Shortwave Spectral Radiative Closure Studies at the ARM Southern Great Plains Climate Research Facility

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Radiative Closure Experiment Design

Step 1: Determine best estimate of atmospheric and surface properties at the SGP ACRF. To do this, use ARM's sophisticated aerosol and cloud remote sensing instrumentation, daily radiosonde launches, and surface microwave radiometers.

Step 2: Input these properties to the line-by-line radiative transfer model LBLRTM/CHARTS with the HITRAN 2004 line parameter database, including updates through 2007, and MT_CKD continuum model. Compute transmittance, radiance/irradiance.

Step 3: Determine best estimate of radiative properties from available radiometric measurements.

Step 4: Compare measured and modeled radiative quantities for many cases in both clear and cloudy conditions.

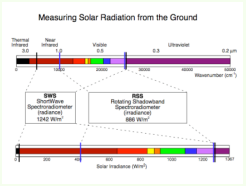
Step 5: Diagnose cause of measurement/model discrepancies. Improve Steps 1 through4.
Repeat Experiment**.**
This is the ***ARM Shortwave Quality Measurement Experiment (SW QME).***

The Spectral Questions?

- Is there good consistency between measurements and model calculations across all absorption bands of the same atmospheric constituent (e.g. water vapor)?
- How do we extrapolate the aerosol properties and the surface albedo properties from the limited spectral measurements to the UV and near-IR?
- Can we achieve closure using ARM's Value-Added Products, such as MergedSounding (atmospheric state), Aerosol Best Estimate, the Surface Albedo VAP, and Microbase (clouds)?
- What are the impacts of using extraterrestrial spectra derived from independent methodologies?

SGP Spectral Shortwave Measurements

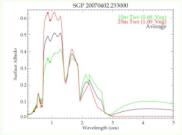
SWS

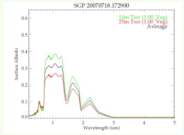


RSS

Spectral Surface Albedo

Using the MFRSR, the 10m/25m MFR, and data from a surface albedo atlas, an algorithm has been developed to create a spectral surface albedo.



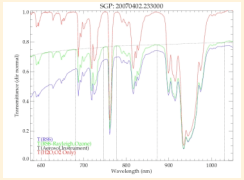


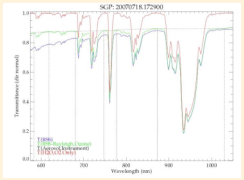
Select 8 Initial Cases

Select cloud-free cases with a range of precipitable water vapor (PWV) and solar zenith angles. The TSI provides cloud fraction at sonde launch time.

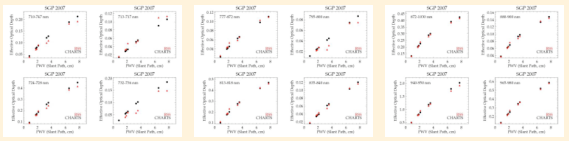
Phase I: Initial Water Vapor Radiative Closure Studies with the RSS

RSS Data Processing



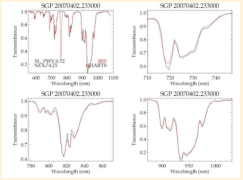


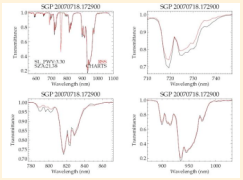
There are several strong water vapor absorption bands in the shortwave. To look at the consistency of the water vapor spectroscopic parameters and the PWV measurements across each band, "water-only" LBLRTM/CHARTS direct-beam transmittance calculations are compared to those derived from the RSS. Spectral differences in the water vapor bands are examined as a function of slant-path PWV in the figures below. Figures to the right illustrate in which bands the discrepancies exist.



To study water vapor issues, Rayleigh scattering and ozone were removed. The aerosol effects were removed from the RSS transmittances using piecewise functions defined at anchor points outside the water vapor bands.

Spectral Comparisons





What's Next?

- Process many more cloud-free cases to clarify issues in water vapor bands.
- Add aerosols to calculation for direct and diffuse comparison between RSS and SWS measurements.
- Move into non-radiosonde launch times and cloudy sky periods.