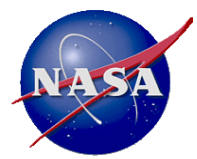


The HypIRI Separate Platforms Whitepaper

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Pre Formulation Guidance

- **from HypsIRI 2013 Pre-Formulation Review Guidance Letter:**
 - **[i.2]** Complete a draft science objectives white paper specifying the value of the individual science measurements and the potential science return of individual instruments on separate platforms.
- **Title of Whitepaper:**
 - **The Hyperspectral Infrared Imager (HypsIRI) – Science Impact of Deploying Instruments on Separate Platforms**



Status

JPL Publication 14-13



NASA 2014 The Hyperspectral Infrared Imager (HypIRI) – Science Impact of Deploying Instruments on Separate Platforms

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Prepared for

**National Aeronautics and
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by

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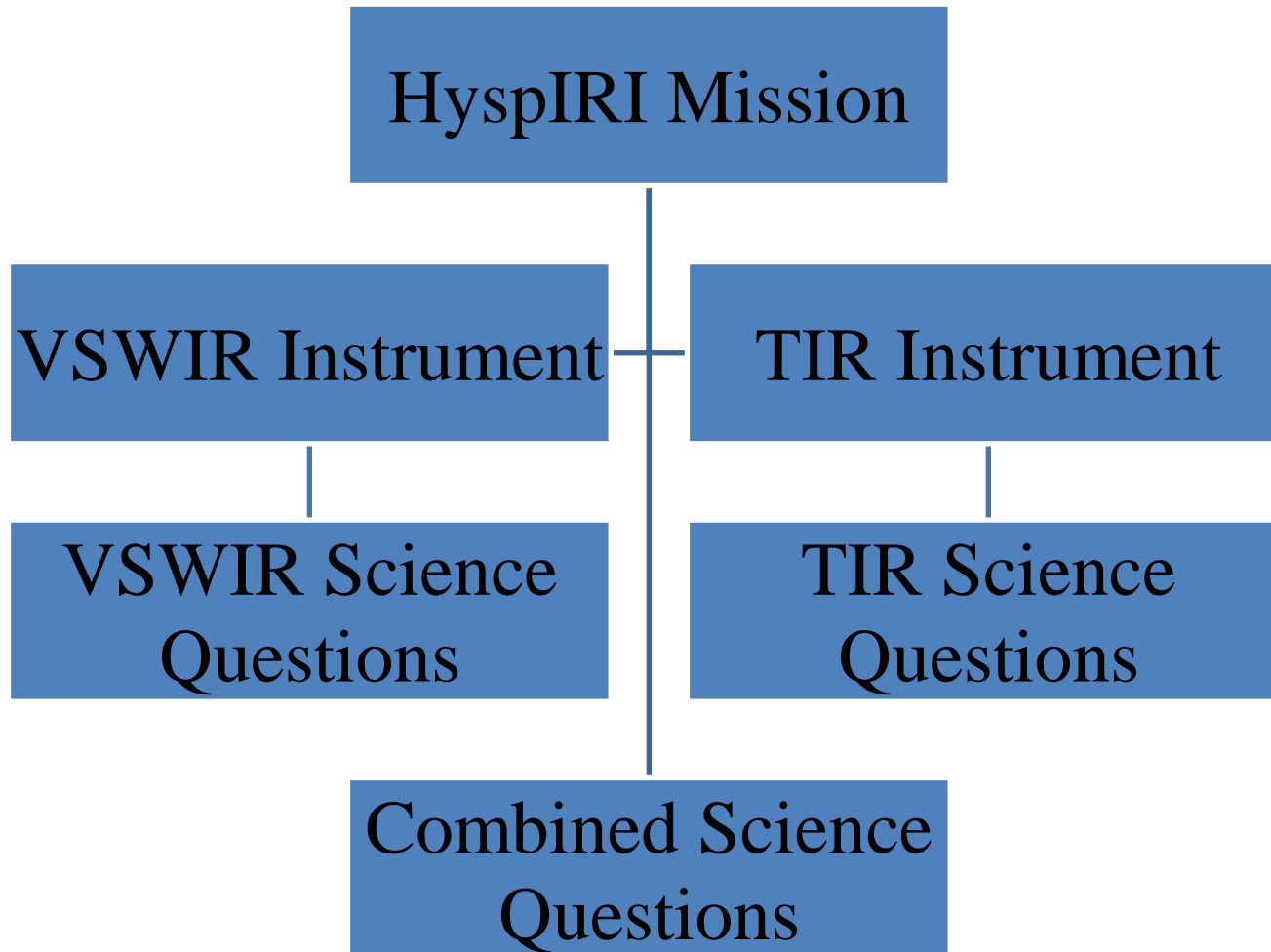
May 2014

The penultimate draft has now been completed.

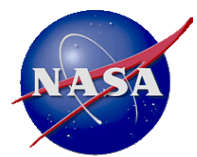
Final corrections from the SSG and Steering Committee are required by 6/6/14



Approach



Evaluate Combined Questions only which require both VSWIR and TIR data
Also looked at different overpass times and non sun synchronous orbits, e.g. ISS



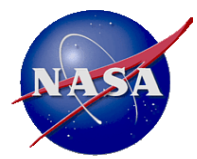
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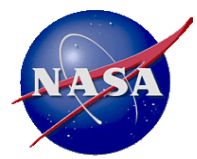
At the start of the document is:
 Abstract
 Preface
 Executive Summary

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Combined Overarching Questions

- CQ1. Coastal Ocean, and Inland Aquatic Environments
 - What is the status of inland and coastal aquatic ecosystems in the context of local and regional thermal climate, land-use change, and other environmental factors?
- CQ2. Wildfire, Fuel and Recovery
 - How are fires and vegetation composition coupled?
- CQ3. Volcanoes and Related Signatures
 - Do volcanoes signal impending eruptions through changes in the temperature of the ground, rates of gas and aerosol emission, temperature and composition of crater lakes, or health and extent of vegetation cover?
- CQ4. Ecosystem Function and Diversity
 - How do species, functional type, and biodiversity composition within ecosystems influence the energy, water and biogeochemical cycles under varying climatic conditions?
- CQ5. Earth Surface Composition and Change
 - What is the composition of exposed terrestrial surface of the Earth and how does it respond to anthropogenic and non anthropogenic drivers?
- CQ6 Human Health and Urbanization
 - How do patterns of human environmental and infectious diseases respond to leading environmental changes, particularly to urban growth and change and the associated impacts of urbanization?



CQ1. Coastal Ocean, and Inland Water Environments

CQ1. Coastal Ocean, and Inland Water Environments	VSWIR and TIR instruments (HypIRI)	VSWIR and TIR separated by < 3 minutes	VSWIR and TIR separated by < 1 week	VSWIR and TIR separated by a few months
	Percent Science Accomplished [%]			
What are the feedbacks between climate and habitat structure, biogeochemical cycling, biodiversity, and ecosystem productivity of shallow aquatic habitats?	100	90	10	0
What are the ecological linkages of landscape-scale ocean-atmosphere interactions including the hydrologic cycle, aerosol production and transport, and cloud radiative forcing?	100	90	10	0
How are small-scale processes in shallow benthic habitats related to changes in functional community types (coral reefs, submerged aquatic vegetation and floating aquatic vegetation), productivity, and biogeochemical cycling including material fluxes and water quality?	100	90	10	0
How can these observations be used to guide the management and utilization of resources in the shallow aquatic environment?	100	90	10	0
What are the seasonal expressions and cycles for terrestrial and shallow aquatic ecosystems, functional groups and diagnostic species?	100	90	10	0
What is the susceptibility and likely response in the context of changes in climate, land use, and disturbance?	100	90	10	0

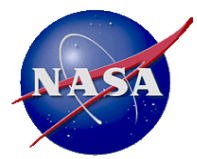
Oceans chose to assign an average value to each option, all other areas looked at impact per question. The impact of the 1 week separation was noticeably worse for oceans than for the other 5 areas.



CQ2. Wildfire, Fuel and Recovery

CQ2. Wildfire, Fuel and Recovery	VSWIR and TIR instruments (HyspIRI)	VSWIR and TIR separated by < 3 minutes	VSWIR and TIR separated by < 1 week	VSWIR and TIR separated by a few months
	Percent Science Accomplished [%]			
How does the timing, temperature and frequency of fires affect long-term ecosystem health?	100	100	100	10
How does vegetation composition and fire temperature impact trace gas emissions?	100	100	100	10
How do fires in coastal biomes affect terrestrial biogeochemical fluxes into estuarine and coastal waters and what is the subsequent biological response?	100	100	100	5
What are the feedbacks between fire temperature and frequency and vegetation composition and recovery?	100	100	100	10
How does vegetation composition influence wildfire severity?	100	100	100	10
On a watershed scale, what is the relationship of vegetation cover, soil type, and slope to frequency of debris flows?	100	100	100	10
How does invasive vegetation cope with fire in comparison to native species?	100	100	100	10

No impact if measurements separated by a week but severe impact if separated by a few months



CQ3. Volcanoes and Surface Signatures

CQ3. Volcanoes and Surface Signatures	VSWIR and TIR instruments (HypIRI)	VSWIR and TIR separated by < 3 minutes	VSWIR and TIR separated by < 1 week	VSWIR and TIR separated by a few months
	Percent Science Accomplished [%]			
What do comparisons of thermal flux and SO ₂ emission rates tell us about the volcanic mass fluxes and the dynamics of magma ascent?	100	100	90	70
Does pressurization of the shallow conduit produce periodic variations in SO ₂ flux and lava dome surface temperature patterns that may act as precursors to explosive eruptions?	100	100	100	0
Can measurements of the rate at which lava flows cool allow us to improve forecasts of lava flow hazards?	100	90	80	70
Does the temperature and composition of volcanic crater lakes change prior to eruptions?	100	100	100	0
Do changes in the health and extent of vegetation cover indicate changes in the release of heat and gas from crater regions?	100	100	100	0

Little impact if instruments separated by < 1 week. Severe impact for selected questions if measurements separated by a few months



CQ4. Ecosystem Function and Diversity

CQ4. Ecosystem Function and Diversity	VSWIR and TIR instruments (HyspIRI)	VSWIR and TIR separated by < 3 minutes	VSWIR and TIR separated by < 1 week	VSWIR and TIR separated by a few months
	Percent Science Accomplished [%]			
How can we enhance phenological & stress characterization through synergy between reflective and emitted radiation with higher frequency temporal sampling?	100	95	30	0
How is energy partitioned between latent and sensible heat fluxes as a function of different plant types and fractional cover and how does this impact hydrology?	100	95	40	0
How is physiological function affecting water and carbon exchange expressed at the ecosystem scale, especially seasonal down-regulation due to environmental stress factors?	100	95	30	0
What is the vegetation phenological response to seasonal and interannual changes in temperature and moisture due to climate change and how does this response vary at the community/species level?	100	95	40	0
What are the feedbacks between changes in canopy composition, mortality and retrieved canopy temperatures resulting from disturbances (e.g., disease, moisture deficiency, insect attack, fire, land degradation, fragmentation) in natural and managed ecosystems?	100	95	40	0
How do climate-induced temperature and moisture changes impact the distribution and spread of invasive and native species?	100	95	40	0

Severe impact if measurements separated by a few months
Larger impact if measurements separated by < 1 week



CQ5. Surface Composition and Change

CQ5. Surface Composition and Change	VSWIR and TIR instruments (HypIRI)	VSWIR and TIR separated by < 3 minutes	VSWIR and TIR separated by < 1 week	VSWIR and TIR separated by a few months
	Percent Science Accomplished [%]			
What is the composition of the exposed terrestrial surface of the Earth?	100	100	90	80
How does the surface mineralogy and soil composition relate to the plant physiology and function on the terrestrial surface of the Earth?	100	100	90	40
How is the composition of exposed terrestrial surface responding to anthropogenic and non anthropogenic drivers (desertification, weathering, disturbance e.g. logging, mining)?	100	100	30	0
How do types and distributions of altered rocks define regional trends in hydrothermal fluid flow for magmatic arcs and tectonic basins, better define hydrothermal deposit models, and assist in the discovery of new economic deposits?	100	100	100	90
How do regional trends of minerals and shale thermal maturity within basins better define depositional models and assist in the discovery of new hydrocarbon reserves?	100	100	100	90

Limited impact, except for certain questions where impact could be severe

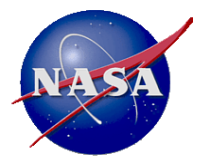


CQ6. Human Health and Urbanization

CQ6. Human Health and Urbanization	VSWIR and TIR instruments bore-sighted (HypIRI)	VSWIR and TIR separated by < 3 minutes	VSWIR and TIR separated by < 1 week	VSWIR and TIR separated by a few months
Percent Science Accomplished [%]				
How do land surface characteristics such as vegetation state, soil moisture, temperature, and land cover composition affect heat and drought, and vector- and animal-borne diseases?	100	100	80	25
What changes can be observed and measured in emissivity's of urban surfaces and how do emissivity's change for different cities around the world as they impact the urban heat island and associated land-atmosphere energy balance characteristics?	100	100	90	50
How does the distribution of urban and peri-urban impervious surfaces affect regional energy balance fluxes, hydrologic processes, biogeochemical fluxes, and what is the response of ecosystems to these changes?	100	100	100	25
What is the status and availability of freshwater resources including snow and ice and how is this related to climate variability, land-use, and population growth?	100	100	80	25

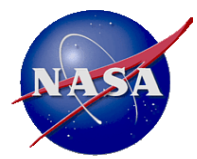
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Limited impact, except for separations of a few months



Analyzing the results

	VSWIR and TIR instruments (HyspIRI)	VSWIR and TIR separated by < 3 minutes	VSWIR and TIR separated by < 1 week	VSWIR and TIR separated by a few months
CQ1. Coastal Ocean, and Inland Water Environments	100.00	90.00	10.00	0.00
CQ2. Wildfire, Fuel and Recovery	100.00	100.00	100.00	9.17
CQ3. Volcanoes and Surface Signatures	100.00	98.00	94.00	28.00
CQ4. Ecosystem Function and Diversity	100.00	95.00	36.67	0.00
CQ5. Surface Composition and Change	100.00	100.00	82.00	60.00
CQ6. Human Health and Urbanization	100.00	100.00	87.50	31.25
	100.00	97.17	68.36	21.40



Summary and Conclusions

- Separate platforms whitepaper largely complete
- Final comments by 6/6/14
- In general:
 - Minimal impact for separation for <3 minutes.
 - Minimal impact for separation of < 1 week, except aquatic and to lesser extent ecosystem function and diversity.
 - Large impact for separation of a few months for all areas
- For Combined Science Questions requiring both VSWIR and TIR Analysis suggests:
 - VSWIR and TIR separated by < 3 minutes accomplish 97% of science
 - VSWIR and TIR separated by < 1 week accomplish 68% of science
 - VSWIR and TIR separated by a few months accomplish 21% of science
- Special thanks to the SSG for their help in putting the separate platforms whitepaper together