Final Report: DE-FG02-05ER64024
PI: Peter Pilewskie, University of Colorado

Installation of new Shortwave Spectrometer for permanent operation at SGP

In May 2006 the new ShortWave Spectrometer (SWS) was installed in the Optical Trailer at the Southern Great Plains Central Facility SGP on 27 April 2006. The SWS began full operation 28 April 2006 and has run continuously to the present. Over 25 GB of spectra has been collected, calibrated and archived.

3-D radiative transfer simulations

Retrieved fields of cloud optical thickness and effective radius to from the MODIS Airborne Simulator were used to reproduce 3D cloud fields that were used a input to 3D radiative transfer simulations and then compared with simultaneous Solar Spectral Flux Radiometer (SSFR) spectral irradiance measurements. The influence of both horizontal and vertical cloud structure, using accurate versus approximated optical properties in the radiative transfer model on the modeled irradiance was examined, as was the influence of using the full phase function versus using approximations of single scattering properties. In a related study, cloud microphysical and radiation data from two field experiments were compared measured irradiances with the modeled counterpart, using various 3D cloud models as input for two 3D radiative transfer models. Two papers were published.

Direct measurement of aerosol radiative forcing efficiency

The SSFR and the NASA Ames 14-channel Airborne Tracking Sunphotometer (AATS-14) made simultaneous measurements from the Sky Research J-31 aircraft during NEAQS-ITCT, with nineteen missions over the Gulf of Maine between 12 July and 8 August 2004. SSFR and AATS measurements were used to derive the change in net spectral irradiance per change in aerosol optical depth as measured along horizontal flight legs: $dF/d(AOD)$, or aerosol radiative forcing efficiency [W m^{-2} AOD^{-1}]. Unlike ground-based measurements of direct aerosol radiative forcing which rely upon the advection of various air masses over a measurement site during an extended period of time, the airborne method has the advantage of being quasi-instantaneous. Ten cases were found to be well suited for analysis using this gradient forcing method, and they exhibited a high degree of variability in the derived aerosol forcing efficiency, likely the result of changing aerosol characteristics with changing airmass during the experimental period. Over the integrated solar spectrum the mean instantaneous forcing was -135 W m^{-2}. Converting to a 24 hour average, this equates to a forcing efficiency of -83 Wm^{-2}, a magnitude similar to that observed during INDOEX. Variability among the cases examined was attributed to differences in aerosol single scattering albedo and this quantity was derived for each case based upon best fit between measured and modeled forcing efficiency. The details of this research have been summarized in a paper [Redemann, Pilewskie, et al., 2006].

Peer reviewed publications funded wholly or in part under this grant:

Kokhanovsky, A., B. Mayer, W. von Hoyningen-Huene, S. Schmidt, and P. Pilewskie, Retrieval of cloud spherical albedo from top-of-atmosphere reflectance measurements performed at a single observation angle, Atmos. Chem. Phys., 7, 1-5, (2007).

McBride, P., P. Pilewskie, S. Schmidt, O. Coddington, New Insights Into the Column Radiative Budget Using Ground Based Hyperspectral Zenith Radiance Measurements, American Geophysical Union Fall Meeting, 10–14 December 2007, San Francisco.

Redemann, J., P. Pilewskie, P. B. Russell, J. M. Livingston, S. Howard, B. Schmid, J. Pommier, W. Gore, J. Eilers, and M. Wendisch, Airborne measurements of spectral direct aerosol radiative forcing in the Intercontinental chemical Transport Experiment/Intercontinental Transport and Chemical Transformation of anthropogenic pollution J. Geophys. Res., 111, D14210, doi:10.1029/2005JD006812 (2006).

Schmidt, K. S., P. Pilewskie, S. Platnick, G. Wind, P. Yang, and M. Wendisch, Comparing irradiance fields derived from Moderate Resolution Imaging Spectroradiometer airborne simulator cirrus cloud retrievals with SSFR measurements, J. Geophys. Res. 112, D24206, doi: 10.1029/2007JD008711 (2007).

Schmidt, S., V. Venema, F. Di Giuseppe, R. Scheirer, M. Wendisch, and P. Pilewskie, Reproducing cloud microphysical and irradiance measurements using three 3D cloud generators. Quart. J. Roy. Meteorol. Soc., 133, 624 (2007).

Wendisch, M., P. Yang, and P. Pilewskie, Effects of ice crystal habit on the thermal infrared radiative properties and forcing of cirrus clouds, J. Geophys. Res., 112, D08201, doi:10.1029/2006JD007899 (2007).