Instrument Development for Atmospheric Radiation Measurement (ARM): Status of the Atmospheric Emitted Radiance Interferometer-Extended Resolution (AERI-X), the Solar Radiance Transmission Interferometer (SORTI), and the Absolute Solar Transmission Inferometer (ASTI)

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Three instruments are currently under development for Atmospheric Radiation Measurement (ARM) at the University of Denver. The AERI-X (Atmospheric Emitted Radiance Interferometer - Extended Resolution) and the SORTI (Solar Radiance Transmission Interferometer) are joint projects with the University of Wisconsin (Hank Revercomb). The prototype SORTI has been operational at the Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) site since January 1994. An AERI-X pre-prototype was installed in Eureka, Northwest Territories (NWT), Canada, in September 1994. The ARM AERI-X prototype has been running in Denver since December and will be tested at the SGP CART during the April intensive observation period (IOP). A demonstration ASTI (Absolute Solar Transmission Interferometer) has collected data from Denver and a prototype for ARM is under construction.

The SORTI prototype was installed at the SGP CART site in November 1993 and has been routinely operated by site staff since January 1994. Approximately 1000 spectra, occupying 2.5 Gbytes has been accumulated and stored on optical disk (the data are available from the authors). Figure 1 shows an example of a small region of the spectra obtained with the SORTI prototype, along with line-by-line, layer-by-layer simulations. Although the basic agreement is excellent, significant differences remain. For example the water vapor line at about 1106.7 cm^{-1} does not have correct wings, even though the simulation was done using the closest radiosonde ascent. At the level of fine detail, the ozone lines do not have quite the right depth, because a generic ozone profile has been used.

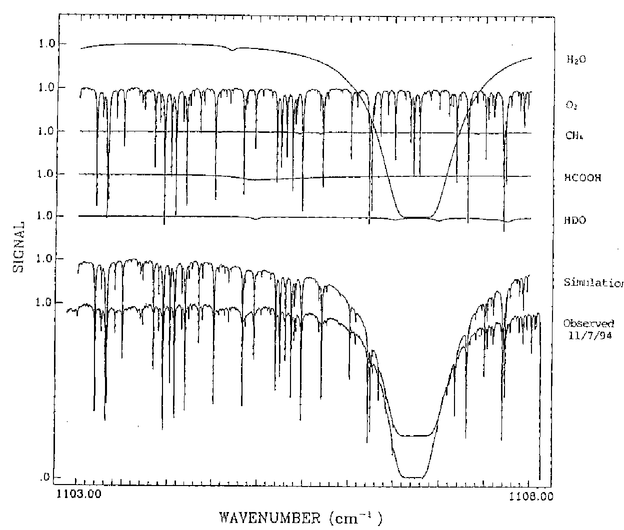

Figure 1. Line-by-line, layer-by-layer simulation of prototype SORTI spectrum from November 7, 1994, at the SGP CART site. The simulation used the closest radiosonde for temperature and water vapor, and a generic mid-latitude atmosphere for all of the constituents. The observed and calculated spectra have been normalized to 1 at the largest value in the frame. The contributions of the most significant absorbers in this region are shown in the upper section. Note that the strong water line near 1106.7 cm^{-1} does not match very well. Some of the smaller features do not have the right depth, because a generic atmosphere has been used.

Two AERI-X prototypes have been constructed. These instruments use a different interferometer than the standard AERI, but the same calibration fixtures. The second instrument was built for the National Science Foundation and was finished first. It was installed at the Canadian Atmospheric Environment Service NDSC station at Eureka, Northwest Territories (80°N, 86°W) last September. Figure 2 illustrates the difference between a mid-latitude location (Denver) in the summer and an arctic location in winter. The largest difference is in the amount of water vapor, while the temperature difference shows as well, particularly on the edge of the CO_2 band near 750 cm^{-1}. The ARM prototype will be tested at the SGP CART site during the April IOP.

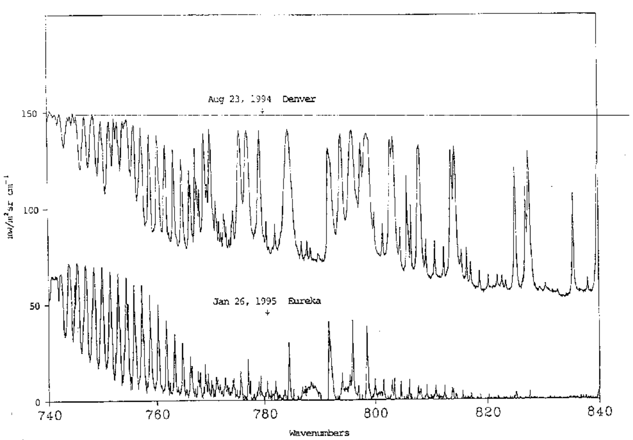

Figure 2. Atmospheric emission spectra obtained with an AERI-X prototype. Both are 30-minute observing sequences, with a 30° elevation angle. Spectra are on the same scale.

The ASTI development instrument has successfully produced radiometrically calibrated spectra of the solar spectrum arriving at the ground in Denver. An example of these spectra from a noon run on March 14, 1995, is shown in Figure 3.

An ASTI prototype is under construction. The prototype will have automatic filter changing and calibration, among other improvements.

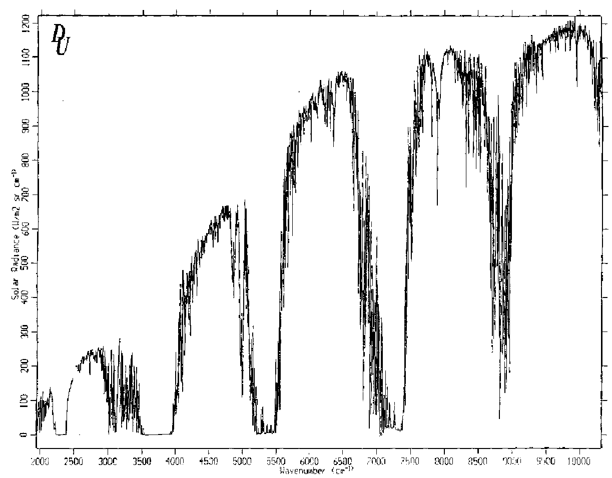

Figure 3. Solar spectrum on March 14, 1995. Resolution 4 cm^{-1}; approximate airmass 1.35.