CLARREO: decadal change accuracy for space based emitted infrared spectra, reflected solar spectra and radio occultation

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CLARREO (Climate Absolute Radiance and Refractivity Observatory) is one of the four Tier 1 missions recommended by the recent NRC decadal survey report on Earth Science and Applications from Space (NRC, 2007). The CLARREO mission addresses the need to rigorously observe climate change on decade time scales and to use decadal change observations as the most critical method to determine the accuracy of climate change projections such as those used in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4). A rigorously known accuracy of both decadal change observations as well as climate projections is critical in order to enable sound policy decisions. The CLARREO mission accomplishes this critical objective through highly accurate and SI traceable decadal change observations sensitive to many of the key uncertainties in climate radiative forcings, responses, and feedbacks that in turn drive uncertainty in current climate model projections. The same uncertainties also lead to uncertainty in attribution of climate change to anthropogenic forcing.

The CLARREO breakthrough in decadal climate change observations is to achieve the required levels of accuracy and traceability to SI standards for a set of observations sensitive to a wide range of key decadal change variables. These accuracy levels are determined both by the projected decadal changes as well as by the background natural variability that such signals must be detected against. The accuracy for decadal change traceability to SI standards includes uncertainties of calibration, sampling, and analysis methods. Unlike most other missions, all of the CLARREO requirements are judged not by instantaneous accuracy, but instead by accuracy in large time/space scale average decadal changes.

Given the focus on decadal climate change, the NRC Decadal Survey concluded that the single most critical issue for decadal change observations was their lack of accuracy and low confidence in observing the small but critical climate change signals. CLARREO is the recommended attack on this challenge, and builds on the last decade of climate observation advances in the Earth Observing System as well as metrological advances at NIST (National Institute of Standards and Technology) and other standards laboratories.

The presentation will summarize the planned CLARREO observations, science priorities, and science requirements. The approach includes a dual strategy to provide climate change benchmarks directly from time/space averaged CLARREO observations through optimal spectral fingerprinting, as well as to serve as a set of reference spectrometers in orbit capable of improving the calibration of other weather and climate sensors. The CLARREO observations include a nadir viewing infrared interferometer covering the spectral region of 200 to 2000 inverse cm, with 1 inverse cm spectral resolution, and with an absolute accuracy on orbit of 0.1K (3 sigma confidence bound). They also include a nadir viewing reflected solar spectrometer covering the spectral region from 320 to 2300nm, with 4 nm spectral sampling, and accuracy in nadir reflectance of 0.3% (2 sigma confidence bound). The solar spectrometer will be capable of pointing to the moon and sun for calibration, as well as tracking time/angle/space matched observations when used for Reference Intercalibration of other radiometers such as CERES or VIIRS. Finally, the observations include radio occultation receivers and antennas to allow use of both the GPS and Gallileo Global Navigational Satellite Systems.