“Observing climate change from space: Approach, Requirements, and Economic Value”

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Observing climate change requires the unambiguous detection and attribution of a trend signal in a climate variable (e.g., surface air temperature) above the background noise of the natural variability of the Earth system. A primary metric for testing climate models is the observation of the decadal trend in climate parameters. The ability to detect and attribute trends in climate variables depends on the absolute accuracy of the measured trend. Present space-based observing systems have largely been designed for imaging and weather forecasting, for which high absolute accuracy is not a requirement. Detecting trends in climate with the present satellite observing systems requires decades for climate trends to be confidently determined. In this paper we show that new instruments with high absolute accuracy can substantially shorten the time to detect and attribute decadal change in the climate system. Furthermore, the knowledge of climate trends gained in a shorter time can have substantial economic value (US $9 - $17 Trillion) because societal decisions on emissions paths and mitigation approaches can be made sooner. The approach described here forms the cornerstone of the basis and rationale for the proposed NASA Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission. Over the past 15 years NASA and its partners have developed the technology to achieve factors of 3 to 5 improvement in the calibration of infrared spectral radiances, and factors of 10 in reflected solar spectra. These calibrated spectra form benchmarks of the climate system from which trends can be derived. They can also be used to calibrate numerous other satellite sensors to climate change accuracy, allowing trends in multiple climate parameters to be determined. The technology, measurement approach, and economic value of the CLARREO mission will be presented.