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Study of atmospheric pollution by arid aerosol in the absence of dust storms

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. We performed analysis of atmospheric ground layer structure over thermally heterogeneous sand dune terrains in arid regions with consideration of climatic and meteorological data (Kalmykia, Sub-Aral region). Based on the analysis and field measurements data (1991-2004) principal physical mechanisms of particle lifting into atmosphere are found. Measurements of aerosol characteristics distribution and boundary layer characteristics in 2003-2004 showed deviation from typical understanding of its structure. Such deviations result from “spotted” structure of underlying surface caused by relief and temperature heterogeneity. It was discovered that at worm season and weak wind convective processes rise from Kalmykia sand masses to atmosphere significant amount of long-term aerosol with sizes below 5 mkm (including fine aerosol (0.01 – 0.1 mkm)). It plays significant role in aerosol atmospheric pollution formation and climate. Also micro-invertive layers appear and particle concentration above them grows with height. Nebulosity and other meteors reducing soil heating decrease erosion. Investigations allow to assume (and prove) hypothesis on structure of boundary layer over sand-dune terrains in arid regions and mechanisms of particle lifting. Correlation analysis of field measurements shows existence of several mechanisms of fine particles entry into atmosphere from sub-surface desert soils depending on both weather conditions and particle size. At low-wind weather (1-2 m/s) particles with sizes of $<$0.5 mkm rise by means of turbulent diffusion and do not correlate with larger size particles. Thus investigation of some natural (desert) regions far influence

on other needs complex modeling for different aerosol fractions. Modeling of larger particles (>2-3 mkm) transport can be performed with regional MM5 model which we adopted, with particle transport analysis using HYSPLIT system. It was found that vegetation in arid regions may cause both increase and decrease of aerosol erosion resulting in vortex formation. Laboratory analysis of aerosol and soil samples show increased concentrations of arsenic, copper, nickel and chrome in Kalmykia. Also we estimated toxic compounds and derivatives influence on vegetation condition in the region. We have analyzed possible ways of their intrusion into soil and plants tissues and influence on human health.

Two series of laboratory experiments were performed which proved possibility of non-saltational erosion mechanism of fine aerosol. A statistically significant result was received on fine (0.1-0.2 mkm) particles separation. The investigations were fulfilled with support of RFBR grant RF 03-05-64775.