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A Ground-based Network of Boundary Layer Thermodynamic Profilers: The Infrared Option

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High temporal resolution profiles of water vapor are critical for a wide range of operational and research applications. Several high-level reports have specified the need for high temporal resolution temperature and humidity profiles in the boundary layer (lowest few kilometers of the troposphere) across the continental U.S. A network of these observations would be extremely useful for improving short-term and longer-term weather forecasts of significant weather events (e.g., convection initiation, severe weather and precipitation, winter storms), air quality forecasting, fire weather forecasting, and to aid decision making in the transportation, agriculture, renewable energy, and homeland security areas.

Due to the high temporal and vertical resolution requirements, these observations would need to be made with ground-based remote sensors. The Atmospheric Emitted Radiance Interferometer (AERI) is an infrared spectrometer that measures the downwelling emitted radiance from the atmosphere that can be inverted to provide profiles of temperature and humidity, as well as cloud properties and trace gas concentrations. An introduction to the AERI will be provided, the methodology used to retrieve thermodynamic profiles from the AERI radiance observations will be summarized, and an discussion on uncertainties, biases, and information content will be provided. The AERI thermodynamic retrievals were used to evaluate the analyses and forecasts from the NOAA's operational Rapid Refresh model (RAP); this evaluation will highligh a diurnal bias in the RAP's (version 3) thermodynamic evolution in the boundary layer, which was not identified with more traditional observations.