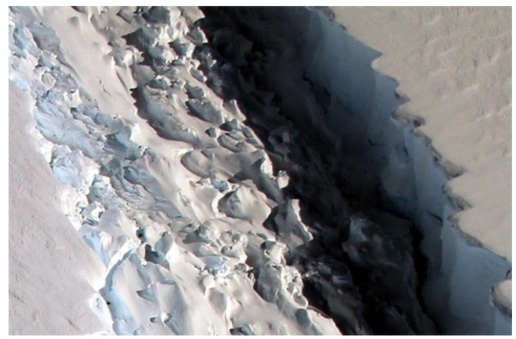
Welcome to the
4th NASA Surface Biology and Geology Community Webinar

- Please turn off your video
- Please stay muted
- Please use chat to ask a question to "Everyone"
- We will answer as many questions as time allows at the end
- Any questions we don't get to will be answered within a week in writing with the answers posted at: https://sbg.jpl.nasa.gov
- Send us questions or feedback anytime to sbg@jpl.nasa.gov


Watch it live:
https://mars.nasa.gov/mars2020/timeline/landing/watch-online/
NASA Perseverance is landing immediately after this webinar.
2

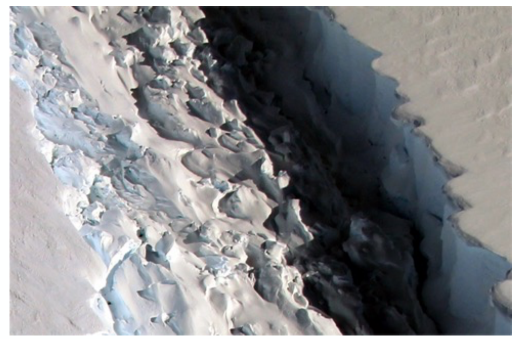
SCIENCE






Dr. Karen M. St. Germain,
Earth Science Division Director, NASA Headquarters

SCIENCE



Dave Schimel, Jet Propulsion Lab, California Institute of Technology
Ben Poulter, Goddard Space Flight Center
and the SBG Science and Applications Co-Leads

Science Objective and Measurement Target Development Process

SATM and ATM Developed from DS document

SATM/ATM Vetted by Community Review

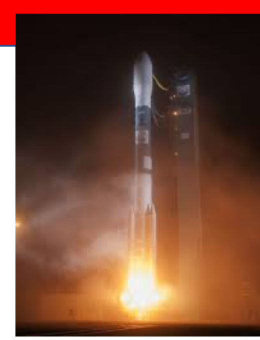
SATM Final

Handoff to Architecture

Recommendation

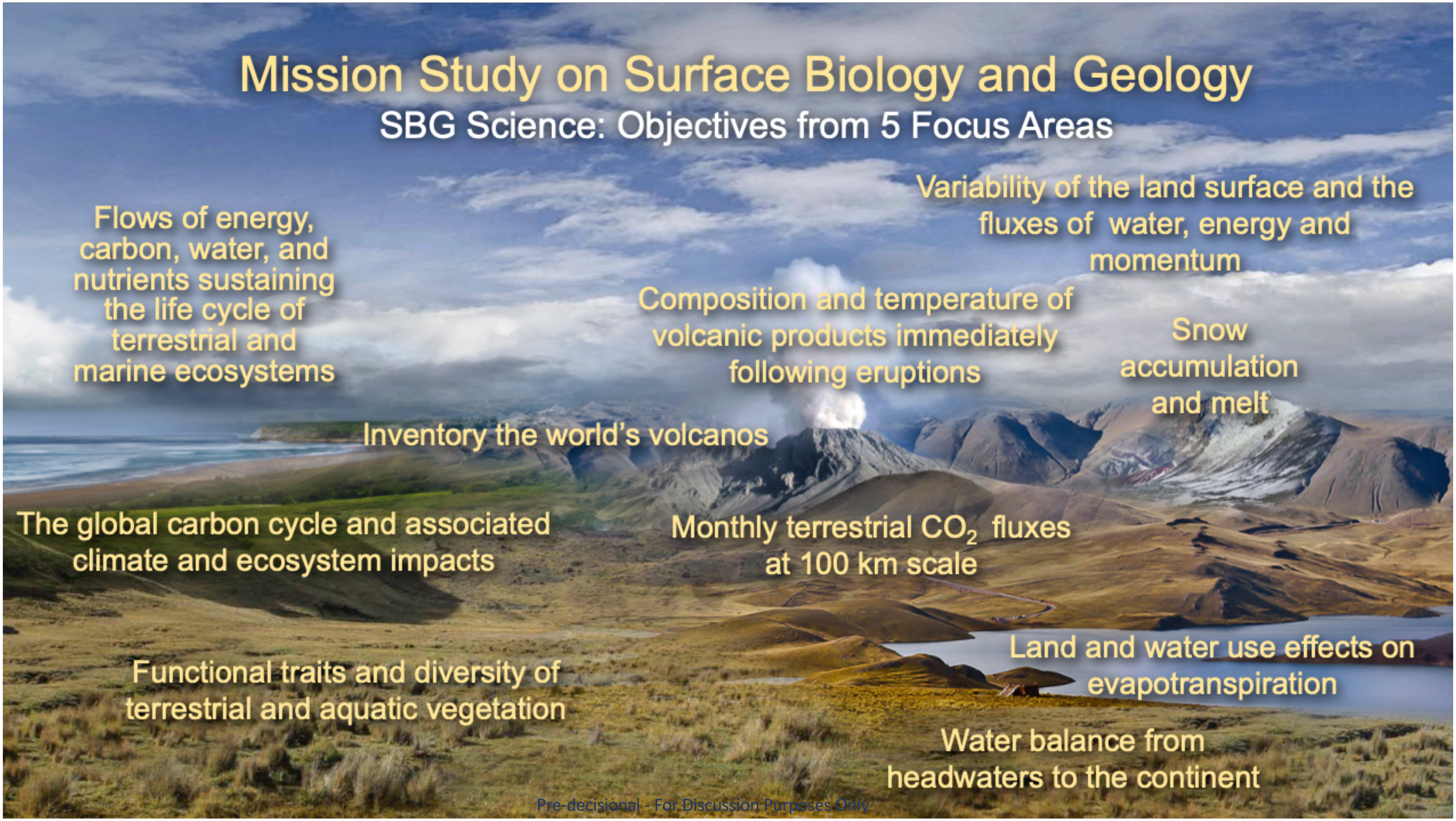
Authorization to Proceed

Formulation



SBG Activities

- Architecture study completed and report-out being written.
- Task plan for pre-Phase-A being developed.
- SBG Team staffing up to enter pre-Phase A.
- Summer internships available at JPL and GSFC.
- SBG team is investigating international collaborations for data sharing and harmonization.
- Pathfinder activities funded and proceeding.
- Applications study ongoing.
- Synergy activities beginning.


Mission Study on Surface Biology and Geology
SBG Science: Objectives from 5 Focus Areas
Flows of energy, carbon, water, and nutrients sustaining the life cycle of terrestrial and marine ecosystems
Variability of the land surface and the fluxes of water, energy and momentum
Composition and temperature of volcanic products immediately following eruptions
Snow accumulation and melt
Inventory the world's volcanos
The global carbon cycle and associated climate and ecosystem impacts
Monthly terrestrial CO_2 fluxes at 100 km scale
Land and water use effects on evapotranspiration
Functional traits and diversity of terrestrial and aquatic vegetation
Water balance from headwaters to the continent

	Decadal Survey Priority	Panel	Earth Science/Application Objectives from the Decadal Survey Science and Applications Traceability Matrix
5 Most Important	**E1c**	Ecosystems	Quantify the physiological dynamics of terrestrial and aquatic primary producers to determine the structure, function, and biodiversity of Earth's ecosystems.
	E2a		Quantify the fluxes of CO_2 and CH_4 globally at spatial scales of 100 to 500 km and monthly temporal resolution with uncertainty <25% between land ecosystems and atmosphere and between ocean ecosystems and atmosphere.
	E3a		Quantify the flows of energy, carbon, water, nutrients, etc. sustaining the life cycle of terrestrial and marine ecosystems and partitioning into functional types to understand resource flows and changes within ecosystems.
	H1c	Hydrology	Quantify rates of snow accumulation, snowmelt, ice melt, and sublimation from snow and ice worldwide at scales driven by topographic variability to determine how water cycle is changing.
	S1a	Solid Earth	Measure the pre-, syn-, and post-eruption surface deformation and products of Earth's entire active land volcano inventory at a time scale of days to weeks. Allow forecast of hazards in socially relevant timeframe.
7 Very Important	**E1a**	Ecosystems	Quantify the distribution of the functional traits, functional types, and composition of vegetation and marine biomass, spatially and over time in order to determine the structure, function, and biodiversity of Earth's ecosystems.
	H2a	Hydrology	Quantify how changes in land use, water use, and water storage affect evapotranspiration rates and local and regional precipitation systems, groundwater recharge, temperature extremes, and carbon cycling in the short and long term
	H4a		Monitor and understand hazard response in rugged terrain and land margins to heavy rainfall, temperature and evaporation extremes, and strong winds at multiple temporal and spatial scales. This socioeconomic priority improves preparedness and mitigation of water-related extreme events.
	S1c	Solid Earth	Forecast and monitor landslides, especially those near population centers, in a socially relevant time frame.
	S2b		Assess surface deformation (<10 mm), extent of surface change (<100 m spatial resolution) and atmospheric contamination, and the composition and temperature of volcanic products following a volcanic eruption (hourly to daily temporal sampling).
	C3a	Climate	Quantify CO_2 fluxes at spatial scales of 100-500 km and monthly temporal resolution with uncertainty <25% to enable regional-scale process attribution explaining year-to-year variability by net uptake of carbon by terrestrial ecosystems (i.e., determine how much carbon uptake results from processes such as CO_2 and nitrogen fertilization, forest regrowth, and changing ecosystem demography.) Determine the variations in the global carbon cycle and ecosystem impacts thereof.
	W3a	Weather	Determine how spatial variability in surface characteristics modifies regional cycles of energy, water and momentum (stress) to an accuracy of 10 W/m^2 in the enthalpy flux, and 0.1 N/m^2 in stress, and observe total precipitation to an average accuracy of 15% over oceans and/or 25% over land and ice surfaces averaged over a 100 × 100 km region and 2- to 3-day time period. Improves understanding of influences on weather and air quality.

SATM Capability Codes identify measurement objectives to achieve specific science priorities

Capability Code	VSWIR Spatial	VSWIR Temporal	VSWIR Range	VSWIR Sensitivity	TIR Spatial	TIR Temporal	TIR Range	TIR Sensitivity
A	30 m	≤8 days for global coverage*	≤380 - ≥2500 nm, @ ≤10nm	SNR ≥400 VNIR, SNR ≥250 SWIR, accuracy ≤5%	60 m	≤1 day for global coverage*	≥5 bands in 8-12 um, ≥ 1 band in 3 -4.5 um	≤1K Absolute, ≤0.2K NeDT / band
B	<60 m	≤16 days for global coverage*	≤380 nm - ≥1000 nm, @ ≤10nm	≤10% Absolute accuracy	60 m – 100 m	≤3 days for global coverage*	≥5 bands in 8-12 um	≤1.5% Absolute, <1K NeDT / band
C			VNIR multiband		≥ 100 m	≤5 days for global coverage*	≥3 bands in 8-12 um	

Decadal Survey Question	DS SATM Desirements	Fully meets?
H1-a (Surface Energy)	AAAB-ABBA	Revisit
H1-c (Snow)	AAAB-ABBA	Revisit
H2-a (ET)	AAA*-ABBA	Revisit
H4-a (Snow)	AAAB-ABBA	Revisit
W3-a (Surface Energy)	NA-BABA	Yes
E1-a (Functional Traits)	ABAA-NA	Yes
E1-c (Physiology)	ABAA-NA	Yes
E3-a (Flows of Material)	ABAA-ABBA	Yes
S1-a (Volcanos)	AAAA-AABA	Revisit and resolution
S1-c. (Landslides)	AAAA-ACB*	Revisit
S2-b (Eruptive Products inc. Temperature)	AAAA-AAA*	Revisit and resolution

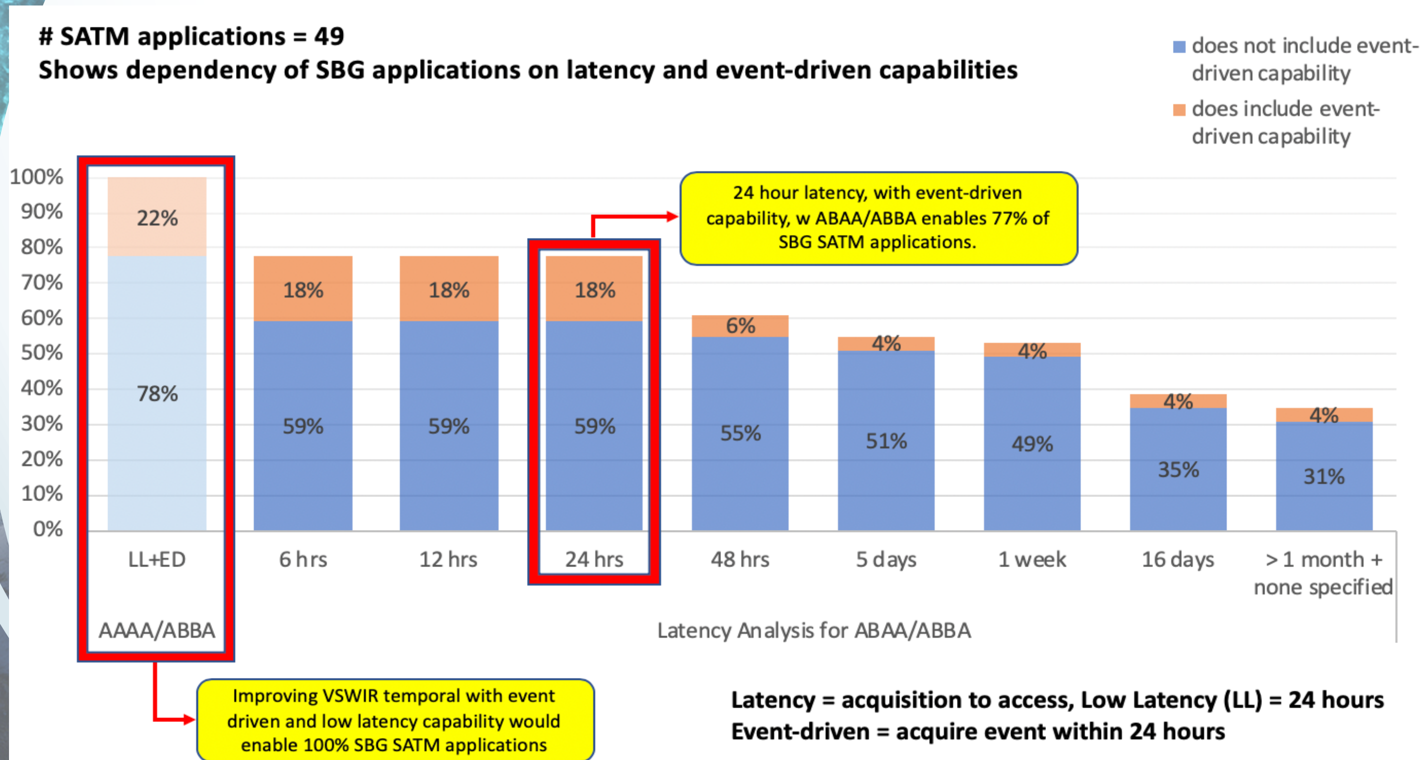
- The Decadal Survey provided quantitative measurement targets.
- SBG will make major contributions towards these targets.
- International collaboration can provide additional revisit.
- Commercial sensors and data fusion may provide higher resolution.

SBG Notional Performance Targets Support Decadal Survey Data Products

SBG Performance Parameters

	GSD	Revisit	Spectral Range and Resolution	Sensitivity
VSWIR	30 m	16 days Global repeat coverage, ~10 days with partner	0.38 or 0.4 to 2.5μm 10nm or better, Continuous coverage	SNR: VNIR >400 SWIR >250
TIR	60 m	3 days Global repeat coverage, 1 day with partner	8 to 12μm 3 to 5μm >5 Bands desired, 8 recommended	NEdT <0.2 K

Enabling Event Driven and Low Latency Capabilities Enables 77% of Applications:



Latency = acquisition to access, Low Latency (LL) = 24 hours
Event-driven = acquire event within 24 hours

SBG Synergy Activities

Aquatic Cross-Mission Exchange (ACME)
Member Missions: SBG, PACE and GLIMR

Identify shareable resources, mutually beneficial opportunities, overlapping activities and find ways to synergize efforts across aquatic missions in order to reduce risk, save cost and better our support of the research and applications needs of the aquatic remote sensing communities.

Current Tasks:

- **Consistent coastal mask**
- **Glint avoidance strategy**
- **Harmonized algorithms**
- **Collaborative Cal/Val**
- **SBG Ships-at-Sea Campaign Model**

Kevin Turpie, Chair	(SBG Cal/Val Co-Lead, Aquatic Studies Group Chair)
Liane Guild	(SBG R&A Steering Committee, Aquatic Studies Group Co-Chair)
Stephanie Schollaert Uz	(SBG Applications Co-Lead)
Phil Townsend	(SBG SISTER Co-Lead, Algorithms Co-Lead, Terrestrial Liaison)
Michelle Gierach	(SBG SISTER Co-Lead)
Jeremy Werdell	(PACE Proj Scientist)
Heidi Dierssen	(PACE Science Team Lead)
Carlos Del Castillo	(PACE Ocean Ecology Lab Chief)
Joe Salisbury	(GLIMR PI)
Antonio Mannino	(GLIMR Co-I, PACE Deputy Proj Scientist)
Maria Tzortziou	(GLIMR Co-I)

NASA Headquarters
Laura Lorenzoni
Woody Turner

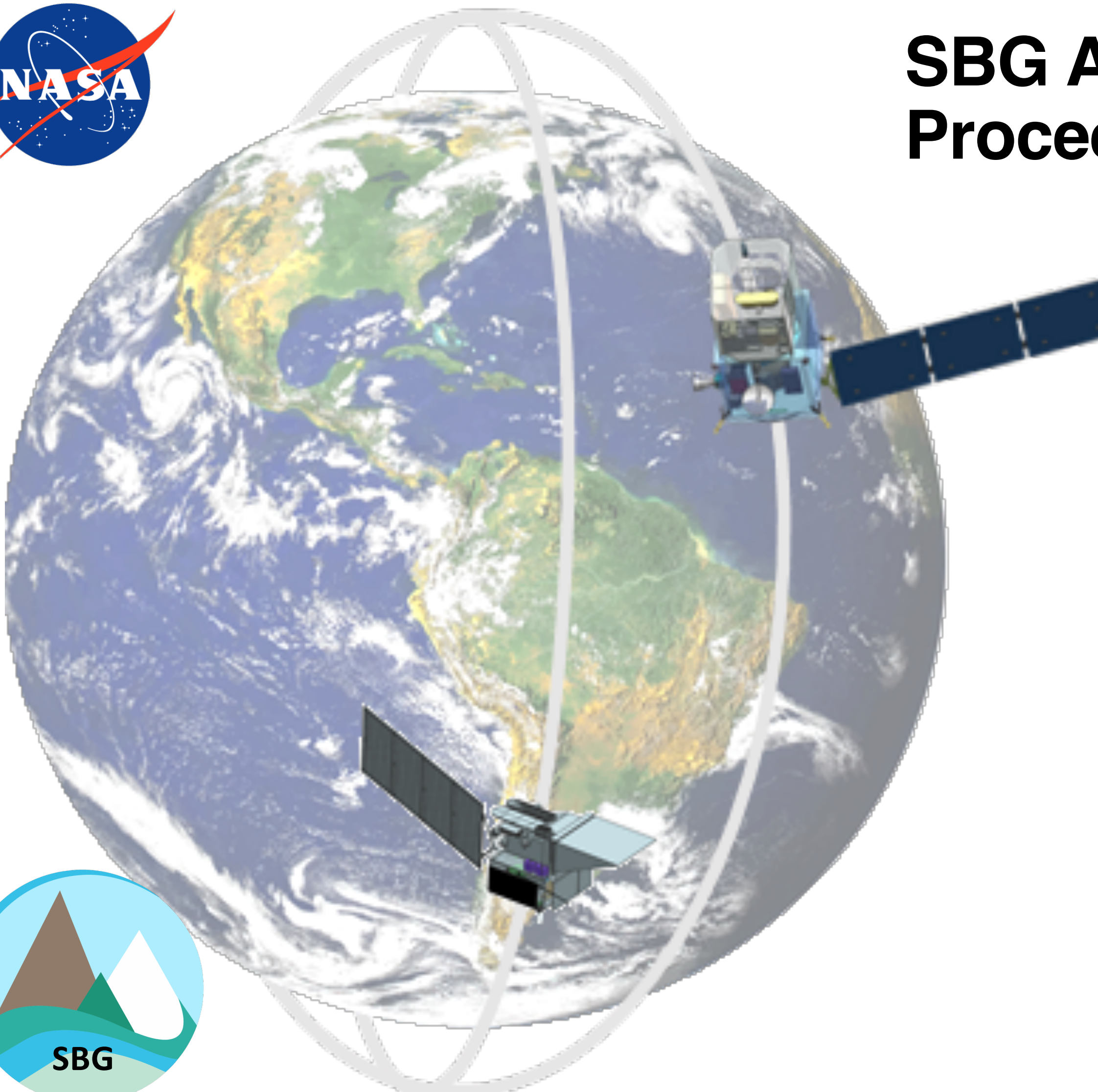
Synergies between SBG and the Aerosol / Cloud Convection and Precipitation (A-CCP) Observable

- The A/CCP observable aims to measure aerosol and cloud properties, and will likely include an airborne component
- A series of workshops is evaluating areas of potential synergy between the two DOs
- The first workshop identified 28 different potential areas of overlap

Categories	Synergies identified	Examples
Enabling Science	**4**	**Evapotranspiration and energy fluxes**
Observations, Data, Campaigns	**10**	**Surface reflectance** from SBG as a basemap for lidar, etc.
Models	**4**	**End-to-end architecture simulation** for OSSEs, mission design
Assets	**6**	Share resources for **radiometric calibration infrastructure**
Retrieval Algorithms	**4**	**Validate atmospheric retrievals** – joint algorithms, campaigns

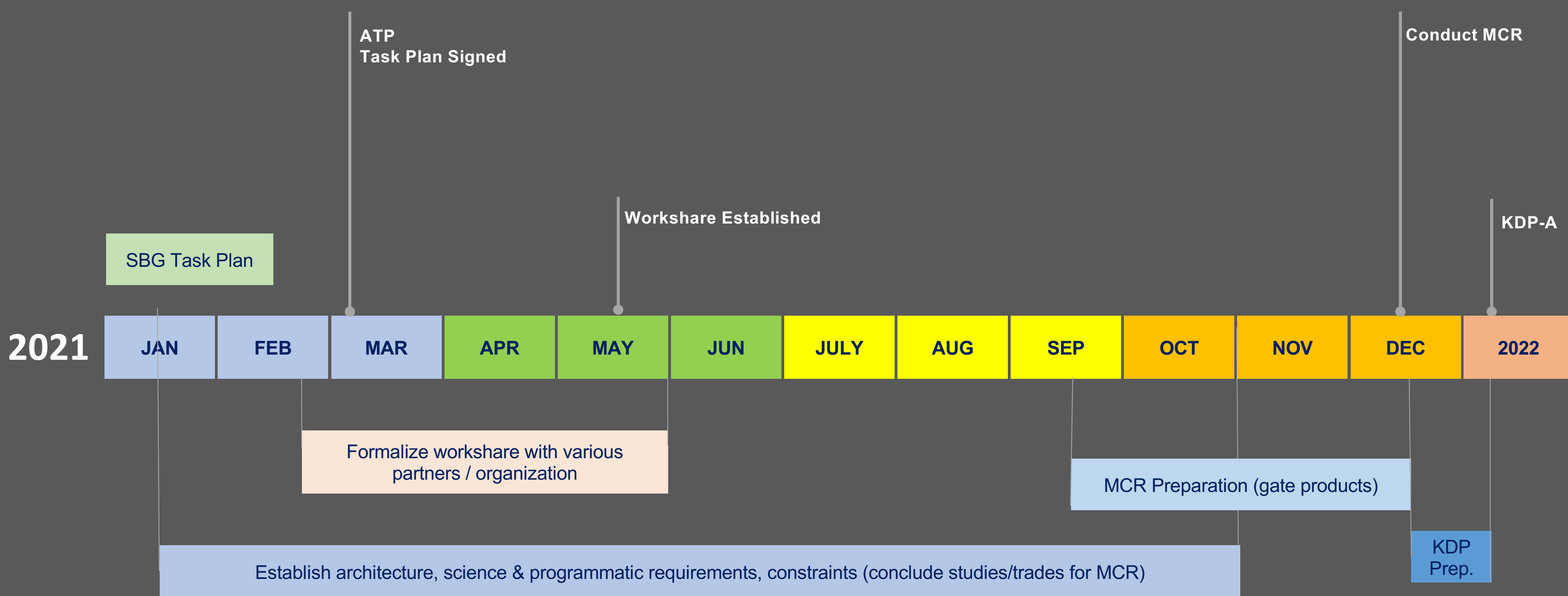
The Way Forward: Next Steps

SBG Anticipates Direction to Proceed to Pre-Phase A

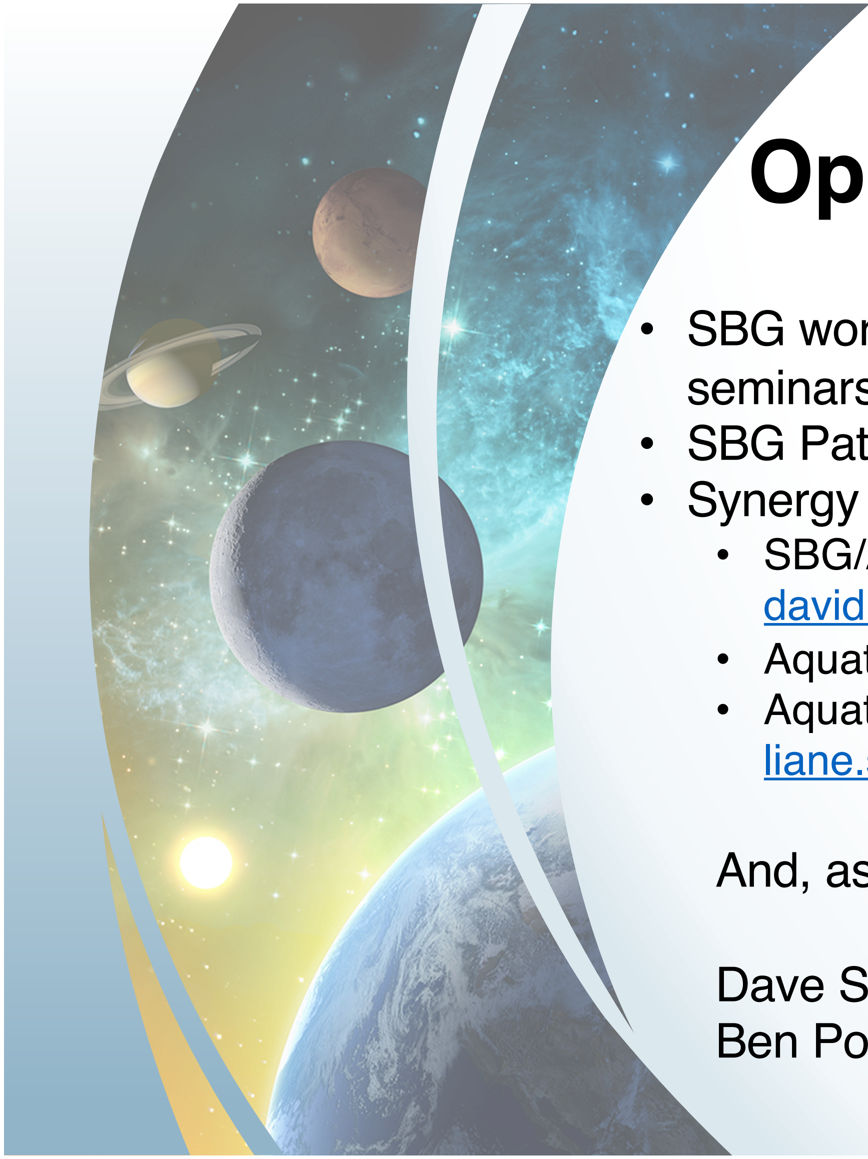


- SBG Architecture Study results presented to NASA.
- 2020 DO Annual Review sessions held October – November 2020.
- SBG Team staffing up to enter pre-Phase A.
- SBG initiating international collaborations to reduce revisit time and deliver harmonized data products.
- Pathfinder activities funded and proceeding.

Notional Timeline Completes SBG MCR & KDP-A by 2022



- Mission Concept Review approximately 9 months after Authorization To Proceed
- NASA KDP-A in 2nd Q 2022
- System Requirements Review / Mission Definition Review & NASA KDP-B in 1st Q 2023



Opportunities for Involvement

- SBG working groups: ongoing, regular meetings and seminars.
- SBG Pathfinders: see next talks.
- Synergy activities points of contact:
  - SBG/A-CCP activities (David Thompson, david.r.thompson@jpl.nasa.gov)
  - Aquatic Studies Group (Kevin Turpie, kturpie@umbc.edu)
  - Aquatic Cross-Mission Exchange (Liane Guild, liane.s.guild@nasa.gov)

And, as always:

Dave Schimel (dschimel@jpl.nasa.gov)
Ben Poulter (Benjamin.poulter@nasa.gov)

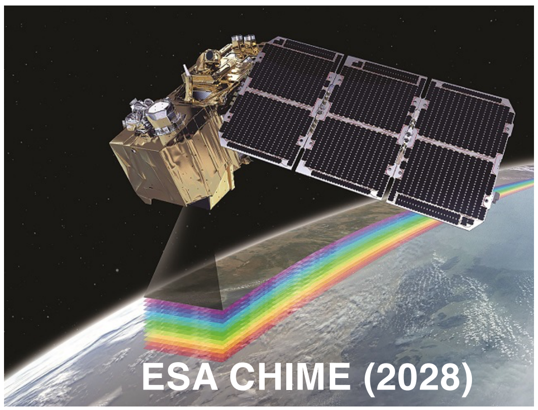
International Synergies

Objective: Interoperable data across the VSWIR and TIR from complementary missions

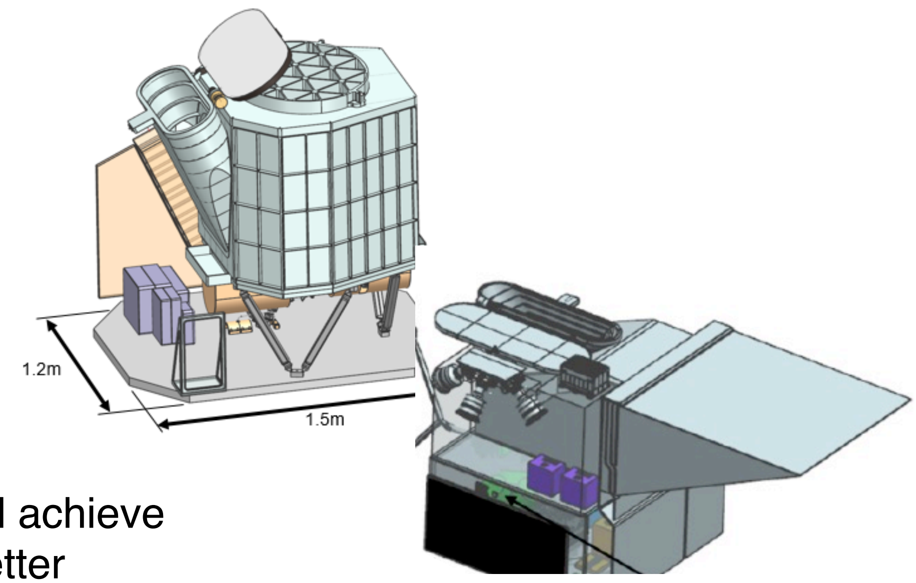
- No specific instructions in *Decadal Survey* but of interest to all agencies
- Informal coordination to create virtual constellations

- SBG Lead: Chip Miller, JPL
- Crossover with Algorithms, Cal/Val, Modeling Working Groups, as well as SISTER and MEET-SBG Pathfinder activities

Improving 3 and 16 Day Revisit Enhanced Revisit by International Data Sharing

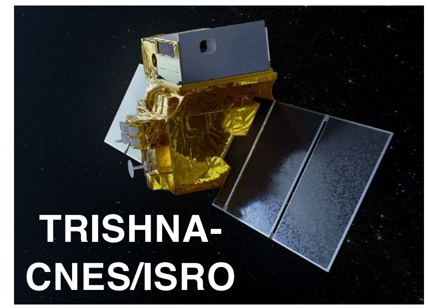


SBG VSWIR concept

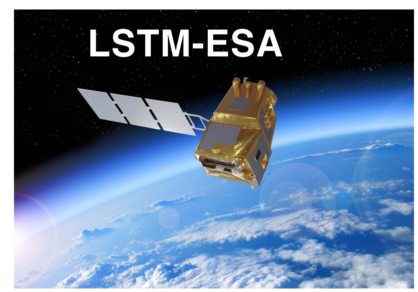


SBG VSWIR + CHIME could achieve 8 to 11 day revisit or better

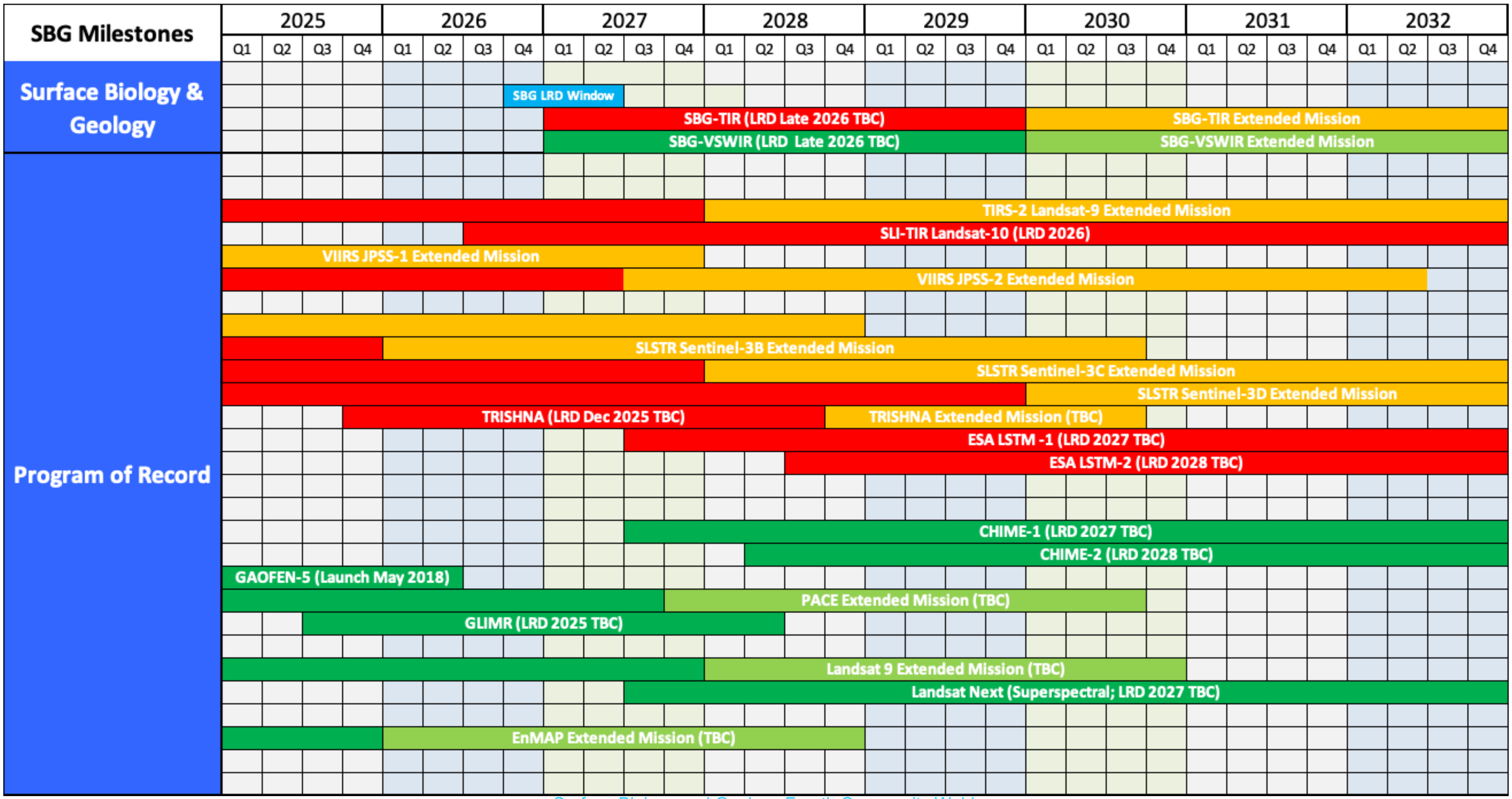
SBG TIR concept



SBG-TIR + LSTM + TRISHNA could achieve 1 to 1.5 day revisit or better



Timelines of Missions



Multiple Commercial Constellations are Planned in Coming Years

Orbital Sidekick

SCANWORLD

SATELLITEVU

SPACEFAB.US

cosine measurement systems

HySpecIQ

Orbita Aerospace

HYPERSAT℠

SATELLOGIC

SpecTIR®

KP LABS

Reaktor Space Lab

SATREVOLUTION

SARANIASAT Advanced Remote Sensing

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement by the United States Government or the Jet Propulsion Laboratory, California Institute of Technology

SBG-CHIME Synergies

400-2500 nm VSWIR 2027/8 launch

- Ground swath >128 km, 30 m spatial
- 22-day revisit (632 km), 2nd satellite

SBG synergy

- Reduced intervals, increased coverage
- Cross-/co-calibration, harmonized data

2021 AVIRIS-NG Europe Campaign

- CHIME algorithm/product development
- Enable harmonization efforts with current NASA AVIRIS-NG work

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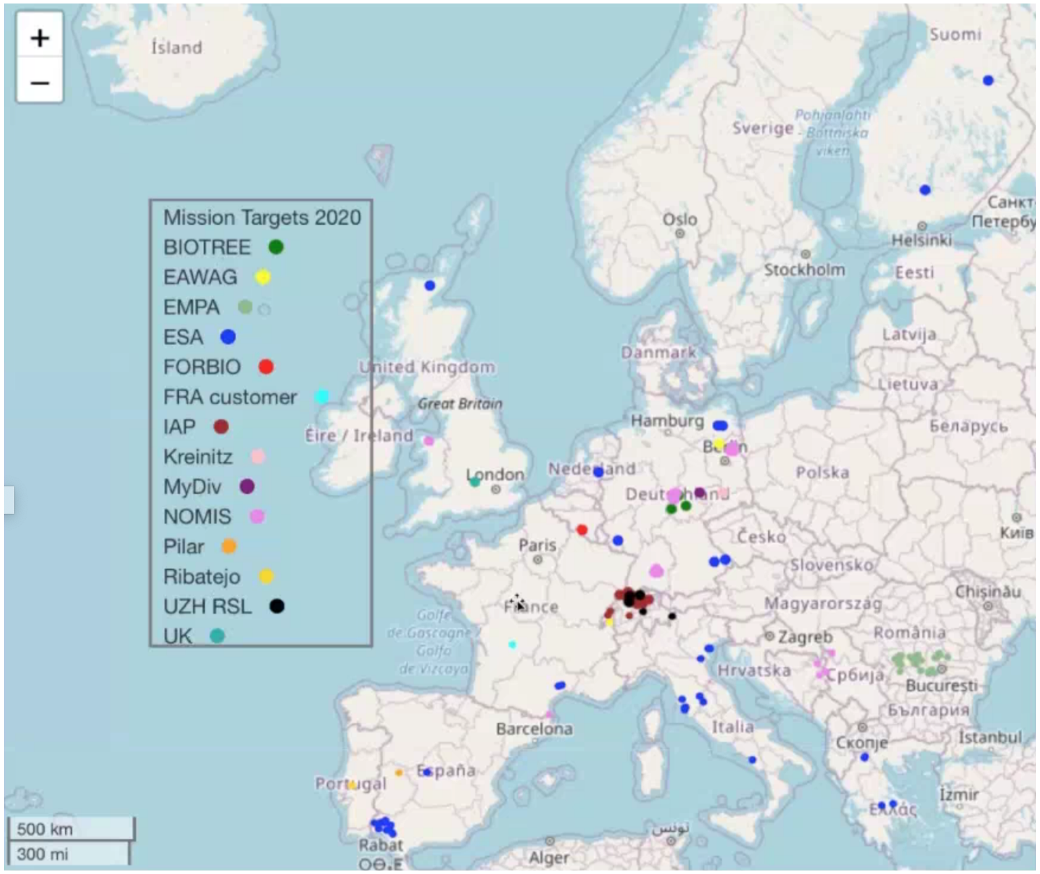
Copernicus Hyperspectral Imaging Mission for the Environment - Mission Requirements Document

Prepared by	Earth and Mission Science Division
Reference	ESA-EOPSM-CHIM-MRD-3216
Issue/Revision	2.1
Date of Issue	23/07/2019
Status	Issued
Document Type	Mission Requirements Document (MRD)
Distribution	Public

European Space Agency
Agence spatiale européenne




2021 Pre-SBG/CHIME Airborne Campaign Targets



SBG-CHIME Working Groups

Calibration-Validation (SBG Lead: Kurt Thome)

- Objective: comparison/harmonization of radiance measurements
- Ensure compatible calibration procedures and targets

Modeling and Simulation (SBG Lead: Ben Poulter)

- Objective: ensure compatibility of pre-launch data characterization
- Integrate OSSEs (observing system simulation experiments) from both

Data / Product / Algorithm Harmonization (SBG Lead: Phil Townsend)

- Objective: Identify common products and compare planned algorithms
- Develop a plan to generate harmonized products in advance of launch, especially for products that either:
    - Have different algorithms between missions (e.g., atmospheric correction), or
    - Are planned for one mission but not the other (e.g., coastal/aquatic products)

Data Harmonization

- Neither mission has selected algorithms
  - Both missions have nominal product lists
- Both missions have broad expectations on classes of algorithms expected to be used
- Because of data volumes and processing (in)efficiencies, both missions are currently expecting to make some use of emulation / machine learning (or related)
- We are engaging with the PRISMA and EnMAP teams as well

SBG-CHIME
Data Harmonization

CORE Product Harmonization

Land Surface Reflectance (i.e., atmospheric correction)
BRDF Correction
Albedo
Land Cover Classification / Plant Functional Types (not listed for CHIME)

Derived Products (L2+):

	CHIME High Priority Product	SBG Proposed Product	CHIME Proposed Approach
1	Quantification on non-photosynthetic vegetation	Proportional Cover: GV, NPV, Substrate	Indices
2	Canopy nitrogen content (nitrogen uptake) [kg/ha]	Vegetation Traits: Nitrogen	RTM Inversion or Empirical (ML, PLSR, GPR)
3	Canopy water content	Vegetation Traits: Canopy Water	Indices or Empirical
4	Leaf and canopy pigment content (Chlorophyll)	Vegetation Traits: Chlorophyll	Indices or LUT inversion
5	Leaf dry mass	Not Currently Listed	Indices or LUT inversion
6	Specific Leaf Area (SLA)	Vegetation Traits: LMA	Indices
7	Soil organic carbon content	Substrate Composition: Soil type and soil constituents	Spectral analysis or ML/PLSR
8	Soil textural and structural composition (e.g clay, silt, sand, iron oxides, gypsum and carbonate contents)	Substrate Composition: Soil type and soil constituents	Spectral analysis or ML/PLSR
9	Mineral identification ~~and abundances~~ (Kaolinite, Smectite, Jarrosite, Dolomite)	Substrate composition: Mineral areal fractional abundance	Tetracorder
10	Kaolin Cristallinity	Substrate composition: Mineral areal fractional abundance	Indices
11	Hematite-goethite distribution	Substrate composition: Mineral areal fractional abundance	Indices
12	Ferric oxide contents	Substrate composition: Mineral areal fractional abundance	Indices
	Not Currently Listed	Snow and Ice	
	Not Currently Listed	Coastal and Aquatic Ecosystems	




SBG-Thermal IR Synergies

Similar working groups are being assembled for:

- TRISHNA - CNES (France) and ISRO (India)
- LSTM (Land Surface Temperature Monitoring, Sentinel 8) (ESA)

TIR Mission	Launch Date (lifetime)	Spatial Resolution	Temporal Resolution	Local Observation Time	Thermal Infrared Bands	Additional Bands
TRISHNA	2025 (5 yrs)	50m	3 days	13:00	4	6 VSWIR
SBG-TIR (*desired)	2027 (5 yrs)	<60m	3 days	13:00	5	2 VSWIR 2 MIR
LSTM	2028 (7-12 yrs)	30-50m	3 days (1 day when second platform launched	13:00	3-5	6 VSWIR 1 MIR

SISTER: SBG **S**pace-based **I**maging **S**pectroscopy and **T**hermal pathfind**ER**

SISTER is an active collaboration between Jet Propulsion Laboratory (JPL), Ames Research Center (ARC), Goddard Space Flight Center (GSFC), industry, academic institutions, and non-profit organizations

Phil Townsend (University of Wisconsin, Madison) – Co-Lead
Michelle Gierach (JPL) – Co-Lead, JPL Center Lead
Ben Poulter (GSFC) – GSFC Center Lead
Ian Brosnan (ARC) – ARC Center Lead

SISTER: SBG **S**pace-based **I**maging **S**pectroscopy and **T**hermal pathfind**ER**

Overview and Objectives – SBG will need:

- Architecture and workflows for high-dimensional, high-value data
- Mature hyperspectral algorithms for global application
- Calibration/validation (cal/val) network and protocols for SBG science themes and their products
- Entrainment and engagement of a diverse science community

SISTER: SBG **S**pace-based **I**maging **S**pectroscopy and **T**hermal pathfind**ER**

- Prototype architectures and workflows to generate prototype high-dimensional, high-value SBG data
  - Example data sources: AVIRIS, PRISM, Hyperion, HISUI, PRISMA, DESIS, HICO, EMIT (*Pathfinder for Geology/Earth Surface*), ECOSTRESS (*Pathfinder for Thermal IR*), etc
  - Implement select atmospheric correction approach(es) and L2B+ algorithms (*informed by the Algorithms and Applications Working Groups*)
- Distribute prototype SBG data to community, and develop community engagement strategy
- Assess and provide recommendations on cal/val network and instrumentation needs

Fall AGU iposter: https://agu2020fallmeeting-agu.ipostersessions.com/default.aspx?s=CA-76-5E-CB-B5-91-01-5B-5F-80-8E-D1-70-C2-62-C5

SISTER: SBG **S**pace-based **I**maging **S**pectroscopy and **T**hermal pathfind**ER**

WE ARE HERE

Y1 → Y2

Prototype workflows and system components

Implement select atmospheric correction approach(es)

Draft early engagement strategy

Y2 → Y3

Implement select prototype L2B+ algorithms

Generate and distribute prototype SBG data

Assessment of current L2B+ cal/val capabilities

Y3 → Y5

Adapt workflows based on emerging SBG ATBDs

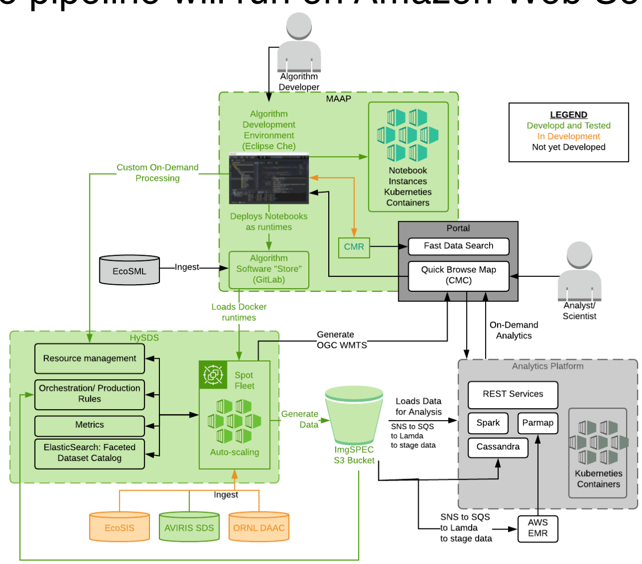
Generate and distribute prototype SBG data

Recommendations on cal/val network & instrumentation

Architectures and Workflows

Cloud-Based Prototype

- Led by Jet Propulsion Laboratory (JPL)
- Leverages framework developed as part of a 2018 NASA AIST (*ImgSpec*; *PI: P. Townsend*) that utilizes heritage NASA-funded information technologies for big data satellite missions
- The pipeline will run on Amazon Web Services



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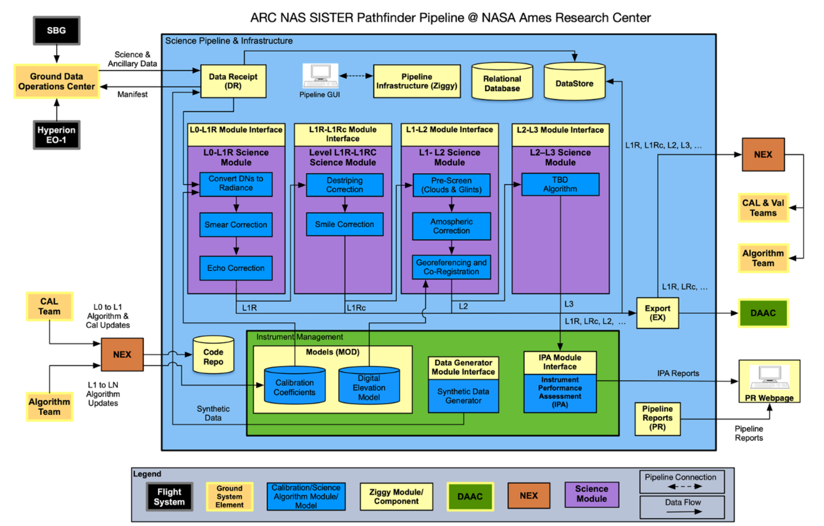
High Performance Computing (HPC)-Based Prototype

- Led by Ames Research Center (ARC)
- Leverages pipelines developed and operated for NASA's Kepler and Transiting Exoplanet Survey Satellite (TESS) missions
- The initial pipeline will run on HPC facilities at ARC; HPC-cloud based solutions will be investigated



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Prototype SBG Algorithms & Products

SISTER will implement select L2B+ algorithms (informed by the Algorithms and Applications Working Groups) to generate prototype SBG products for community evaluation and engagement

SBG Algorithm Class	SBG Algorithm Products (examples)
CORE Algorithms	
Earth Surface Temperature and Emissivity	Land Surface Temperature* and Emissivity
VSWIR Reflectance	Land and Water Reflectances, BRDF Corrections, Albedo
Cover Classifications	Cloud, Water, Land Cover, Plant Functional Types, etc.
PRODUCT Algorithms	
Terrestrial Ecosystems	
Vegetation Traits	Nitrogen, LMA, Chlorophyll, Canopy water
Evapotranspiration	ET*, Evaporative stress index
Proportional Cover	GV, NPV, Substrate, Snow/Ice, Burned Area
Geology/Earth Surface	
Substrate Composition	Mineral type*, Fractional abundance*, Soil types and constituents
Volcanic Gases and Plumes	SO_2, Volcanic ash
High Temperature Features	Volcanic temperature anomalies (lava temperature), Forest fires
Aquatic and Coastal Ecosystems	
Water Biogeochemistry	Pigments, CDOM, Suspended particulate matter
Water Biophysics	Diffuse light attenuation, Inherent optical properties, Euphotic depth, PAR
Aquatic Classification	Phytoplankton functional types, Floating vegetation, Benthic cover, Wetlands
Snow and Ice	
Snow albedo	Albedo, Grain size, SSA, Light absorbing particles, Fractional cover

**Leverages ECOSTRESS and EMIT algorithms*




How Can You Get Involved with SISTER?

1. Let us know if you have SBG-relevant ground truth data
   - Where, what, when?

2. Evaluate prototype SBG data for your science discipline

3. Use prototype SBG data in your own workflows/algorithms

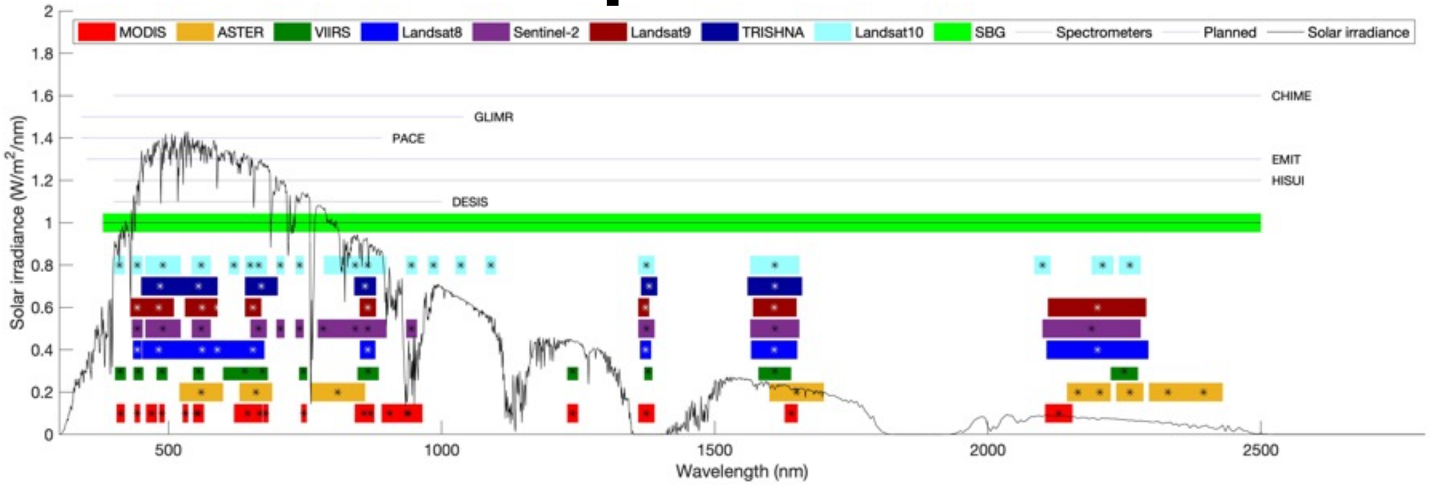
If interested, please email sbg@jpl.nasa.gov ,
or mgierach@jpl.nasa.gov and
philip.a.townsend@jpl.nasa.gov directly

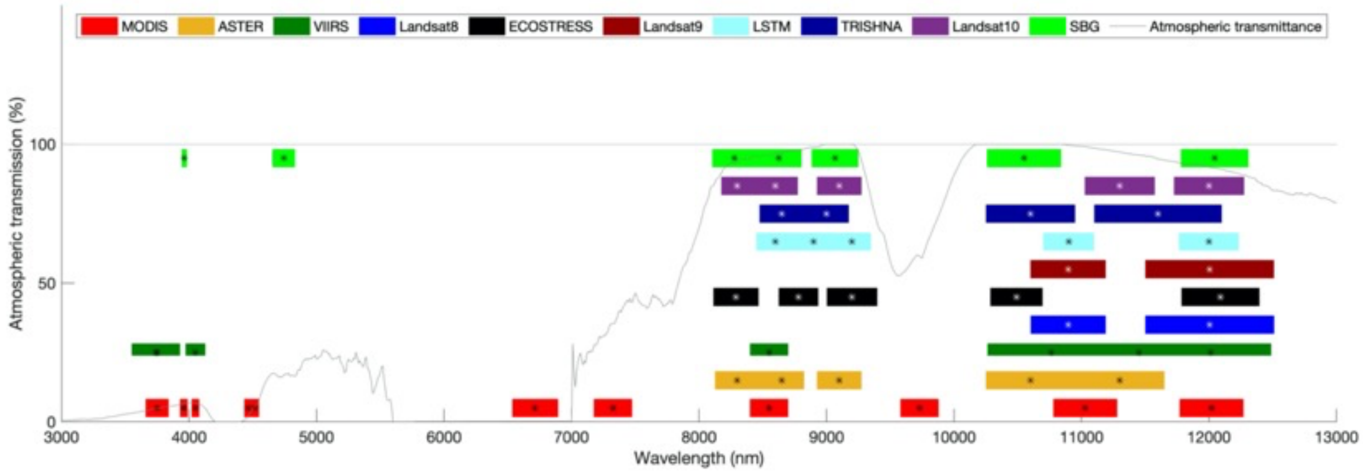
MEET-SBG : Modeling End-to-End Traceability for SBG

NASA Surface Biology and Geology Precursor Study

Core Team: Ben Poulter, Jon Chrone, Jennifer Dungan, Vanessa Genovese, Glynn Hulley, Katherine Mcbrayer, Shawn Serbin, Alexey Shiklomanov, David Thompson, Weile Wang

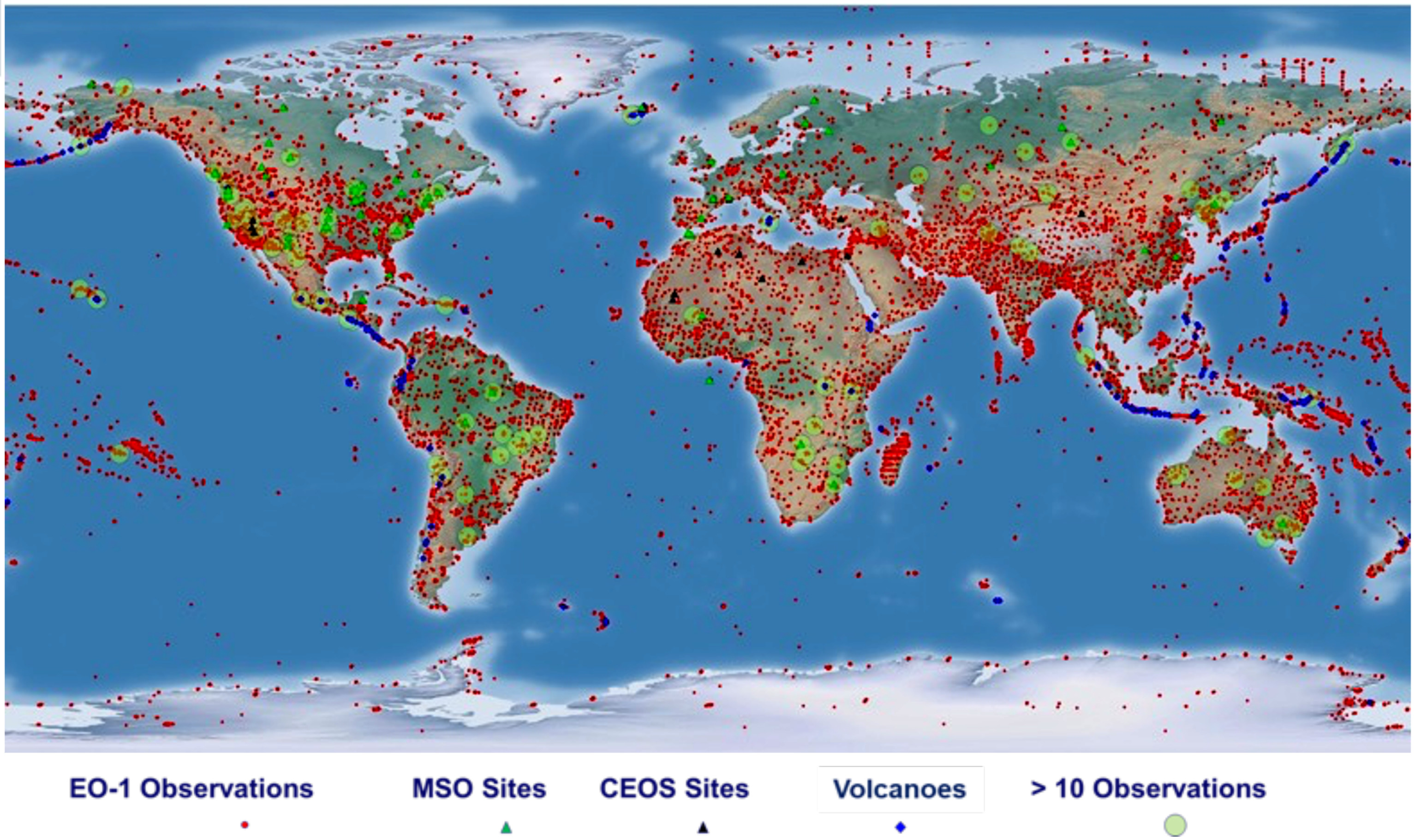
Motivation: Unprecedented Obs.





Motivation: Limited Global Archive

e.g., EO-1 Collected 90,995 Hyperion VSWIR Images 2000-2017






Goals of MEET-SBG

Modeling End-To-End Traceability for SBG (MEET-SBG)

MEET-SBG is developing a modeling framework to determine Level 1 requirements and to quantify (and trace) Level 2, and eventually Level 3 & 4, uncertainties.

During Pre-Phase A, MEET-SBG informs the SBG Program Level Requirements Appendix (aka the PLRA).

In long-term, MEET-SBG invests in long-term modeling support for imaging spectroscopy and for thermal infrared radiometry activities.

Work Packages (WP) for MEET-SBG

WP1: VSWIR Uncertainty Quantification (Alexey Shiklomanov, GSFC)

Hypertrace (ISOFIT) workflow

Experiments: evaluation of constellations

WP2: TIR Uncertainty Quantification (Glynn Hulley, JPL)

TEUsim model

Used in Landsat NEXT and ECOSTRESS instrument studies

WP3: SBG Global Simulator (Jennifer Dungan, Ames)

Develop global synthetic VSWIR archive based on multispectral band infilling

WP4: Observing System Simulation Experiment (Ben Poulter, GSFC)

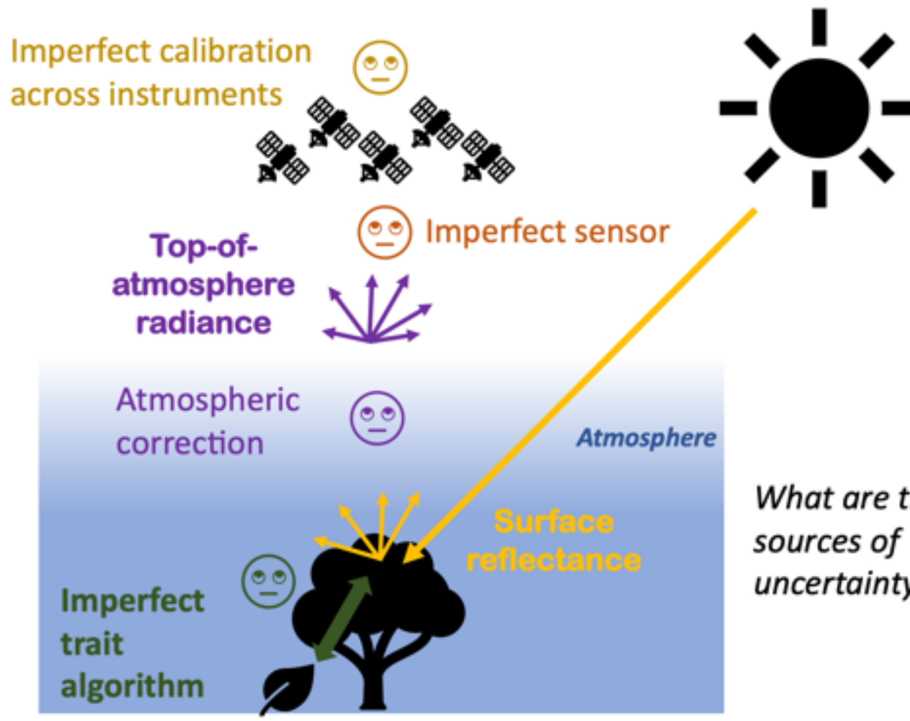
Land-surface model data assimilation of expected L3 products

Work Package 1: VSWIR UQ

- Hypertrace is a VSWIR uncertainty quantification workflow
- Traces uncertainty for aquatics, vegetation, snow, mineral retrievals

Sources of uncertainty in remote sensing of plant traits

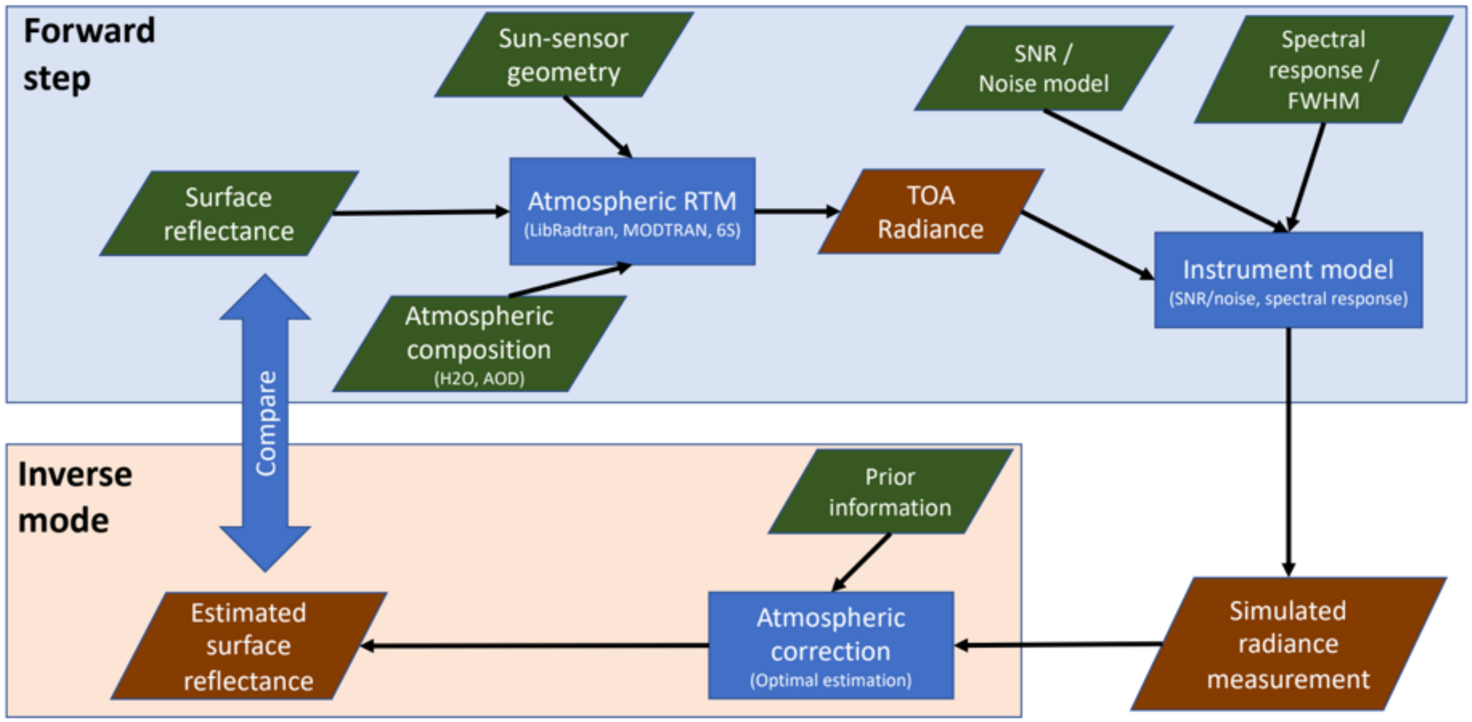
How large are the overall uncertainties in trait retrievals?



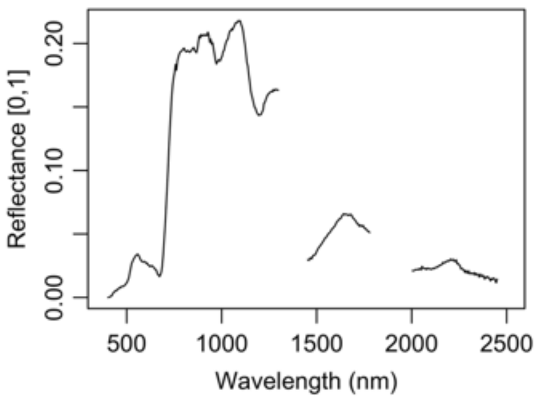
What are the largest sources of uncertainty?

Work Package 1: VSWIR UQ

Hypertrace automated workflow



Work Package 1: VSWIR UQ

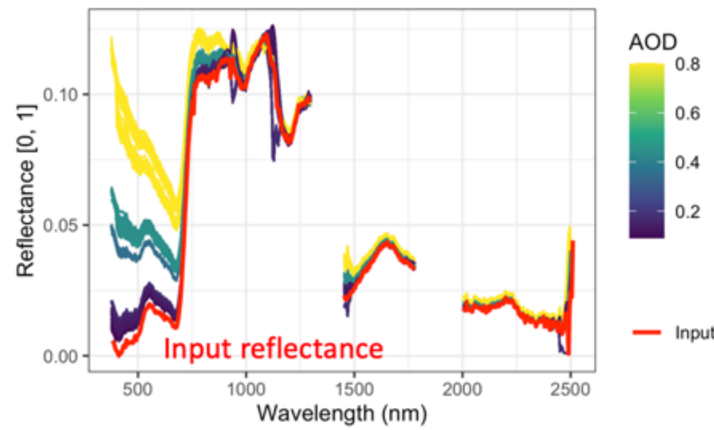


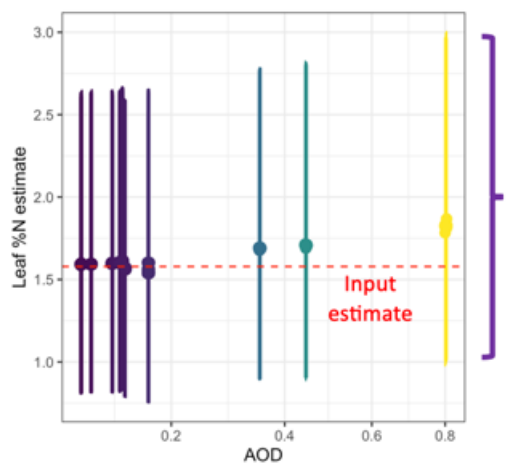
10 atmospheres

4 instrument signal-noise ratios

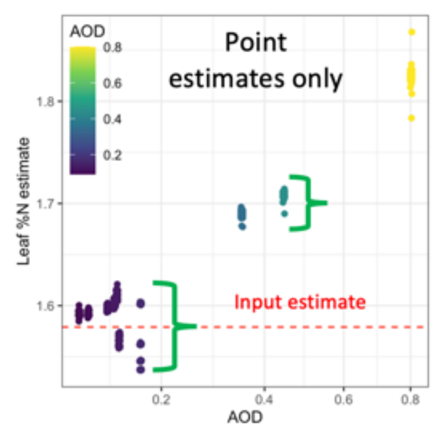
3 constellation configurations

Workflow





Uncertainty from algorithm



Uncertainty from atmosphere

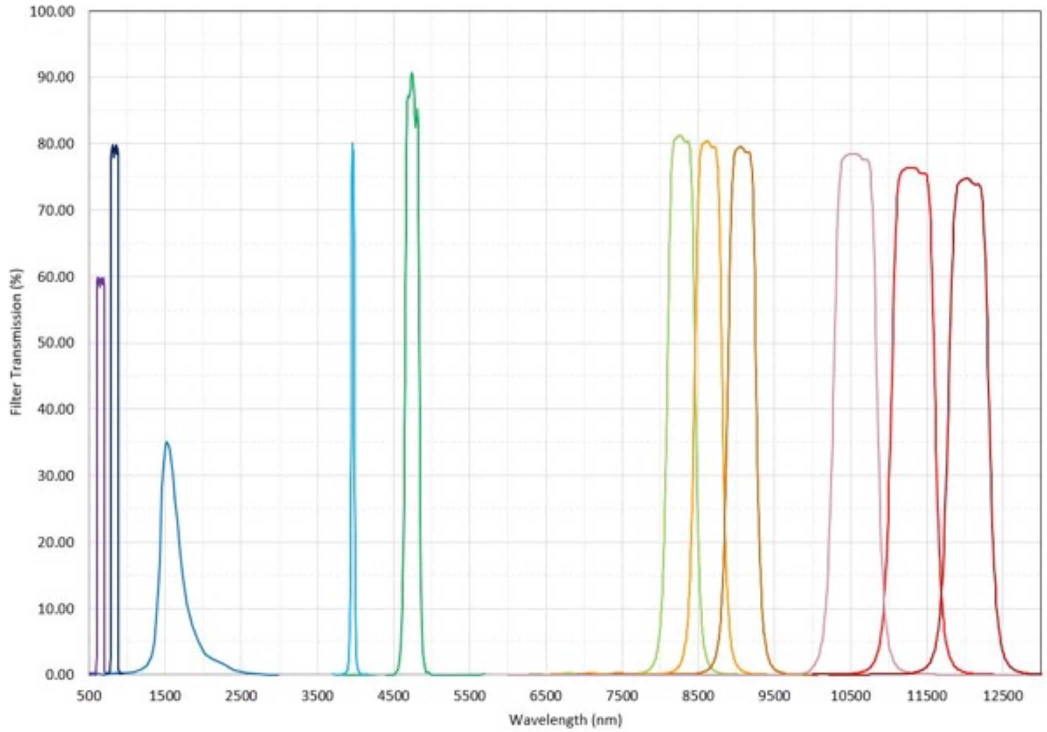
Uncertainties from geometry + noise

Work Package 2: TIR UQ

Trace TIR retrieval uncertainties for:

1. Land Surface Temperature (LST) and emissivity retrieval uncertainty
2. Volcanic trace gas applications (SO_2) and hot-target detection
3. Mineral mapping (improving silicate/feldspar/clay discrimination w 10.05 um band) and carbonate detection (calcite/dolomite) w 11.35 um band

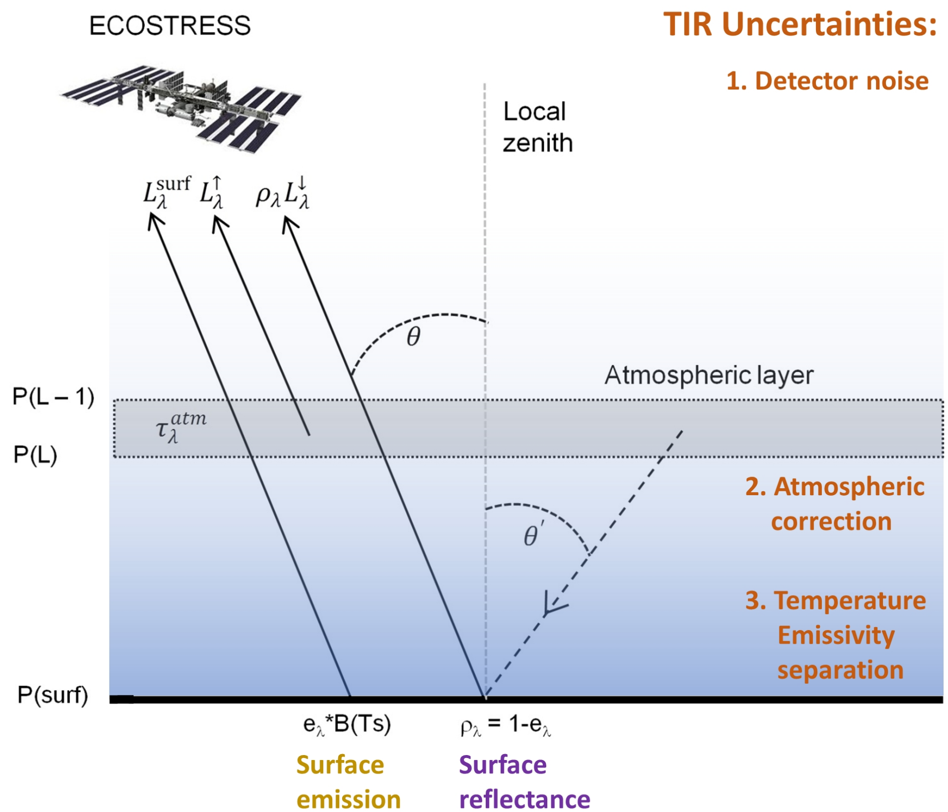
Example of full SBG-TIR instrument band response model






Work Package 2: TIR UQ

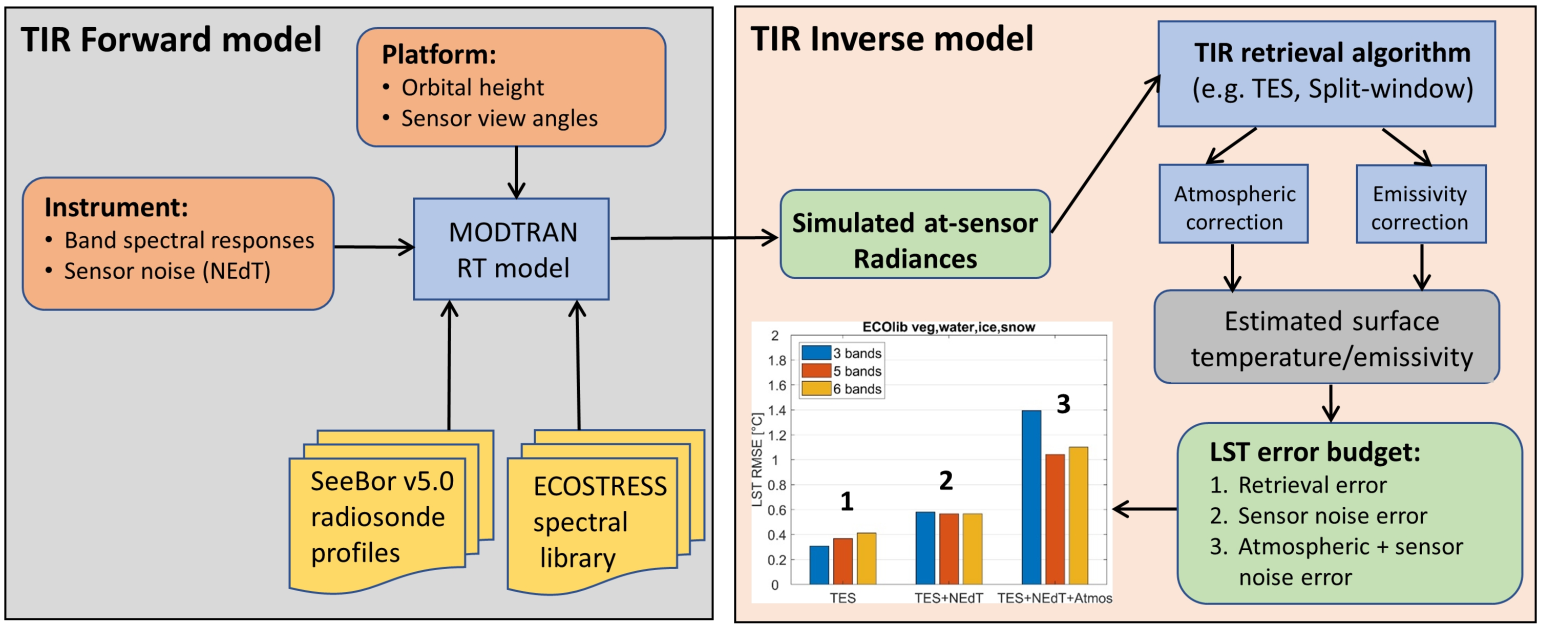
- The JPL Temperature Emissivity Uncertainty Simulator (TEUSim) traces LST and emissivity retrieval uncertainties for atm. conditions, sensor geometries, instruments, and algorithms.



Work Package 2: TIR UQ

TEUSim TIR workflow

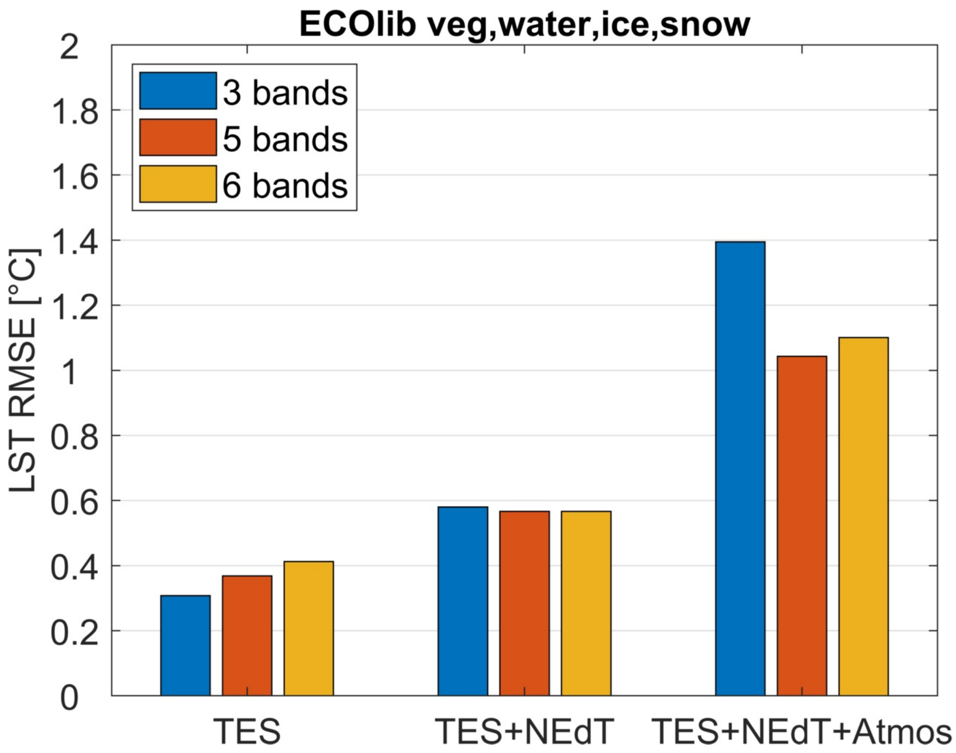
(Temperature Emissivity Uncertainty Simulator)



Work Package 2: TIR UQ

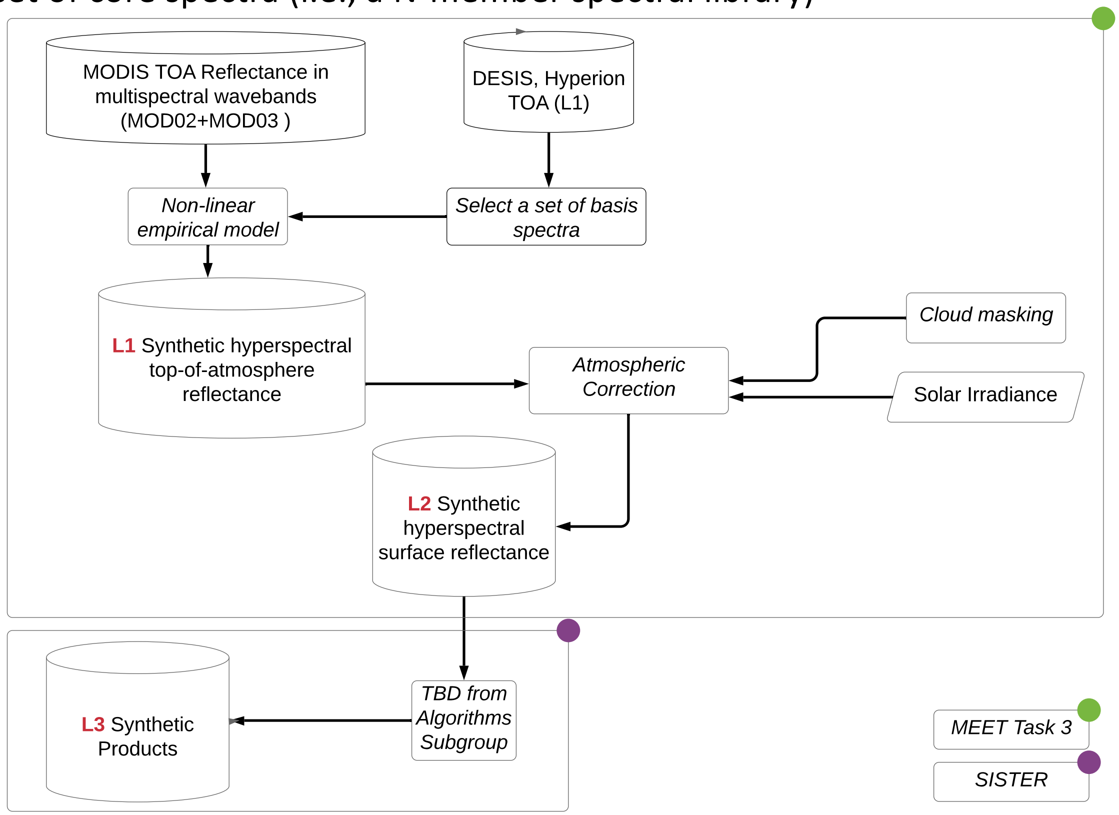
Example LST error budget for vegetation, water, ice, snow surfaces, and 3 instrument models:

1. Retrieval (TES)
2. Retrieval (TES) plus noise (NEdT)
3. Retrieval (TES) plus noise (NEdT) plus atmospheric error (Atmos)



Work Package 3: Synthetic SBG

- Generate synthetic "hyperspectral" data based on multi-spectral measurements (e.g., MODIS) and a set of core spectra (i.e., a N-member spectral library)

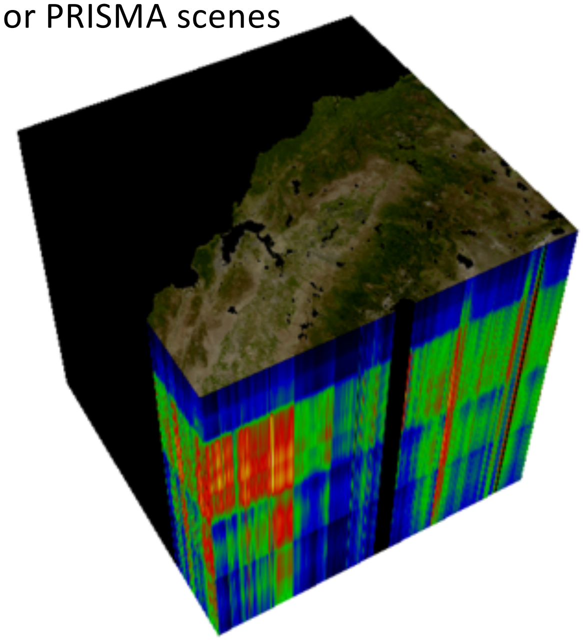





Work Package 3: Synthetic SBG

- ‘At-scale’ SBG-like data generated, global timeseries for representative year will be used in SISTER activity, testing of science data system, etc.
- Evaluation of technique using coincident MODIS + DESIS or PRISMA scenes

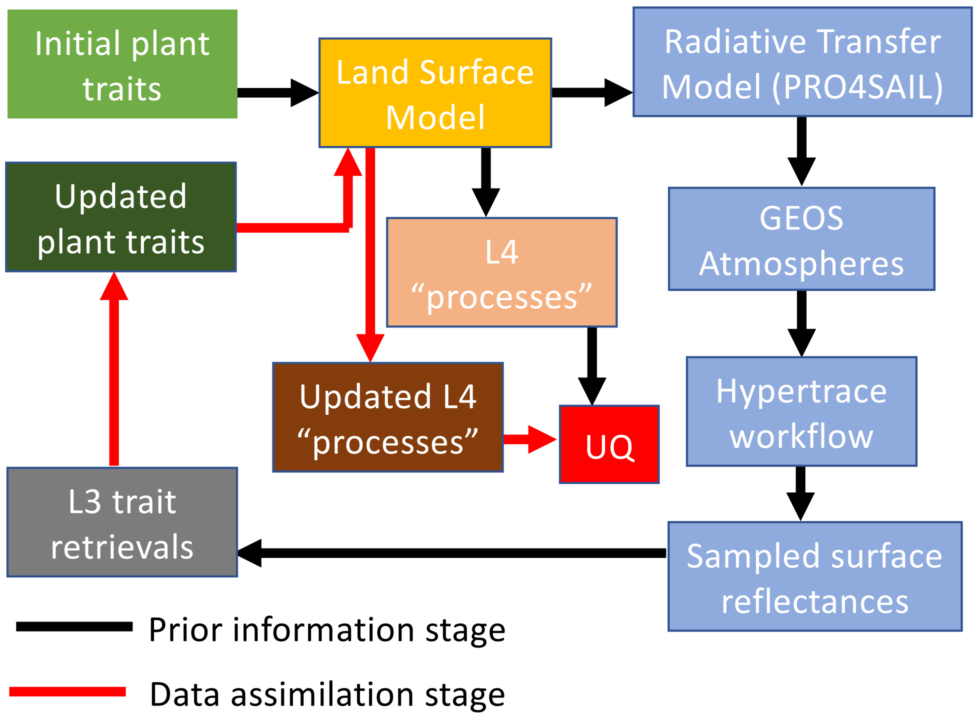


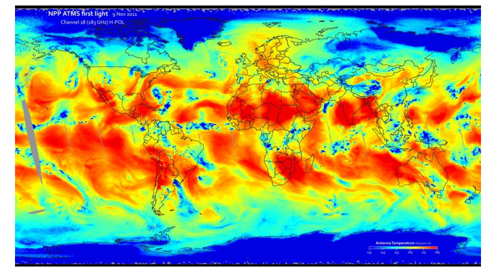


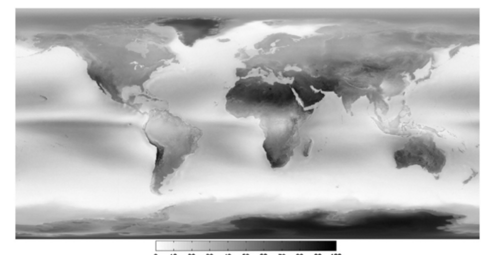
Example of synthetic hyperspectral data cube for California
Left: MODIS surface reflectance (RGB)
Middle: Synthetic surface reflectance (RGB)
Right: Synthetic surface reflectance (HSI data cube)

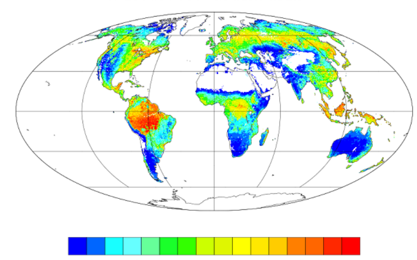
Work Package 4: OSSE

- Address how SBG architecture can improve global Earth system processes
- Adapt to aquatic processes





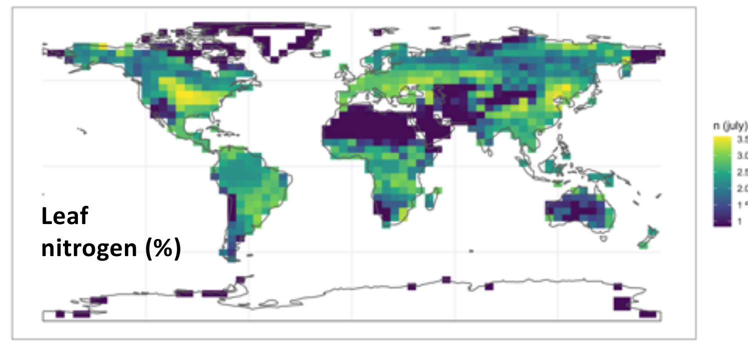


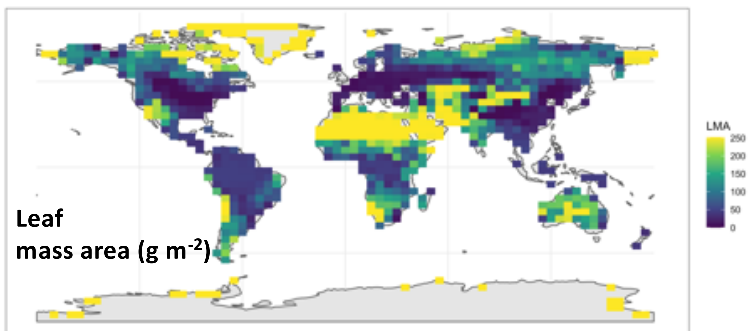


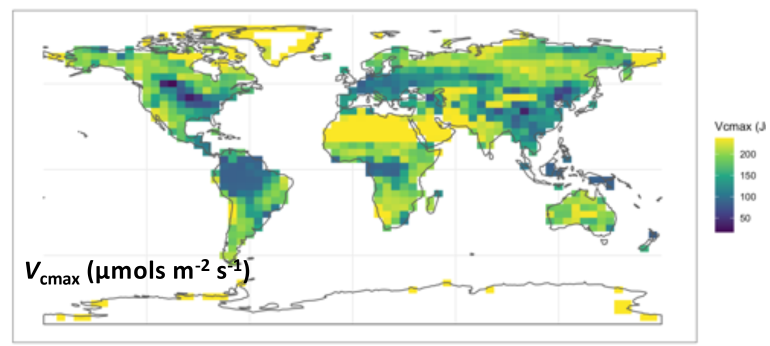



Work Package 4: OSSE

- First-order simulation: CLM+ PRO4SAIL reflectances, with PLSR trait retrieval, reproduces global patterns of leaf N, LMA, and Vcmax










MEET-SBG: Next Steps

Encourage community participation

Contact benjamin.poulter@nasa.gov or sbg@jpl.nasa.gov to join

Reach out on Slack sbg-modeling.slack.com & sbgcommunity.slack.com

Expansion of activities to:

- Joint VSWIR and TIR UQ activities
- SISTER data pipeline
- Science data systems with at-scale data volume
- Alternative atmospheric correction approaches

Inform the Pre-Phase A MCR Gate Products and Program Level Requirements Appendix (PLRA)

Synergistic activities with ESA CHIME ‘modeling & simulations’

SBG Special Issue

JGR
Biogeosciences

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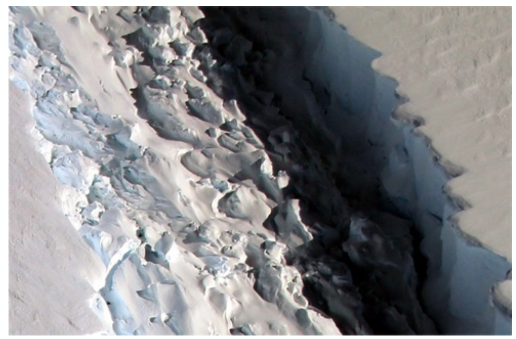
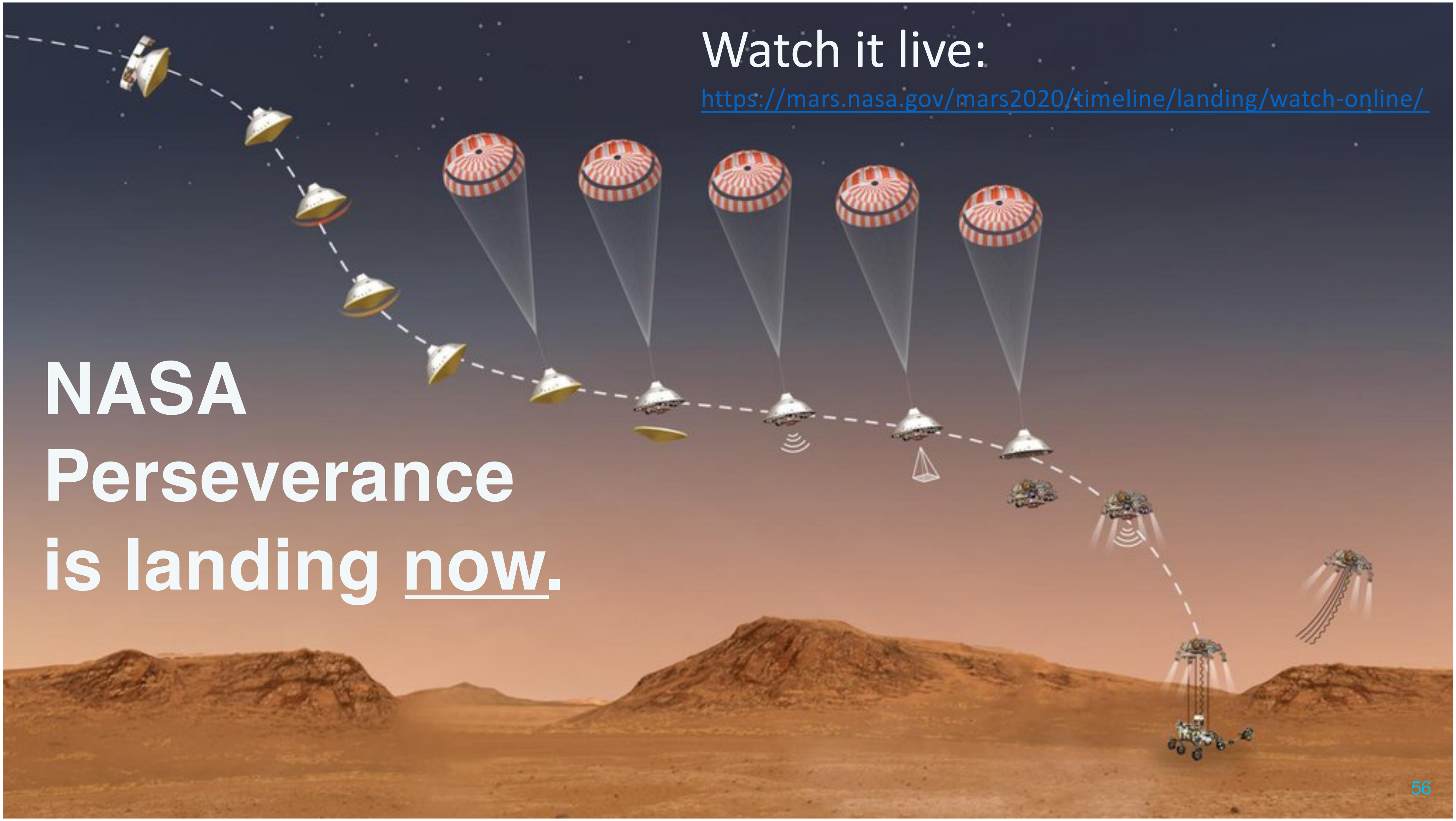


Woody Turner,
Program Scientist, NASA Headquarters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