Atmos. Chem. Phys. Discuss., 7, S3818–S3822, 2007
www.atmos-chem-phys-discuss.net/7/S3818/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Urban Visible/SWIR surface reflectance ratios from satellite and sun photometer measurements in Mexico City" *by* A. D. de Almeida Castanho et al.

C. Gatebe (Referee)

charles.k.gatebe@nasa.gov

Received and published: 7 August 2007

Atmos. Chem. Phys. Discuss., 7, 8113-8139, 2007

Urban Visible/SWIR surface reflectance ratios from satellite and sun photometer measurements in Mexico City

A. D. de Almeida Castanho, R. Prinn, V. Martins, M. Herold, C. Ichoku, and L. T. Molina

The paper by Castanho et al. entitled "Urban Visible/SWIR surface reflectance ratios from satellite and sun photometer measurements in Mexico" is an attempt to establish a correlation between the surface reflectance in the blue (0.47 μm), red (0.66 μm),

and near-infrared (2.1 μm) for use in retrieval of aerosol optical properties from satellite measurements over urban areas like Mexico City. The study was motivated by inadequacy of the current technique, which assumes a fixed relationship between the surface reflectance in the blue (0.47 μm), red (0.66 μm), and near-infrared (NIR; 2.1 μm) and used operationally to retrieve aerosol optical properties globally from Moderate Resolution Imaging Spectroradiometer (MODIS).

AERONET Sun photometer data taken at Universidad Nacional Autonoma de Mexico (UNAM) from 1999-2005 (or 2002-2005?) were used to determine aerosol optical models (single scattering albedo, asymmetry parameter, and extinction efficiency) for Mexico City. A network of Sun photometers (a total of eight deployed during MILAGRO field campaign in Mexico: five Microtops II instruments and three Cimel Sun photometers) was used to determine aerosol optical depth (and water vapor) during the intensive observing period from March 5-28, 2006. These results were used to perform atmospheric correction of MODIS Level-1B top-of-the-atmosphere radiances at 1.5 km spatial resolution in order to estimate surface reflectance in a 10 km x 10 km grid box centered at each of the eight sunphotometer sites. Ratios of surface reflectance, blue:NIR, and red:NIR were computed from MODIS data for the period 2002-2005 (UNAM site) and March 2006 (all the sites) and compared with a reference library that is based on high spatial resolution (4 m) data from AVIRIS (Airborne Visible and Infrared Imaging Spectroradiometer). The new red ratio (red/NIR) of 0.73 was used to retrieve aerosol optical depth over Mexico City following a procedure similar to the one that is used in MODIS operational aerosol optical depth retrieval. The new ratio showed a better agreement with AERONET optical depth as compared to the old ratio of 0.56.

The strength of this study lies in the determination of aerosol models for Mexico City based on the analysis of Sun photometer measurements at UNAM from 1999-2005 (or 2002-2005?). The results are comparable to those obtained in a similar study by Dubovik et al. (2002) (Variability of Absorption and Optical Properties of Key Aerosol

ACPD
7, S3818–S3822, 2007

Types Observed in Worldwide Locations, Journal of Atmospheric Science, vol. 59, 590-608), which analyzed Mexico City AERONET data for the period 1999-2000. The study tries to make a strong case for the new ratio (0.73) for use in MODIS retrieval algorithm (instead of the current ratio of 0.56) to retrieve aerosol optical properties in urban areas. However, the new ratio requires additional analysis and verification/validation. It is not clear how the new ratio would perform in the current MODIS operational algorithm, which has different sets of aerosol and atmospheric models and a different radiative transfer algorithm than the one used in this study. If the new ratio is robust enough, then it should be tested with MODIS data taken over other urban areas. Also, NASA's Jetstream-31 aircraft carried a number of radiation instruments during MILAGRO (e.g. Cloud Absorption Radiometer, Research Scanning Polarimeter and Solar Spectral Flux Radiometer), and collected good data that could be used to validate the new ratio.

The paper is otherwise well structured and well written, and the reviewer recommends its publication in ACP; but it is important to address comments made in this report.

Other comments:

1. The title: "Urban Visible/SWIR surface reflectance ratios from satellite and sun photometer measurements in Mexico City," does not seem to capture the overall theme of this study. The study is about aerosol retrieval from satellite measurements over Mexico City and the title ought to reflect that.

2. A flow chart showing steps followed in the quality assurance would be easier to follow and is recommended.

3. Only 4 out of 9 pixels are averaged to simulate reflectance at 1.5 km resolution. Certainly this results in under sampling and introduces a bias in simulated reflectance. The authors need to address this issue.

4. MODIS Level-1B reflectance data at 500 m resolution is used to compute the standard deviation of the reflectance at 0.66 μm. It is not clear how the authors obtained

ACPD
7, S3818–S3822, 2007

EGU

500 m resolution data given that MODIS does not have 500 m resolution band at 0.66 μm.

5. Page 8119, lines 1-13. The authors need to show wavelengths, bandpasses, and other important optical characteristics specific to the five Microtops-II instruments.

6. Page 8120, lines 10-11. Microtops II calibration (against Cimel sunphotometer) was done on March 2-4 and March 25-27 and no calibration in between. It is not clear how the authors determined the calibration for March 5-24.

7. Page 8121, line 4. "The Aerosol optical properties were analyzed using AERONET measurements from 1999-2000." And then on page 8122, line 14 "Aerosol optical properties were defined using the AERONET database from 2002 until 2005." The authors need to confirm that the intervals are correct?

8. Page 8123, line 8. Do the authors mean "sensor zenith angle $> 40^{\circ}$" or "sensor zenith angle $<40^{\circ}$?"

9. Page 8123, line 12. It is not clear how the "scattering angle $> 140^{\circ}$" relates to "BRDF effect" as implied in this sentence.

10. Page 8124, line 5-6. The ".... the blue ratio results are presented in Fig. 2b just as a reference, and will not be considered any further in the rest of this paper." The reviewer then wonders how the authors obtained aerosol optical depth at 550 nm as shown in Figure 5, if not through interpolation of blue and red bands.

11. Page 8124, line 8. "The reflectance of an aerosol layer ...." The reviewer recommends the use of "scattering" instead of " reflectance" in this sentence.

12. Page 8125, line 10. ".... analysis of the surface spectral reflectance over urban areas requires a high spatial resolution due to the heterogeneity of the surface cover" and then on line 17, ".... the 4 m resolution can still have a mix of different surface materials or shadows ...." As the authors may have discovered increasing the spatial resolution does not necessarily improve surface homogeneity, but might make it worse.

ACPD

7, S3818–S3822, 2007

A lower spatial resolution data (e.g. 10 km) would be preferable in order minimize BRDF effects from small structures, shadows, etc. In this study the effect of BRDF on the new ratio was not addressed and may be important.

13. Page 8127, line 4, delete “for.”

14. Page 8127, line 9, the authors recommend use of the ratio of 0.73 over urban areas based on their results from Mexico City. But there is not enough evidence to show that the new ratio would work in other urban cities.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 8113, 2007.