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The Determination of Aerosol Optical Thickness and Particulate Matter Concentration Using Satellite Observations

A. A. Kokhanovsky(1), P. Glantz(2), W. von Hoyningen-Huene(1), J. P. Burrows(1)

(1) Institute of Environmental Physics, University of Bremen, O. Hahn Allee 1, D-28334 Bremen, Germany (alex@iup.physik.uni-bremen.de), (2) Department of Applied Environmental Science, Stockholm University, Frescativagen 50, SE-10691 Stockholm, Sweden

The aerosol concentrations in urban areas are by far higher compared to the remote rural locations. This causes an increased mortality among urban population due to penetration of various toxic substances through respiratory systems of humans (Medina et al., 2004). The most dangerous species are tiny particles with diameters in the micrometer size range; <1 (PM1), <2.5 (PM2.5), and <10 (PM10). This is why many national environmental agencies have developed networks for the continuous measurements of particulate matter (PM) using ground-based instrumentation. These measurements of the PM concentration are based on a number of quite different principles and the most robust technique involves collection of particles with sizes smaller than a given value and subsequent weighting of samples. This is quite a tedious work and the spatial coverage of the measurements is also restricted to few locations in the city (mostly at road conjunctions and other highly polluted places). Therefore, several methods to retrieve PM concentrations from space using passive optical remote sensing have been developed (Al Saadi et al., 2005). All of them are based on the determination of the aerosol optical thickness (AOT) and the use of the proportionality between AOT and PM (see, e.g., Kokhanovsky et al., 2006): PM=kAOT. The coefficient k depends on many factors: the boundary layer height; the humidity; the particle size distribution; the density of particles; the chemical composition of the particles and, therefore, their refractive index; the shape of the particles; the inter-

nal structure of the particles; the vertical profiles of the aerosol concentrations. The theoretical determination of all these factors using satellite measurements is a difficult matter. Therefore, often a typical constant value of the conversion parameter k is used. However, this parameter is not constant and can vary considerably even for a fixed location. Therefore, there is a need to constrain the main factors listed above in the retrieval procedure based on satellite observations. This paper is aimed to the description of a new approach for the determination of the size of particles from the satellite top-of-atmosphere spectral reflectance measurements and applications of the technique to the determination of PM at several worldwide locations. Comparisons between satellite derived PM and ground measured PM are presented.