



HyspIRI Science Workshop

Background and Overview

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Background



- January 2007: NRC releases Earth Science & Applications from Space report (the Decadal Survey) to NASA, NOAA, & USGS
- Calls for 17 satellite missions as an integrated set of space measurements in the decade 2010-2020 (14 NASA, 2 NOAA, 1 both)
- NRC places missions in 3 temporal tiers (2010-2013, 2013-2016, 2016-2020)
- Tier 2 contains a Hyperspectral Infrared Imager or HypsIRI mission: hyperspectral imager in visible to SWIR & thermal multispectral scanner
- Targets:
 - Global ecosystem (terrestrial & aquatic) condition & change
 - Global surface temperature & emissivity measures for hazards, water use & availability, urbanization, & land surface composition & change
- Decadal Survey recommendations set boundary conditions for mission design efforts & discussions at this workshop
 - We rarely stray from them & only do so for the most compelling reasons of science, cost, mission design, etc.



HyspIRI Steering Committee



- NASA HQ
 - Woody Turner, John LaBrecque – co-Program Scientists
 - Steve Neeck – Program Executive
 - Martha Maiden – Data
 - Diane Wickland – Terrestrial Ecology
 - Paula Bontempi/Fred Lipschultz – Ocean Biology
 - Bob Smith, Amy Walton – ESTO
 - John Haynes – Applied Sciences
 - Craig Dobson – Ecosystem Structure
- JPL
 - Rob Green – VSWIR Science Lead
 - Simon Hook – TIR Science Lead
 - Francois Rogez – Mission Design
- GSFC
 - Betsy Middleton – GSFC Science Lead
 - Steve Ungar – Science & Mission Design
 - Bob Knox – Science & Mission Design
 - Jon Ranson – Science Management
- ARC
 - Matt Fladeland – Aircraft



HyspIRI Science Study Group



- Rob Green/Simon Hook JPL co-leads
- Mike Abrams JPL
- Rick Allen UID
- Martha Anderson USDA
- Greg Asner Carnegie
- Bryan Bailey/Dave Meyer USGS
- Paul Bissett FERI
- Alex Chekalyuk Lamont-Doherty
- James Crowley USGS
- Ivan Csiszar NOAA
- Heidi Dierssen UConn
- Friedman Freund ARC
- John Gamon Alberta
- Louis Giglio GSFC
- Greg Glass JHU
- Jim Irons GSFC
- Bob Knox GSFC
- Lyle Mars USGS
- Betsy Middleton GSFC
- Peter Minnett U Miami
- Frank Muller-Karger UMass
- Scott Ollinger UNH
- Anupma Prakash UAF
- Dale Quattrochi MSFC
- Vince Realmuto JPL
- Dar Roberts UCSB
- Dave Siegel UCSB
- Phil Townsend UWI
- Kevin Turpie GSFC
- Steve Ungar GSFC
- Susan Ustin UC Davis
- Rob Wright UHI



SSG Products



- Draft the scientific rationale for the HypsIRI mission
- Help design first HypsIRI Science Workshop
- Develop Overarching Science Questions & Subquestions for hyperspectral VSWIR sensor, multispectral TIR sensor, & combined VSWIR/TIR
- Questions both aquatic & terrestrial
- Draft white paper making the case for the mission around the Science Questions
- Assemble Science Traceability Matrices for each subquestion linking:

Science Questions → Measurement Objectives → Measurement Requirements → Instrument Requirements → Other Mission & Measurement Requirements

- This is how we deliberately go from science to mission requirements



Overarching Question Topics



- VQ1 Pattern in Spatial Distribution of Ecosystems
- VQ2 Ecosystem Function, Physiology & Seasonal Activity
- VQ3 Biogeochemical Cycles
- VQ4 Ecosystem Response to Disturbance
- VQ5 Ecosystems & Human Wellbeing
- VQ6 Earth Surface & Shallow Water Composition

- TQ1 Volcanoes & Earthquakes
- TQ2 Wildfires
- TQ3 Water Use & Availability
- TQ4 Human Health & Urbanization
- TQ5 Earth Surface Composition & Change

- CQ1 Coastal, Ocean, & Inland Aquatic Environments
- CQ2 Wildfires
- CQ3 Volcanoes
- CQ4 Ecosystem Function & Diversity
- CQ5 Land Surface Composition & Change
- CQ6 Human Health & Urbanization



Workshop Overview



- Guidance
 - This is a “working” workshop with interactive breakout sessions & key points captured by rapporteurs.
 - This is a Science workshop.
 - Our Science is the science called for in the NRC Decadal Survey.
- Objectives
 - Review with the broader community the work of the 2007 hyperspectral & thermal mission concept teams & the 2008 HypsIRI Science Study Group
 - Review the Science Questions
 - Review the Whitepaper
 - Review the Science Traceability Matrices for VQ’s & TQ’s (CQ Leads will seek to ensure CQ requirements captured by VQ & TQ STMs)
- Ultimate Products
 - Final HypsIRI White Paper with improved science questions
 - Updated HypsIRI Science Traceability Matrices
- **Together: Whitepaper & Traceability Matrices provide scientific rationale for the HypsIRI Mission & set the stage for mission design & tradeoffs**



Workshop Agenda - Day 1



- **AM**
 - Mission Overviews & Presentations of VSWIR Questions
 - Question Presentations by SSG members
- **PM**
 - VSWIR Breakout Sessions
 - Two 1.25 hour sessions separated by a break so we will address each of the 6 questions twice, allowing individuals to take in two sessions & provide more cross discipline interaction
 - Led by SSG members
 - Review Science Questions
 - Review Whitepaper content
 - Review STMs
 - Break to allow breakout leads & rapporteurs to prepare for Plenary
 - Plenary
 - Report on each question breakout—key issues raised, revisions to STMs & whitepaper content



Workshop Agenda - Day 2



- **AM**

- Discussion of potential HyspIRI airborne campaign(s)
 - Ideas for campaign research topics
- Presentations of TIR Questions
- TIR Breakout Section 1
- First of two 1.25 hour sessions separated by lunch addressing each of the 5 questions twice, allowing individuals to take in two sessions & provide more cross discipline interaction
 - Led by SSG members
 - Review Science Questions
 - Review Whitepaper content
 - Review STMs

- **PM**

- Second TIR breakout session
- Break to allow breakout leads & rapporteurs to prepare for Plenary
- Plenary reports from breakouts
- Special session on advanced technologies for HyspIRI mission
 - ESTO & GSFC presentations
 - Interested in ideas from the community



Workshop Agenda – Day 3



- **AM**

- Presentations of Combined Questions
- First of two 1.25 hour sessions separated by lunch addressing each of the 6 questions twice
 - Led by SSG members
 - Review Science Questions
 - Review Whitepaper content
 - Review STMs

- **PM**

- Second combined breakout session
- Break to allow breakout leads & rapporteurs to prepare for Plenary
- Plenary reports from breakouts
- Discussion & review of VSWIR & TIR measurement baselines vis-à-vis science questions
- Discussion of potential international & domestic partnerships
- Workshop review & next steps



Sample Science Traceability Matrix



Science Objectives	Measurement Objectives	Measurement Requirements	Instrument Requirements	Other Mission and Measurement Requirements
TQ1 Volcanoes and Earthquakes: How can we help predict and mitigate earthquake and volcanic hazards through detection of transient thermal phenomena?				
<p>Do volcanoes signal impending eruptions through changes in surface temperature or gas emission rates and are such changes unique to specific types of eruptions? [DS 227]</p>	<p>Detect, quantify and monitor subtle variations in: 1) surface temperatures 2) sulfur dioxide emissions at low, non-eruptive flux levels. Compilation of long-term baseline data sets.</p>	<p>Temperature measurements in the range -20 to 100 °C. TIR radiance measurements at ~8 μm; 5 other TIR bands for use in SO2 retrieval algorithm; 7 day repeat.</p>	<p>7 TIR channels, 7-12 μm Pixel size ≤60 m NEΔT ~0.02 K. >95% abs. radiometric calibration</p>	<p>Nighttime data acquisitions.</p>
<p>What do changes in the rate of lava effusion tell us about the maximum lengths that lava flows can attain, and the likely duration of lava flow-forming eruptions? [DS 226]</p>	<p>Area covered by active lava flows; Lava flow surface temperatures; Radiant flux from lava flow surfaces.</p>	<p>Temperature measurements in the range 0 to 1200 °C (active lava), and 0-50 °C (ambient background). 5 day repeat.</p>	<p>1 low gain channel at ~4 μm (NEΔT ~ 1-2 K) 2 nominal gain channels at 10-12 μm Pixel size ≤90 m Rapid bright target recovery at 4 μm (<2 pixels), bands saturate at 1200C</p>	<p>Nighttime data acquisitions. NIR/SWIR hyperspectral data is beneficial. Rapid response off nadir pointing capability. Rapid re-tasking for acquisition of targets of opportunity.</p>



REQUIREMENTS CREEP



Going Forward in 2009



- Early: With your help, HypsIRI SSG & Steering Committee will improve & complete whitepaper/STMs to demonstrate the compelling scientific case for the HypsIRI mission
 - This is your chance to strengthen the rationale for this mission through its potential scientific return
- Early: Potential ROSES call for HypsIRI precursor airborne science
- Throughout: Plan for HypsIRI Science Team
- Throughout: Continue refinement of the mission design, schedule, & cost using the Science Traceability Matrices to define requirements & explore mission-related tradeoffs
- Throughout: Initiate additional studies, as necessary, to support mission
- Late Summer: 2nd HypsIRI Science Workshop focusing on reports from relevant scientific investigations
 - We are building a cross-discipline, integrated research community
 - Big question science for/from a mission with multiple capabilities
- Late: HypsIRI ready for Mission Concept Review & transition to Phase A status