Baseline vs Minimum

Baseline	Minimum
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	380 to 2500 nm at ≤10 nm sampling at >80% 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
>60% seasonal and >80% annual coverage of the terrestrial and shallow water regions of the Earth	> 50% seasonal and >70% annual coverage of the terrestrial and shallow water regions of the Earth
three years with a subset of measurements available near-real-time for designated science and applications.	two years.
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	8 spectral bands from the 3-5 micron and 8-12 micron regions of the spectrum at >80% the specified noise-equivalent-delta-temperature and accuracy at ≤60 m nadir spatial sampling with ≤5 day revisit
>60% Monthly, >70% seasonal and >85% annual coverage of the terrestrial and shallow water regions of the Earth	> 40% Monthly, > 60% seasonal and >70% annual coverage of the terrestrial and shallow water regions of the Earth

Note: We will keep you informed of any changes such as the change in the saturation limit of the MIR band to 1100K

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

Overview

Beginning in January 2007 a Mission Concept effort for HyspIRI Mission has been under way with involvement of NASA HQ, JPL, GSFC, and a broad Science Study Group and the 2008 workshop, 2009 workshop, 2010 symposium.

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 SSG and the relevant communities 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 review key elements of the HyspIRI draft preliminary Level 1 Requirements and Success Criteria.

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.

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Level 1 Requirements and Mission Success Criteria

Contents

DRAFT

Level 1 Requirements and Mission Success Criteria

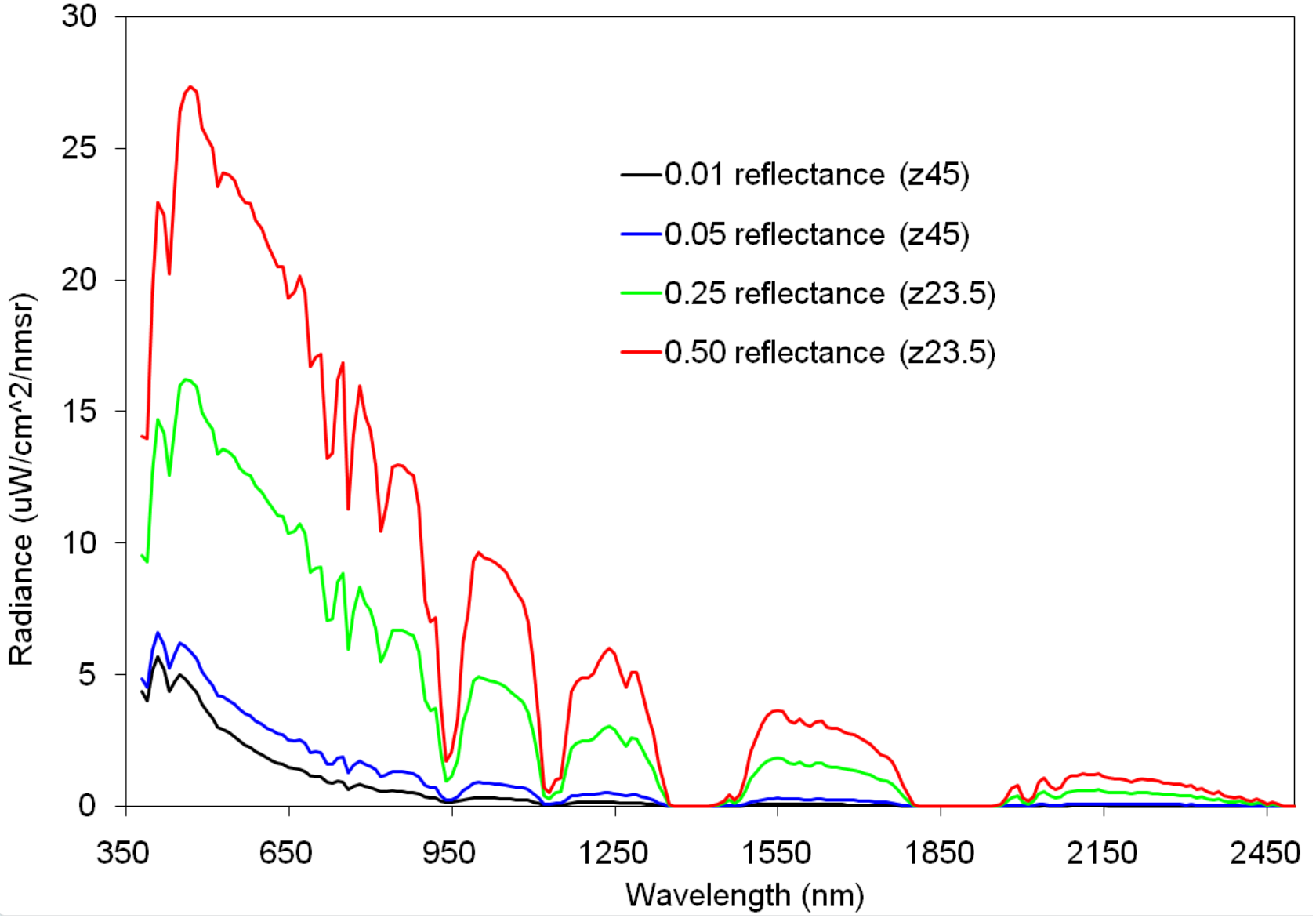
4. Performance Requirements

4.1 Science Requirements

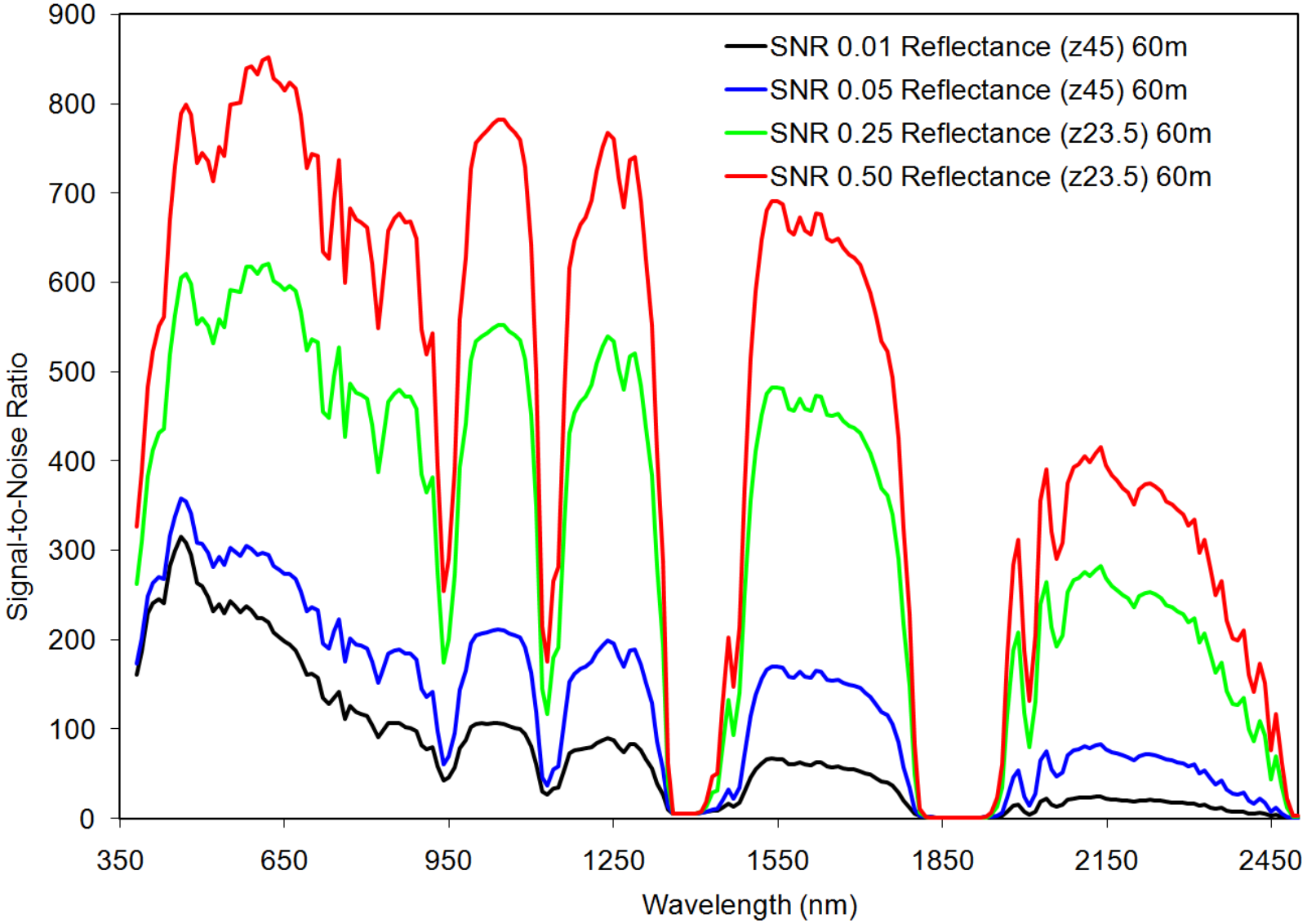
The science objectives in Section 2.2 can be achieved by either the baseline or minimum science mission requirements listed here, but the baseline mission provides substantially more value to NASA and the Earth Science Community.

- **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 or remote sensing reflectance for shallow water 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 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 Benchmark Radiances



Level 1 Requirements and Mission Success Criteria
VSWIR SNR



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
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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

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

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.

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 or remote sensing reflectance for shallow water regions across the solar reflected spectrum from 380 to 2500 nm at ≤10 nm sampling at >80% 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 >80% 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 threshold mission shall provide combined global mapping data sets.

Summary

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

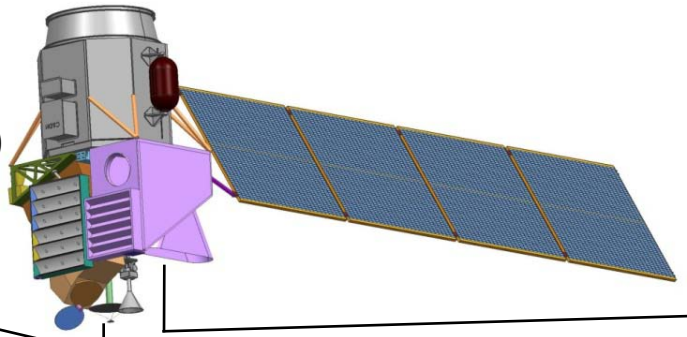
We will review these Level 1 Requirements and Success Criteria at the end of the workshop.

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

NRC Decadal Survey - HyspIRI

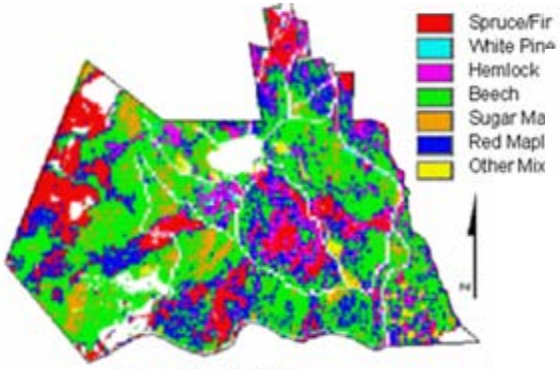
Global vegetation species-type and physiological condition, including agricultural lands, for biosphere feedback and land-atmosphere interactions; Spectroscopically derived terrestrial land cover composition/albedo including snow, ice, dust climate interaction; Fire: fuel, occurrence, intensity and recovery globally, as well as volcano emissions; Fine spatial & temporal scale measures of surface temperature and energy balance, including urban heat Islands.

Visible ShortWave InfraRed (VSWIR) Imaging Spectrometer



Multispectral Thermal InfraRed (TIR) Scanner

Map of dominant tree species, Bartlett Forest, NH



Soil C:N Ratio

White Mountain National Forest, NH