



GOES-R Cloud and Aerosol Validation during the NSF DC3 field mission



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Correlative Measurements

Autonomous High-spectral Resolution Lidar (AHSRL)

Solar Spectral Flux Radiometer (SSFR)

The UW-SSEC lidar group (Edwin Eloranta, Lead) has developed a High Spectral Resolution Lidar (HSRL) for both ground-based and aircraft platforms.

The University of Colorado LASP SSFR group (Sebastian Schmidt, Lead) has deployed UV-VIS-NIR radiometers for both ground-based and aircraft platforms.

- The HSRL lidars provide vertical profiles of optical depth, backscatter cross-section depolarization, and backscatter phase function.
- All HSRL measurements are absolutely calibrated by reference to molecular scattering that is measured at each point in the lidar profile.
- This enables the HSRL to measure backscatter cross-sections and optical depths without prior assumptions about the scattering properties of the atmosphere.
- The HSRL was deployed to Norman, OK during the National Science Foundation (NSF) Deep Convective Clouds and Chemistry (DC3) Experiment during May-June, 2012

- SSFR provides multi-spectral retrievals of cloud optical thickness, effective radius, liquid/ice water path, as well as aerosol single scattering albedo and asymmetry parameter (with HSRL).
- The instrument is calibrated using a NIST-traceable lamp and has a radiometric accuracy of 3-5% and a precision of 0.5%.
- Each SSFR consists of 2 identical pairs of spectrometers, which cover the wavelength range from 350 nm-1000 nm and 950 nm - 2150 nm with 8-12 nm spectral resolution.
- The SSFR was deployed to Boulder, CO during the National Science Foundation (NSF) Deep Convective Clouds and Chemistry (DC3) Experiment during May-June, 2012

MODIS and GOES-R ABI proxy Aerosol Optical Depth (AOD) retrieval validation studies using the Norman AHSRL measurements allow us to demonstrate the use of AHSRL measurements for GOES-R ABI aerosol validation.

GOES PATMOS-X cloud microphysical retrieval validation studies using the Boulder SSFR measurements allow us to demonstrate the use of SSFR measurements for GOES-R ABI cloud validation.

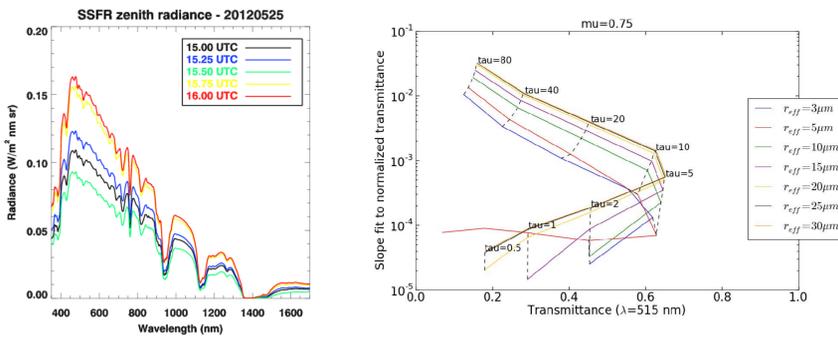
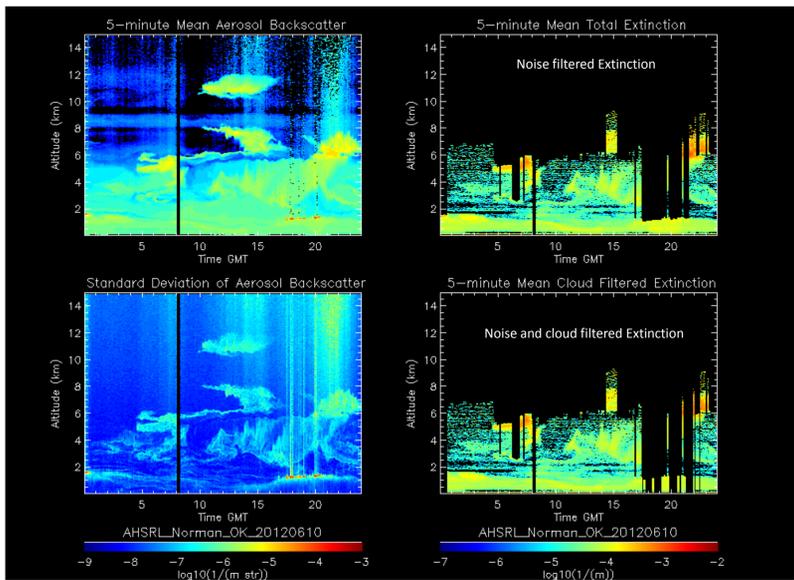
Data processing and cloud transmittance retrieval

AHSRL data processing

SSFR cloud transmittance retrieval

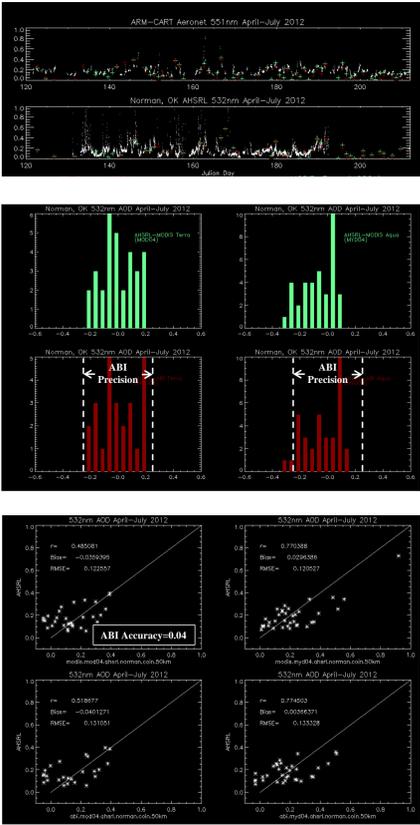
- Apply box-car (1-2-1) smoother in vertical and compare to 5-minute average backscatter to identify high frequency "noise". Remove extinction measurements above the altitude where the "noise" first becomes larger than 50% of the smoothed aerosol backscatter
- Use a $1 \cdot 10^{-3}$ 1/(m str) mean aerosol backscatter and $1 \cdot 10^{-4}$ 1/(m str) standard deviation of aerosol backscatter threshold to identify clouds. Remove extinction profiles where either the 5-minute mean aerosol backscatter or standard deviation satisfy the cloud threshold
- Integrate cloud and noise filtered extinction profile in vertical to obtain AHSRL AOD

- For ground-based SSFR observations, zenith-viewing radiance fore-optics are used along with hemispheric irradiance measurements.
 - Cloud optical thickness and effective radius is derived from zenith-viewing spectral transmitted radiance using the spectral slope of the transmitted radiance between 1565 nm and 1634 nm, normalized to its value at 1565 nm and the transmittance at 515 nm [McBride et al., 2011]
- 1) Normalizing the near-infrared transmittance by its value at 1565 nm before calculating the spectral slope reduces the dependence of the retrieval on spectrally correlated errors, such as radiometric uncertainty.



McBride, P. J., K. S. Schmidt, P. Pilewskie, A. S. Kittelman, and D. E. Wolfe (2011), A spectral method for retrieving cloud optical thickness and effective radius from surface-based transmittance measurements, Atmos. Chem. Phys., 11(14), 7235-7252, doi:10.5194/acp-11-7235-2011

Validation Results



Images here show a comparison of SSFR retrievals from the ground-based installation at Boulder to those from GOES for May 25, 2012.

GOES data processed through GOES-R AWG Algorithms.

Being based on transmission viewed from below, SSFR should be able to retrieve higher (and more accurate) optical depths for thick clouds. This appears to be the case here (optical depth > 60)

Also, we expect SSFR particle radii to be generally less than those from GOES and this appears to be true here.

GOES-R's higher temporal and spatial resolution should increase the accuracy of these comparisons.

