ARM Radiative Heating Profile Workshop

From: Hank Revercomb
Date: 7 January 2007
Re: Thoughts on measuring net fluxes/heating:

1. Are direct measurements the best approach to investigate heating rates? The answer is probably application specific. It is not clear to me that measuring profiles of net flux to get heating rates (from the vertical divergence) is generally a better way to learn about radiative heating than less direct approaches that determine heating rates from other types of accurate measurements and calculations. Careful definition of the application, requirements, and uncertainties are needed to evaluate the trade-offs for practical options before proceeding to develop new instrumentation for ARM.

2. TOA Example: Spacecraft climate missions have moved away from measuring Flux to measuring Radiance (CERES as compared to Vern Suomi's first in 1959 and the ERB/ERBE follow-ons) and proposed missions are now moving toward measuring Spectral Radiance (Climsat, Arrhenius, new benchmark missions). These quantities carry more information than fluxes that integrate over both spatial and spectral variations, and spectrally resolved radiances can be measured with very high accuracy.

3. Surface example:
   AERI zenith viewing spectral radiances have helped identify and diagnose uncertainties in ground-based IR flux observations, and provide more information about mechanisms for any changes observed.

4. Difficulties of measuring accurate net flux profiles:
   a. Highly dependent on ***non-local x-y geometry*** that is hard to sample.
   b. Achieving adequate ***simultaneity*** to get meaningful heating rates
   c. Establishing accurate ***cosine angular response*** about the zenith (including basic sensor response and stable pointing).
   d. Deviations from ***flat spectral response*** cause source dependent radiometric calibration errors, even if the non-flatness is known.

5. Options need to be carefully evaluated. Many types of observations are now available to constrain atmospheric heating that were not practical a half century ago when broadband radiance observations were new and contributed a great deal to understanding the role of atmospheric radiation in climate.