

Comparison of RSS Spectral Measurements and LBLRTM/CHARTS Model Calculations for Clear Skies

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The visible/near-infrared rotating shadow-band spectroradiometer (RSS) was permanently deployed and has operated since May 2003 at the U.S. Department of Energy's Atmospheric Radiation Measurement program's central facility between Lamont and Billings, Oklahoma, USA. This paper focuses on the comparison between RSS measurements and line-by-line radiative transfer calculations with the model LBLRTM/CHARTS. The analysis of the spectral residuals is accomplished by examining the three components of this study: the radiation measurements, the calculations of the radiative transfer models, and the characterization of the atmospheric state. There are several critical inputs to the model in this wavelength range, including independent measurements of water vapor, ozone, and aerosol properties, as well as the spectral ground reflectivity. While aerosol optical depth can be derived from the RSS, this study uses an independent measurement from another sunradiometer at the SGP site; aerosol single scattering albedo and asymmetry parameters are derived from *in situ* measurements; the total water vapor column is obtained from a two-channel microwave radiometer; ozone is from the TOMS web site toms.gsfc.nasa.gov with supplemental ground-based data from the web site uvb.nrel.colostate.edu; and the spectral albedo is based on multi-filter radiometer measurements over pasture and over crops, the predominant surface types surrounding the site. To eliminate an additional source of uncertainty associated with the extraterrestrial spectrum, the analysis compares measurement-derived and modeled spectral direct and diffuse transmittances between 360 and 1070 nm, rather than irradiances. The RSS-transmittance is calculated by taking the ratios of the measured irradiances to the Langley-derived, top-of-the-atmosphere irradiances. A range of aerosol loading, surface conditions and solar positions are included in the study.

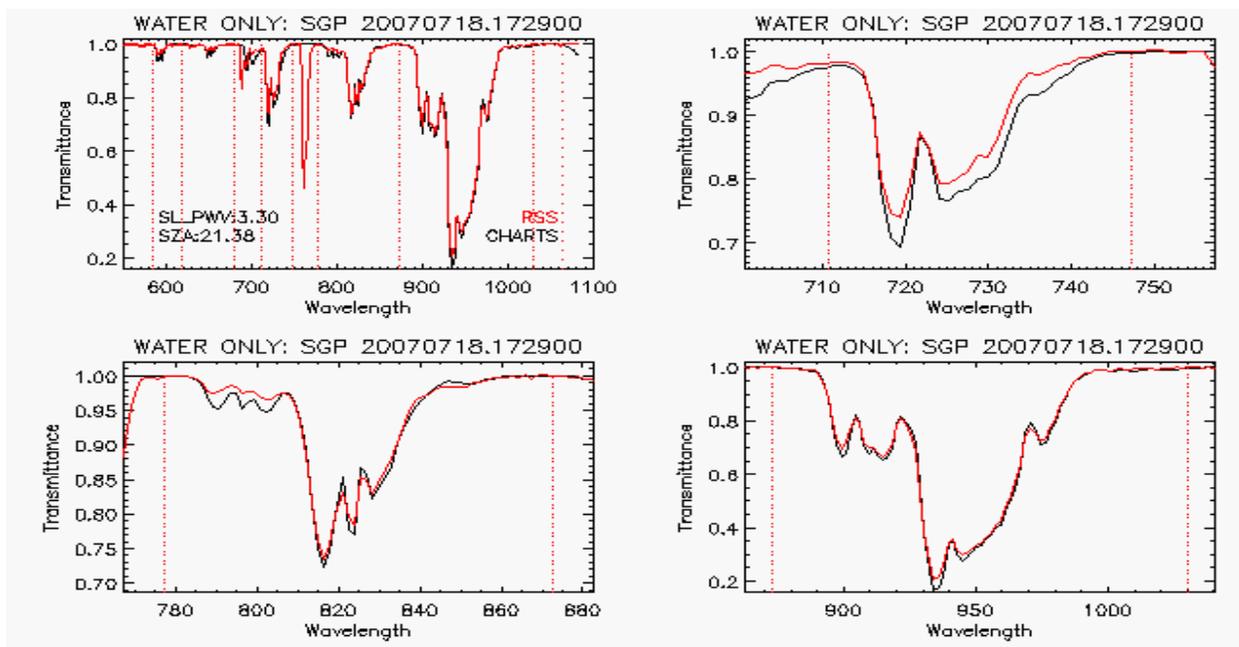


Figure 1. There are several strong water vapor absorption bands in the shortwave. To look at the consistency of the water vapor spectroscopic parameters and the precipitable water vapor measurements across each band, “water-only” LBLRTM/CHARTS clear-sky, direct-beam transmittance calculations are compared to those derived from the RSS for a case on July 18, 2007 at the ARM Southern Great Plain Central Facility. This figure illustrates in which bands the discrepancies exist. Many more cases have also been processed.