is the angular distance between supervision points on sky sphere.

Results of calculations

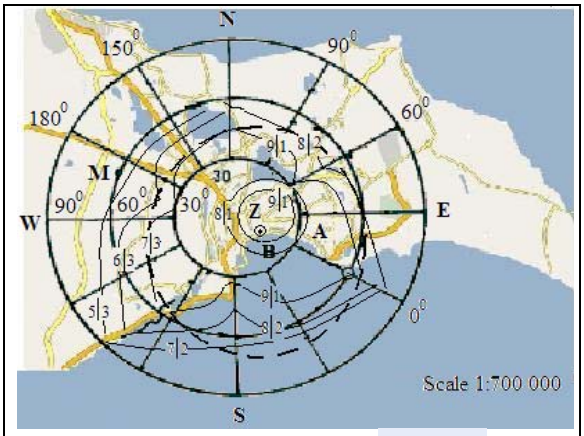

Figure. Distributions $r\cdot10$ (the first digit), $\varepsilon\cdot10$ (the first digit). Baku, July - August, 2009, in the forenoon.

For carrying out of numerical calculations data actinophotometric measurements in territory of the Baku are lower used. Results of calculations are shown in figure with use of sky coordinates system. In figure the dashed line approximately allocates area of the raised pollution of atmospheric air for territories of the Baku. In this figure the curves of distributions of characteristics ε, r for various points of supervision are resulted. For calculation ε the condition $\varepsilon < \eta$ is used. The first figures at curves correspond $\varepsilon\cdot10$, the second figures on these curves correspond $r\cdot10$. Apparently from figure various variations of a field of pollution of city air in various sites of territory of a city are obviously allocated. In Baku 4 areas having various features of a variation of levels of pollution of city air are allocated: southern ($\rho \sim 110^0$), western ($\rho \sim 90^0$), northeast ($\rho \sim 160^0$) and central. This specifies in distinction of background pollution of urban air on city territories.

Conclusion. On territory of the city clearly distinguished the various areas of high air pollution. With regard to the conditions of the city of Baku are 4 areas with different trends in variation of the air pollution level.

References

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