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Spectral Reflectance over Urban Surfaces

B. Mey (1), X. Gu (2), T. Yu (2), X. Chen (2), J. Heintzenberg (3), B. Heese (3), A. Krämer (4), H. Jahn (4), M. v. Schönermark (5), and M. Schwarzbach (5)

(1) Johannes Gutenberg University, Institute for Atmospheric Physics, Mainz, Germany (bmey@uni-mainz.de), (2) Institute of Remote Sensing Applications, Chinese Academy of Science, Beijing, P.R. China , (3) Leibniz Institute for Tropospheric Research, Leipzig, Germany, (4) Department for Public Health Medicine, School of Public Health, Bielefeld University, Bielefeld, Germany, (5) Institute of Space Systems, University Stuttgart, Stuttgart, Germany

Particulate air pollution is a serious issue in Megacities, since they constitute a major source of particulate matter (PM) in the atmosphere causing severe health threats. The World Health Organization estimates that urban air pollution, mainly PM, is responsible for 800,000 premature deaths worldwide. Furthermore, uncertainties in the particulate pollution which is quantified by the aerosol optical depth (AOD) lead to respective uncertainties in the simulated radiative forcing and as a consequence to different climatic effects in global climate simulations.
The AOD can be retrieved from top of the atmosphere (TOA) reflectance measured by satellite sensors. One of the problems in the AOD retrieval from satellite data is the assumption of spectral surface reflectance which is highly variable in time and space, especially over megacities. As the satellite cannot distinguish between surface and atmospheric signal the retrieved AOD significantly depends on the accuracy of the surface reflectance fields used in the retrieval. This surface reflection uncertainty propagates into the derived radiative forcing of the aerosol particles and related dynamic effects.
We performed detailed measurements of the surface reflection over urban regions to overcome this problem. The surface reflectance was derived from airborne and ground-based measurements. The instrumental setup for the ground-based measurements consists of LIDAR systems, radio soundings and a CCD camera (single channel camera with charge coupled device chip – CCD chip) with high spatial resolution on a rotating stage. Airborne data is collected with the SMART-Albedometer (Spectral Modular Airborne Radiation measurement sysTem) and a spectral three-channel CCD camera (Geospatial Systems Inc. MS-4100). The combination of these instruments is used to merge the obtained data into reflectance map of high spatial and spectral resolution, which will be used to support satellite aerosol retrieval for heterogeneous surfaces like Megacities. The reflectance data is used to improve the AOD retrievals of the Moderate Resolution Imaging Spectroradiometer (MODIS) above heterogeneous surfaces like Megacities. Comparing the AOD retrieval using the explicite measured surface reflection instead of the standard assumption gives an estimate of the accuracy of the AOD retrieval above Megacities.
First results of the spectral surface reflection measured over Leipzig (Germany) in September 2007 as well as a brief overview over a field experiment conducted in November 2008 in the surroundings of Beijing, Hebei province, China are presented.