The MODIS MOD07 Collection 6 products: The impact of the H2O/CO2/O3 channel spectral shifts

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Abstract: The operational algorithm for retrieving temperature and moisture profiles and total column ozone and water vapor from infrared (IR) radiance observations (MOD07) is the NASA-AEI MODIS instrument. It is a clear-sky synthetic regression algorithm that had not been widely modified for MOD07 Collection 6 (Col6) updates. Here we describe the enhanced infrared (IR) to visible (VIS) Terra/Modis spectral shifts that were applied to MOD07 Collection 6 data during early 2007. Significant improvements were achieved in data processing and MOD07 collocations. The MOD07 MOD07 algorithm modifications for Collection 6 • Update the relative transfer model to CRTM V2 (from prototype CRTM V1.2) • Apply zero bias adjustment in the relative transfer calculation • Apply H2O/CO2/O3 channel spectral shifts (Tobin et al., 2006, JGR, Tobin, 2007, Quinn, and Toth, 2011) • Update masks for Terra and Aqua • Update surface emissivity using the Sobelin database of clear sky cases at the ARM SGP-ACRF (36° 36’N;97° 29’W) site has been derived from MODIS land and air mass MODIS data and is now available for the ARM SGP-SGP site measurements and the Atmospheric Infrared Sounder (AIRS) retrievals which will update the MODIS/Terra and MODIS/Aqua Total Ozone Mapping Spectrometer (TOMS) products.

The effect of the H2O/CO2/O3 channel spectral shifts on TPW over the SGP ARM Cart Site

A database of clear-sky cases at the ARM SGP-CAP (36°36’N, 97°29’W) site has been developed for evaluation of the MOD07 total precipitable water (TPW) product. This database includes all overpass determination to be clear during the period from launch through August 2005 for 345 Terra and 317 Aqua cases. MODIS sensor zenith angle was set at 15° to the local, OK, SGP area for all cases. These cases are readily reproducible in-house to test any changes to the algorithm or training data. The database includes the MOD07 TPW retrieval product for MOD07 with and without Terra/Modis spectral shifts. TPW comparisons at the ARM SGP site between MOD07 and MOD07 derived TPW. Dry and wet cases are separated. SRF shift (yes or no) is indicated in the second column. Note that for the Aqua/Cod/CRTM2 cases the SRF of the band was also shifted by 2 wavevectors.

The effect of the H2O/CO2/O3 channel spectral shifts on Total Ozone over Budapest, Hungary

The MOD07 total ozone data were compared to the daily NCEP/NCAR reanalysis (NCEP) data for Europe and the surface Brewer measurements, representing the most accurate measurements of the vertically integrated ozone values. The Brewer spectrophotometer is located in Budapest, the observation site of the Hungarian Meteorological Service (as the 152nd member of the Brewer Network). The MOD07 data were received by the polar orbiting satellite receiving station of the EOT-W越稿, University of Budapest (47.475°N, 19.062°E) and processed using the IBAPX software. The comparisons were performed using MOD07 data of selected overpasses for 2007 comprising 102 and 44 mostly cloud free overpasses of Terra and Aqua, respectively, in the vicinity of Budapest and the Carpathian Basin.

The H2O/CO2/O3 channel spectral shifts

First, Tobin et al. (JGR, 2006) comparison between AIRS and MOD07 radiances suggested the Aqua/MODIS H2O channels (27, 28) need to be more opaque and the CO2 channels (34-36) less opaque. In our earlier study (using CRTM V1.2) a positive improvement was realized for the Aqua/MODIS TPW over the SGP Cart site by applying the spectral shifts, particularly for the wet tests (TPW = 10 mm) when the bias error was reduced by 1.9 mm and the bias was reduced by 2.3 mm. In this study using CRTM V2.2 even without applying the spectral shifts, the OPRTIO-based transmission algorithm of the new CRTM/V2.2 reduces the bias by 1.1 mm for the wet cases (TPW = 10 mm) and applying the spectral shifts yields no further improvement for Aqua/MODIS and slight degradation for Terra/MODIS. This may suggest investigating the H2O shifts in the other direction. In the future we are planning to study further the effect of the H2O bands.

Globally gridded TPW (above) and TOZ (right) comparison of MODIS with AIRS separated by sea/land and day/night time. (MODIS minus) × 10 angle (viewing angle < 42°)

Conclusions and Future Plans

• Overall, application of Terra spectral shifts shows significant improvement (reduced bias and rmse) for MOD07 TPW products over the SGP CART site over Budapest (Hungarian capital) and global validation sites.

• In the study (using CRTM V1.2) a positive improvement was realized for the Aqua/MODIS TPW over the SGP-Cart site by applying the spectral shifts, particularly for the wet cases (TPW = 10 mm) when the bias error was reduced by 1.9 mm and the bias was reduced by 2.3 mm. In this study using CRTM V2.2 even without applying the spectral shifts, the OPRTIO-based transmission algorithm of the new CRTM/V2.2 reduces the bias by 1.1 mm for the wet cases (TPW = 10 mm) and applying the spectral shifts yields no further improvement for Aqua/MODIS and slight degradation for Terra/MODIS. This may suggest investigating the H2O shifts in the other direction. In the future we are planning to study further the effect of the H2O bands.

• In the near future we are planning to investigate the effect of the collocation corrections Terra/MODIS level 2 data on the MOD07 TPW, TOZ and Temperature products on a global scale.

• For globally gridded products of MODIS Atmosphere Products see http://disc.sci.gsfc.nasa.gov/IMAGE/index.html

References

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