

CLARREO Pathfinder Mission Overview

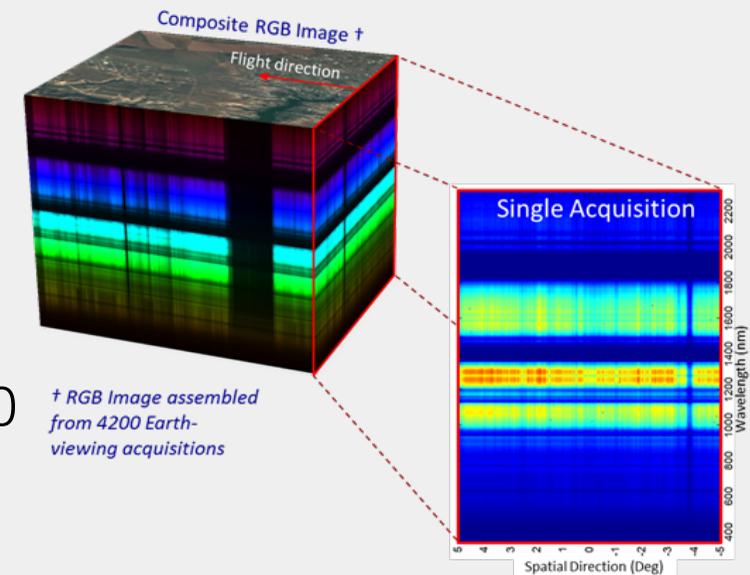
Yolanda Shea (*CPF Project Scientist*)

& CPF Team

October 14, 2021

- **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

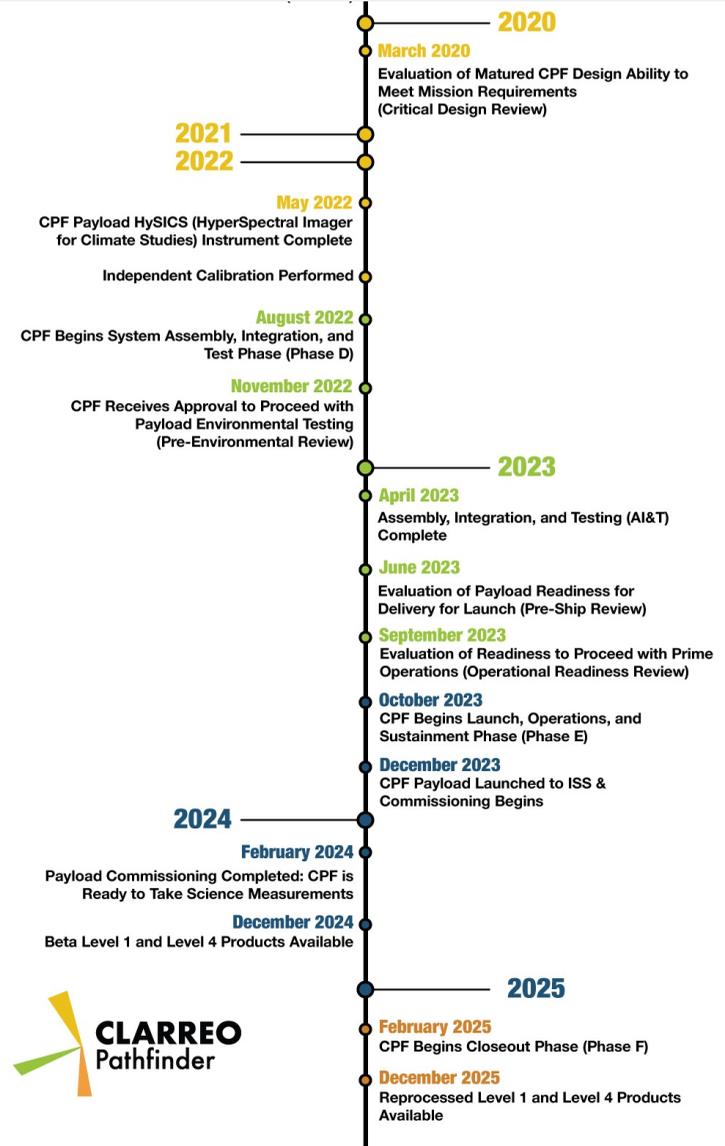


CLARREO Pathfinder Schedule



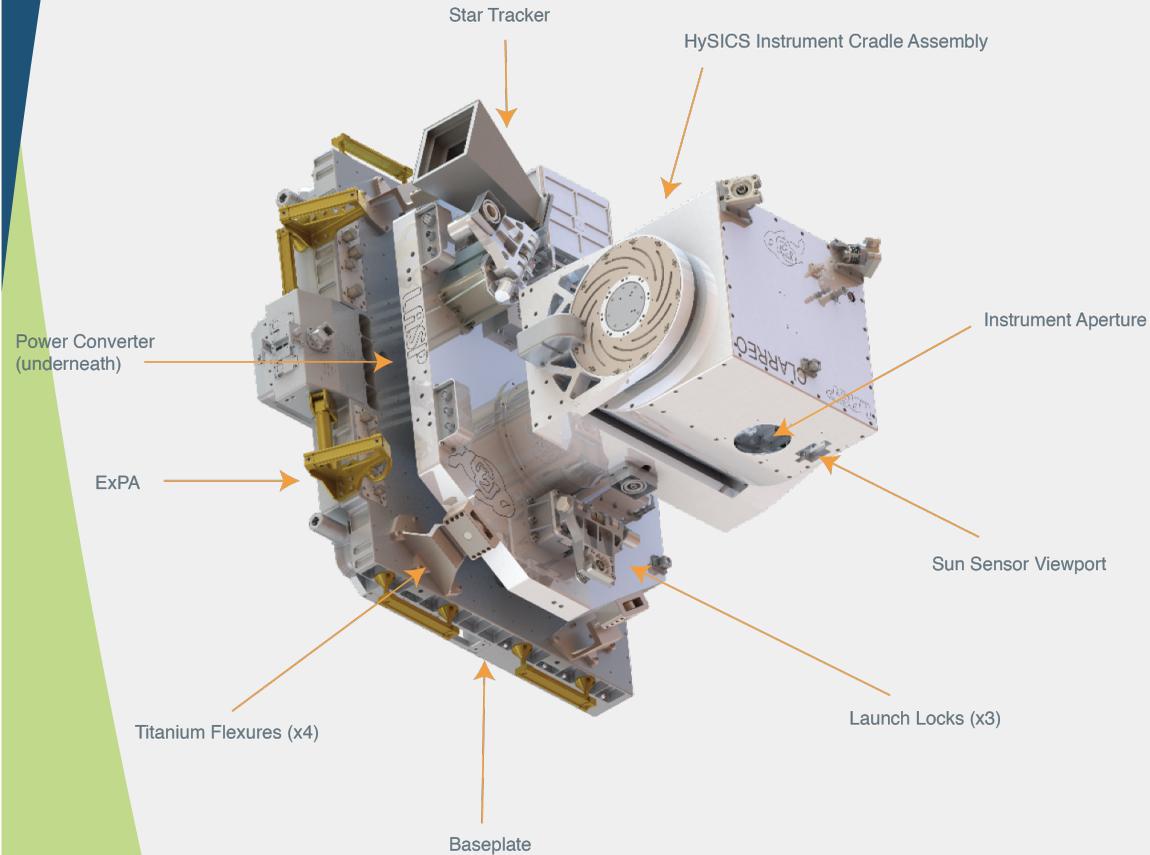
Key

- Pre-Phase A
- Phase A
- Phase B
- Phase C
- Phase D
- Phase E
- Phase F



- 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

HySICS: Hyperspectral Imager for Climate Science

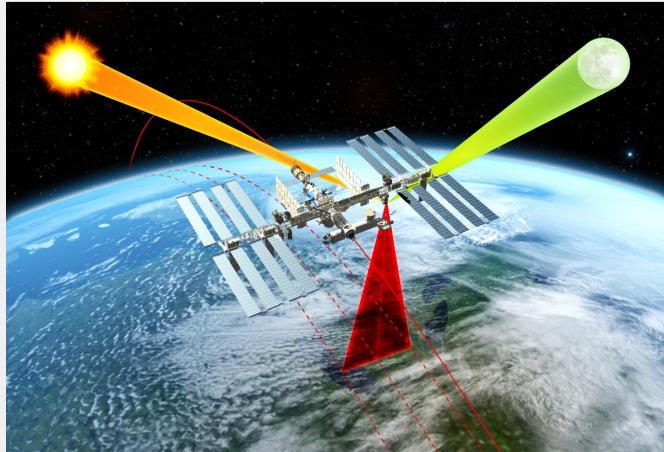


Radiometric Uncertainty	0.3% (1-sigma)
Spectral Range	350 nm - 2300 nm
Spectral Sampling	3 nm
Swath Width	10° (70 km nadir)
Spatial Sampling	0.5 km
Sampling Rate	15 Hz

Kopp et al 2017

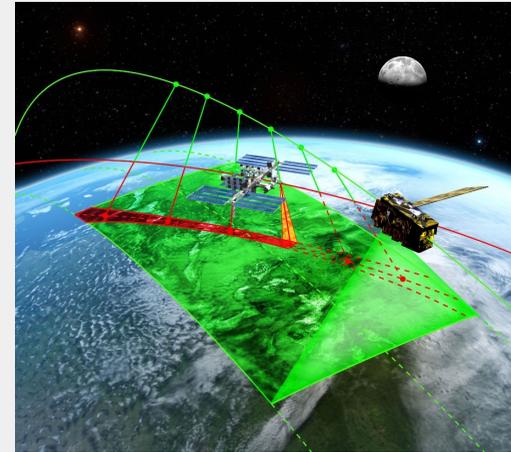
CPF Science Objectives

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

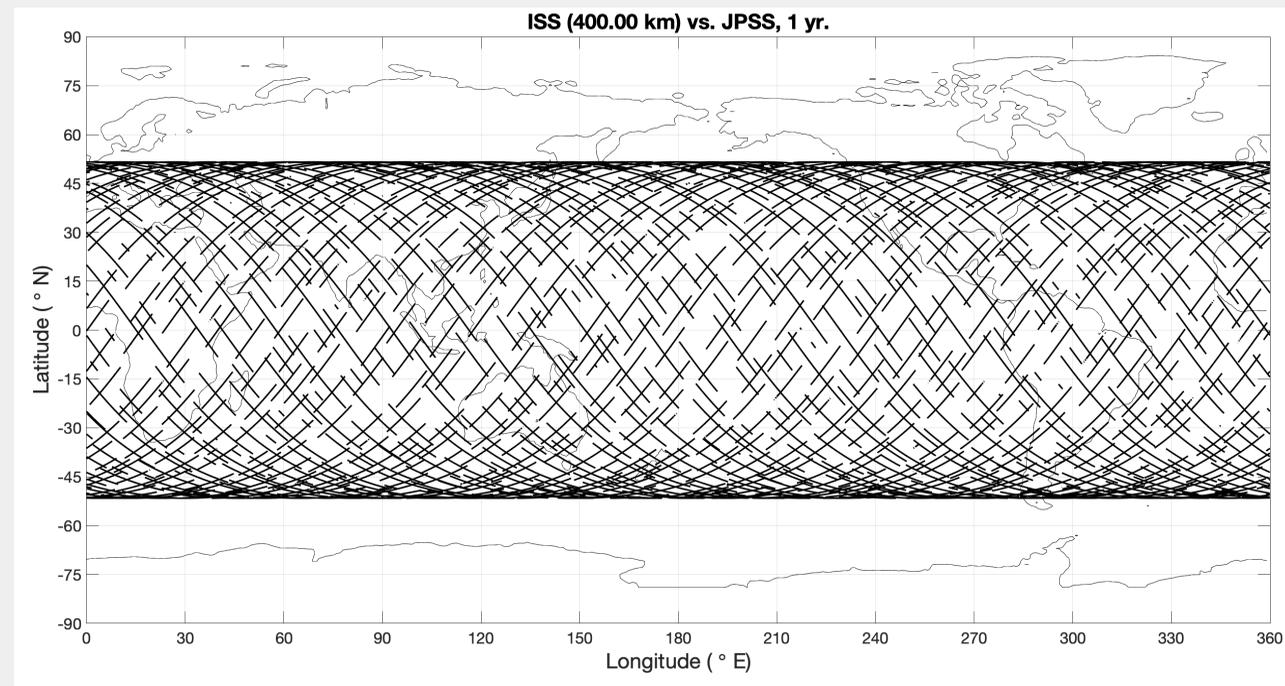


Demonstrate ability to transfer calibration other key RS satellite sensors by inter-calibrating with CERES & VIIRS.

	Objective #1	Objective #2
Uncertainty	Spectrally-resolved & broadband reflectance: $\leq 0.3\%$ (1σ)	Inter-calibration Sampling Difference: $\leq 0.3\%$ (1σ)
Data 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

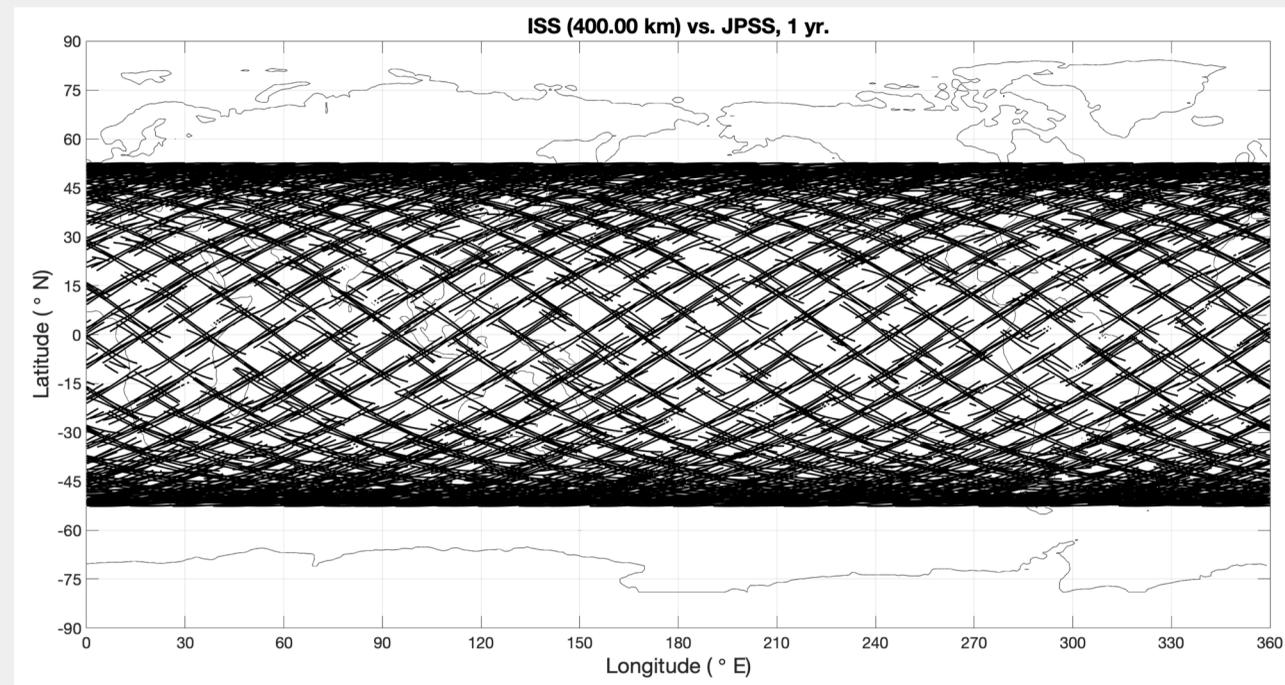
- Inter-calibration sampling difference uncertainty requirements are met (in part) by acquiring and analyzing data from an aggregation of inter-calibration events
- More events improves reduction of data matching noise

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



- 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 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	<ul style="list-style-type: none"> Develop partial (nearly-global) climate benchmark prototype Potential for overlap with TRUTHS Additional opportunities for use in science studies
LEO On-orbit Inter-calibration	<ul style="list-style-type: none"> Measurements and data analysis for CERES and VIIRS Only Potential Landsat measurements 	<ul style="list-style-type: none"> Additional flexibility to inter-calibrate other on-orbit LEO sensors (e.g. PACE, Sentinel, commercial sensors)
GEO On-orbit Inter-Calibration	<ul style="list-style-type: none"> Demonstration measurements with 1 GEO 	<ul style="list-style-type: none"> Expand GEO inter-calibration measurements (e.g. TEMPO, GOES, GERB, Himawari series, GeoCarb)
Enhanced Land/DCC Pseudo-Invariant Calibration Site (PICS) Characterization	<ul style="list-style-type: none"> Measurements over high priority PICS 	<ul style="list-style-type: none"> Additional PICS added with additional viewing opportunities
Improved characterization of the Moon	<ul style="list-style-type: none"> Leveraging existing ops mode to cover libration and phase angles available 	<ul style="list-style-type: none"> Additional sampling within libration and phase angles to further make lunar models more robust

- 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, yolanda.shea@nasa.gov, 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