Electrical Enrichment of Bioaerosols near Ground Level

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During fair weather, a population of particles has been observed near ground level with a size distribution skewed in favor of fine (<2.5 microns AD) particles, when compared to the particle population at two meters. Investigation of this layer, at a height (altitude) of 20 cm above ground level, shows that it can contain a disproportionately elevated concentration of viable bioaerosols. The ability to predict and better understand this phenomenon may be of significant importance in bioaerosol sampling and in children's health, and in bioaerosol source attribution.

Concurrent ambient aerosol samples were taken outdoors at heights of 20 cm above ground level and 200 cm above ground level. The samples were taken in a rural setting in Missouri, USA over a period of three years, using particle counters, APS, and a 6-stage viable impactor. Atmospheric electrical measurements were taken at 20 cm and 200 cm using an ion gauge and a static meter. Meteorological data were taken and weather patterns were recorded. Biological samples were cultured, enumerated, gram stained and classified. Particle counter data were reduced and compared to bioaerosol particulate matter concentrations.

Results show that the concentration ratio of fine particles near the ground during fair weather varies from approximately 200% to 1000% that of the population at two meters.

The formation of this concentration of micron-sized biological particles is theorized to be due to levitation due to the typical net negative natural charge of the earth and the biological particles. The net negative natural charge present on populations of biological aerosols near the ground appears to be increased by accumulation of negative charges produced during the evaporation of water in the environment.

Reference: Yao, M. and Mainelis, G. Utilization of Natural Electrical Charges on Airborne Microorganisms for their Collection by Electrostatic Means, JAS, 37(4) 2006.