



HyspIRI Update



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NASA Headquarters
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HyspIRI Decadal Survey Mission

Key Science and Science Applications

Climate: Ecosystem biochemistry, condition & feedback; spectral albedo; carbon/dust on snow/ice; biomass burning; evapotranspiration

Ecosystems: *Global* biodiversity, plant functional types, physiological condition, and biochemistry including agricultural lands

Fires: Fuel status; fire frequency, severity, emissions, and patterns of recovery *globally*

Coral reef and coastal habitats: *Global* composition and status

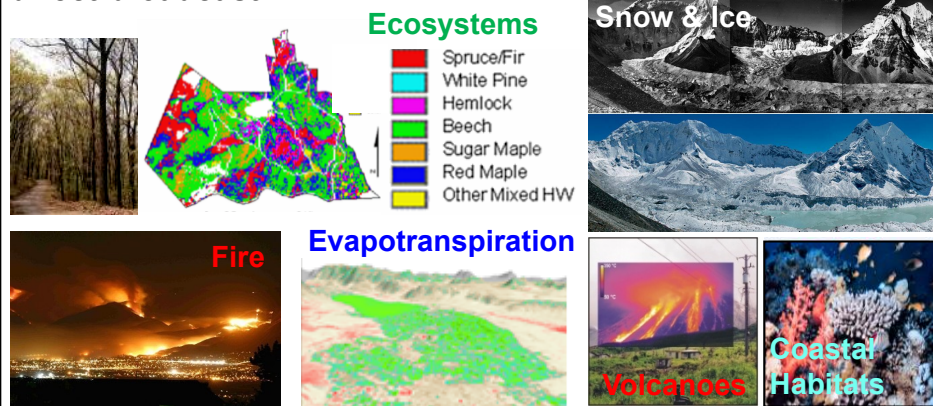
Volcanoes: Eruptions, emissions, regional and *global* impacts

Geology and resources: *Global* distributions of surface mineral resources and improved understanding of geology and related hazards

Applications: Disasters, EcoForecasting, Health/AQ, Water

Mission Urgency

The HyspIRI science and applications objectives are critical today and uniquely addressed by the combined imaging spectroscopy, thermal infrared measurements, and IPM direct broadcast.



Measurement

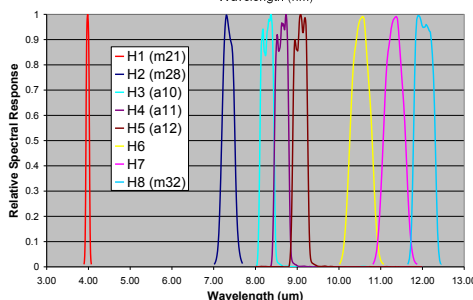
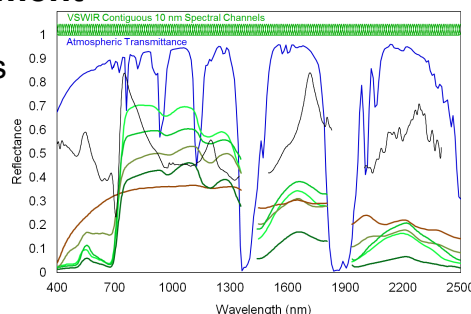
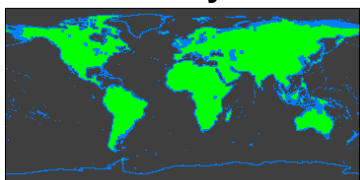
Imaging Spectrometer (VSWIR)

- 380 to 2500nm in ≤ 10 nm bands
- 30 m spatial sampling
- 16 days revisit
- **Global land and shallow water**

Thermal Infrared (TIR)

- 8 bands between 4-12 μ m
- 60 m spatial sampling
- 5 days revisit; day/night
- **Global land and shallow water**

IPM-Low Latency data subsets



Mission Concept Status

Level 1 Measurement Requirements: Vetted at community workshops and in literature (100s of refereed journal articles)

Payload: VSWIR Imaging Spectrometer, TIR Multi-spectral Radiometer, and Intelligent Payload Module (IPM)

Original 60 m DS option: Mature

ISS options: VSWIR/TIR Mature, ECOSTRESS EVI selected

Separate Smallsat Mission option: VSWIR and TIR solutions developed with TEAM I/X

SLI Compatible Option: HyspIRI VSWIR being evolved to 30 m at 185 km swath and 16 day global revisit. Requires Dyson spectrometer architecture and other technologies.

Near term option: Global with 45 km- or 90 km-swath at 30 m

Preparatory airborne campaigns: Measurements used to advance and refine science, applications, algorithms, and data processing.



HyspIRI Guidance for FY2016

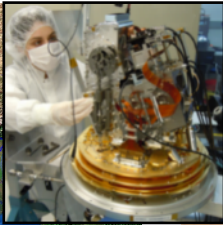
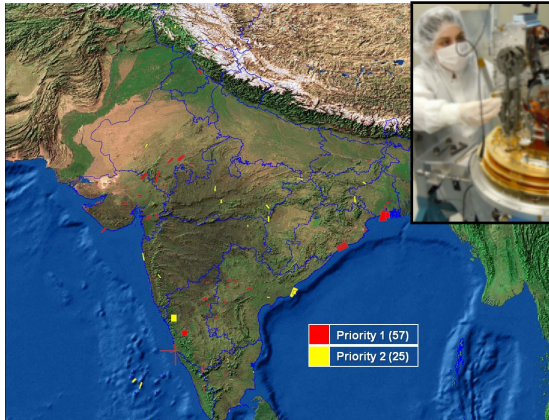
(Per 10/30/2015 Guidance Memo from Eric Ianson)

1. Continue to build broad community understanding via workshops/symposia
2. Continue to conduct HyspIRI data product generation and benchmarking with airborne and satellite data
3. Continue to carry out instrument mission trade studies, including smallsat and ISS opportunities, to provide lower cost and more adaptable instrument and/or mission approaches, including risk reduction and IPM for throughput/low latency
4. Continue to explore options to ensure the HyspIRI VSWIR and TIR instruments meet the Sustainable Land Imaging measurement requirements, including compatibility with heritage data product resolutions, inter-sensor band synthesis
5. Utilize the ECOSTRESS mission development for HyspIRI risk reduction
6. Continue to engage potential international and domestic partners in addressing opportunities to lower mission cost while maintaining Level 1 mission requirements, and strengthen synergies with upcoming international missions
7. Prepare materials updating the NRC 2017 Decadal Survey on status and value of HyspIRI and provide NRC with options for accomplishing the mission
8. Refine and update the HyspIRI comprehensive development report

FY16 Funding = \$2M + \$360,000 over guide

AVIRIS-NG India Winter 2015-2016 Airborne Campaign

This joint airborne campaign obtained first of its kind high fidelity **AVIRIS-NG** imaging spectroscopy measurements of a diverse set of Asian environments for research.



Pre-campaign Science Meeting Sept 2015

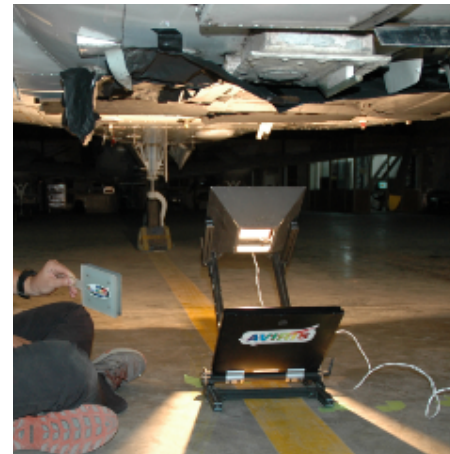
- The campaign enables new scientific and applications research in these Indian environments:

- Natural ecosystems
- Water resources, snow and ice
- Geology and natural hazards
- Coastal and inland waters, coral reefs
- Agricultural lands and urban areas

- This joint science and applications campaign could lead to a future joint space mission.

- **Solicitation for data use in ROSES 2016 A.31**

(Slide courtesy of JPL/Rob Green)

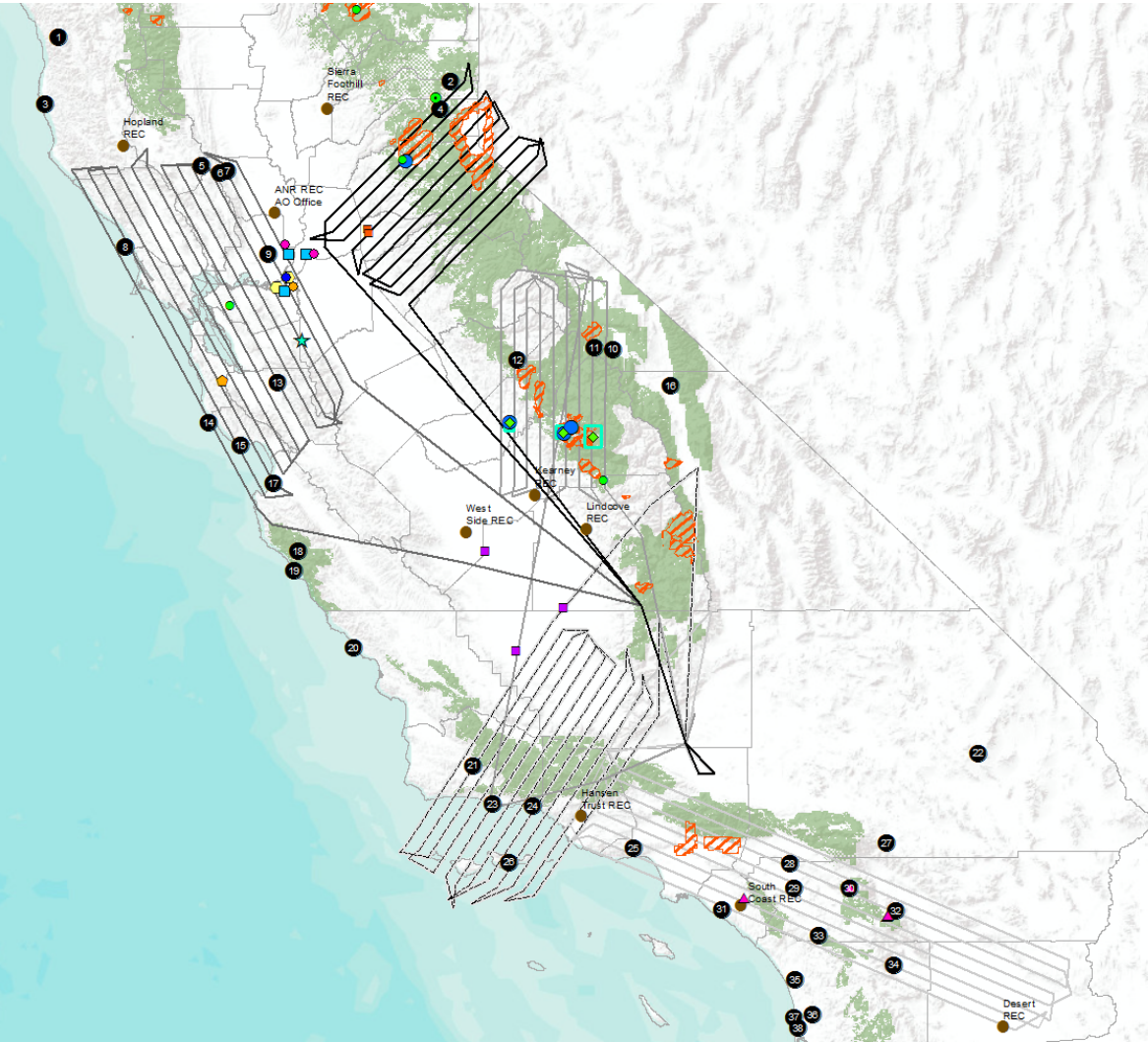




HyspIRI Airborne Preparatory Mission - CA

Summer 2016 Acquisition

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



AVIRIS-C

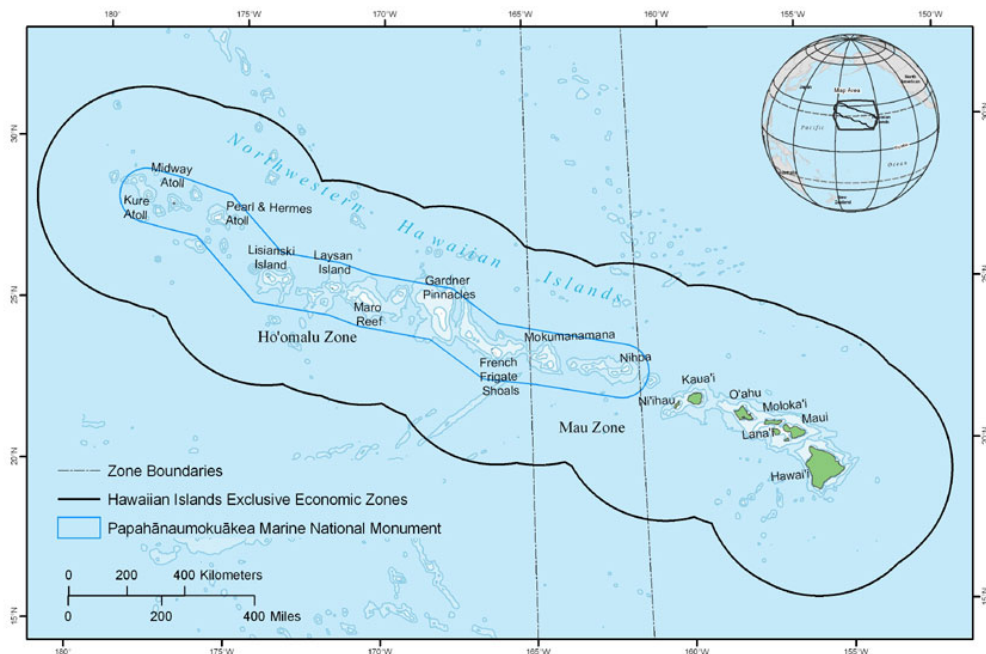
MASTER

PI TEAM:

Wendy Calvin/University of Nevada - Reno
Matthew Clark/Sonoma State University
Bo-Cai Gao/Naval Research Laboratory
Bernard Hubbard/USGS
George Jenerette/University of California, Riverside
Thomas Kampe/NEON
Raphael Kudela/University of California, Santa Cruz
Ira Leifer/University of California, Santa Barbara
Paul Moorcroft/Harvard University
Dar Roberts/University of California, Santa Barbara
Philip Townsend/University of Wisconsin-Madison
Susan Ustin/University of California, Davis
Jan van Aardt/Rochester Institute of Technology
Dongdong Wang/University of Maryland



HyspIRI Preparatory Airborne Hawaii Campaign for Coral Reefs and Volcanoes



Coral Reef Investigators

- Steve Ackleson/NRL
- Kyle Cavanaugh/UCLA
- Heidi Dierssen/UCONN
- Paul Haverkamp/Cramer Fish Sciences
- Eric Hochberg/BIOS
- ZhongPing Lee/UMASS Boston

Volcano Investigators

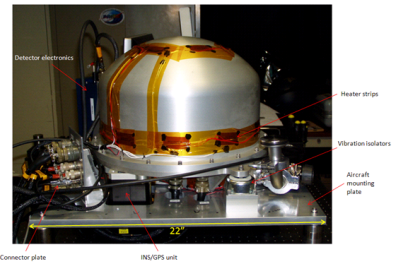
- Chad Deering/Michigan Tech
- David Pieri/JPL
- Michael Ramsey/University of Pittsburgh
- Vincent Realmuto/JPL
- Greg Vaughan/USGS Flagstaff

Flights planned for mid January to early March 2017



Future Spectroscopy Aboard the ER-2

PRISM



ER-2 Payload Areas

Nose

- 16" camera ports
- One RF-transparent config

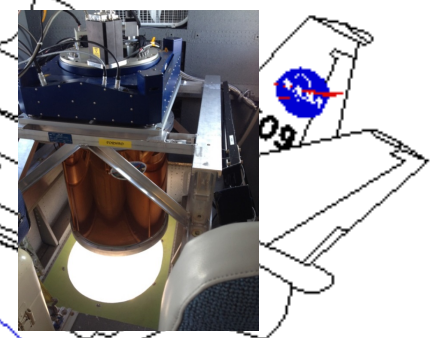
Q-bay (equipment bay)

- One or two 16" camera ports

Left and Right "Superpods"

- Fore, mid, and aft segments
- Aft is unpressurized, with open ports (no windows)

HyTES



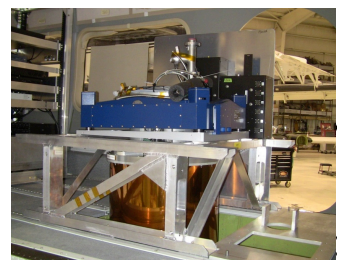
Centerline Pod

System 20 pod

- On trailing edge of right wing



AVIRIS-C



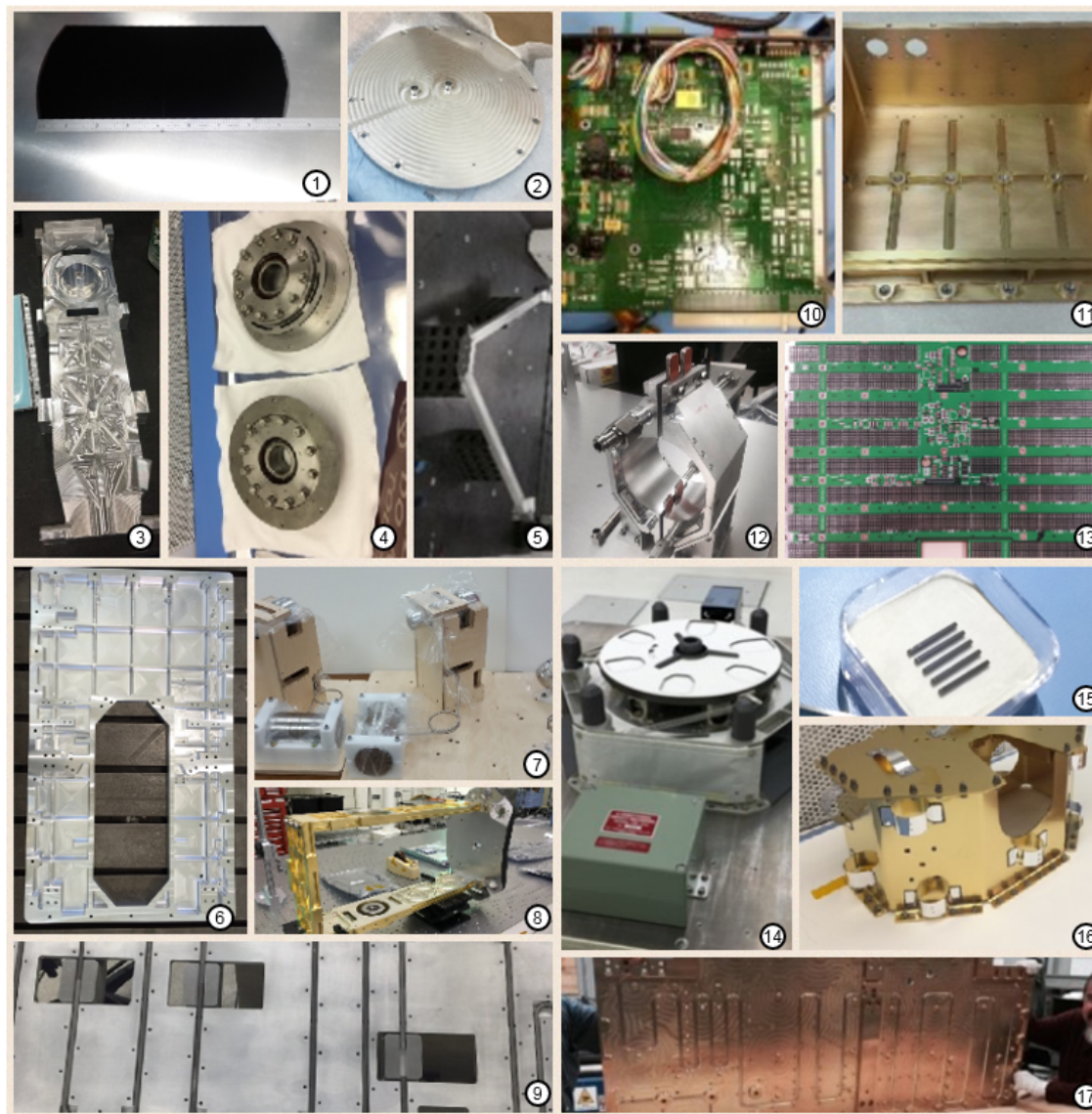
AVIRIS-NG



ECOSTRESS Progress

1. Blackbody Coating
2. Cold Target
3. Scan Mechanism Yoke
4. Scan Mechanism Bearing Assembly
5. Radiometer Bipods
6. Nadir Panel
7. Tactical Cryocoolers
8. Yoke Assembly
9. Cold Panel Tubing
10. BB Motor Controller PWA
11. PCE Chassis
12. Compressor Heat Exchanger
13. CEU Backplane
14. PIU
15. 12um Filters
16. Detector Cold Shroud
17. Cold Panel

Launch: April 2018





Decadal Survey 2017

*The National Academies of
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DECADAL SURVEY FOR EARTH SCIENCE AND APPLICATIONS FROM SPACE

Division on Engineering and Physical Sciences

- ▶ ESAS 2017 HOME
- ▶ ABOUT THE SURVEY
- ▶ STEERING COMMITTEE
- ▶ PAST MEETINGS AND EVENTS
- ▶ COMMUNITY INPUT
- ▶ SSB HOME
- ▶ DEPS HOME

Community Input and White Papers

ESAS 2017 Request for Information (RFI #2)

In late September 2015, the Committee on Earth Science and Applications from Space requested community input (RFI #1) to help understand the role of space-based observations in addressing the key challenges and questions for Earth System Science in the coming decade. The responses to this RFI are available at the survey website. The responses guided the since-appointed steering committee's initial discussions on survey organization; in particular, regarding the structure of its supporting [study panels](#). The responses will also continue to inform the work of the committee and will be made available to the soon to be formed study panels.

By design, the initial RFI did not ask the community for ideas on how to address an identified challenge/question in Earth System Science. Building on RFI #1, the committee now requests ideas for specific science and applications targets (i.e., objectives) that promise to substantially advance understanding in one or more of the Earth System Science themes associated with the survey's [study panels](#):

I. Global Hydrological Cycles and Water Resources

The movement, distribution, and availability of water and how these are changing over time

II. Weather and Air Quality: Minutes to Subseasonal

Atmospheric Dynamics, Thermodynamics, Chemistry, and their interactions at land and ocean interfaces

III. Marine and Terrestrial Ecosystems and Natural Resource Management

Biogeochemical Cycles, Ecosystem Functioning, Biodiversity, and factors that influence health and ecosystem services

IV. Climate Variability and Change: Seasonal to Centennial

Forcings and Feedbacks of the Ocean, Atmosphere, Land, and Cryosphere within the Coupled Climate System

V. Earth Surface and Interior: Dynamics and Hazards

Core, mantle, lithosphere, and surface processes, system interactions, and the hazards they generate

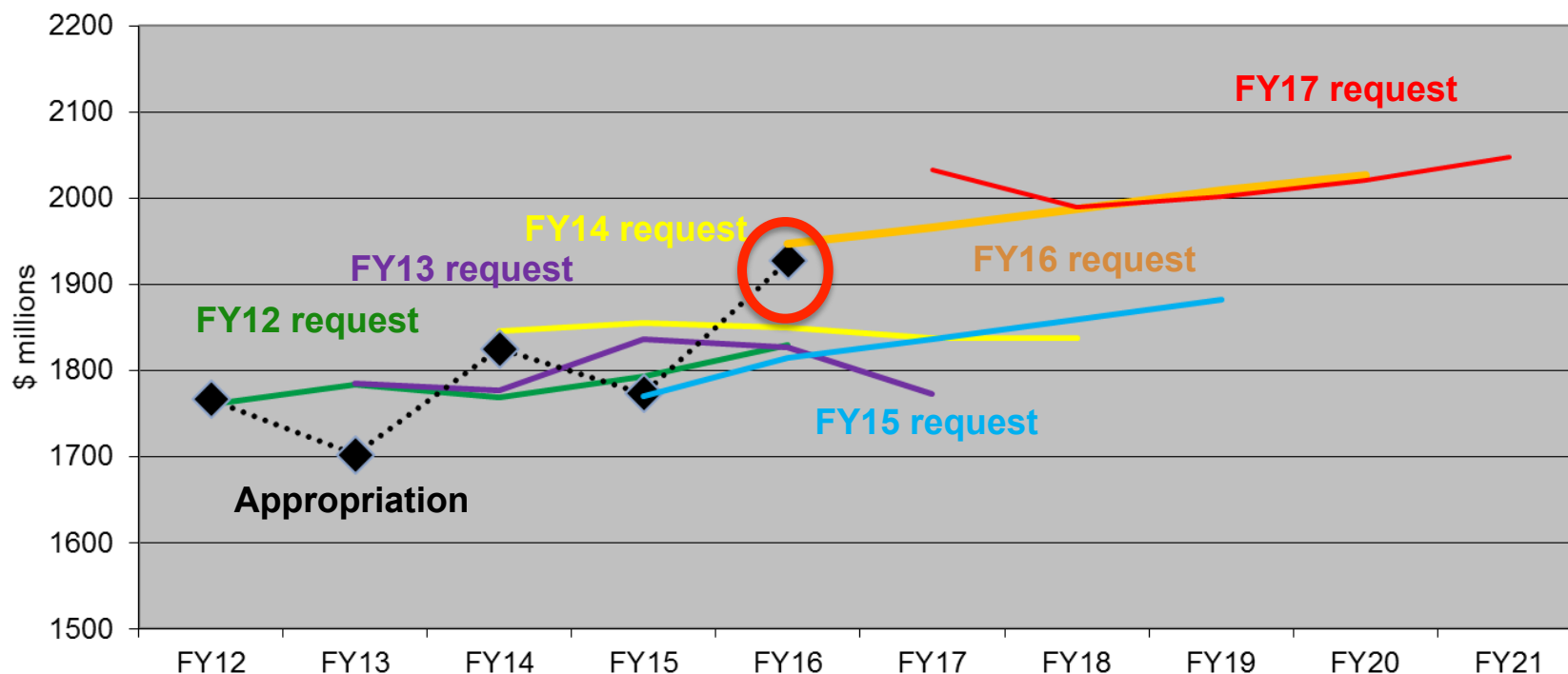
18 white papers submitted in response to the 2nd Request for Information!
Available online at <http://hyspiri.jpl.nasa.gov/nrc-decadal-survey>



ESD Budget: FY17 Request/Appropriation

ESD Total						
\$M	FY16 (op plan)	FY17	FY18	FY19	FY20	FY21
FY16 PBS	\$ 1,927	\$ 1,966	\$ 1,988	\$ 2,009	\$ 2,027	
FY17 PBS		\$ 2,032	\$ 1,990	\$ 2,001	\$ 2,021	\$ 2,048

- ESD budget jumps significantly in FY17 – then becomes consistent with FY16 PBR for the out years*





Speaking to Biologists & Ecologists



remote sensing



Article

Associations of Leaf Spectra with Genetic and Phylogenetic Variation in Oaks: Prospects for Remote Detection of Biodiversity

Jeannine Cavender-Bares ^{1,*}, Jose Eduardo Meireles ^{1,*}, John J. Couture ², Matthew A. Kaproth ¹, Clayton C. Kingdon ², Aditya Singh ², Shawn P. Serbin ^{2,3}, Alyson Center ^{1,4}, Esau Zuniga ⁵, George Pilz ⁵ and Philip A. Townsend ²

(Remote Sens. 2016, 8, 221; doi:10.3390/rs8030221)

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Imaging spectroscopy links aspen genotype with below-ground processes at landscape scales

Michael D. Madritch¹, Clayton C. Kingdon², Aditya Singh², Karen E. Mock⁴, Richard L. Lindroth³ and Philip A. Townsend²

¹Department of Biology, Appalachian State University, Boone, NC 28608, USA

²Department of Forest and Wildlife Ecology, and ³Department of Entomology, University of Wisconsin, Madison, WI 53706, USA

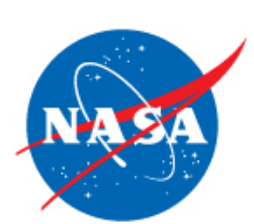
⁴Department of Wildland Resources, Utah State University, Logan, UT 84322, USA



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Research

(Phil. Trans. R. Soc. B 369: 20130194. <http://dx.doi.org/10.1098/rstb.2013.0194>)



Thank You