SPATIAL VARIABILITY OF SPECTRAL TRANSMITTANCE OF THE ATMOSPHERE

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The paper describes the technique for determining spatial scales of the fields of spectral transmittance of the atmosphere. As shown in the paper, the field scale varies from 500 *to* 1500 km *depending on the geographic region and coincides with the spatial scale of pressure fields and geopotential ones.*

The spectral atmospheric transmittance describes the conditions of the optical radiation propagation through the atmosphere and characterizes the physical processes occurring in the air. Knowledge of the spectral transmittance conditions is important for a lot of fundamental problems, such as theory of climate, and some applications, for example, forecast of the optical state of the air for providing information for different systems. When developing the techniques for forecasting the optical state of the air we need to have the data on spatial variability of the optical parameters and, in particular, energy extinction determined via the spectral transmittance. This makes it possible to determine the limits of variation of one or other optical characteristic of the air, scales, dynamics of its variation, and so on.

At present the similar problems have been solved practically in hydrometeorology.[1] As to the optical parameters, the first efforts are only made.[2] However, taking into account the fact that we are dealing with different characteristics of one and the same medium, it is expected that the estimates obtained will be similar, and then, based on the data available in meteorology we could determine all the necessary parameters of variability of optical parameters. The present paper gives an estimate of spatial scales of variability of spectral atmospheric transmittance.

Figure 1 shows the field of spectral transmittance of the entire atmospheric depth over the territory of the former Soviet Union. We notice that the field of spectral transmittance is inhomogeneous. Several zones of elevated or reduced transmittance can be separated out in this field. The scales of such inhomogeneities are different, from some hundreds to some thousands kilometers that is typical for most atmospheric characteristics. This fact does not allow their most characteristic scales to be separated out quantitatively.

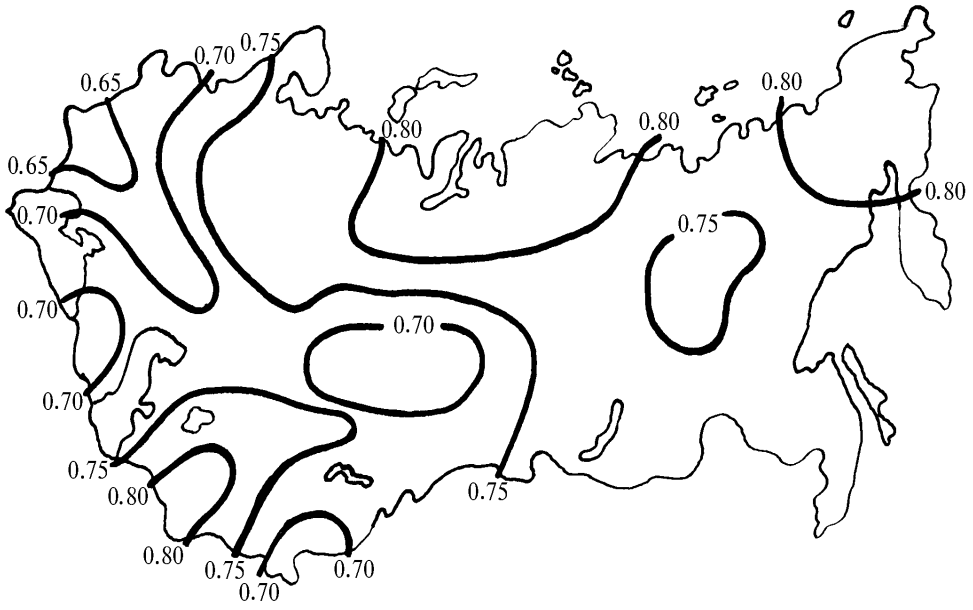

Fig. 1. *Average annual spectral atmospheric transmittance* (λ= 627 nm) *over the territory of Russia and adjacent countries.*

To make a quantitative analysis, the determination the spatial correlation functions or interconnected with them structural functions is done, as a rule.[3] We calculated the spatial autocorrelated functions of atmospheric spectral transmittance based on the data of ozonometric network.[4] Since the stations of this network are located at a considerable distance one from another , the calculation was made using the daily mean values of transmittance, and the transition to spatial frequencies was performed using the wind velocity taken equal to 10 m/s. Thus obtained estimates of correlation functions are shown in Fig. 2.

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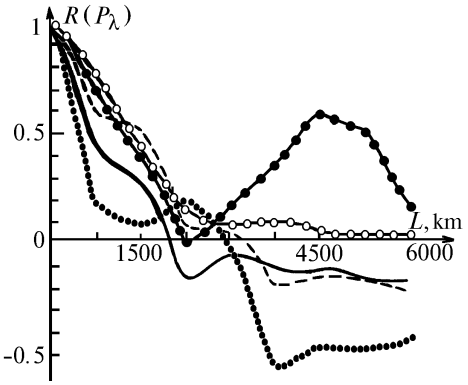

FIG 2. Spatial correlation functions of spectral transmittance. (λ = 530 nm)*:* —— *Arkhangel'sk;* – – – – *Vladivostok;* ●●● *Odessa,* ○–○–○–○– *Omsk,* ●–●–●– *– Chardzhou.*

Figure 2 shows that if the scale of inhomogeneities of spectral transmittance distribution is estimated by the level of correlation function equal 0.5, then the scale can vary from 500 up to 1500 km depending on geographic region. The value of the scale is less in the west coastal regions and larger in the continental ones. The analysis of inhomogeneities of meteorological fields carried out in Ref. 3 indicates that scale values closest to ours are those obtained for geopotential or pressure fields. The scales of inhomogeneities of the rest meteorological elements are less. Thus, this result confirms our conclusion on correlation of the fields of spectral transmittance of the entire depth of the atmosphere with main synoptic objects.[5]

We are going to determine not only large-scale inhomogeneities but also mesoscale and temporal ones.

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