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Ground-based High Spectral Resolution Observations of the Entire Terrestrial Thermal Spectrum Under Extremely Dry Conditions in Northern Chile

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A field experiment was conducted in northern Chile in 2009 at an altitude of 5.3 km to evaluate the accuracy of line-by-line radiative transfer models in regions of the spectrum that are typically opaque at the surface due to strong water vapor absorption bands. This experiment, the second Radiative Heating in Underexplored Bands Campaign (RHUBC-II), deployed Fourier Transform spectrometers, microwave radiometers, broadband radiometers, surface meteorology, and radiosondes to characterize the atmospheric state and downwelling radiation. The suite of spectrally resolved radiance instruments collected simultaneous observations that, for the first time ever, spanned the entire terrestrial thermal spectrum (i.e. from 10 to 3000 cm-1, or 1000 to 3.3 μm). These radiance observations, together with collocated water vapor and temperature profiles, are used to provide an evaluation of the accuracy of two line-by-line radiative transfer models. These observations provide evidence that the large changes made to the water vapor continuum absorption model, which resulted from analysis of RHUBC-I dataset collected in northern Alaska in 2007, improved the accuracy of the line-by-line radiative transfer model but also suggests that additional modifications are needed. The large changes to the water vapor continuum absorption coefficients that resulted from the RHUBC-I analysis have a significant radiative and dynamical impact on climate simulations from the Community Earth System Model (CESM), which highlights the importance of improving the accuracy of the water vapor absorption coefficients in these typically opaque spectral bands and in particular in the far-infrared (wavelengths between 15 and 100 μm).