Thriving on Our Changing Planet

*A Decadal Strategy for Earth Observations from Space**

Surface Biology and Geology Designated Observables

Quick Summary: Recommendations

1 VISION & STRATEGY

"Thriving on our Changing Planet"

2 SCIENCE & APPLICATIONS

Address **35 key science/applications questions,** from among hundreds suggested. Those with objectives prioritized as most important fell into **six categories**:

- Coupling of the Water and Energy Cycles
- Ecosystem Change
- Extending & Improving Weather and Air Quality Forecasts
- Sea Level Rise
- Reducing Climate Uncertainty & Informing Societal Response
- Surface Dynamics, Geological Hazards and Disasters

3 OBSERVATIONS

Augment the **Program of Record** with **eight priority observables**:

- **Five** that are specified to be implemented:
  - *Aerosols*
  - *Clouds, Convection, & Precipitation*
  - *Mass Change*
  - *Surface Biology & Geology*
  - *Surface Deformation & Change*
- **Three** others to be selected competitively from among seven candidates
- Structure **new NASA mission program elements** to accomplish this
- Methods for new NASA capabilities to be **leveraged by NOAA and USGS**

4 PROGRAMMATICS

- CROSS-AGENCY
- NASA
  - Flight
  - Technology
  - Applications
- NOAA
- USGS

SBG Organization, Roles & Work Flow Are Well-Defined

NASA HQ
Dave Jarrett
Woody Turner
Ben Phillips
Paula Bontempi

Center Executive Steering Committee
Ryan Spackman- NASA ARC
James Irons- NASA GSFC
Randy Friedl- JPL Chair
David Young- NASA LaRC
Gary Jedlovec- NASA MSFC

SBG Study Coordinator
Jamie Nastal- JPL

Research and Application Team
Dave Schimel- JPL, Coordinator
Betsy Middleton- GSFC
Jeff Luvall-MSFC
Science Steering Committee
Working Groups:
Algorithms
Cal/Val
Modeling
Applications
Requirements & Traceability

Architecture Teams

Architecture Formulation Team
Kelley Case- JPL, Co- Coordinator
Belgacem Jaroux- ARC, Co-Coordinator

(A-Team Workshops for candidate architectures and detail architecture)

Phase 1: Identify Candidate Architectures
Tony Freeman- JPL, Lead
Ben Poulter- GSFC, Deputy Lead

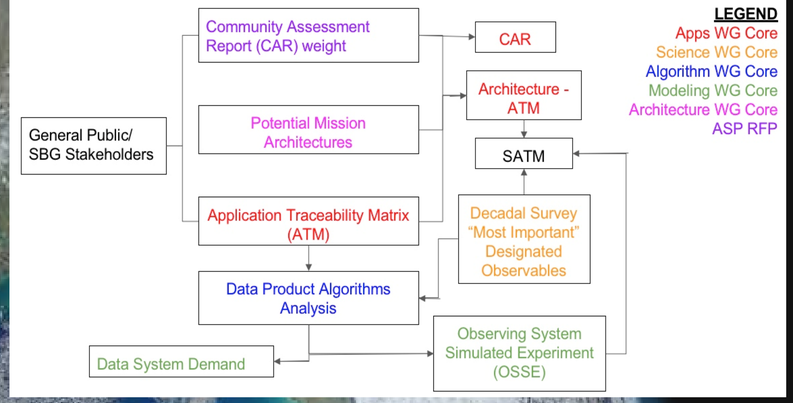
Phase 2: Architecture Assessment
David Bearden- JPL, Lead
Jim Price- LaRC, Deputy Lead

Phase 3: Architecture Design
Amit Sen- JPL, Lead
Ben Poulter- GSFC, Deputy Lead

Cost Estimation Team
Jim Hoffman-JPL, Co-Coordinator
Jordan Klovstad- LaRC, Co-Coordinator

Deliverable Preparation
Phase 4: Final Report, MCR material
Jamie Nastal- JPL, Lead

SBG Designated Observable Working Group Structure and Deliverables



DS Question	Focused Science Topic	Application Focus Group	Application Concept	Decision Approach	L2+ VSWIR (one row) and TIR (another row)	Spatial	Temporal	Latency	Other Design Considerations	End Users	Ancillary
H-2. How do anthropogenic changes in climate, land use, water use, and water storage, interact and modify the water and energy cycles locally, regionally and globally and what are the short- and long-term consequences?	Land Surface Fluxes, Ecosystem traits and biodiversity - terrestrial	Disasters	Fuel Mapping for wildfire danger management. Post fire severity assessment and recovery	Use veg composition, structure, health, chemical properties to inform mitigation actions like thinning based either directly on the maps or integration into fire simulation models.Use vegetation traits to monitor and predict live fuel moisture, an important component of wildfire danger in some ecosystems, over time. Could inform how areas are classified as "burn/no burn" and public	L4-Plant functional type L4-Dead/Dormant Vegetation Maps L3-Green Vegetation and Non-photosynthetic vegetation L3/4-Fuel classification L3-Live Fuel Moisture L3-Vegetation Traits L2-Surface Reflectance L3-Evapotranspiration	30m x 30m	annual -wkly	NA	sun-synchronous	USFS GTAC and regional offices National Parks Service Bureau of Land Management USGS EROS - LANDFIRE	lidar for structure, field data to parameterize
E-1. What are the structure, function, and biodiversity of Earth's ecosystems, and how and why are they changing in time and space?	Ecosystem traits and biodiversity - terrestrial	Forest Mangement	Given accelerating change, restoration and/or management of dynamic habitat conditions to enhance resilience, limit biodiversity loss, and recover endangered species (terrestrial)	Use of terrestrial veg composition, structure, health to target areas for habitat restoration (like native species replantings or removal of invasives). ET can be used to monitor improvement of water consumptive use due to	L2-Land surface temperature L4-Evaporative Stress Index L3-Evapotranspiration L2-Land surface temperature	30m x 30m 30m x 30m	annual	NA	sun-synchronous	USFS GTAC and regional offices National Parks Service Bureau of Land Management USGS EROS - LANDFIRE US FWS, State level FWS, New Mexico Office of the State Engineer	lidar for structure, field data to parameterize ECOSTRESS ancillary
E-1. What are the structure, function, and biodiversity of Earth's ecosystems, and how and why are they changing in time and space?	Ecosystem traits and biodiversity - terrestrial	Carbon-Forest Management	Monitor carbon accounting for carbon markets	Use veg composition, structure, and health to target areas for reforestation and afforestation	L4-Plant functional type L3-Dead/Dormant Vegetation L3-Green vs Non-Green/Non-Photosynthetic Veg L3/4-Vegetation Classification L2-Surface Reflectance	30m x 30m	Annual	NA	sun-sychronous	SERVIR Conservation International Gates Foundation WWF WRI World Bank REDD+	lidar for structure, field data to parameterize
H-1. How is the water cycle changing? Are changes in evapotranspiration and precipitation accelerating, with greater rates of evapotranspiration and thereby precipitation, and how are these changes expressed in the space-time distribution of rainfall, snowfall, evapotranspiration, and the frequency and magnitude of extremes such as droughts and floods?	Snow Monitoring	Water Management	Improving estimates of streamflow volumes and timing for water resources management, flood control, ecosystem flows, and hydropower	Apply snow properites products in streamflow estimates provided by operational agencies to inform water allocation, flood control, hydropower, and water use.	L4 - Snow Water Equivalent L4 - Snow Density L3 - Albedo L3 - Snow Grain Size L3 - Fractional Cover: Snow - Vegetation - Bare Rock - Soil - Water L3 - Snow Radiative Forcing L2 - Surface Reflectance L2 - Land Surface Temperature (LST)	90m X 90m	90-365 days	90-365 days		Western States Water Council State Water Agencies (in areas where snow is major water supply) NOAA (responsible for hydroforecasts)	Lidar snow depth
H-2. How do anthropogenic changes in climate, land use, water use, and water storage, interact and modify the water and energy cycles locally, regionally and globally and what are the short- and long-term consequences?	Land Surface Fluxes	Water management	Improving estimates of evapotranspiration from wetlands and riparian ecosystems to monitor water demands for wetland and riparian ecosystems, improve accurate accounting of consumptive use by in water limited regions, and identify habitat loss and degradation.	Apply improved ET products in estimates of water demand to improve water accounting and ensure adequate instream flows for wetland and riparian ecosystems.	L3 - Green Vegetation and Non-photosynthetic vegetation L3 - NDVI L2 - Surface Reflectance (L2) NDVI (L2) L3 - Evapotranspiration L2 - Land Surface Temperature L2 - Land Surface Emissivity	< 100 m	Daily (ideal), 3-5 days (acceptable), < = 8 days (minimum)	8-16 days		Federal, state and local water management agencies, NGOs	
S-1. How can large-scale geological hazards be accurately forecast in a socially relevant timeframe?	Landslides	Disasters	High spatial-resolution time series of distribution of vegetation and rock/soil composition		L3 - GV: NPV: Substrate: Rock L2 - Surface Reflectance	30-45 m	weekly		Precipatation measurements, slope, aspect, soil moisture		
H-1. How is the water cycle changing? Are changes in evapotranspiration and precipitation accelerating, with greater rates of evapotranspiration and thereby precipitation, and how are these changes expressed in the space-time distribution of rainfall, snowfall, evapotranspiration, and the frequency and magnitude of extremes such as droughts and floods?	Snow Monitoring	Water Management	Land surface radiative forcing to constrain weather forecasting and climate model inputs	Apply snow properites products in streamflow estimates provided by operational agencies to inform water allocation and water use.	L4 - Light Absorbing Impurities L3- Snow Grain Size L3 - Fractional Snow Cover Area L3 - Snow Cover Area L3 - Albedo L2 - Surface Reflectance L2 - Surface Temperature L2 - Surface Emissivity	10-30 m x 10-30 m 60-100 m x 60-100 m	3 - 16 days TIR should be contemporaneous with VSWIR but possibly multiple revisits per sensing day	Within 24 hours of acquisition	Synergy with other US and international VSWIR/TIR multispectral instrument needs to be considered here	Western States Water Council State Water Agencies (in areas where snow is major water supply) NOAA (responsible for hydroforecasts) USGS National Water Network, academic science community	Lidar snow depth
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HyspIRI Science and Applications

Key Science and Science Applications

Climate: Ecosystem biochemistry, condition & feedback; spectral albedo; carbon/dust on snow/Ice; biomass burning; evapotranspiration.

Ecosystems: Global plant functional-type, physiological condition, and biochemistry including agricultural lands.

Fires: Fuel status, fire occurrence, severity, emissions, and patterns of recovery globally.

Coral reef and coastal habitats: Global composition and status.

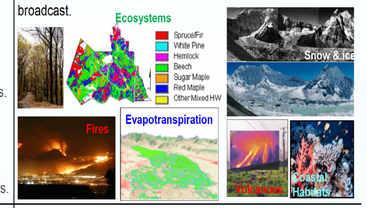
Volcanoes: Eruptions, emissions, regional and global impact.

Natural and resources: Global distributions of surface mineral resources and improved understanding of geology and related hazards.

Societal Factors: Urban environment, habitability and resources.

Mission Urgency

The HyspIRI science and application objectives are important today and uniquely addressed by the combined imaging spectroscopy, thermal infrared measurements, and IPM direct broadcast.

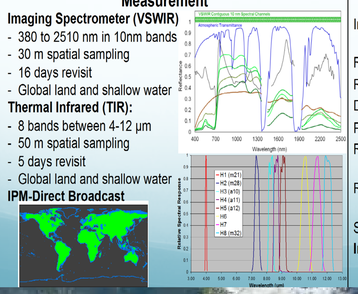


Measurement

Imaging Spectrometer (VSWIR)
- 380 to 2510 nm in 10nm bands
- 30 m spatial sampling
- 16 days revisit
- Global land and shallow water

Thermal Infrared (TIR):
- 8 bands between 4-12 µm
- 50 m spatial sampling
- 5 days revisit
- Global land and shallow water

IPM-Direct Broadcast



Workshop Objectives

- Interact with broad science and applications research community
- Review science inputs to the Decadal Survey
- Review HyspIRI Mission Concept efforts in 2017
- Discuss ECOSTRESS TIR mission headed to the ISS
- Present new relevant Science and Applications Research
- Review results from the U.S. HyspIRI preparatory airborne campaigns
- Review AVIRIS-NG VSWIR Asian Environments campaign in India
- Support current Decadal Survey process

Information and Registration at: http://hyspiri.jpl.nasa.gov

SBG Applications Working Group (AWG)

The Applications Working Group will recruit, coordinate and integrate input on applications needs, data product requirements and training/education and other needs:

- The AWG will identify key applications requirements, latency, revisit, specific products.
- The AWG will cultivate stakeholders and end users via joint activities, workshops, thematic working groups, and design and dissemination of tailored SBG data products.
- Characterize the SBG Communities of Practice and Potential and produce a SBG Community Assessment Report.

Participation Sign Up List: http://tinyurl.com/SBGApplicationsWG

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Christine Lee, christine.m.lee@jpl.nasa.gov and Natasha Stavros - natasha.stavros@jpl.nasa.gov – JPL
Nancy Glenn, nancyglenn@boisestate.edu – Boise State University

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