



Hyperspectral imaging ISRO plans

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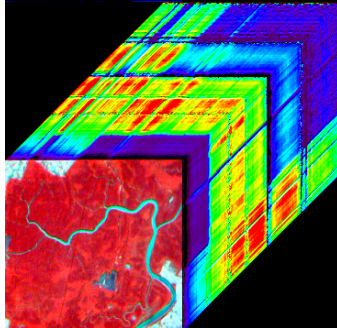
13th August 2009

HysplRI science meet

Data Sources



Hyperion



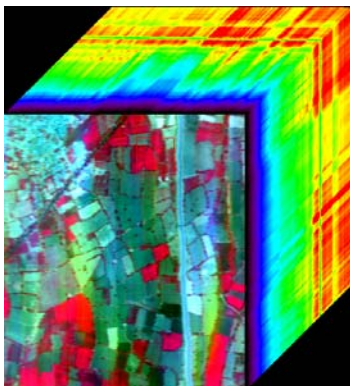
224 bands
400-2500 nm range
Spectral Resol. 10/11 nm
Spatial Resol. 30 m
Swath 7.5 km

Field Spectroradiometer

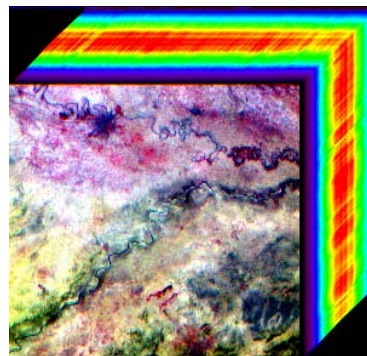


350-1075 (2500) nm range
Resol. 3nm (350-1000nm)
10 nm (100-2500 nm)

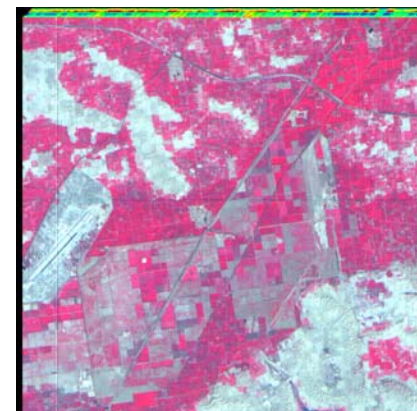
AIMS



HySi/IMS-1



CHRIS/PROBA

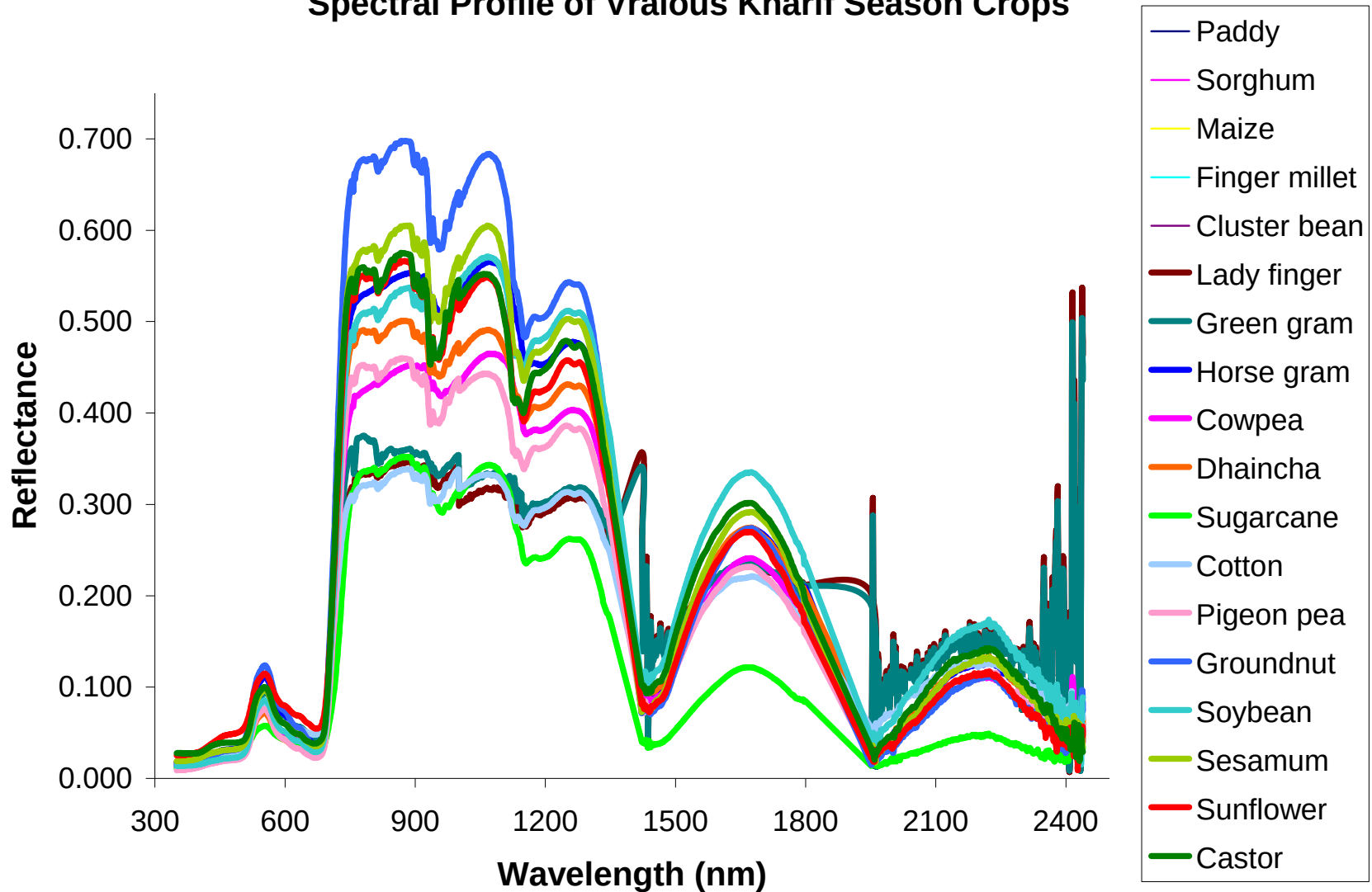


Various data set:
Land set has
18 bands
438-1035 nm range
6-10 nm bandwidth
Spatial Resol. 17m
Swath 14 km
Multi-angular (5 angles)

Towards Building a Spectral Library

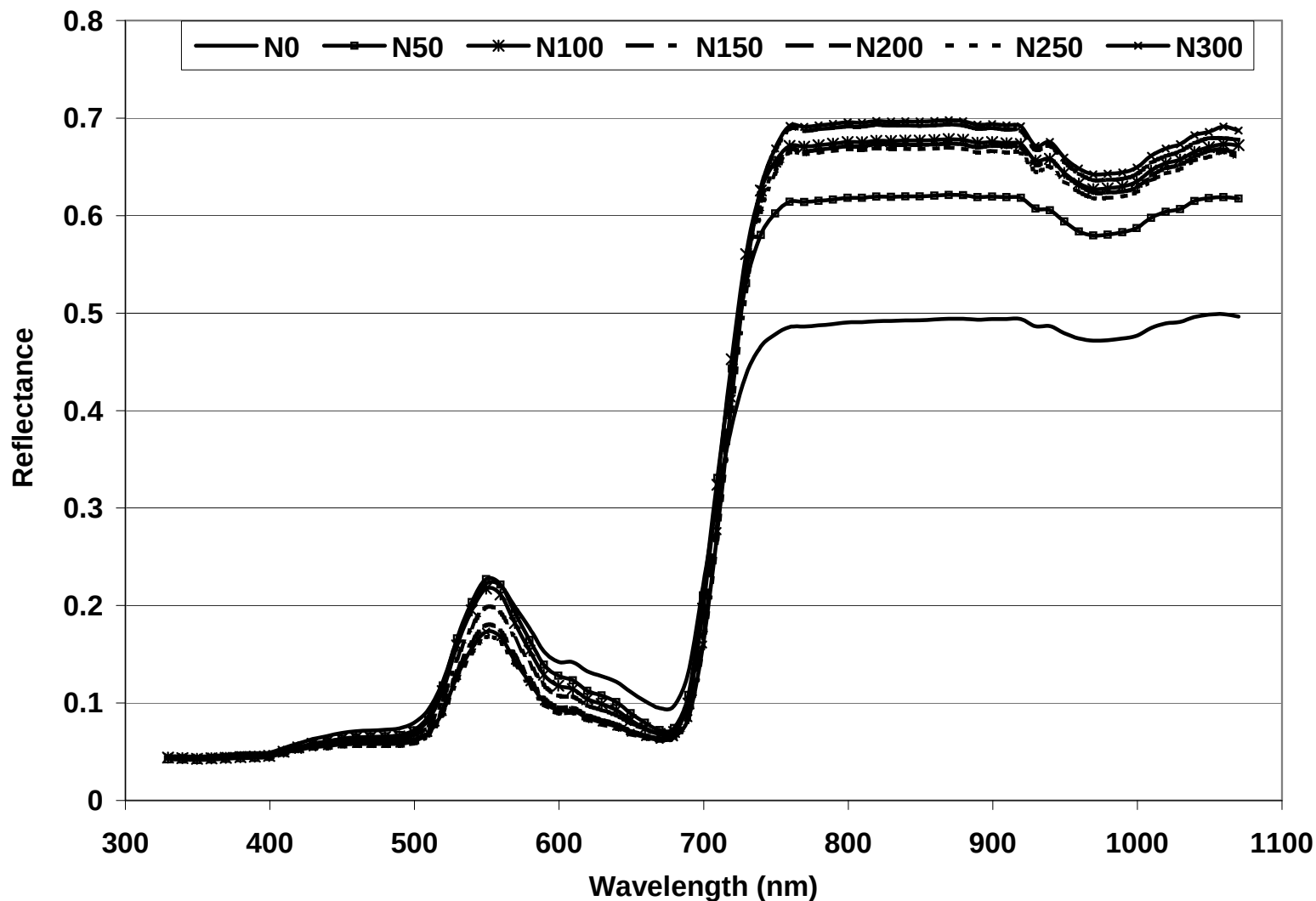


Spectral Profile of Various Kharif Season Crops



Other Spectral Observations include: Tree Species in Palampur & Vadodara, Flowering Plants, Pulse crops at Lalitpur

Crop Stress Detection (Nitrogen)



- 7 levels of nitrogen applied to potato crop
- Lower level of nitrogen had low NIR reflectance and high red reflectance

Forest Species Classification

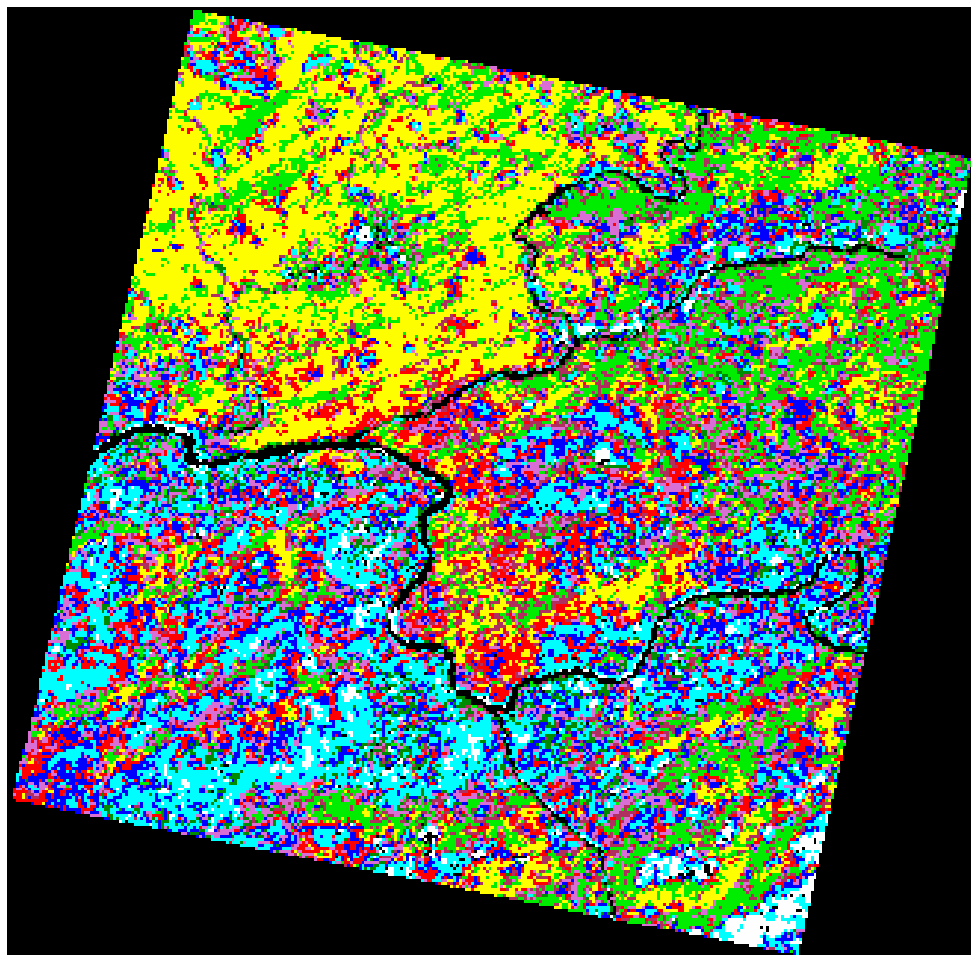


Study Area: Shoolpaneswar Forest

Data Used: Hyperion Data of October

Approach: Band Selection using PLSR technique, SAM Classification

Spectral Angle Mapper 9 band

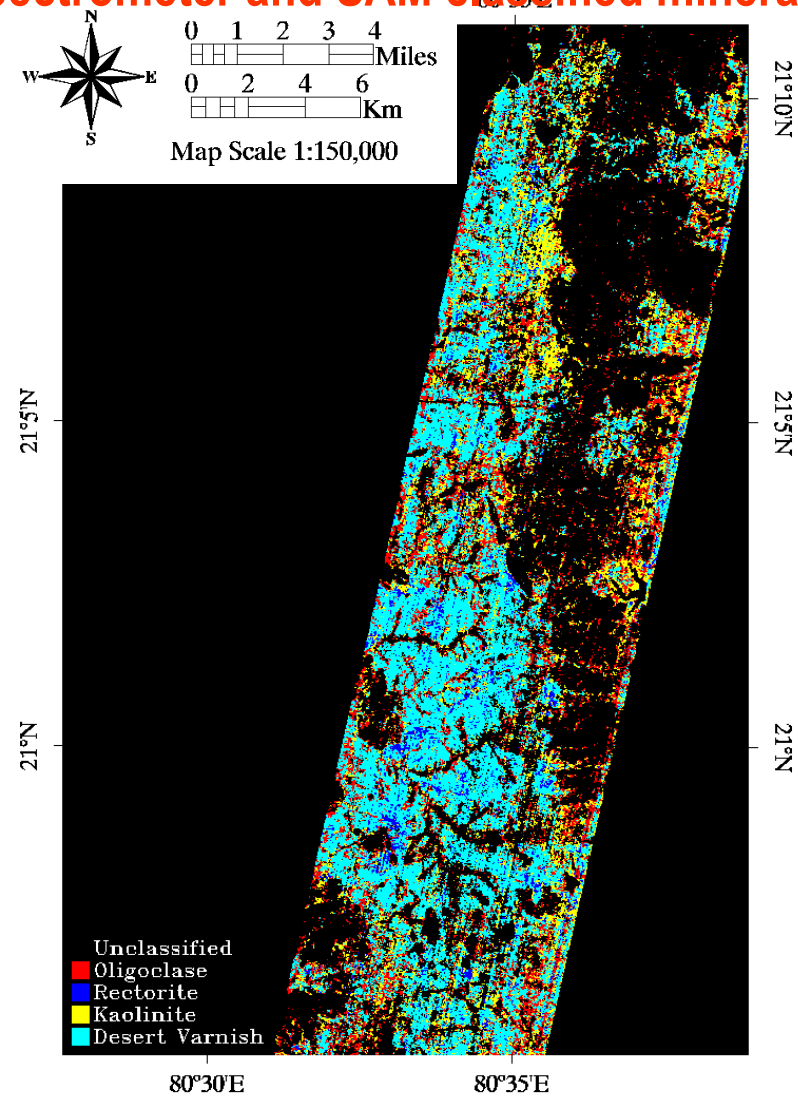
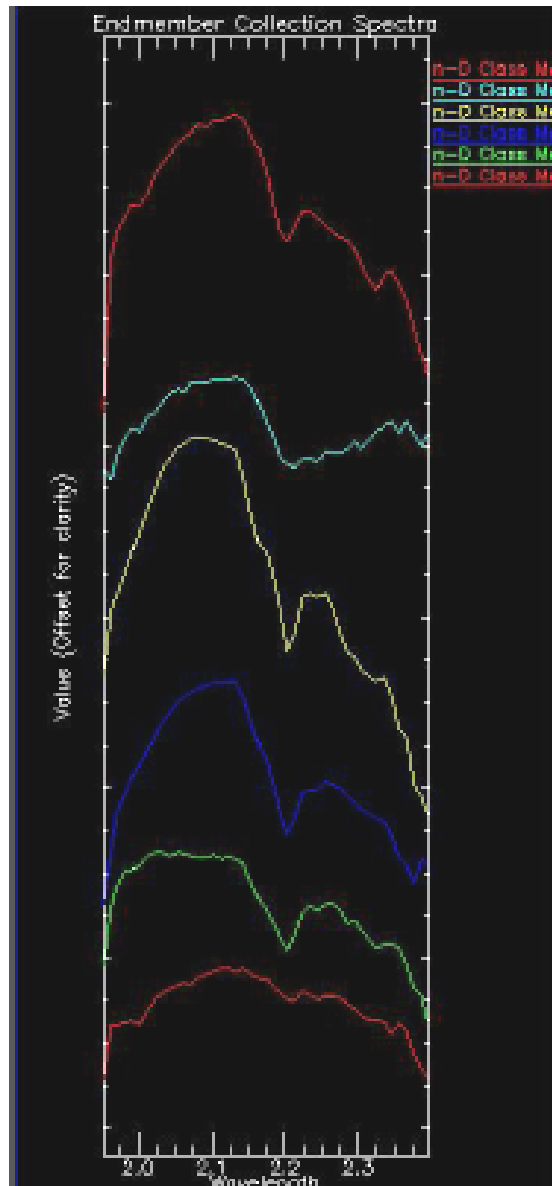


- Tectona*
- Dendrocalamus*
- Mangifera*
- Madhuca*
- Pongamia*
- Ficus*
- Barren land , roads
- Farm land
- Human settlement

Geological Study using Hyperion data

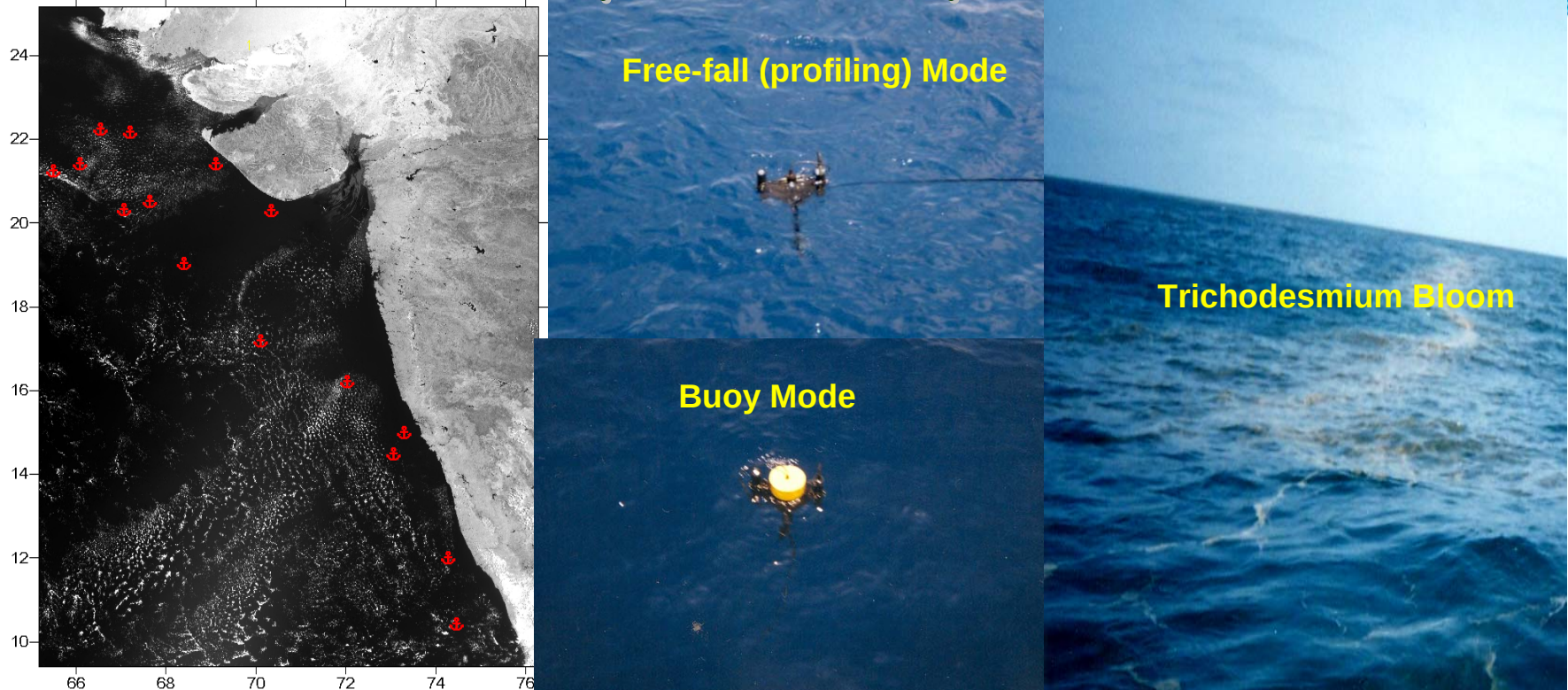


End Member Spectra derived using ASD Spectrometer and SAM classified mineral map



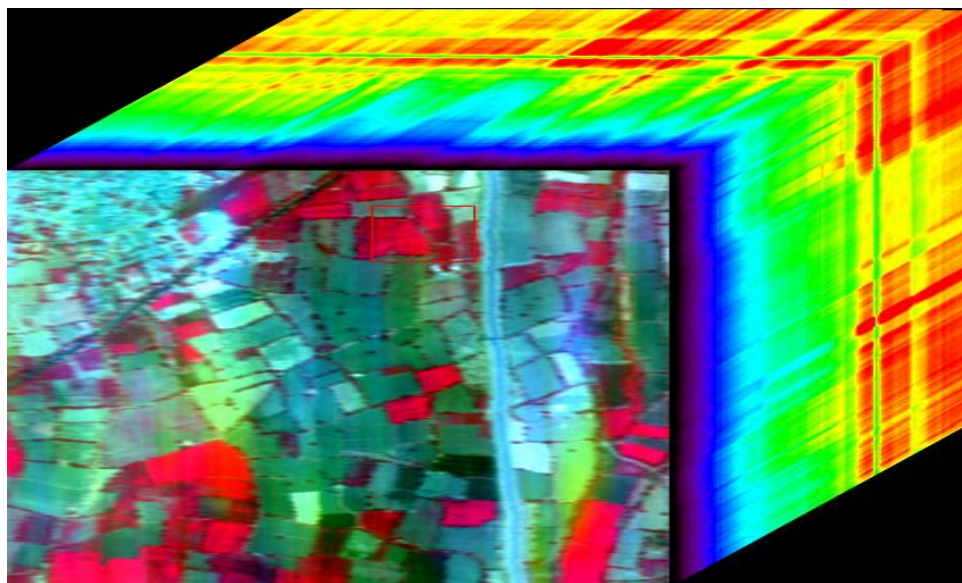
Parts of Dongargarh area (Chattisgarh) showing weathered/altered minerals

Ocean Optical Properties



- Bio-optical characterization of Arabian Sea water in open ocean and coastal waters using hyperspectral under water radiometer
- Cruise started from Kochi and went up to off Veraval; Encountered *Trichodesmium* blooms
- Hyperspectral under water radiometer with 3.0 nm spectral resolution in 300 – 900 nm spectral range both Free-fall (profiling) mode and Buoy mode

AirBorne Imaging Spectrometer AIMS



Altitude: 6 km

GSD : 4 m

Swath : ~1.6 km

Spectral Range: 456-889 nm

Number of Bands: 143

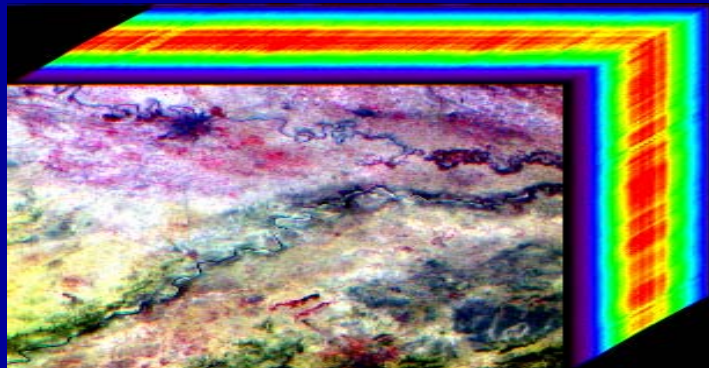
Band Width: 3.3-4.1 nm

Grating



- Airborne Hyperspectral Imager (AHySI)
 - Spectral Range: 420-950 nm;
 - Spectral sampling interval: 1.2 nm;
 - Number of Bands: 512
 - Bandwidth: 12-15 nms
 - Wedge filter
 - 5 meter GSD

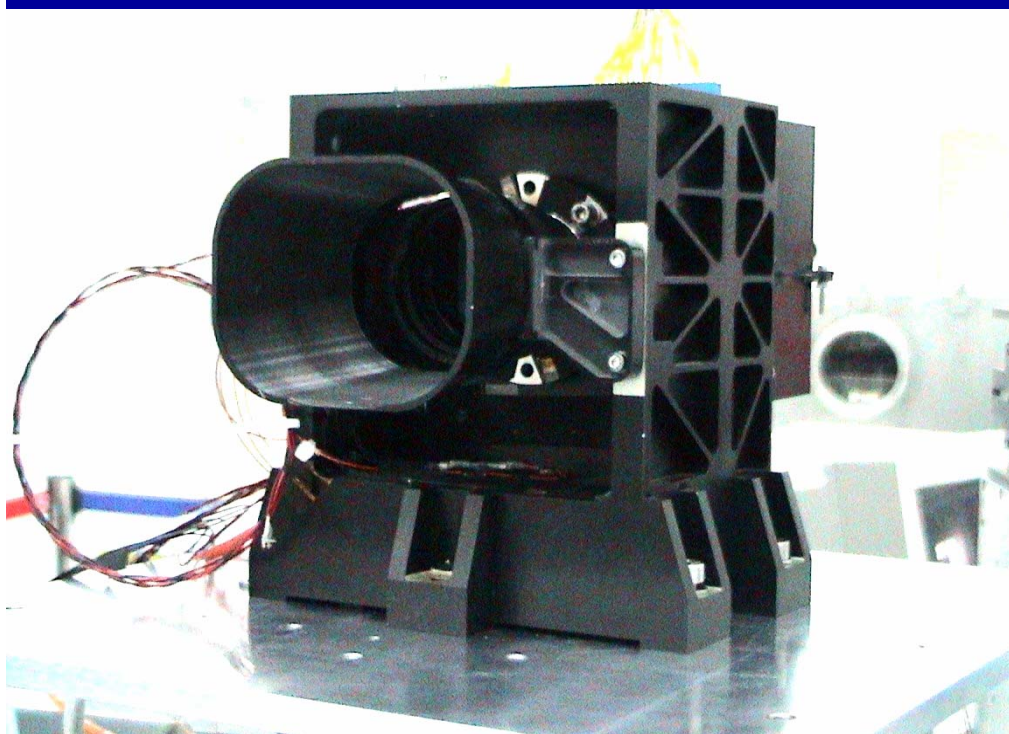
Hyperspectral imager on IMS-1



Size (mm) : 155 (R) x 194 (P) x 211 (Y)

Mass (kg) : 2.9

Power (W): 0.88 (Regulated), 2.5 (Raw)



64 bands

400-950 nm range

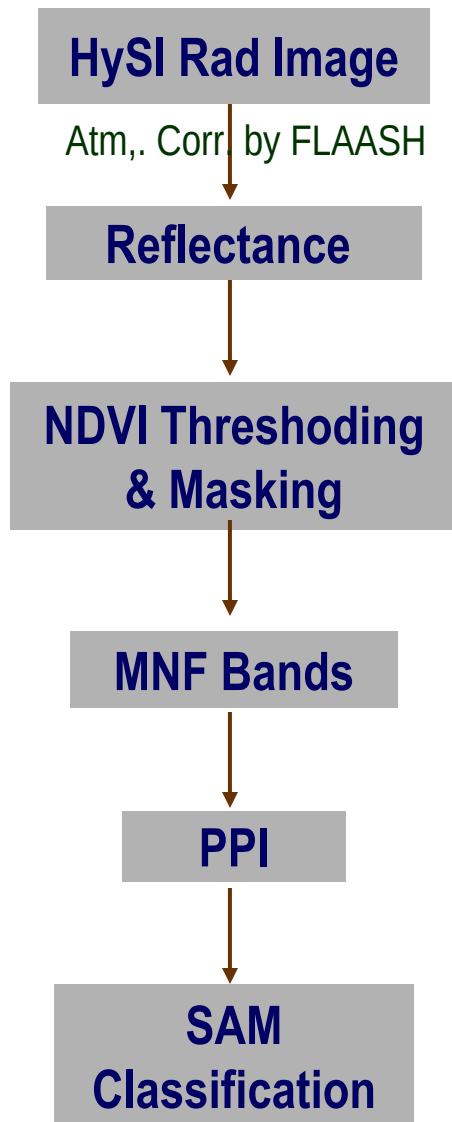
Spectral interval 8 nm

GSD 500 m

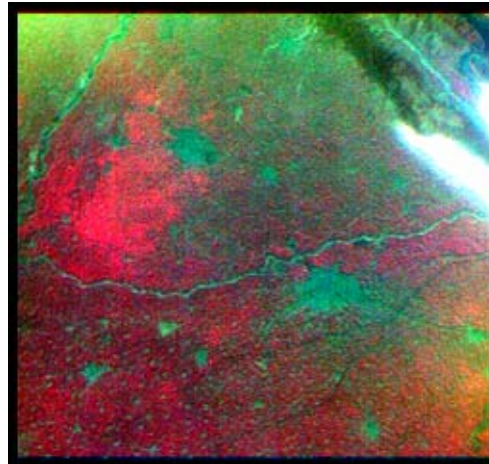
Swath 129.5 km

Quantisation 10 bits

Crop Classification using HySI Data

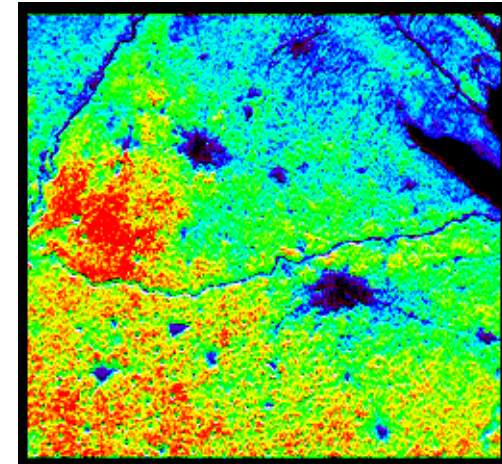


HySI FCC

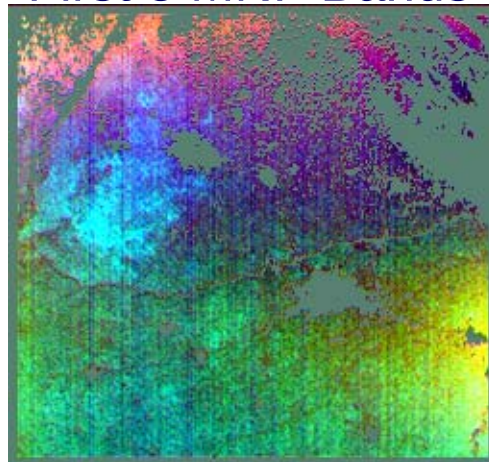


Part of Punjab, India
22-Dec, 2008

NDVI

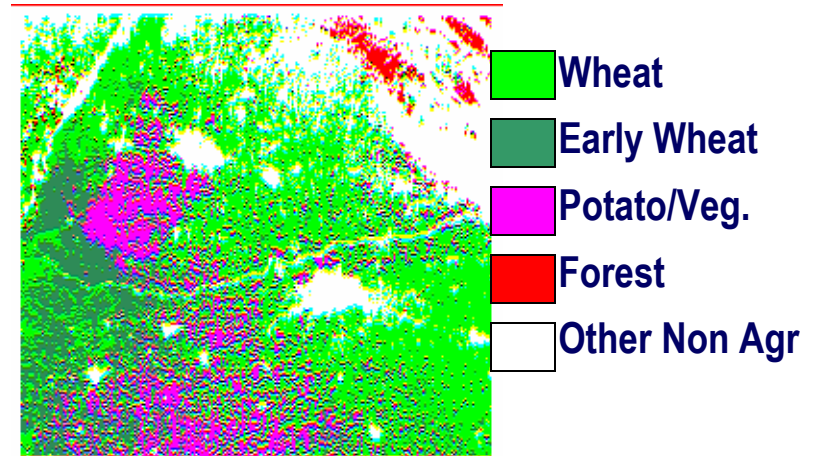


First 3 MNF Bands

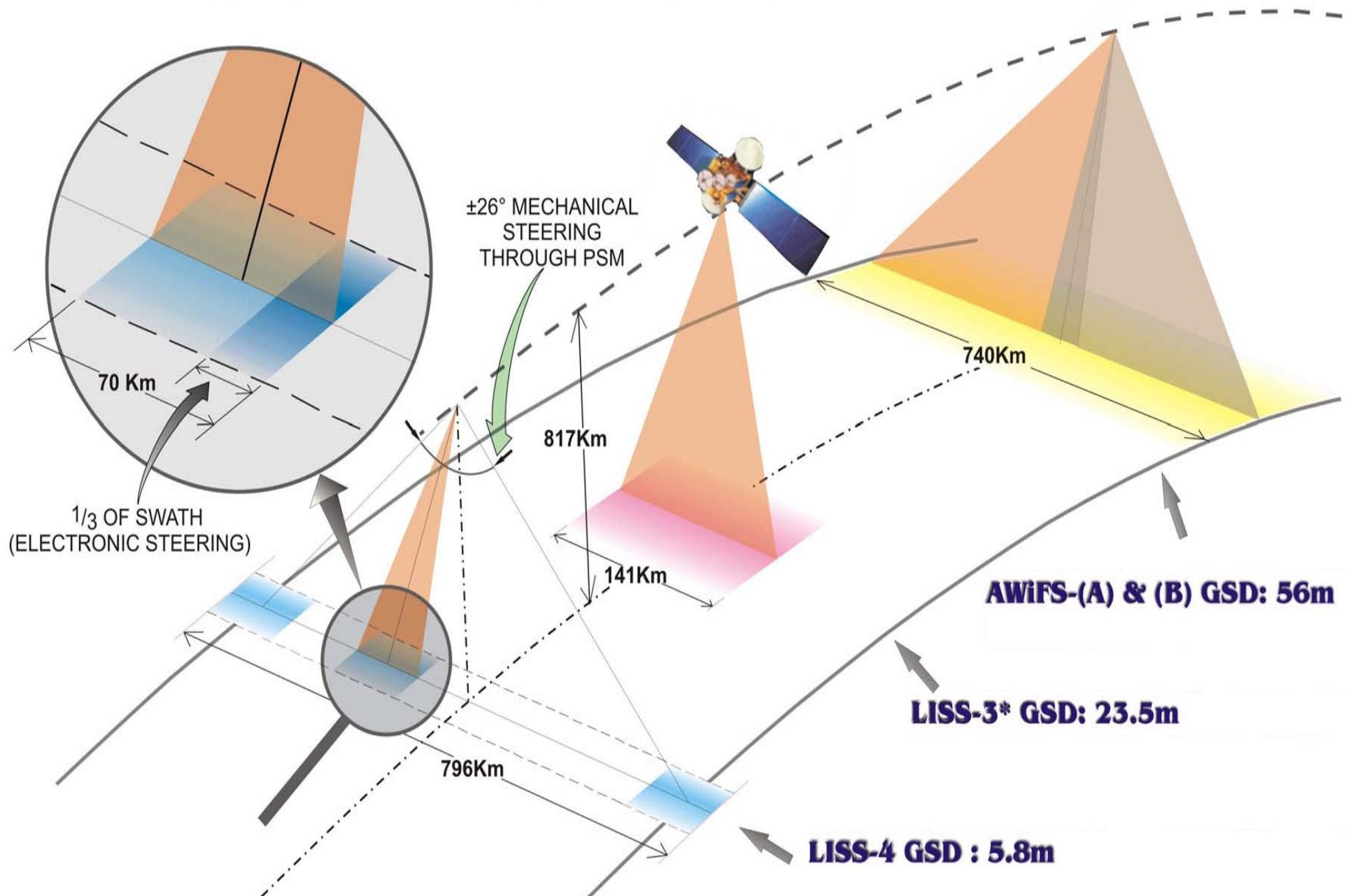


Non Agriculture Mask

Classified Image



IRS-P6 THREE TIER IMAGING

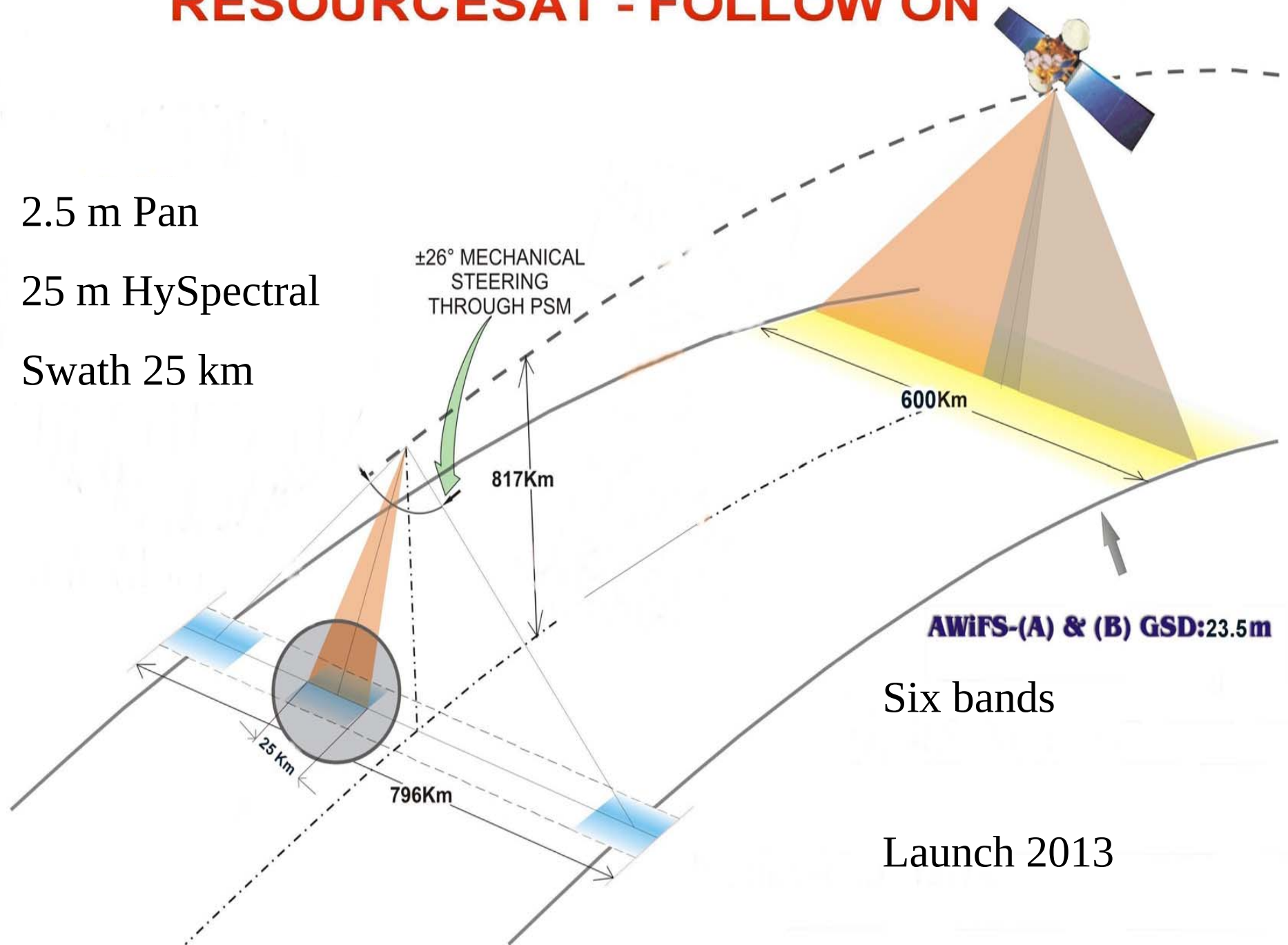


RESOURCESAT - FOLLOW ON

2.5 m Pan

25 m HySpectral

Swath 25 km



Spaceborne HSI - LEO, 630 km



Technique	Pushbroom
Spectral Coverage (nm)	VNIR : 400 ~ 900 SWIR: 850 ~ 2400
Spectral Resolution (nm)	VNIR Better than 3 nm SWIR : 6 - 7 nm
Spatial Resolution	25 m
Swath	25 Km
Optics	All reflective
SNR	VNIR : > 500 @ 495 nm SWIR : > 350 @ 2200 nm
Digitization (bits)	> 14
Spectral Dispersion	Grating
Data rate	VNR: 2.3 Gbits/sec (for 166 Bands) SWIR : 2.3 Gbits/sec (for 256 Bands)

GEO Based High Resolution Imaging mission

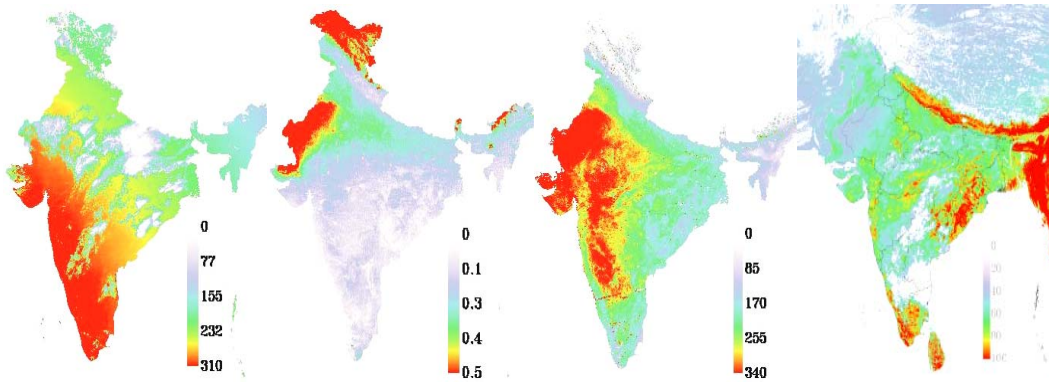


Imaging in visible and IR bands

- ❖ Multi spectral VNIR 50 m
- ❖ Hyper spectral VNIR 250m
- ❖ Hyper spectral SWIR 500m
- ❖ Multi spectral TIR 1500m



Imager	Area Covered	Time for Scanning
Vis - Mx	500km x 7800km	10 min
VNIR Hyps	250km x 7800km	10 min
SWIR Hyps	250km x 7800km	10 min
TIR - Mx	250km x 7800 km	10 min
Vis	4500km x 7800 km	90 min



Current

1000 m GSD

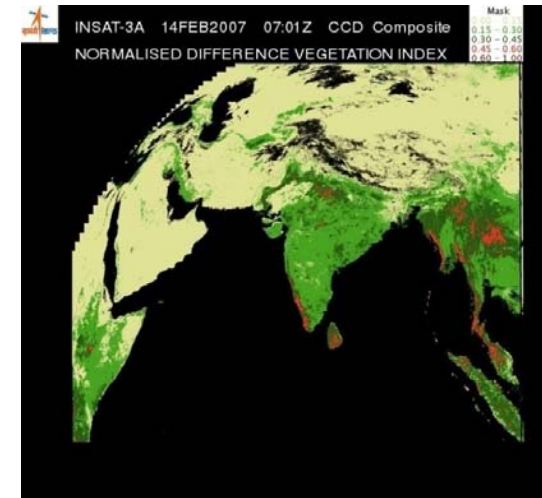
3

Vis
bands

SWIR

TIR

8000 m single Band



New

~50 m GSD

4

~250m Hyperspectral

~500 m Hyperspectral

~1500 m Multi band

❖ GISAT Payload consists of

- ✓ 700mm RC telescope
 - ✓ Array detectors in VNIR, SWIR and TIR bands
 - ✓ Camera electronics and data handling system
 - ✓ Electronically steerable transmit antenna system
-
- ✓ High agility platform to enable large payload steering requirements

❖ *Data rate for various bands*

Imager	Slow scan (0.005°/s)	Fast scan (0.02°/s)
HRMXVNIR (4 bands, 50m resolution, 500Km swath)	34 Mbps	134Mbps
HYSI(VNIR) (60 bands, 250m resolution, 250Km swath)	3 Mbps	12Mbps
HYSI(SWIR) (150 bands, 250m resolution, 250Km swath)	25 Mbps	98Mbps
HRMXTIR (3 bands, 1.5Km resolution, 250Km swath)	0.02 Mbps	0.08Mbps
Net overall Data Transmission Rate	≈ 64 Mbps	≈ 200 Mbps

Spacecraft designed for direct injection into geo-stationary orbit by GSLV.

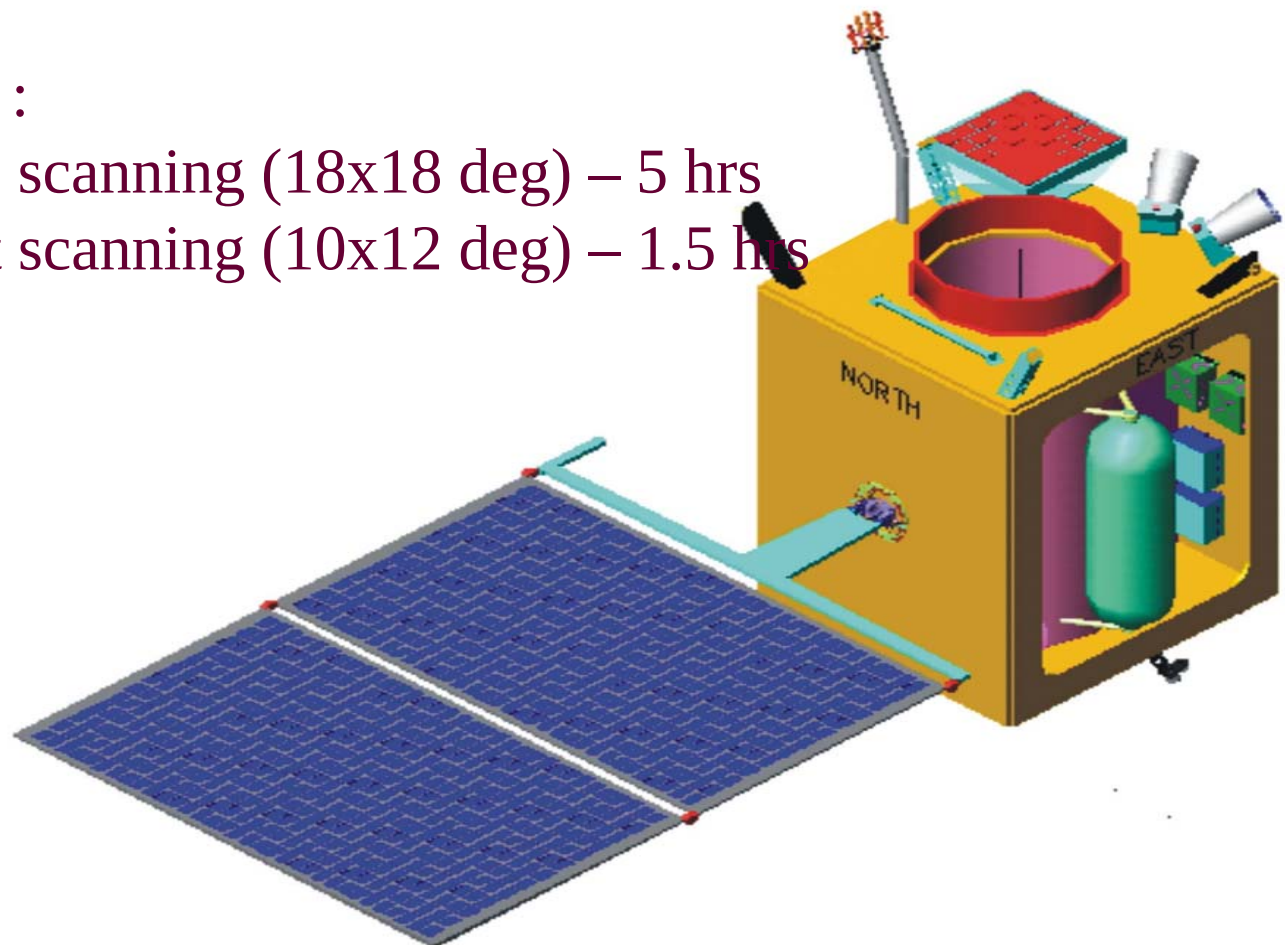
GISAT orbital slot is around 83deg E.

Scanning modes :

Earth disc scanning (18x18 deg) – 5 hrs

Sub continent scanning (10x12 deg) – 1.5 hrs

Launch 2012



Summary

Airborne: Currently Airborne Hyperspectral imagers operate in VNIR

Extension: SWIR (upto 2.5 microns) and
TIR (7 to14 microns)

Spaceborne Hyperspectral imagers

Hyperspectral imager in VNIR region flown on IMS

Resourcesat 3 will carry Hyperspectral sampler

Geoplatform based Hyperspectral imager is being developed

Thank you