



NASA

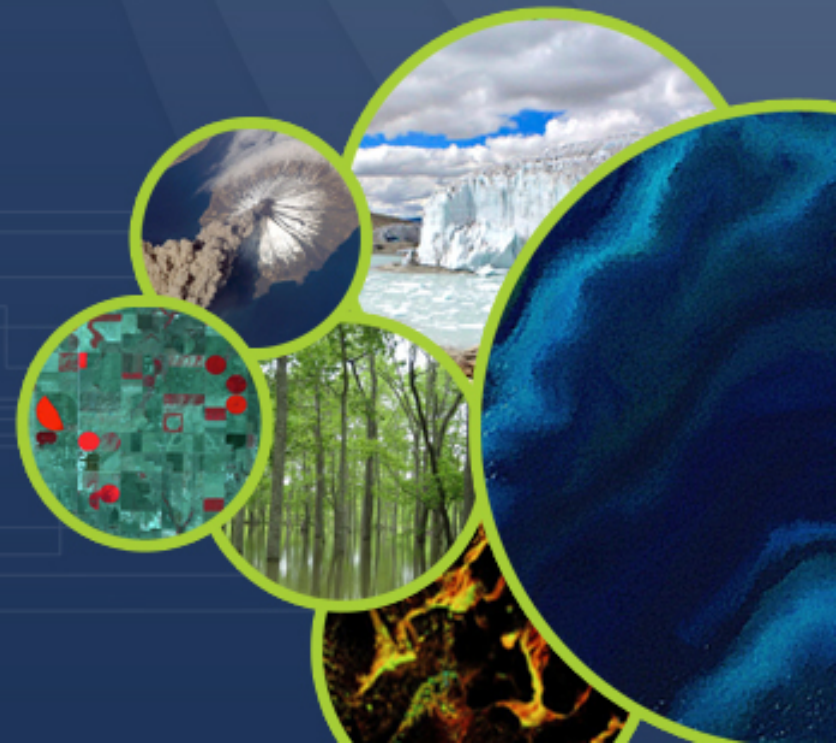
Report on Cal/Val Activities

K. Thome

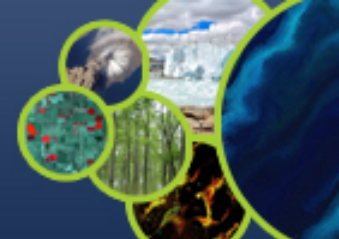
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WGCV Plenary # 47

July 14-17, 2020



Working Group on Calibration and Validation



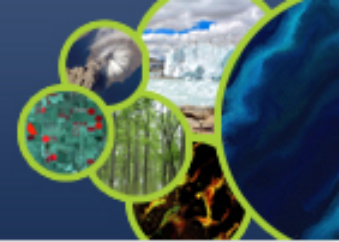
On-orbit Missions and Partnerships

- International
- Interagency
- Primary Ops
- Extended Ops

International Space Station

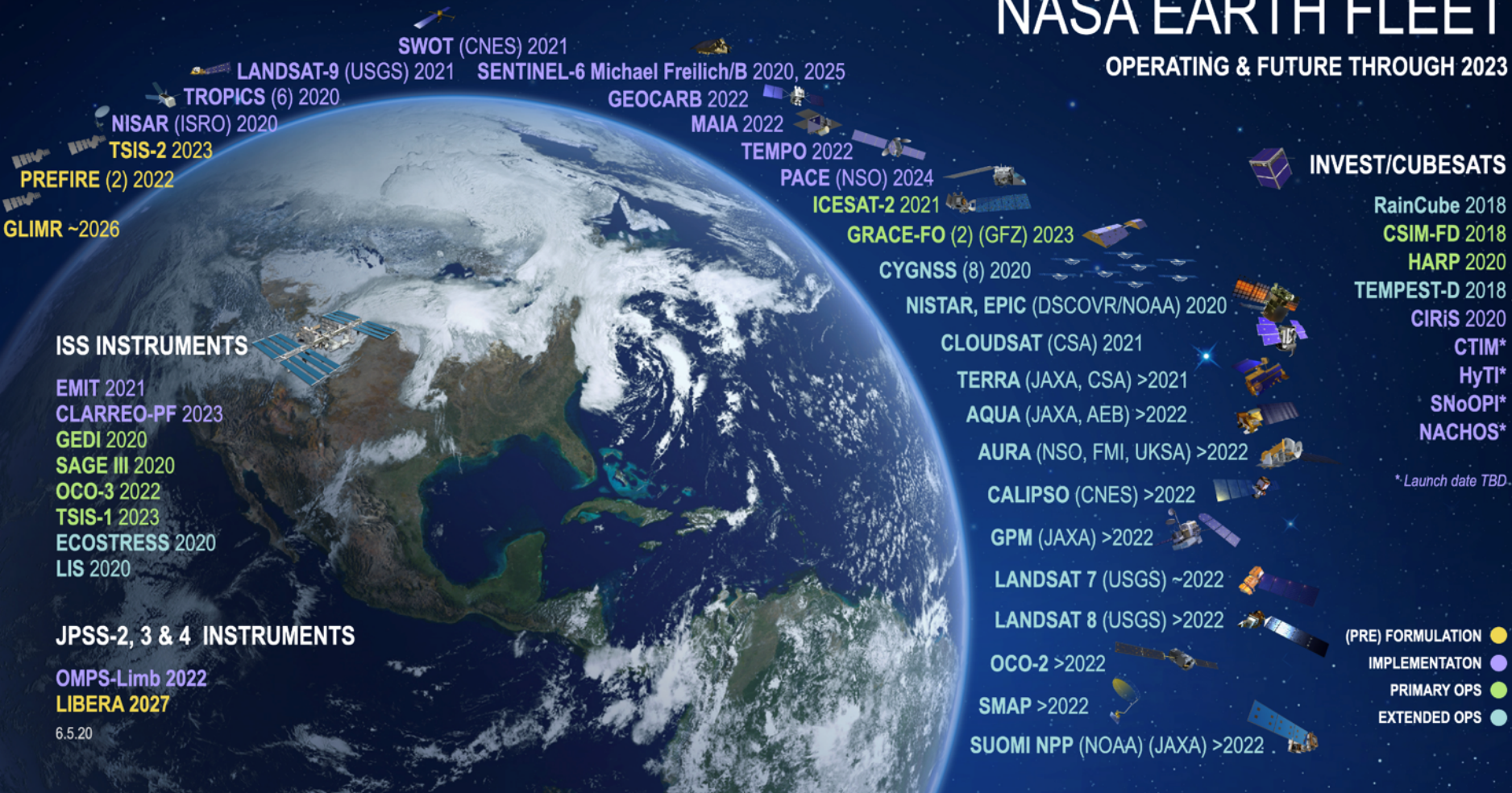
- LIS on ISS 2017
- SAGE III on ISS 2017
- TSIS-1 on ISS 2017
- ECOSTRESS on ISS (EVI-2) 2018
- GEDI on ISS (EVI-2) 2018
- OCO-3 on ISS 2019

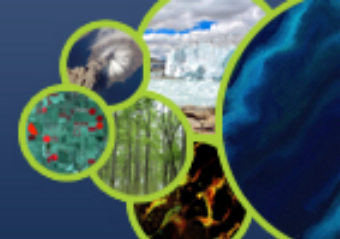




NASA EARTH FLEET

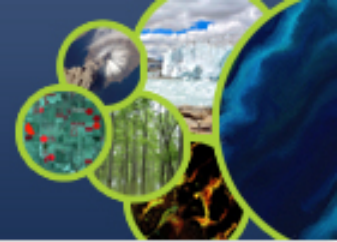
OPERATING & FUTURE THROUGH 2023





Not shown in charts are 2017 Earth Sciences Decadal Survey Missions that are currently listed by designated observables

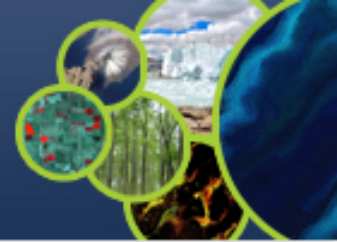
Observable	Science/Applications Summary	Candidate Measurement Approach	ESAS maximum cost
Aerosols	Aerosol properties, aerosol vertical profiles, and cloud properties to understand their effects on climate and air quality	Backscatter lidar and multichannel/multi-angle/polarization imaging radiometer flown together on the same platform	CATE Cap \$800M
Clouds, Convection, And Precipitation	Coupled cloud-precipitation state and dynamics for monitoring global hydrological cycle and understanding contributing processes including cloud feedback	Radar(s), with multi-frequency passive microwave and sub-mm radiometer	CATE Cap \$800M
Mass Change	Large-scale Earth dynamics measured by the changing mass distribution within and between the Earth's atmosphere, oceans, ground water, and ice sheets	Spacecraft ranging measurement of gravity anomaly	Est Cap \$300M
Surface Biology and Geology	Earth surface geology and biology , ground/water temperature, snow reflectivity, active geologic processes, vegetation traits and algal biomass	Hyperspectral imagery in the visible and shortwave infrared, multi- or hyperspectral imagery in the thermal IR	CATE Cap \$650M
Surface Deformation and Change	Earth surface dynamics from earthquakes and landslides to ice sheets and permafrost	Interferometric Synthetic Aperture Radar (InSAR) with ionospheric correction	Est Cap \$500M



Use SBG example that is similar for all designated observables

- Decadal Survey gave direction on SBG Observing priorities: Terrestrial vegetation physiology, functional traits, and health
 - Inland and coastal aquatic ecosystems physiology, functional traits, and health
 - Snow and ice accumulation, melting, and albedo
 - Active surface changes (eruptions, landslides, etc.)
 - Effects of changing land use on surface energy, water, momentum, and C fluxes
 - Managing agriculture, natural habitats, water use/quality, and urban development
- Based on SBG Science and Applications Traceability Matrices
- Value Framework assesses architectures by performance, cost and risk
- Selected architectures developed to support an MCR

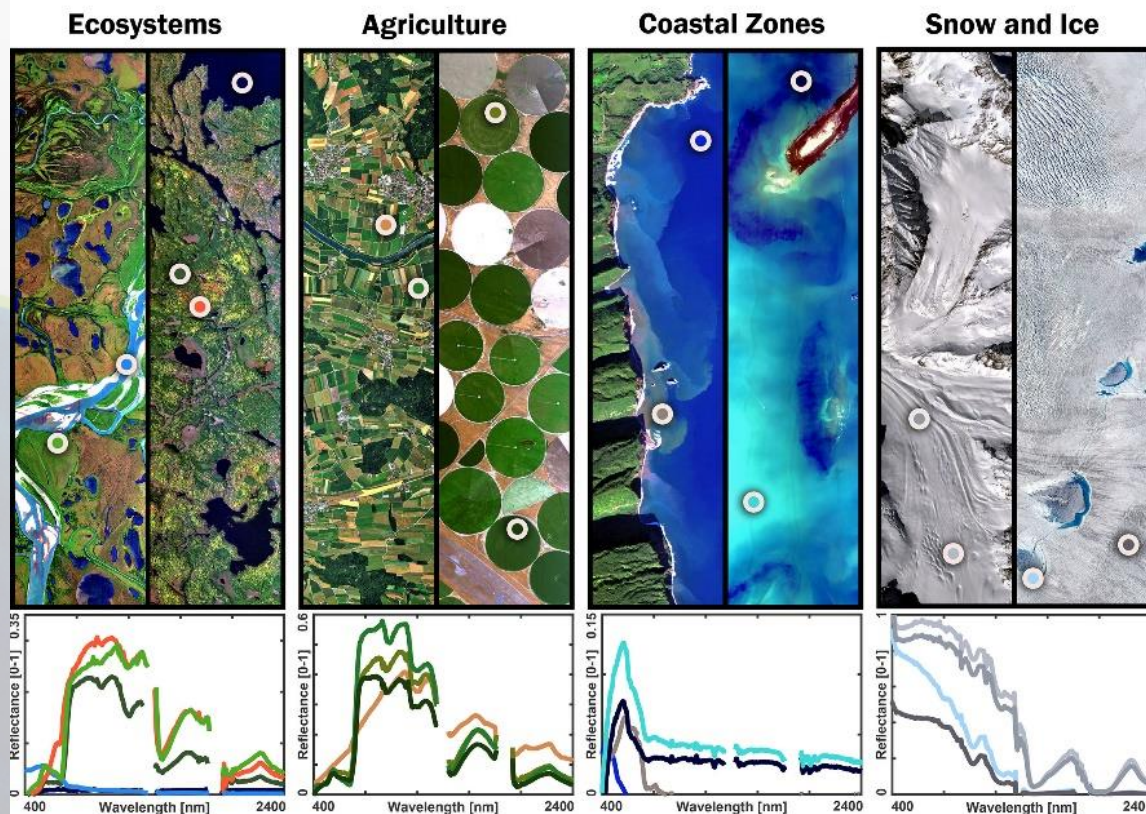




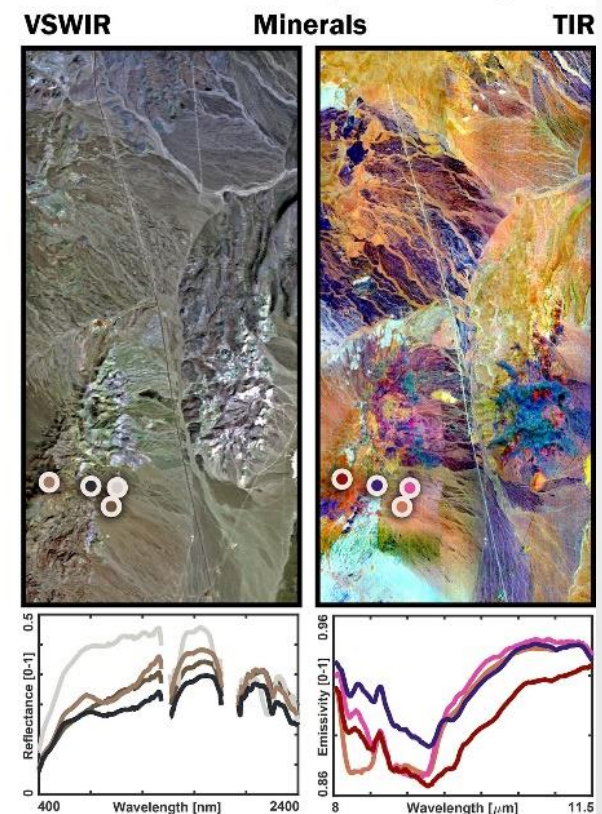
SBG Working Groups contribute to engagement and transparency

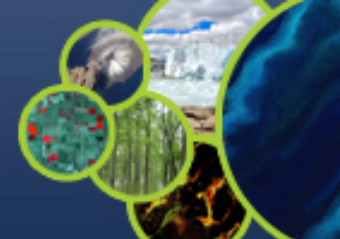
- WG have a core team with open membership
- WG Co-Leads organize, present and participate in SBG community and international workshops

SBG provides data for many focus areas ...



... and will see the world in two critical spectral regions





SBG CalVal WG provided calibration strategies for achieving desired uncertainty tolerance as input to design sessions

Calibration strategy recommendations for architectures assumed:

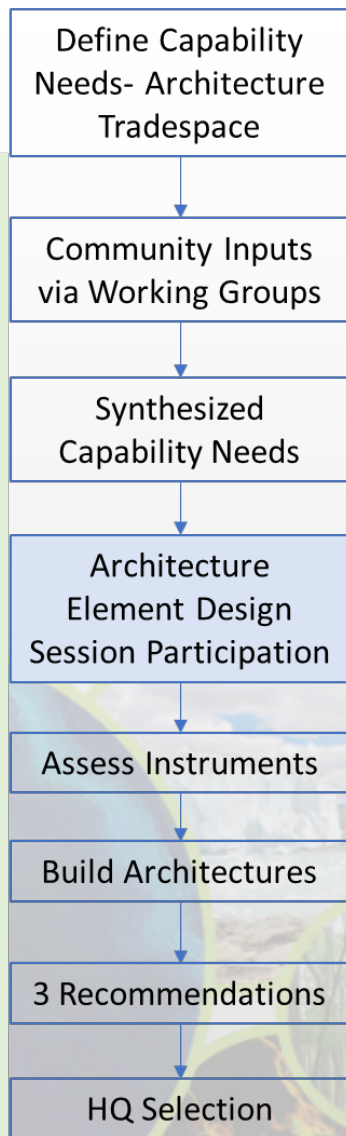
- Accuracy 5% rel. uncertainty surface reflectance, including dark targets
- $\leq 1^\circ\text{K}$ abs. uncertainty surface temperature
- Pointing knowledge for subpixel geometric accuracy
- Stability to ensure change detection, geolocation and global mosaicking

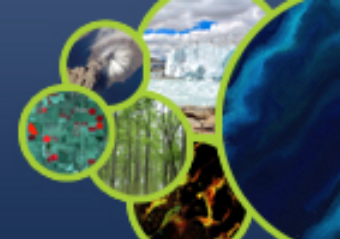
Radiometric (R), Thermal (T), Spectral (S), & Geometric (G)

	Guidance to Architecture Team		Purpose
On-Orbit Calibration and Monitoring 		Lunar Calibration (R,S,G)	Accuracy Stability (long-term)
		Solar Calibration (R,S)	Accuracy Stability (short-term)
		Black Body (T)	Accuracy Stability (short-term)
		Stellar Navigation (G)	Maneuvers, Geolocation
		Vicarious Calibration (R,T,S,G)	Accuracy Stability (long-term)

Phase 1

Phase 2

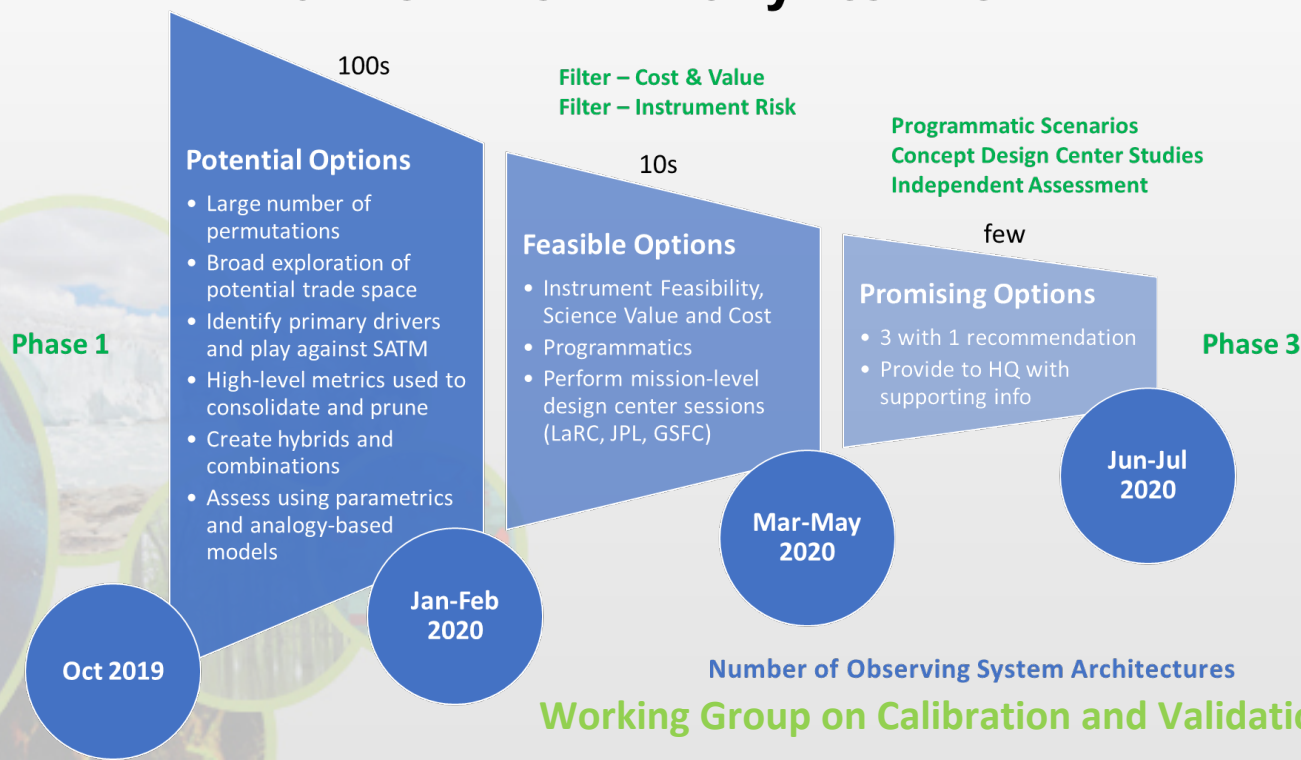


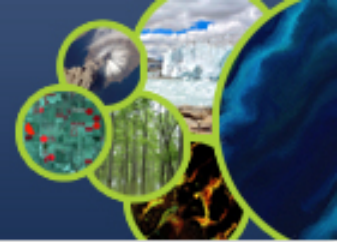


SBG Studies have three core objectives

- Identify and characterize high value observing architectures
- Assess performance and cost effectiveness of architectures against SBG research and applications objectives
- Detailed candidate architectures that enable near-term science return

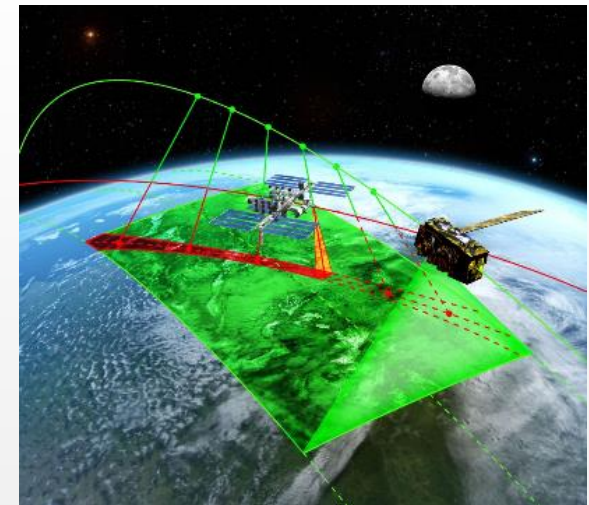
Funnel - from “Many” to “Few”

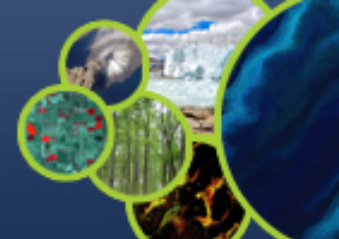




CLARREO Pathfinder passed CDR in March 2020

- Demonstrate
 - Essential measurement technologies for the Reflected Solar portion of the full Tier 1 Decadal Survey-recommended CLARREO mission
 - On-orbit, high accuracy, SI-Traceable calibration
 - Ability to transfer calibration to operational sensors
- Formulation, implementation, launch to ISS, and operation of a Reflected Solar (RS) Spectrometer
- Class D Mission with late 2022/early 2023 launch for nominal 1-year mission life
- Additional 1 year science data analysis





FDA-12: Inventory of space data product formats used by CEOS agencies.	Q4 2019	Develop an inventory of current product format used in CEOS agencies and identify recommendations to facilitate interoperability	WGCV
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Plan after WGCV-45 was to work towards Q4 2019 deadline with closure taking place at the next joint WGCV/WGISS meeting (by Q2 2020)

- Leverage CARD4L product reviews and Level 1 interoperability task
- WGISS/WGCV Data Formats and Interoperability in the framework of FDA and Quality Indicators in Discovery Metadata
 - Survey on QI currently used by different sensor families will provide a starting point for the list of product formats used in CEOS agencies
 - WGISS defining approach to include QIs for the test case in discovery metadata searchable by end users
 - Definition of quality/uncertainty parameters and methods to incorporate these into the data stream as part of the L1 interoperability
- WGISS and SEO developing *CEOS Earth Analytics Interoperability Lab* to provide a platform for CEOS projects to test interoperability (talk later in WGCV-47)
- Possible options
 - WGCV continues to work on FDA-12 as planned with closure likely at next joint WGISS/WGCV meeting
 - Work with CEO to consider activities of CEOS Earth Analytics Interoperability as sufficient to close FDA-12
 - Work with CEO to move FDA-12 to being under WGISS/SEO