ARM Atmospheric Radiation Measurement Program

FY 1993

HIGH-SPECTRAL-RESOLUTION RADIANCE MEASUREMENTS

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Objective: To design and deliver three instruments to provide highly accurate observations of the emitted atmospheric radiation and of atmospheric transmission.

Product: Fourier transform infrared (FTIR) spectroscopic expertise and instrumentation to support the improvement of high-resolution LBL radiative-transport codes and to improve the physical understanding of longwave radiation transport in the atmosphere.

Approach: State-of-the-art FTIR radiometric instrumentation will be developed to acquire high quality, high-spectral-resolution, infrared, atmospheric-radiance data and atmospheric molecular-absorption data, especially in the water vapor-continuum region. The data acquired with this instrumentation will be compared with the predictions of infrared-radiation-transport models, such as FASCOD3, to identify candidate areas for code improvements (e.g., by implementing improved or alternative spectral-line parameters).

Three instrument types will provide the highly accurate observations needed for detailed comparisons with LBL calculations and for determining the radiative characteristics of clouds, aerosols, and trace gases. Two (AERI and AERI-X) will make highly accurate measurements of the atmospheric emitted radiation, and the third (SORTI) will measure the atmospheric transmission to high accuracy with observations of the sun at different air masses.

The AERI (atmospheric-emitted-radiance interferometer) instrument will operate over the spectral range of 4 to 20 c m (2500 to 500 wavenumbers) at a resolution of 1 wavenumber. It will be sufficiently inexpensive to be deployed throughout the ARM networks and will provide the link between point measurements and the larger scale. A system of AERI instruments would also provide important 3-D measurements of meteorological parameters in the lower atmosphere.

The AERI-X instrument will provide improved spectral resolution (0.1 wavenumber) over the wavelength range from 4 to 20 c m. It will provide the higher spectral resolution needed at a more limited number of locations to acquire the best available emission observations for comparison with LBL calculations.

The solar radiance transmission interferometer (SORTI) measurements with a resolution of 0.002 wavenumber will yield the atmospheric transmission at essentially full resolution. It will reveal deficiencies in the way model calculations handle absorption line shapes and line interactions.

Results to Date: The AERI prototype has been operated successfully at the Southern Great Plains (SGP) CART site in the June 1993 intensive operational period (IOP), with data released to the Science Team in near real time. The software systems developed for automatic, stand-alone operation were successfully demonstrated. The SORTI has successfully collected data at the University of Denver and is ready for tests at CART. Good agreement was achieved between the SORTI and a similar instrument operated simultaneously.
