Summary of Characterization Work at USGS EROS
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
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 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
First image rec’d was Pan- Sharpened
  - Numerous curious artifacts later attributed to this

Asked for un-sharpened image
  - Delivered in Jan’14
  - Most artifacts disappeared

Future analyses uncertain
Native vs. Pan-sharpened
## MTF and Signal-to-Noise

### Table: MTF and Signal-to-Noise Ratios

<table>
<thead>
<tr>
<th>Product</th>
<th>Band</th>
<th>PAN / MS</th>
<th>RER</th>
<th>FWHM</th>
<th>MTF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A (Along)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>Band_1</td>
<td>MS 1</td>
<td>0.52</td>
<td>1.8</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>Band_2</td>
<td>MS 2</td>
<td>0.64</td>
<td>1.2</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Band_3</td>
<td>MS 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Band_4</td>
<td>MS 4</td>
<td>0.42</td>
<td>2.1</td>
<td>&lt; 2%</td>
</tr>
<tr>
<td>PAN</td>
<td></td>
<td></td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** These are from one image only, with minimal reference.

### Table: Quality Metrics

<table>
<thead>
<tr>
<th>Product</th>
<th>Quality</th>
<th>Band</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>SNR</td>
<td>Band_1</td>
<td>~99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Band_2</td>
<td>~45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Band_3</td>
<td>~31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Band_4</td>
<td>~280</td>
</tr>
<tr>
<td></td>
<td>Radiometric resolution</td>
<td>PAN</td>
<td>~63</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PAN + MS</td>
<td>&gt; ±0.5 pixel, MS</td>
</tr>
</tbody>
</table>

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**USGS**
VNREDSat-1

Geometric Quicklook using L-8 data:

Mean: -60m E, -318m N
Std.Dev: 32m E and 22m N
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 1\textsuperscript{st}, '13
- ~45° angle
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™

- 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

- **Communication:**
  - Over 100 publications in journals and proceedings
  - Over 40 instruments on 36 satellites
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 | GSD (m) | Visible and Near-IR (0.4-1.0 µm) | Short-Wave IR (3.5-8.0 µm) | Mid-Wave IR (3.5-8.0 µm) | Thermal IR (8.0-14.0 µm)
---|---|---|---|---|---|---|---
Landsat 8 | OLI | 185km | 12 | 30 | 15 | 10 | 5 | 30 | 60 | 15
| TIRS | 183km | 12 | 10 | 5 | 30 | 60 | 15
Landsat 7 | ETM+ | 185km | 12 | 30 | 10 | 80 | 15
Landsat 4 & 5 | MSS | 185km | 8 | 79 | 30 | 60 | 15
| TM | 185km | 8 | 79 | 30 | 60 | 15
Landsat 1-2 | MSS | 185km | 8 | 79 | 30 | 60 | 15
| ETM+ | 185km | 8 | 79 | 30 | 60 | 15
Landsat 3 | MSS | 185km | 8 | 79 | 30 | 60 | 15

#### Spectral Coverage Representation and Ground Sample Distance (in meters)

- **TIRS** 185km 12 100
- **15**
- **30**
- **60**
- **MSS** 185km 8 79
- **30**
- **60**
- **Landsat 1-2** RBV 183km 80
- **Landsat 3** RBV 183km 40

#### Relevant publications

- **Via ASPRS?**
- **Your ideas?**