Spectrally Dependent Calibration Requirement for CLARREO IR Instrument

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The infrared (IR) spectrometer of the Climate Absolute Radiance and Reflectivity Observatory (CLARREO) will measure the Top of Atmospheric (TOA) thermal radiance spectra from 200 to 2000 cm^{-1}. It is designed to detect trends of atmospheric temperature, moisture, cloud, and surface properties even in the presence of measurement gaps. Wielicki et al [1] have studied the CLARREO measurement requirements for achieving climate change absolute accuracy in orbit. The goal of this study is to further quantify the spectrally dependent calibration requirement for CLARREO IR instrument. Spectral fingerprinting method is used to evaluate how the calibration error affects our ability to detect the changes that are smaller than the natural variability of temperature and moisture. The temperature, humidity, and surface skin temperature variability and the associated correlation time are derived using Modern Era Retrospective-Analysis for Research and Applications (MERRA) and European Center for Medium-Range Weather Forecasts (ECMWF) reanalysis data. The results are further validated using the climate model simulation results. To detect an accurate trend for a geophysical parameter, the observation system has to be able to separate the natural variability from the climate changes. Therefore, even for a perfect observation system, one has to make long enough observations to minimize the contribution from the natural variability. With the derived natural variability and correlation time as the reference, the calibration requirement for the IR instrument can be deduced based on a spectral fingerprinting method.

Keywords: Climate trend detection, remote sensing, satellite instrument intercalibration

