HysplRI

DRAFT PRELIMINARY

Level 1 Requirements and Mission Success Criteria

NASA Earth Science and Applications Decadal Survey

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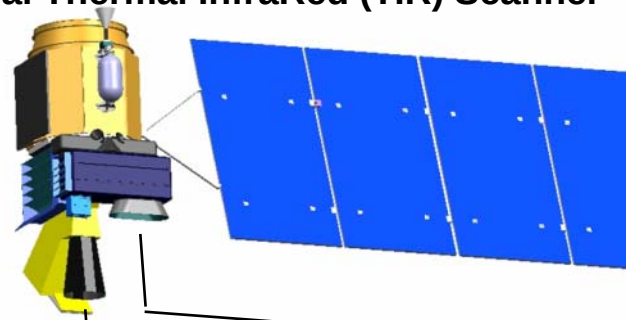
This is a Key Enabling NASA Documents for the MCR and for the life of the Mission

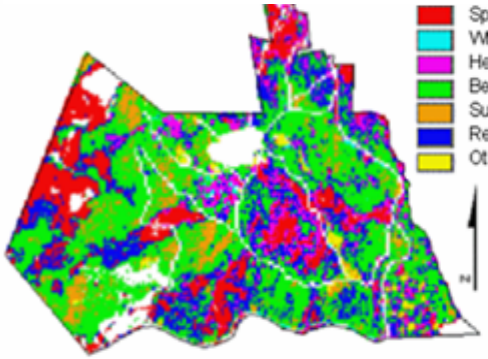
Visible ShortWave InfraRed (VSWIR) Imaging Spectrometer
+
Multispectral Thermal InfraRed (TIR) Scanner

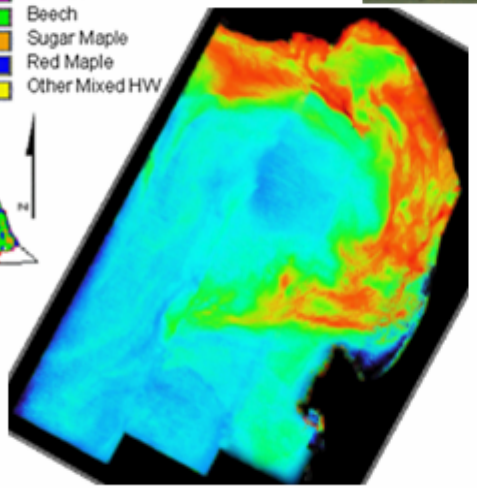


VSWIR: Plant Physiology and Function Types (PPFT)

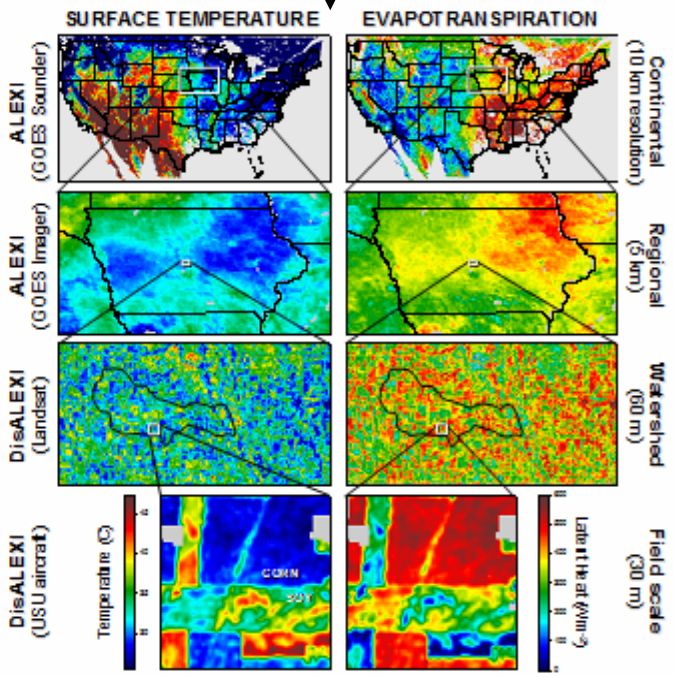
Multispectral TIR Scanner

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 HyspIRI 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 HyspIRI 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 HyspIRI to proceed to the next step in the NASA Mission process.

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

Level 1 Requirements and Mission Success Criteria

Contents

Level 1 Requirements and Mission Success Criteria

The HyspIRI Project Manager has overall management responsibility for the success of the project. The HyspIRI 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 HyspIRI, and a NASA-designated Distributed Active Archive Center (DAAC) is responsible for public distribution of HyspIRI data and long-term science data archiving.

NASA will competitively select a HyspIRI **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 HyspIRI **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

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.

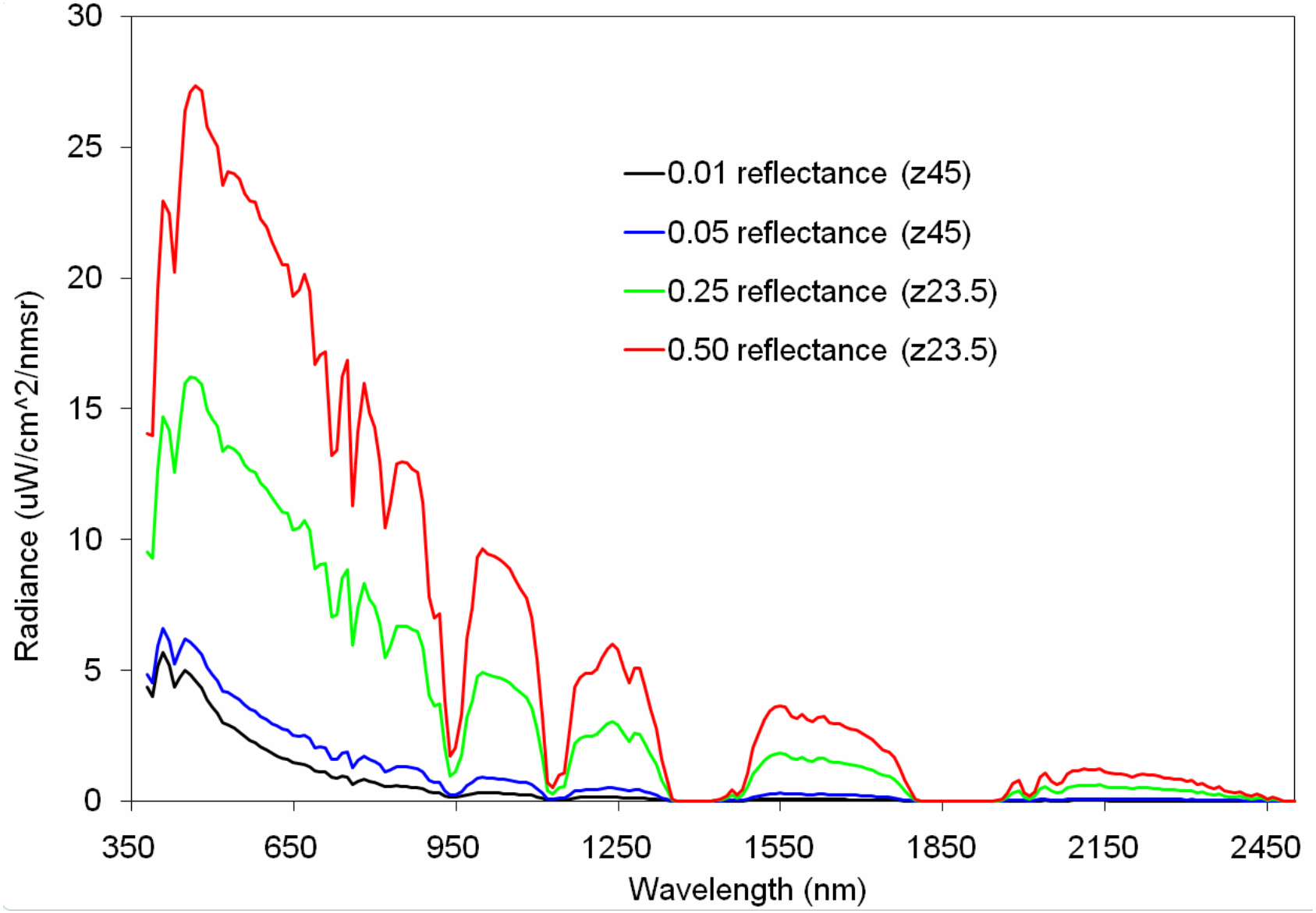
4.1.1 Requirement: Baseline Science Mission

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 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 nadir 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.

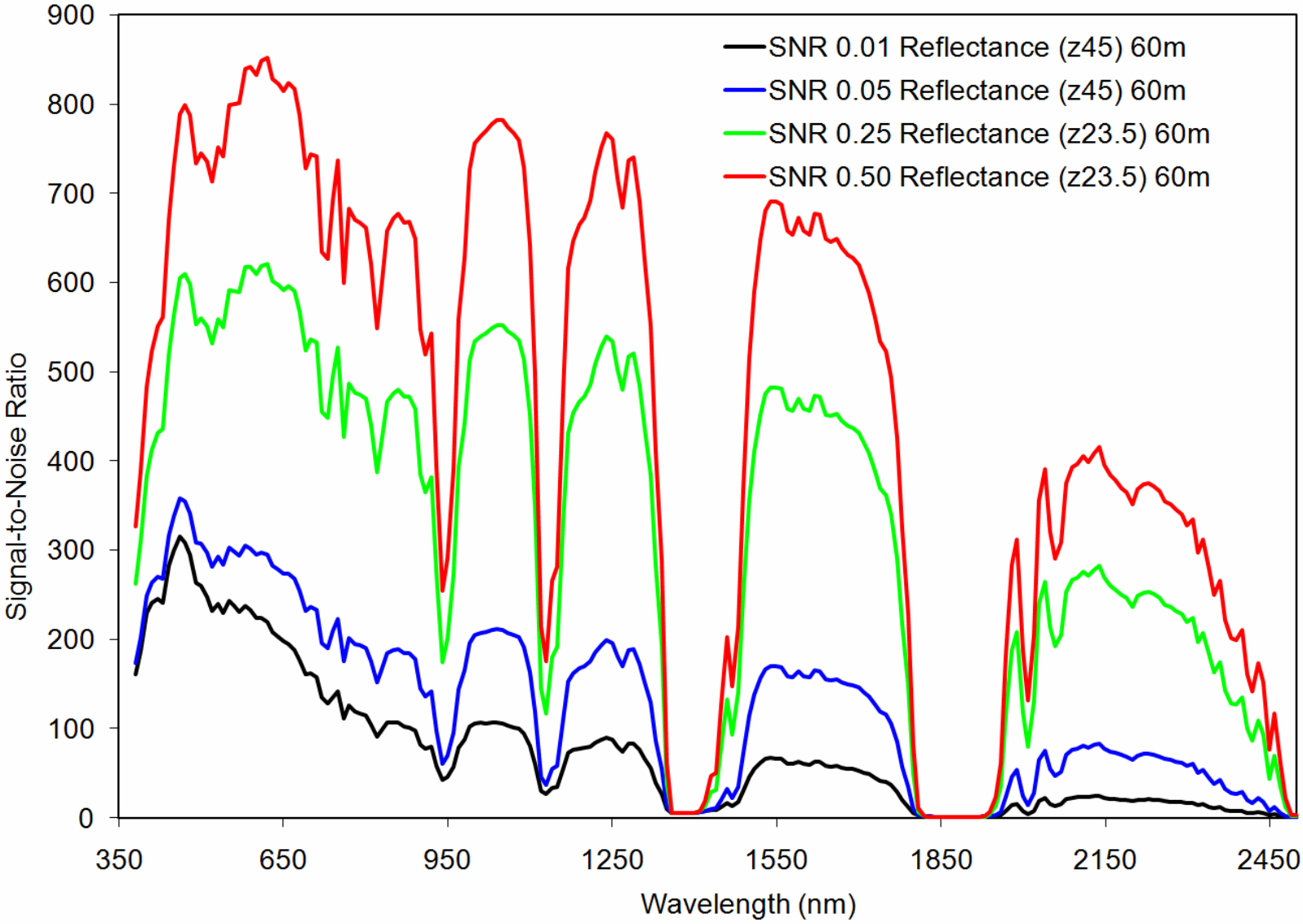
Level 1 Requirements and Mission Success Criteria (VSWIR Performance)

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
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

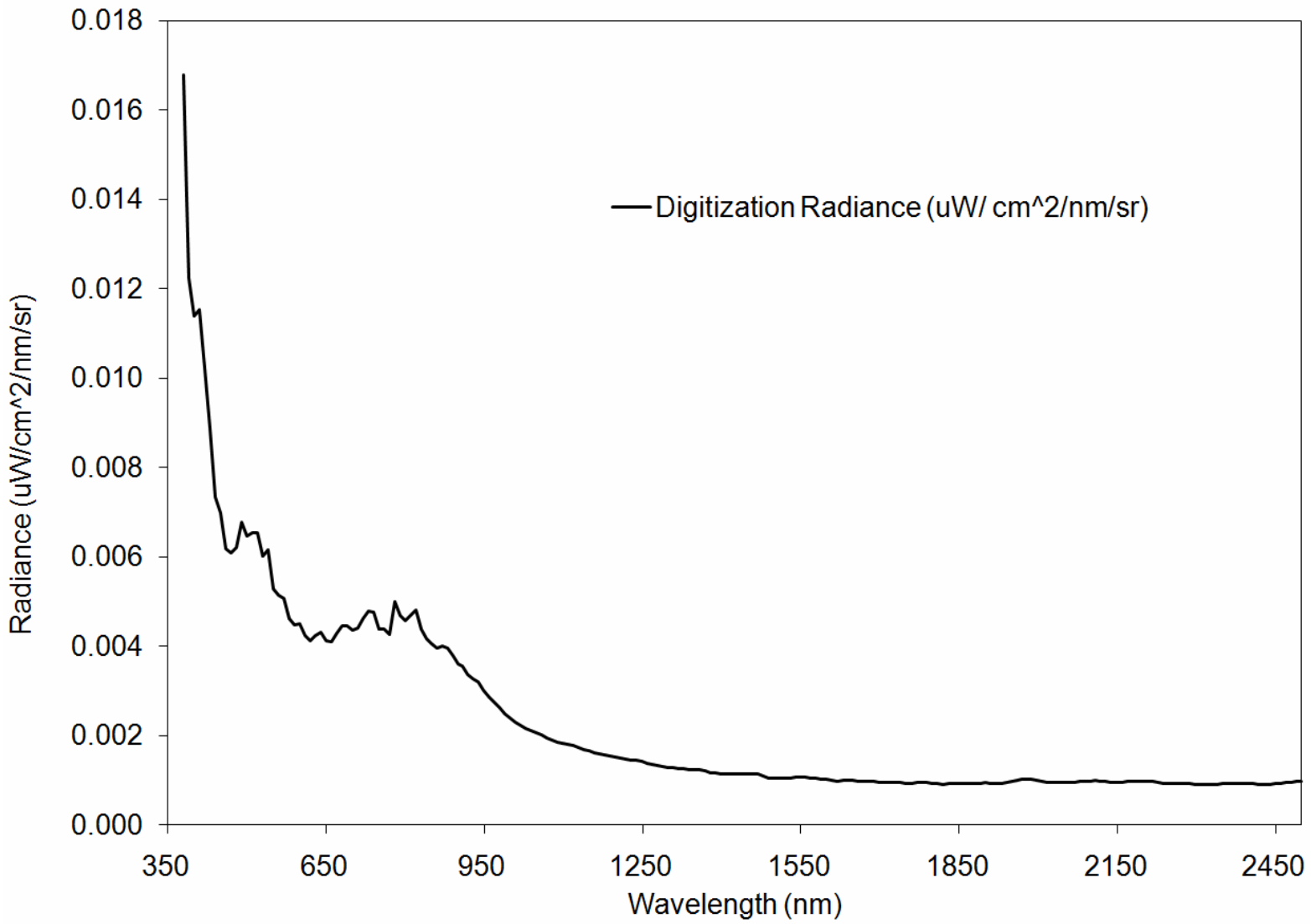
Level 1 Requirements and Mission Success Criteria
VSWIR Benchmark Radiances



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 nadir 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

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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 nadir 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.

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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 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 nadir 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 nadir 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 nadir 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.

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4.2 Data Product Requirements

4.2.1 **Requirement:** No later than six (6) months after the end of the observatory commissioning phase, the HyspIRI 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 HyspIRI 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 HyspIRI 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 HyspIRI 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:** HyspIRI launch vehicle requirements will be established prior to KDP-C.

4.5 Science Measurement Validation Requirements

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

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6. Education and Public Engagement Requirements

6.1 Requirement: HyspIRI 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 HyspIRI 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 HyspIRI 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 HyspIRI 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.

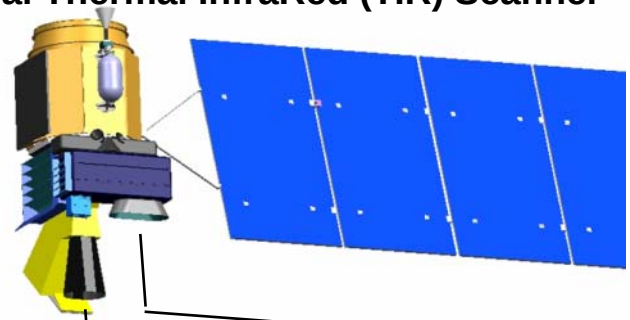
Please keep these Level 1 Requirements and Success Criteria in mind as we proceed through the workshop.

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

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

The HyspIRI Mission Concept

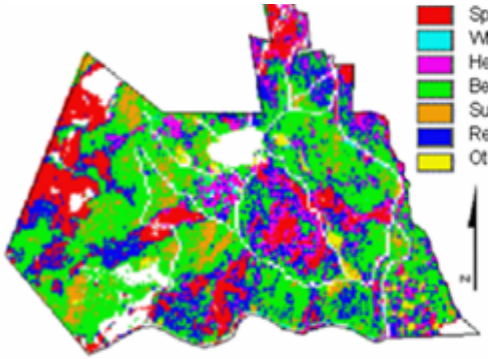
Visible ShortWave InfraRed (VSWIR) Imaging Spectrometer
+
Multispectral Thermal InfraRed (TIR) Scanner

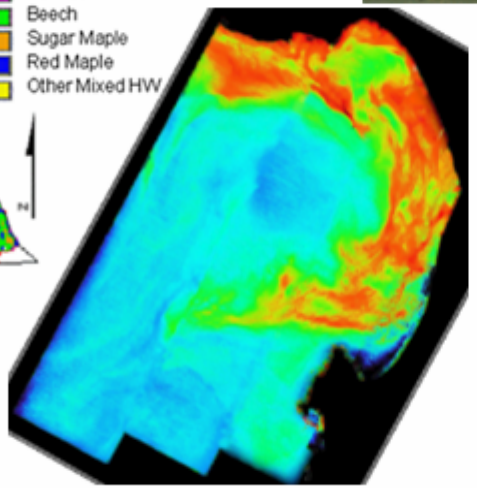


VSWIR: Plant Physiology and Function Types (PPFT)

Multispectral TIR Scanner

Map of dominant tree species, Bartlett Forest, NH





Red tide algal bloom in Monterey Bay, CA