NOAA-USGS Land Product Validation System

STAR JPSS Science Team Meeting
14 May 2014

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GOES-R
Geostationary Operational Environmental Satellite R-Series

JPSS
Joint Polar Satellite System

Land Product Validation System (LPVS)

What is LPVS

Why LPVS developed/hosted at EROS

Highlights of LPVS

1. Inventory & Ordering
2. Analysis Tools

Path Forward

Summary

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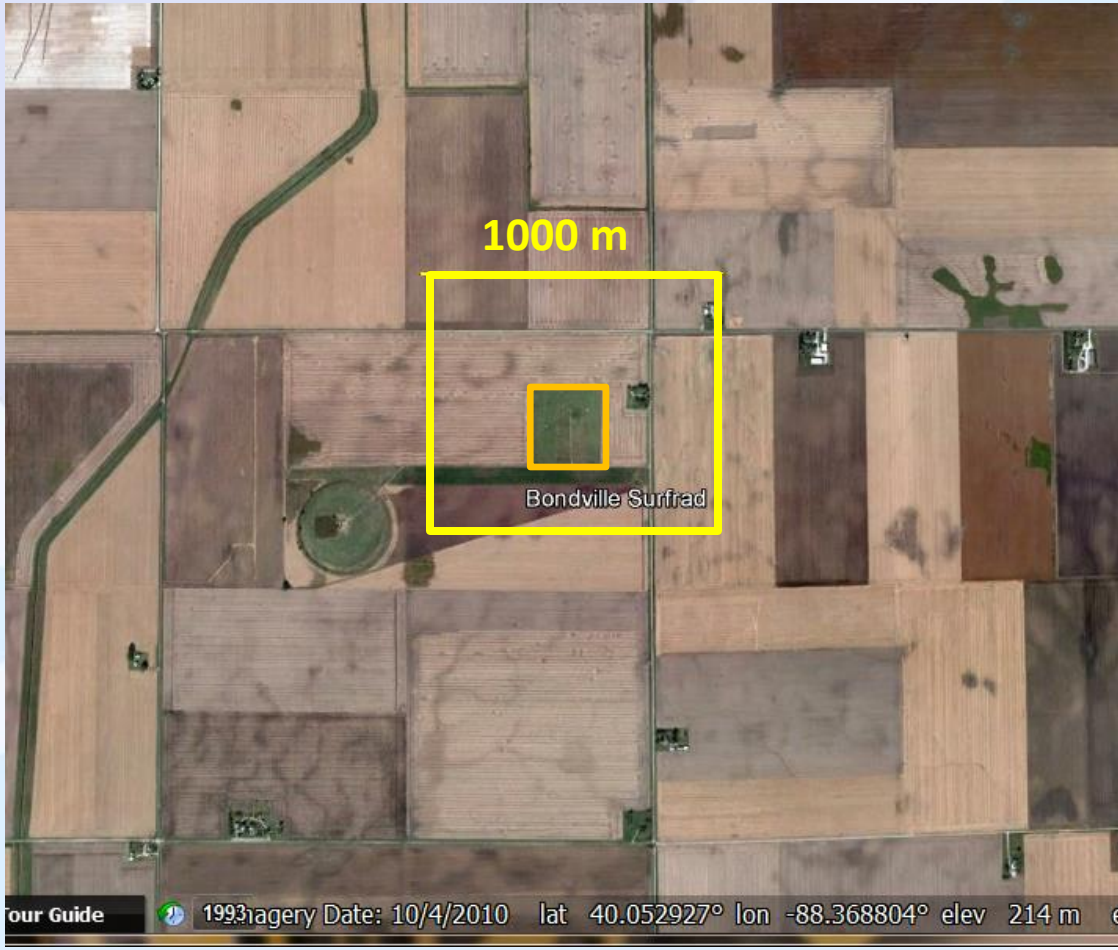
What is LPVS

1. General characteristics
2. Desired functionality

A web-based system designed to use moderate to high-resolution satellite data for validation of GOES-R ABI and JPSS VIIRS products.

Bondville, IL SURFRAD



What is LPVS

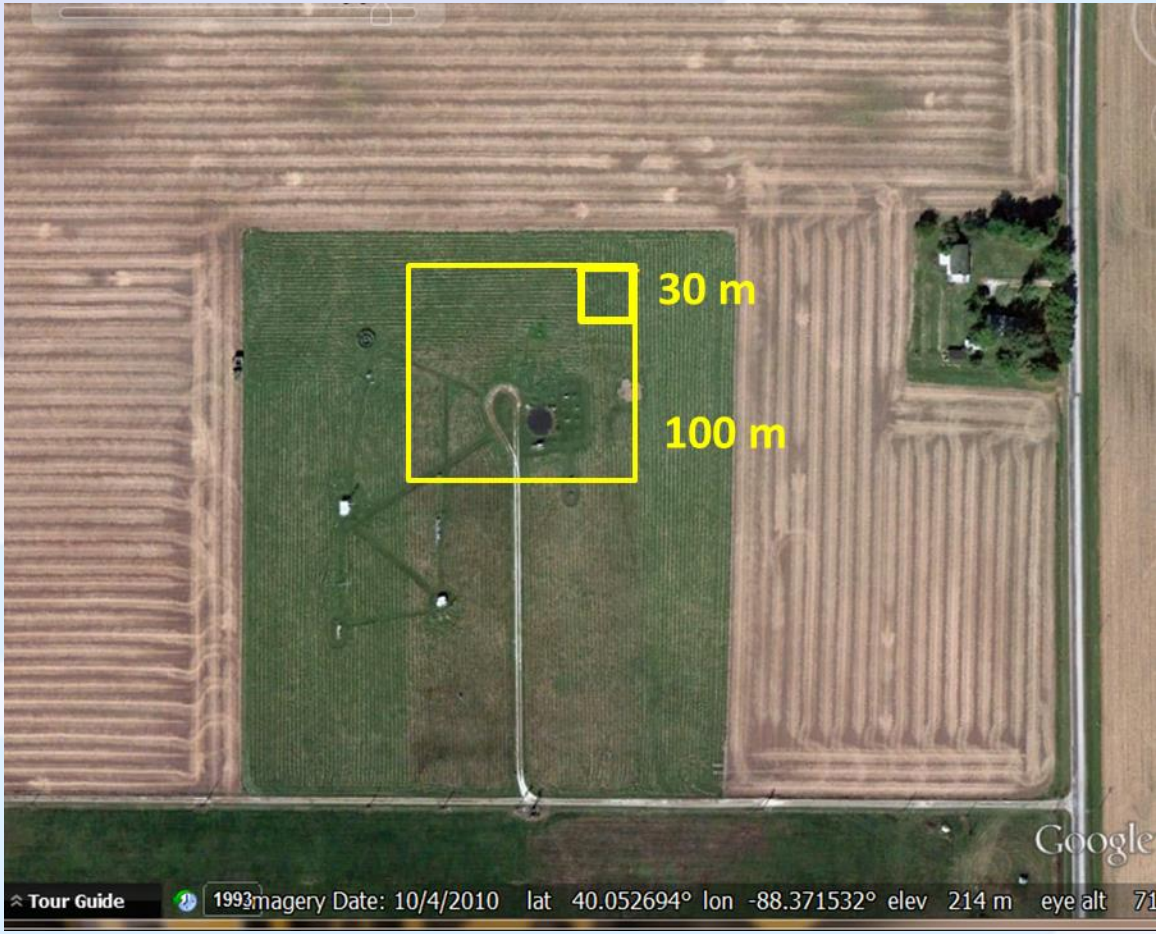
1. General characteristics
2. Desired functionality

Landsat 8 spatial resolution

vis/near IR 30 m

Thermal IR 100 m

Bondville, IL SURFRAD



What is LPVS

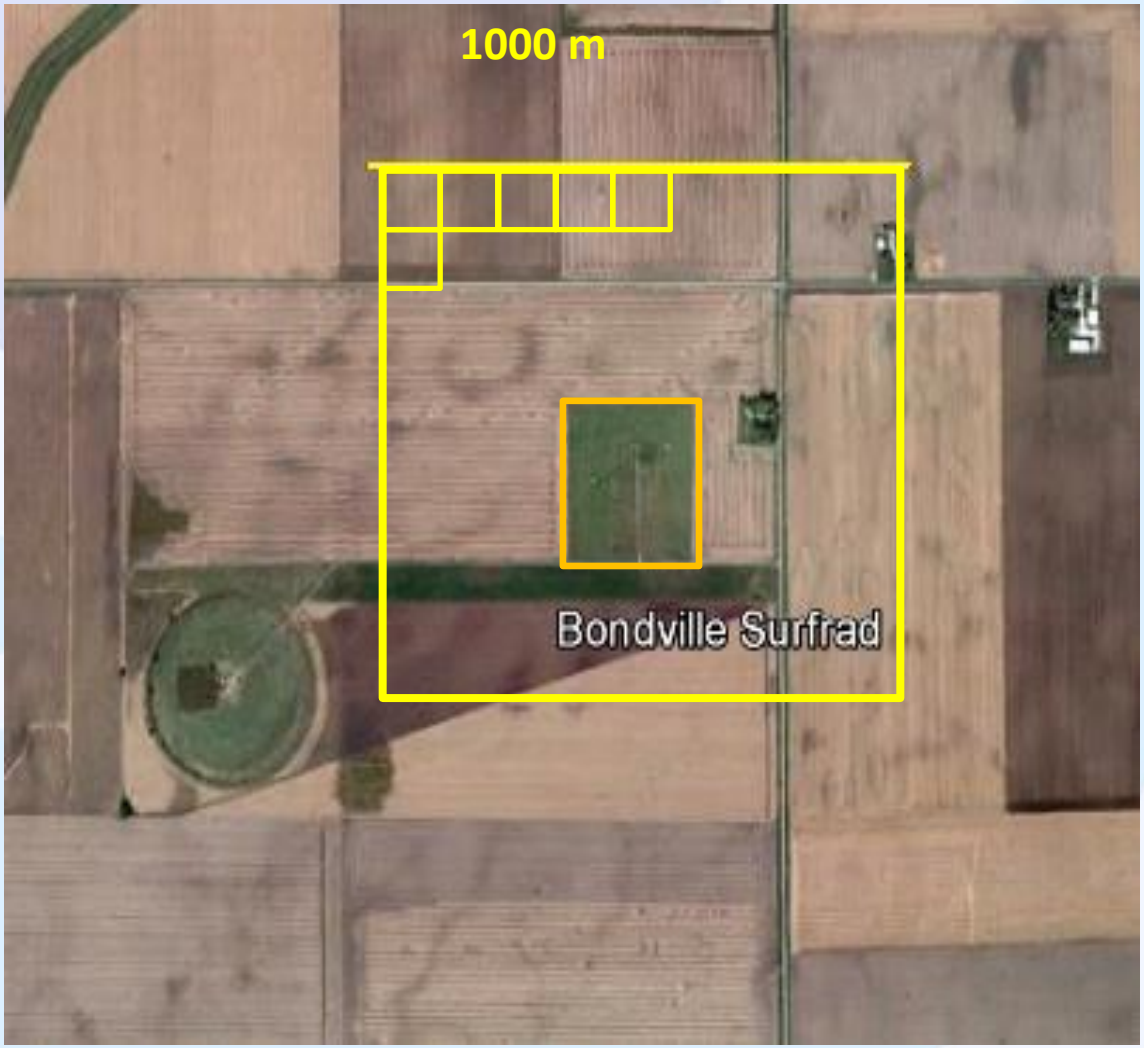
1. General characteristics
2. Desired functionality

Landsat sampling for 1000 x 1000 m target:

- 1100 samples at 30 m resolution
- 100 samples at 100 m resolution

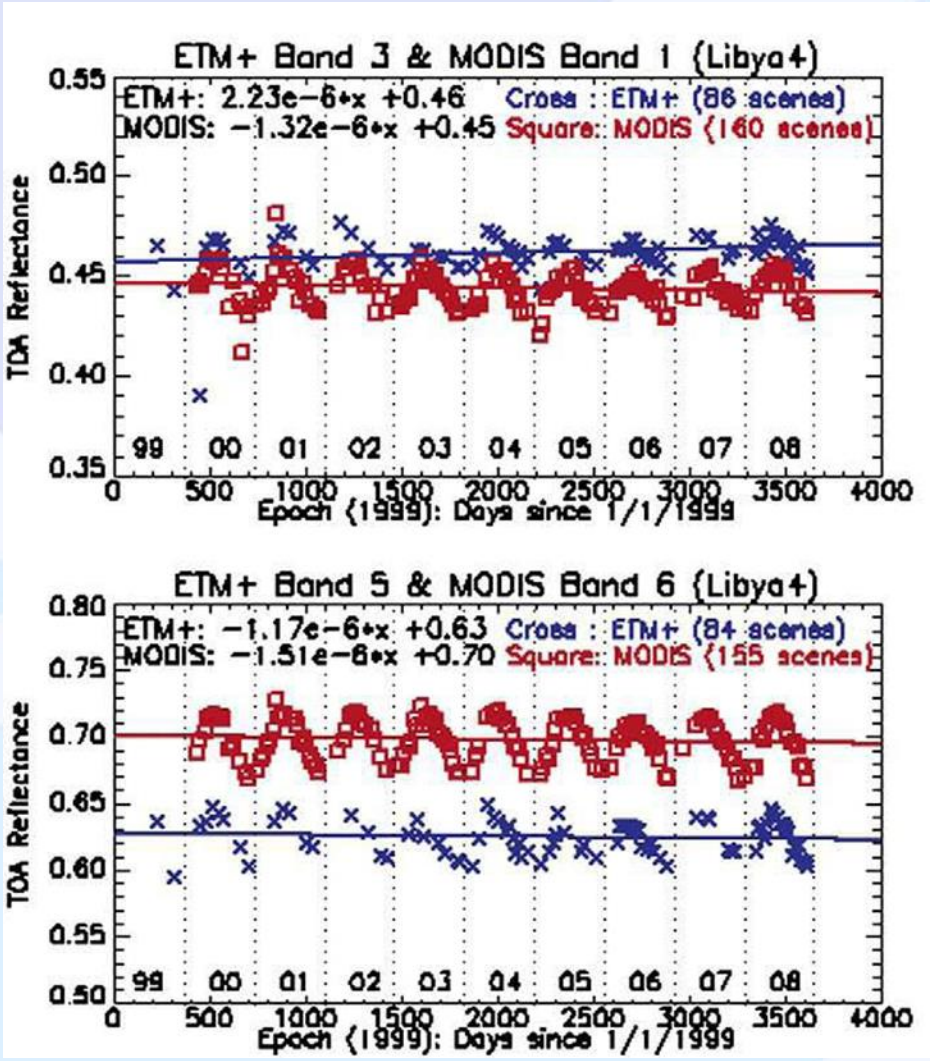
Ready for GOES-R and JPSS-VIIRS pre- and post-launch testing and validation.

Bondville, IL SURFRAD



What is LPVS: General Characteristics
Output examples

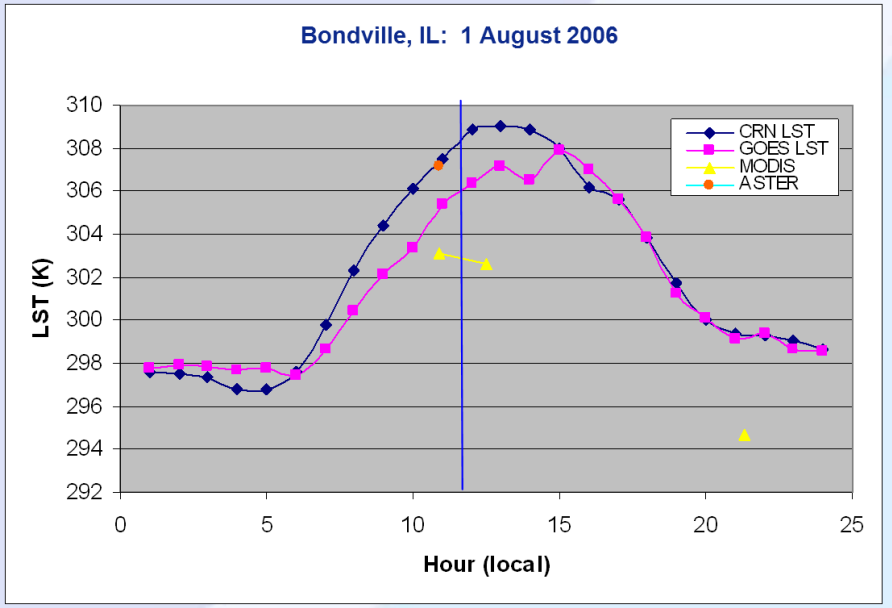
Trending of similar bands of data from multiple sensors.



What is LPVS: General Characteristics
Output examples

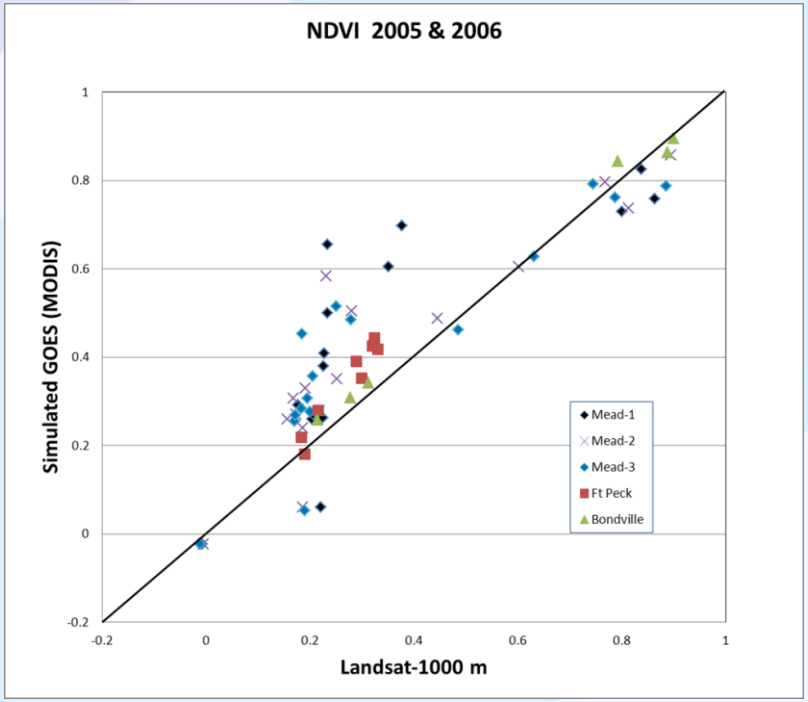
Land Surface Temp.

Multiple sensor (satellite and in situ) comparisons for single location and date.



NDVI

Multiple sensor comparison for multiple locations and multiple dates.



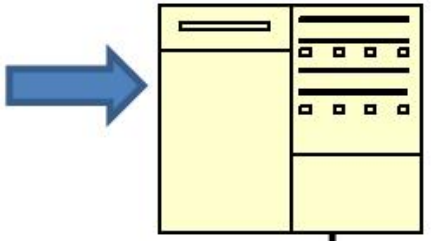
What is LPVS

Characteristics and desired functionality

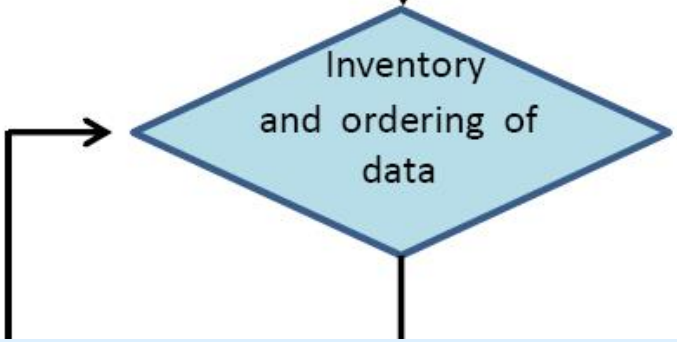
GOES-R ABI and VIIRS Land Product Validation System

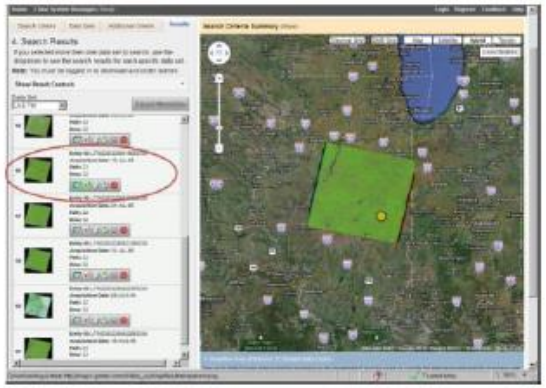
NPP & JPSS VIIRS
GOES-R ABI
Landsat-7 & -8
MODIS
Sentinel-2
others..
& In Situ

On demand data acquisition
Automated data acquisitions



Data and Inventory information stored at EROS.





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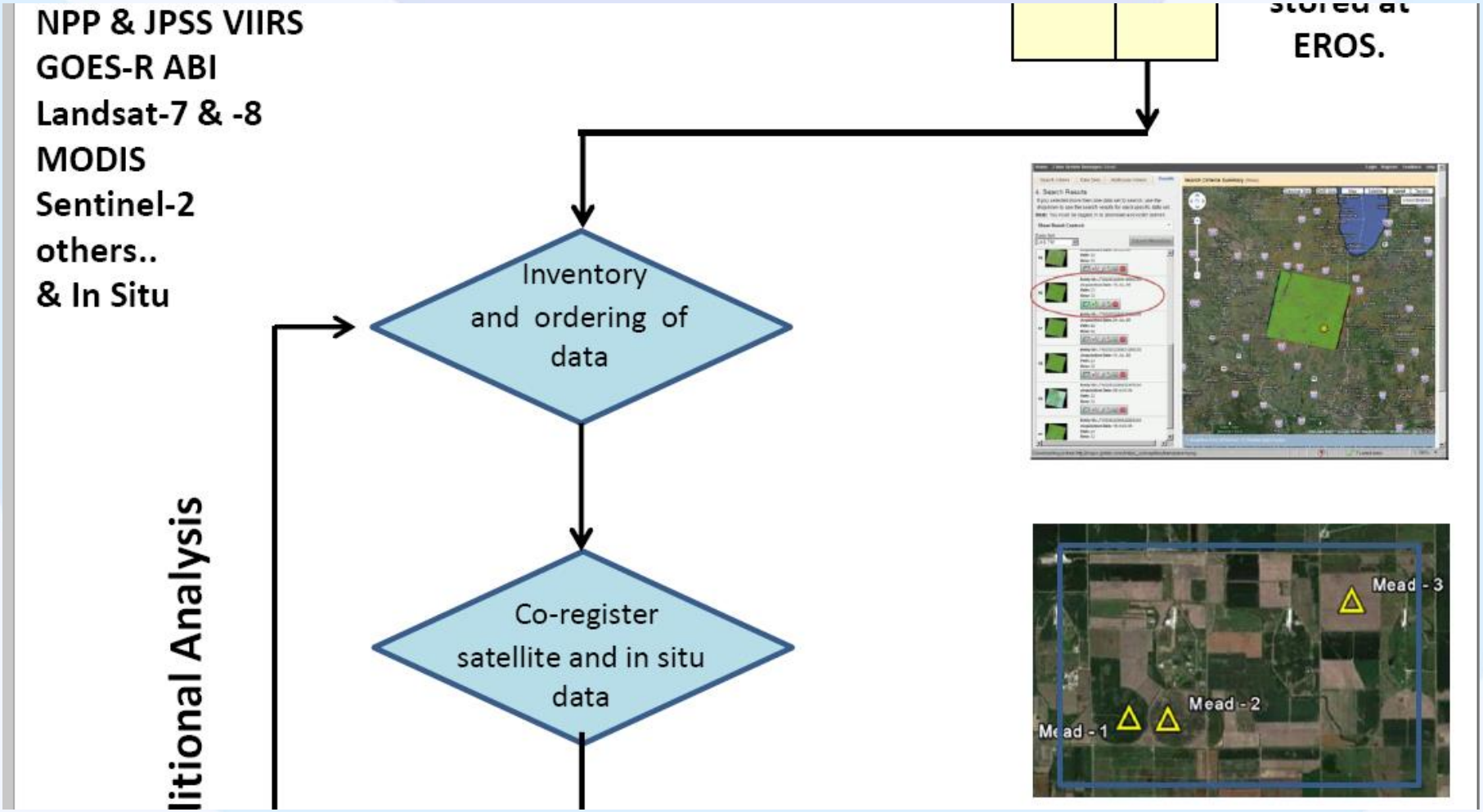

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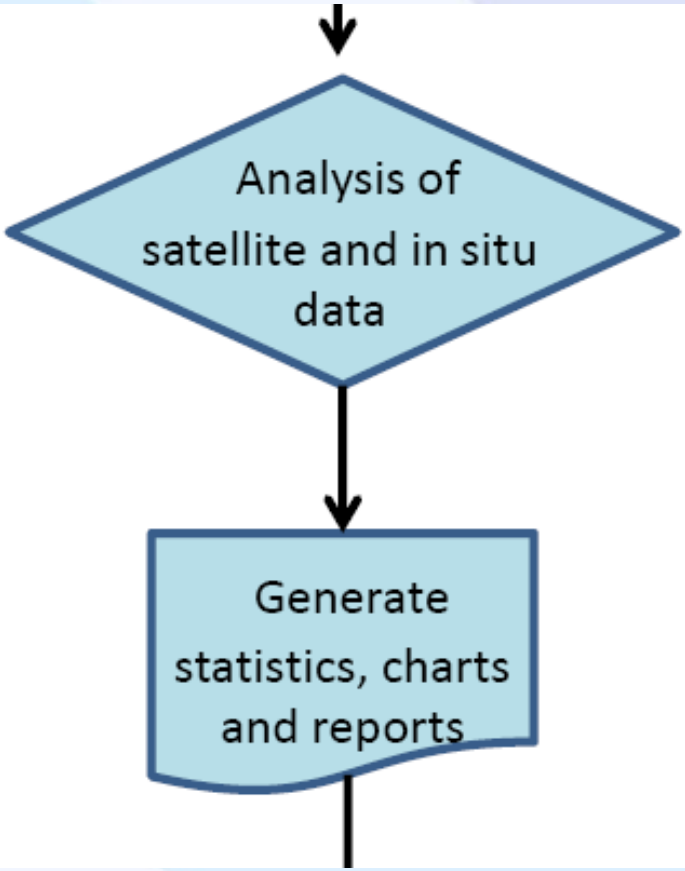

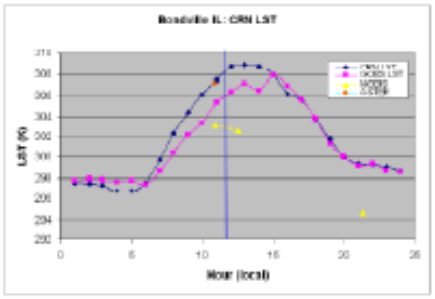

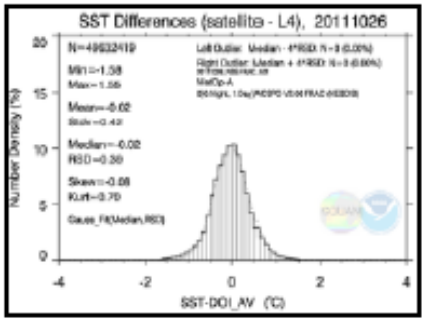

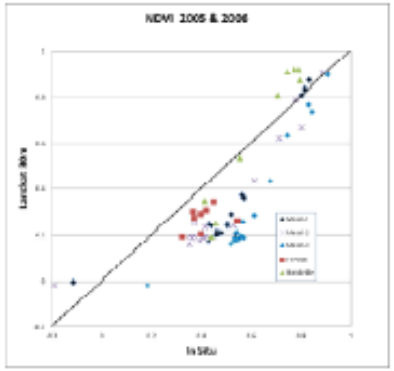

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Why LPVS developed/hosted at EROS

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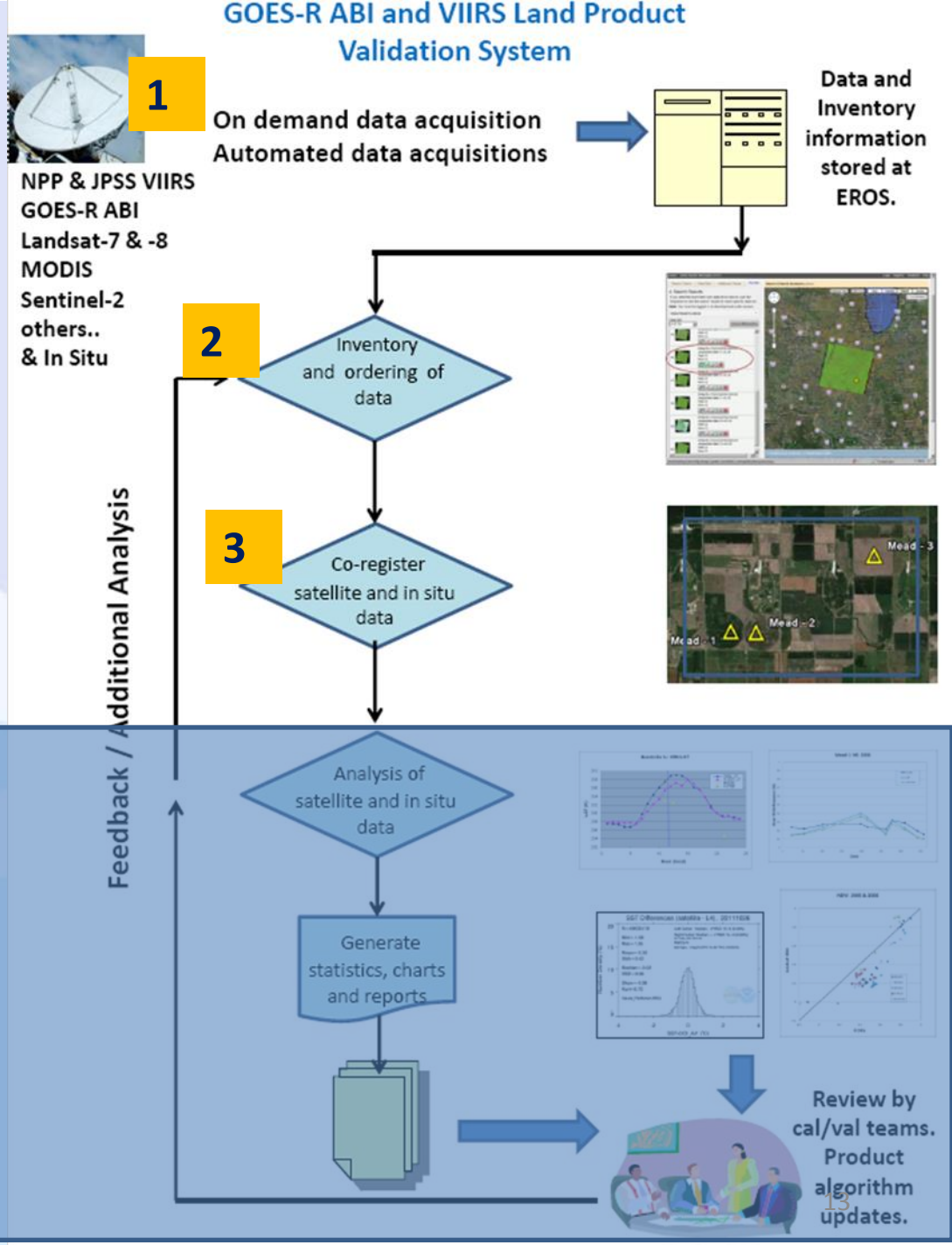
Why LPVS developed and hosted at USGS/EROS?

1. Facility Assets
2. Landsat
3. Landsat product development



Why LPVS developed and hosted at USGS/EROS?

1. Facility Assets
2. Landsat characteristics
3. Landsat product development

Launched 11 Feb. 2013

LDCM (Landsat 8)

11 Bands

9 vis to mid-IR; 15-30 m resolution

2 thermal IR; 100 m resolution ➡ 30 m

Absolute calibration of OLI and TIRS

Bands	Wavelength (micrometers)	Resolution (meters)
Band 1 - Coastal aerosol	0.43 - 0.45	30
Band 2 - Blue	0.45 - 0.51	30
Band 3 - Green	0.53 - 0.59	30
Band 4 - Red	0.64 - 0.67	30
Band 5 - Near Infrared (NIR)	0.85 - 0.88	30
Band 6 - SWIR 1	1.57 - 1.65	30
Band 7 - SWIR 2	2.11 - 2.29	30
Band 8 - Panchromatic	0.50 - 0.68	15
Band 9 - Cirrus	1.36 - 1.38	30
Band 10 - Thermal Infrared (TIRS) 1	10.60 - 11.19	100
Band 11 - Thermal Infrared (TIRS) 2	11.50 - 12.51	100

http://landsat.usgs.gov/band_designations_landsat_satellites.php

Landsat characteristics

Landsat 8

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VIIRS

VIIRS Band	Spectral Range (um)	Nadir HSR (m)
DNB	0.500 - 0.900	750
M1	0.402 - 0.422	750
M2	0.436 - 0.454	750
M3	0.478 - 0.498	750
M4	0.545 - 0.565	750
I1	0.600 - 0.680	375
M5	0.662 - 0.682	750
M6	0.739 - 0.754	750
I2	0.846 - 0.885	375
M7	0.846 - 0.885	750
M8	1.230 - 1.250	750
M9	1.371 - 1.386	750
I3	1.580 - 1.640	375
M10	1.580 - 1.640	750
M11	2.225 - 2.275	750
I4	3.550 - 3.930	375
M12	3.660 - 3.840	750
M13	3.973 - 4.128	750
M14	8.400 - 8.700	750
M15	10.263 - 11.263	750
I5	10.500 - 12.400	375
M16	11.538 - 12.488	750

● Dual-gain Band

Landsat characteristics

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Landsat characteristics

GOES-R ABI
Visible/NIR

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3	0.846–0.885
4	1.371–1.386
5	1.58–1.64
6	2.225–2.275

Landsat characteristics

GOES-R ABI
Visible/NIR

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GOES-R ABI

IR Bands

7	3.80–4.00
8	5.77–6.6
9	6.75–7.15
10	7.24–7.44
11	8.3–8.7
12	9.42–9.8
13	10.1–10.6
14	10.8–11.6
15	11.8–12.8
16	13.0–13.6

Why LPVS developed and hosted at USGS/EROS?

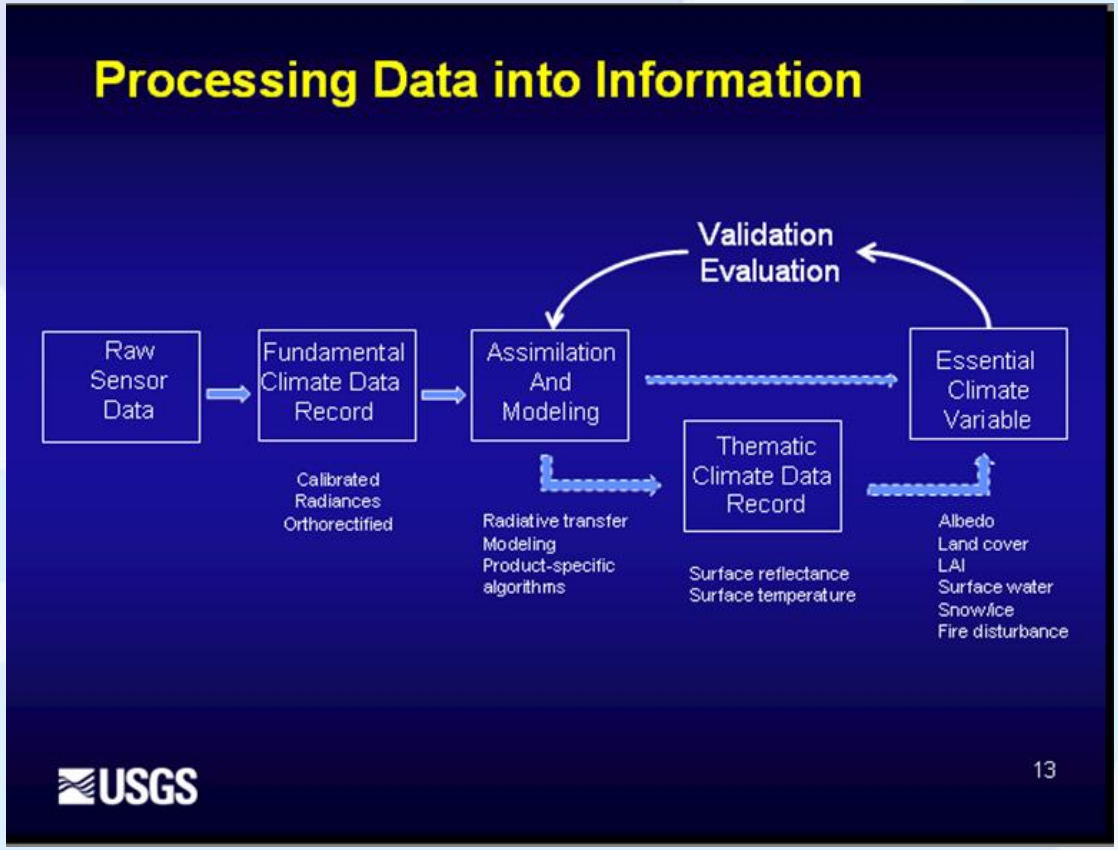
1. Facility Assets
2. Landsat
3. Landsat product development

CDRs and ECVs (some available starting in Q3 2014)

CDRs
Surface Reflectance (and NDVI),
Land Surface
Temperature/Emissivity

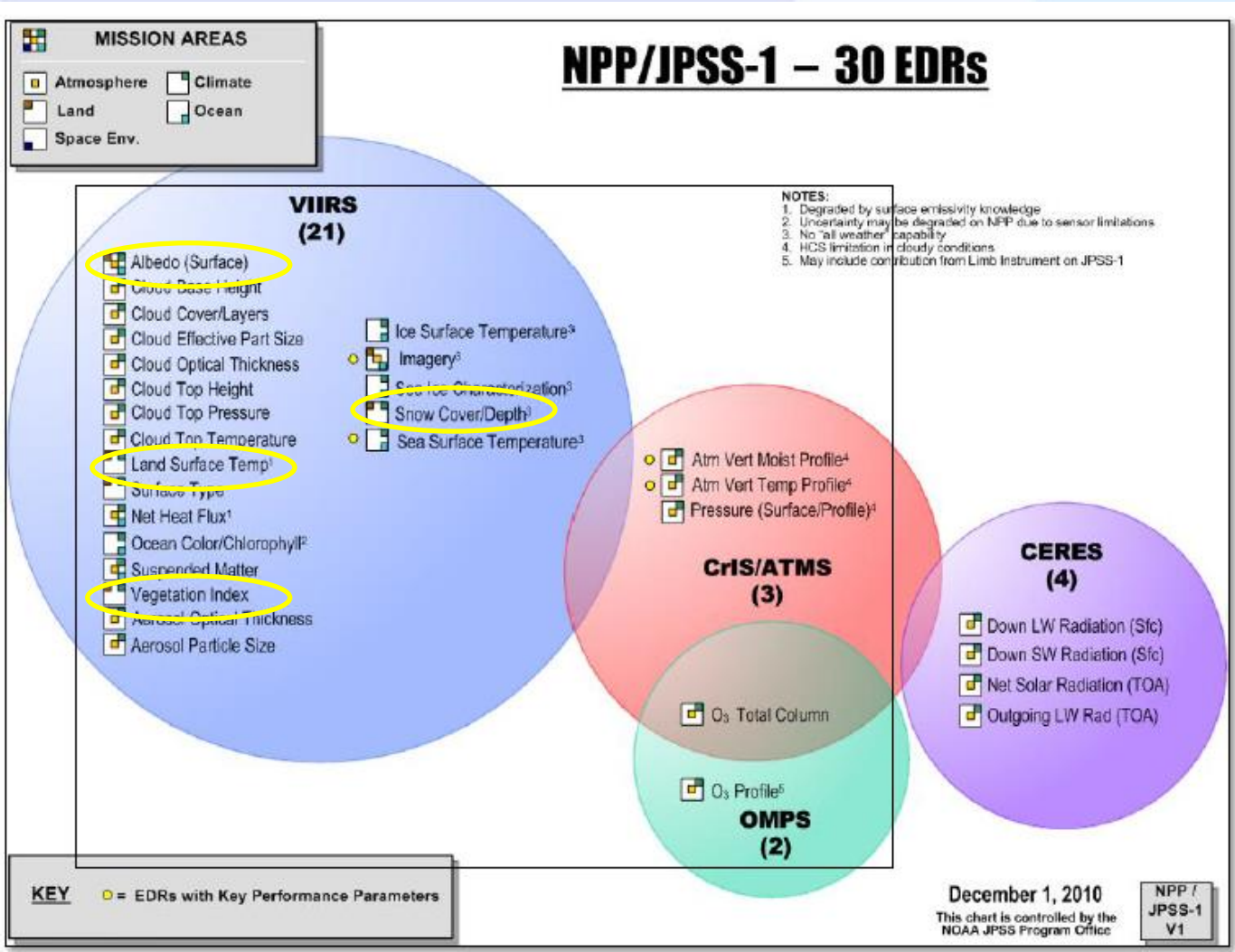
ECVs
Surface Water Extent,
Burned Area Extent,
Snow Covered Area

Landsat Product Development



EROS-NOAA validation synergy

Several products of mutual interest (**e.g. VIIRS**)



EROS-NOAA validation synergy

Several products of mutual interest (**e.g. GOES-R ABI**)

KEY		
ABI	SUVI	EXIS
GLM	SEISS	MAG

ABI: Advanced Baseline Imager

SUVI: Solar Ultraviolet Imager

EXIS: Extreme Ultraviolet and X-ray Irradiance Suite

GLM: Geostationary Lightning Mapper

SEISS: Space Environment In-Situ Suite

MAG: Magnetometer

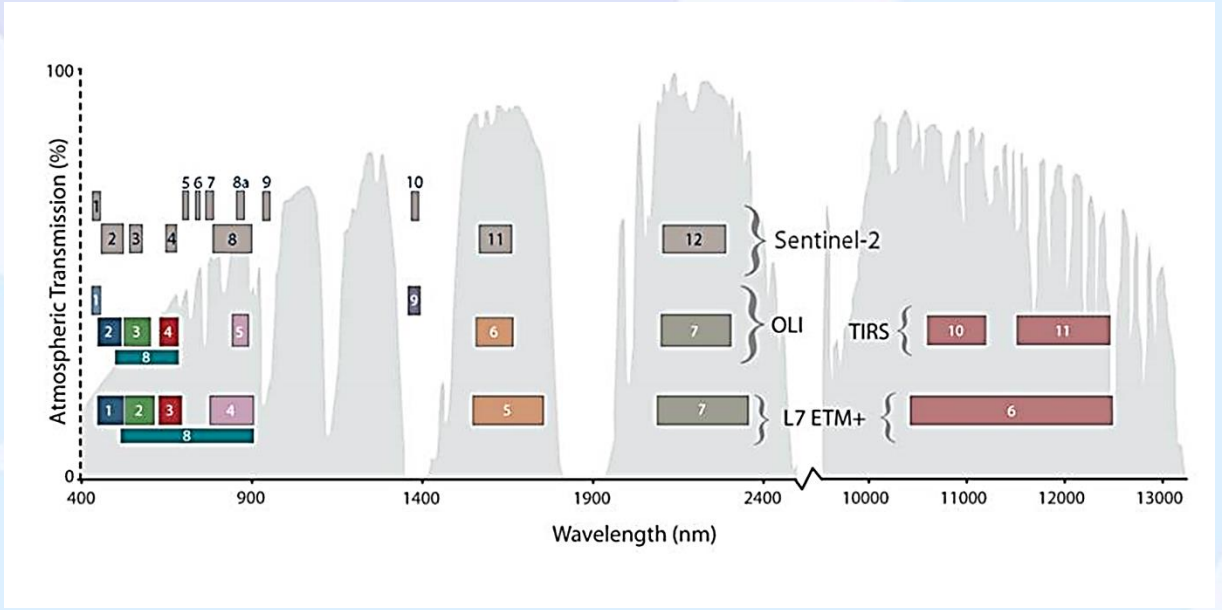
BASELINE PRODUCTS
Aerosol Detection (Including Smoke and Dust)
Aerosol Optical Depth (AOD)
Volcanic Ash: Detection and Height
Cloud and Moisture Imagery
Cloud Optical Depth
Cloud Particle Size Distribution
Cloud Top Phase
Cloud Top Height
Cloud Top Pressure
Cloud Top Temperature
Hurricane Intensity
Lightning Detection: Events, Groups & Flashes
Rainfall Rate / QPE
Legacy Vertical Moisture Profile
Legacy Vertical Temperature Profile
Derived Stability Indices
Total Precipitable Water
Clear Sky Masks
Radiances
Downward Shortwave Radiation: Surface
Reflected Shortwave Radiation: TOA
Derived Motion Winds
Fire/Hot Spot Characterization
Land Surface Temperature (Skin)
Snow Cover
Sea Surface Temperature (Skin)
Energetic Heavy Ions
Mag. Electrons & Protons: Low Energy
Mag. Electrons & Protons: Med & High Energy
Solar & Galactic Protons
Geomagnetic Field
Solar Flux: EUV
Solar Flux: X-Ray
Solar Imagery: X-Ray

OPTION 2 PRODUCTS
Aerosol Partical Size
Aircraft Icing Threat
Cloud Ice Water Path
Cloud Layers/Heights
Cloud Liquid Water
Cloud Type
Convective Initiation
Enhanced "V" / Overshooting Top Detection
Low Cloud and Fog
Tropopause Folding Turbulence Prediction
Visibility
Probability of Rainfall
Rainfall Potential
Absorbed Shortwave Radiation: Surface
Downward Longwave Radiation: Surface
Upward Longwave Radiation: Surface
Upward Longwave Radiation: TOA
Ozone Total
SO2 Detection
Flood/Standing Water
Ice Cover
Snow Depth (Over Plains)
Surface Albedo
Surface Emissivity
Vegetation Fraction: Green
Vegetation Index
Currents
Currents: Offshore
Sea and Lake Ice: Age
Sea and Lake Ice: Concentration
Sea and Lake Ice: Motion

Why LPVS developed and hosted at USGS/EROS

Sentinel-2
13 Bands
4 bands at 10 m resolution
6 bands at 20 m
3 bands at 60 m

Landsat-7, Landsat-8 and Sentinel-2 Spectral Bands



Anticipated launch 2015

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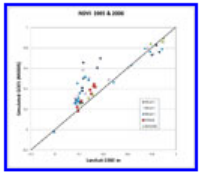


Within the next few years the National Oceanic and Atmospheric Administration (NOAA) will launch two environmental satellites, the Geostationary Operational Environmental Satellite - R Series (GOES-R), and the Joint Polar Satellite System (JPSS). Each will carry instruments to monitor current meteorological conditions, observe information for use in numerical weather prediction models, and provide high quality products for monitoring trends in the long-term climate.

The U.S. Geological Survey (USGS) Earth Resources Observation and Science Center (EROS) is collaborating with NOAA to develop a *Land Product Validation System (LPVS)*. This system will facilitate the characterization and validation of land-related products from GOES-R and JPSS (e.g., surface reflectance, Normalized Difference Vegetation Index, and Land Surface Temperature). The LPVS plans to utilize data from the USGS Landsat satellites, the European Space Agency (ESA) Sentinel series, and others, to validate land products from the GOES-R Advanced Baseline Imager (ABI) and JPSS Visible Infrared Imager Radiometer Suite (VIIRS) sensors. The LPVS will also be useful for validation of the VIIRS products available from the Suomi NPP (National Polar-orbiting Partnership) satellite currently on orbit, as well as for characterization and validation of future Landsat-8 products.

The LPVS will include data access, inventory, and analysis functions so that data from multiple archives can be co-registered and compared statistically through a single interface. This functionality is evolving through a prototype phase (2012) and a beta operational phase (2013) before becoming operational in 2014. The land science community is encouraged to test LPVS capabilities, and is invited to provide feedback to the development project.

Access LPVS Prototype Data Search and Retrieval Services

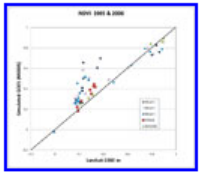
Access LPVS Prototype Test Site Trending

Community Feedback Form

User Support

Project Partners:

Land Product Validation System (LPVS)



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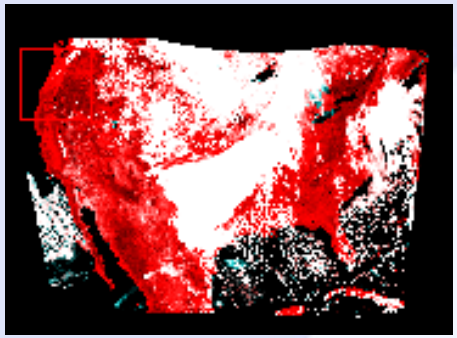
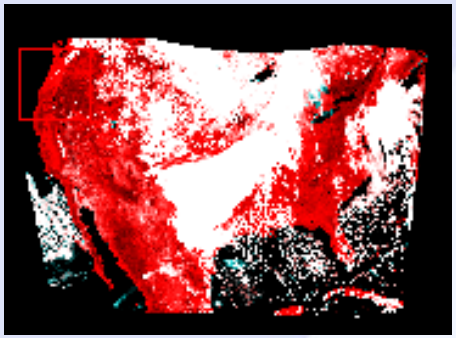
http://lpvsexplorer.cr.usgs.gov/

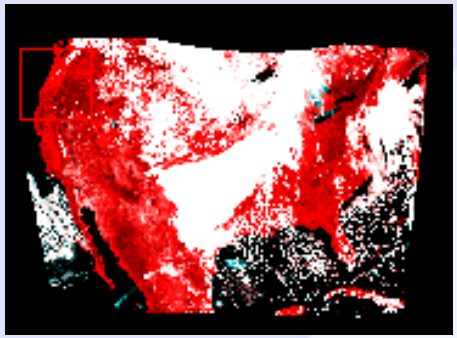
Search for Landsat data on date of simulated GOES-R ABI data : 23 April 2013 (provided by Univ. Wisc./CIMSS).

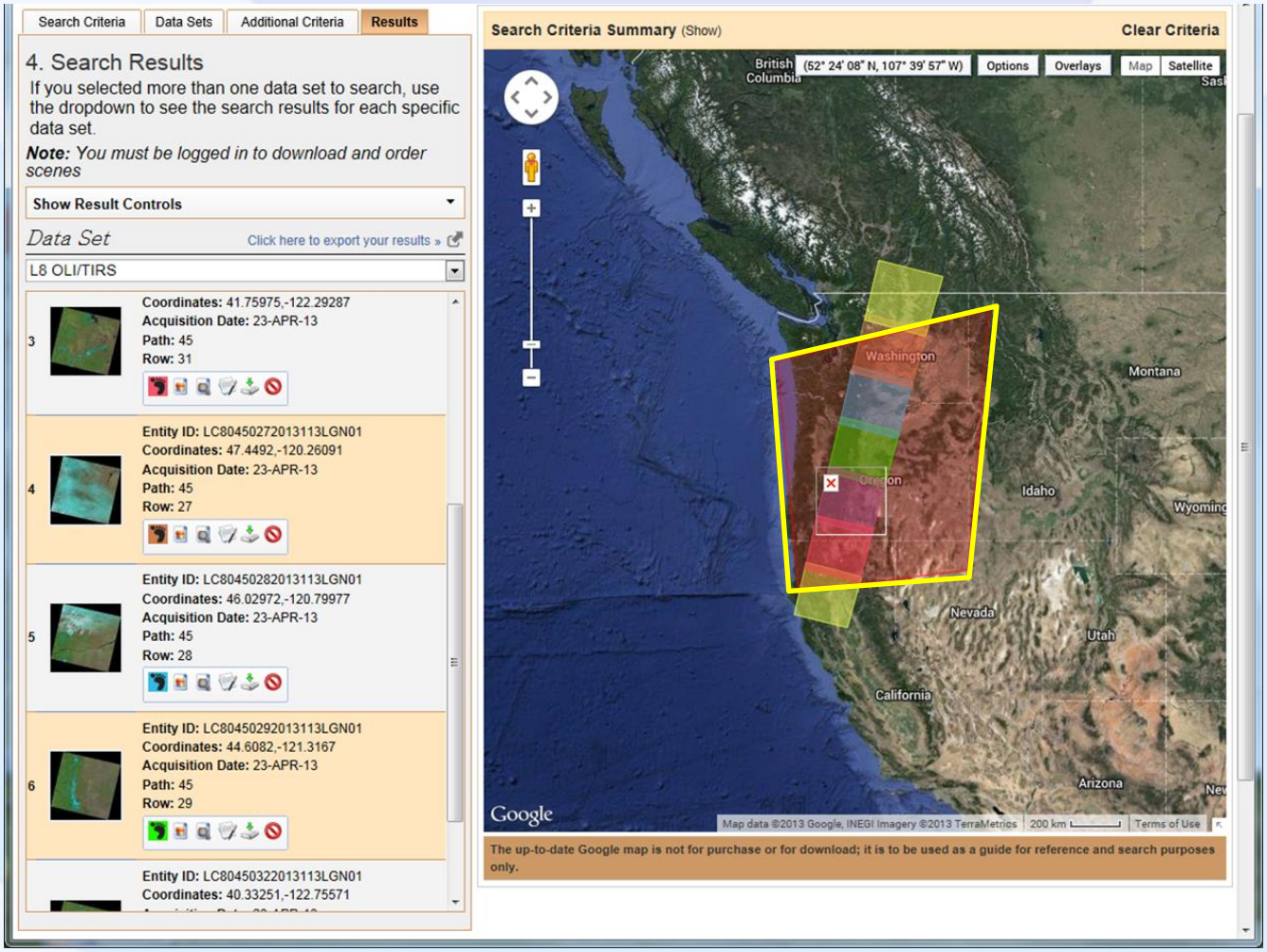


Search for Landsat data on date of simulated GOES-R ABI data (23 April 2013).



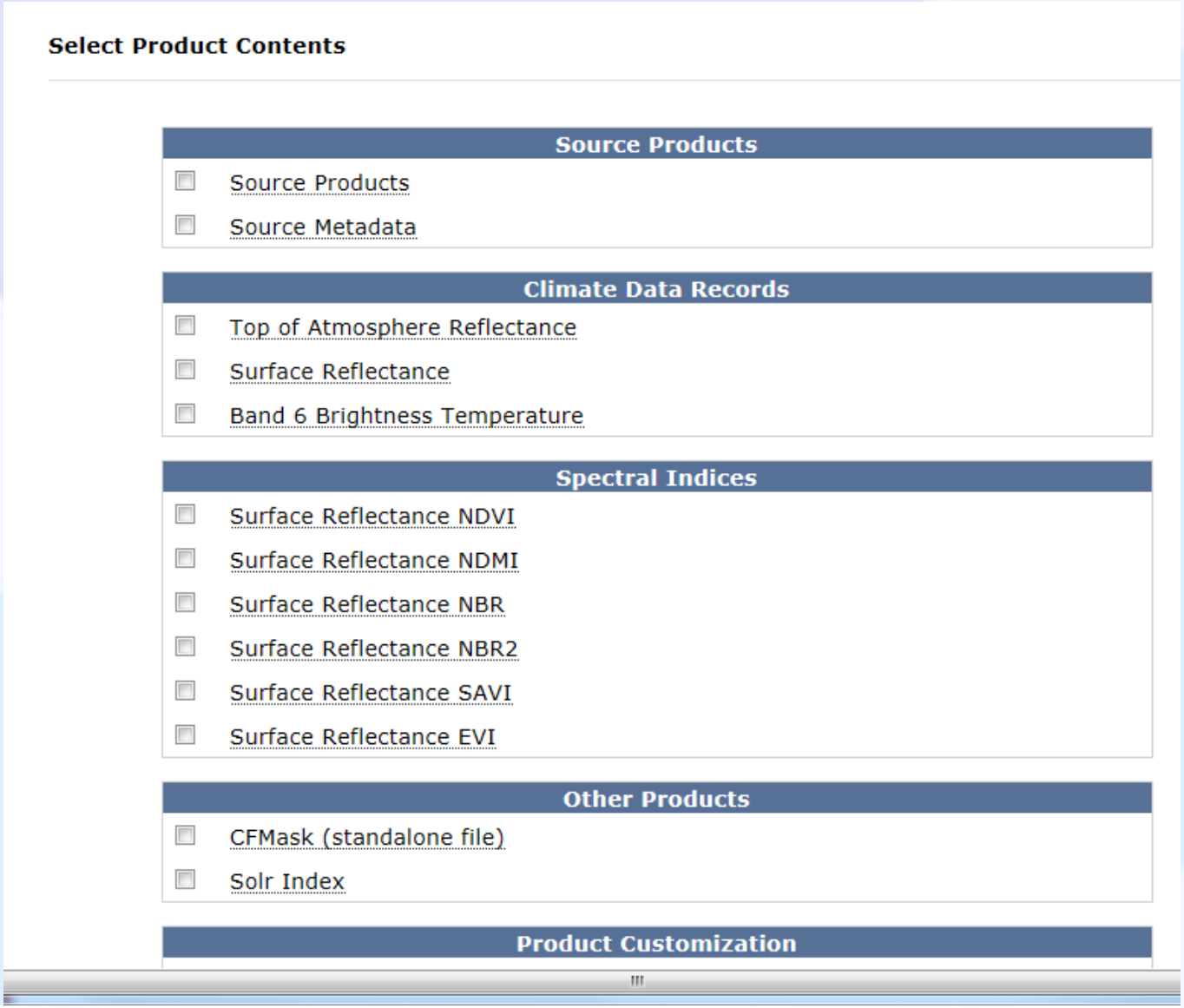
Search for Landsat data on date of simulated GOES-R ABI data (23 April 2013).





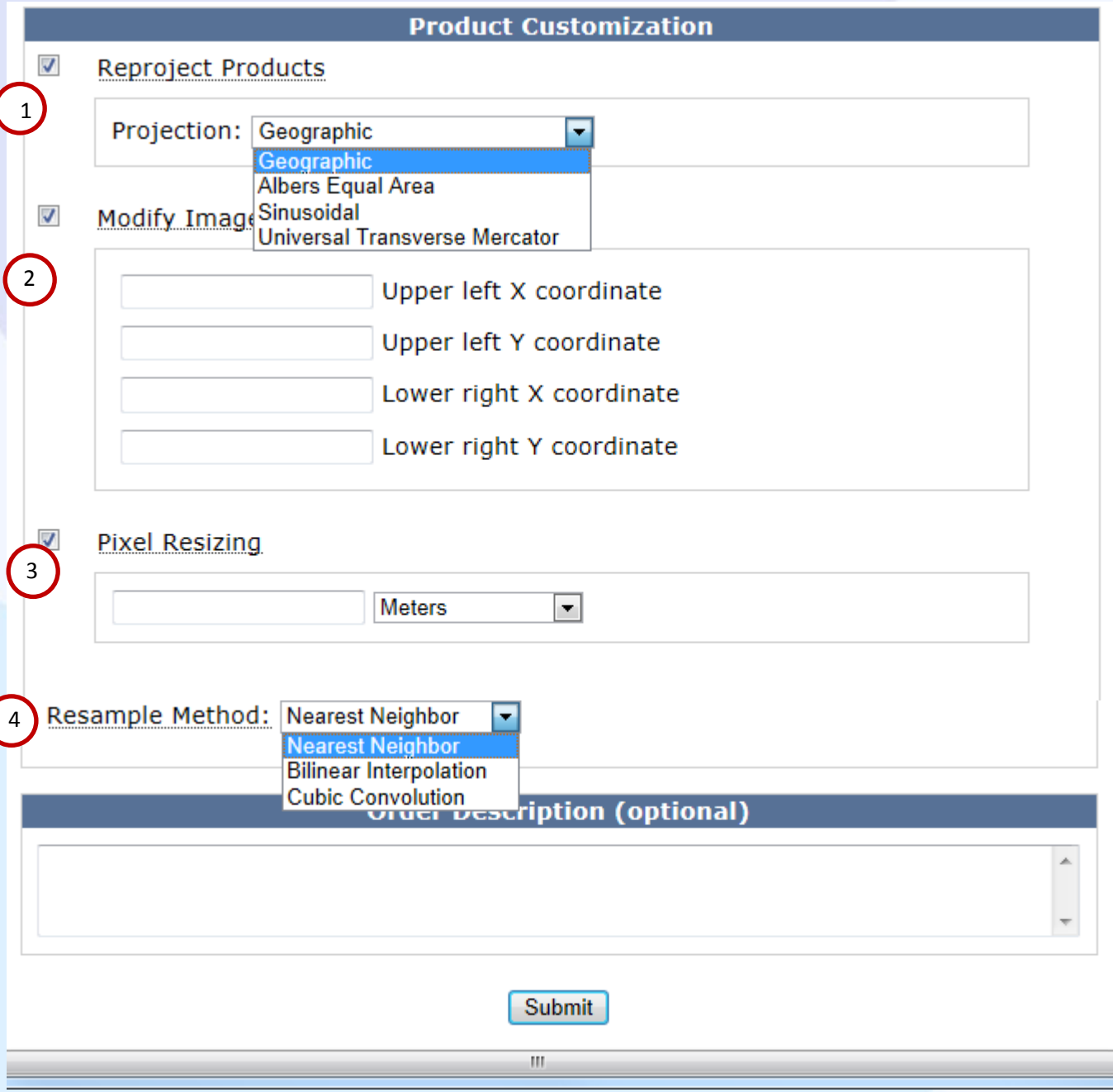
Enhanced Landsat Products

Additional ECVs and CDRs will be added to menu as available.



Enhanced Functionality

1. Auto-registration of data to common map projections for analysis.
2. User defines area of interest for analysis
3. Match pixel size for all images
4. Several resampling options



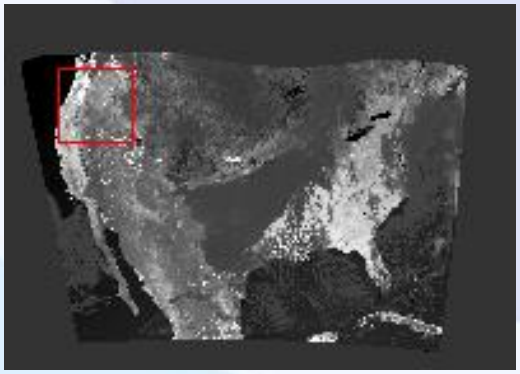
Example of New Functionality

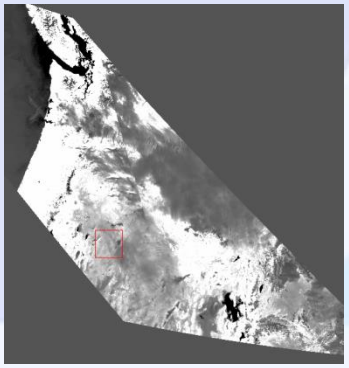
Example of georegistration of ABI, VIIRS and Landsat for 23 April 2013.

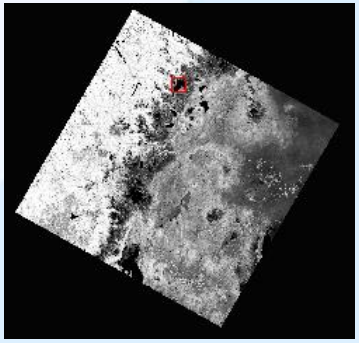
Simulated GOES-R ABI

VIIRS

Landsat

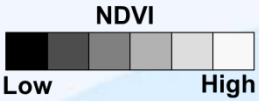


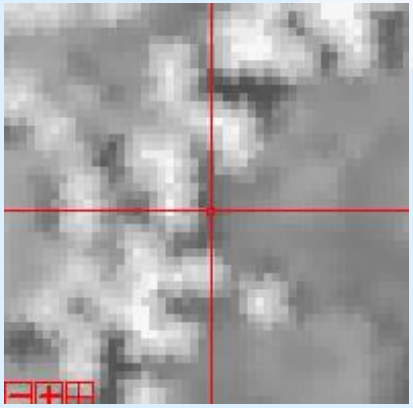


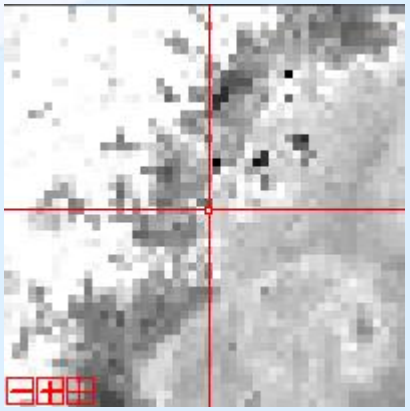


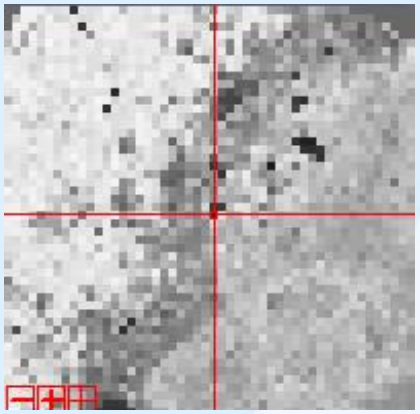
Georegistered Data

- **Same Pixel Size: 2222 m**
- **Same Map Projection: Lambert Azm Eq Area**



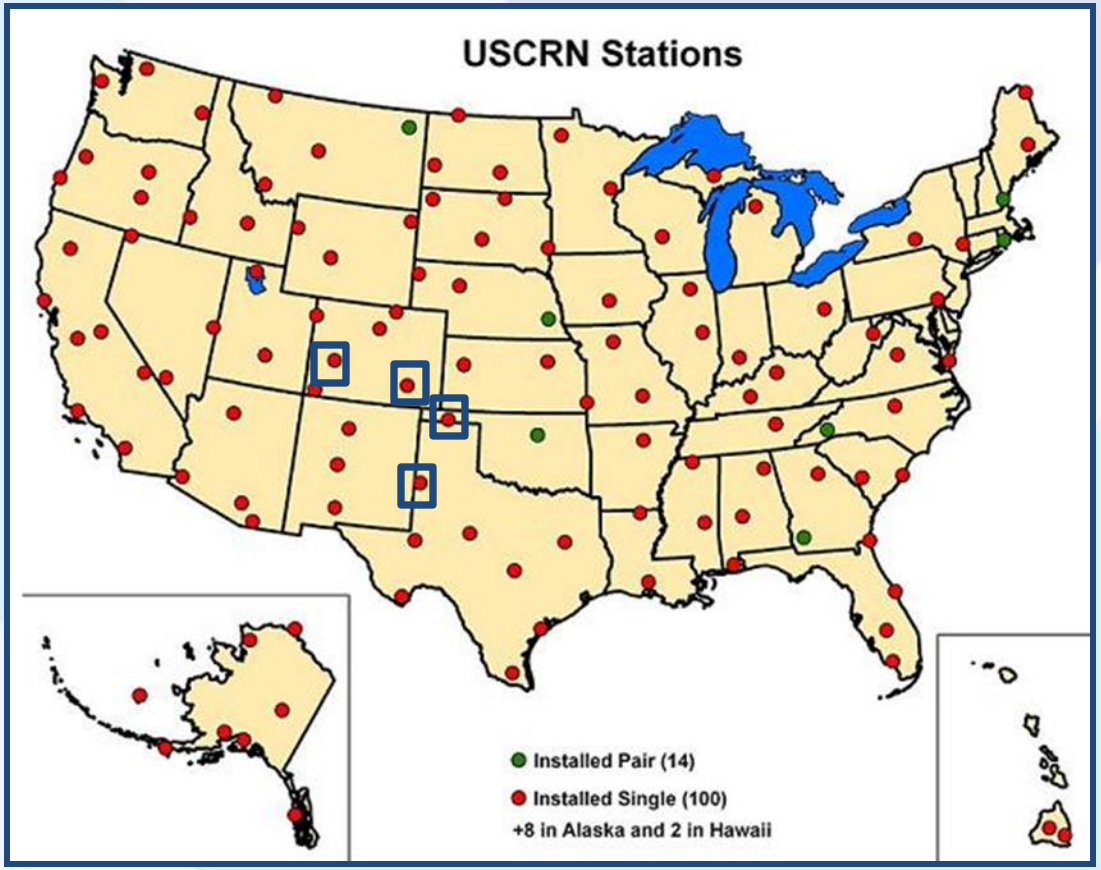


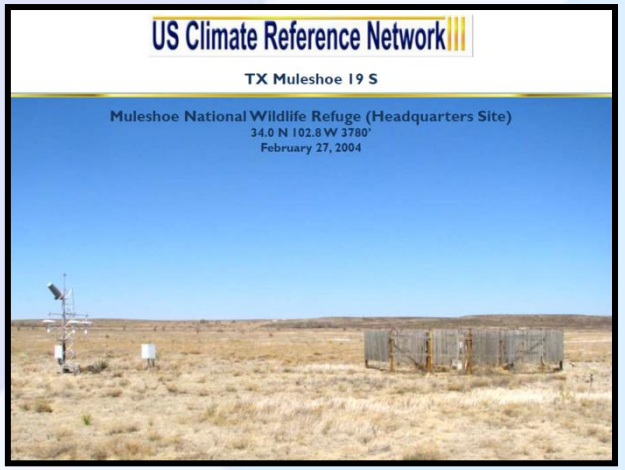


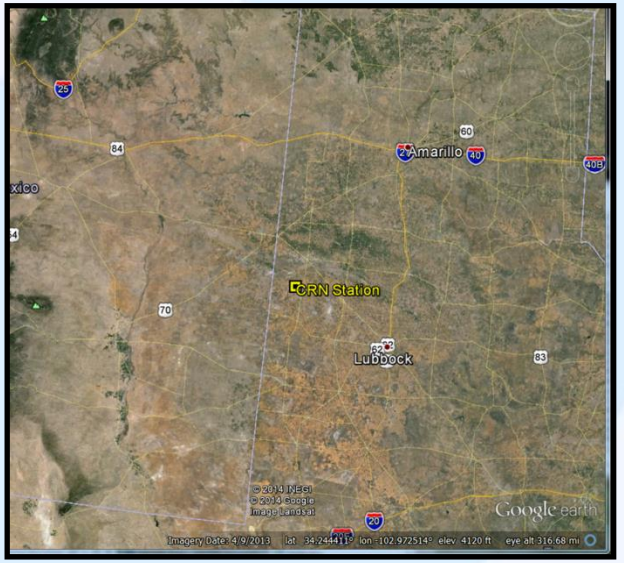


Example of New Functionality

Data extracted for VIIRS (NOAA and NASA products) and Landsat 8 for four CRN stations located within NASA golden tile (h09v05).



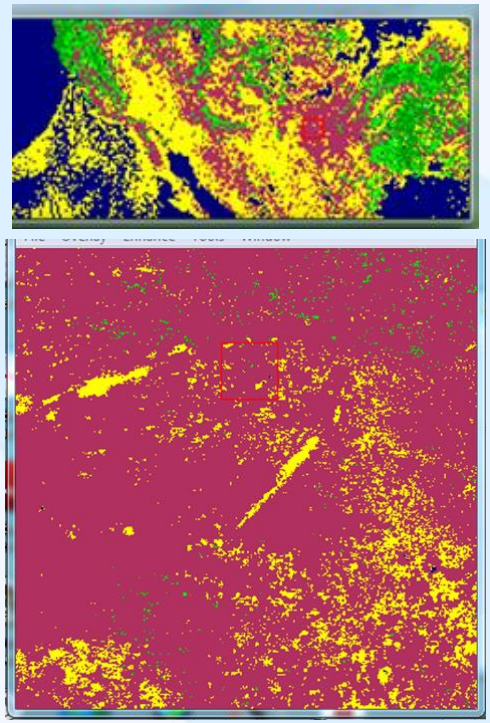




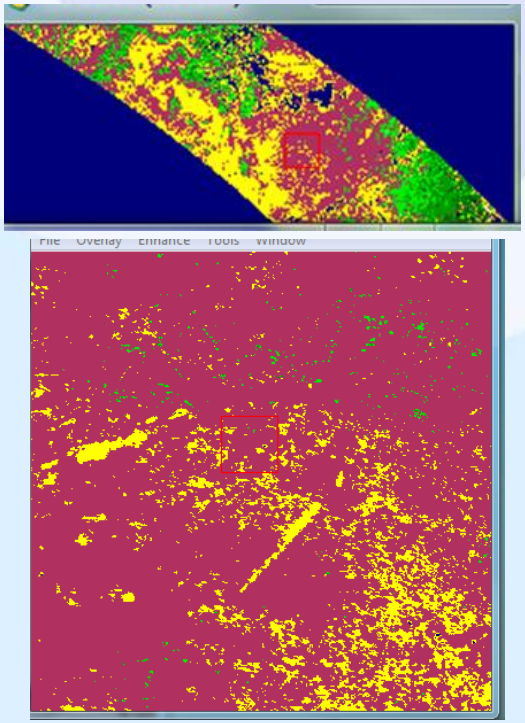
Example of New Functionality

Data extracted for VIIRS (NOAA and NASA products) and Landsat 8 for four CRN station locations (sample regions of 0.5 x 0.5 degrees).

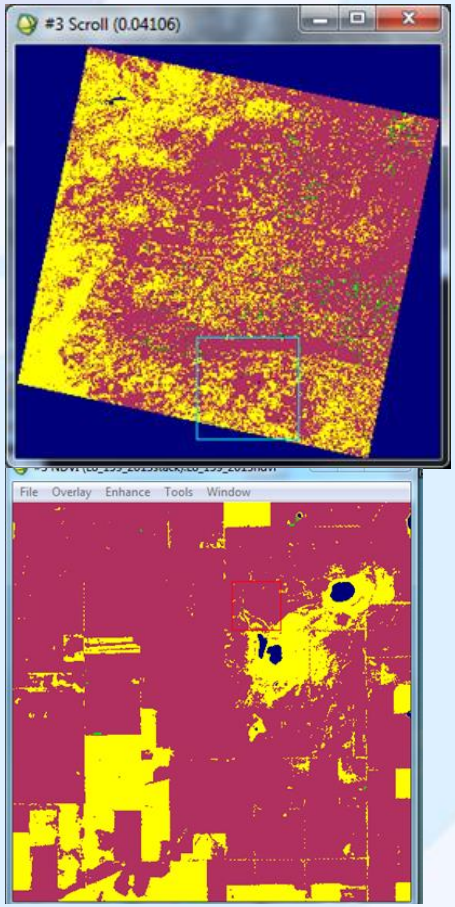
NOAA VIIRS
(STAR GVI Daily)



NASA VIIRS
(NPP_DSRFHKD_L2GD



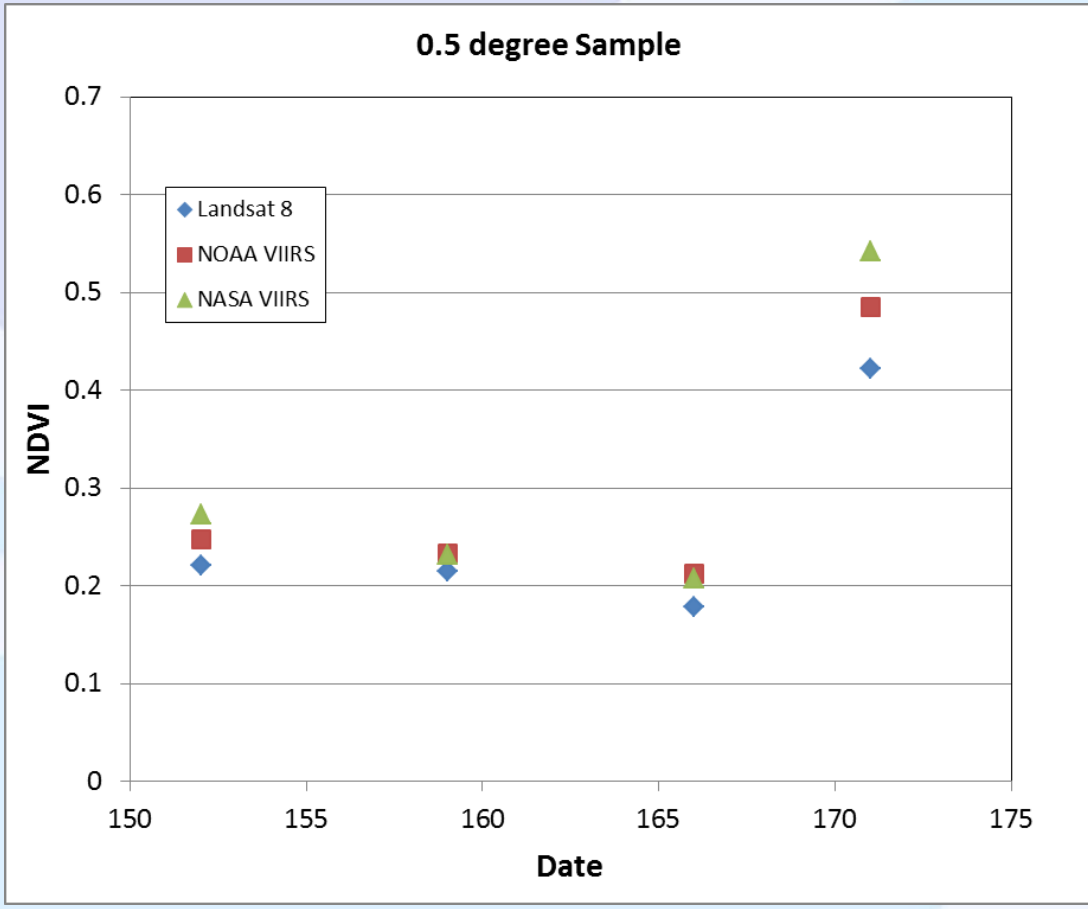
Landsat 8



Example of Potential Analysis

Multisensor/multidate comparison for four CRN station locations in 2013:

- Goodwell, OK, day 152
- Muleshoe, TX, day 159
- LaJunta, CO, day 166
- Montrose, CO day 171



Each point within figures represents .5 x .5 degree sample

Data included in analysis:

- Landsat 8: TOA NDVI
- NOAA-VIIRS: TOA NDVI
- NASA-VIIRS: TOC NDVI

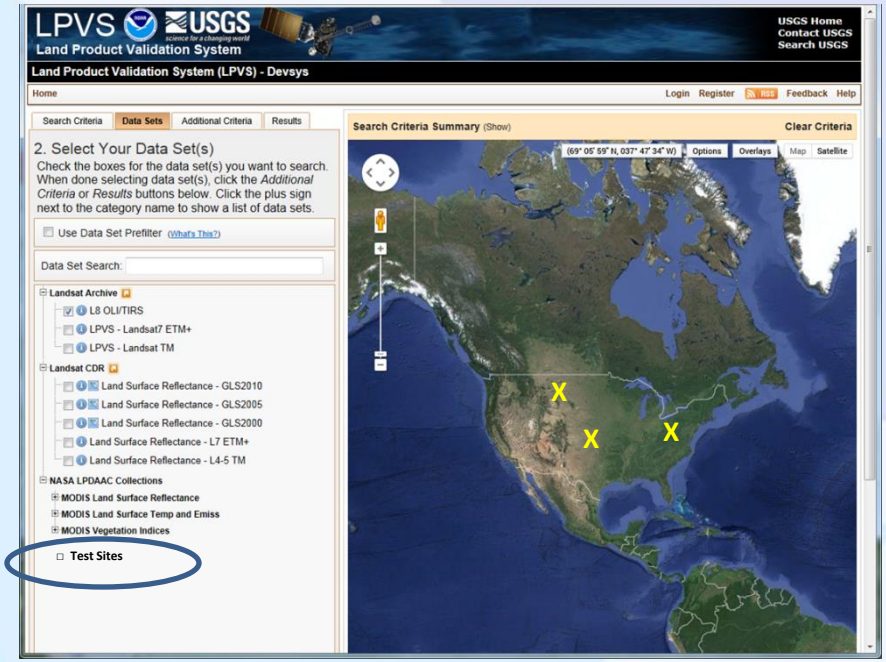
Land Product Validation System (LPVS)

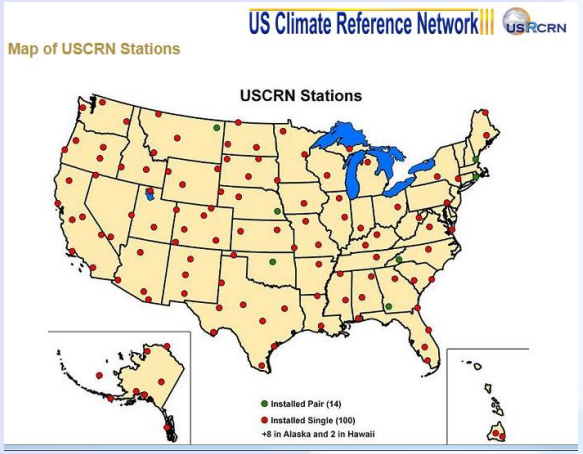
What is LPVS
Why LPVS developed/hosted at EROS
Highlights of LPVS
1. Inventory & Ordering
2. Analysis Tools

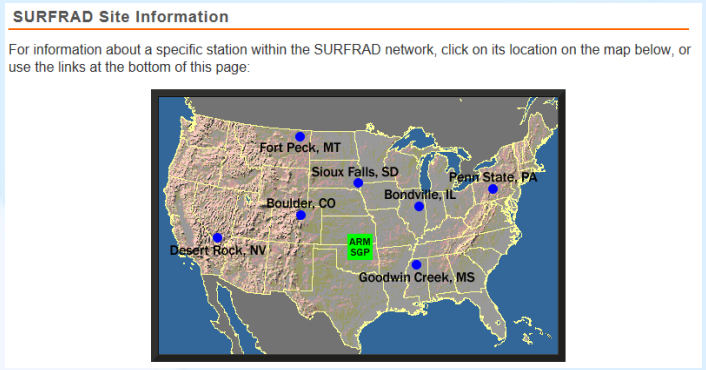
Path Forward

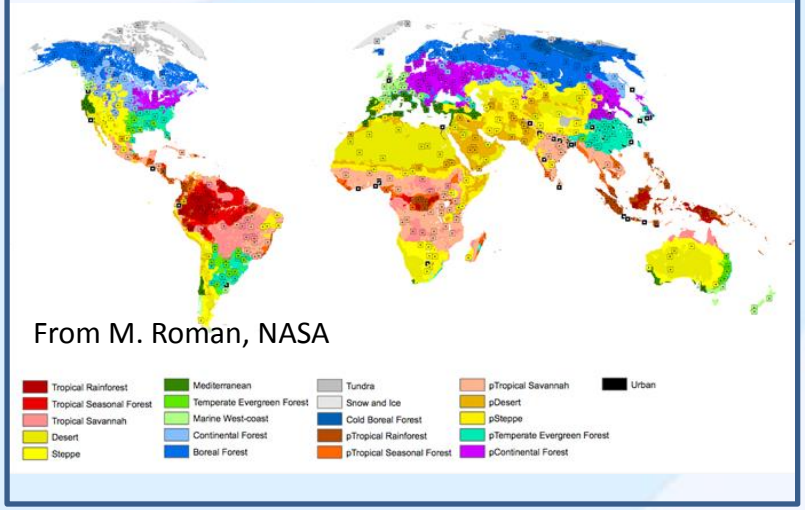
Summary

Predefined sample sites: user selectable for satellite (and potential in situ) inter-comparisons









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What is LPVS

A web-based system designed to use moderate to high-resolution satellite data for validation of GOES-R ABI and JPSS VIIRS products.

Ready for GOES-R and JPSS-VIIRS pre- and post-launch testing and validation.