



## CLARREO Pathfinder

### Pathfinder to the Climate Absolute Radiance and Refractivity Observatory Mission

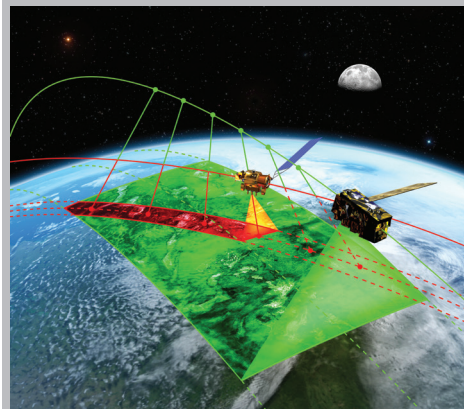
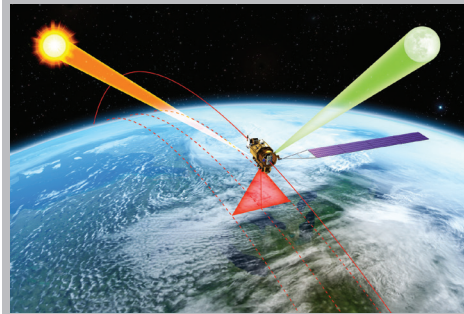
CLARREO Pathfinder (CPF) will have a Reflected Solar spectrometer on the International Space Station (ISS) starting in 2021 that will detect the complete spectrum of radiation from the Sun reflected by Earth. CLARREO Pathfinder (CPF) provides a crucial step toward informing strategic planning by government agencies (e.g. DoD and DOE), the operation and sustainment of key national assets (e.g. coastal military installations), and risk assessment by the reinsurance industry in response to hazards such as flooding and inundation.

According to the World Resources Institute, more than 123 million Americans reside in coastal communities, which account for nearly half of the U.S. GDP. Additionally, the DoD Strategic Environmental Research and Development Program states that the infrastructure, operations, and readiness capabilities of more than 1,700 coastal military installations are potentially vulnerable to increased coastal flooding in the coming decades. CLARREO Pathfinder will demonstrate the technology we need to effectively assess such threats to U.S. national security and way of life.

The Climate Absolute Radiance and Refractivity Observatory (CLARREO) Mission was recommended as a top priority Earth Science mission by the National Research Council's Earth Science Decadal Survey in 2007. The CLARREO team has since identified several reduced-cost implementation options, including a \$400M mission on ISS that still provides 75% of the original science value. A Pathfinder to the full CLARREO mission began in 2016 that will demonstrate breakthrough measurement technologies required for a full CLARREO mission for a life cycle cost of less than \$100M. CLARREO Pathfinder will demonstrate improved measurement accuracy by factors of 3 to 10 over current Earth-viewing sensors, enabling a revolutionary improvement in the characterization of the Earth from space.

This mission will reduce the risk of a full CLARREO mission by demonstrating the ability to achieve high accuracy measurements tied to accepted international standards using on-orbit calibration approaches. The CPF instrument will also demonstrate the capability to calibrate many other satellite sensors observing reflected solar radiation that will cross the instrument's path in orbit. This includes a wide range of space-borne sensors including imagers for clouds, aerosols, surface vegetation, snow/ice, and ocean color; atmospheric composition sensors; radiation budget instruments; high resolution land imagers (e.g. Landsat); and commercial constellations of land imagers (e.g. over 170 PlanetLab sensors, 13 Terra Bella sensors). By providing more accurate calibration levels to existing and future sensors, CPF enables production of more accurate data products for weather forecasting and climate modeling.

CLARREO Pathfinder builds on more than 10 years of U.S. technology development and science research led by NASA Langley with key U.S. partners including NASA Goddard, NIST, DOE, and the Laboratory for Atmospheric and Space Physics at the University of Colorado. CPF provides the in-orbit calibration standard sensor for U.S. and international satellite instruments. With China and the UK moving to implement their own satellite calibration references, CPF keeps the U.S. in the lead in this critical area of satellite and Earth Science innovation.



CLARREO Pathfinder Calibration and Inter-Calibration Concepts: CLARREO Pathfinder has two primary objectives to demonstrate essential measurement technologies on orbit: 1) (top) calibrate the instrument using stable, well-known sources: the Sun and the Moon and 2) (bottom) transfer that calibration to other instruments that cross its path.



Two national assets, NASA Langley Research Center and Langley Air Force Base in Hampton, VA, saw a 7 to 7 1/2 foot storm surge when Tropical Storm Isabel impacted the Hampton Roads area. Improved flooding predictions that will be assisted by the technology demonstrated by CLARREO Pathfinder are crucial as coastal areas face the threat of increased flooding in the coming decades.

# CLARREO-PF

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