meeting summaries

2014 HyspIRI Product Symposium Summary

David Landis, *NASA's Goddard Space Flight Center/Sigma Space Corporation, david.r.landis@nasa.gov*
Betsy Middleton *NASA's Goddard Space Flight Center, elizabeth.m.middleton@nasa.gov*
Lisa Henderson, *NASA's Goddard Space Flight Center/Sigma Space Corporation, lisa.henderson@nasa.gov*

Introduction

The Hyperspectral Infrared Imager (HyspIRI) satellite-based mission will study the world's ecosystems and provide critical information on natural disasters such as volcanoes, wildfires, and drought. Data from HyspIRI will be used for a wide variety of studies primarily in the role of the carbon cycle in ecosystem processes, and Earth surface and interior phenomena.

The mission will provide a benchmark on the state of the world's ecosystems, against which future changes can be assessed. The mission will also assess the pre-eruptive behavior of volcanoes and the likelihood of future eruptions, as well as the carbon and other gases released from wildfires.

HyspIRI will operate in low-Earth orbit, and includes two instruments: an imaging spectrometer that will take measurements from visible to short-wave infra-red (VSWIR) wavelengths in contiguous 10-nm bands between 380 and 2500 nm, and a multispectral imager that will take measurements in the mid- and thermal-infrared (TIR) region of the spectrum between 3 and 12 μm. The VSWIR and TIR instruments both have a spatial resolution of 60 m (~197 ft) at nadir. The VSWIR spectrometer will have global coverage every 19 days; the TIR instrument will have global coverage every 5 days (due to a larger swath width). HyspIRI also includes an Intelligent Payload Module (IPM), which will enable direct broadcast of a subset of the data for immediate needs, such as disaster aid.

The mission was recommended as a *Tier 2* priority in the 2007 National Research Council Decadal Survey that was requested by NASA, the National Oceanic and Atmospheric Administration (NOAA), and U.S. Geological Survey (USGS). HyspIRI is in the Pre-formulation Phase of its development, and has not had an official launch date assigned. Additional information on the mission may be found at the HyspIRI website at *hyspiri.jpl.nasa.gov.*

Meeting Overview

More than 120 scientists gathered on June 4-5, 2014, for the fourth annual HyspIRI Product Symposium at NASA's Goddard Space Flight Center (GSFC) in Greenbelt, MD. This year's symposium theme was *HyspIRI: Enabling the Evolution of Land Imaging with New Approaches and Products,* with a special focus on understanding how HyspIRI data can help address sustainable land-imaging requirements.

The symposium incorporated seven sessions that addressed:

- HyspIRI's evolving mission and products;

- compatibility with other U.S. missions and the Sustainable Land Imaging (SLI) initiative;

- ecosystem studies and aquatic ecology;

- public health and disasters;

- new HyspIRI-like datasets, instrument and data calibration issues, and product validation;

- the IPM; and

- ground data processing and distribution.

The symposium included 41 presentations, 6 posters, and 2 demonstration sessions, with discussion of approaches to developing new potential products in land and coastal imaging. Owing to the depth and breadth of information provided at the workshop, only an upper-level summary will be provided here. The full workshop agenda, presentations, and speakers list are available at the HyspIRI symposium website at *hyspiri. jpl.nasa.gov/events/2014-hyspiri-science-symposium.*

Day 1

Opening Comments

The opening session, on *Evolving the HyspIRI Mission and Products,* began with **Betsy Middleton** [GSFC] giving an overview of the symposium. Then **Woody Turner** [NASA Headquarters (HQ)—*Program Scientist for Biological Diversity* and *Program Manager for Ecological Forecasting*] presented the 2014 guidance

study on the status of the HyspIRI mission and discussed current activities. **Steve Volz** [NASA HQ—*Associate Director for Flight Programs*[1]] provided an update on *NASA's Evolving Vision for Space* and described how the HyspIRI mission fits into that framework. **Rob Green** [NASA/Jet Propulsion Laboratory (JPL)] summarized the *Comprehensive Mission Report, 2008-2013*. **Jacqueline Lemoigne** [GSFC] discussed the challenges with the systems architecture for distributed spacecraft missions by identifying cost and risk implementation of future NASA missions. Finally, **Simon Hook** [JPL] talked about a *white paper* summary on the science impact of deploying VSWIR and TIR instruments on separate platforms (*hyspiri.jpl.nasa.gov/downloads/reports_whitepapers/HyspIRI-Separate-Platforms-Whitepaper-140722-1326.pdf*).

[1] As of November 2, 2014, Volz left NASA to lead NOAA's Satellite and Information Service (NESDIS).

Technical Sessions

Petya Campbell [University of Maryland, Baltimore County (UMBC)] chaired the first technical session, *HyspIRI's Compatibility with other U.S. Missions and the SLI initiative*; presentations in this session are summarized in **Table 1**. **Susan Ustin** [University of California, Davis] chaired the second session, on *HyspIRI's Scientific Products for Ecosystem Studies*, with presentations in this session summarized in **Table 2**. **Kevin Turpie** [UMBC] and **Jeff Luvall** [NASA's Marshall Space Flight Center (MSFC)], chaired the next sessions on *Aquatic Ecology, Public Health, and Disasters*, with presentations summarized in **Table 3**.

Table 1: Day 1, Session 1 Technical Presentations: HyspIRI's Compatibility with Other U.S. Missions and the SLI Initiative.

Presenter(s)	Affiliation	Topic
Del Jenstrom and **Jeff Masek**	GSFC	Architecture Study Scope & Methods/Hyperspectral Imaging and Sustainable Land Imaging (SLI)
Ray Byrnes	USGS	SLI for USGS
Miguel Roman	GSFC	Committee for Earth Observation Satellites (CEOS) Essential Climate Variables and SLI
Jim Irons	GSFC	Overview of Landsat 8 and the Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)
Robert Wolfe	GSFC	Overview of the Visible Infrared Imaging Radiometer Suite (VIIRS) and Moderate Resolution Imaging Spectroradiometer (MODIS) instruments
Carlos Del Castillo	GSFC	Pre-Aerosol, Cloud, and Ocean Ecosystem (PACE) mission

Table 2. Day 1, Session 2 Technical Presentations: HyspIRI's Scientific Products for Ecosystem Studies.

Presenter	Affiliation	Topic
Fred Huemmrich	UMBC	Retrieving light use efficiency (LUE) using Hyperion data and how this could be done with HyspIRI on a global scale
Qingyuan Zhang	UMBC	Retrieving the new fraction of incident photosynthetically active radiation absorbed by chlorophyll (faPARchl) product from space
Ben Cheng	Sigma Space Inc.	Retrieving Gross Primary Production in Forests and Agriculture
Ray Kokaly	USGS	Vegetation Feature Analysis and Spectral Comparison Using the USGS Processing Routines in IDL for Spectroscopic Measurements (PRISM) Software
Philip Townsend	University of Wisconsin	The Ecosystem Spectral Information System (EcoSIS)
Saurabh Prasad	University of Houston	Mapping Fire Scars Using Hyperspectral Imagery and Kernel Based Image Analysis
Wesley Moses	U.S. Naval Research Lab (NRL)	Coastal Remote Sensing Using the Hyperspectral Imager for Coastal Oceans (HICO*): Results, Challenges and Applications for HyspIRI

*HICO flies onboard the International Space Station and is a special camera that separates light into hundreds of wavelengths to reveal details about the Earth's coasts, including water depth and visibility.

Table 3. Day 1, Session 3 Technical Presentations: Aquatic Ecology, Public Health, and Disasters.

Presenter	Affiliation	Topic
Wesley Moses	NRL	HyspIRI Aquatic Studies Group (HASG) Activities
Joseph Ortiz	Kent State University	Decomposition of Hyperspectral Data for use in Case 2 Environments
Arnold Dekker	Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Role of Space Borne Imaging Spectrometry in Global Water Quality Monitoring
John Haynes	NASA HQ	Health and Air
Stuart Frye	Stinger Ghaffarian Technologies (SGT)	CEOS Disaster Risk Management for Societal Benefit activities
Rick Wessels	USGS	Monitoring North Pacific Volcanoes with near-real-time satellite data
Mike Ramsey	University of Pittsburgh	SLI Requirements to Monitor Surface Soil Moisture with HyspIRI-like Data

Day 2

Day two started with **Rob Green** [JPL] and **Steve Ungar** [GSFC] chairing a session on *New HyspIRI-like Datasets and HyspIRI Calibration Topics*. Presentations in this session are summarized in **Table 4**. D**an Mandl** (GSFC) chaired the next session, on *The Intelligent Payload Module (IPM)*, with presentations summarized in **Table 5**.

Table 4. Day 2, Session 1 Technical Presentations: New HyspIRI-like Datasets and HyspIRI Calibration.

Presenter	Affiliation	Topic
Ian McCubbin	GSFC	An overview of the HyspIRI airborne campaign
Rob Green	JPL	Level 2 processing of the Airborne Visible/InfraRed Imaging Spectrometer (AVIRIS) HyspIRI Preparatory Campaign measurements
Jorge Gonzales	NOAA	HyspIRI Flight Campaigns for Summer Sea-Land Thermal Gradients and Sea-Breezes in Los Angeles, CA
Bo-Cai-Gao	NRL	An overview on atmospheric correction of hyperspectral imaging data from aircraft and satellites
Pat Cappelaere	Vightel	A demonstration on getting processed satellite data onto smart phones and tablets using social media
Rob Green	JPL	Calibration and validation of AVIRIS Classic (C) and AVIRIS Next Generation (NG)
Joel McCorkel	GSFC	Overview on calibrating Landsat-7 and 8 and current and upcoming hyperspectral instruments
Chris Neigh	GSFC	Hyperion long-term stability at the Libya-4 desert calibration site
Lawrence Ong	Science Systems and Applications, Inc. (SSAI)	Earth Observing-1 (EO-1) calibration
Steve Ungar	GSFC	Geo-correction or geo-corruption using various pushbroom systems

Table 5. Day 2, Session 2 Technical Presentations: The Intelligent Payload Module.

Presenter	Affiliation	Topic
Dan Mandl	GSFC	IPM concept evolution
Vuong Ly	GSFC	IPM prototype and metrics for data processing components
Steve Chien	JPL	Generation of Landsat 8 data products onboard EO-1
Charles Norton	JPL	CubeSat technology flight validation and the Intelligent Payload Experiment (IPEX)
Steve Chien	JPL	Flight validation of HyspIRI IPM concepts on IPEX CubeSat
Chris Wilson	University of Florida	A multifaceted hybrid system for space computing
Vuong Ly	GSFC	Update on the NASA data cloud
Maria Patterson	University of Chicago	Cloud-based scanning analytics for hyperspectral data
Molly Brown	GSFC	Overview of NASA's mFarms (African farmers getting crop-related science data on their cell phones);
Pat Cappelaere	Vightel	OpenGeoSocial Application Programming Interface (API): Product Discovery/Distribution via Social Networks
John Evans	Global Science and Technology, Inc. (GST)	Distributed architecture for satellite observation support of disasters

Day 3

On the final day of the meeting, **Kevin Turpie** [UMBC] hosted a meeting of the HyspIRI Aquatic Study Group (HASG). Presentations during the meeting are summarized in **Table 6**. As an added benefit, **Ray Kokaly** [USGS] facilitated a one-day tutorial on custom processing routines for spectroscopic measurements using ENVI image processing software.

Table 6. Day 3: HyspIRI Aquatic Study Group Presentations.

Presenter(s)	Affililation(s)	Topics
Kevin Turpie	UMBC	HASG overview and progress report
Liane Guild and **Sherry Palacios**	NASA's Ames Research Center	Phytoplankton functional types and coastal water quality
Heidi Dierssen	University of Connecticut	The Portable Remote Imaging Spectrometer (PRISM) airborne hyperspectral instrument and observations of submerged aquatic vegetation
Bo-Cai Gao	NRL	Atmospheric correction of satellite images taken over water

Summary

The participants presented valuable information on the HyspIRI Mission. A clear conclusion of the meeting was that successful use of HyspIRI data and implementation of an information system and improved technology (such as IPM) will produce a better and more usable set of global-scale products.

The next HyspIRI Science and Applications Workshop will be held October 14-16, 2014, in Pasadena, CA. ▬

meeting summaries