Overview of the AVIRIS-NG Campaign in India and the Diversity of New Environments Measured with Relevance to HyspIRI

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NASA and ISRO Joint AVIRIS-NG Campaign in India
The campaign enables new scientific and applications research in these unique 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 could lead to a future joint space mission to provide routine access to this class of measurement for both nations.
Imaging Spectroscopy: Ecosystem Example

≥100’s of Parallel Spectrometers

Ecosystem composition, function, chemistry, etc.
• Designed to exceed existing instruments in the spectral, spatial, radiometric and uniformity domains

• Uses 21st century space elements: design, grating, slit, mounts, alignment/calibration

Spectral X-track Uniformity > 95%
Spectral IFOV Uniformity > 95%

Alignment complete
ISRO B200 Aircraft
AVIRIS-NG on US B200 King Air
August 2015
US B200 Aircraft
AVIRIS-NG radiance image cube acquired near the edge of the Greenland ice sheet. Radiance spectra were extracted for a number of targets in the full flight line. The radiance spectra will be atmospherically corrected and used to generate the higher level products: grain size, melt state, impurities, etc.
NASA ISRO Imaging Spectroscopy Campaign
17th of December 2015 to 8th of March 2016

57 priority 1 sites have been acquired on cost and on schedule.

Sites collected have science and applications objectives spanning: coastal zone; mangrove forests; Asian soils; Asian forests; hydrocarbon alteration; mineralogy; agriculture; urban; and calibration/validation.
NASA AVIRIS-NG Installed on the ISRO B200 Aircraft

- 11 Dec 2015, AVIRIS-NG is installed on the ISRO B200 and is cooling down to operational temperatures (~150K).
- AVIRIS-NG Imaging Spectrometer
  - Spectral: 380 to 2510 nm @ 5 nm
  - Radiometric: ≥95% calibration with high SNR
  - Spatial: 2 to 8 m sampling

AVIRIS-NG in the hanger prior to installation

AVIRIS-NG Installed 11 Dec 2015
NRSC hanger where AVIRIS-NG is being install in the ISRO B200 Aircraft
Local calibration validation site.
During the week of January 11th, 2016 the AVIRIS-NG team (Ernesto Diaz, Peter Sullivan, and Andrew Thorpe) acquired NIST traceable radiometric calibration and flat-field measurements for AVIRIS-NG at the Hyderabad hanger while the aircraft was undergoing routine maintenance.
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The First 13 of 57 AVIRIS-NG Data Sets
65 flight lines (~2 TB) processed to L1 and L2 and delivered back to ISRO in two weeks
Radiance & reflectance for three surface types in a Feb 3 flight line
AVIRIS-NG Imaging Spectroscopy
Forestry: Shoolpaneshwar, Gujarat, India

L1 Radiance ($\mu$W/cm$^2$/nm/sr)

L2 Reflectance
AVIRIS-NG Imaging Spectroscopy
Geology: Ambaji, Gujarat, India

L1 Radiance (μW/cm²/nm/sr)

L2 Reflectance
AVIRIS-NG Imaging Spectroscopy
Costal Ocean: Pirotan, India

L1 Radiance (μW/cm²/nm/sr)

L2 Reflectance
AVIRIS-NG Imaging Spectroscopy
Snow/Ice: Himachal Pradesh, India

L1 Radiance ($\mu$W/cm$^2$/nm/sr)

L2 Reflectance
Test of L3 Product Canopy Water Absorption

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Equivalent water thickness (EWT)
Test of L3 Ecosystem Product

ang20160203t060655

Spectral Mixture Analysis (SMA)

Non-photosynthetic vegetation
Green vegetation
Substrate (soil, rock, anthropogenic, etc.)
Currently Unmapped
• All 317 flight lines for the 57 sites imaged have been received and processed.

• Copies of the L1 and L2 are being shipped back to ISRO.

• Plans are underway to reopen the ROSES opportunity with pathways to establish connections with ISRO researchers.

• Quicklooks can be found at https://avirisng.jpl.nasa.gov/cgi/flights.cgi?step=view_all_flights
AVIRIS-NG was installed on an ISRO B200 aircraft and began measuring science targets in India on the 17th of December 2015 and completed acquisitions on the 8th of March 2016.

AVIRIS-NG returned safely to JPL on 22 April 2016.

During the campaign imaging spectroscopy measurements were acquired for all 57 planned sites, 317 flight lines.

Sites collected have science and applications objectives spanning: coastal zone; mangrove forests; Asian soils; Asian forests; hydrocarbon alteration; mineralogy; agriculture; urban; and calibration/validation.

All 57 sites have been cleared by MoD with some portions of 30 flight lines redacted.

The data have been transferred to JPL and are being processed. Upon completion, copies of the L1 radiance and L2 reflectance are being sent to ISRO.

Quicklook images of AVIRIS-NG India campaign data sets can be found at:

https://avirisng.jpl.nasa.gov/cgi/flights.cgi?step=view_all_flights

The NASA ROSES opportunity for U. S. investigators to work collaboratively with Indian researchers is planned to be reopened.

Weekly telecons continue with ISRO to track the status and processing of all data sets for use by Indian and U.S. researchers.

There is broad and enthusiastic interest in the joint science and applications research that can be pursued with these first of their kind measurements.