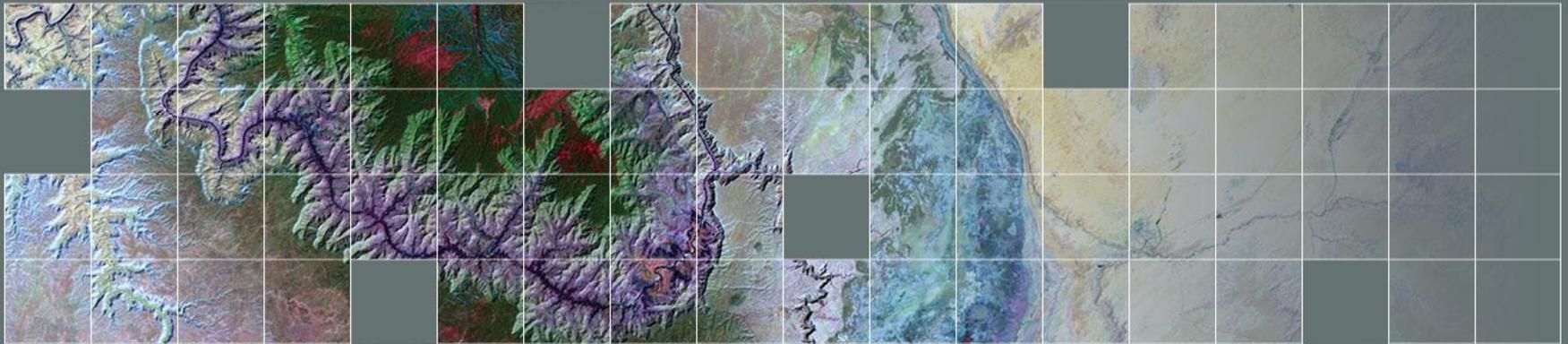




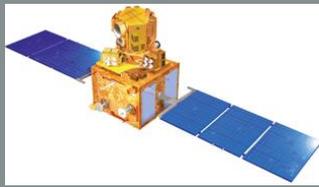
Climate and Land Use Change
Earth Resources Observation and Science (EROS) Center

Summary of Characterization Work at USGS EROS



Author: Jon Christopherson, SGT, Inc.
Date: Friday, March 28th, 2014

ResourceSat-2

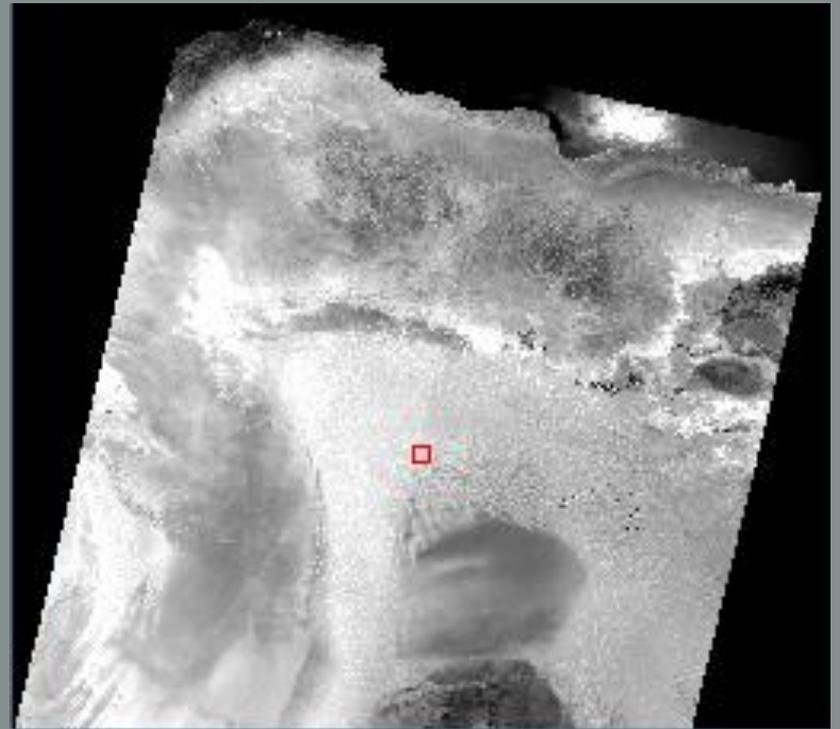
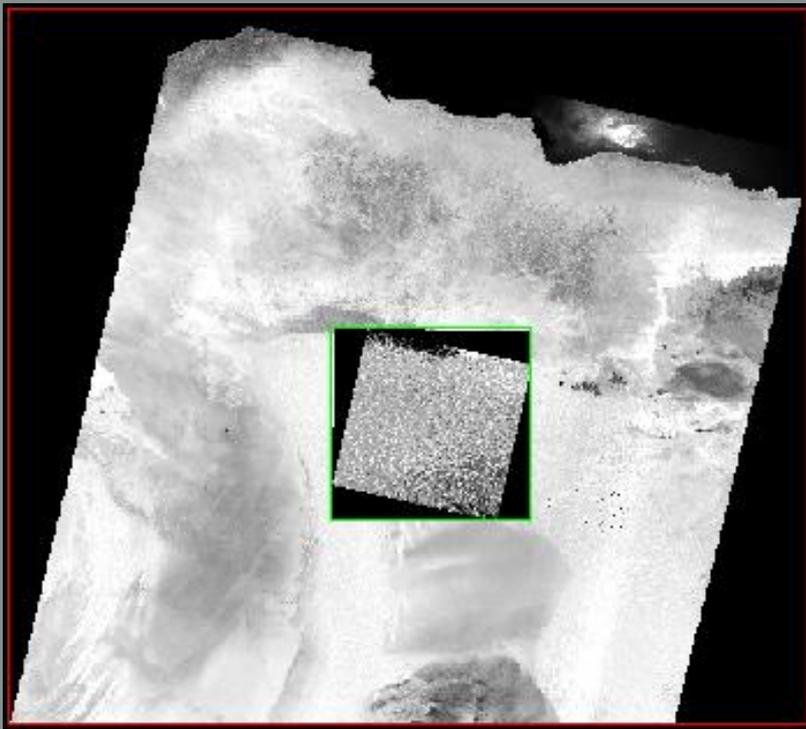


- ResourceSat-2, launched Apr 20, 2011
- Follow-on to ResourceSat-1
- 3 Instruments:
 - AWiFS-2: 56m GSD, 740km swath, G,R,NIR, SWIR-1
 - LISS-III: 23m GSD, 140km swath, G,R,NIR,SWIR-1
 - LISS-IV: 5.8m GSD, 23.9km swath, G, R, NIR
- Sun-synchronous orbit,
altitude =827 km,
inclination = 98.7°

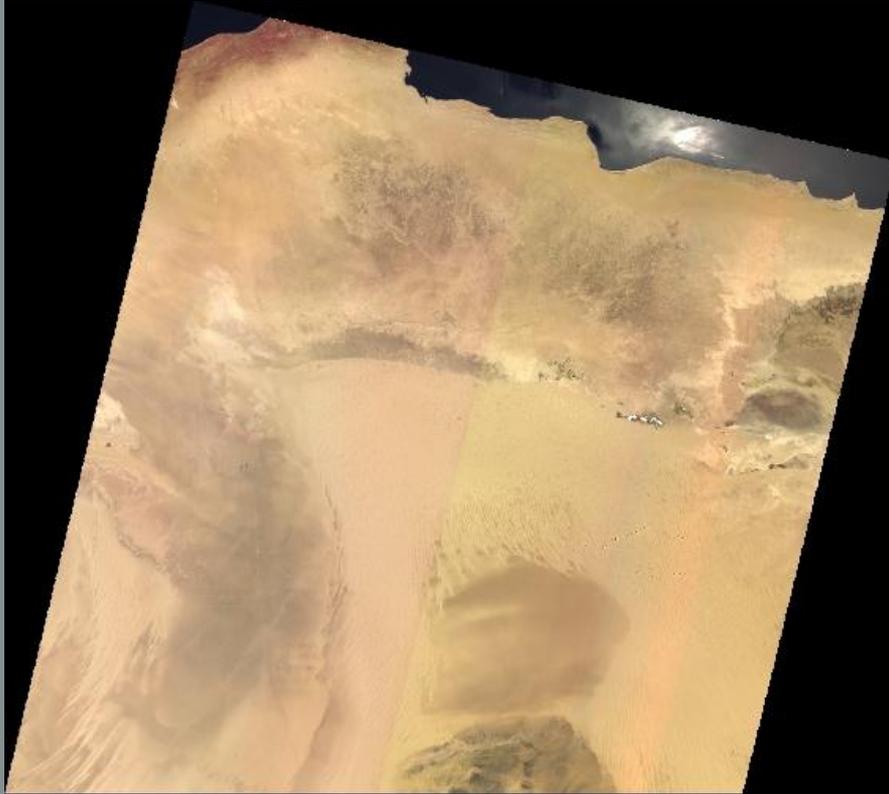
ResourceSat-2



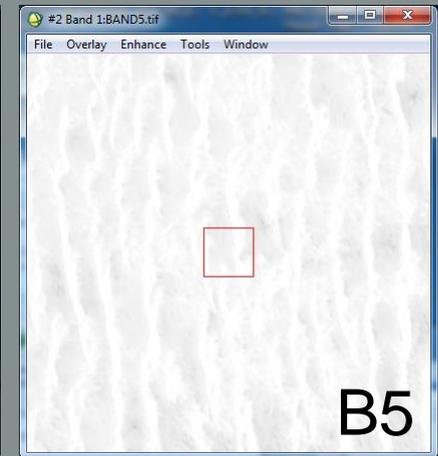
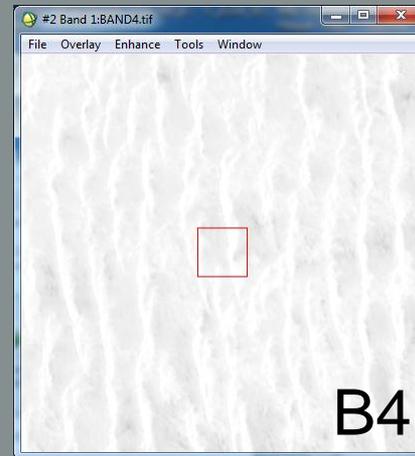
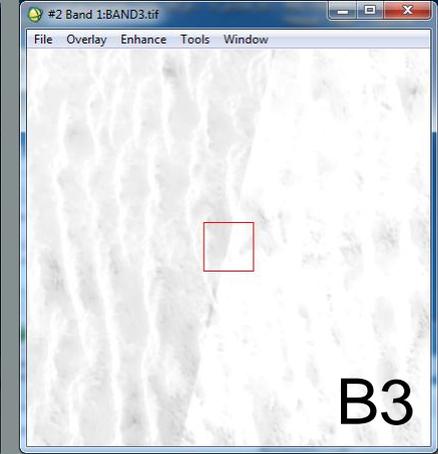
- AWIFS-2 vs L8 OLI vs Libya-4 Test Site



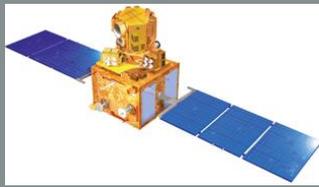
ResourceSat-2



- Date Of Pass= 20-JUN-2013

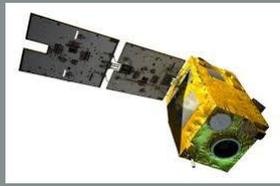


ResourceSat-2

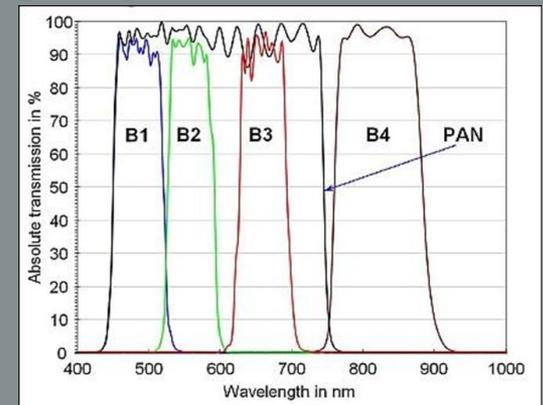


- **Intermediate analyses:**
 - A vs. B discrepancy in Band 3
 - 18% to 28% difference w.r.t. L8 OLI
 - May be attributable to spectral response – need RSRs
- **Plans:**
 - Analyze/compare all three sensors to each other
 - Compare to OLI
 - Geometry

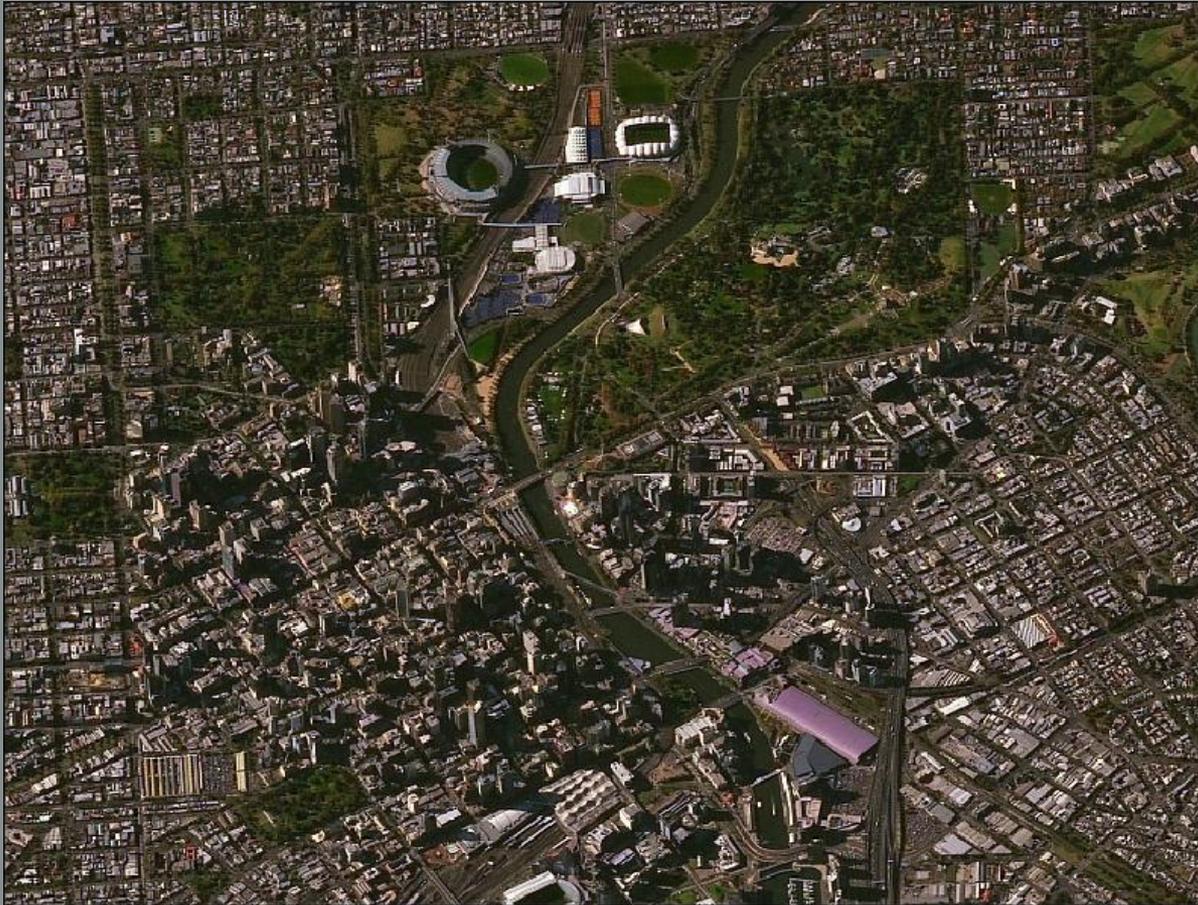
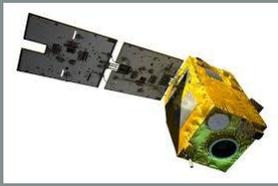
VNREDSat-1



- VNREDSat-1A spacecraft was launched on May 7, 2013.
- Vietnam Natural Resources, Environment and Disaster Monitoring Satellite
- Built by EADS Astrium AstroSat-100 bus
 - 120kg, 2.5m pan, 10m VNIR
 - 17.5km swath at nadir
 - 12-bit imager, coded to 10-bit for downlink
 - Sun-synchronous orbit, altitude = 704 km, inclination = 98.7°

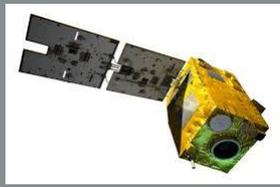


VNREDSat-1

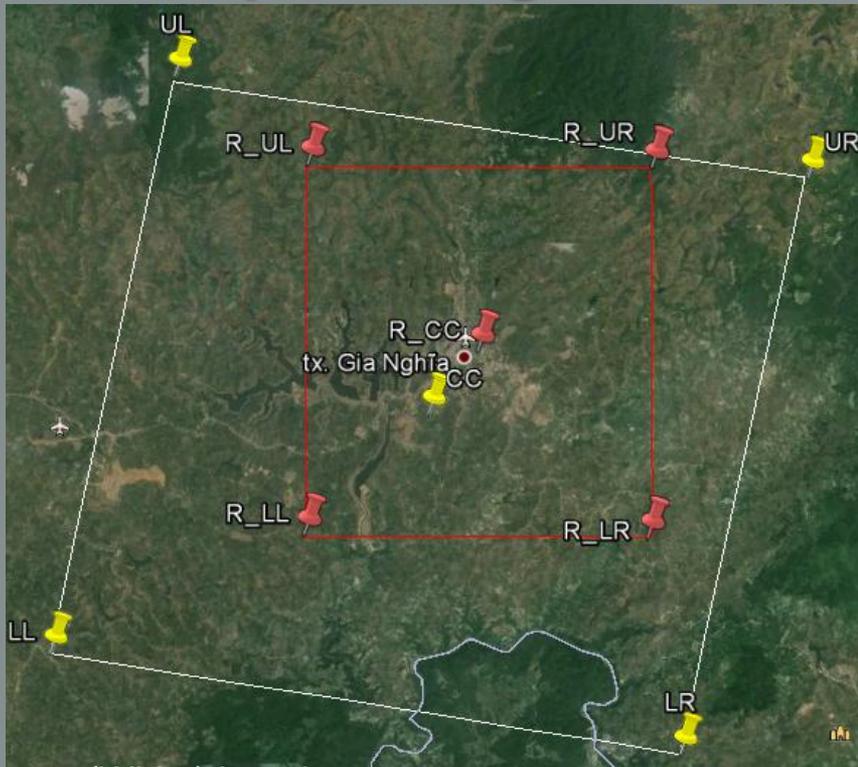


VNREDSat-1 image of the city of Melbourne, Australia, May 9, 2013 (image credit: Astrium)

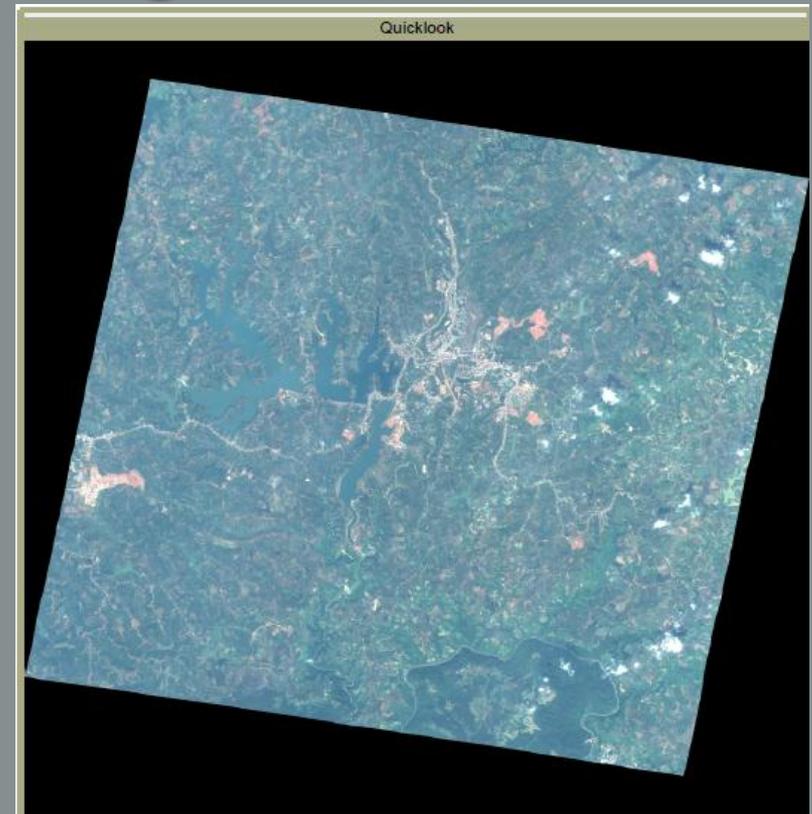
VNREDSat-1



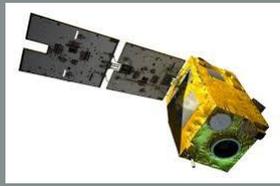
■ Sample image over DakNong ,Vietnam



- (White) Imaging area
- (Red) Product area

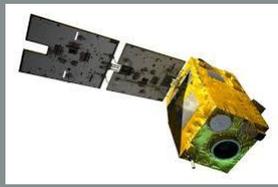


VNREDSat-1



- **First image rec'd was Pan-Sharpended**
 - Numerous curious artifacts later attributed to this
- **Asked for un-sharpended image**
 - Delivered in Jan'14
 - Most artifacts disappeared
- **Future analyses uncertain**

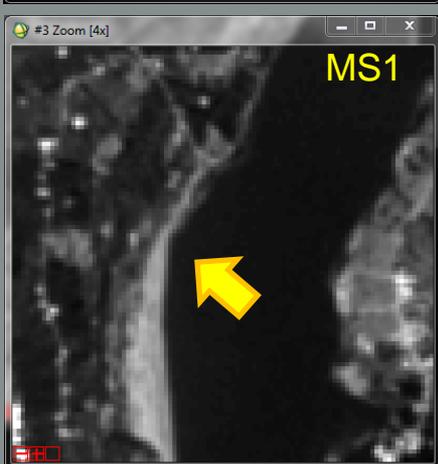
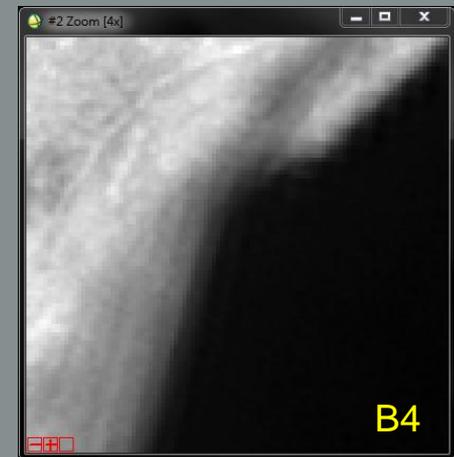
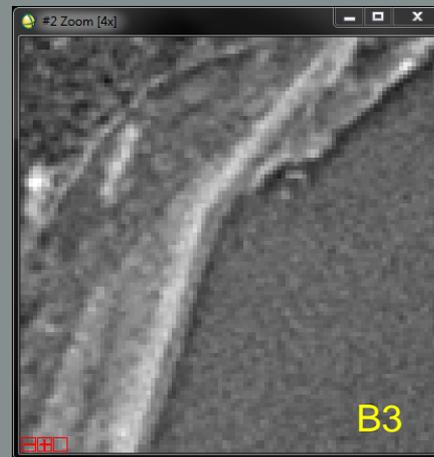
VNREDSat-1



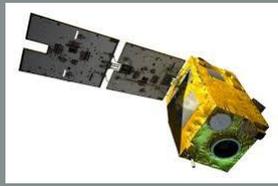
Native vs. Pan-sharpened



PAN sharpened



VNREDSat-1



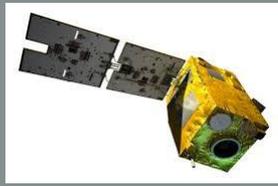
■ MTF and Signal-to-Noise

NOTE: these are from one image only, with minimal reference

Product	Band	PAN / MS	RER	FWHM	MTF
2A (Along)					
1A	Band_1	MS 1	0.52	1.8	9%
	Band_2	MS 2	0.64	1.2	15%
	Band_3	MS 3			
	Band_4	MS 4	0.42	2.1	< 2%
PAN			0.32		

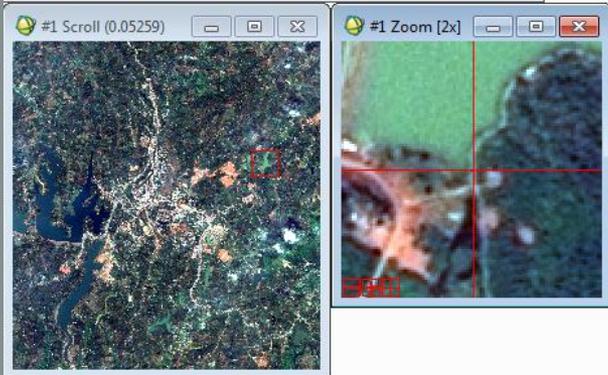
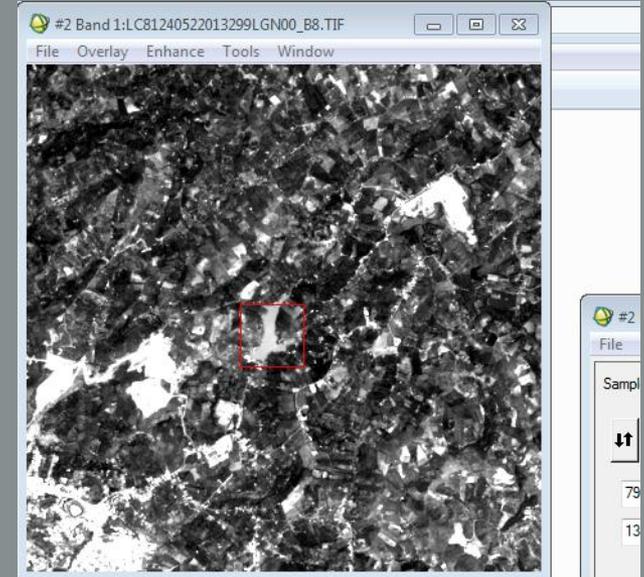
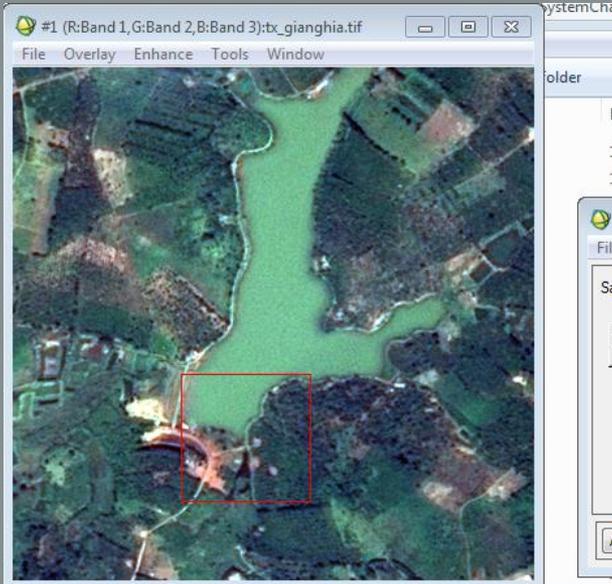
Product	Quality	Band	Value
2A	SNR	Band_1	~99
		Band_2	~45
		Band_3	~31
		Band_4	~280
		PAN	~63
	Radiometric resolution		8 bit
	Mis-registration	PAN + MS	> ±0.5 pixel, MS

VNREDSat-1



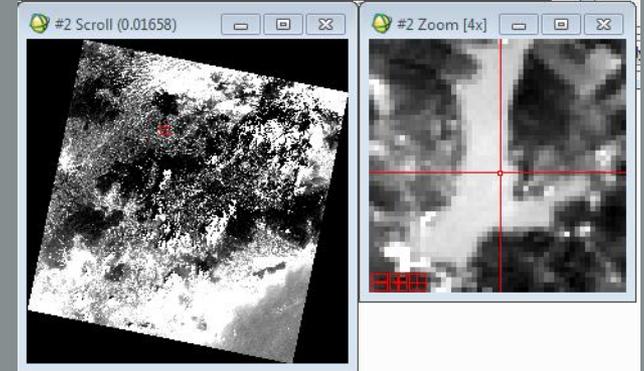
Geometric Quicklook
using L-8 data:

Mean: -60m E , -318m N
Std.Dev : 32m E and 22m N



VNREDSAT-1

Landsat 8



Planet Labs



- Based in San Francisco
- Size: 10 cm x 10 cm x 30 cm
- Mass: ~ 5.8 kg.
- Launches:
 - Dove-1: 4/21/13, 241 × 357km, 51.6° (6 day life)
 - Dove-2: 4/19/13, 96.08°
 - Doves-3&4: 11/21/13, 594 × 815km, 97.7°
 - Flock-1 (#5 thru 32): February, 2014 from ISS
 - And many more....

Planet Labs



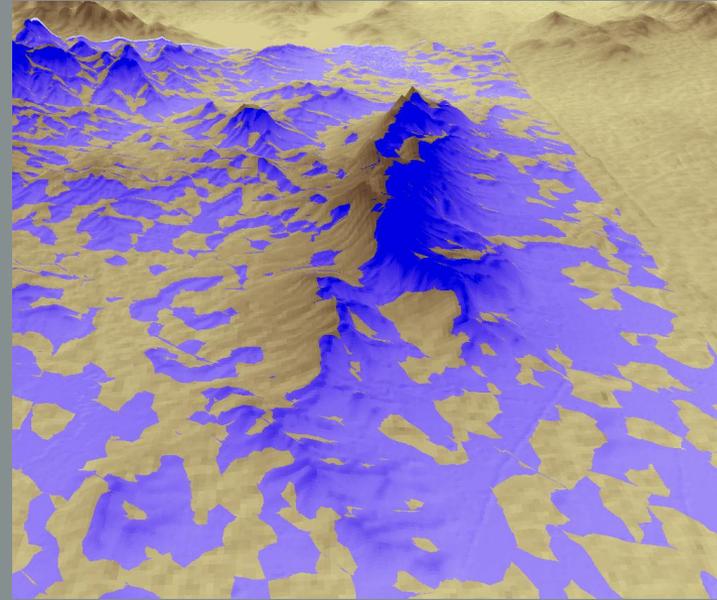
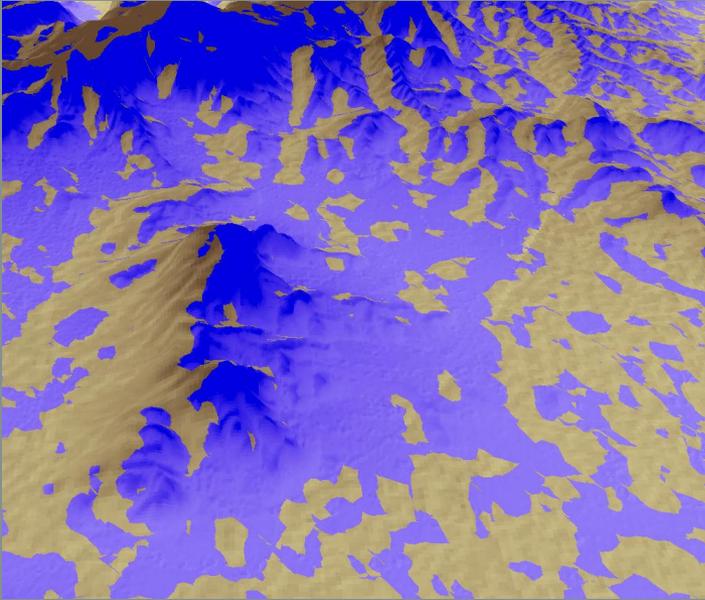
- Dove-2
- ~570km
- Shizuoka, Japan
- May 1st, '13
- ~ 45° angle



P 05-01-13 FROM DOVE 2
IMAGE © 2013 PLANET LABS INC. ALL RIGHTS RESERVED.

-
- **Airbus Defence & Space and Infoterra GmbH**
 - Vertical accuracy: 2m (relative) / 10m (absolute)
 - 12m x 12m raster
 - High Geometric precision
 - **Our analysis only on sample dataset – so far**
 - We lacked control
 - **We Compared to ASTER DEM**
 - Number of check points: 667
 - Mean: -0.14m
 - STD: 7.0m
-

- **WorldDEM (blue) and ASTER DEM (brown)**
 - Wagga Wagga, Australia
 - Note apparent E-W shift
- **Future Plans: Analyze over USGS range(s)**



Other Activities

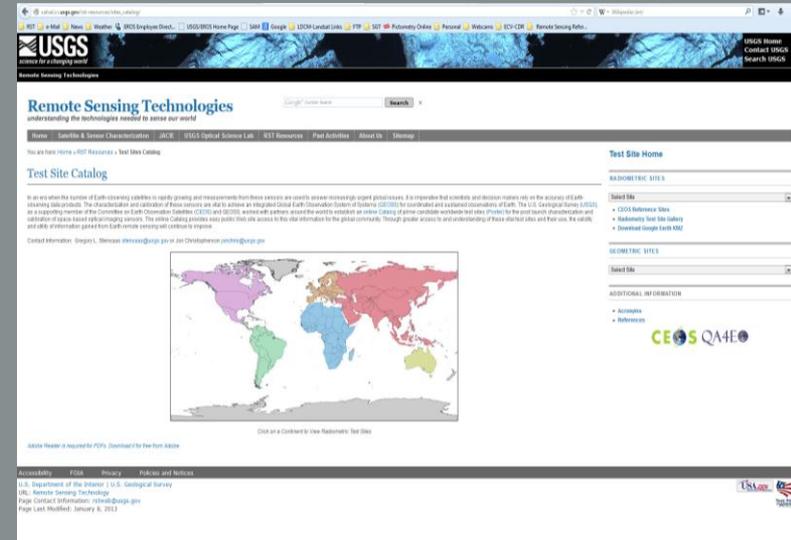
■ Test Sites:

- RST maintains Geometric Test Sites
 - Sioux Falls, SD; Pueblo, CO, Rolla, MO
- Developing Lidar Test Site(s)
- WorldWide Test Site Catalog

■ http://calval.cr.usgs.gov/rst-resources/sites_catalog/

■ Communication:

- Over 100 publications in journals and proceedings
- Over 40 instruments on 36 satellites



Satellite Reference

- **Many Satellite References Exist:**
 - CEOS MIM Database
 - Union of Concerned Scientists Satellite Database
 - EO Portal – Excellent individual resources
 - WMO OSCAR
 - Zarya.Info
 - Gunter's Space Page
 - Jonathan's Space Page
 - ASPRS Satellite Info
- **But each lack features to quickly and easily compare Land Remote Sensing satellites**

Satellite References

- Satellite Catalog
 - Supports NLIR
- To Include?
 - Tech Specs
 - Data Availability
 - Relevant publications
- Via ASPRS?
- Your ideas?

Satellite Name	Sensor	Nominal Swath	Bits	GSD (m)	Spectral Coverage Representation and Ground Sample Distance (in meters)			
					Visible and Near-IR (0.4-1.0 μm)	Short-Wave IR (1.0-2.5 μm)	Mid-Wave IR (3.5-8.0 μm)	Thermal IR (8.0-14.5 μm)
Landsat 8	OLI	185km	12	30				
	TIRS	185km	12	100				
Landsat 7	ETM+	185km	8	15 30 60				
Landsat 4 & 5	MSS	185km	8	79				
	TM	185km	8	30 60				
Landsat 1-2	RBV	183km		80				
Landsat 3	RBV	183km		40				
Landsat 1-3	MSS	183km	8	79 240				
CBERS-3 (lost on launch, 9 Dec. 2013)	MuxCAM	120km	8	20				
	PanMUX	60km	8	5 10				
	IRS	120km	8	40 80				
	WFI	866km	10	64				
KOMPSAT3	AEISS	16.8km	14	0.7 2.8				
NPP (and future JPSS)	VIIRS Day-Night	3000km	12	750				
	VIIRS Moderate			375				
Pleiades 1A & 1B	HIRI	20km	12	0.7 2.8				
ResourceSat-2	AWIFS	740km	10	56				
	LISS-3	141km	10	23.5				
	LISS-4	70km	10	5.8				
Sentinel-2	MSI	290km	12	10 20 60				
SPOT-6	NAOMI (2x)	60km	12	2.2 8.8				
Terra	MODIS	2330km	12	250				
				500				
	ASTER	60km	8	15				
				30				
WorldView-2	WV110	16.4km	11	0.46 1.84				
WorldView-3	WV022	13.1 km	11	0.31				
				1.24				
				3.7				
	CAVIS Atm. Corr.			30				