



HyspIRI

DRAFT PRELIMINARY

Level 1 Requirements and Mission Success Criteria

NASA Earth Science and Applications Decadal Survey

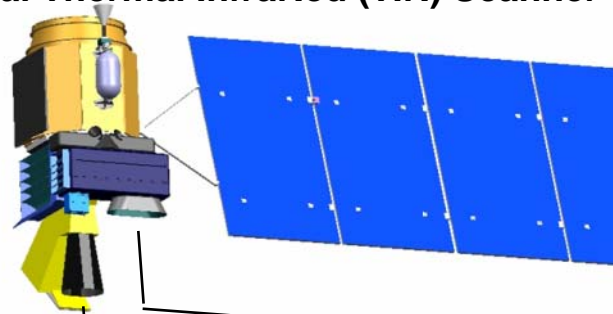
Robert O. Green, Simon Hook, Betsy Middleton,
Stephen Ungar, Bob Knox, Woody Turner, John
LaBrecque and the HyspIRI Team



This is a Key Enabling NASA Documents for the MCR and for the life of the Mission



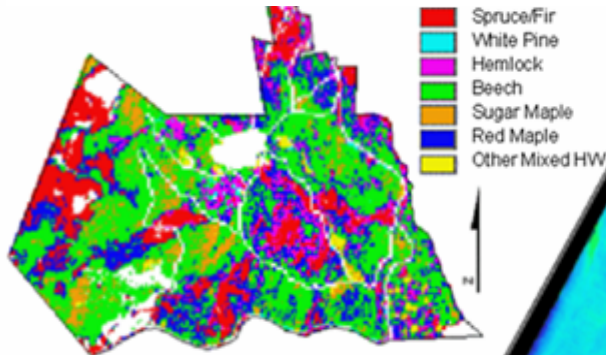
Visible ShortWave InfraRed (VSWIR) Imaging Spectrometer
+
Multispectral Thermal InfraRed (TIR) Scanner



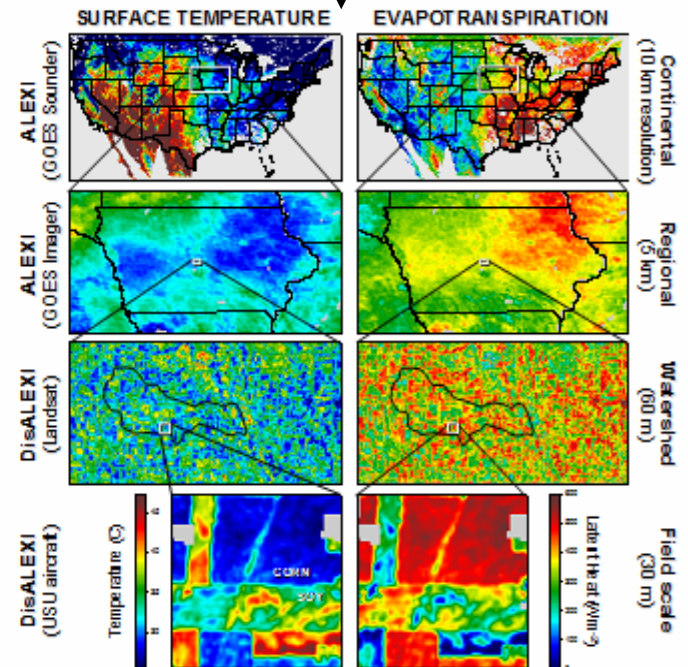
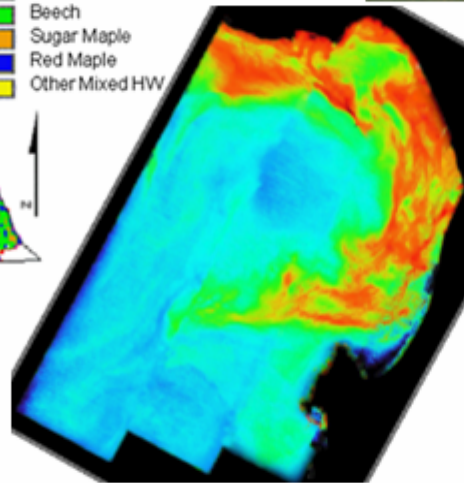
VSWIR: Plant Physiology and Function Types (PPFT)

Multispectral TIR Scanner

Map of dominant tree species, Bartlett Forest, NH



Red tide algal bloom in Monterey Bay, CA





Overview



Beginning in January 2007 a Mission Concept effort for HypsIRI Mission has been under way with involvement of NASA HQ, JPL, GSFC, and an broad Science Study Group and the 2008 Workshop.

Beginning with the call of the NASA Earth Science and Applications Decadal Survey this team has worked to develop a end-to-end concept for implementation of the HypsIRI Mission.

Based on this effort and with input from last years workshop a set of Level 1 Requirements and Success Criteria have been develop in accordance with the required NASA process.

In this presentation we are going to look in detail at the draft preliminary Level 1 Requirements and Success Criteria document.

This is a required and enabling document for HypsIRI to proceed to the next step in the NASA Mission process.

Note: The HypsIRI Mission must remain appropriately aligned with the Decadal Survey.



HyspIRI Science Study Group



Mike Abrams	JPL	michael.j.abrams@jpl.nasa.gov	818-354-0937
Rick Allen	UID	rallen@kimberly.uidaho.edu	208-423-6601
Martha Anderson	USDA	Martha.Anderson@ars.usda.gov	301-504-6616
Greg Asner	Stanford	gpa@stanford.edu	650-462-1047
Bryan Bailey	USGS EROS	gbb Bailey@usgs.gov	605-594-6001
Paul Bissett	FERI	pbissett@flenvironmental.org	813-866-3374 x102
Alex Chekalyuk	Lamont-Doh.	chekaluk@ldeo.columbia.edu	845-365-8552
James Crowley	USGS	jcrowley@usgs.gov	703-648-6356
Ivan Csiszar	UMD	icsiszar@hermes.geog.umd.edu	301-405-8696
Heidi Dierssen	U Conn.	heidi.dierssen@uconn.edu	
Friedmann Freund	Ames	friedemann.t.freund@nasa.gov	
John Gamon	U A	gamon@gmail.com	
Louis Giglio	UMD	louis_giglio@ssaihq.com	301 867-2030
Greg Glass	JHU	gglass@jhsp.edu	410-955-3708
Robert Green	JPL	rog@jpl.nasa.gov	
Simon Hook	JPL	simon.j.hook@jpl.nasa.gov	818-354-0974
James Irons	GSFC	James.R.Irons@nasa.gov	301-614-6657
Bob Knox	GSFC	Robert.G.Knox@nasa.gov	301-614-6656
John Mars	USGS	jmars@usgs.gov	703-648-6302
Betsy Middleton	GSFC	elizabeth.m.middleton@nasa.gov	301-614-6670
Peter Minnett	U. Miami	pminnett@rsmas.miami.edu	305-361-4104
Frank Muller Karger	U. MA Dart.	fmullerkarger@umassd.edu	508 999 8193
Scott Ollinger	UNH	scott.ollinger@unh.edu	
Anupma Prakash	UAF	prakash@gi.alaska.edu	907-474-1897
Dale Quattrochi	MSFC	dale.quattrochi@nasa.gov	256-961-7887
Vince Realmuto	JPL	Vincent.J.Realmuto@jpl.nasa.gov	818-354-1824
Dar Roberts	UCSB	dar@geog.ucsb.edu	
Dave Siegel	UCSB	davey@icess.ucsb.edu	805-893-4547
Phil Townsend	U of Wisc.	ptownsend@wisc.edu	608-262-1669
Kevin Turpie	GSFC	kevin.r.turpie@nasa.gov	301-286-9996
Steve Ungar	GSFC	stephen.g.ungar@nasa.gov	
Susan Ustin	UC Davis	susan@cstars.ucdavis.edu	
Rob Wright	UHI	wright@higp.hawaii.edu	808-956 9194



HYSPIRI

**Visible to Short Wavelength Infrared Imaging Spectrometer and Thermal Infrared Imager
(HyspIRI) Decadal Survey Earth Science and Applications Mission**



Level 1 Requirements and Mission Success Criteria

Level 1 Requirements and Mission Success Criteria

Version X-5.0
Date: July 27, 2009

Document Revision History

Revision	Date	Sections Changed
1.0	04/28/09	Baseline
2.0	05/15/09	Changes accepted and baseline requirement entered
3.0	07/20/09	Refined performance requirements
4.0	07/27/09	Accepted initial steering committee changes throughout
5.0	08/05/09	Accepted changes from J. LaBrecque geology and NH and SSG



Level 1 Requirements and Mission Success Criteria



Contents

1. Scope.....	4
2. Science Definition	4
2.1. Mission Imperative	4
2.2. Science Objectives.....	4
2.3. Implementation Approach.....	4
3. Project Definition.....	5
3.1 Roles and Responsibilities.....	5
3.2 Project Category.....	6
3.3 Governing Program Management Council.....	6
3.4 Payload Risk Classification.....	6
3.5 Termination Review.....	6
4. Performance Requirements.....	6
4.1 Science Requirements	6
4.2 Data Product Requirements	8
4.3 Observatory and Mission Operations Requirements.....	8
4.4 Launch Requirements.....	8
4.5 Science Measurement Validation Requirements	8
5. Program Requirements.....	8
5.1 Cost Requirements.....	8
5.2 Cost Management and Scope Reduction.....	9
5.3 Schedule Requirements.....	9
5.4 External Agreement Definition	9
5.5 Safety Requirements	9
6. Education and Public Engagement Requirements.....	9
7. Mission Success Criteria.....	9
7. Concurrences.....	10
8. Approvals.....	10



Level 1 Requirements and Mission Success Criteria



1. Scope

This document describes the Level 1 science, mission, schedule and cost requirements governing the Visible to Short Wavelength Infrared Imaging Spectrometer and Thermal Infrared Imager HypIRI Mission. Level 1 requirements serve as the basis for mission assessments conducted by NASA during the formulation and implementation phases and provide the baseline for determining science mission success during the operational phase.

The Earth Science Division (ESD) of the Science Mission Directorate (SMD) at NASA Headquarters has determined that HypIRI will be implemented as a TBD mission within the NASA Earth Systematic Mission (ESM) Program managed by Goddard Space Flight Center (GSFC). The TBD NASA center is assigned responsibility for the overall success of the HypIRI project. The Director of TBD has delegated the project implementation authority to the TBD center directorate and the HypIRI Project Manager. Changes to Level 1 requirements specified herein must be approved by NASA SMD.



Level 1 Requirements and Mission Success Criteria



1. Scope

This document describes the Level 1 science, mission, schedule and cost requirements governing the Visible to Short Wavelength Infrared Imaging Spectrometer and Thermal Infrared Imager HypsIRI Mission. Level 1 requirements serve as the basis for mission assessments conducted by NASA during the formulation and implementation phases and provide the baseline for determining science mission success during the operational phase.

The Earth Science Division (ESD) of the Science Mission Directorate (SMD) at NASA Headquarters has determined that HypsIRI will be implemented as a TBD mission within the NASA Earth Systematic Mission (ESM) Program managed by Goddard Space Flight Center (GSFC). The TBD NASA center is assigned responsibility for the overall success of the HypsIRI project. The Director of TBD has delegated the project implementation authority to the TBD center directorate and the HypsIRI Project Manager. Changes to Level 1 requirements specified herein must be approved by NASA SMD.



Level 1 Requirements and Mission Success Criteria



2. Science Definition

2.1. *Mission Imperative*

HYSPIRI is one of the missions recommended by the National Research Council's Committee on Earth Science and Applications from Space, (*Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*, Space Studies Board, National Academies Press, 2007). HYSPIRI data have both high scientific value and high applications value. The high accuracy, resolution, and global coverage of HYSPIRI solar reflectance, temperature and thermal emissivity measurements are invaluable across many science and applications disciplines including ecology, biogeochemistry, biodiversity, coastal ocean and inland water research, geology, natural hazards, hydrology, climate, studies of the carbon cycle, and related applications.

2.2. *Science Objectives*

The HypsIRI Project will implement a spaceborne earth observation mission designed to collect and provide global surface reflectance, water leaving radiance, thermal emissivity and surface temperature imaging measurements that will enable science and applications users to advance the current understanding of the Earth's ecology, biogeochemistry, biodiversity, coastal and inland water research, geology, natural hazards, hydrology, climate, and studies of the carbon cycle.



Level 1 Requirements and Mission Success Criteria



2.3. Implementation Approach

The HypsIRI observatory employs a dedicated spacecraft with a pair of instruments that will be launched into an 11:00 a.m., sun-synchronous orbit on an expendable launch vehicle. The baseline HypsIRI instruments include a visible to short wavelength infrared imaging spectrometer and a multiband thermal infrared imaging radiometer operating in the 4 – 12 micron range. Observations made with these instruments will be analyzed to yield estimates of surface reflectance, water leaving radiance, thermal emissivity and surface temperature at a nominal ground sample distance of 60 m. The measurements will be acquired for a period of three years. A Calibration and Validation Plan will be developed and implemented to assess random errors, and spatial and temporal biases in the data.



Level 1 Requirements and Mission Success Criteria



3. Project Definition

3.1 Roles and Responsibilities

The HyspIRI Project Manager shall report to NASA according to Figure 1.

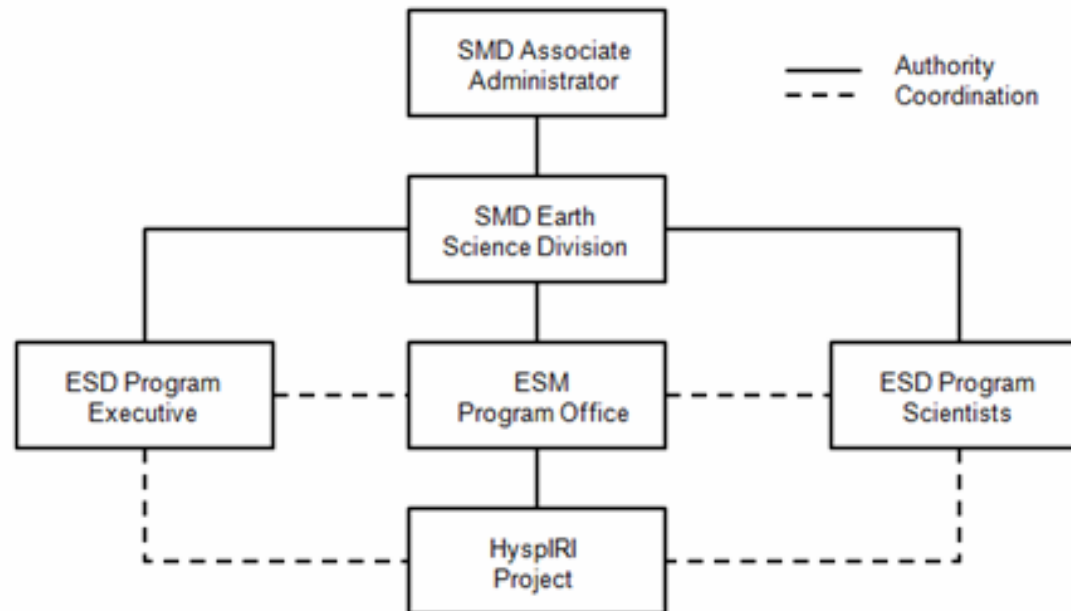


Figure 1. HyspIRI Lines of Authority and Coordination



Level 1 Requirements and Mission Success Criteria



The HypsIRI Project Manager has overall management responsibility for the success of the project. The HypsIRI Project Scientist has overall management responsibility for the science elements of the project. Specific assigned roles and responsibilities are:

TBD Center(s) is responsible for providing: the Project Manager, Project Scientist; project management; system engineering and mission design; safety and mission assurance; spacecraft; instrument integration; launch; mission operations and the associated mission operations ground data system; science data processing and delivery of calibrated/validated science data products to an archive for public distribution.

NASA is responsible for providing a launch vehicle and launch services for HypsIRI, and a NASA-designated Distributed Active Archive Center (DAAC) is responsible for public distribution of HypsIRI data and long-term science data archiving.

NASA will competitively select a HypsIRI Science Definition Team (SDT) that will be initiated in Phase A and continue until one year before launch to provide guidance to the project on measurement requirements, product definition, algorithm development, calibration, validation, and liaison with the broader science and applications communities.

NASA will competitively select a HypsIRI Science Team (ST) that will be initiated one year before launch and carry into the operations phase of the mission. The ST will support the project on calibrating and validating science data products, and liaison with the broader science and applications communities.

NASA will appoint a Science Team Leader (STL) who will represent the SDT and ST to the Project and advise the Project on science issues including the science impact of potential descoping activities, the need for reprocessing data, and the transition of the data to a permanent archive.



Level 1 Requirements and Mission Success Criteria



3.2 Project Category

HyspIRI shall be a Category 2 project, as defined in NPR 7120.5D.

3.3 Governing Program Management Council

The governing Program Management Council (PMC) is the NASA SMD PMC.

3.4 Payload Risk Classification

The HyspIRI payload risk classification shall be Class C, as defined in NPR 8705.4.

3.5 Termination Review

SMD may convene a termination review, in accordance with NPR 7120.5D, section 2.5.6, if the performance requirements defined in Section 4.1.2 cannot be achieved.



Level 1 Requirements and Mission Success Criteria



4. Performance Requirements

4.1 Science Requirements

The science objectives in Section 2.2 can be achieved by either the baseline or minimum science mission requirements listed here, but the baseline mission provides substantially more value to NASA and the Earth Science Community.

4.1.1 Requirement: Baseline Science Mission

- a) To address the Decadal Survey and community identified science and application questions related to terrestrial and coastal ocean ecosystem composition, function, and change as well as surface composition (DS113-115), the baseline science mission shall provide global mapping measurements of the surface reflectance and water leaving radiance (for persistently water covered regions) across the solar reflected spectrum from 380 to 2500 nm at ≤ 10 nm sampling at the specified signal-to-noise ratio and accuracy with $>95\%$ spectral/spatial uniformity at ≤ 60 m spatial sampling with <20 day revisit to provide $>60\%$ seasonal and $>80\%$ annual coverage of the terrestrial and shallow water regions of the Earth for at least three years with a subset of measurements available near-real-time for designated science and applications.



Level 1 Requirements and Mission Success Criteria (VSWIR Performance)

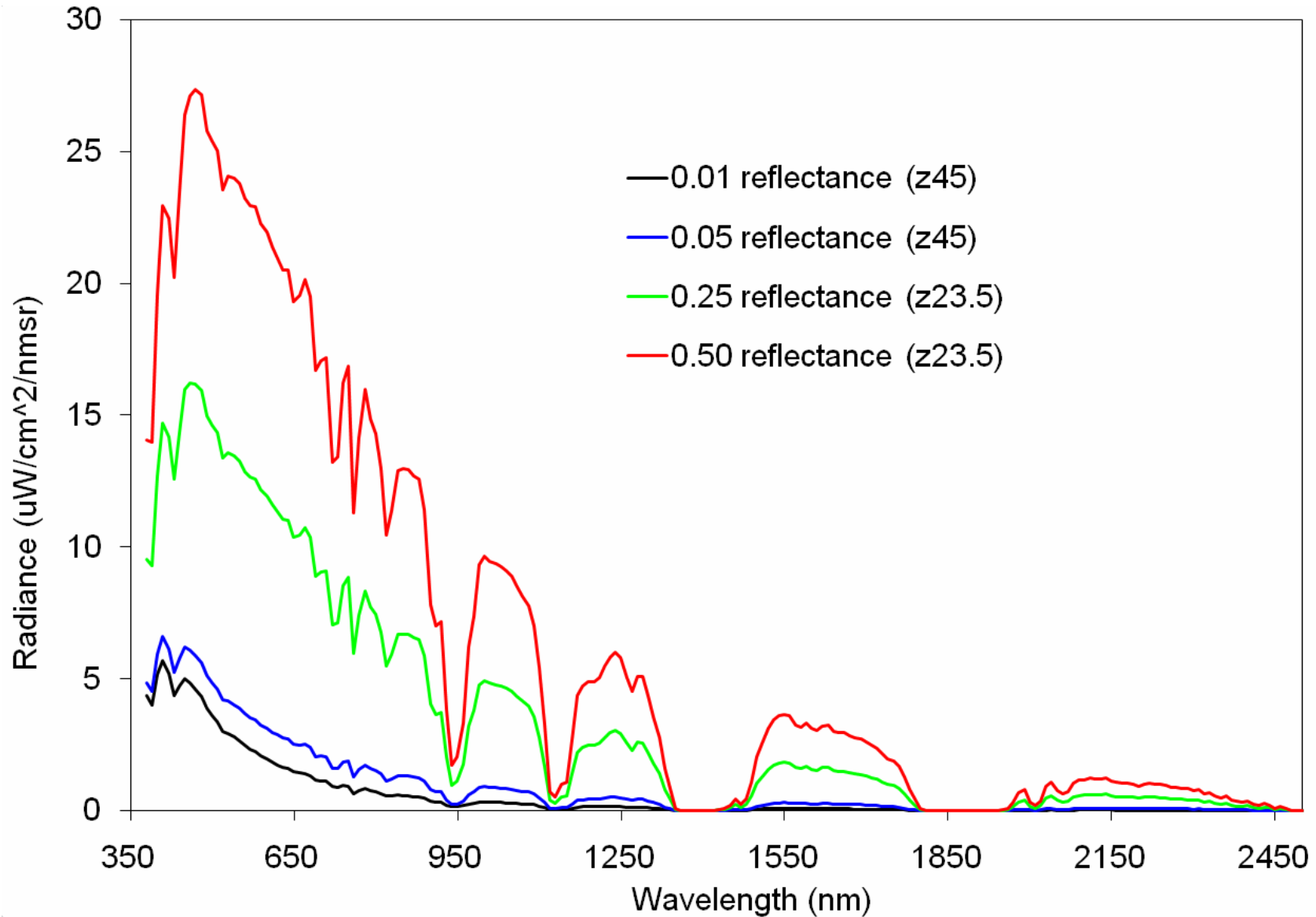


wavelength	0.01 reflectance (z45)	0.05 reflectance (z45)	0.25 reflectance (z23.5)	0.50 reflectance (z23.5)	wavelength	SNR 0.01 Reflectance (z45) 60m	SNR 0.05 Reflectance (z45) 60m	SNR 0.25 Reflectance (z23.5) 60m	SNR 0.50 Reflectance (z23.5) 60m	wavelength	Digitization Radiance (uW/cm ² /nm/sr)
380	4.34E+00	4.84E+00	9.54E+00	1.41E+01	380	1.61E+02	1.73E+02	2.62E+02	3.27E+02	380	1.68E-02
390	3.99E+00	4.51E+00	9.28E+00	1.40E+01	390	1.87E+02	2.02E+02	3.09E+02	3.89E+02	390	1.22E-02
400	5.17E+00	5.93E+00	1.27E+01	1.95E+01	400	2.29E+02	2.49E+02	3.83E+02	4.83E+02	400	1.14E-02
410	5.69E+00	6.61E+00	1.47E+01	2.29E+01	410	2.41E+02	2.63E+02	4.12E+02	5.23E+02	410	1.15E-02
420	5.20E+00	6.14E+00	1.42E+01	2.25E+01	420	2.45E+02	2.70E+02	4.31E+02	5.51E+02	420	1.02E-02
430	4.37E+00	5.24E+00	1.26E+01	2.02E+01	430	2.40E+02	2.67E+02	4.36E+02	5.62E+02	430	8.88E-03
440	4.74E+00	5.77E+00	1.44E+01	2.34E+01	440	2.82E+02	3.16E+02	5.19E+02	6.70E+02	440	7.33E-03
450	5.01E+00	6.20E+00	1.60E+01	2.64E+01	450	2.99E+02	3.38E+02	5.63E+02	7.31E+02	450	6.99E-03
460	4.84E+00	6.09E+00	1.62E+01	2.71E+01	460	3.15E+02	3.58E+02	6.05E+02	7.89E+02	460	6.18E-03
470	4.60E+00	5.88E+00	1.62E+01	2.73E+01	470	3.08E+02	3.54E+02	6.09E+02	7.99E+02	470	6.09E-03
480	4.31E+00	5.61E+00	1.59E+01	2.72E+01	480	2.94E+02	3.41E+02	5.98E+02	7.88E+02	480	6.21E-03
490	3.87E+00	5.12E+00	1.50E+01	2.58E+01	490	2.63E+02	3.09E+02	5.53E+02	7.34E+02	490	6.77E-03
500	3.61E+00	4.86E+00	1.46E+01	2.54E+01	500	2.59E+02	3.07E+02	5.60E+02	7.45E+02	500	6.47E-03
510	3.38E+00	4.62E+00	1.43E+01	2.50E+01	510	2.47E+02	2.97E+02	5.50E+02	7.36E+02	510	6.54E-03
520	3.02E+00	4.20E+00	1.34E+01	2.35E+01	520	2.32E+02	2.81E+02	5.31E+02	7.13E+02	520	6.53E-03
530	2.94E+00	4.16E+00	1.36E+01	2.41E+01	530	2.39E+02	2.93E+02	5.59E+02	7.52E+02	530	6.02E-03
540	2.79E+00	4.02E+00	1.34E+01	2.40E+01	540	2.29E+02	2.84E+02	5.49E+02	7.42E+02	540	6.16E-03
550	2.65E+00	3.87E+00	1.33E+01	2.38E+01	550	2.43E+02	3.03E+02	5.91E+02	8.00E+02	550	5.28E-03
560	2.47E+00	3.67E+00	1.29E+01	2.32E+01	560	2.37E+02	2.98E+02	5.90E+02	8.00E+02	560	5.15E-03
570	2.33E+00	3.53E+00	1.27E+01	2.29E+01	570	2.31E+02	2.94E+02	5.89E+02	8.01E+02	570	5.07E-03
580	2.23E+00	3.43E+00	1.26E+01	2.29E+01	580	2.37E+02	3.05E+02	6.17E+02	8.40E+02	580	4.62E-03
590	2.08E+00	3.25E+00	1.22E+01	2.22E+01	590	2.32E+02	3.02E+02	6.17E+02	8.42E+02	590	4.47E-03
600	1.96E+00	3.13E+00	1.19E+01	2.19E+01	600	2.24E+02	2.94E+02	6.09E+02	8.33E+02	600	4.50E-03
610	1.84E+00	2.99E+00	1.16E+01	2.14E+01	610	2.23E+02	2.97E+02	6.19E+02	8.48E+02	610	4.23E-03
620	1.73E+00	2.87E+00	1.13E+01	2.09E+01	620	2.16E+02	2.89E+02	6.04E+02	8.27E+02	620	4.14E-03
2200	1.72E-02	7.31E-02	4.71E-01	9.37E-01	2200	1.81E+01	6.44E+01	2.36E+02	3.51E+02	2200	9.85E-04
2210	1.87E-02	8.00E-02	5.10E-01	1.02E+00	2210	1.96E+01	6.96E+01	2.49E+02	3.68E+02	2210	9.79E-04
2220	1.89E-02	8.11E-02	5.16E-01	1.03E+00	2220	2.01E+01	7.12E+01	2.52E+02	3.74E+02	2220	9.65E-04
2230	1.88E-02	8.05E-02	5.12E-01	1.02E+00	2230	2.02E+01	7.15E+01	2.53E+02	3.75E+02	2230	9.52E-04
2240	1.82E-02	7.79E-02	4.97E-01	9.90E-01	2240	1.98E+01	7.05E+01	2.51E+02	3.72E+02	2240	9.39E-04
2250	1.74E-02	7.47E-02	4.78E-01	9.52E-01	2250	1.92E+01	6.87E+01	2.47E+02	3.66E+02	2250	9.30E-04
2260	1.64E-02	7.03E-02	4.52E-01	9.00E-01	2260	1.82E+01	6.55E+01	2.39E+02	3.55E+02	2260	9.28E-04
2270	1.60E-02	6.89E-02	4.43E-01	8.83E-01	2270	1.79E+01	6.45E+01	2.36E+02	3.51E+02	2270	9.26E-04
2280	1.55E-02	6.67E-02	4.30E-01	8.56E-01	2280	1.74E+01	6.31E+01	2.32E+02	3.46E+02	2280	9.23E-04
2290	1.50E-02	6.43E-02	4.15E-01	8.28E-01	2290	1.69E+01	6.14E+01	2.28E+02	3.41E+02	2290	9.19E-04
2300	1.39E-02	5.94E-02	3.87E-01	7.70E-01	2300	1.58E+01	5.79E+01	2.19E+02	3.28E+02	2300	9.14E-04
2310	1.44E-02	6.17E-02	3.98E-01	7.94E-01	2310	1.65E+01	5.99E+01	2.24E+02	3.35E+02	2310	9.09E-04
2320	1.16E-02	4.92E-02	3.23E-01	6.43E-01	2320	1.35E+01	4.98E+01	1.97E+02	2.98E+02	2320	9.06E-04
2330	1.26E-02	5.39E-02	3.51E-01	6.99E-01	2330	1.46E+01	5.37E+01	2.08E+02	3.12E+02	2330	9.07E-04
2340	1.04E-02	4.39E-02	2.90E-01	5.78E-01	2340	1.21E+01	4.50E+01	1.84E+02	2.79E+02	2340	9.11E-04
2350	8.65E-03	3.61E-02	2.42E-01	4.82E-01	2350	1.00E+01	3.77E+01	1.63E+02	2.50E+02	2350	9.18E-04
2360	9.78E-03	4.11E-02	2.72E-01	5.41E-01	2360	1.12E+01	4.19E+01	1.74E+02	2.66E+02	2360	9.27E-04
2370	7.28E-03	3.01E-02	2.02E-01	4.03E-01	2370	8.36E+00	3.16E+01	1.43E+02	2.22E+02	2370	9.33E-04
2380	6.32E-03	2.56E-02	1.74E-01	3.46E-01	2380	7.26E+00	2.72E+01	1.28E+02	2.02E+02	2380	9.36E-04
2390	6.21E-03	2.50E-02	1.71E-01	3.40E-01	2390	7.15E+00	2.68E+01	1.27E+02	2.00E+02	2390	9.36E-04
2400	6.71E-03	2.72E-02	1.85E-01	3.67E-01	2400	7.76E+00	2.91E+01	1.35E+02	2.11E+02	2400	9.29E-04
2410	4.50E-03	1.74E-02	1.20E-01	2.39E-01	2410	5.30E+00	1.94E+01	9.96E+01	1.61E+02	2410	9.21E-04
2420	3.75E-03	1.41E-02	9.89E-02	1.96E-01	2420	4.45E+00	1.60E+01	8.65E+01	1.42E+02	2420	9.16E-04
2430	4.95E-03	1.93E-02	1.34E-01	2.66E-01	2430	5.87E+00	2.16E+01	1.09E+02	1.74E+02	2430	9.12E-04
2440	4.13E-03	1.58E-02	1.10E-01	2.18E-01	2440	4.90E+00	1.78E+01	9.37E+01	1.52E+02	2440	9.14E-04
2450	1.85E-03	6.03E-03	4.28E-02	8.47E-02	2450	2.21E+00	7.07E+00	4.37E+01	7.65E+01	2450	9.19E-04
2460	3.00E-03	1.06E-02	7.60E-02	1.51E-01	2460	3.53E+00	1.21E+01	6.98E+01	1.17E+02	2460	9.27E-04
2470	1.58E-03	4.68E-03	3.39E-02	6.69E-02	2470	1.84E+00	5.38E+00	3.49E+01	6.21E+01	2470	9.43E-04
2480	7.80E-04	1.65E-03	1.07E-02	2.08E-02	2480	8.99E-01	1.89E+00	1.18E+01	2.21E+01	2480	9.57E-04
2490	4.00E-04	4.60E-04	1.39E-03	2.34E-03	2490	4.56E-01	5.24E-01	1.58E+00	2.64E+00	2490	9.69E-04
2500	4.30E-04	5.10E-04	1.68E-03	2.90E-03	2500	4.80E-01	5.70E-01	1.87E+00	3.21E+00	2500	9.88E-04



Level 1 Requirements and Mission Success Criteria

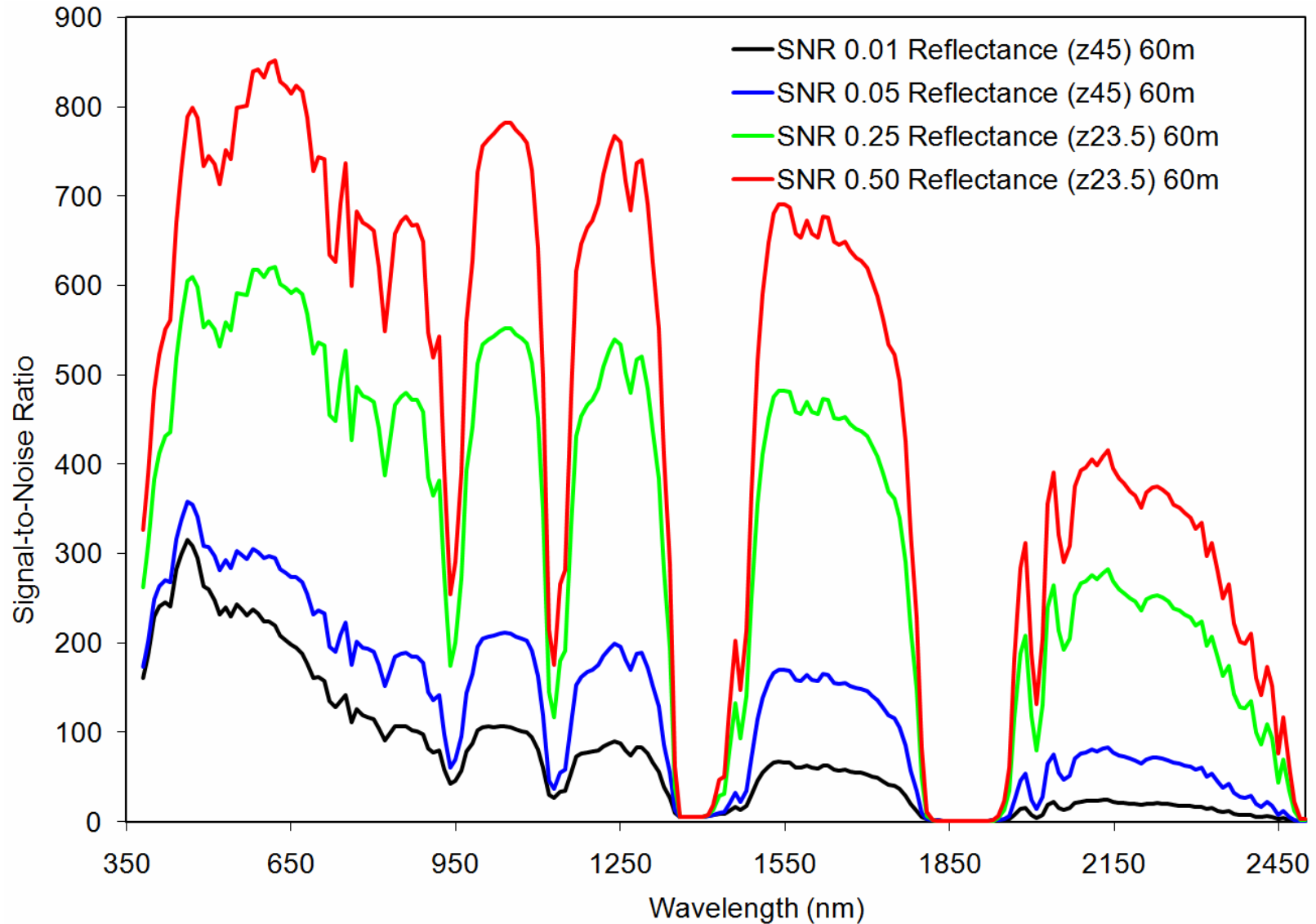
VSWIR Benchmark Radiances





Level 1 Requirements and Mission Success Criteria

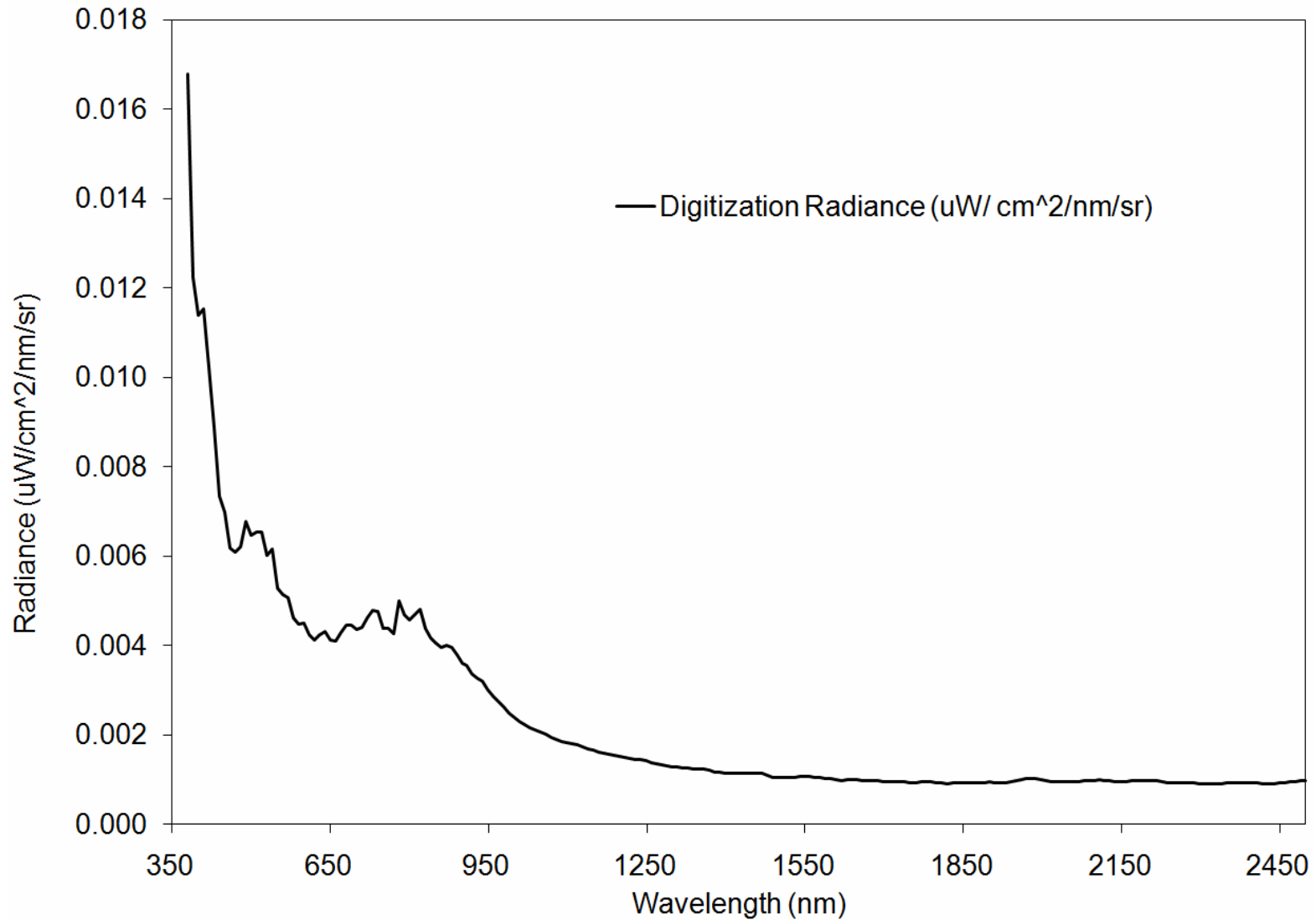
VSWIR SNR





Level 1 Requirements and Mission Success Criteria

VSWIR Digitization Radiance





Level 1 Requirements and Mission Success Criteria



- b) To address the Decadal Survey and community-identified science and application questions related to volcanoes, wild fires, water usage, urbanization and surface composition (DS113-115), the baseline science mission shall provide global mapping measurements of the surface radiance, temperature and emissivity with 8 spectral bands from the 3-5 micron and 8-12 micron regions of the spectrum at the specified noise-equivalent-delta-temperature and accuracy at ≤ 60 m spatial sampling with ≤ 5 day revisit to provide $>60\%$ Monthly, $>70\%$ seasonal and $>85\%$ annual coverage of the terrestrial and shallow water regions of the Earth for at least three years with a subset of measurements available near-real-time for designated science and applications.



Specified NEdT



	Wavelength	Spectral Bandwidth	Min Nominal Radiance and Temperature	Max Nominal Radiance and Temperature	NEdT at Min nominal Temperature	NEdT at Max Nominal Temperature	NEdT at 300 K
	(microns)	(microns)	(W/m ² /micron/sr)	(W/m ² /micron/sr)	Kelvin	Kelvin	Kelvin
Band 1	3.98	0.08	14 (400 K)	9600 (1400 K)	1	0.12	11.2
Band 2	7.35	0.32	0.34 (200 K)	110 (500 K)	2.8	0.22	0.28
Band 3	8.28	0.34	0.45 (200 K)	100 (500 K)	2	0.22	0.24
Band 4	8.63	0.35	0.57 (200 K)	94 (560 K)	1.6	0.24	0.24
Band 5	9.07	0.36	0.68 (200 K)	86 (500 K)	1.2	0.24	0.22
Band 6	10.53	0.54	0.89 (200 K)	71 (500 K)	0.64	0.22	0.16
Band 7	11.33	0.54	1.1 (200 K)	58 (500 K)	0.56	0.26	0.16
Band 8	12.05	0.52	1.2 (200 K)	48 (500 K)	0.52	0.3	0.18

Digitization @ min radiance	Digitization @ max radiance	Digitization @ 300 K
(W/m ² /micron/sr)	(W/m ² /micron/sr)	(W/m ² /micron/sr)
4.0e-2 (0.12 K)	4.0e-2 (0.01 K)	5.0e-2 (1.4 K)
5.6e-3 (0.30 K)	5.6e-3 (0.009 K)	5.6e-3 (0.03 K)
4.8e-3 (0.23 K)	4.8e-3 (0.009 K)	4.8e-3 (0.03 K)
4.5e-3 (0.19 K)	4.5e-3 (0.009 K)	4.5e-3 (0.03 K)
4.1e-3 (0.15 K)	4.1e-3 (0.010 K)	4.1e-3 (0.03 K)
2.5e-3 (0.08 K)	2.5e-3 (0.008 K)	2.5e-3 (0.02 K)
2.2e-3 (0.07 K)	2.2e-3 (0.010 K)	2.2e-3 (0.02 K)
2.1e-3 (0.06 K)	2.1e-3 (0.012 K)	2.1e-3 (0.02 K)

Notes

Center wavelength is the average of the max and min wavelengths at the FWHM
 Spectral bandwidth is the FWHM
 Minimum nominal radiance is 200K except for 4 um band where it is 400K
 Maximum nominal radiance is 500K except for 4 um band where it is 1400K



Level 1 Requirements and Mission Success Criteria



- c) To address Decadal Survey and community-identified science and application questions (DS113-115), requiring combined reflectance, emissivity and temperature measurements, the baseline mission shall provide combined global mapping data sets with both reflectance from 380 to 2500 nm at ≤ 10 nm and emissivity, temperature and surface radiance from the 3-5 and 8-12 micron regions each at ≤ 60 m spatial sampling with < 20 day revisit to provide $> 60\%$ seasonal and $> 80\%$ annual coverage of the terrestrial and shallow water regions of the Earth for at least three years with a subset of measurements available near-real-time for designated science and applications.



Level 1 Requirements and Mission Success Criteria



A termination review will be called if these requirements cannot be met

4.1.2 Requirement: Minimum Science Mission

- a) To address the Decadal Survey and community identified science and application questions related to terrestrial and coastal ocean ecosystem composition, function, and change as well as surface composition (DS113-115), the baseline science mission shall provide global global mapping measurements of the surface reflectance and water leaving radiance (for persistently water covered regions) across the solar reflected spectrum from 380 to 2500 nm at ≤ 10 nm sampling at $>90\%$ of the specified signal-to-noise ratio and accuracy with $> 90\%$ spectral/spatial uniformity at ≤ 60 m spatial sampling with < 20 day revisit to provide $> 50\%$ seasonal and $> 70\%$ annual coverage of the terrestrial and shallow water regions of the Earth for at least two years.



Level 1 Requirements and Mission Success Criteria



- b) To address the Decadal Survey and community identified science and application questions related to volcanoes, wild fires, water usage, urbanization and surface composition (DS113-115), the baseline science mission shall provide global mapping measurements of the surface temperature as well as emissivity and surface radiance in 8 spectral bands from the 3-5 micron and 8-12 micron regions of the spectrum at $>90\%$ the specified noise-equivalent-delta-temperature and accuracy at ≤ 60 m spatial sampling with ≤ 5 day revisit to provide $> 40\%$ Monthly, $> 60\%$ seasonal and $> 70\%$ annual coverage of the terrestrial and shallow water regions of the Earth for at least two years.
- c) To address Decadal Survey and community identified science and application questions requiring combined reflectance, emissivity and temperature measurements, the baseline mission shall provide combined global mapping data sets with both reflectance from 380 to 2500 nm at ≤ 10 nm and emissivity, temperature and surface radiance from the 3-5 and 8-12 micron regions each at ≤ 60 m spatial sampling with ≤ 20 day revisit to provide $> 50\%$ seasonal and $> 70\%$ annual coverage of the terrestrial and shallow water regions of the Earth for at least two years.



Level 1 Requirements and Mission Success Criteria



4.2 Data Product Requirements

4.2.1 Requirement: No later than six (6) months after the end of the observatory commissioning phase, the HypsIRI project shall begin to make available for delivery to the DAAC the first release of validated instrument data products (Level 1 radiance and Level 2 surface products) for distribution to the public.

4.2.2 Requirement: No later than twelve (12) months after the end of the observatory commissioning phase, the HypsIRI project shall begin to make available for delivery to the DAAC the first release of validated geophysical data products defined by the science team for distribution to the public.

4.2.3 Requirement: The final data products produced by the HypsIRI mission shall be delivered to the DAAC within six (6) months after the end of the mission.

4.3 Observatory and Mission Operations Requirements

4.3.1 Requirement: The HypsIRI mission shall complete the In-Orbit Checkout (IOC) period within 60 days after launch, and then operate beyond the end of the IOC for a period long enough to meet the Science Requirements (Section 4.1).

4.4 Launch Requirements

4.4.1 Requirement: HypsIRI launch vehicle requirements will be established prior to KDP-C.

4.5 Science Measurement Validation Requirements

4.5.1 Requirement: The HypsIRI validation program shall demonstrate that retrievals of surface reflectance, water leaving radiance, temperature, emissivity and surface radiance meet the Science Requirements (Section 4.1).



Level 1 Requirements and Mission Success Criteria



5. Program Requirements

5.1 Cost Requirements

5.1.1 Requirement: The total cost for the HypsIRI mission shall include the formulation, implementation, launch, operations calibration, validation, and generation of science data products as established in 4.0.

5.1.2 Requirement: The total cost for the HypsIRI mission shall include the SDT and ST whose roles and scope are described in Section 3.1.

5.1.3 Requirement: Contributions from non-NASA partners shall be without exchange of funds between NASA and these partners.

5.1.4 Requirement: The total NASA cost for the HypsIRI mission shall be established at KDP C.

5.2 Cost Management and Scope Reduction

5.2.1 Requirement: Provided that due consideration is given to the use of budgetary and schedule reserves, the HypsIRI project shall pursue scope reduction as needed to control cost and mitigate risk. Scope reductions that reduce science capability below the baseline science mission require the concurrence of NASA SMD.

5.3 Schedule Requirements

5.3.1 Requirement: The HYSPIRI mission launch readiness date will be established at the KDP C.

5.4 External Agreement Definition

5.4.1 Requirement: All agreements between NASA and each non-NASA mission partner shall be coordinated through NASA SMD and the NASA Office of External Relations as appropriate.

5.5 Safety Requirements

5.5.1 Requirement: The HypsIRI project shall implement a Safety and Mission Assurance Plan that is consistent with requirements in NPR 8705.4 for a Class C payload mission.



Level 1 Requirements and Mission Success Criteria



6. Education and Public Engagement Requirements

6.1 Requirement: HypsIRI shall develop and execute an Education and Public Engagement Plan that utilizes unique scientific and/or engineering aspects of the mission to inspire and motivate the nation's students and teachers as well as to engage and educate the public. The plan optimizes educational and cost effectiveness and builds upon the resources and capabilities that NASA has accrued in education and public engagement.

7. Mission Success Criteria

The HypsIRI Mission will be considered successful if it:

- 7.1 Launches into a near-polar sun-synchronous orbit that provides near global coverage every 19 days for the VSWIR instrument and every five days for the TIR instrument.
- 7.2 Makes global space-based measurements of (as specified in section 4.1.2)
- 7.3 Records, calibrates, validates, publishes, and archives science data records and validated geophysical data products in a NASA Distributed Active Archive Center (DAAC) for use by the scientific and applications communities.

8. Concurrences

9. Approvals



Summary



Beginning in January 2007 a Mission Concept effort for HypsIRI Mission has been under way with involvement of NASA HQ, JPL, GSFC, and an broad Science Study Group and the 2008 Workshop.

Beginning with the call of the NASA Earth Science and Applications Decadal Survey this team has worked to develop a end-to-end concept for implementation of the HypsIRI Mission.

Based on this effort and with input from last years workshop a set of Level 1 Requirements and Success Criteria have been develop in accordance with the required NASA process.

Please keep these Level 1 Requirements and Success Criteria in mind as we proceed through the workshop.

We will review these Level 1 Requirements and Success Criteria at the end of the workshop.

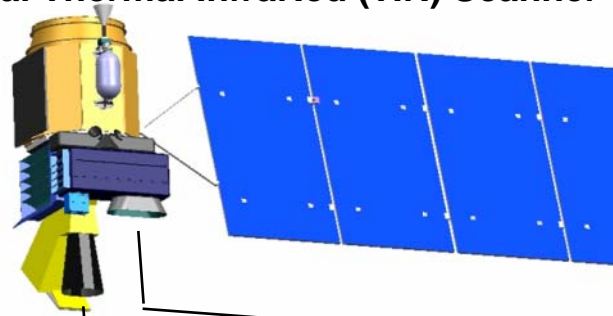
Note: The HypsIRI Mission must remain appropriately aligned with the Decadal Survey.



The HypsIRI Mission Concept



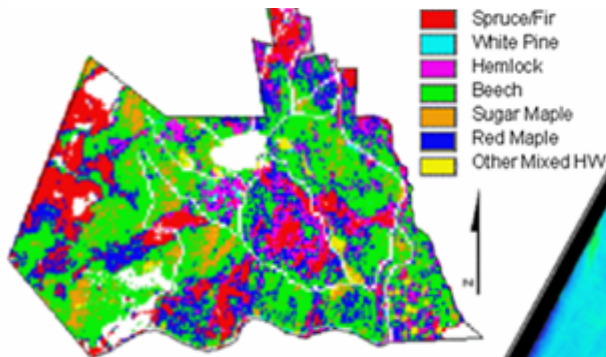
Visible ShortWave InfraRed (VSWIR) Imaging Spectrometer
+
Multispectral Thermal InfraRed (TIR) Scanner



VSWIR: Plant Physiology and Function Types (PPFT)

Multispectral TIR Scanner

Map of dominant tree species, Bartlett Forest, NH



Red tide algal bloom in Monterey Bay, CA

