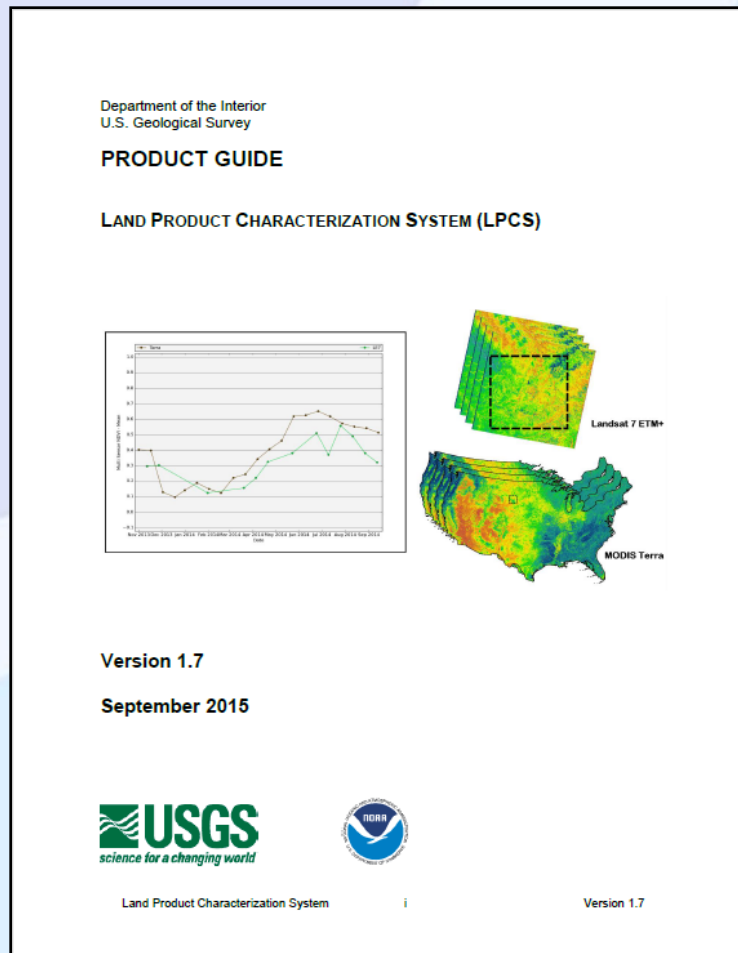


# Land Product Characterization System

*CEOS Land Surface Imaging-VC-2*  
*20 July 2016*

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



# Land Product Characterization System (LPCS)

What is LPCS

Highlights of LPCS

1. Inventory & Ordering
2. Analysis Tools

Path Forward

1. Status and Readiness
2. CEOS LPV collaboration

Summary

# Land Product Characterization System (LPCS)

## What is LPCS

### Highlights of LPCS

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### Summary

## What is LPCS

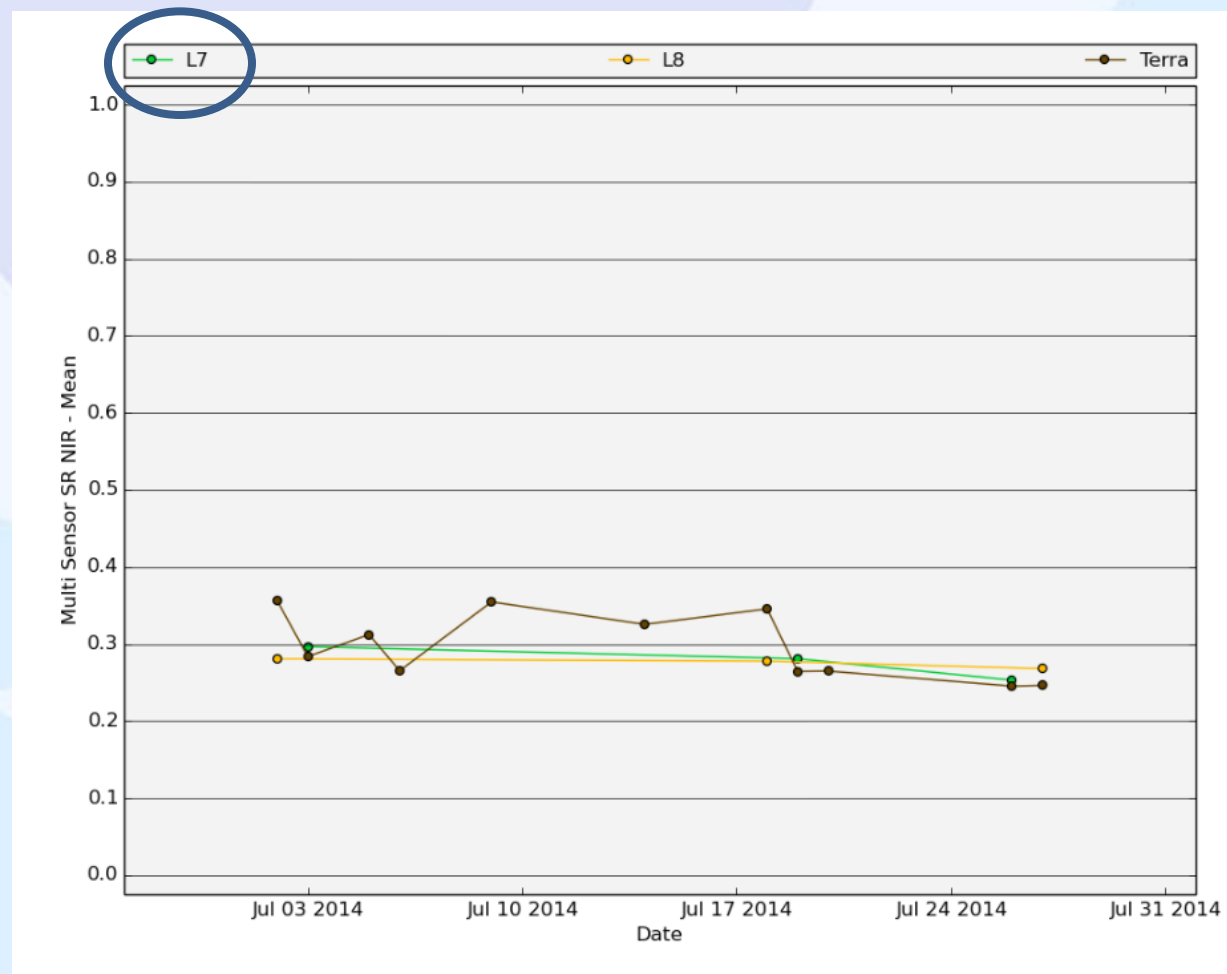
A web-based system designed for comparative analysis of satellite data and higher-level land products.

The screenshot displays the Land Product Characterization System (LPCS) web interface. The header features the LPCS logo, the USGS logo with the tagline "science for a changing world", and a satellite image. Navigation links for "USGS Home", "Contact USGS", and "Search USGS" are in the top right. A "Page Expires In 1:59:07" timer is also present. The main navigation bar includes "Home", "Login", "Register", "RSS", "Feedback", and "Help". Below this, a tabbed interface shows "Search Criteria", "Data Sets", "Additional Criteria", and "Results". The "Data Sets" tab is active, displaying a section titled "2. Select Your Data Set(s)" with instructions: "Check the boxes for the data set(s) you want to search. When done selecting data set(s), click the *Additional Criteria* or *Results* buttons below. Click the plus sign next to the category name to show a list of data sets." Below the instructions is a checkbox for "Use Data Set Prefilter" with a link to "(What's This?)". A "Data Set Search:" input field is provided. The data sets are organized into a tree structure: "GOES-R" (containing "ABI" with a sub-item "Simulated GOES-R ABI (5/30/2013-6/30/2013)"), "Landsat Archive" (containing "Landsat Surface Reflectance - L8 OLI/TIRS", "Landsat Surface Reflectance - L7 ETM+", and "Landsat Surface Reflectance - L4-5 TM"), "NASA LPDAAC Collections (MODIS)" (containing "MODIS Vegetation Indices" and "MODIS Land Surface Reflectance"), and "VIIRS" (containing "NASA" and "NOAA"). On the right, a "Search Criteria Summary (Show)" section includes a "Clear Criteria" button and a map view. The map shows North America with a selected area in the northern United States, displaying coordinates (53° 26' 08" N, 155° 33' 59" W) and buttons for "Map", "Satellite", "Options", and "Overlays".

## What is LPCS: Output example

Trending of similar bands of  
data from multiple sensors.

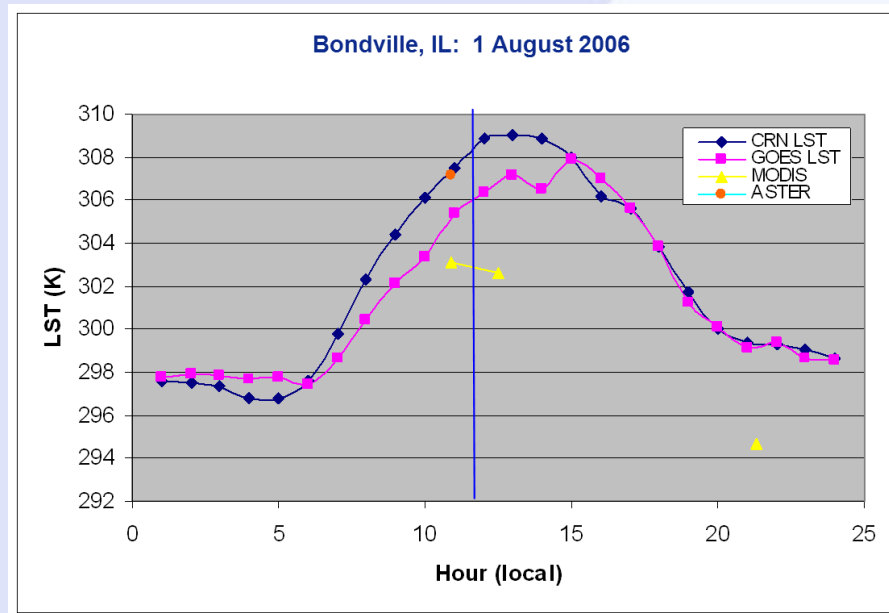
*Near-IR Surface Reflectance*



## What is LPCS: Output examples

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

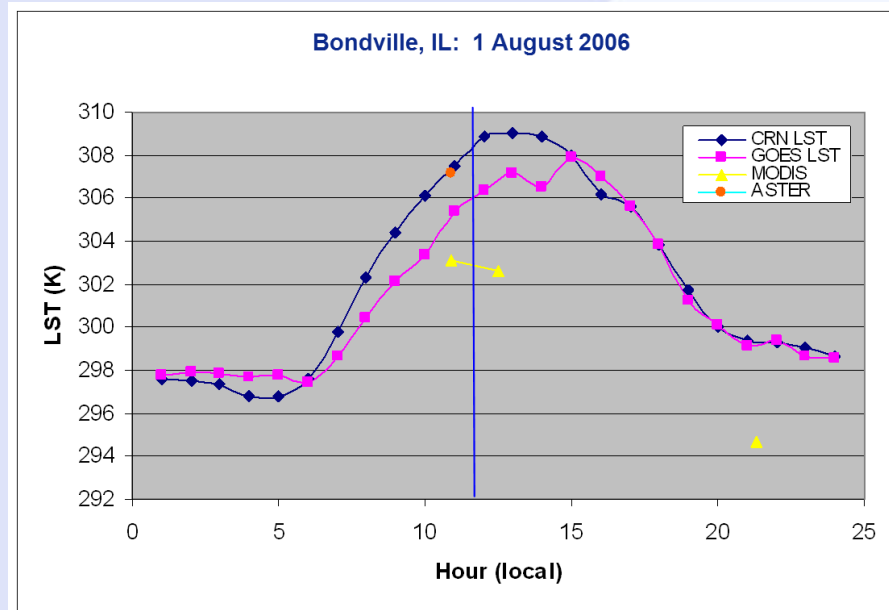
Land  
Surface  
Temp.



## What is LPCS: Output examples

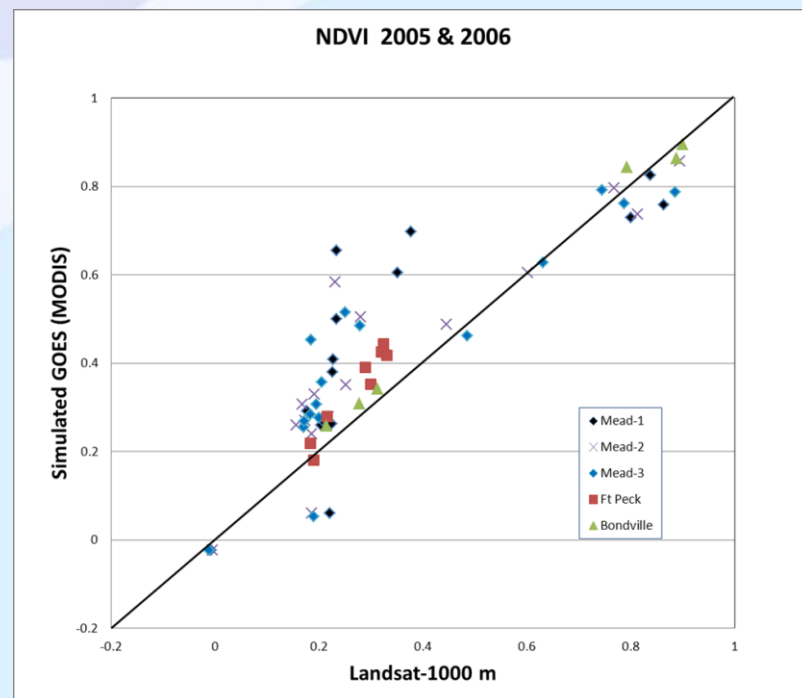
Multiple sensor (satellite and in situ) comparisons for *single location and date*.

Land  
Surface  
Temp.



Multiple sensor comparison for *multiple locations and dates*.

NDVI





## What is LPCS

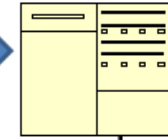
A web-based system designed for comparative analysis of satellite data and higher-level land products.



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

## GOES-R ABI and VIIRS Land Product Validation System

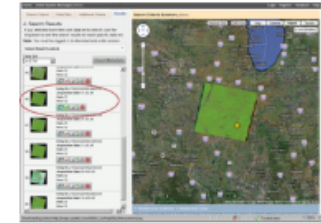
On demand data acquisition  
Automated data acquisitions



Data and  
Inventory  
information  
stored at  
EROS.

Feedback / Additional Analysis

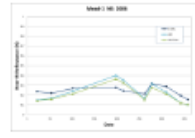
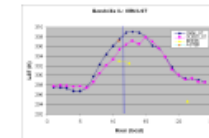
Inventory  
and ordering of  
data



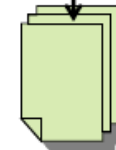
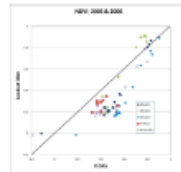
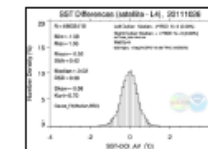
Co-register  
satellite and in situ  
data



Analysis of  
satellite and in situ  
data



Generate  
statistics, charts  
and reports



Review by  
cal/val teams.  
Product  
algorithm  
updates.



# Land Product Characterization System (LPCS)

What is LPCS

Highlights of LPCS

1. **Inventory & Ordering**
2. Analysis Tools

Path Forward

1. Status and Readiness
2. CEOS LPV collaboration

Summary

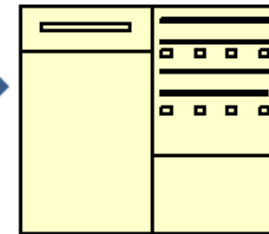
# Inventory and Ordering

## GOES-R ABI and VIIRS Land Product Validation System

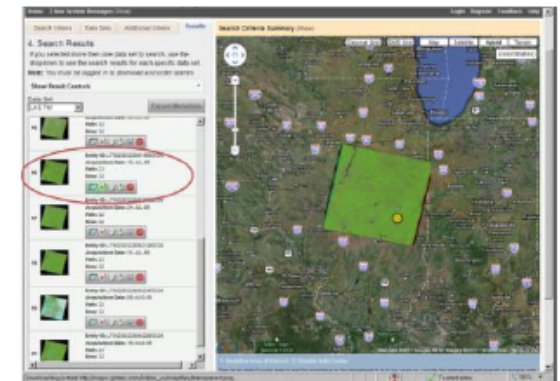
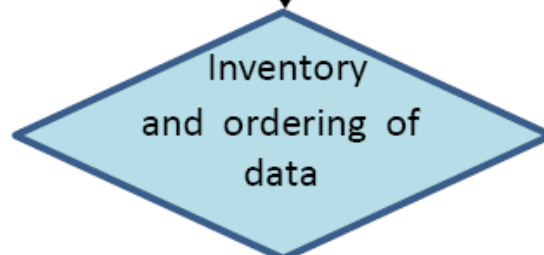


NPP & JPSS VIIRS  
GOES-R ABI  
Landsat-7 & -8  
MODIS  
Sentinel-2  
others..  
& In Situ

On demand data acquisition  
Automated data acquisitions



Data and  
Inventory  
information  
stored at  
EROS.



# Inventory and Ordering

Begin at Search Criteria and Data Select tabs of LPCS.

*Included data sets not arbitrary.*

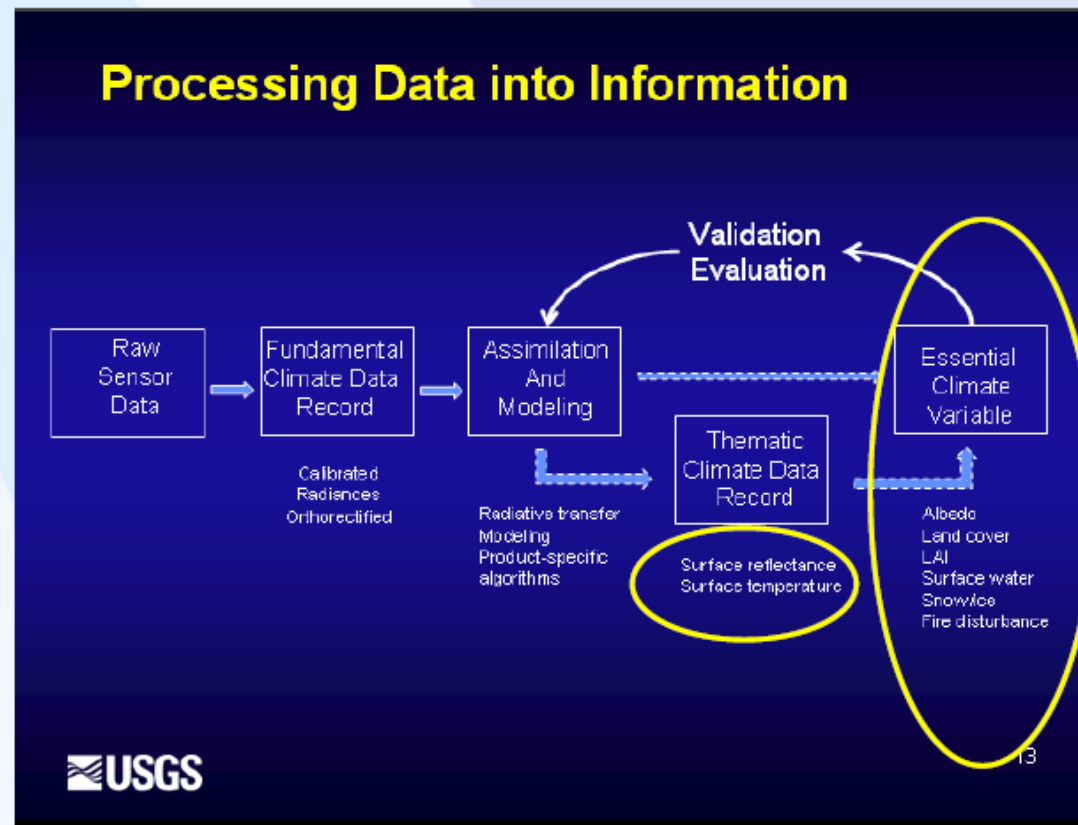
The screenshot displays the Land Product Characterization System (LPCS) web interface. The header includes the LPCS logo, the USGS logo with the tagline "science for a changing world", and a satellite image. Navigation links for "USGS Home", "Contact USGS", and "Search USGS" are in the top right. A "Page Expires In 1:59:07" timer is also present. The main navigation bar contains "Home", "Login", "Register", "RSS", "Feedback", and "Help". Below this, a secondary navigation bar has "Search Criteria", "Data Sets", "Additional Criteria", and "Results" tabs. The "Data Sets" tab is active, showing a section titled "2. Select Your Data Set(s)" with instructions: "Check the boxes for the data set(s) you want to search. When done selecting data set(s), click the *Additional Criteria* or *Results* buttons below. Click the plus sign next to the category name to show a list of data sets." A checkbox for "Use Data Set Prefilter" with a link "(What's This?)" is available. Below is a "Data Set Search:" input field. A tree view on the left lists data categories: "GOES-R" (with "ABI" and "Simulated GOES-R ABI (5/30/2013-6/30/2013)"), "Landsat Archive" (with "Landsat Surface Reflectance - L8 OLI/TIRS", "Landsat Surface Reflectance - L7 ETM+", and "Landsat Surface Reflectance - L4-5 TM"), "NASA LPDAAC Collections (MODIS)" (with "MODIS Vegetation Indices" and "MODIS Land Surface Reflectance"), and "VIIRS" (with "NASA" and "NOAA"). On the right, a "Search Criteria Summary (Show)" section includes a "Clear Criteria" button and a map. The map shows North America with a selected area in the Pacific Northwest, displaying coordinates "(53° 26' 08\" N, 155° 33' 59\" W)" and buttons for "Map", "Satellite", "Options", and "Overlays".

# Inventory and Ordering

## USGS-NOAA validation synergy

### USGS Requirements

- Landsat ECVs



### USGS ECVs

- Albedo
- Land Cover
- LAI
- Surface Water
- Snow/Ice
- Fire disturbance
- LST

# USGS-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

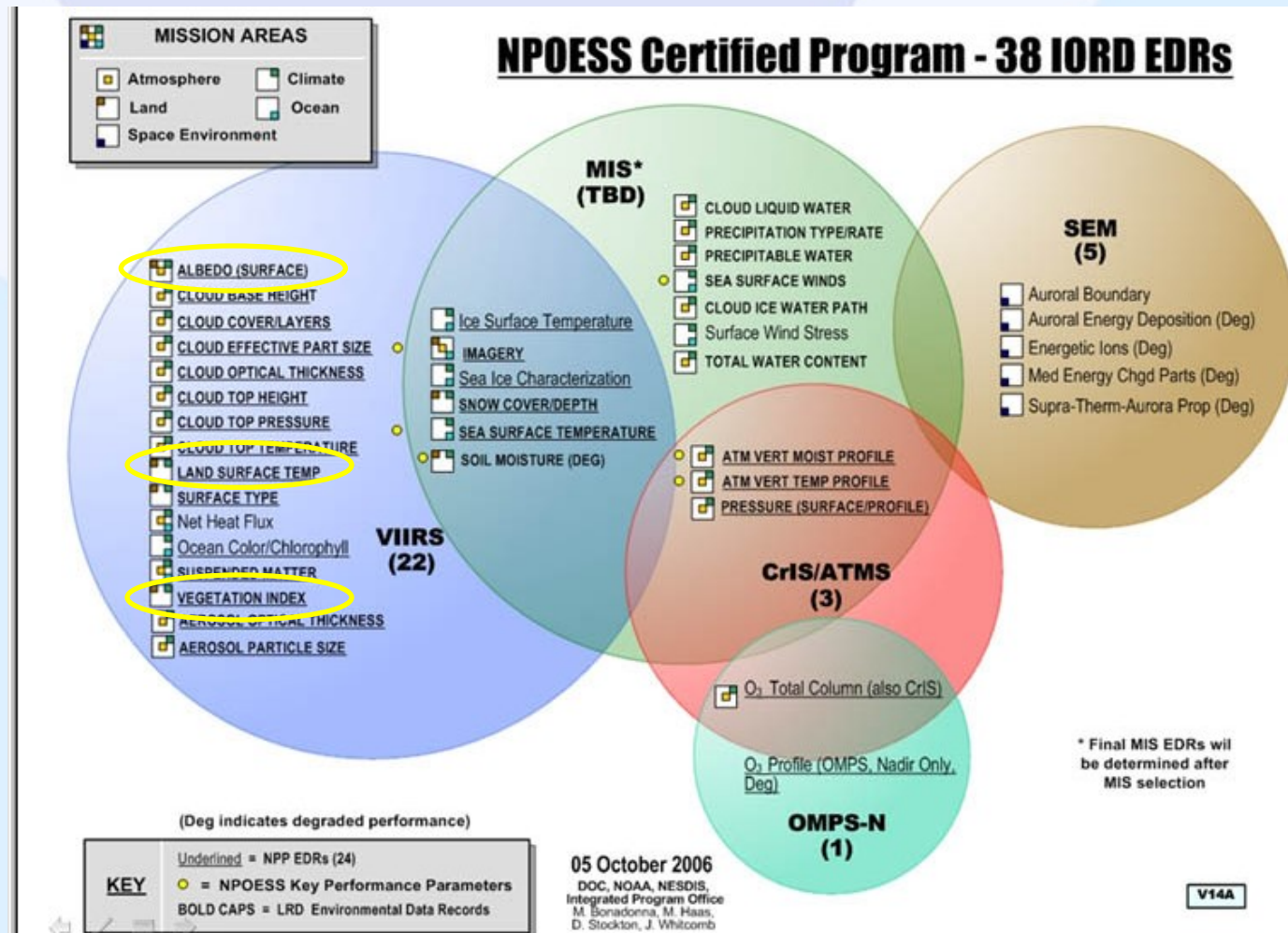
## OPTION 2 PRODUCTS

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



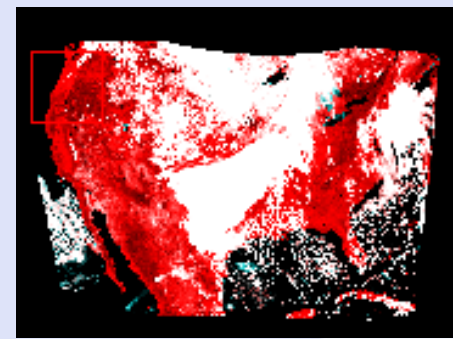
# USGS-NOAA validation synergy

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



# Inventory and Ordering

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



LPVS

USGS

Land Product Validation System

science for a changing world



USGS Home  
Contact USGS  
Search USGS

Land Product Validation System (LPVS) - Devsys

HomeLoginRegisterRSSFeedbackHelp

Search CriteriaData SetsAdditional CriteriaResults

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/PlacePath/RowFeatureCircle

ShowClear

CoordinatesPredefined AreaShapefileKML

Degree/Minute/SecondDecimal

1. Lat: 47° 09' 35" N, Lon: 124° 48' 16" W

2. Lat: 48° 34' 29" N, Lon: 116° 11' 29" W

3. Lat: 41° 06' 45" N, Lon: 117° 04' 13" W

4. Lat: 40° 26' 48" N, Lon: 123° 55' 32" W

Use MapAdd CoordinateClear Coordinates

Date RangeResult Options

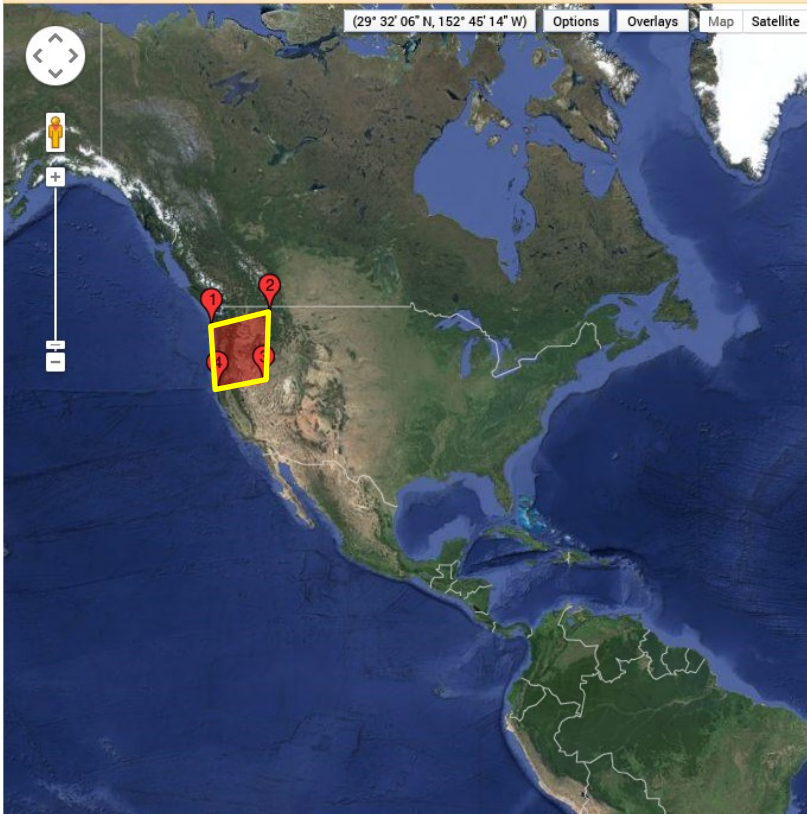
Search from: 04/23/2013 to: 04/23/2013

Search months: (all)

Data Sets »Additional Criteria »Results »

Search Criteria Summary (Show)Clear Criteria

(29° 32' 06" N, 152° 45' 14" W)OptionsOverlaysMapSatellite

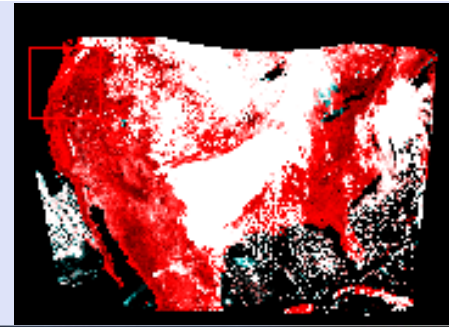


15



# Inventory and Ordering

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



**LPVS**  **USGS**  
science for a changing world  
**Land Product Validation System**

**Land Product Validation System (LPVS) - Devsys**

[USGS Home](#) [Contact USGS](#) [Search USGS](#)

Search Criteria | Data Sets | Additional Criteria | **Results**

### 4. Search Results

If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

**Note:** You must be logged in to download and order scenes

Show Result Controls

Data Set [Click here to export your results »](#)

L8 OLI/TIRS

3		Coordinates: 41.75975,-122.29287 Acquisition Date: 23-APR-13 Path: 45 Row: 31
4		Entity ID: LC80450272013113LGN01 Coordinates: 47.4492,-120.26091 Acquisition Date: 23-APR-13 Path: 45 Row: 27
5		Entity ID: LC80450282013113LGN01 Coordinates: 46.02972,-120.79977 Acquisition Date: 23-APR-13 Path: 45 Row: 28
6		Entity ID: LC80450292013113LGN01 Coordinates: 44.6082,-121.3167 Acquisition Date: 23-APR-13 Path: 45 Row: 29
		Entity ID: LC80450322013113LGN01 Coordinates: 40.33251,-122.75571

**Search Criteria Summary (Show)** [Clear Criteria](#)

British Columbia (52° 24' 08" N, 107° 39' 57" W) Options Overlays Map Satellite



Google

Map data ©2013 Google, INEGI Imagery ©2013 TerraMetrics 200 km Terms of Use

The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

# Inventory and Ordering

## Define Output Products

Choose higher level products from selected data. *Additional ECVs and CDRs will be added to menu as available.*

### Select Product Contents

Source Products	
<input type="checkbox"/>	<a href="#">Source Products</a>
<input type="checkbox"/>	<a href="#">Source Metadata</a>

Climate Data Records	
<input type="checkbox"/>	<a href="#">Top of Atmosphere Reflectance</a>
<input type="checkbox"/>	<a href="#">Surface Reflectance</a>
<input type="checkbox"/>	<a href="#">Band 6 Brightness Temperature</a>

Spectral Indices	
<input type="checkbox"/>	<a href="#">Surface Reflectance NDVI</a>
<input type="checkbox"/>	<a href="#">Surface Reflectance NDMI</a>
<input type="checkbox"/>	<a href="#">Surface Reflectance NBR</a>
<input type="checkbox"/>	<a href="#">Surface Reflectance NBR2</a>
<input type="checkbox"/>	<a href="#">Surface Reflectance SAVI</a>
<input type="checkbox"/>	<a href="#">Surface Reflectance EVI</a>

Other Products	
<input type="checkbox"/>	<a href="#">CFMask (standalone file)</a>
<input type="checkbox"/>	<a href="#">Solr Index</a>

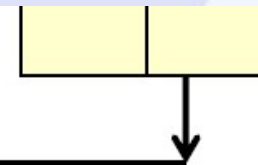
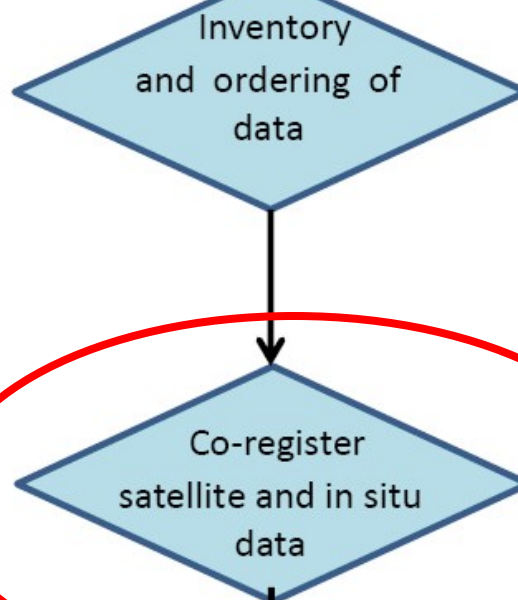
Product Customization	
-----------------------	--



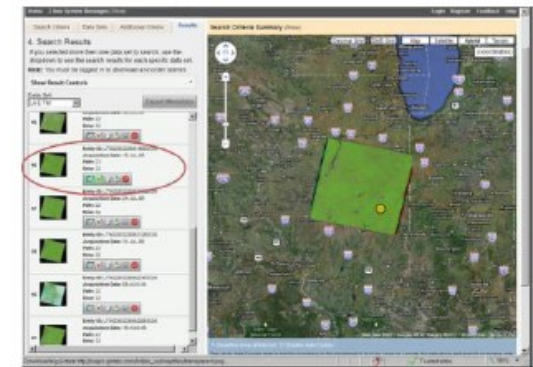
# Inventory and Ordering

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

Additional Analysis



stored at  
EROS.



# Inventory and Ordering

## Define Output Products *Product Customization*

- 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

Product Customization

1

Reproject Products

Projection: 

Geographic

Geographic

Albers Equal Area

Sinusoidal

Universal Transverse Mercator

2

Modify Image

Upper left X coordinate

Upper left Y coordinate

Lower right X coordinate

Lower right Y coordinate

3

Pixel Resizing

Meters

4

Resample Method: 

Nearest Neighbor

Nearest Neighbor

Bilinear Interpolation

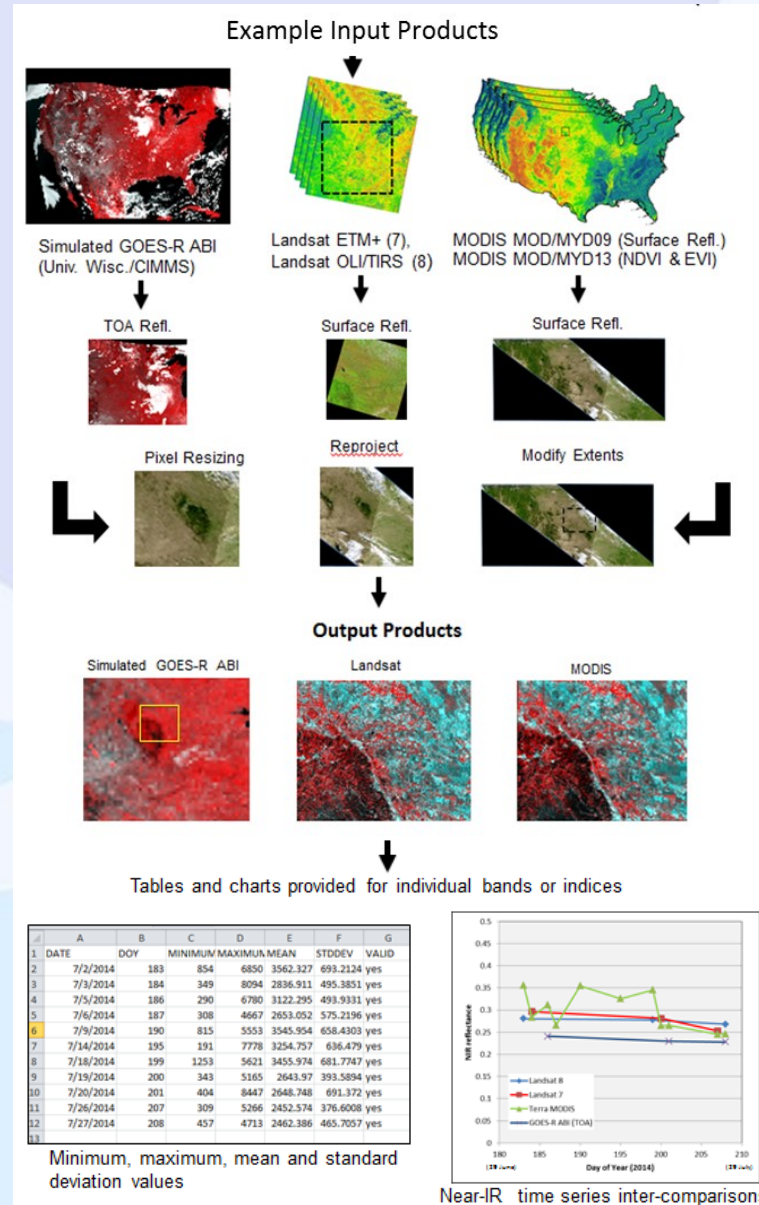
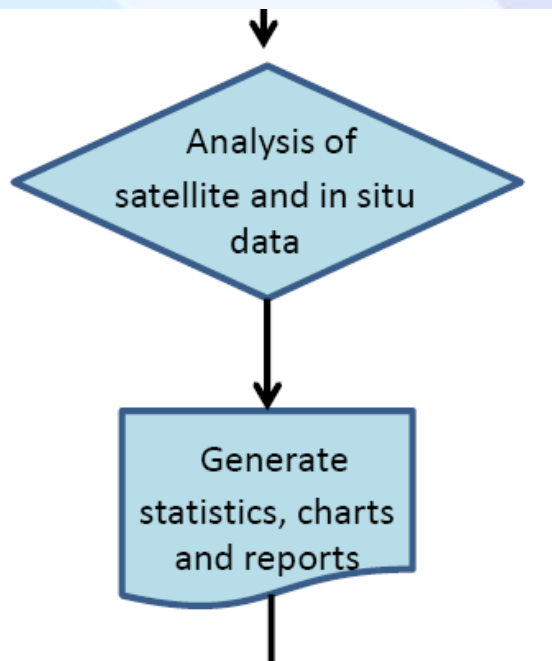
Cubic Convolution

Order Description (optional)

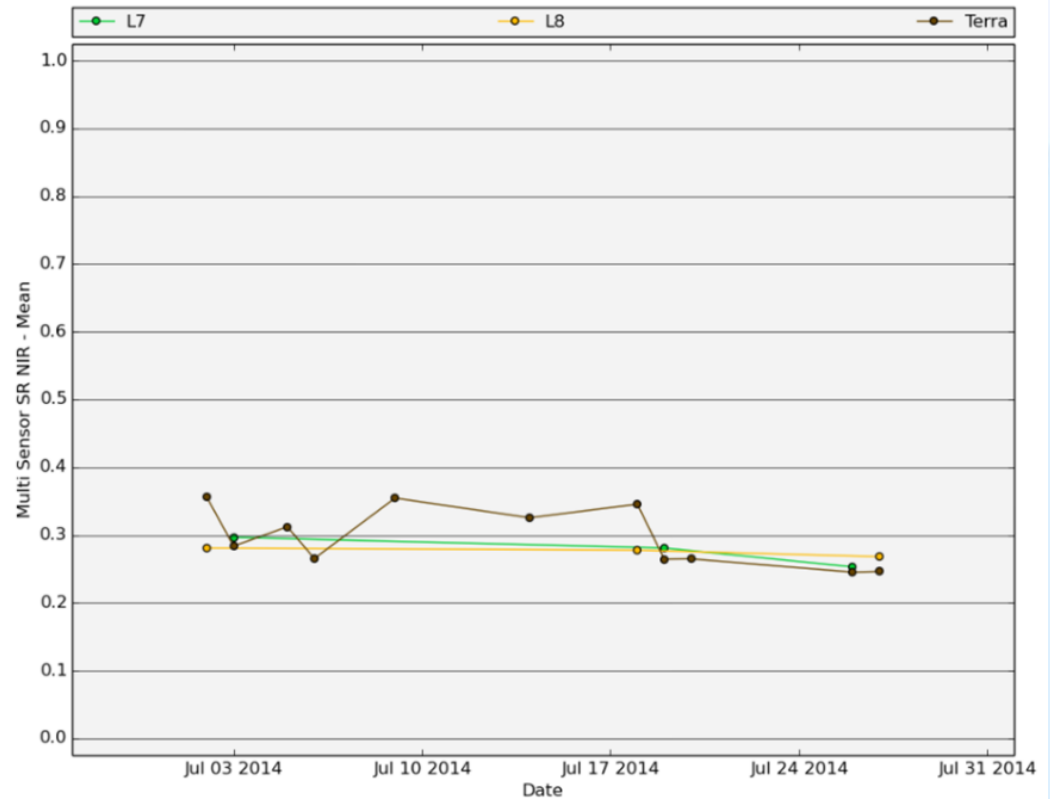
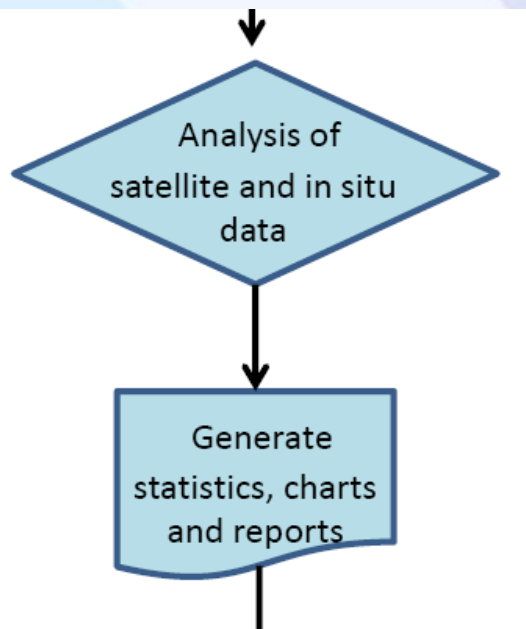
Submit



# Analysis Tools

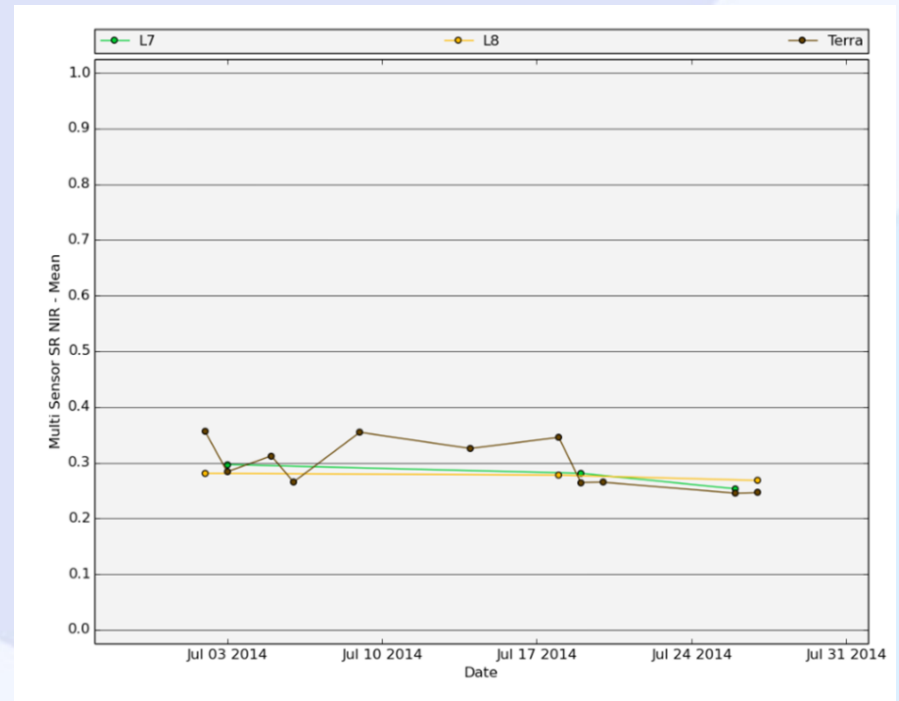
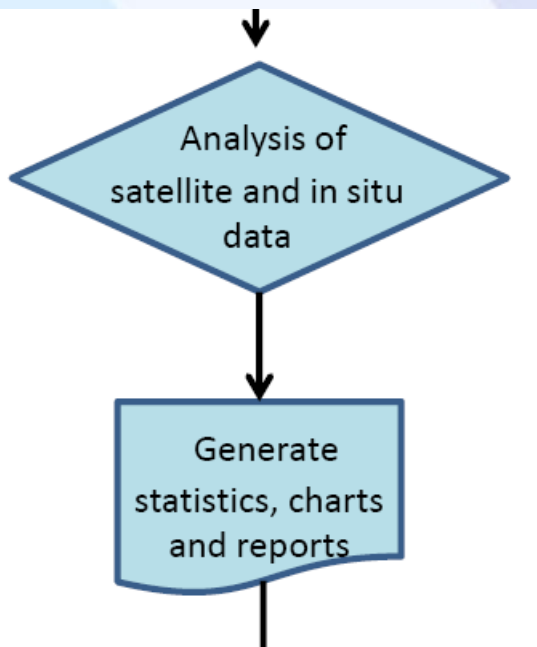


## Analysis Tools



*Near-IR Surface Reflectance (L7, L8, and Terra/MODIS).*

# Analysis Tools



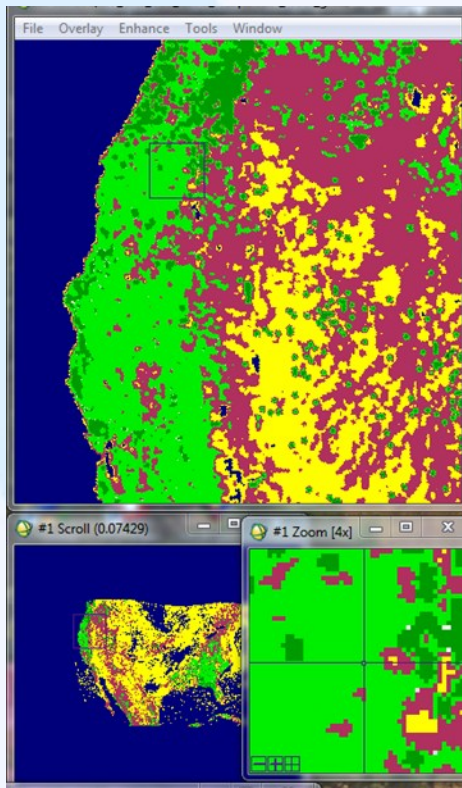
	A	B	C	D	E	F	G
1	DATE	DOY	MINIMUM	MAXIMUM	MEAN	STDDEV	VALID
2	7/2/2014	183	854	6850	3562.327	693.2124	yes
3	7/3/2014	184	349	8094	2836.911	495.3851	yes
4	7/5/2014	186	290	6780	3122.295	493.9331	yes
5	7/6/2014	187	308	4667	2653.052	575.2196	yes
6	7/9/2014	190	815	5553	3545.954	658.4303	yes
7	7/14/2014	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							



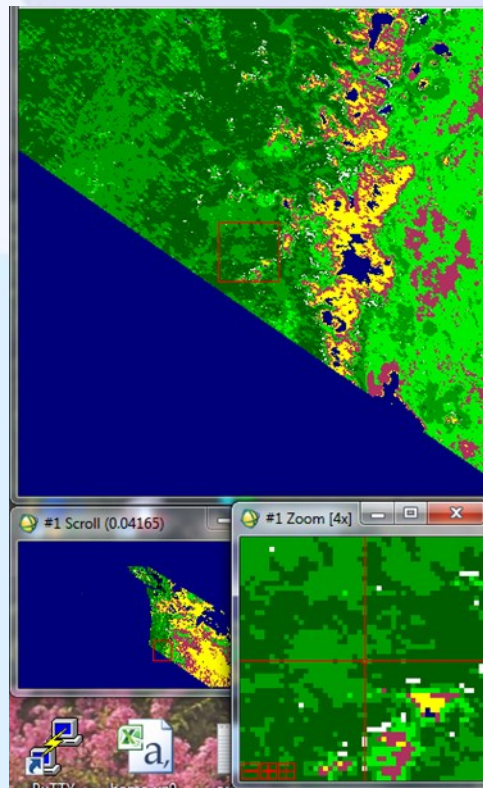
## Analysis Tools

LPCS also provides as output products the georegistered images selected for analysis.

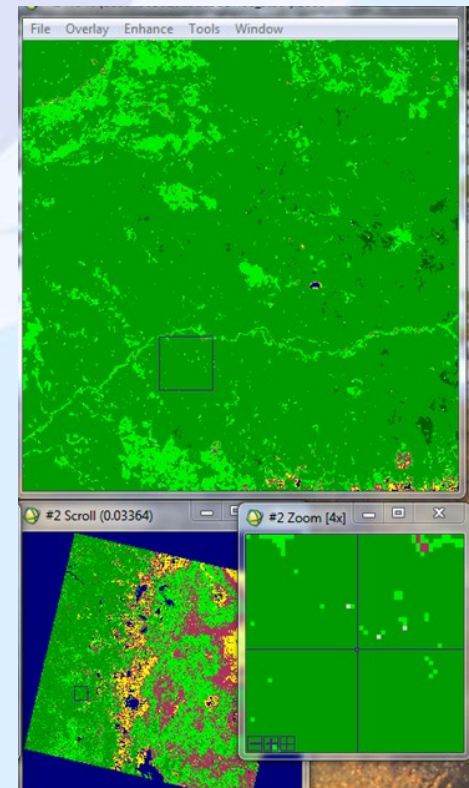
Simulated GOES-R ABI



VIIRS



Landsat 8

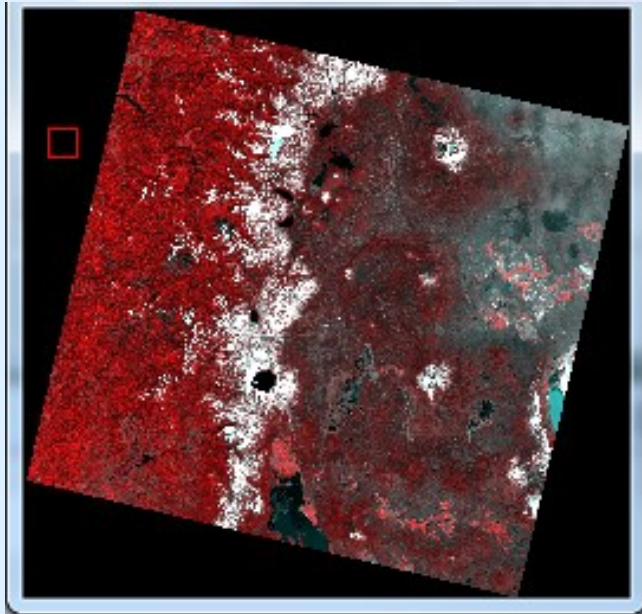


## Analysis Tools

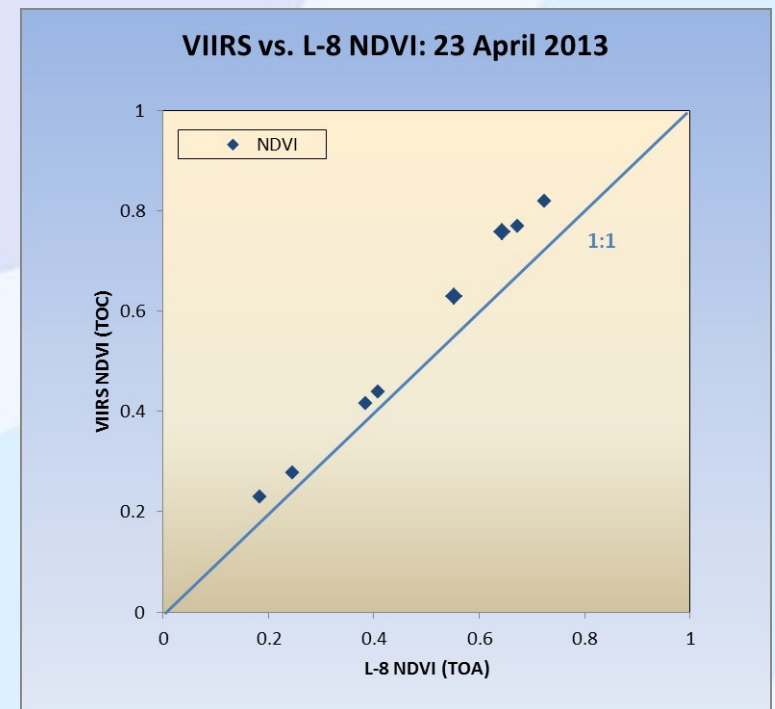
### Example of Potential Analysis

*VIIRS (TOC) NDVI* compared to *Landsat-8 (TOA) NDVI*

Each point within figures represents 100 km<sup>2</sup> sample area.



Landsat 8: 23 April 2013, NW USA.



# 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**

- 1. Status and Readiness**
2. CEOS LPV collaboration

Summary

## LPCS Status and Readiness

Current: Users access system, order and download data, and retrieve downloaded data into processing subsystem.

Future (*September 2016*):  
Seamless ordering and processing of data.



**Add Input Products ([Show Available Products](#))**

**Scene List**

[Choose File](#) No file chosen

**Select Product Contents**

**Source Products**

- ☐ Original Input Products
- ☐ Original Input Metadata
- ☐ Customized Input Products

**Additional Processing (Landsat Only)**

**Climate Data Records**

- ☐ Top of Atmosphere Reflectance
- ☐ Surface Reflectance
- ☐ Brightness Temperature

**Spectral Indices**

- ☐ Surface Reflectance NDVI
- ☐ Surface Reflectance NDMI
- ☐ Surface Reflectance NBR
- ☐ Surface Reflectance NBR2
- ☐ Surface Reflectance SAVI
- ☐ Surface Reflectance MSAVI
- ☐ Surface Reflectance EVI



## LPCS Status and Readiness

Introduction of future *data sets* and *analysis tools* within LPCS are planned, however, require additional resources.

### Current



**Landsat 8**



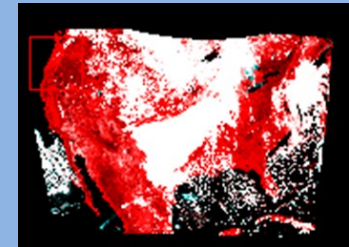
### Future



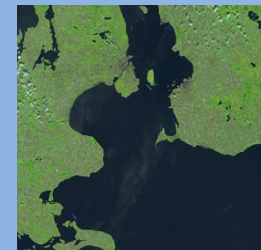
Joint Polar Satellite System  
(JPSS) Visible Infrared Imaging  
Radiometer Suite (VIIRS)



NOAA-NASA Geostationary  
Operational Environmental  
Satellites - R Series (GOES-R)



European Space Agency  
(ESA) Sentinel-2



**sentinel-3**

→ GMES MEDIUM RESOLUTION LAND AND OCEAN MISSION



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1. Inventory & Ordering
2. Analysis Tools

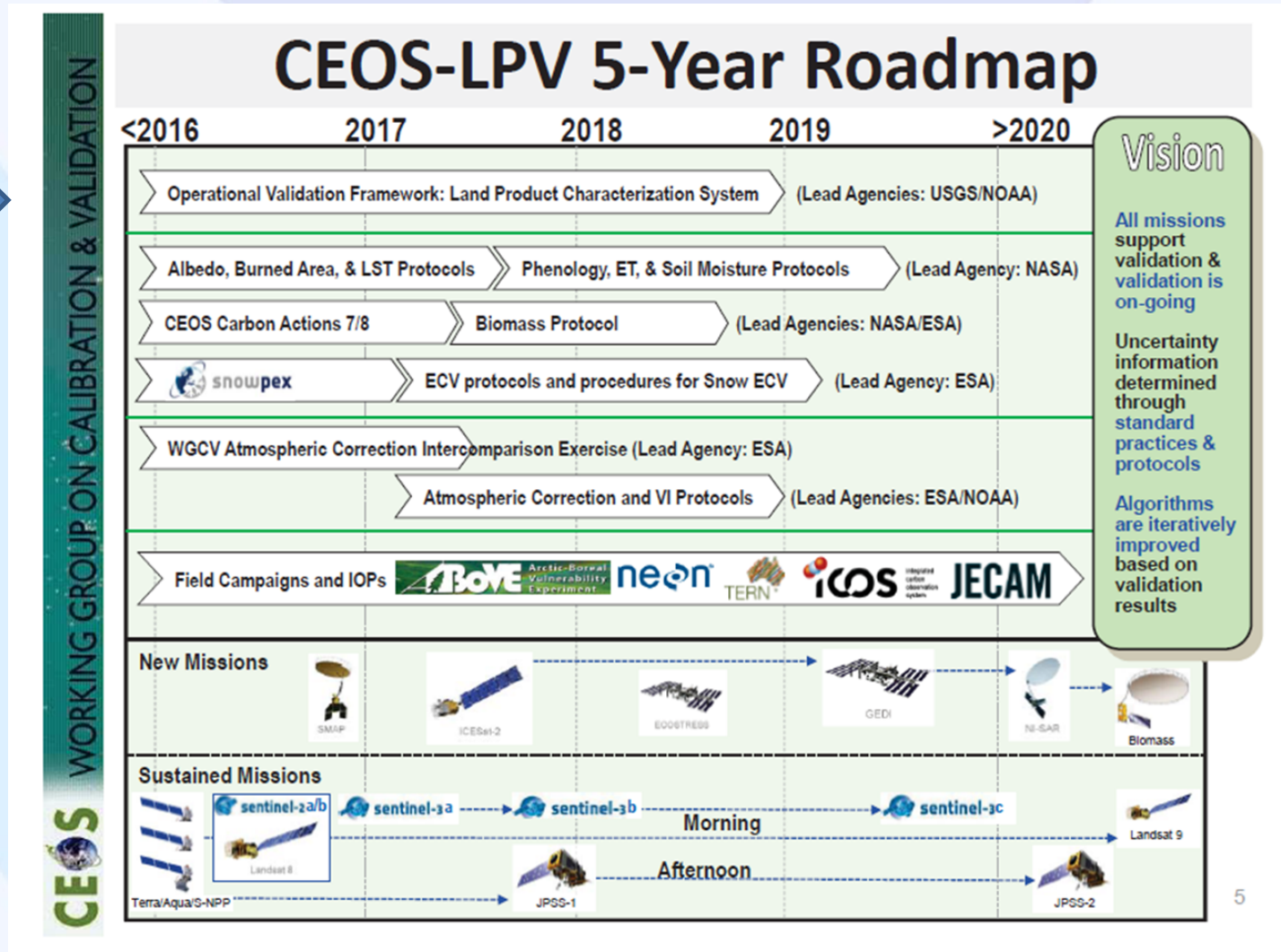
**Path Forward**

1. Status and Readiness
- 2. CEOS LPV collaboration**

Summary

# CEOS LPV collaboration

LPCS proposed/accepted as CEOS-LPV Online Validation Tool.





# CEOS LPV collaboration

Albedo will be added to LPCS as requested by CEOS-LPV.

# LP DAAC

LAND PROCESSES DISTRIBUTED ACTIVE ARCHIVE CENTER

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[Home](#) > [MODIS](#) > [MODIS Products Table](#) > [MCD43A3](#)

## Albedo 16-Day L3 Global 500m

### MCD43A3

The MODerate-resolution Imaging Spectroradiometer (MODIS) Albedo product (MCD43A3) provides 500-meter data describing both directional hemispherical reflectance (black-sky albedo) and bihemispherical reflectance (white-sky albedo). The MCD43A3 product contains 16 days of data provided in a level-3 gridded data set in Sinusoidal projection.

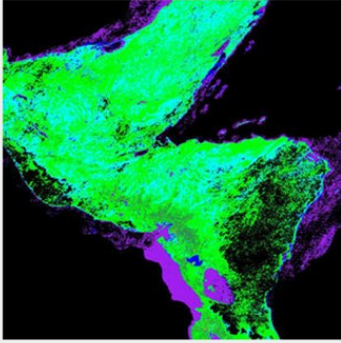
Both Terra and Aqua data are used to generate this product, providing the highest probability for quality input data and designating it as an MCD, meaning Combined product.

Version-5 MODIS BRDF & Albedo products have attained Validation Stage 3.

#### Change Points of Interest

- 500m product now available
- Quality information stored as a separate product (MCD43A2)
- Reduced file volume: internal compression
- Phased production strategy: Produced every 8 days with 16 days of acquisition (i.e., production period 2001001 includes acquisition between Days 001 and 016, production period 2001009 includes acquisition between Days 009 and 024)
- More: Collection 005 Change Summary for MODIS BRDF/Albedo (MCD43) Algorithms ([PDF](#))

Short Name: MCD43A3




This is a representation of the first of the three model parameters used to reconstruct surface anisotropic effects and correct directional reflectances to a common view geometry, or to compute integrated albedos. The colors describe isotropic weighting parameters for data acquired between February 26 and March 13, 2001 over Central America, including the Yucatan Peninsula, El Salvador, Honduras, Nicaragua, and some of Costa Rica (h09v07).

[Version 005](#)

# CEOS LPV collaboration

Additional analysis tools also requested by CEOS-LPV.



The screenshot shows the LP DAAC (Land Processes Distributed Active Archive Center) website. The header features the LP DAAC logo, NASA and USGS logos, and navigation links: Home, About, Dataset Discovery, Citing Our Data, Tools (selected), User Resources, and User Services. A search bar and a 'Login with URS' button are also present. The breadcrumb trail indicates the path: Home > Tools > LDOPE Tools.

## LDOPE Tools

The Land Data Operational Products Evaluation ([LDOPE](#)) facility, collocated with the MODIS Adaptive Processing System (MODAPS) at the Goddard Spaceflight Center (GSFC), is responsible for the overall coordination of the QA activities in support of the MODIS Science Team.

LDOPE develops and maintains a number of software tools designed to manipulate, visualize, and analyze MODIS data. A subset of LDOPE QA tools is available to the user community to help parse and interpret the QA Science Dataset (SDS) layers. Written in C, they are executed either from the command-line or invoked via scripts. These tools, numbering about two-dozen, are provided as command-line executables and source code. Previously, a number of platforms were supported. The new release (version 1.7) consolidates the availability of the software in Windows, Linux and Mac OSX operating systems. While the User Manual is in the process of being updated, a shorter set of instructions is available to help users install the tools and get started. The syntax descriptions and examples provided in the User Guide are still valid, and users are advised to consult them for further insight.

No distribution or re-use constraints associated with this software exists. Users and developers using or modifying this software should credit the original authorship for these tools. Please acknowledge the use of these tools, including use of significant code fragments taken from the source code, with a sentence such as "Software tools provided by the MODIS land quality assessment group (Roy et al. 2002)".

Roy, D.P., Borak, J.S., Devadiga, S., Wolfe, R.E., Zheng, M., Descloitres, J., 2002, The MODIS Land Product Quality Assessment Approach, *Remote Sensing of Environment*, 83, 62-76.

### Download

Please log in to download files.

- [Windows 32 bit](#)
- [Windows 64 bit](#)
- [LDOPE-1.7-linux-32-installer.run.zip](#)
- [LDOPE-1.7-linux-64-installer.run.zip](#)
- [Mac OSX](#)
- [Test code](#)

### Manuals

- [Users Manual](#)
- [Installation Instructions for LDOPE Tools](#)
- [L2G\\_Lite\\_Tool\\_Doc](#)
- [Comp\\_SDS\\_Diff\\_Tool\\_Doc](#)

# Land Product Characterization System (LPCS)

What is LPCS

Why LPCS developed/hosted at EROS

Highlights of LPCS

1. Inventory & Ordering
2. Analysis Tools

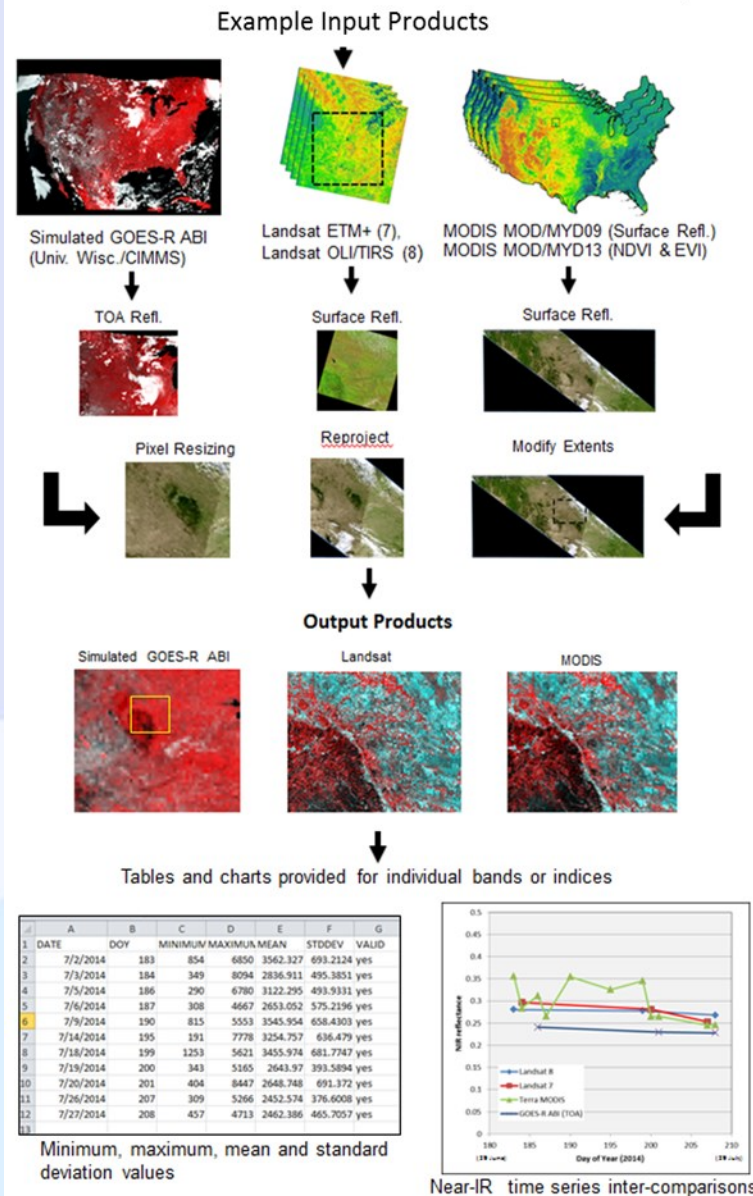
Path Forward

1. Status and Readiness
2. Expectations for User Interactions

**Summary**

## Summary

A web-based system designed for comparative analysis of satellite data and higher-level land products.



Questions?