Validation of the Global Distribution of CO_2 Volume Mixing Ratio in the Mesosphere and Lower Thermosphere from SABER

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The Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument on board the Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) satellite has been measuring the limb radiance in 10 broadband infrared channels over the altitude range from ~ 400 km to the earth surface since 2002. The kinetic temperatures and CO2 volume mixing ratios (VMRs) in the mesosphere and lower thermosphere have been simultaneously retrieved using radiances in the 15 and 4.3μm bands of CO_2 under non-local thermodynamic equilibrium (non-LTE) conditions. This paper presents results of a validation study of the SABER CO_2 VMRs obtained with a 2-channel, self-consistent temperature/CO_2 retrieval algorithm. Results are based on comparisons with coincident CO_2 measurements made by the Atmospheric Chemistry Experiment-Fourier Transform Spectrometer (ACE-FTS) and simulations using the Specified Dynamics version of the Whole Atmosphere Community Climate Model (SD-WACCM). The SABER CO_2 VMRs are in agreement with ACE-FTS observations within reported systematic uncertainties from 65 to 110 km. The annual average SABER CO_2 VMR decreases from a well-mixed value above ~80 km. Latitudinal and seasonal variations of CO_2 VMRs are substantial. SABER observations and the SD-WACCM simulations are in overall agreement for CO2 seasonal variations, as well as global distributions in the mesosphere and lower thermosphere. Not surprisingly, the CO_2 seasonal variation is shown to be driven by the general circulation, converging in the summer polar mesopause region and diverging in the winter polar mesopause region.