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High-Spectral-Resolution Radiance Measurements

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KEYWORDS:

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

APPROACH: tate-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. Three instrument types will provide the highly accurate observations needed for detailed comparisons with LBL calculations and for determining the radiative character- istics 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 μm (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 μm. 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: Three instruments have been developed: the atmospheric emitted radiance interferometer (AERI), the extra-high-resolution AERI (AERI-X), and the solar radiance transmission interferometer (SORTI). AERI and SORTI prototypes have been used for the collection of atmospheric radiance and transmittance data at the Southern Great Plains ARM site in Oklahoma.

A Stirling cycle cooler has been preliminarily evaluated for the AERI detectors to eliminate the need for liquid nitrogen onsite. The high spectral resolution AERI-X system has undergone prototype development and testing. And high-resolution spectral data has been spectroscopically analyzed to evaluate models of the infrared water-vapor continuum. Substantial experience has been gained in the automation of FTIR instruments for use at remote sites and in the characterization of the instruments' performance and accuracy.

DELIVERABLES: 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.

COLLABORATIONS:

OTHER: