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Fine-dispersed Aerosol: Sources and Influence on the Processes in Different Atmospheric Layers

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On the basis of meteorological data obtained over the recent decades, it was found that the semidesertified area-atmosphere system significantly affects local climate increasing temperature contrasts. In such regions, under the conditions of intensive aerosol lifting, atmospheric temperature decreases by 0.5-1 K due to radiation heat exchange and albedo changing.

At the same time, desertification results in variations in the characteristics of the underlying surface. In that case, in the absence of intensive aerosol lifting, the soil is intensively heated, which results in an increasing land-surface temperature up to 10 K, as compared to vegetated areas. As a result, the temperature of the atmospheric surface layer increases by 1-3 K, and relative air humidity decreases by 10-3-%. In the absence of dust storms the injection of soil particles to the atmosphere can be produced by organised convective structures in a convective boundary layer (for example, dust devils or columns). The spectrum of the lifting particles sizes at such processes, generally speaking, differs from a spectrum in dust storms and, consequently, additional studies are necessary for estimates of the mass flux to the atmosphere.

Analysis of data shows that in dry hot weather above sandy "saucers" (at presence of barkhan structures) at heights of 1-2 meters micro-inversions of temperature and humidity are formed. This process occurs at temperature of air above 25˚C, surface temperature above 50˚C, and relative humidity less than 40%.Thus the gradient of temperature in bottom (5 cm) layer in absence of an external wind reaches 200-500 Ê/m, i.e., there is a strongly unstable subsurface boundary layer. Thus during dehydration of aggregate particles consisting, as has been shown by soil analysis, from particles of size 80-150 microns, on which there are found organic-mineral fine particles of size 0.01 -0.1 microns. Due to the expense of strong temperature gradient (vertical and horizontal) these particles pass through viscous sub-layer and rise above, as whirlwinds - standing motionless plumes, or dust-devils, or by simple convective flows.

During numerous of expeditions, spatial aerosol distribution was studied from board an aircraft with using a lidar sounding and nephelometric methods. Aircraft lidar sounding was supported by the ground-based nephelometric measurements. Aircraft lidar sounding gave the possibility to discover quasi-periodical convective structures in the atmospheric boundary layer including upwind zones of the scale of a few kilometers. Granulometric analysis reveals fine particles of the dimensions of 0.3-10 μm in sandy ground in the amount of about 10%. Under certain meteorological conditions they can be raised into the atmosphere This aerosol is transported aloft into thin aerosol layers at the heights 600-1000 m with a thickness of about 200-500 m. A hypothesis was made for a breakthrough of a near-surface inversion layer by a jet-type aerosol escape from highly unstable (a temperature gradient above 1000 K/m) atmospheric surface layer.

The spectrum of submicron aerosol is redistributed in the upper atmosphere layers, in particular, due to hydration. One of possible mechanisms of such a process related to activation of ion-dipole interaction under the influence of hard and corpuscular components of solar radiation.

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