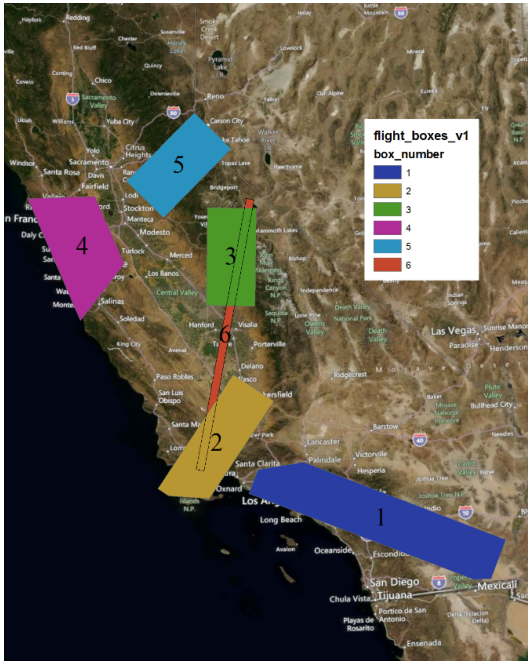
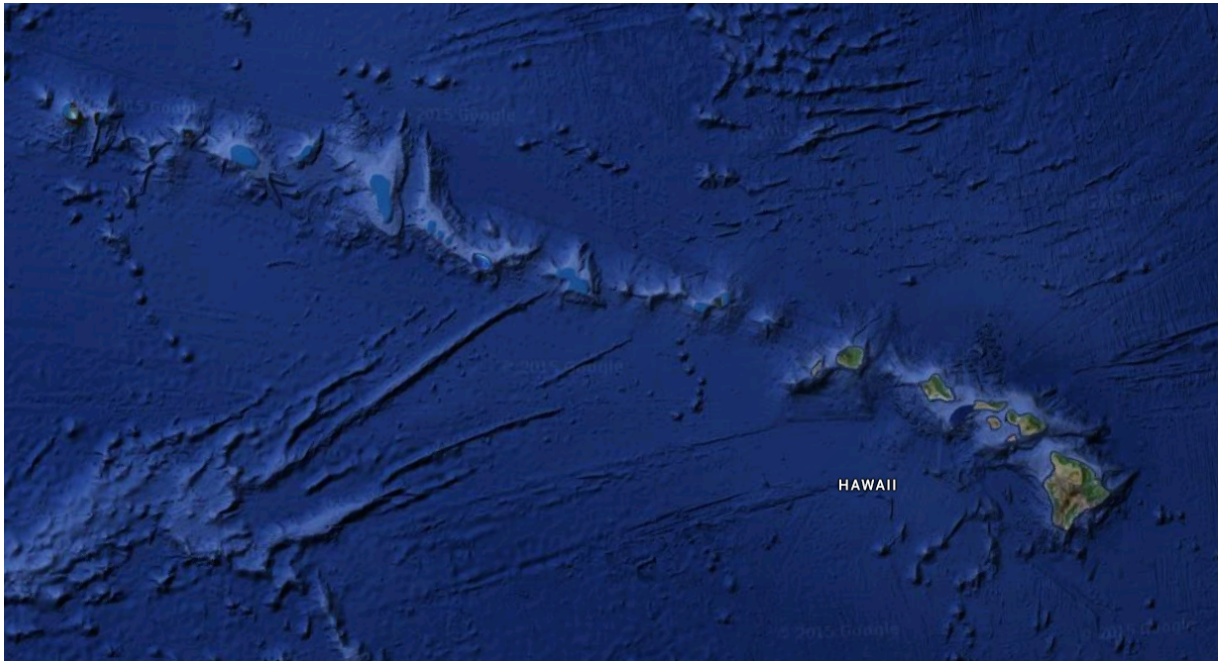
HysplRI Preparatory Airborne Campaigns

Western US: Diversity



Hawaii: Volcanoes and Coral Reefs

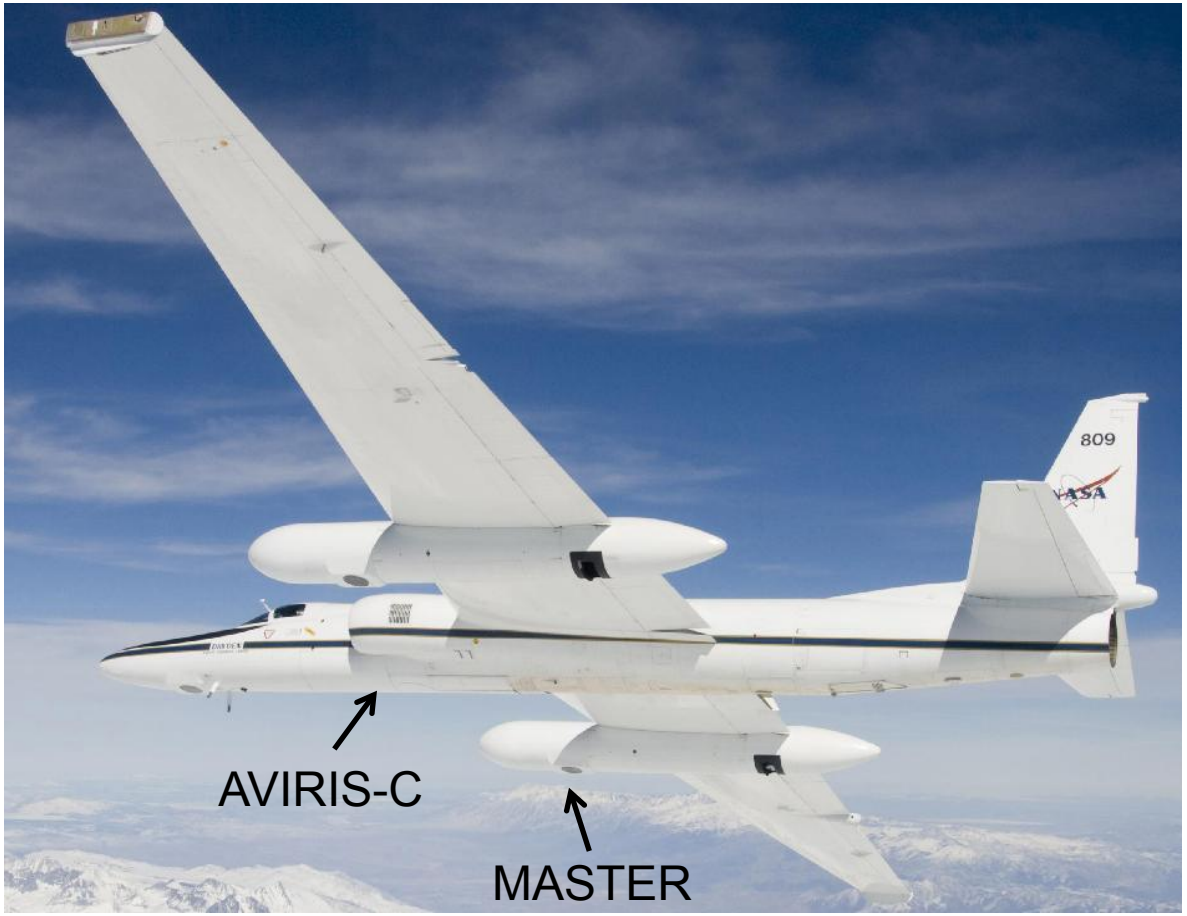


Robert O. Green1 and The HysplRI Community

1Jet Propulsion Laboratory, California Institute of Technology

Preparatory Measurements to Simulate HyspIRI Flights Over California Based from NASA Armstrong

ER-2	*AVIRIS*	*AVIRIS*	*MASTER*	*MASTER*
Altitude	*Resolution*	*Swath*	*Resolution*	*Swath*
65,000 ft	*20 m*	*12 km*	*50 m*	*35 km*



AVIRIS (VSWIR)

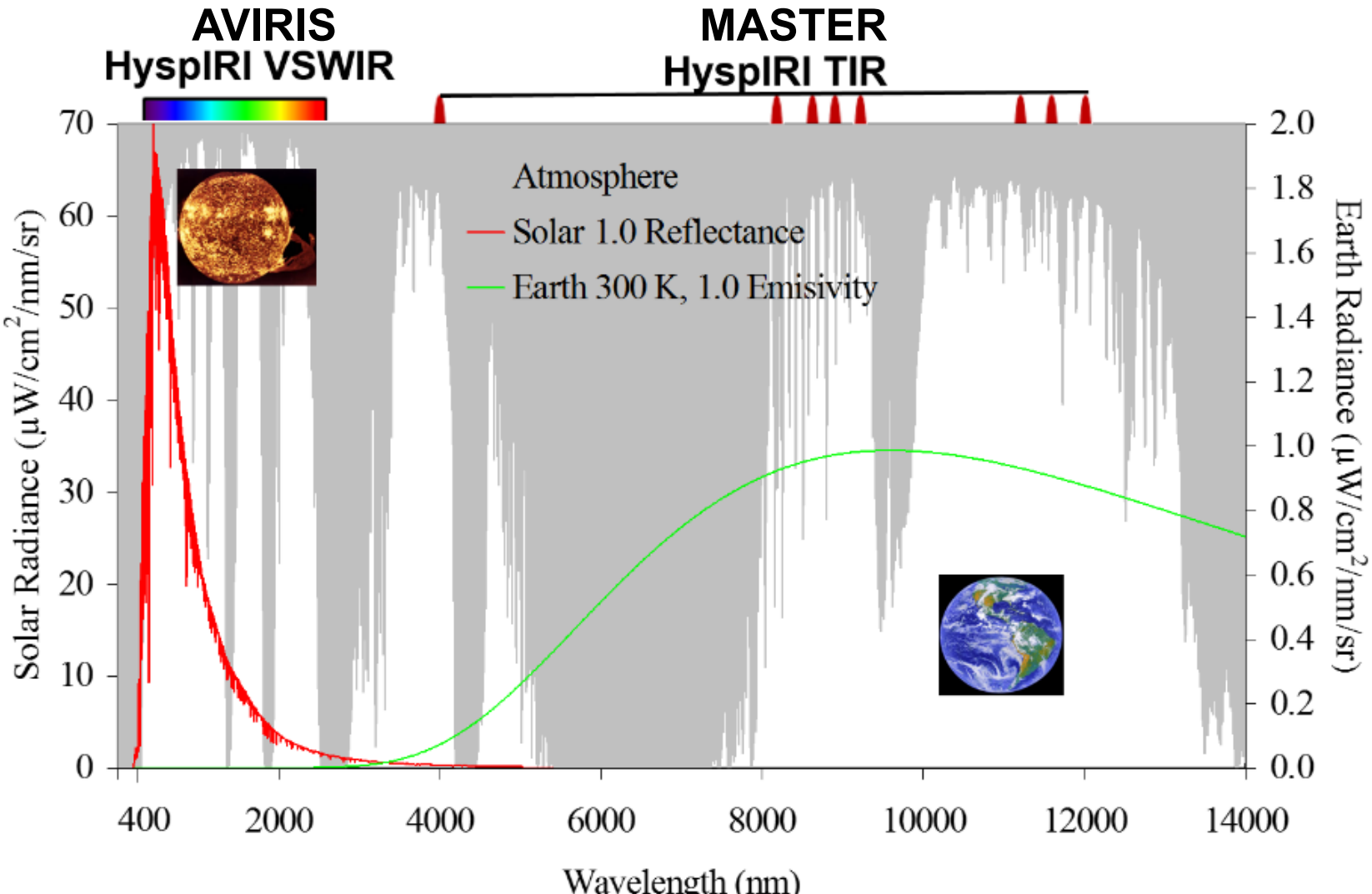
- 10 nm spectral resolution
- 224 bands
- 400-2500 nm
- 1 mrad IFOV
- 34 degree FOV

MASTER (TIR)

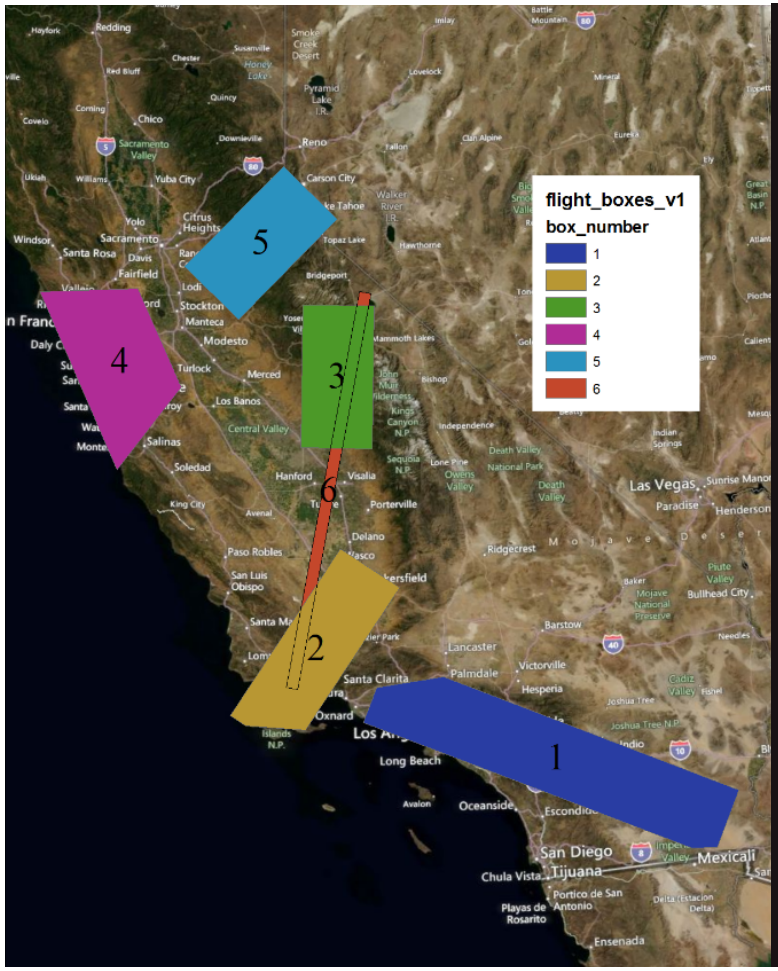
- 50 bands
- 0.4-13 um
- 2.5 mrad IFOV
- 85.92 degrees FOV

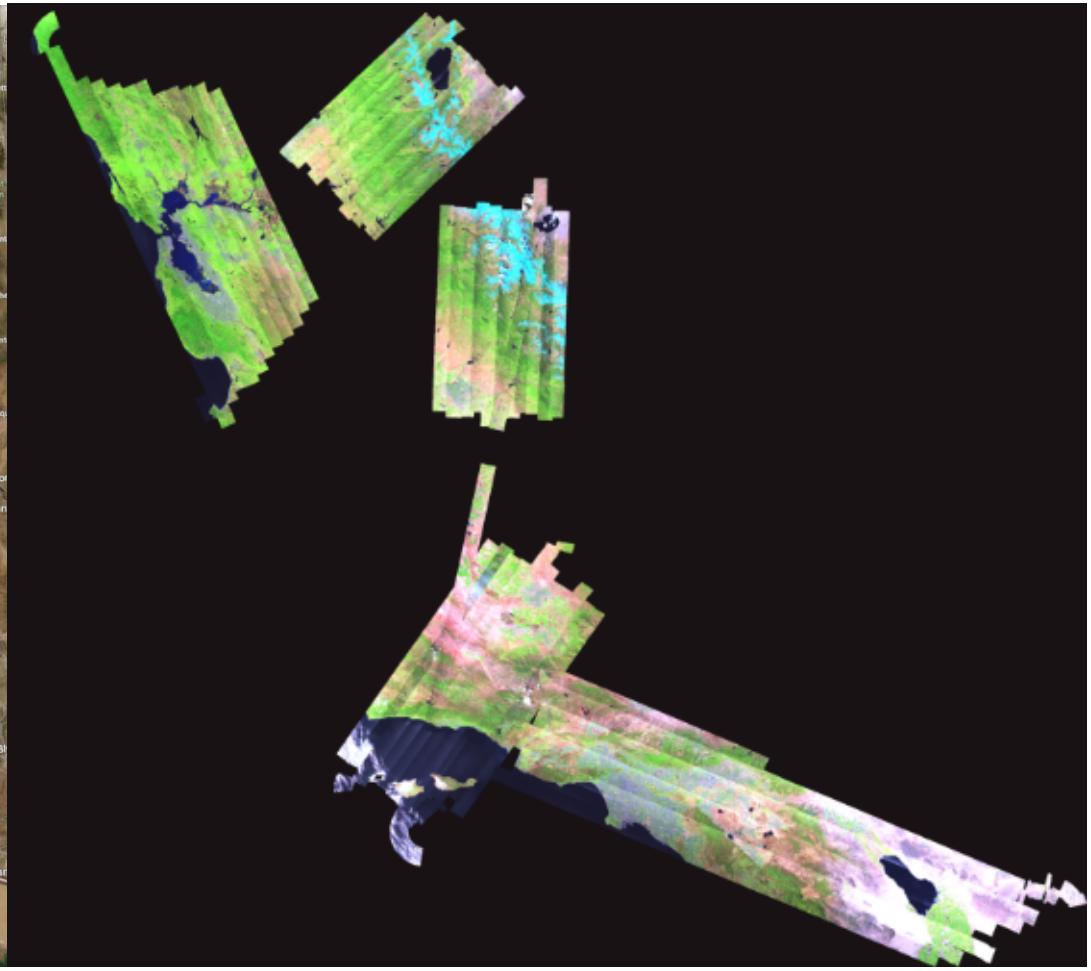
Key HyspIRI Measurements Characteristics

- Global terrestrial and coastal VSWIR spectroscopy at 30 m, 16 days and multispectral TIR at and 60 m.



Example 2013 Spring Mosaics





3 Seasons and 3 Years

Original 14 Investigations

PI	Organization	Investigation
Paul Moorcroft	Harvard	Linking Terrestrial **Biosphere Models** with Imaging Spectrometry Measurements of Ecosystem Composition, Structure, and Function
Dar Roberts	UC Santa Barbara	HyspIRI discrimination of **plant species** and functional types along a strong environmental-temperature gradient
Philip Townsend	UWI	Measurement of **ecosystem metabolism** across climatic and vegetation gradients in California for the 2013-2014 NASA AVIRIS/MASTER airborne campaign
Susan Ustin	UC Davis	Identification of **Plant Functional Types** By Characterization of Canopy Chemistry Using an Automated Advanced Canopy Radiative Transfer Model
Matthew Clark	Sonoma State	Spectral and temporal discrimination of **vegetation cover** across California with simulated HyspIRI imagery
Bo-Cai Gao	NRL	Characterization and **Atmospheric Corrections** to the AVIRIS-Classic and AVIRISng Data to Support the HyspIRI Preparatory Airborne Activities
Bernard Hubbard	USGS	Using simulated HyspIRI data **for soil mineral mapping**, relative dating and flood hazard assessment of alluvial fans in the Salton Sea basin, Southern California
George Darrel Jenerette	UC Riverside	Assessing Relationships Between **Urban Land Cover, Surface Temperature, and Transpiration** Along a Coastal to Desert Climate Gradient
Thomas Kampe	NEON	Synergistic high-resolution airborne measurements of ecosystem structure and process at **NEON** sites in California
Raphael Kudela	UC Santa Cruz	Using HyspIRI at the Land/Sea Interface to Identify **Phytoplankton Functional Types**
Ira Leifer	Bubbleology	Hyperspectral imaging spectroscopic investigation of California natural and anthropogenic fossil **methane** emissions in the short-wave and thermal infrared
Shunlin Liang	UMD	Characterizing **surface energy budget** of different surface types under varying climatic conditions from AVIRIS and MASTER data
Jan van Aardt	RIT	Investigating the impact of spatially-explicit **sub-pixel structural variation** on the assessment of vegetation structure from HyspIRI data
Wendy Calvin	UNV	**Energy and Mineral Resources**: Surface composition mapping that identifies resources and the changes and impacts associated with their development

Drought Impacts on Vegetation Species Measured Using Simulated VSWIR Products

Phil Dennison[1], Austin Coates[1], Dar Roberts[2], Ken Dudley[1], and Keely Roth[3]

[1]University of Utah [2]UC Santa Barbara [3]UC Davis

Objective

• Determine the impacts of California's record drought on vegetation species cover and condition

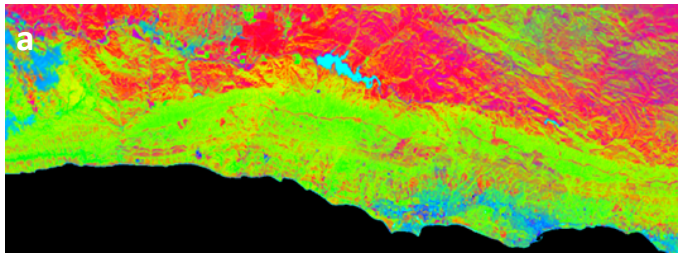
Approach

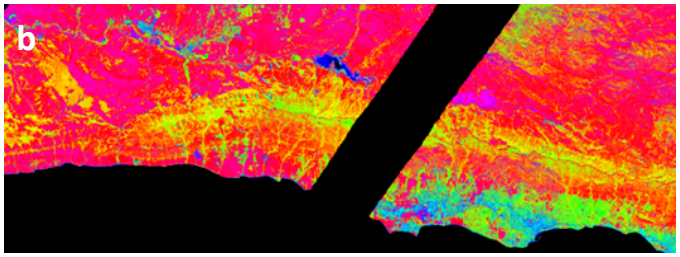
• HyspIRI VSWIR data can resolve differences between non-photosynthetic vegetation (NPV) and soil, measure canopy water absorption, and map dominant vegetation species

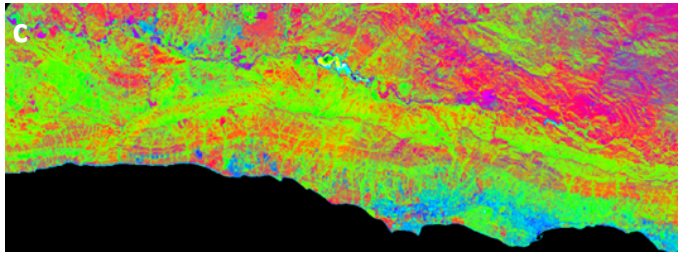
-Increased NPV fractional cover indicates senescence and canopy dieback

-Decreased liquid water thickness, a measure of canopy water content, indicates loss of leaf area and moisture

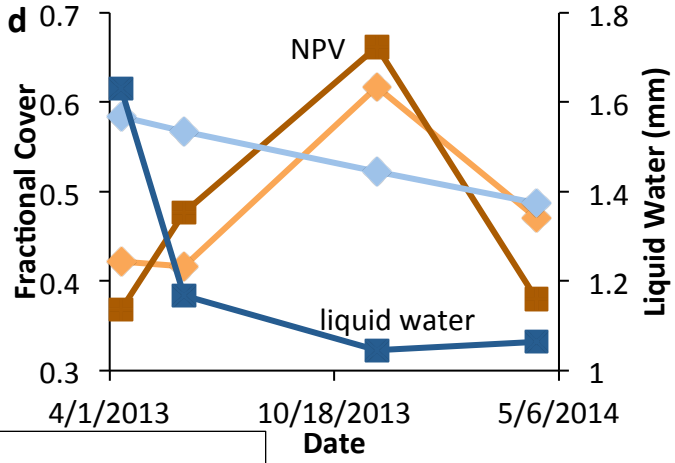
• Fractional cover and liquid water were calculated from simulated HyspIRI VSWIR products for 2013 and 2014 (2nd and 3rd year of drought).







a. Apr. 2013 normalized NPV, GV, and soil fractions; b. November 2013 fractions;
c. April 2014 fractions; d. Species time series NPV and liquid water thickness for ADFA (light shades) and CEME (dark shades)



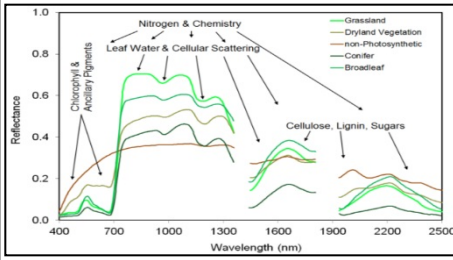
Results

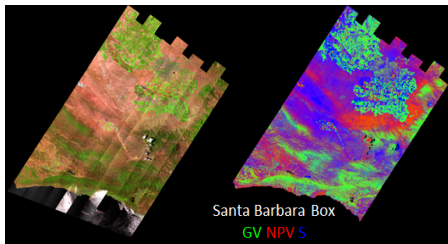
• Grassland and coastal sage scrub phenology dominate the short term change in fractional cover and liquid water when comparing April 2013 to June 2013

• Evergreen chaparral has strong increases in NPV fraction, indicating canopy dieback, when comparing April 2013 to June 2013 and November 2013

• Rainfall in late February/early March 2014 resulted in (likely temporary) recovery in NPV fraction, but minimal recovery in liquid water

• Ceanothus is more sensitive to long term drought compared to chamise, but also exhibits more recovery in GV and NPV fractions following rain





HyspIRI VSWIR Vegetation Species Mapping Across Seasons

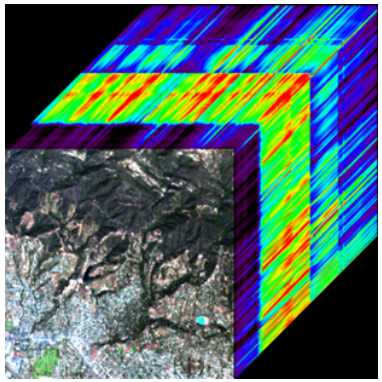
Kenneth Dudley (grad student), **Phil Dennison** – Univ. of Utah, **Dar Roberts** – UC Santa Barbara

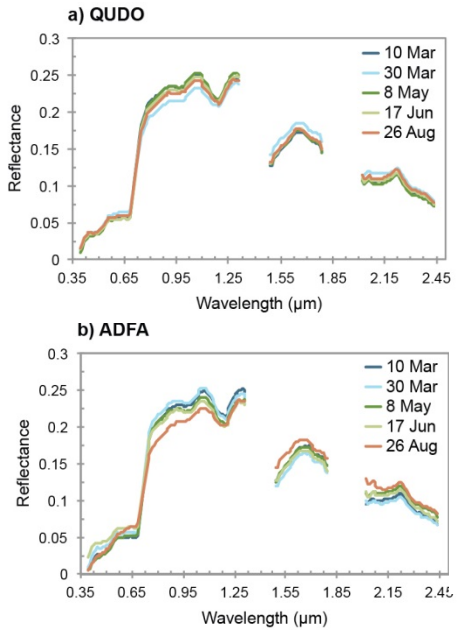
- Objective: Evaluate the ability of imaging spectroscopy data from the HyspIRI Preparatory Campaign to map vegetation species across a range of dates and illumination conditions
  - Imaging spectroscopy contains detailed spectral information that can be used to distinguish vegetation species and functional types
  - Hypothesis: Species can be mapped using a uniform approach even though their phenology varies over space and through time.

- Key Finding: A species map retrieval algorithm that accounts for the range of phenological variability in species reflectance can map species as well as any single date classification
  - A single spectral library created from a range of dates can be applied to any date, allowing species mapping without knowing phenological state in advance

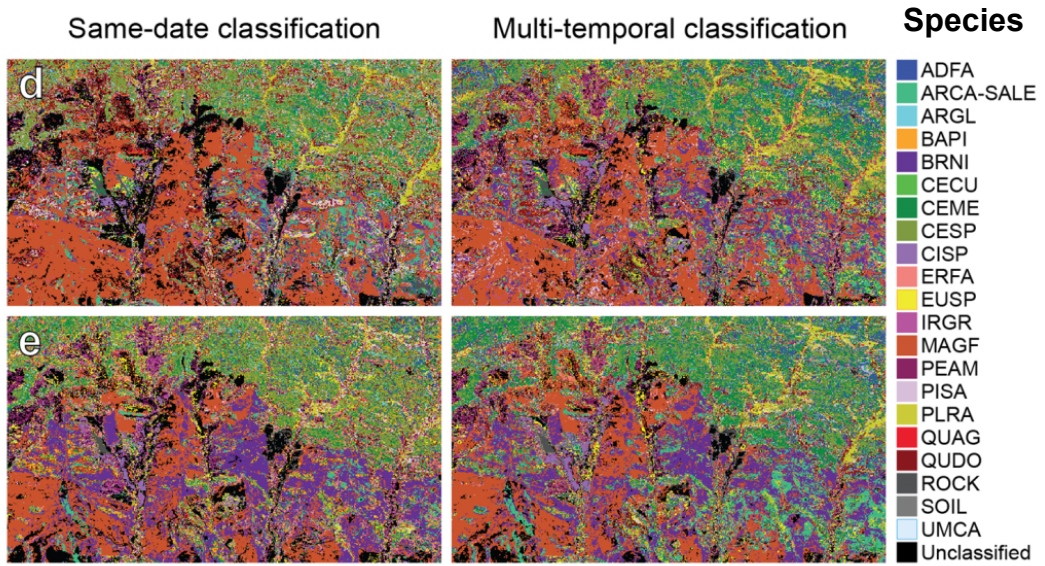
Reflectance of different vegetation species vary through time due to vegetation phenology. Subtle spectral differences can be used to distinguish a) Blue Oak from b) Chamise.

A data cube showing the spectral dimensionality of image spectroscopy data.





A multi-temporal endmember library provides equivalent performance for mapping species compared to single date classifications.



2015 AGU Session Focused on the Western U. S. HyspIRI Preparatory Airborne Campaign

Discriminating Canopy Structural Types from Optical Properties using AVIRIS Data in the Sierra National Forest in Central California, Margarita Huesca Martinez, University of California Davis, Davis, CA, United States

Discriminating plant species across California's diverse ecosystems using airborne VSWIR and TIR imagery, Susan Meerdink, University of California Santa Barbara, Santa Barbara, CA, United States

Effect of Spatial Resolution for Characterizing Soil Properties from Imaging Spectrometer Data, Debsunder Dutta, University of Illinois at Urbana Champaign, Urbana, IL, United States

Field, Laboratory and Imaging spectroscopic Analysis of Landslide, Debris Flow and Flood Hazards in Lacustrine, Aeolian and Alluvial Fan Deposits Surrounding the Salton Sea, Southern California, Bernard Emanuel Hubbard, USGS, Reston, VA, United States

HyspIRI Measurements of Agricultural Systems in California: 2013-2015, Philip A Townsend, University of Wisconsin, Madison, WI, United States

Mapping land surface energy budget from the AVIRIS and MASTER data, Dongdong Wang and Shunlin Liang, University of Maryland College Park, College Park, MD, United States, Mapping land surface energy budget from the AVIRIS and MASTER data

Monitoring the Impacts of Severe Drought on Plant Species in Southern California Chaparral, Philip E Dennison, University of Utah, Salt Lake City, UT, United States

Multiyear Multiseasonal Changes in Leaf and Canopy Traits Measured by AVIRIS over Ecosystems with Different Functional Type Characteristics Through the Progressive California Drought 2013-2015, Susan Ustin, University of California Davis, Davis, CA, United States

Mutli-temporal Imaging Spectroscopy Analysis for the Identification of Coniferous Forest Mortality Related to Drought Stress in the Central Sierra Nevada, California Zachary Tane, US Forest Service Sacramento, Sacramento, CA, United States; University of California Santa Barbara, Geography, Santa Barbara, CA, United States

Refining atmospheric correction for aquatic remote spectroscopy,David R Thompson, Jet Propulsion Laboratory, Pasadena, CA, United States

Seasonal and Inter-Annual Patterns of Phytoplankton Community Structure in Monterey Bay, CA Derived from AVIRIS Data During the 2013-2015 HyspIRI Airborne Campaign, Sherry L. Palacios, NASA Ames Research Center, Moffett Field, CA, United States; Bay Area Environmental Research Institute Moffett Field, Moffett Field, CA, United States

Spectral Age Dating of Volcanic Materials, Neil Pearson, University of Nevada Reno, Reno, NV, United States

Urban Heat Island Variation across a Dramatic Coastal to Desert Climate Zone: An Application to Los Angeles, CA Metropolitan Area, Amin Tayyebi, University of California Riverside, Center for Conservation Biology, Riverside, CA, United States and Darrel Jenerette, University of California Riverside, Riverside, CA, United States

Using HyspIRI Campaign Data for Sub-pixel Classification of the Urban Land Surface, Erin B Wetherley, University of California Santa Barbara, Santa Barbara, CA, United States

Using Imaging Spectrometry to Identify Crops in California's Central Valley, Sarah Shivers, University of California Santa Barbara, Santa Barbara, CA, United States

Assessment of Forest Vulnerability to Climate Change from Imaging Spectroscopy, Gregory Paul Asner, Carnegie Institution for Science, Department of Global Ecology, Stanford, CA, United States and Carnegie Airborne Observatory Team

Constructing Virtual Forest Scenes for Assessment of Sub-pixel Vegetation Structure From Imaging Spectroscopy, Wei Yao, Rochester Institute of Technology, Rochester, NY, United States and Jan A van Aardt, Rochester Institute of Tech., Rochester, NY, United States

A Hyperspectral Thermal Emission Spectrometer (HyTES) for High Altitude Applications, Jonathan M Mihaly, NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, United States

Advances in Mineral Dust Source Composition Measurement with Imaging Spectroscopy at the Salton Sea, CA, Robert O Green, NASA Jet Propulsion Laboratory, Pasadena, CA, United States

Characterizing Geology and Mineralization at High Latitudes in Alaska Using Airborne and Field-Based Imaging Spectrometer Data, Raymond F Kokaly, US Geological Survey, Denver, CO, United States

Comparison of Hyperspectral and Multispectral Satellites for Discriminating Land Cover in Northern California, Matthew L Clark, Sonoma State University, Rohnert Park, CA, United States

Coral Reef Color: Remote and In-Situ Imaging Spectroscopy of Reef Structure and Function, Eric J Hochberg, Bermuda Institute of Ocean Sciences, St.George's, GE, Bermuda

Finding Blackbody Temperature and Emissivity on a Sub-Pixel Scale, David Jonathan Bernstein, Purdue University, West Lafayette, IN, United States

Hyperspectral analysis for qualitative and quantitative features related to acid mine drainage at a remediated open-pit mine, Gwen Davies, University of Nevada Reno, Reno, NV, United States

Hyperspectral and Polarimetric Signatures of Vegetation from AirMSPI and AVIRIS Measurements, Bin Yang, Boston University, Boston, MA, United States

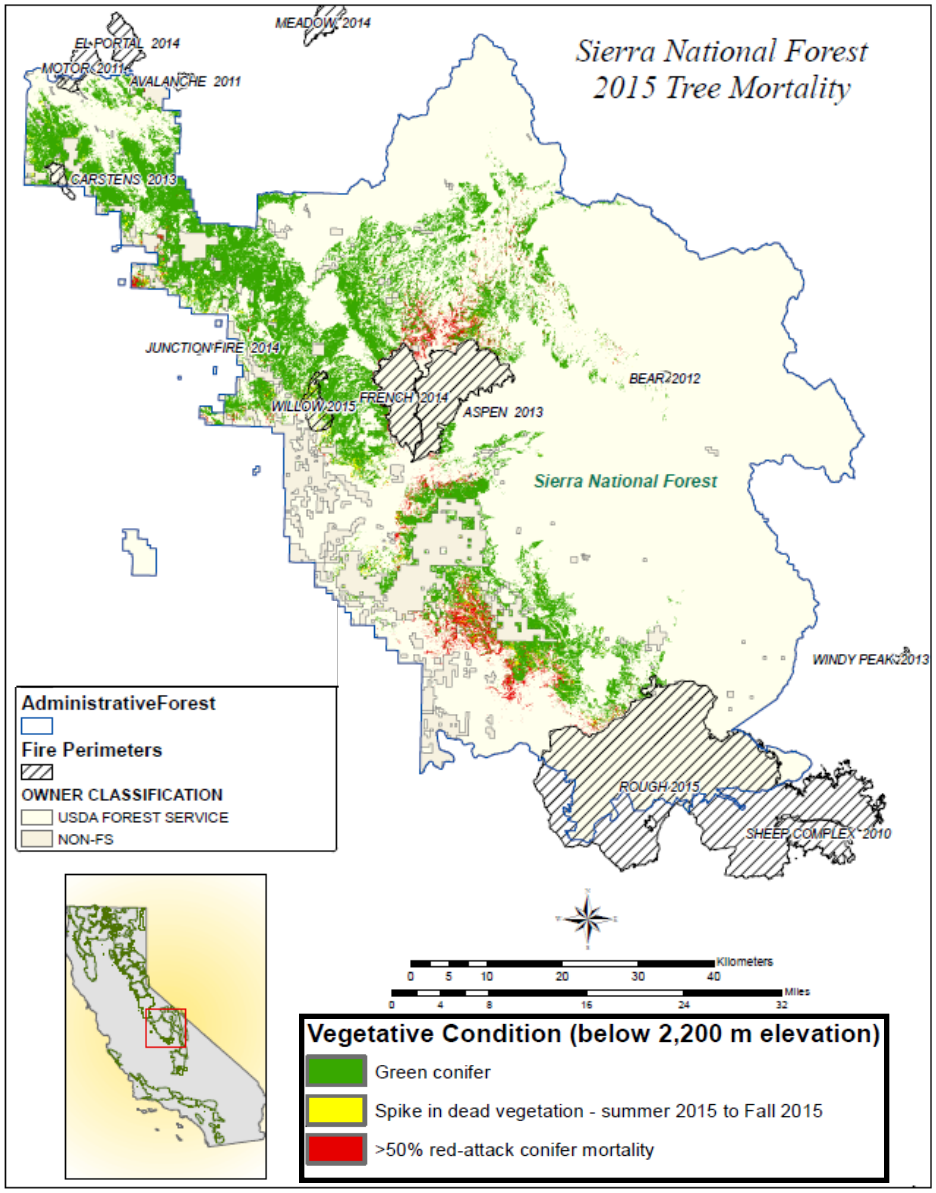
Overview of the technical and scientific status of the EnMAP imaging spectroscopy mission, Luis Guanter, Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences, Potsdam, Germany

Using high-resolution topography and hyperspectral data to classify tree species at the San Joaquin Experimental Range, Steven Daniel Dibb, University of California Santa Cruz, Santa Cruz, CA, United States

A Linear Spatial Spectral Mixture Model for the Improved Estimation of Subpixel Saltcedar Cover along the Forgotten River, Chen Shi, CNU Capital Nornal University, College of Resource Environment and Tourism, Beijing, China

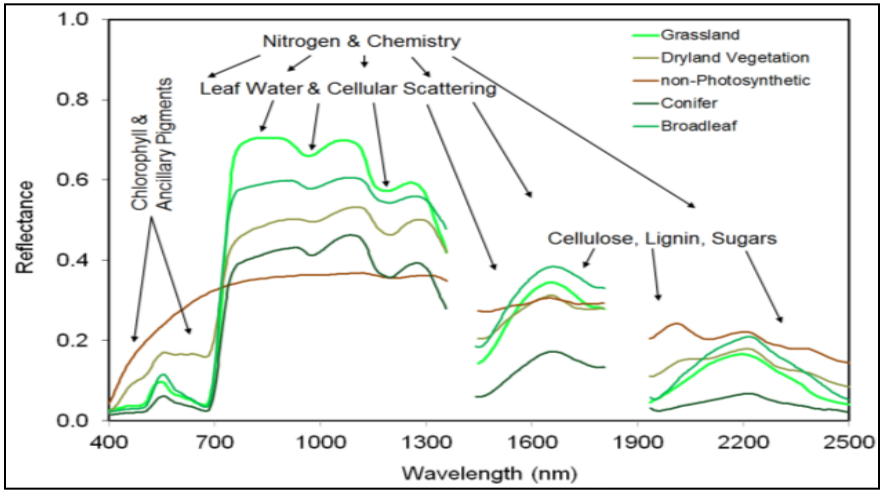
Field-Based and Airborne Hyperspectral Imaging for Applied Research in the State of Alaska, Anupma Prakash, University of Alaska Fairbanks, Fairbanks, AK, United States

Forest Service use of Measurements from HyspIRI Airborne Campaign



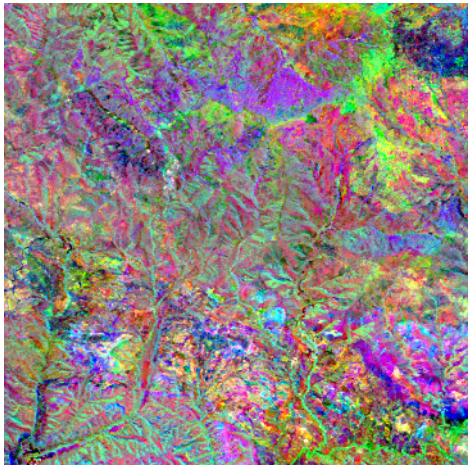
USDA Forest Service, Pacific Southwest Region, Remote Sensing Lab, Map created 5/18/16

This map represents a time-series analysis of images acquired by the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS; http://aviris.jpl.nasa.gov/) from Spring 2013 to Fall 2015. Mortality for Summer 2015 was manually interpreted from Worldview imagery from Spring - Summer 2015 and used for the training the statistical-learning classifier. Landcover was classified into shrub dominant, green conifer dominant, and newly killed (red-attack) conifer dominant. Spectral mixture analysis was used to evaluate the Fall 2015 mortality by comparing 2013 - 2015 changes in the cover fractions and flagging changes greater than 10% in the non-photosynthetic vegetation fraction in Fall 2015 imagery.



Dimensionality of the Earth System Captured with Imaging Spectroscopy

NASA HyspIRI
Preparatory Campaign

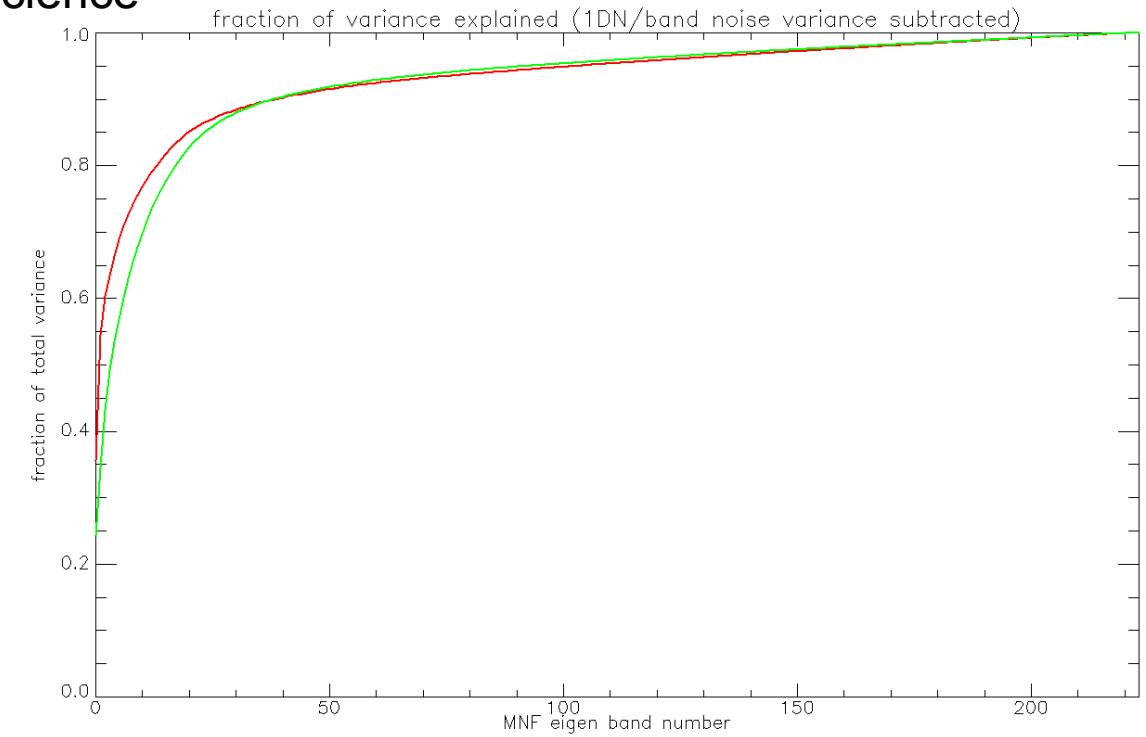


AVIRIS Flight line from Mono Lake to Santa Barbara, CA

A single HyspIRI airborne campaign flight line has 50 content rich eigen images.

A single scene show up to 30 content rich eigen images.

This demonstrates huge dimensionality available for access with imaging spectroscopy for new Earth system science



Some HyspIRI Related Papers

Calvin, Wendy M., and Elizabeth L. Pace. "Utilizing HyspIRI Prototype Data for Geological Exploration Applications: A Southern California Case Study." Geosciences 6.1 (2016): 11.

Hochberg, Eric J., Dar A. Roberts, Philip E. Dennison, Glynn C. Hulley, "Special issue on the Hyperspectral Infrared Imager (HyspIRI): Emerging science in terrestrial and aquatic ecology, radiation balance and hazards," Remote Sensing of Environment 167 (2015):Pages 1-5

Lee, Christine M., Morgan L. Cable, Simon J. Hook, Robert O. Green, Susan L. Ustin, Daniel J. Mandl, Elizabeth M. Middleton, "An introduction to the NASA Hyperspectral InfraRed Imager (HyspIRI) mission and preparatory activities," Remote Sensing of Environment 167 (2015): Pages 6-19

He, Tao, Shunlin Liang, Dongdong Wang, Qinqing Shi, Michael L. Goulden, "Estimation of high-resolution land surface net shortwave radiation from AVIRIS data: Algorithm development and preliminary results," Remote Sensing of Environment 167 (2015):Pages 20-30

Wang, Dongdong, Shunlin Liang, Tao He, Qinqing Shi, "Estimating clear-sky all-wave net radiation from combined visible and shortwave infrared (VSWIR) and thermal infrared (TIR) remote sensing data," Remote Sensing of Environment 167 (2015):Pages 31-39

Realmuto, V.J., P.E. Dennison, M. Foote, M.S. Ramsey, M.J. Wooster, R. Wright, "Specifying the saturation temperature for the HyspIRI 4-μm channel," Remote Sensing of Environment 167 (2015):Pages 40-52

Grigsby, Shane P,. Glynn C. Hulley, Dar A. Roberts, Christopher Scheele, Susan L. Ustin, Maria Mar Alsina, "Improved surface temperature estimates with MASTER/AVIRIS sensor fusion," Remote Sensing of Environment 167 (2015):Pages 53-63

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Serbin, Shawn P., Aditya Singh, Ankur R. Desai, Sean G. Dubois, Andrew D. Jablonski, Clayton C. Kingdon, Eric L. Kruger, Philip A. Townsend, "Remotely estimating photosynthetic capacity, and its response to temperature, in vegetation canopies using imaging spectroscopy," Remote Sensing of Environment 167 (2015):Pages 78-87

Pellissier, Paul A. , Scott V. Ollinger, Lucie C. Lepine, Michael W. Palace, William H. McDowell, "Remote sensing of foliar nitrogen in cultivated grasslands of human dominated landscapes," Remote Sensing of Environment 167 (2015): Pages 88-97

Mitchell, Jessica J., Rupesh Shrestha, Lucas P. Spaete, Nancy F. Glenn, "Combining airborne hyperspectral and LiDAR data across local sites for upscaling shrubland structural information: Lessons for HyspIRI," Remote Sensing of Environment 167 (2015):Pages 98-110

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Dudley, Kenneth L., Philip E. Dennison, Keely L. Roth, Dar A. Roberts, Austin R. Coates, "A multi-temporal spectral library approach for mapping vegetation species across spatial and temporal phenological gradients," Remote Sensing of Environment 167 (2015):Pages 121-134

Roth, Keely L., Dar A. Roberts, Philip E. Dennison, Michael Alonzo, Seth H. Peterson, Michael Beland, "Differentiating plant species within and across diverse ecosystems with imaging spectroscopy," Remote Sensing of Environment 167 (2015):Pages 135-151

Roberts, Dar A., Philip E. Dennison, Keely L. Roth, Kenneth Dudley, Glynn Hulley, "Relationships between dominant plant species, fractional cover and Land Surface Temperature in a Mediterranean ecosystem," Remote Sensing of Environment 167 (2015):Pages 152-167

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Hestir, Erin Lee, Vittorio E. Brando, Mariano Bresciani, Claudia Giardino, Erica Matta, Paolo Villa, Arnold G. Dekker, "Measuring freshwater aquatic ecosystems: The need for a hyperspectral global mapping satellite mission," Remote Sensing of Environment 167 (2015):Pages 181-195

Kudela, Raphael M., Sherry L. Palacios, David C. Austerberry, Emma K. Accorsi, Liane S. Guild, Juan Torres-Perez, "Application of hyperspectral remote sensing to cyanobacterial blooms in inland waters," Remote Sensing of Environment 167 (2015): Pages 196-205

Turpie, Kevin R., Victor V. Klemas, Kristin Byrd, Maggi Kelly, Young-Heon Jo, "Prospective HyspIRI global observations of tidal wetlands," Remote Sensing of Environment 167 (2015):Pages 206-217

Bell, Tom W., Kyle C. Cavanaugh, David A. Siegel, "Remote monitoring of giant kelp biomass and physiological condition: An evaluation of the potential for the Hyperspectral Infrared Imager (HyspIRI) mission," Remote Sensing of Environment 167 (2015): Pages 218-228

Hu, Chuanmin, Lian Feng, Robert F. Hardy, Eric J. Hochberg, "Spectral and spatial requirements of remote measurements of pelagic Sargassum macroalgae," Remote Sensing of Environment 167 (2015): Pages 229-246

Dierssen, H. M., A. Chlus, B. Russell "Hyperspectral discrimination of floating mats of seagrass wrack and the macroalgae Sargassum in coastal waters of Greater Florida Bay using airborne remote sensing," Remote Sensing of Environment 167 (2015): Pages 247-258

Lorenzoni, L., G. Toro-Farmer, R. Varela, L. Guzman, J. Rojas, E. Montes, F. Muller-Karger, "Characterization of phytoplankton variability in the Cariaco Basin using spectral absorption, taxonomic and pigment data" Remote Sensing of Environment 167 (2015): Pages 259-268

Palacios, Sherry L., Raphael M. Kudela, Liane S. Guild, Kendra H. Negrey, Juan Torres-Perez, Jennifer Broughton, "Remote sensing of phytoplankton functional types in the coastal ocean from the HyspIRI Preparatory Flight Campaign," Remote Sensing of Environment 167 (2015): Pages 269-280

Marshall, Michael, and Prasad Thenkabail. "Biomass modeling of four leading world crops using hyperspectral narrowbands in support of HyspIRI mission." Photogrammetric Engineering & Remote Sensing 80.8 (2014): 757-772.

Chien, S., Stanley, et al. "Onboard product generation on earth observing one: a pathfinder for the proposed hyspiri mission intelligent payload module." Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of 6.2 (2013): 257-264.

Olsson, Aaryn D., and Jeffrey T. Morisette. "Comparison of simulated HyspIRI with two multispectral sensors for invasive species mapping." Photogrammetric Engineering & Remote Sensing 80.3 (2014): 217-227.

Mariotto, Isabella, et al. "Hyperspectral versus multispectral crop-productivity modeling and type discrimination for the HyspIRI mission." Remote Sensing of Environment 139 (2013): 291-305.

Abrams, Michael, et al. "Using EO-1 Hyperion data as HyspIRI preparatory data sets for volcanology applied to Mt Etna, Italy." Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of 6.2 (2013): 375-385.

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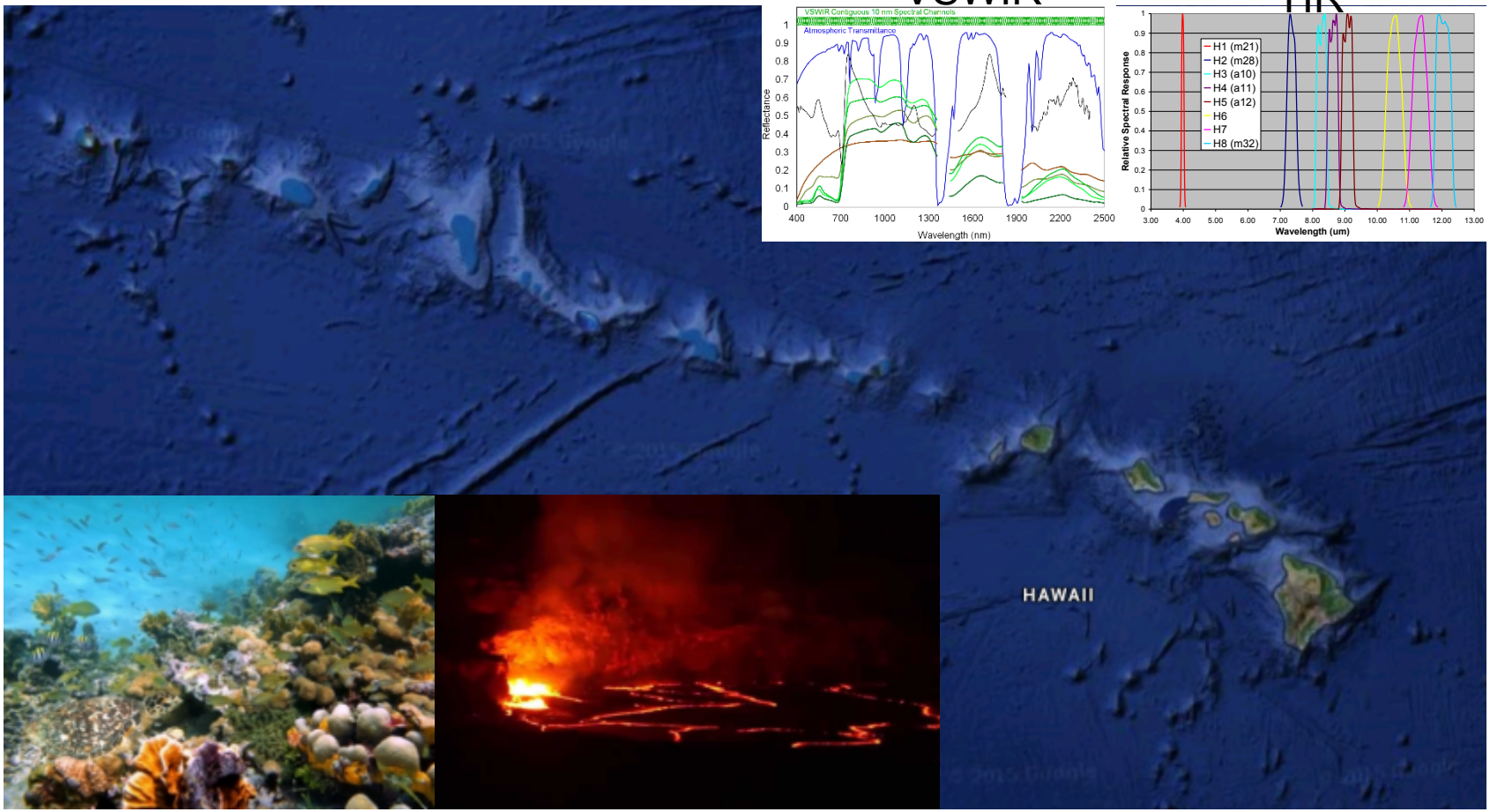
Green, R., et al. "Results of the Decadal Survey HyspIRI Imaging Spectrometer concept study: A high signal-to-noise ratio and high uniformity global mission to measure plant physiology and functional type." Proceedings of IEEE Geoscience and Remote Sensing Symposium (IGARSS). 2008.

HyspIRI Volcano and Coral Reef Airborne Campaign

A.45 HyspIRI Preparatory Airborne Activities and Associated Science: Coral Reef and Volcano Research

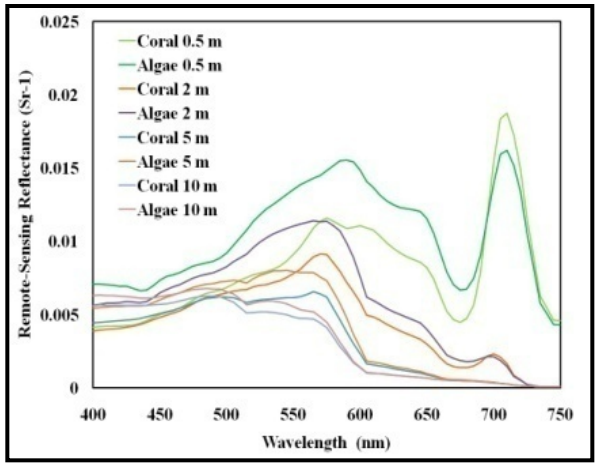
- 10 investigations selected
- Test Level 1 and 2 products for VSWIR and TIR HyspIRI-type measurement
- Advance maturity of higher level products and related algorithms



HyspIRI Preparatory
Hawaii Airborne Campaign

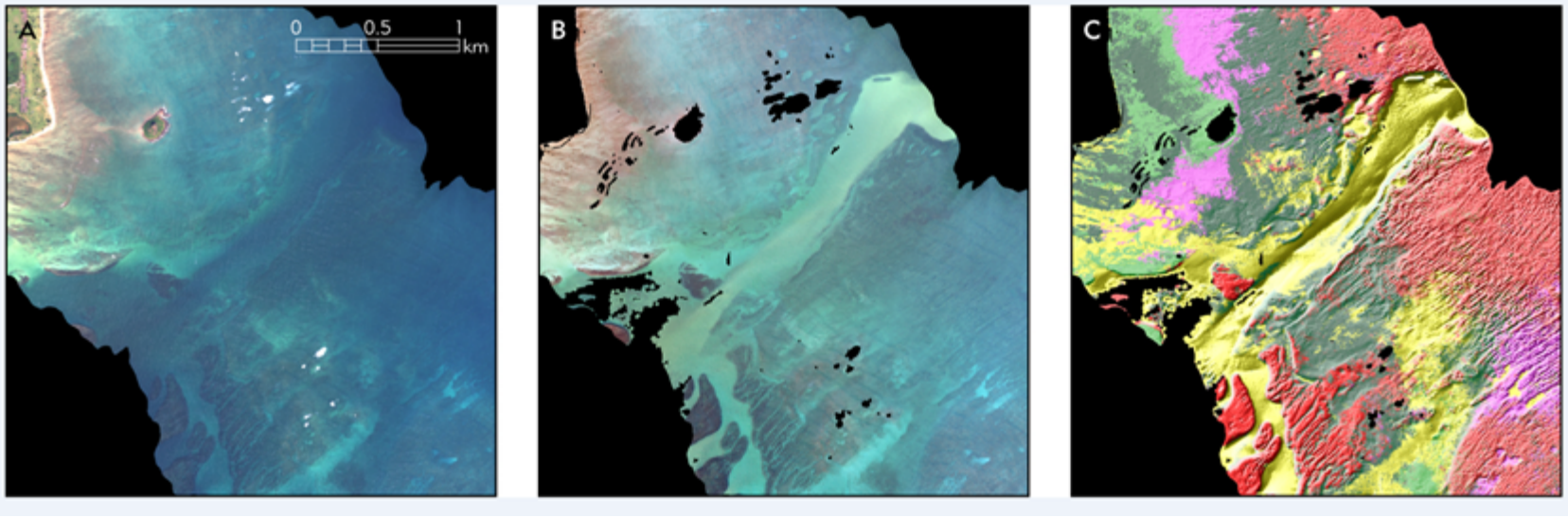
Steven Ackleson/Naval Research Laboratory
Assessing Simulated HyspIRI Imagery for Detecting and Quantifying Coral Reef Coverage and Water Quality Using Spectral Inversion and Deconvolution Methods
Kyle Cavanaugh/University of California, Los Angeles
Using HyspIRI to Identify Benthic Composition and Bleaching in Shallow Coral Reef Ecosystems
Chad Deering/Michigan Technological University
Understanding Basaltic Volcanic Processes by Remotely Measuring the Links Between Vegetation Health and Extent, and Volcanic Gas and Thermal Emissions Using HyspIRI-Like VSWIR and TIR Data
Paul Haverkamp/SP Cramer and Associates
Modeling of Environmental Variables and Land-Use/Land-Cover Change Influence on Declining Hawaiian Coral Reef Health Since 2000 Using HyspIRI-Like Images
Eric Hochberg/Bermuda Institute of Ocean Science (BIOS), Inc.
Coral Reef Condition Across the Hawaiian Archipelago and Relationship to Environmental Forcing
ZhongPing Lee/University Of Massachusetts, Boston
Evaluation and Application of the AVIRIS Data for the Study of Coral Reefs
David Pieri/Jet Propulsion Laboratory
In Situ Validation of Remotely Sensed Volcanogenic Emissions Retrievals Using Aerostats and UAVs
Michael Ramsey/University of Pittsburgh
Quantifying Active Volcanic Processes and Mitigating their Hazards With HyspIRI Data
Vincent Realmuto/Jet Propulsion Laboratory
Mapping the Composition and Chemical Evolution of Plumes from Kilauea Volcano
Richard Vaughan/U.S. Geological Survey Flagstaff
Developing An Automated Volcanic Thermal Alert Algorithm Using Moderate Spatial Resolution VSWIR and TIR Data: Implications For the Future HyspIRI Mission

2000 Coral Spectroscopy Measurements

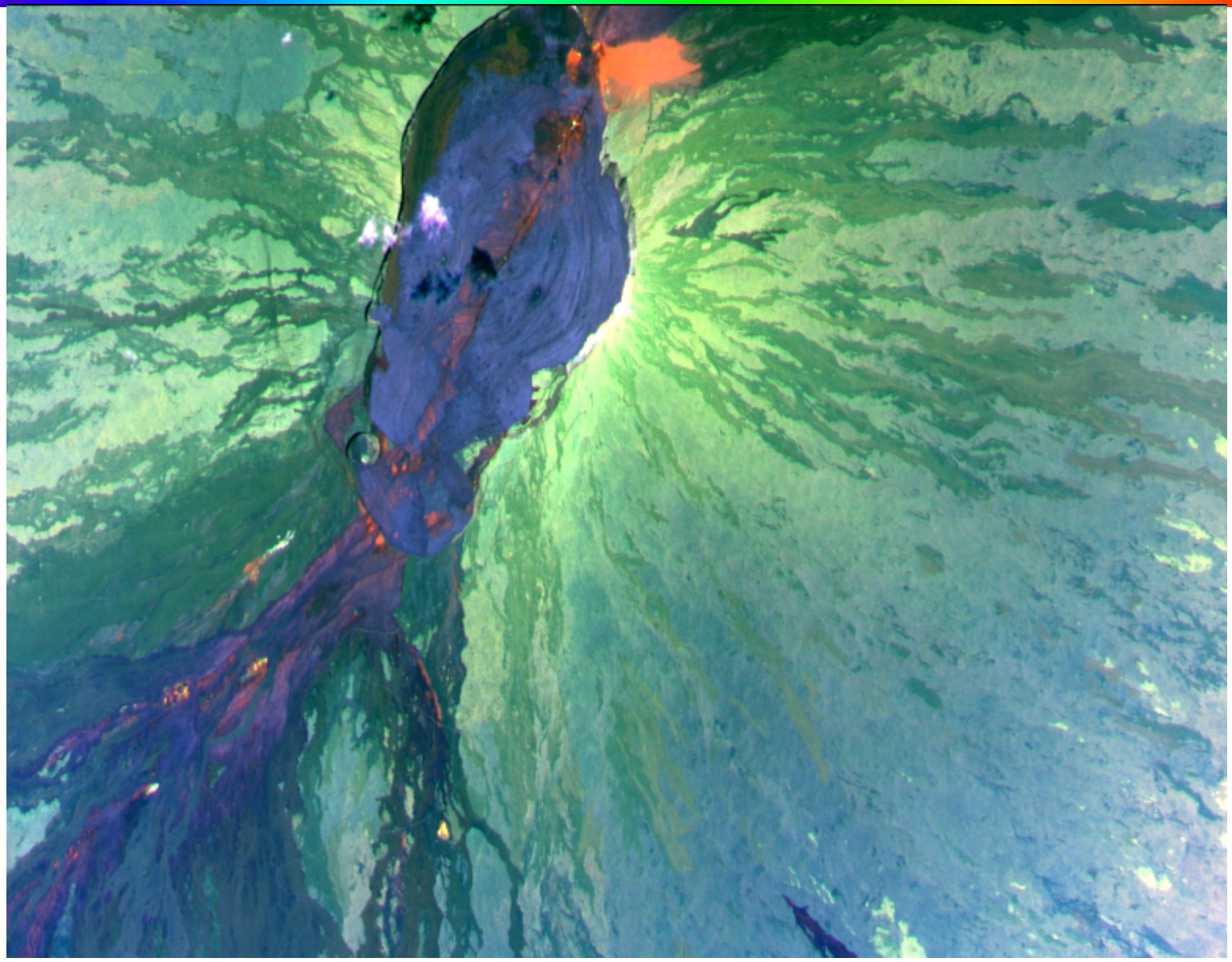


- Composition
- Condition
- Productivity
- Bathymetry
- Water quality

AVIRIS Image of Kaneohe Bay, HI
Classification of the bottom of coastal zones and coral reef types



AVIRIS Hawaii, Kiluaea 000410



HyspIRI Related Inputs to Decadal RFI2 Many Tied to Airborne Campaigns

Wendy	Calvin	Earth Surface Geochemistry and Mineralogy: Processes, Hazards, Soils, and Resources
Philip	Dennison	Global Measurement of Non-Photosynthetic Vegetation
Heidi	Dierssen	Assessing Transient Threats and Disasters in the Coastal Zone with Airborne Portable Sensors
Riley	Duren	Understanding anthropogenic methane and carbon dioxide point source emissions
Joshua	Fisher	Evapotranspiration: A Critical Variable Linking Ecosystem Functioning, Carbon and Climate Feedbacks, Agricultural Management, and Water Resources
Robert	Green	Science and Application Targets Addressed with the 2007 Decadal Survey HyspIRI Mission Current Baseline
Eric	Hochberg	Coral Reefs: Living on the Edge
Simon	Hook	Carbon Emissions from Biomass Burning
Luvall	Jeffrey	A Thermodynamic Paradigm For Using Satellite Based Geophysical Measurements For Public Health Applications
Natalie	Mahowald	Measuring the Earth's Surface Mineral Dust Source Composition for Radiative Forcing and Related Earth System Impacts
Frank	Muller-Karger	Monitoring Coastal and Wetland Biodiversity from Space
Thomas	Painter	Understanding the controls on cryospheric albedo, energy balance, and melting in a changing world
Ryan	Pavlick	Biodiversity
Dale	Quattrochi	High Spatial, Temporal, and Spectral Resolution Instrument for Modeling/Monitoring Land Cover, Biophysical, and Societal Changes in Urban Environments
E. Natasha	Stavros	The role of fire in the Earth System
Philip	Townsend	Global Terrestrial Ecosystem Functioning and Biogeochemical Processes
Kevin	Turpie	GLOBAL OBSERVATIONS OF COASTAL AND INLAND AQUATIC HABITATS
Robert	Wright	PREDICTING CHANGES IN THE BEHAVIOR OF ERUPTING VOLCANOES, AND REDUCING THE UNCERTAINTIES ASSOCIATED WITH THEIR IMPACT ON SOCIETY AND THE ENVIRONMENT