NOAA-USGS Land Product Characterization System

STAR JPSS Science Team Meeting
27 August 2015

Kevin Gallo: NESDIS/STAR
John Dwyer: USGS/EROS
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Calli Jenkerson: SGT/EROS
Ryan Longhenry: USGS/EROS
Greg Stensaas: USGS/EROS

GOES-R
Geostationary Operational Environmental Satellite R-Series

JPSS
Joint Polar Satellite System

LPCS USGS
science for a changing world
Land Product Characterization System

Land Product Characterization System (LPCS)

What is LPCS

Highlights/Status of LPCS

1. Inventory & Ordering
2. Analysis Tools

Path Forward

Summary

Land Product characterization System (LPCS)

What is LPCS

Highlights/Status of LPCS

1. Inventory & Ordering
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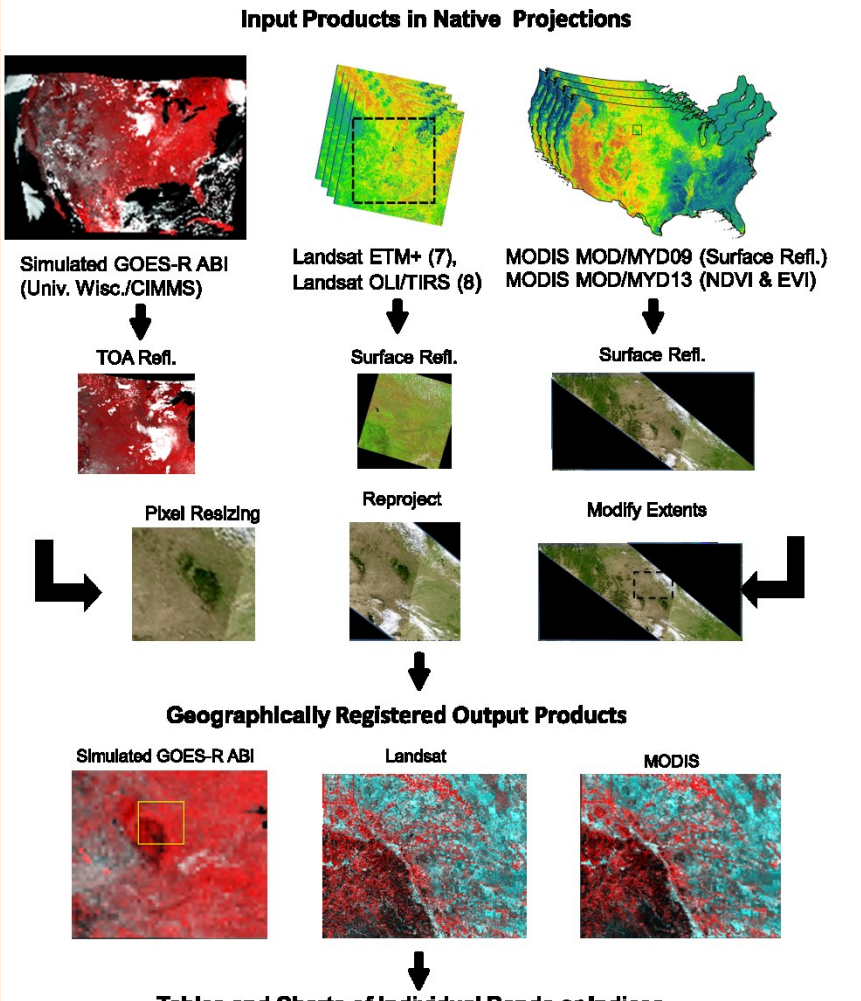
Path Forward

Summary

Land Product Characterization System

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



	A	B	C	D	E	F	G
1	DATE	DOY	MINIMUM	MAXIMUM	MEAN	STDDEV	VALID
2	7/2/2014	183	854	6850	3562.327	693.2124	yes
3	7/3/2014	184	349	8094	2836.911	495.3851	yes
4	7/5/2014	186	290	6780	3122.295	493.9331	yes
5	7/6/2014	187	308	4667	2653.052	575.2196	yes
6	7/9/2014	190	815	5553	3545.954	658.4303	yes
7	7/14/2014	195	191	7778	3254.757	636.479	yes
8	7/18/2014	199	1253	5621	3455.974	681.7747	yes
9	7/19/2014	200	343	5165	2643.97	393.5894	yes
10	7/20/2014	201	404	8447	2648.748	691.372	yes
11	7/26/2014	207	309	5266	2452.574	376.6008	yes
12	7/27/2014	208	457	4713	2462.386	465.7057	yes
13							

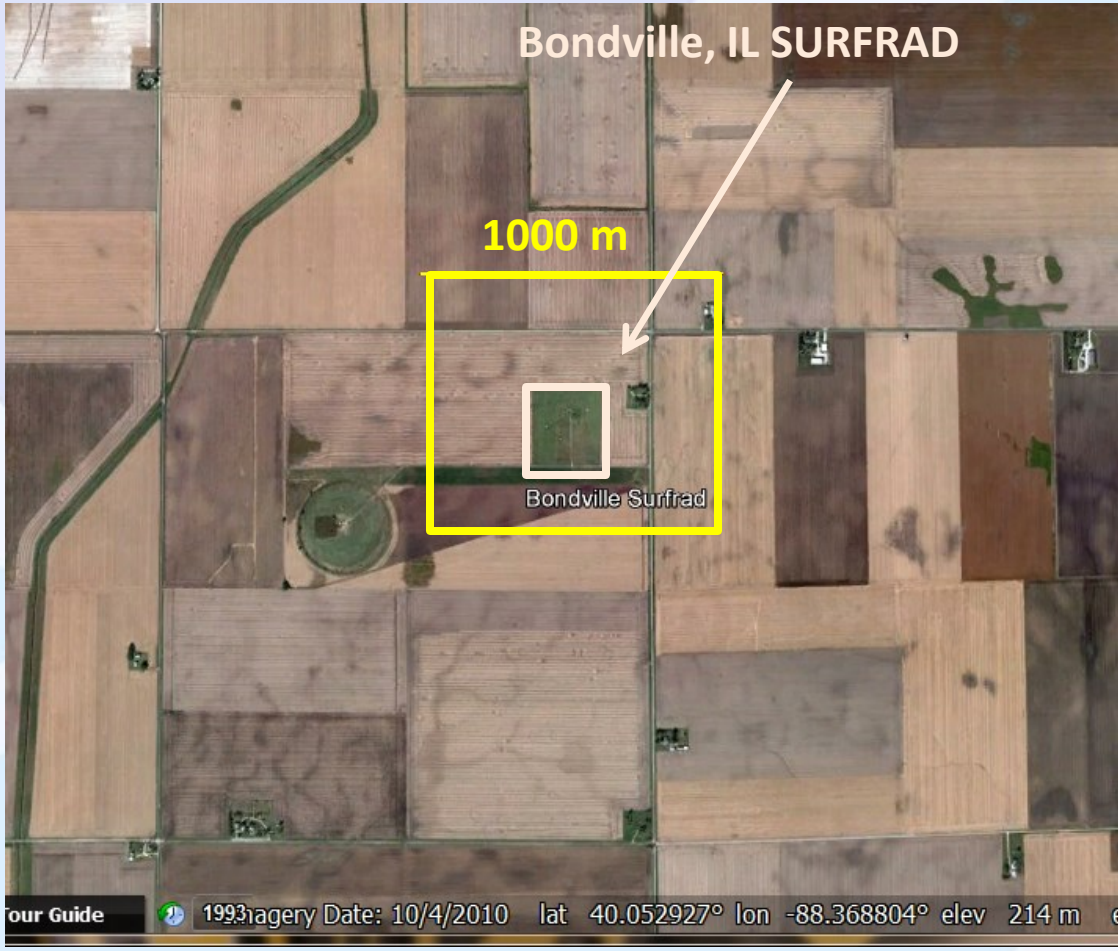
Mean, minimum, maximum, standard deviation

Near-IR time series inter-comparisons

What is LPCS

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 LPCS

1. General characteristics
2. Desired functionality

Landsat 8 spatial resolution

vis/near IR 30 m

Thermal IR 100 m

Bondville, IL SURFRAD

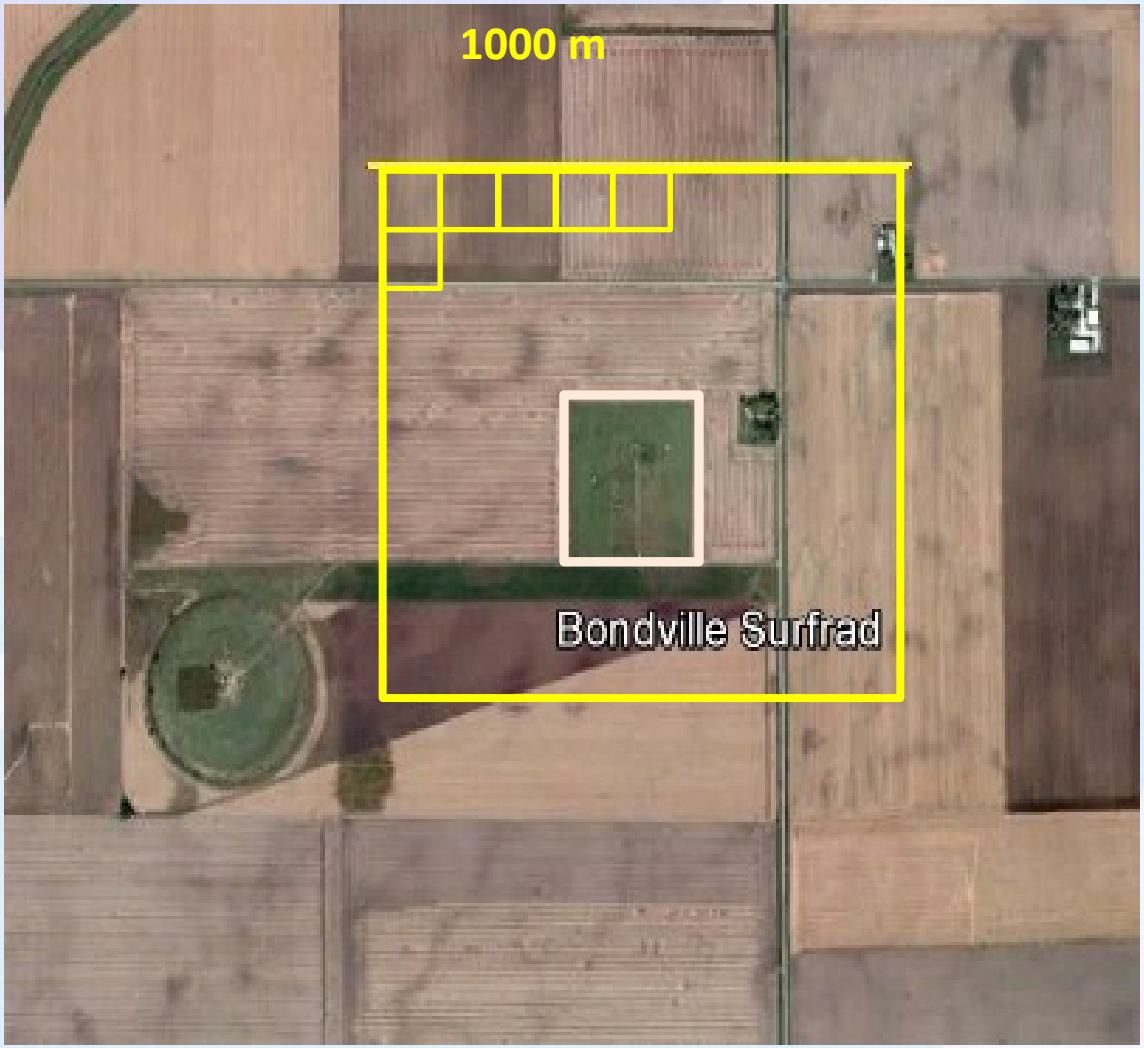
What is LPCS

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

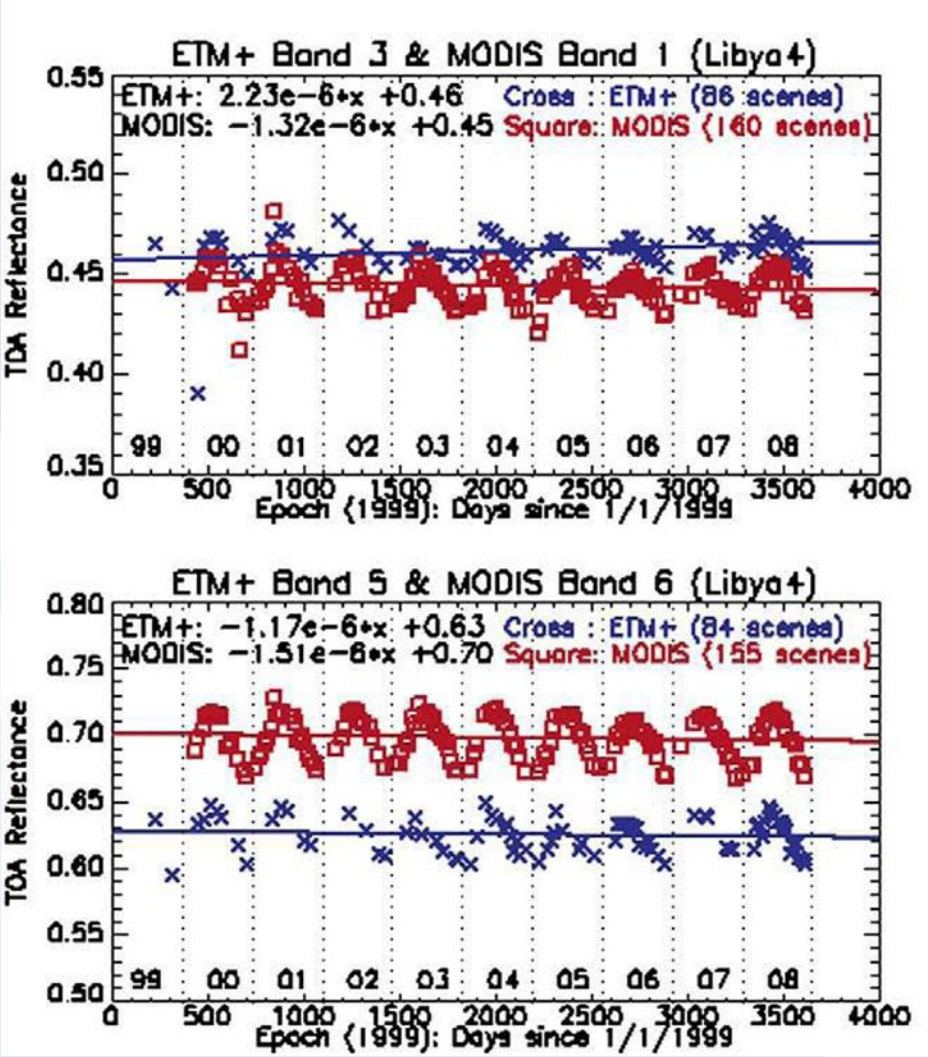
Bondville, IL SURFRAD



What is LPCS: General Characteristics
Potential Output examples

MODIS vs Landsat

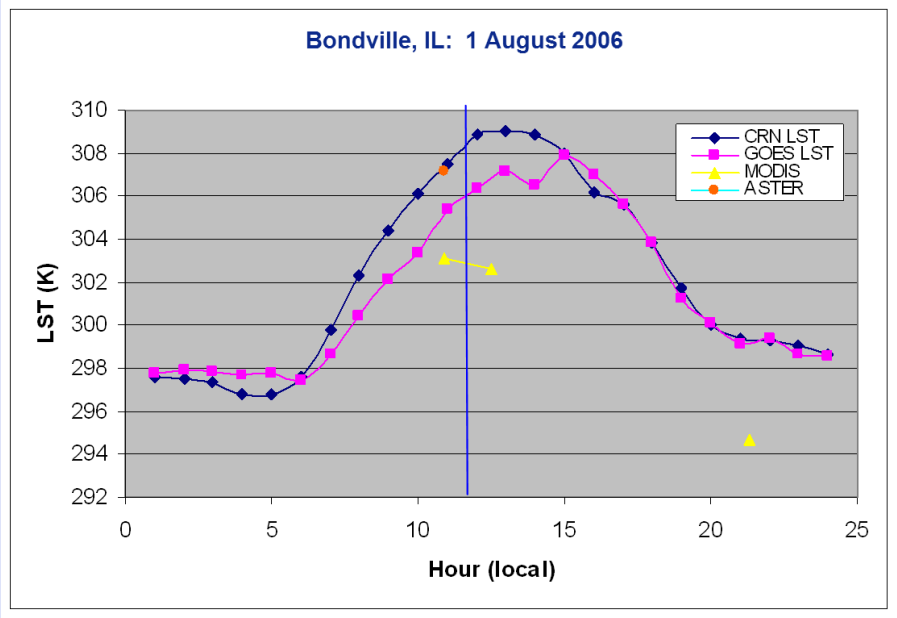
Trending of **similar bands** of data from **multiple sensors**.



What is LPCS: General Characteristics
Potential Output examples

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

Land Surface Temp.



What is LPCS: General Characteristics
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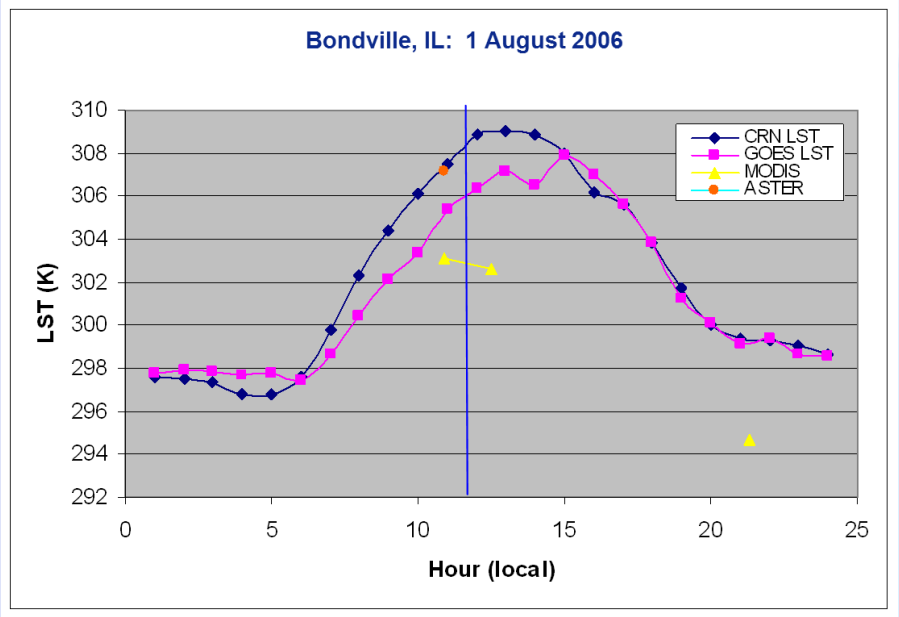
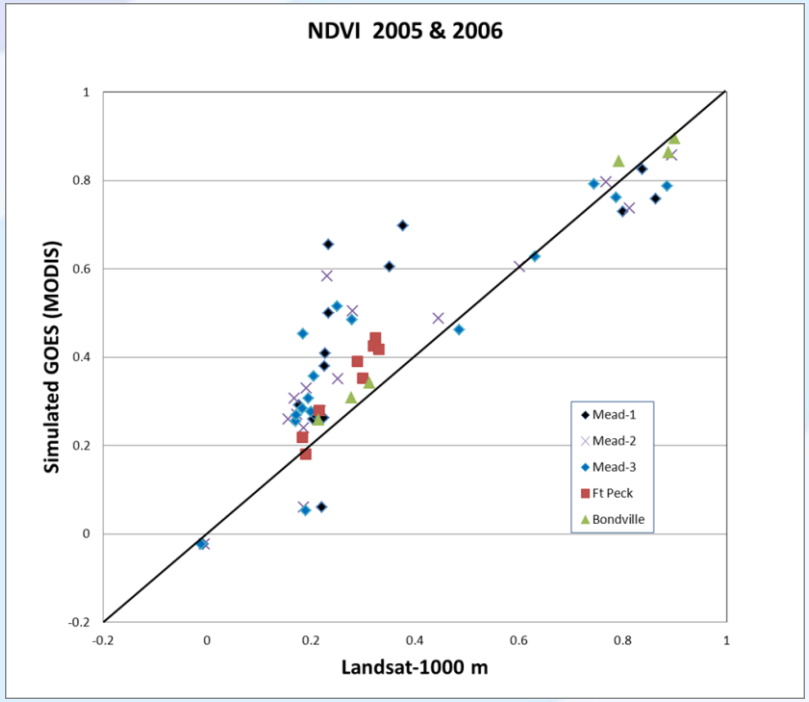
Land Surface Temp.



Multiple sensor comparison for **multiple locations** and **multiple dates**.

NDVI

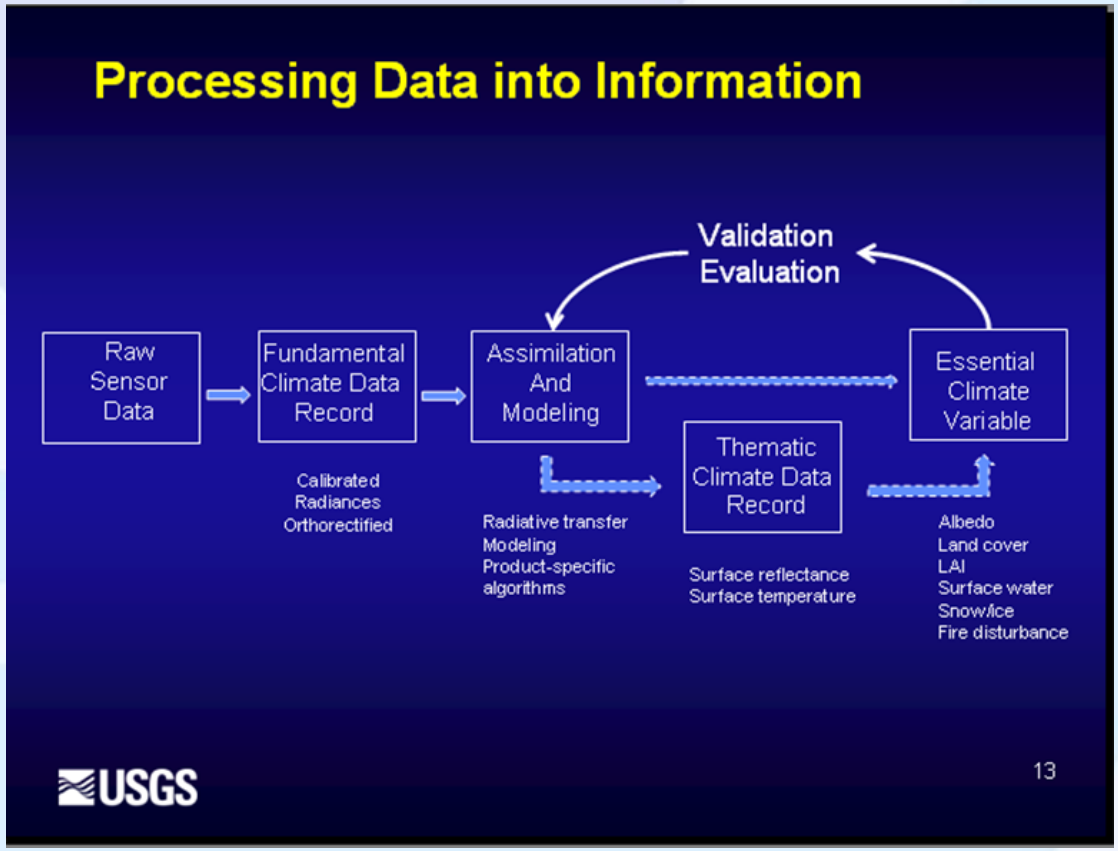


Why LPCS utilization of Landsat?

Landsat Product Development

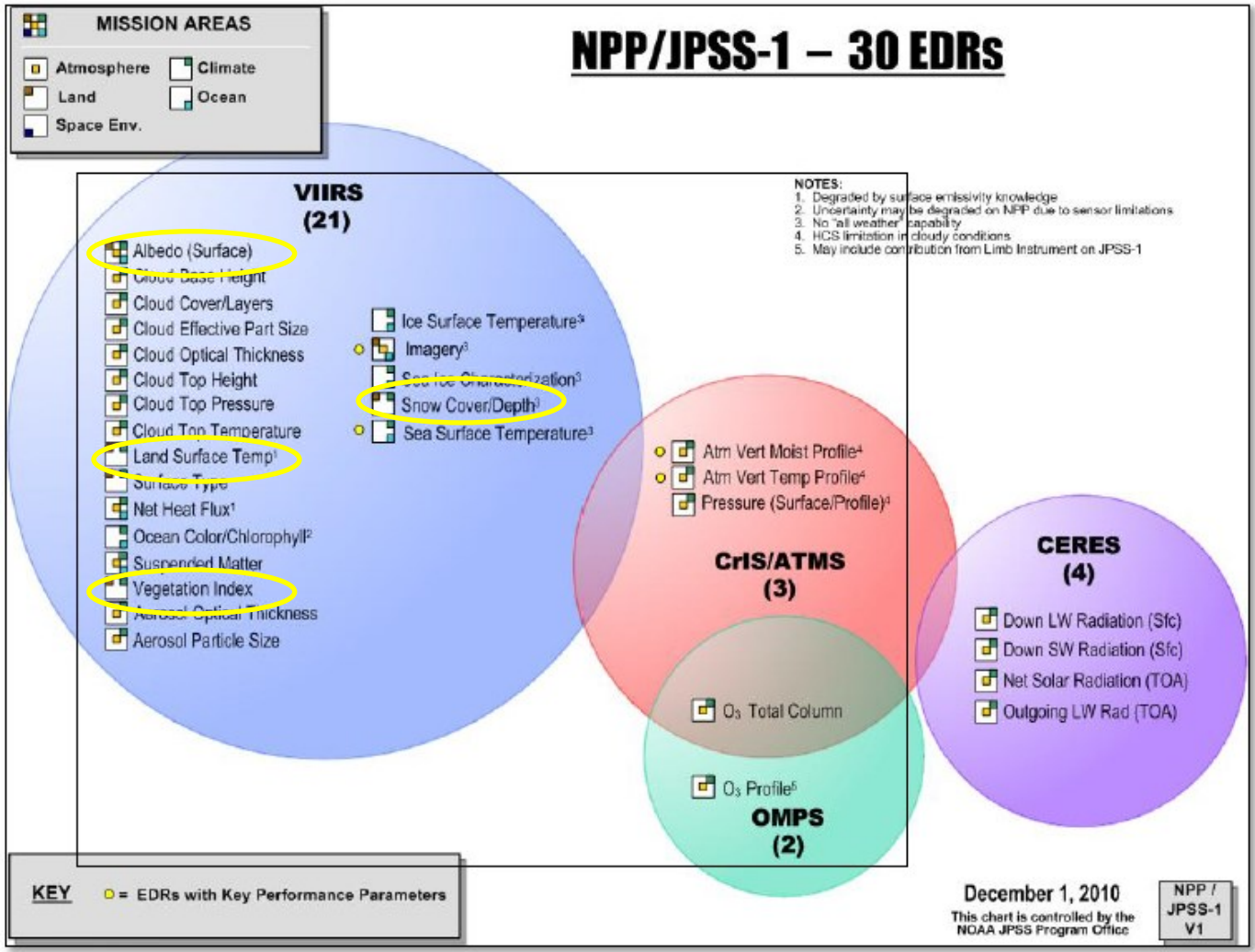
<u>CDRs</u>
Surface Reflectance (and NDVI),
Land Surface
Temperature/Emissivity

<u>ECVs</u>
Surface Water Extent,
Burned Area Extent,
Snow Covered Area



LPCS - VIIRS validation synergy

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



LPCS – GOES-R ABI 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

Land Product characterization System (LPCS)

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Why LPCS developed/hosted at EROS

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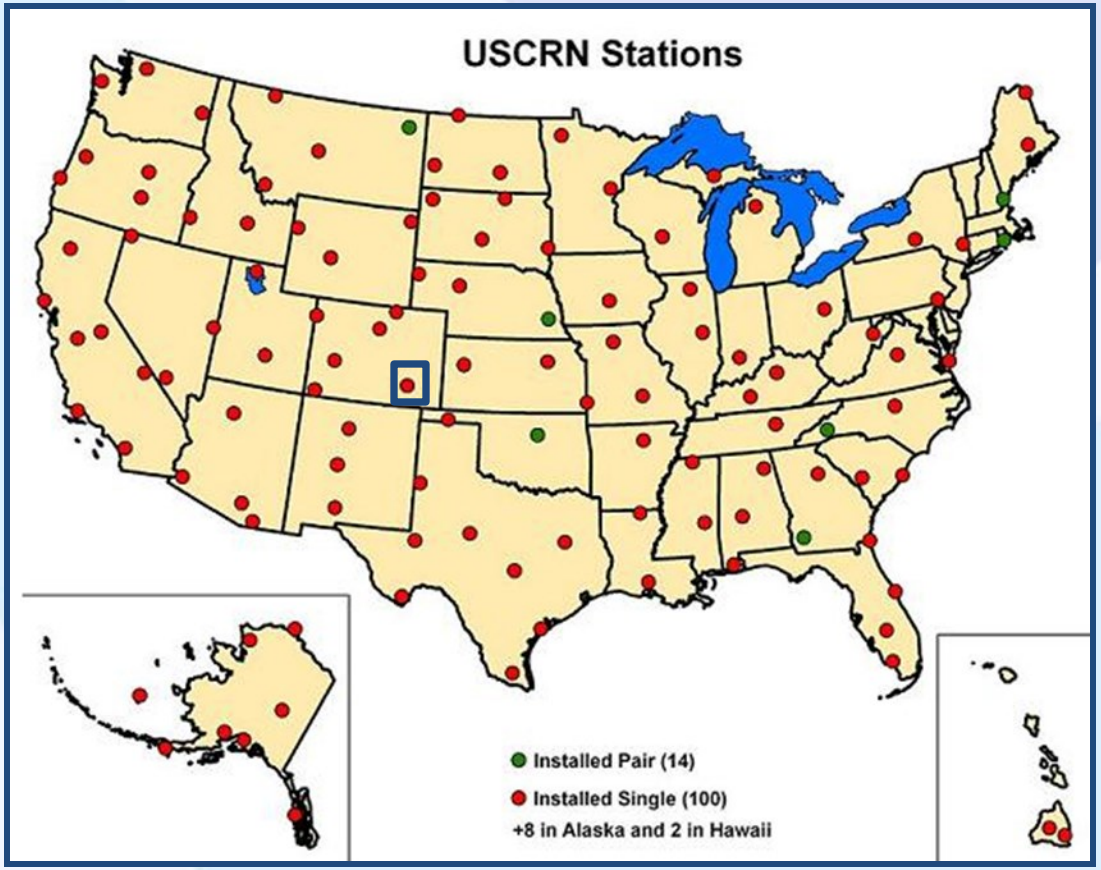
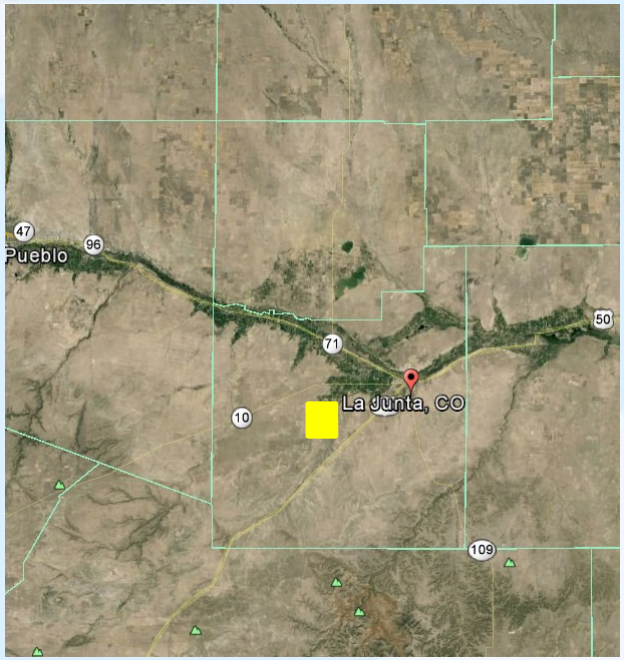
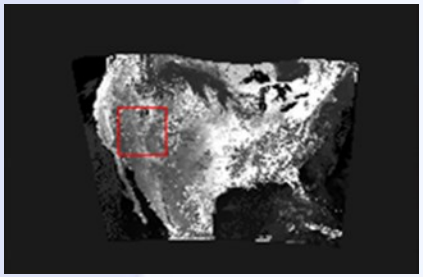
Example of LPCS Functionality

Data extracted for VIIRS (NOAA and NASA products), MODIS, Landsat 8, and simulated GOES-R ABI for the La Junta, CO, CRN station located within NASA golden tile (h09v05).

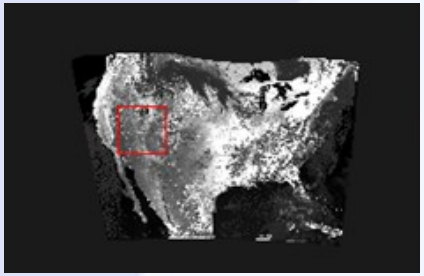




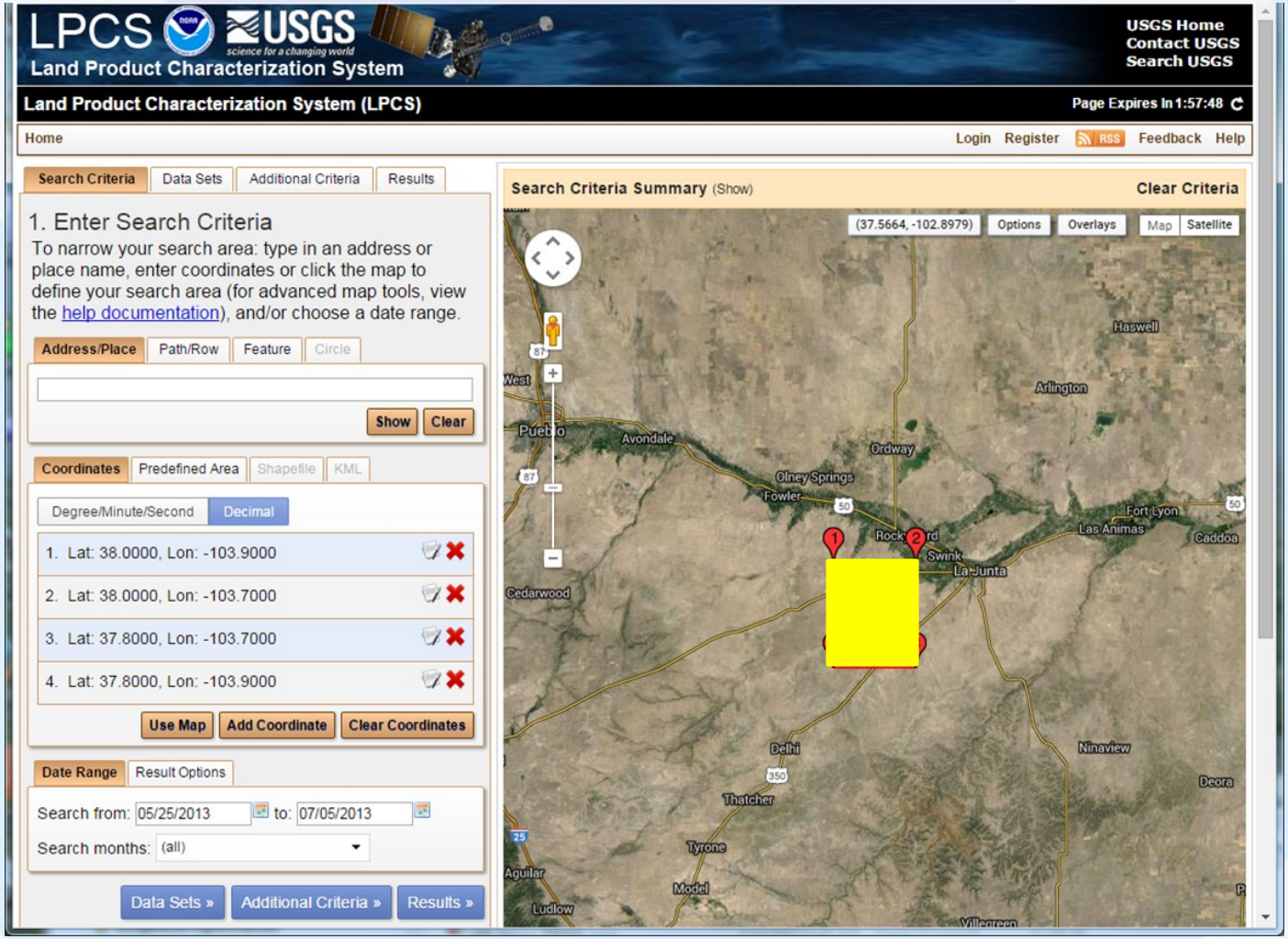
Search within LPCS for Landsat and MODIS data coincident with VIIRS and simulated GOES-R ABI data (provided by Univ. Wisc./CIMSS).



Search for Landsat and MODIS data coincident with VIIRS and simulated GOES-R ABI data (provided by Univ. Wisc./CIMSS).



La Junta CO: Landsat 8 and MODIS data search criteria



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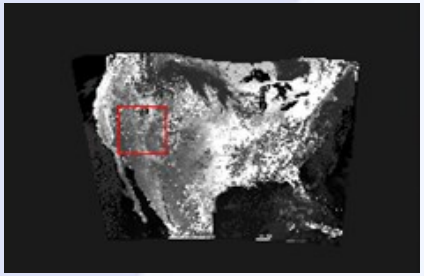
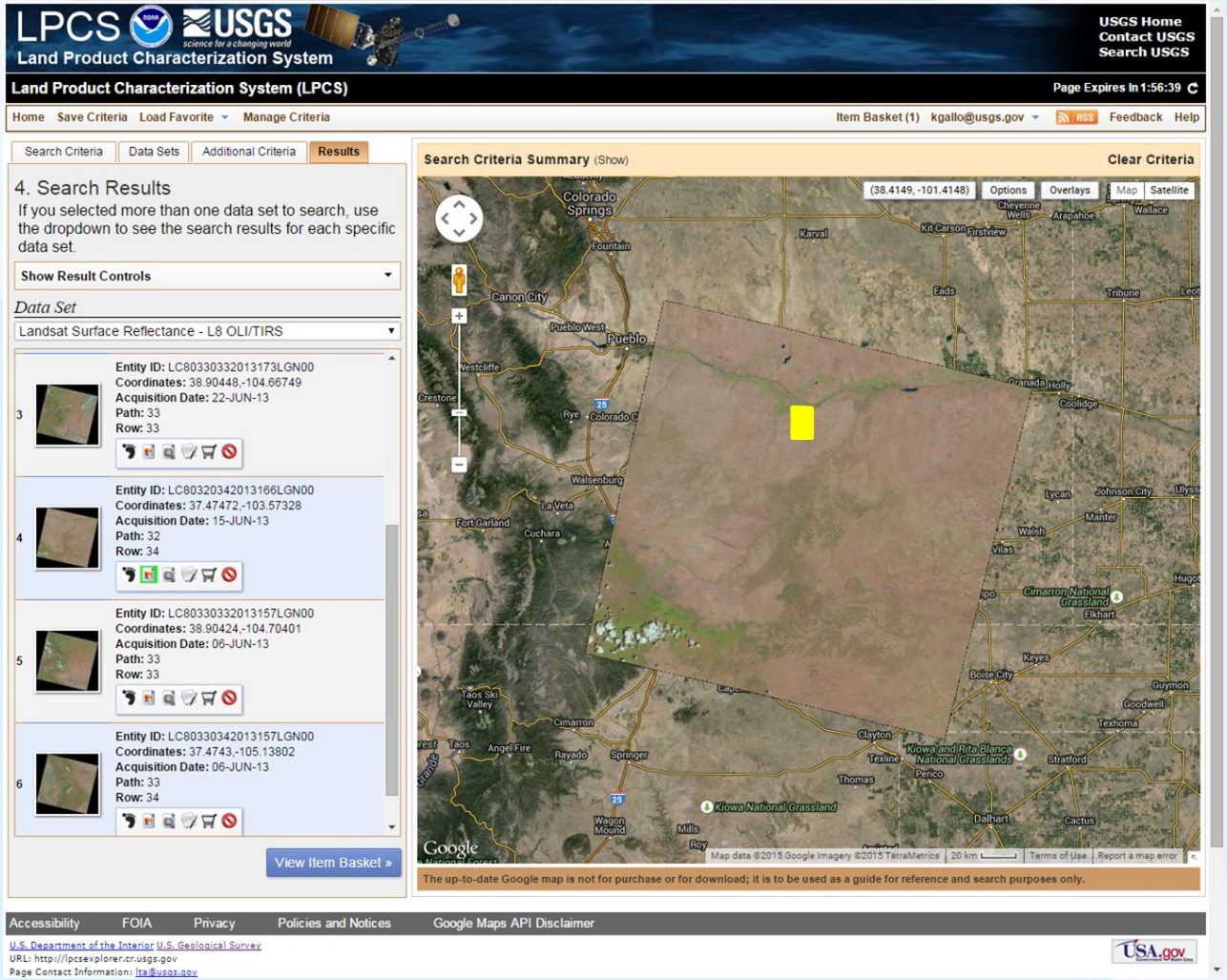
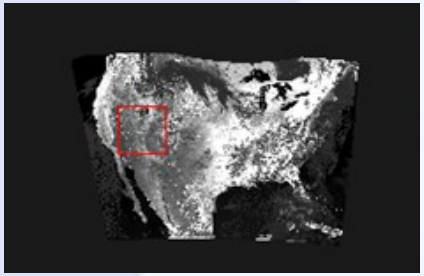


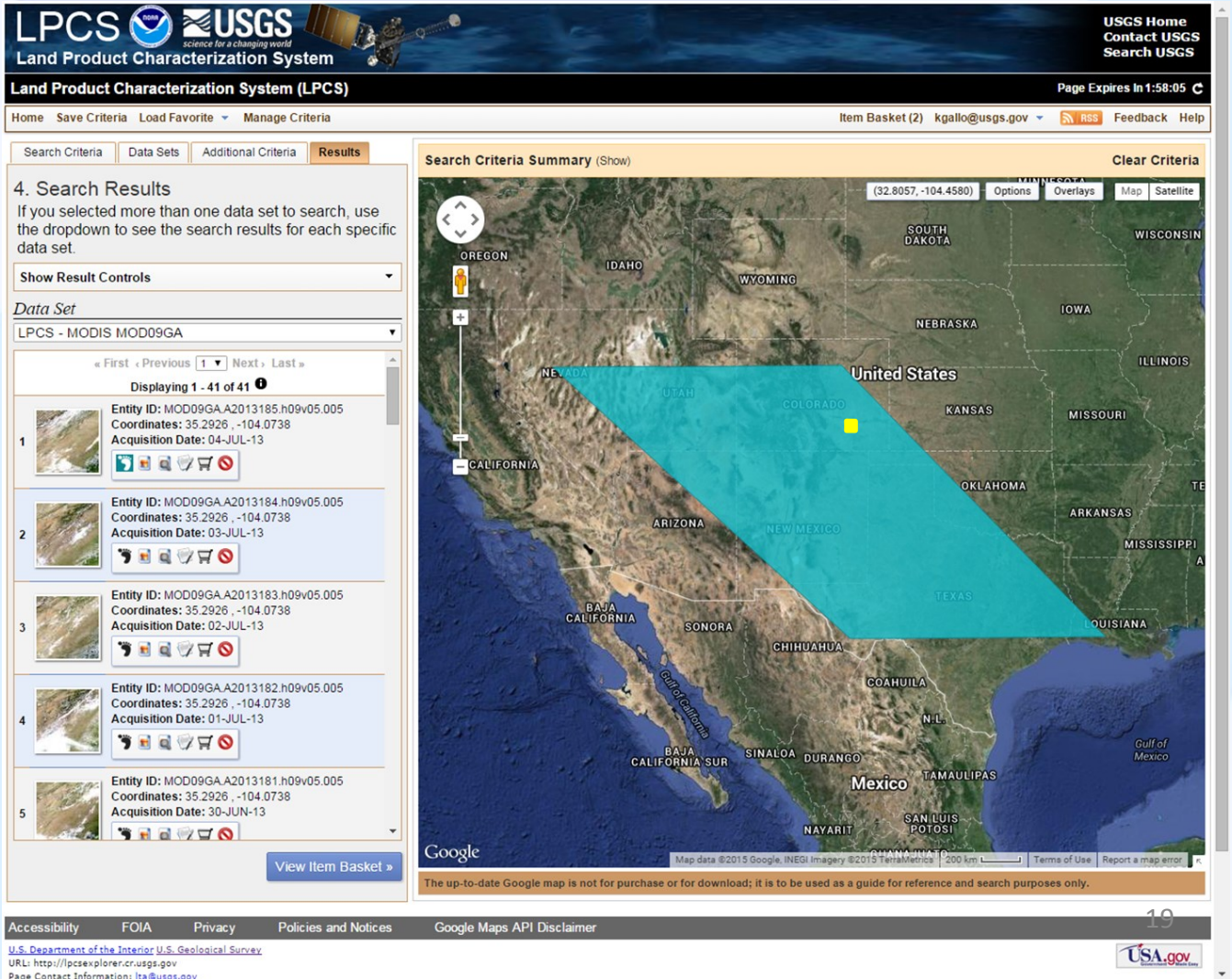
La Junta CO: Landsat 8 data results



Search for Landsat and MODIS data coincident with VIIRS and simulated GOES-R ABI data (provided by Univ. Wisc./CIMSS).



La Junta CO: MODIS-Terra data results



Enhanced Landsat Products

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

Select Product Contents

Source Products

- [ ] Source Products
- [ ] Source Metadata

Climate Data Records

- [ ] Top of Atmosphere Reflectance
- [ ] Surface Reflectance
- [ ] Band 6 Brightness Temperature

Spectral Indices

- [ ] Surface Reflectance NDVI
- [ ] Surface Reflectance NDMI
- [ ] Surface Reflectance NBR
- [ ] Surface Reflectance NBR2
- [ ] Surface Reflectance SAVI
- [ ] Surface Reflectance EVI

Other Products

- [ ] CFMask (standalone file)
- [ ] Solr Index

Product Customization

LPVS USGS science for a changing world
Land Product Validation System

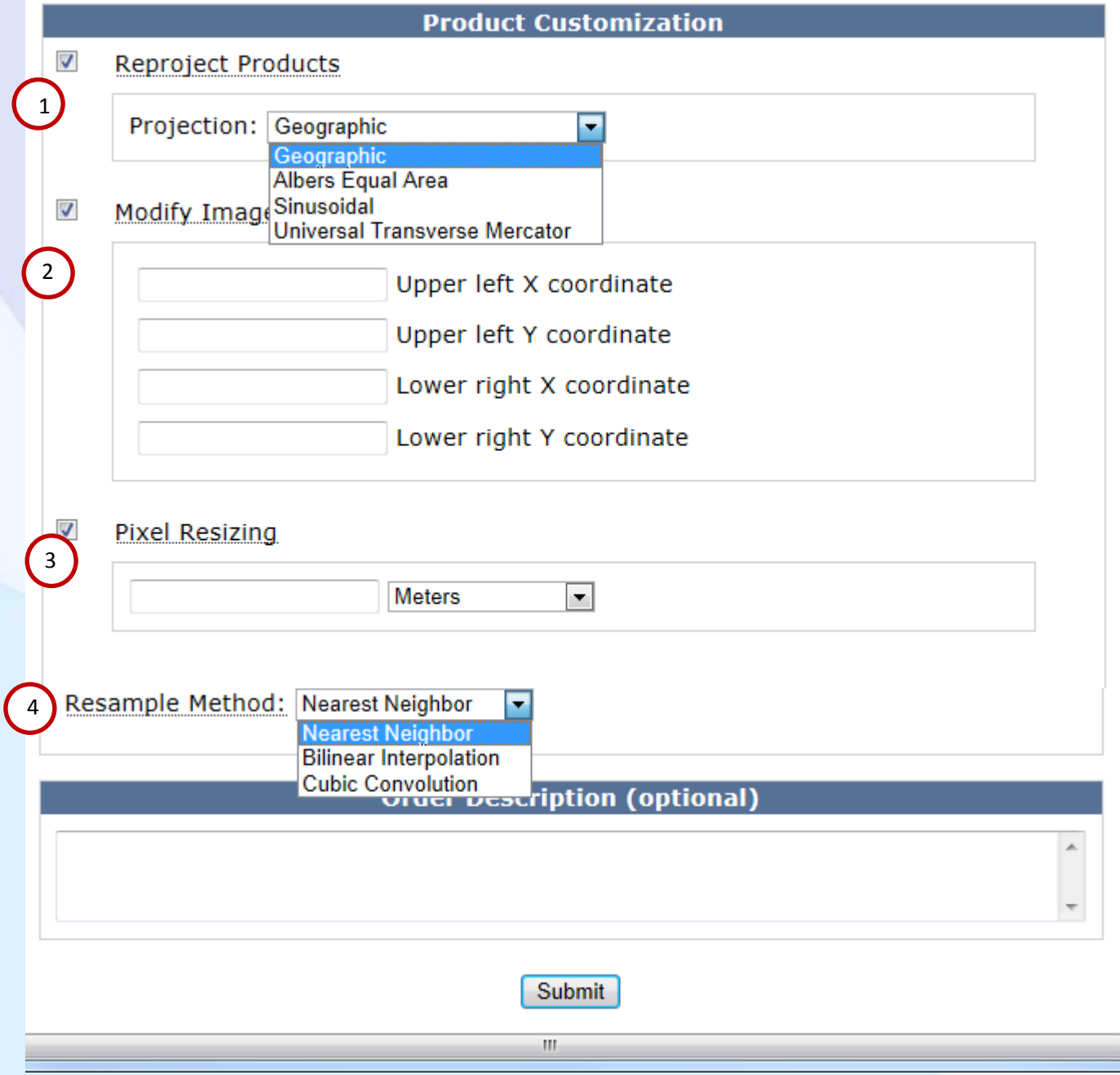
USGS Home
Contact USGS
Search USGS

Earth Resources Observation and Science (EROS) Center

Land Product Validation System (LPVS) Home

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



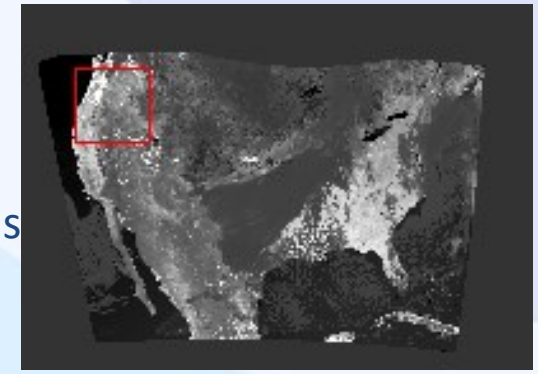
Example of LPCS Functionality

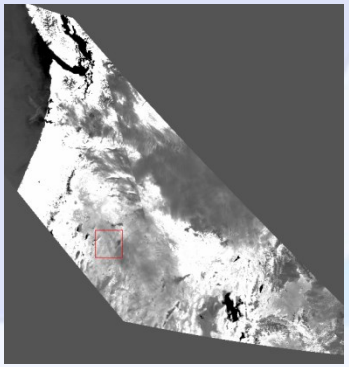
Example of georegistration of simulated ABI, VIIRS and Landsat data.

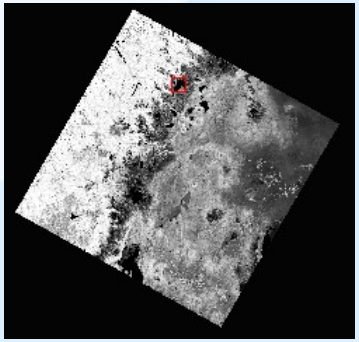
Simulated GOES-R ABI | VIIRS | Landsat

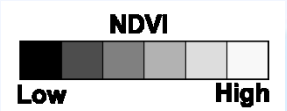
Input Data

Varied Pixel Sizes
Varied Map Projections



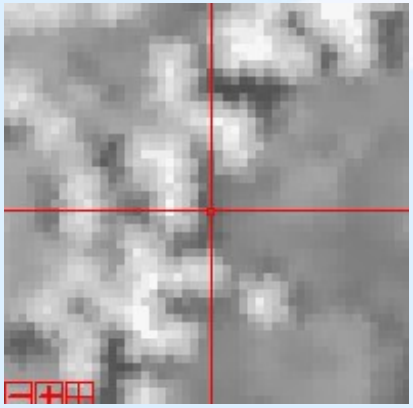


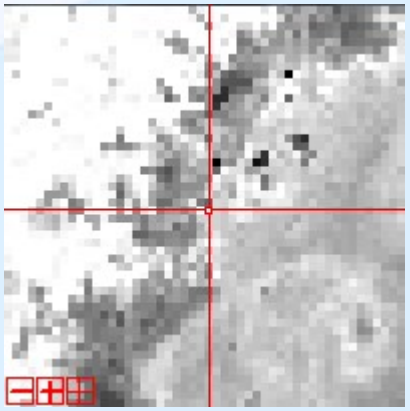


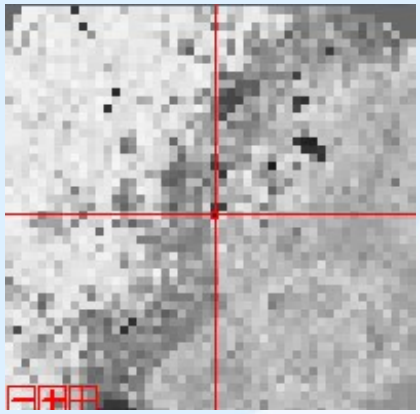


Georegistered Data

Same Pixel Size
Same Map Projection





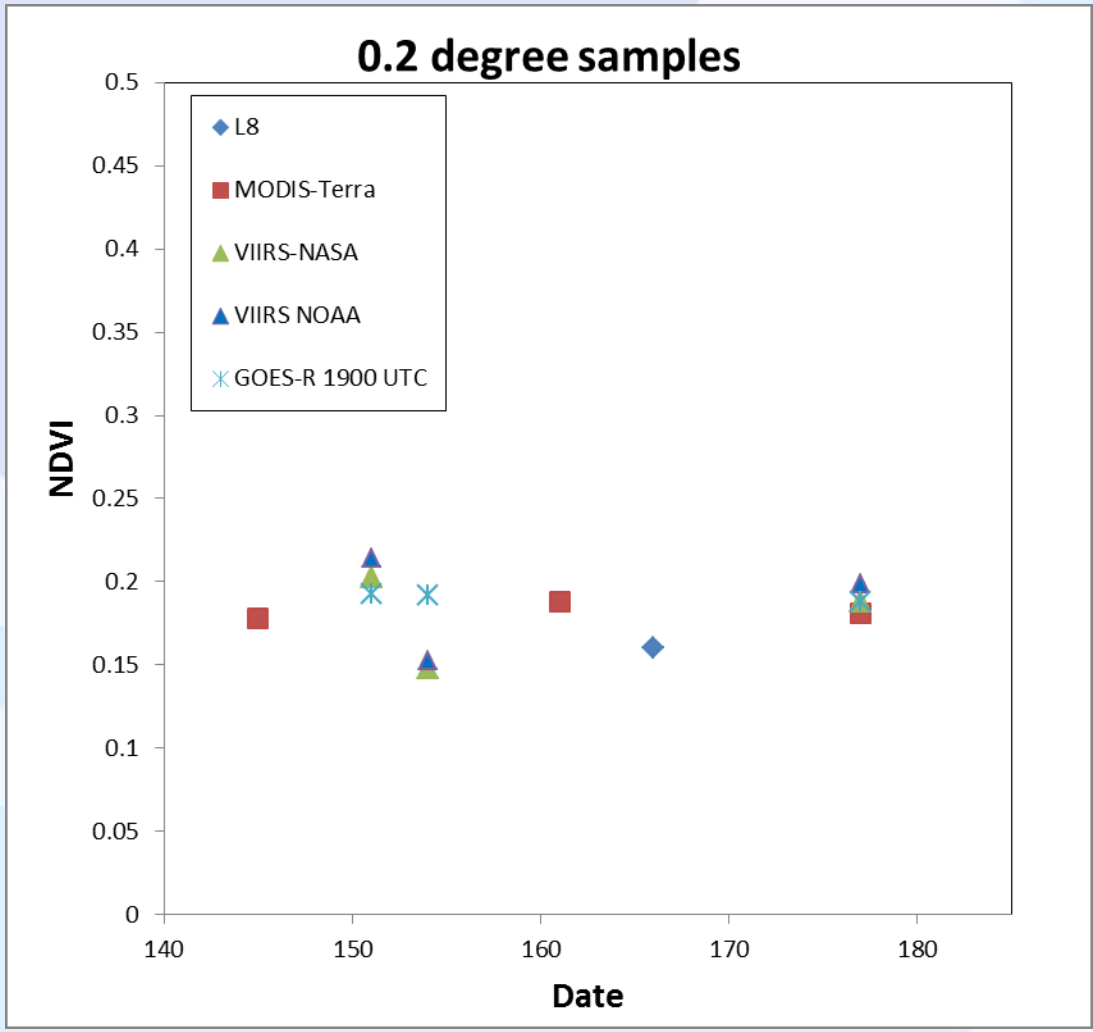


Example of Potential Analysis

Multisensor/multidate comparison for La Junta, CO, CRN station in 2013.

Data included in analysis:

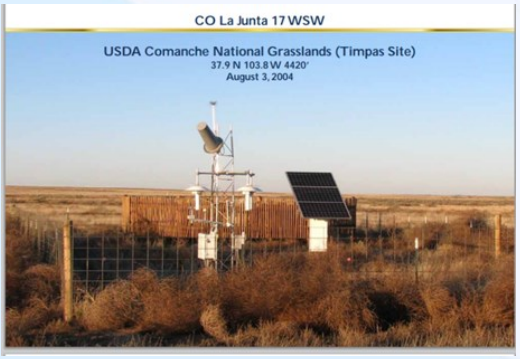
- Landsat 8: TOC NDVI
- NOAA-VIIRS: TOA NDVI
- NASA-VIIRS: TOC NDVI
- MODIS: TOC NDVI
- Simulated GOES-R: TOA NDVI

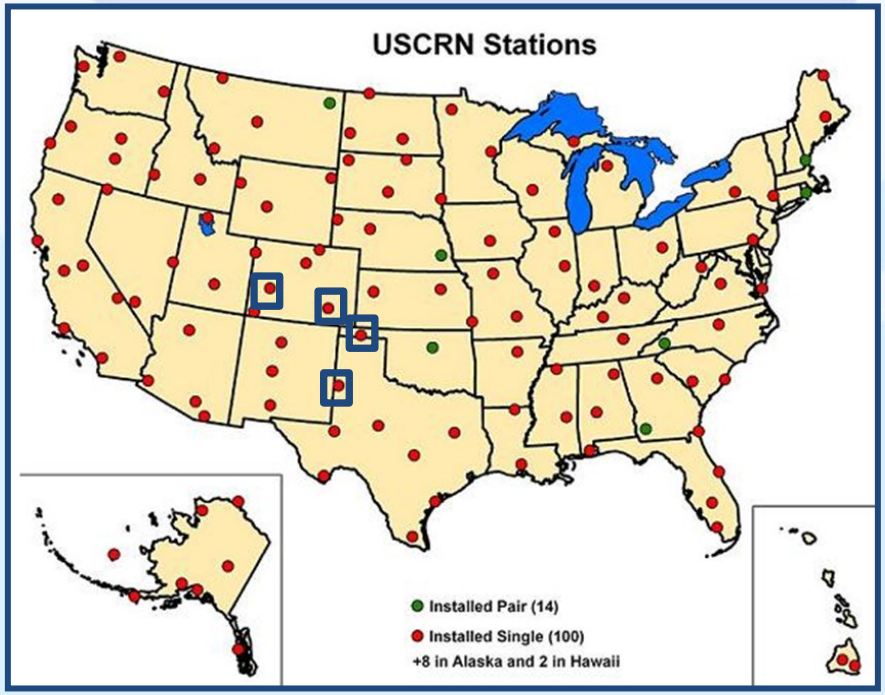


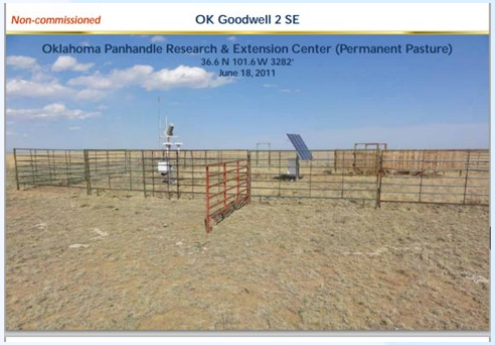
Each point within figures represents 0.2 x 0.2degree sample area.

Example of LPCS Functionality

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







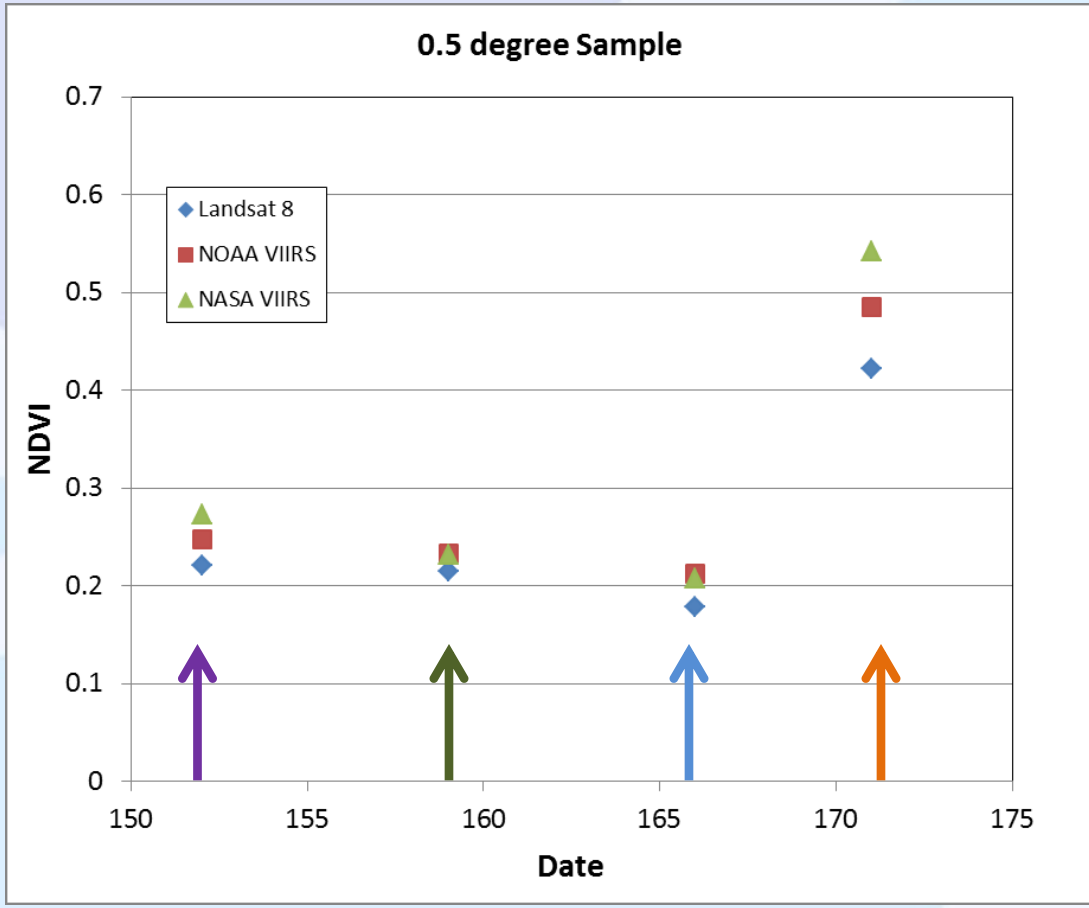
Example of Potential Analysis

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**

Data included in analysis:

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



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

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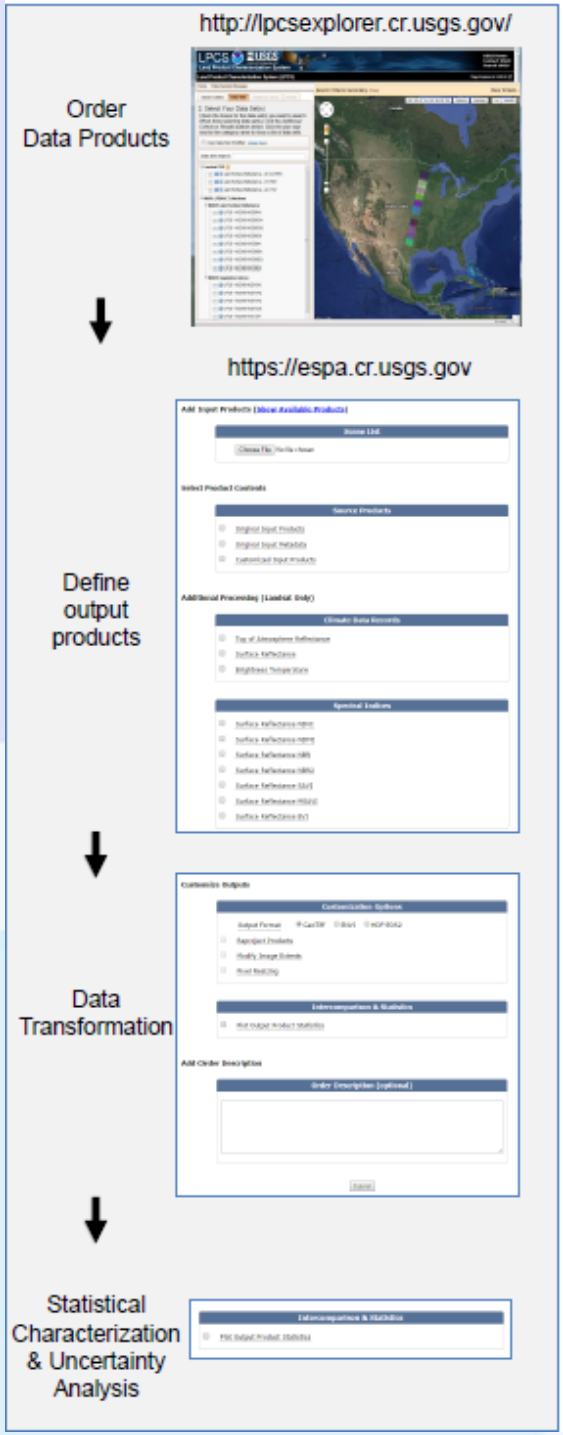
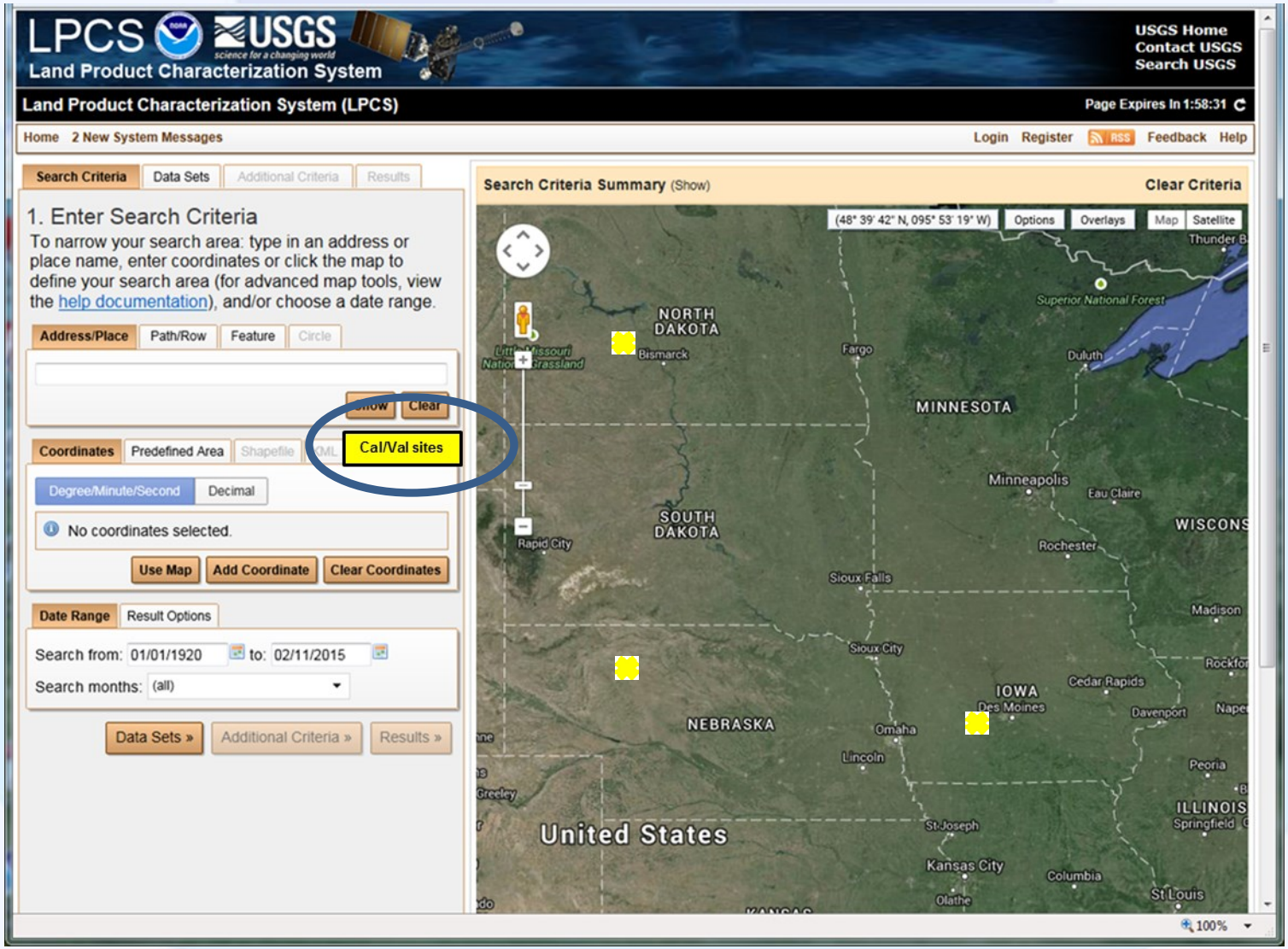
LPCS interface update:
Expected 30 Nov. 2015, one seamless system for LPCS data selection, ordering, and product processing requests.



Path Forward

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



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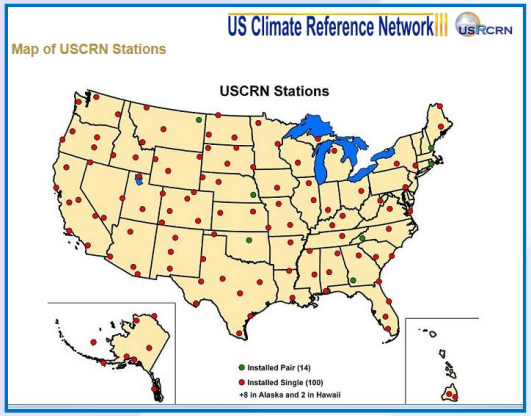
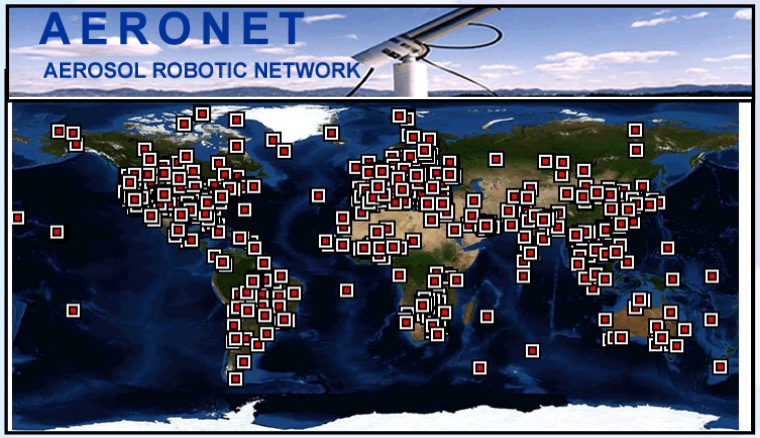
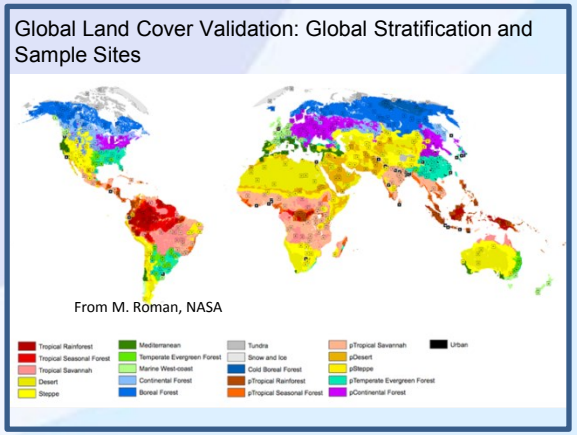
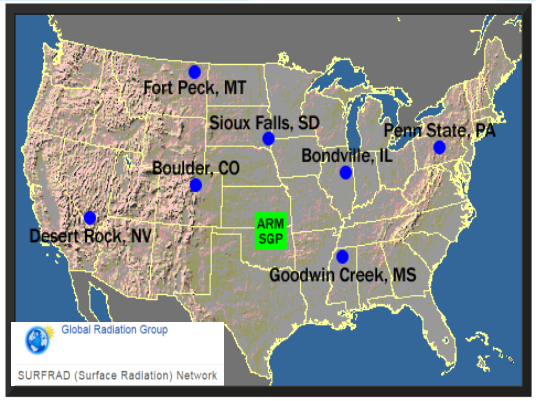
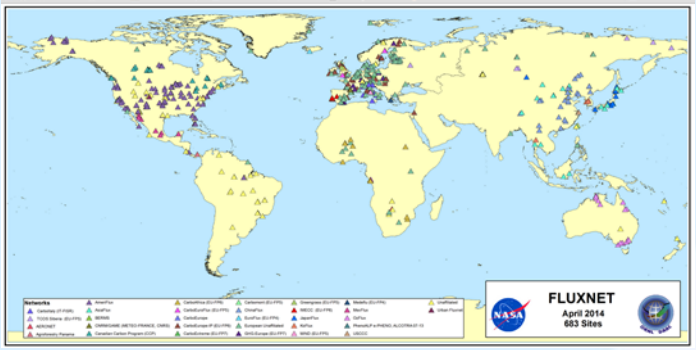




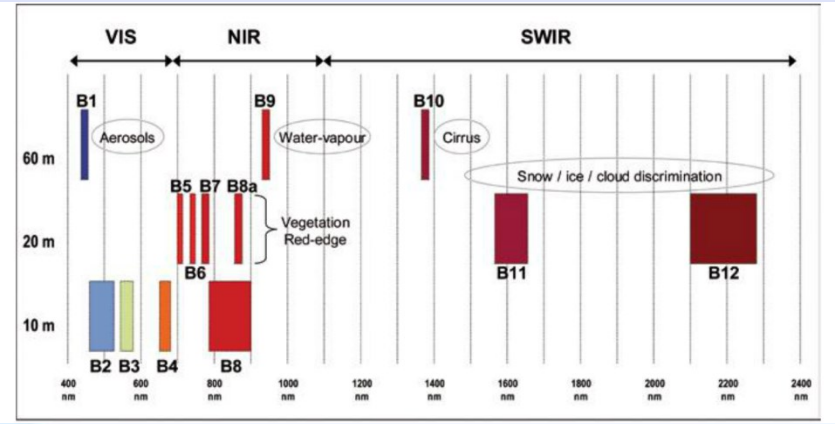






Path Forward

Sentinel-2 and Sentinel-3 data hosted at USGS/EROS



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

Band	λ centre (nm)	Width (nm)	L_{min} (W m^{-2} sr^{-1} µm^{-1})	L_{ref} (W m^{-2} sr^{-1} µm^{-1})	L_{sat} (W m^{-2} sr^{-1} µm^{-1})	SNR @ L_{ref}
Oa1	400	15	21.60	62.95	413.5	2188
Oa2	412.50	10	25.93	74.14	501.3	2061
Oa3	442.50	10	23.96	65.61	466.1	1811
Oa4	490	10	19.78	51.21	483.3	1541
Oa5	510	10	17.45	44.39	449.6	1488
Oa6	560	10	12.73	31.49	524.5	1280
Oa7	620	10	8.86	21.14	397.9	997
Oa8	665	10	7.12	16.38	364.9	883
Oa9	673.75	7.5	6.87	15.70	443.1	707
Oa10	681.25	7.5	6.65	15.11	350.3	745
Oa11	708.75	10	5.66	12.73	332.4	785
Oa12	753.75	75	4.70	10.33	377.7	605
Oa13	761.25	2.5	2.53	6.09	369.5	232
Oa14	764.375	3.75	3.00	7.13	373.4	305
Oa15	767.50	2.5	3.27	7.58	250.0	330
Oa16	778.75	15	4.22	9.18	277.5	812
Oa17	865	20	2.88	6.17	229.5	666
Oa18	885	10	2.80	6.00	281.0	395
Oa19	900	10	2.05	4.73	237.6	308
Oa20	940	20	0.94	2.39	171.7	203
Oa21	1020	40	1.81	3.86	163.7	152

Ocean Land Color Instrument
21 Bands
300 m spatial resolution

Land Product characterization System (LPCS)

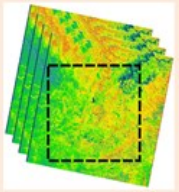
What is LPCS
Why LPCS developed/hosted at EROS
Highlights of LPCS
1. Inventory & Ordering
2. Analysis Tools
Path Forward
Summary

Land Product Characterization System

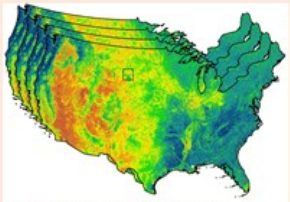
A web-based system designed to use moderate to high-resolution satellite data for characterization, and assist with validation, of GOES-R ABI and JPSS VIIRS products.

Input Products in Native Projections

Simulated GOES-R ABI (Univ. Wisc./CIMMS)



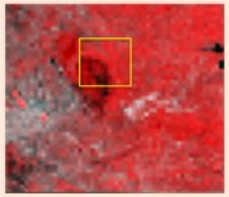
Landsat ETM+ (7), Landsat OLI/TIRS (8)



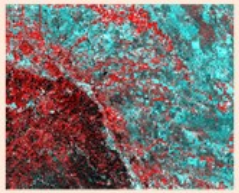
MODIS MOD/MYD09 (Surface Refl.) MODIS MOD/MYD13 (NDVI & EVI)

Geographically Registered Output Products

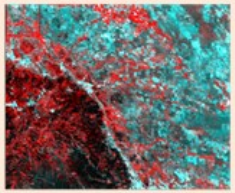
Simulated GOES-R ABI



Landsat



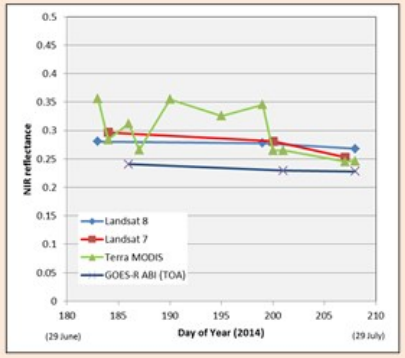
MODIS



Tables and Charts of Individual Bands or Indices

	A	B	C	D	E	F	G
1	DATE	DOY	MINIMUM	MAXIMUM	MEAN	STDDEV	VALID
2	7/2/2014	183	854	6850	3562.327	693.2124	yes
3	7/3/2014	184	349	8094	2836.911	495.3851	yes
4	7/5/2014	186	290	6780	3122.295	493.9331	yes
5	7/6/2014	187	308	4667	2653.052	575.2196	yes
6	7/9/2014	190	815	5553	3545.954	658.4303	yes
7	7/14/2014	195	191	7778	3254.757	636.479	yes
8	7/18/2014	199	1253	5621	3455.974	681.7747	yes
9	7/19/2014	200	343	5165	2643.97	393.5894	yes
10	7/20/2014	201	404	8447	2648.748	691.372	yes
11	7/26/2014	207	309	5266	2452.574	376.6008	yes
12	7/27/2014	208	457	4713	2462.386	465.7057	yes
13							

Mean, minimum, maximum, standard deviation



Near-IR time series inter-comparisons