

CLARREO Pathfinder Mission Overview

Yolanda Shea (*CPF Project Scientist*) & CPF Team October 14, 2021



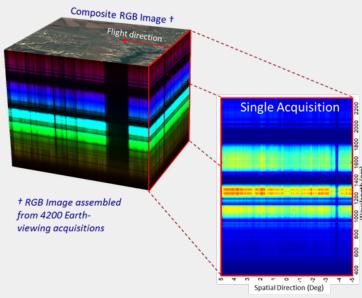


CLARREO Pathfinder on ISS Summary



- Core Mission Objectives: Demonstrate ability to achieve climate-critical high accuracy reflectance measurements of Earth reflectance and inter-calibration with CERES (broadband) & VIIRS (multi-spectral)
- LASP-Led Payload & Reflected Solar Spectrometer (350 2300 nm) & Category 3, Class D Mission
- Nominal 1-year mission operations + 1-year science data analysis
- Currently in Phase C Passed [Virtual] CDR in March 2020.
- Launch Estimated in Late CY 2023

Spectrally-Resolved Earth Reflectance







CLARREO Pathfinder Schedule



Key

Pre-Phase A

Phase A

Phase B

Phase C

Phase D

Phase E

Phase F

-2020

March 2020

Evaluation of Matured CPF Design Ability to Meet Mission Requirements (Critical Design Review)

2021 2022

May 2022

CPF Payload HySICS (HyperSpectral Imager for Climate Studies) Instrument Complete

Independent Calibration Performed

August 2022

CPF Begins System Assembly, Integration, and Test Phase (Phase D)

November 2022

CPF Receives Approval to Proceed with Payload Environmental Testing (Pre-Environmental Review)

- 2023

Assembly, Integration, and Testing (AI&T)

June 2023

Evaluation of Payload Readiness for Delivery for Launch (Pre-Ship Review)

September 2023

Evaluation of Readiness to Proceed with Prime Operations (Operational Readiness Review)

October 2023

CPF Begins Launch, Operations, and Sustainment Phase (Phase E)

December 2023

CPF Payload Launched to ISS & Commissioning Begins

2024

February 2024

Payload Commissioning Completed: CPF is Ready to Take Science Measurements

December 2024

Beta Level 1 and Level 4 Products Available



- 2025

February 2025

CPF Begins Closeout Phase (Phase F)

December 2025

Reprocessed Level 1 and Level 4 Products
Available

- Key Dates Prime Mission
 - ~December 2023: Launch!
 - February 2024: Start Science Operations
 - October 2024: Beta L1 Data Products Available
 - December 2024: Beta L4 Data Products Available
 - December 2024: Estimated start timeframe of CPF Science Team
- Possible Extended Mission
 - ISS Occupancy through 2027
 - Potential Extension through 2030

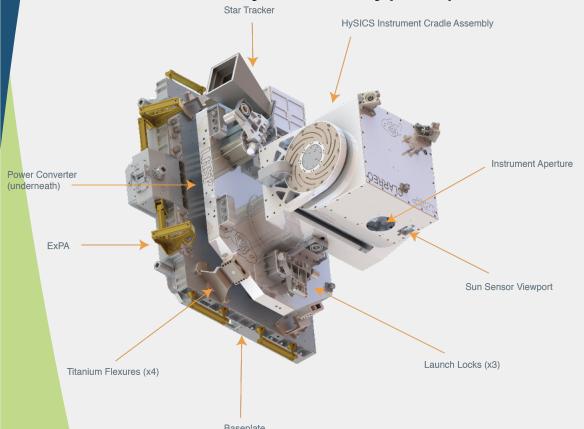




CLARREO Pathfinder Payload



HySICS: Hyperspectral Imager for Climate Science



Radiometric Uncertainty	0.3% (1-sigma)
Spectral Range	350 nm - 2300 nm
Spectral Sampling	3 nm
Swath Width	10° (70 km nadir)
Spatial Sampling	0.5 km
Sampling Rate	15 Hz

Kopp et al 2017

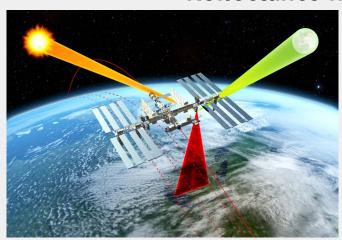




CPF Science Objectives

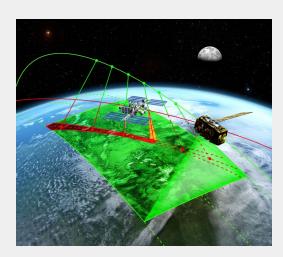


Objective #1: High Accuracy SI-Traceable Reflectance Measurements



Demonstrate on-orbit calibration ability to reduce reflectance uncertainty by a factor of *5-10 times* compared to the best operational sensors on orbit.

Objective #2: Inter-Calibration Capabilities



Demonstrate ability to transfer calibration other key RS satellite sensors by intercalibrating with CERES & VIIRS.

		Objective #1	Objective #2
Uncert	tainty	Spectrally-resolved & broadband reflectance: ≤0.3% (1σ)	Inter-calibration Sampling Difference: ≤0.3% (1σ)
Data P	Product	Level 1A: Highest accuracy, best for inter-cal, lunar obs Level 1B: Approx. consistent spectral & spatial sampling, best for science studies using nadir spectra	Level 4: One each for CPF-VIIRS & CPF-CERES inter-cal. Merged data products including all required info for inter-cal analysis



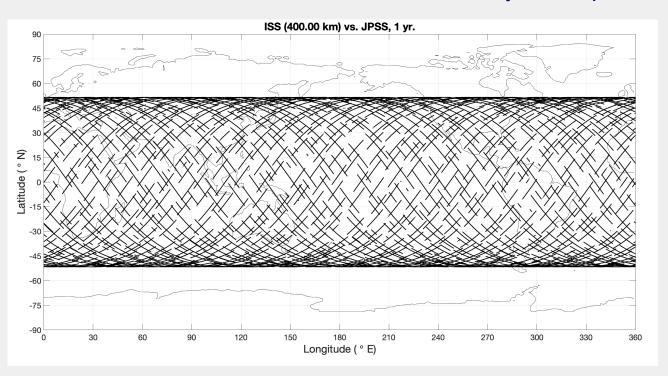


Planned Pointing & Scanning Ops For Improved IC Statistics



- Inter-calibration sampling difference uncertainty requirements are met (in part) by acquiring and analyzing data from an aggregation of inter-calibration events
- More events improves reduction of data matching noise

Predicted inter-calibration event ISS ground tracks (~1,300) between CLARREO Pathfinder on ISS and JPSS-1 for 1-year of operations



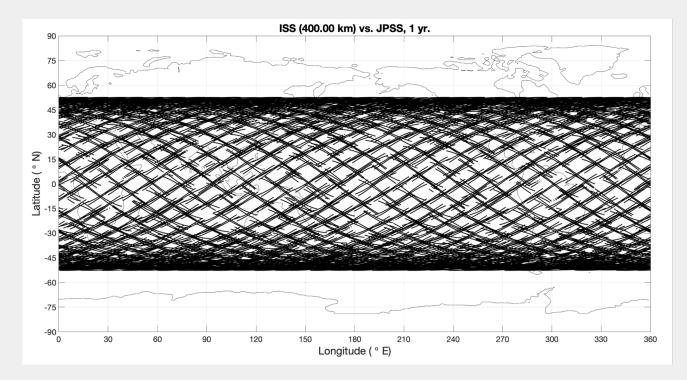


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Predicted inter-calibration event CPF Swaths





Versatility in CPF Observations



Launch-Ready: Late 2023

Prime Mission Ops

Extended Mission Ops (?)

Observation Type	1-Year Mission	1+ Years
On-orbit Instrument Calibration	Demonstrate success of calibration approach over 1 year	Confirm success of calibration approach over longer period
Earth Reflectance and Radiance Nadir Spectra	Will be used to demonstrate achieved calibration, geolocation, etc requirements	 Develop partial (nearly-global) climate benchmark prototype Potential for overlap with TRUTHS Additional opportunities for use in science studies
LEO On-orbit Inter-calibration	 Measurements and data analysis for CERES and VIIRS Only Potential Landsat measurements 	 Additional flexibility to inter-calibrate other on-orbit LEO sensors (e.g. PACE, Sentinel, commercial sensors)
GEO On-orbit Inter-Calibration	Demonstration measurements with 1 GEO	 Expand GEO inter-calibration measurements (e.g. TEMPO, GOES, GERB, Himawari series, GeoCarb)
Enhanced Land/DCC Pseudo-Invariant Calibration Site (PICS) Characterization	Measurements over high priority PICS	 Additional PICS added with additional viewing opportunities
Improved characterization of the Moon	Leveraging existing ops mode to cover libration and phase angles available	Additional sampling within libration and phase angles to further make lunar models more robust



https://clarreo-pathfinder.larc.nasa.gov/



CPF Science Workshop & Looking Forward



- CPF Science Workshop: November 2-3, 2021
 - Educate science community on CPF payload/instrument/measurement details
 - Share & discuss ideas for how CPF measurements can support attendees' research interests
 - Please email me, <u>yolanda.shea@nasa.gov</u>, for invitation and to be added to the invite list
 - These will recur on some regular cadence (based on participants' preference)
- Science Team Solicitation 2024
 - Kaye anticipates ST start date ~ 1 year after launch (currently December 2023)
- From GSICS:
 - Priorities with justification for additional intercalibration targets (sensors, land sites) from CPF
 - Use the GEO, land site, and lunar measurements we take in year 1! This could help
 us further advocate for the additional intercal targets after initial year of operations