iGETT and GeoTech Partnership: Online Resources for Teaching and Using Remote Sensing

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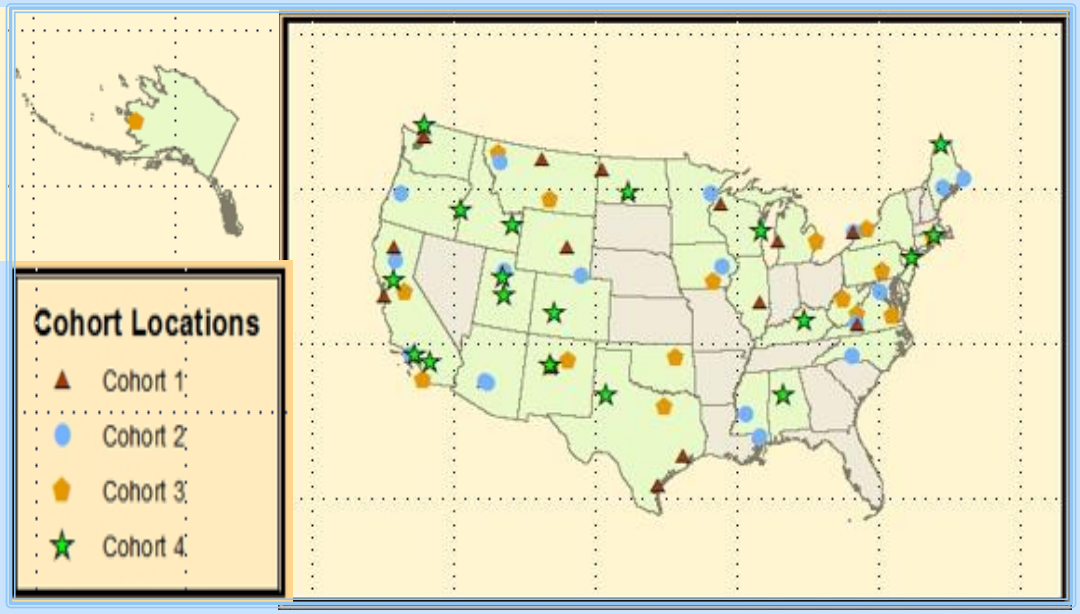
iGETT Remote Sensing Education



NSF Funded Project Hosted by NCGE with support from NASA, USGS, Esri and ITVis – 2007 to 2017

- Partnering with GeoTech

Cohorts 1 & 2

iGETT Staff

- Faculty development for educators teaching GIS but wanting to integrate remote sensing into programs
- Faculty participants created Exercises and Concept Modules

Cohorts 3 & 4

Resources Cohort Participants created:

Student Exercises:

Student Handouts

- step by step or workflow
- Basic to Intermediate Level.
- Assume student “knows” ArcGIS
- Based on “**Real World**” problems
- Most use Landsat data, some Lidar

Concept Modules:

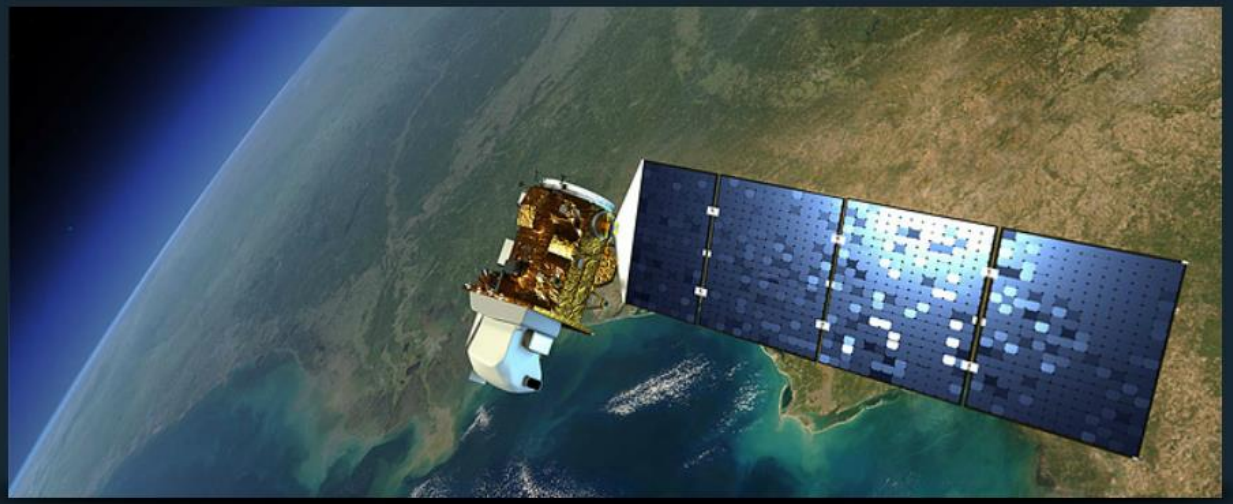
YouTube videos illustrating one remote sensing concept or technique.

Videos posted on YouTube at iGETT Remote Sensing Education Channel

www.igettremotesensing.org

Integrated Geospatial Education and Technology Training

HOME | ABOUT | RESOURCES FOR INSTRUCTION | WEB RESOURCES | PHOTO GALLERY | CONTACT US

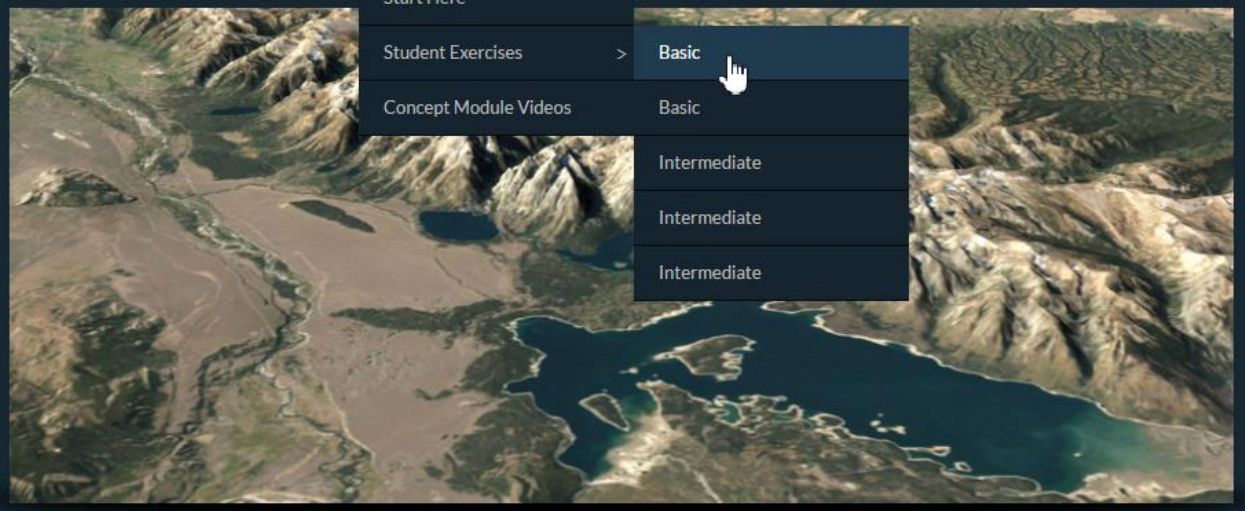


This website provides access to instructional resources (PowerPoint presentations, student exercises and videos) useful for teaching introductory courses (and course modules) in remote sensing and for integrating remote sensing in in geospatial programs. The resources were developed by two consecutive projects, with funding from the National Science Foundation's Advanced Technological Education Program to the National Council for Geographic Education. Integrated Geospatial Education and Technology Training (iGETT) was funded in 2007 and iGETT: Remote Sensing in 2012 (award numbers DUE 0703185 and 1205069). The second project addressed specific newly identified workforce competencies for remote sensing technicians.

The projects were designed to help meet the demand for modern technician-level geospatial technology education by providing both instructional resources and professional development, with a special focus on the needs of two-year colleges. To date, 78 faculty from across the country have participated in the program, which includes two summer institutes and regular webinars over an 18-month period. The participants develop the [illegible] their culminating experience with the project. The last of four faculty cohorts will [illegible]dded to the website as they are finalized.

www.igettremotesensing.org

Integrated Geospatial Education and Technology Training



This section contains the following instructional resources:

- beginner, intermediate and advanced student exercises.
- short videos (concept modules) that explain remote sensing concepts.
- web links for downloading data Landsat data-essential information for doing the student exercises.

A thumbnail description provides an overview of each student exercise. Click on the thumbnails to enlarge them, and click on the blue buttons below the thumbnails to acquire the exercises.

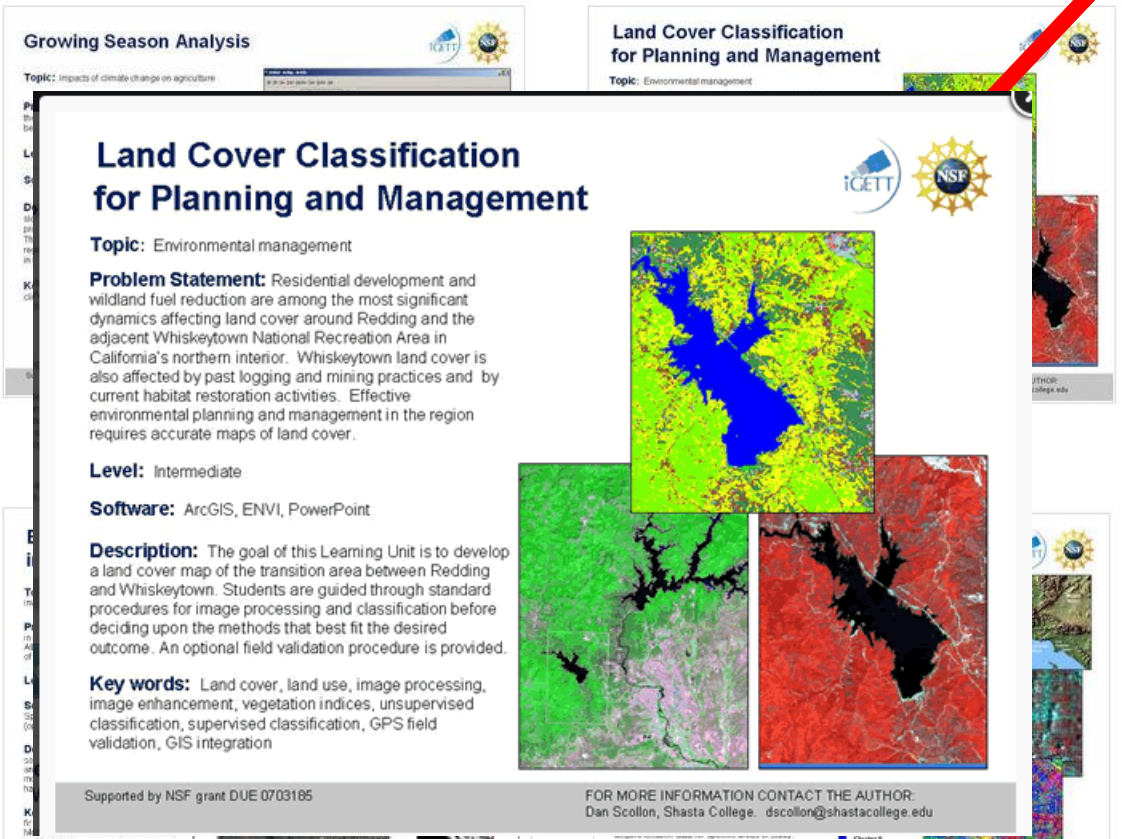
The exercises will download as PDF files. They may be converted to Word Documents and modified, for instructional purposes only, with attribution to the original authors and the National Science Foundation grant number noted on each thumbnail.

Click on the link below for information about downloading Landsat data. Refer students to this site when assigning exercises.

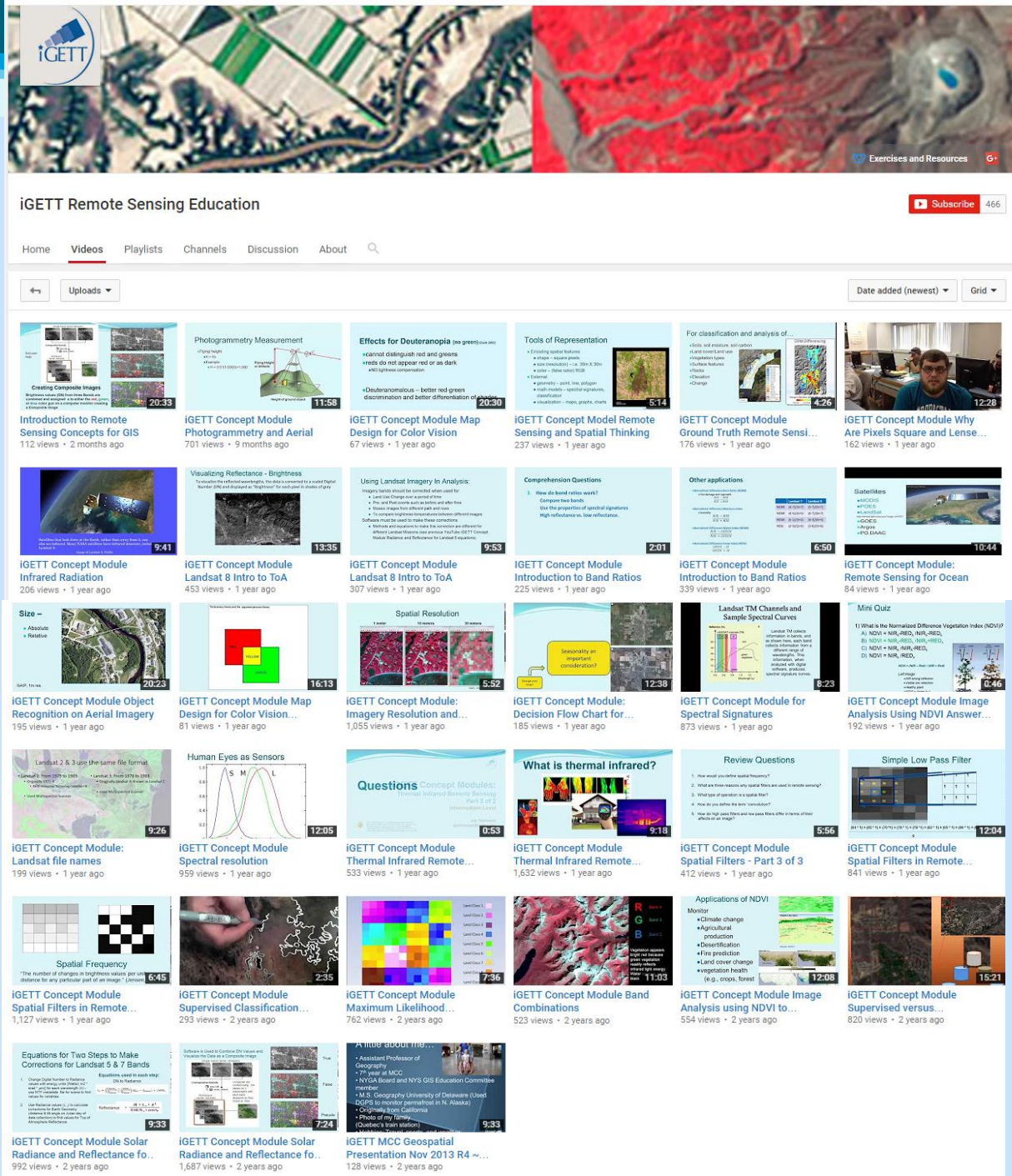
ATA DOWNLOAD INSTRUCTIONS

Integrated Geospatial Education and Technology Training

HOME ABOUT RESOURCES FOR INSTRUCTION WEB RESOURCES PHOTO GALLERY CONTACT US

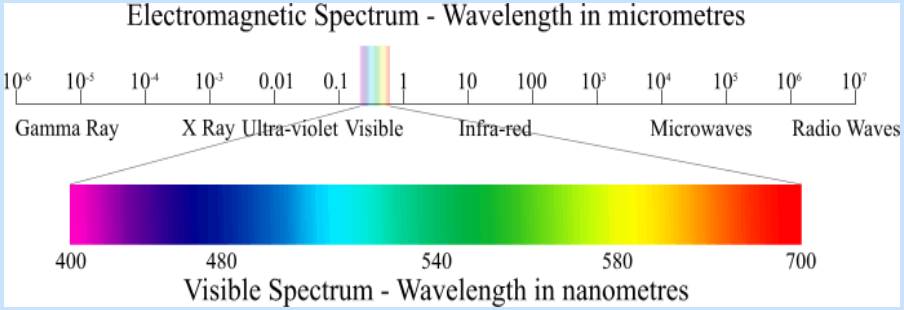


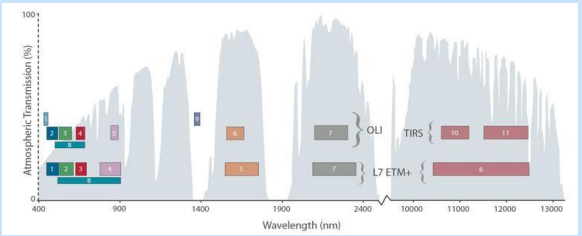
From the YouTube iGETT Remote Sensing Education Channel

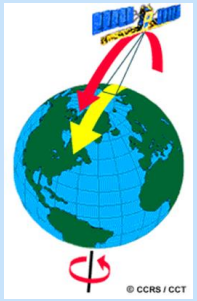


Concept Modules Cover:

Remote Sensing Concepts and Techniques and how to acquire and analyze data!







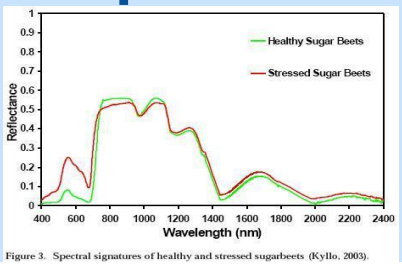
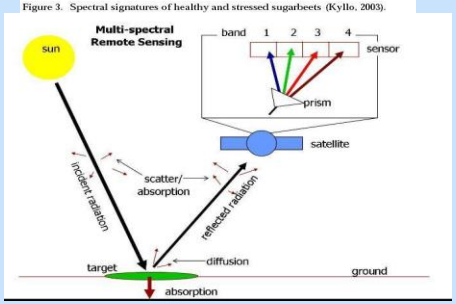
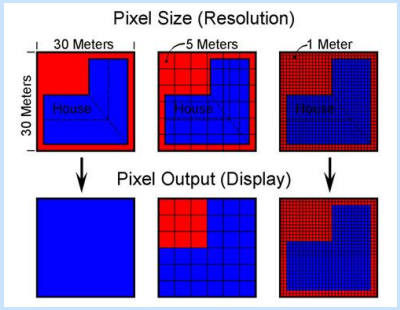
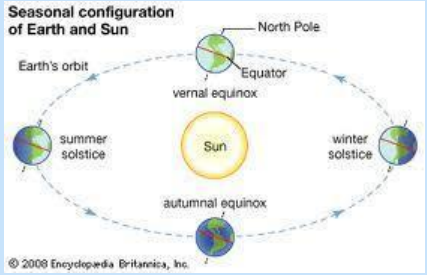


Figure 3. Spectral signatures of healthy and stressed sugarbeets (Kyllo, 2003).







Normal Workflow For Remote Sensing Analysis Using Landsat Imagery

- Identify a problem you want to investigate
  - Find study area location and determine its Landsat path and row
  - Determine how many scenes and what dates are needed
- Go to website for imagery data and determine if dates are available
  - if not available, reevaluate needed data that can "work" for project analysis
- Download imagery data – up to 1 GB per Landsat scene
- Unzip data twice and store all bands in folders
- Create a Project and add imagery data
- Mosaic and Clip imagery bands to study area
- Create composites of each scene (natural, false, pseudo)
- Create signature graphs to identify features (urban, soil, vegetation, etc.)
- Start analysis (NDVI, Classification, ...)

This process can take days!

How about spending an hour or two to ***quickly*** introduce remote sensing and Landsat? You can, with

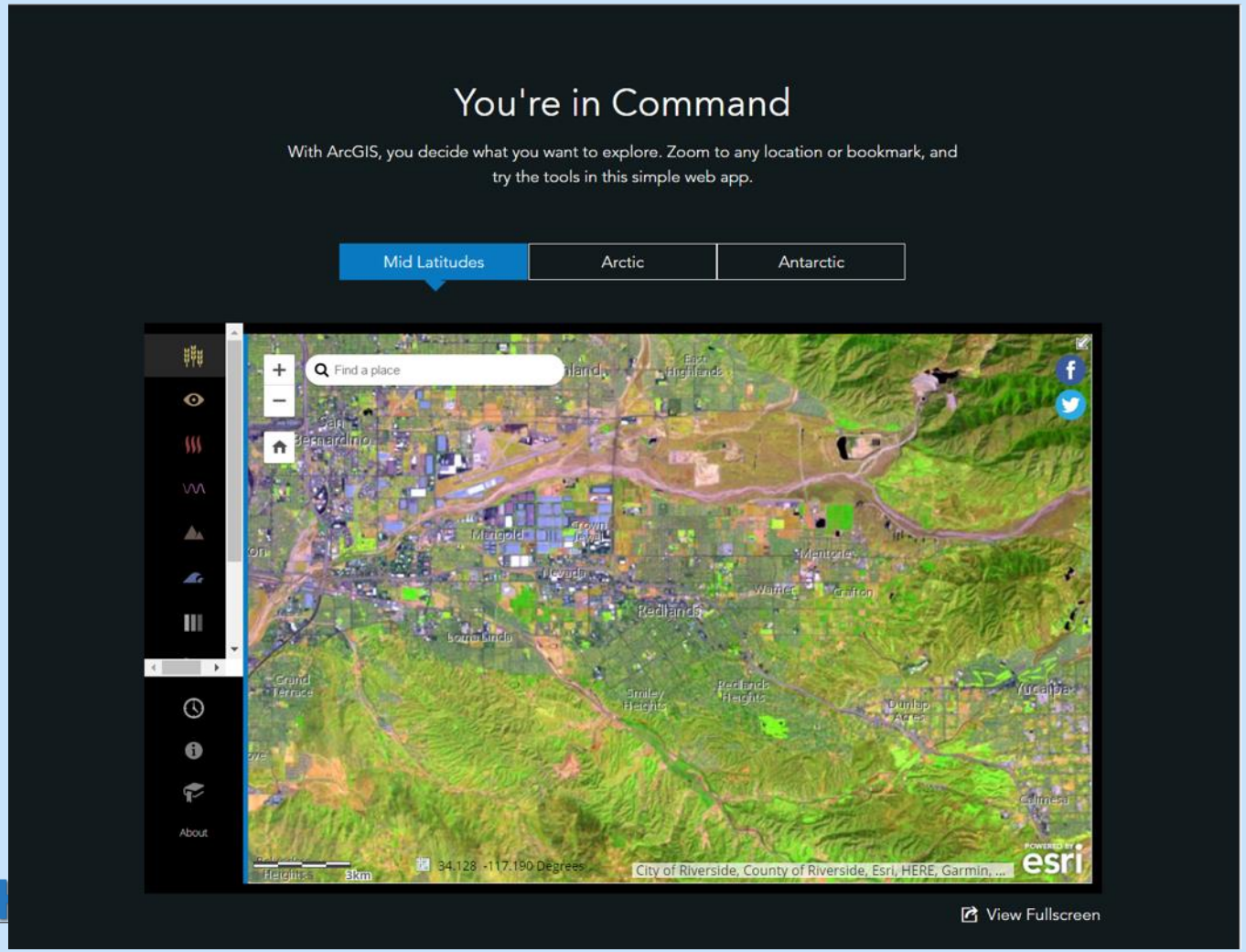
Unlock Earth's Secrets and Landsat Explorer

from Esri at
www.esriurl.com/LandsatOnAWS

Esri's Unlock Earth's Secrets AWS App Uses data from Landsat 8

This is the "default" opening location – Redlands, California using "Agriculture"

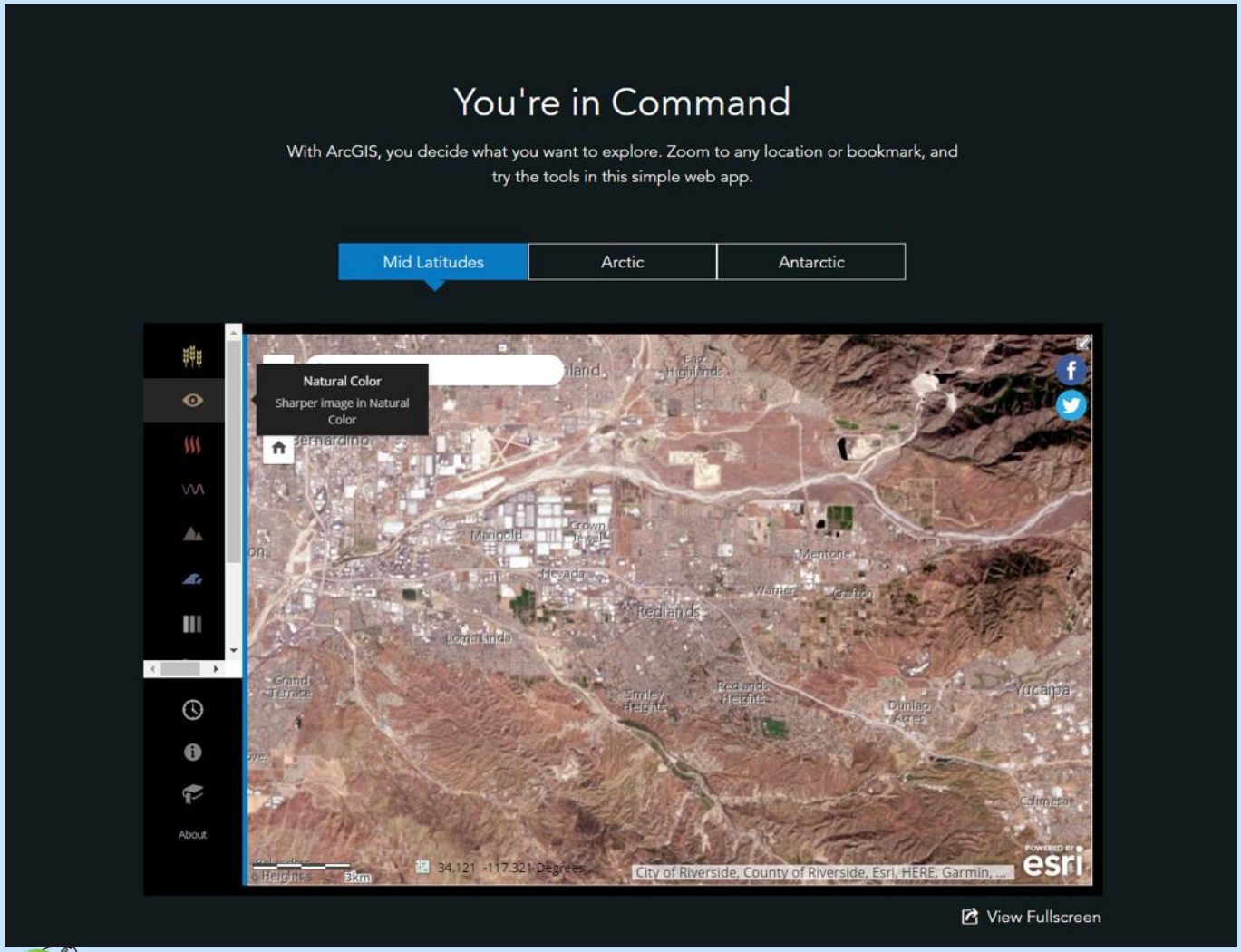
You can change to Any Place!



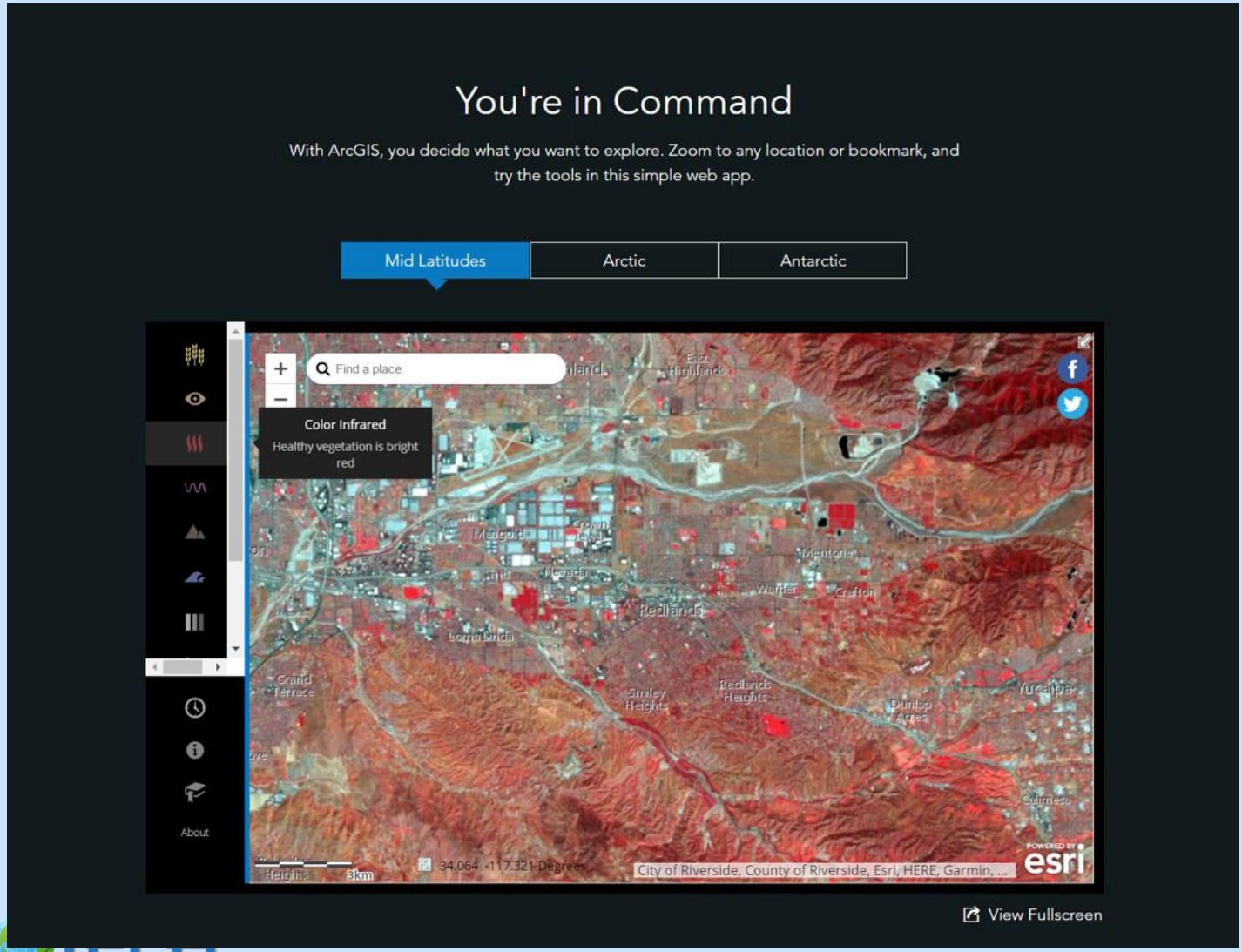
Key For Buttons: Landsat 8 Bands

- •Agriculture: Highlights agriculture in bright green. Bands 6,5,2
- •Natural Color: Sharpened with 15m panchromatic band. Bands 4,3,2+8
- •Color Infrared (False Color): Healthy vegetation is bright red. Bands 5,4,3
- •SWIR (Short Wave Infrared): Highlights rock formations. Bands 7,6,4
- •Geology: Highlights geologic features. Bands 7,4,2
- •Bathymetric: Highlights underwater features. Bands 4,3,1
- •Panchromatic: Panchromatic image at 15m. Band 8
- •Vegetation Index: Normalized Difference Vegetation Index (NDVI). (Band5-Band4)/(Band5+Band4)
- •Moisture Index: Normalized Difference Moisture Index (NDMI). (Band5-Band6)/(Band5+Band6)

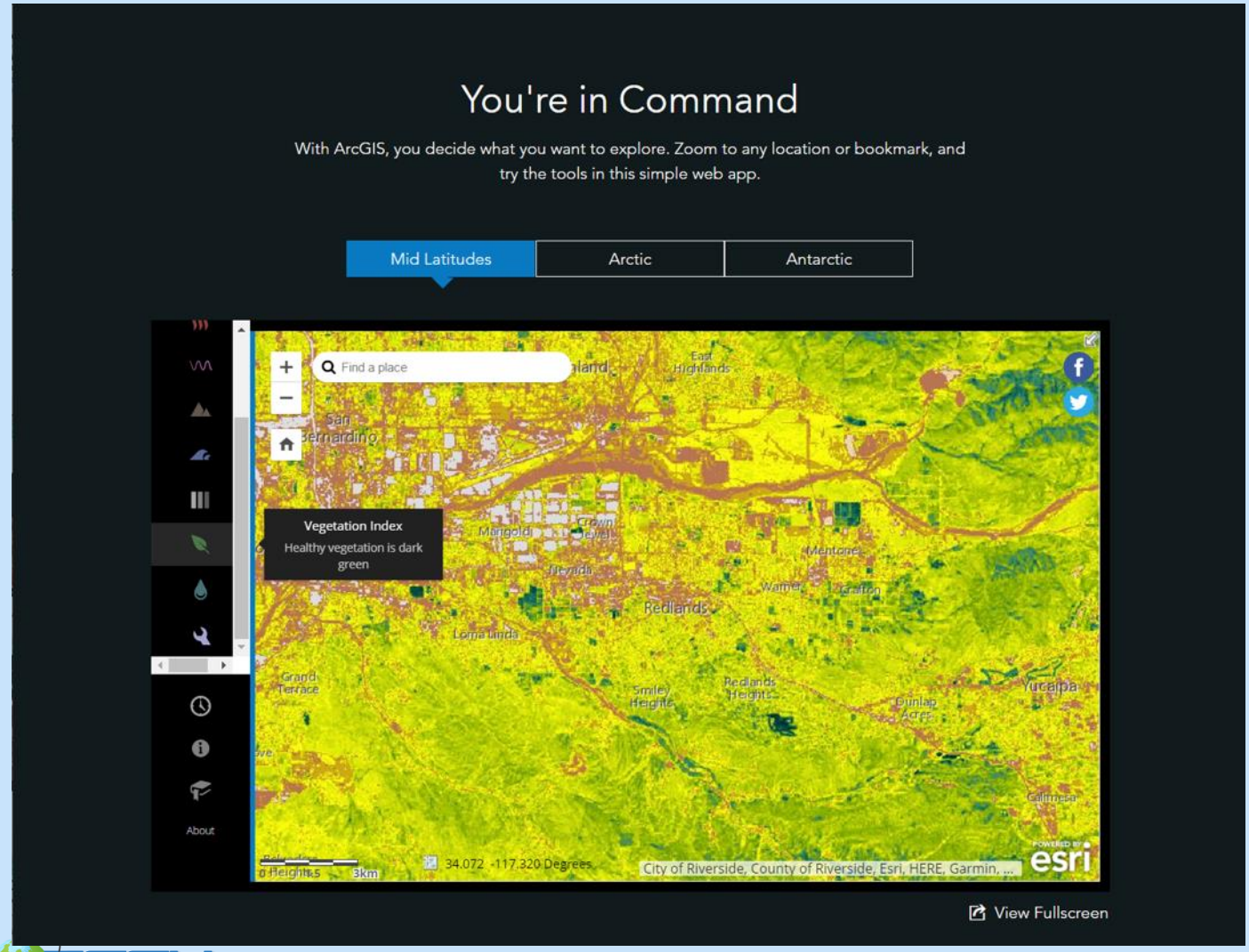
Click on Buttons - Natural Color

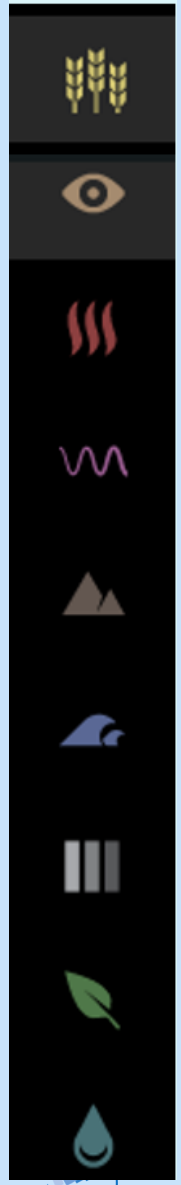


Color Infrared

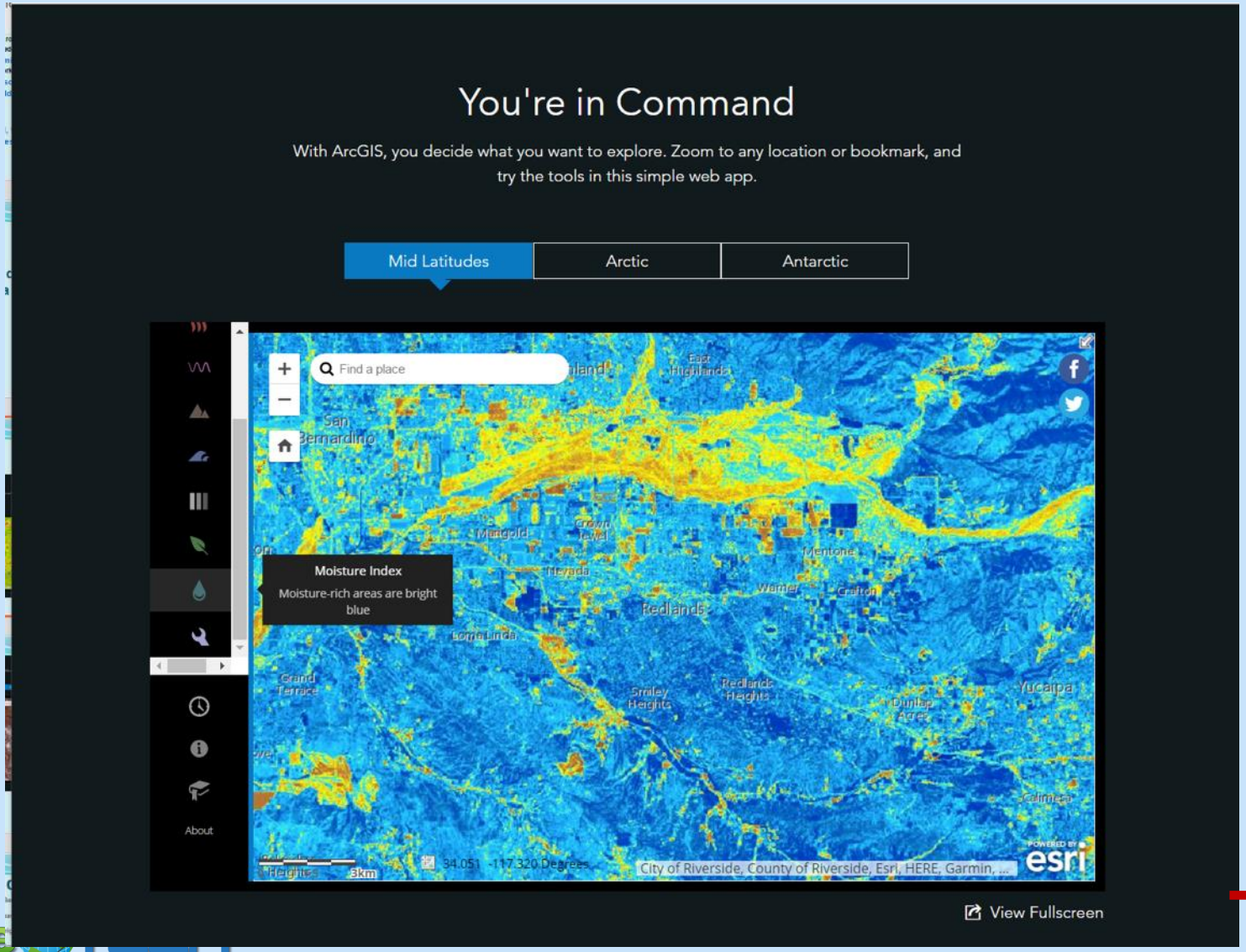


NDVI – Vegetation Index

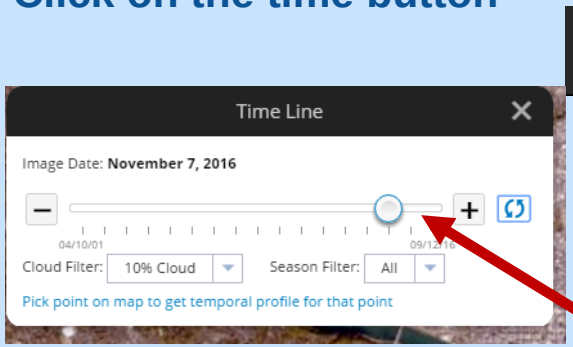




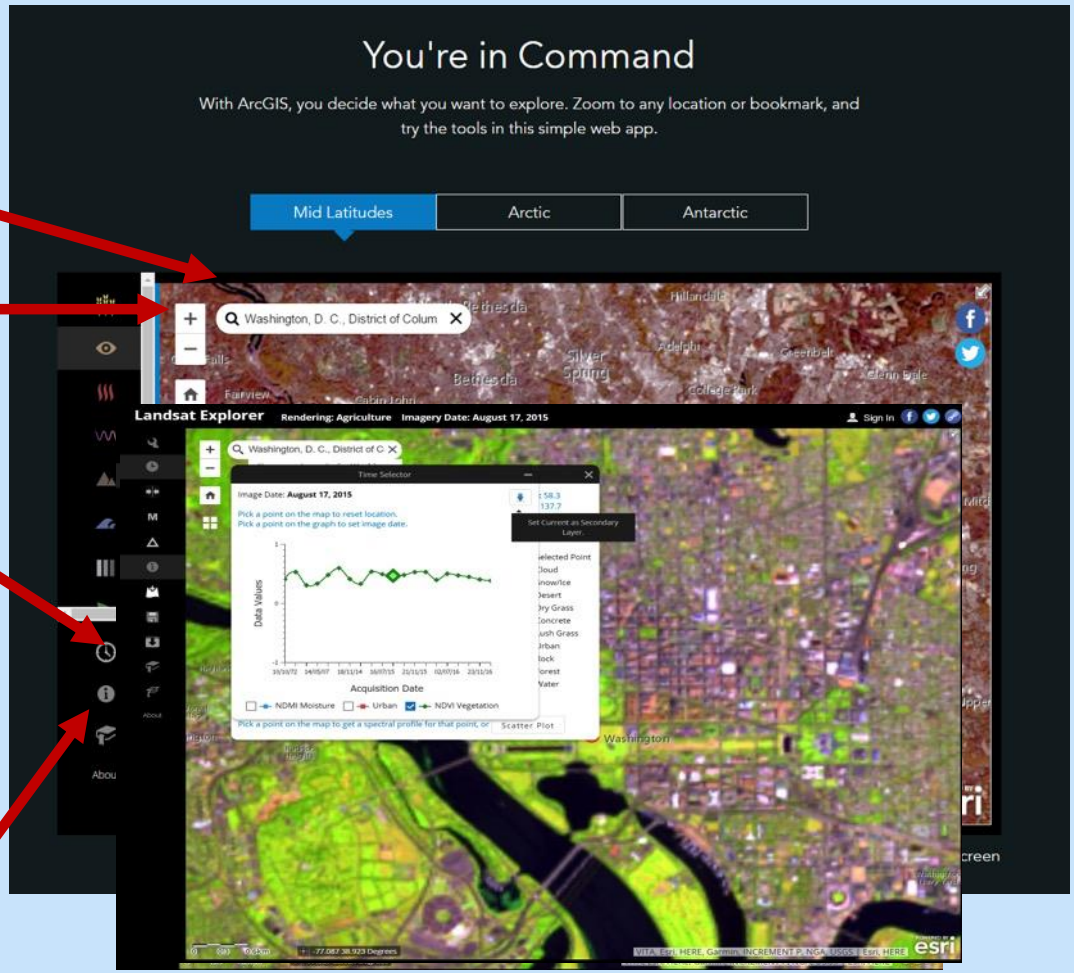
Moisture Index



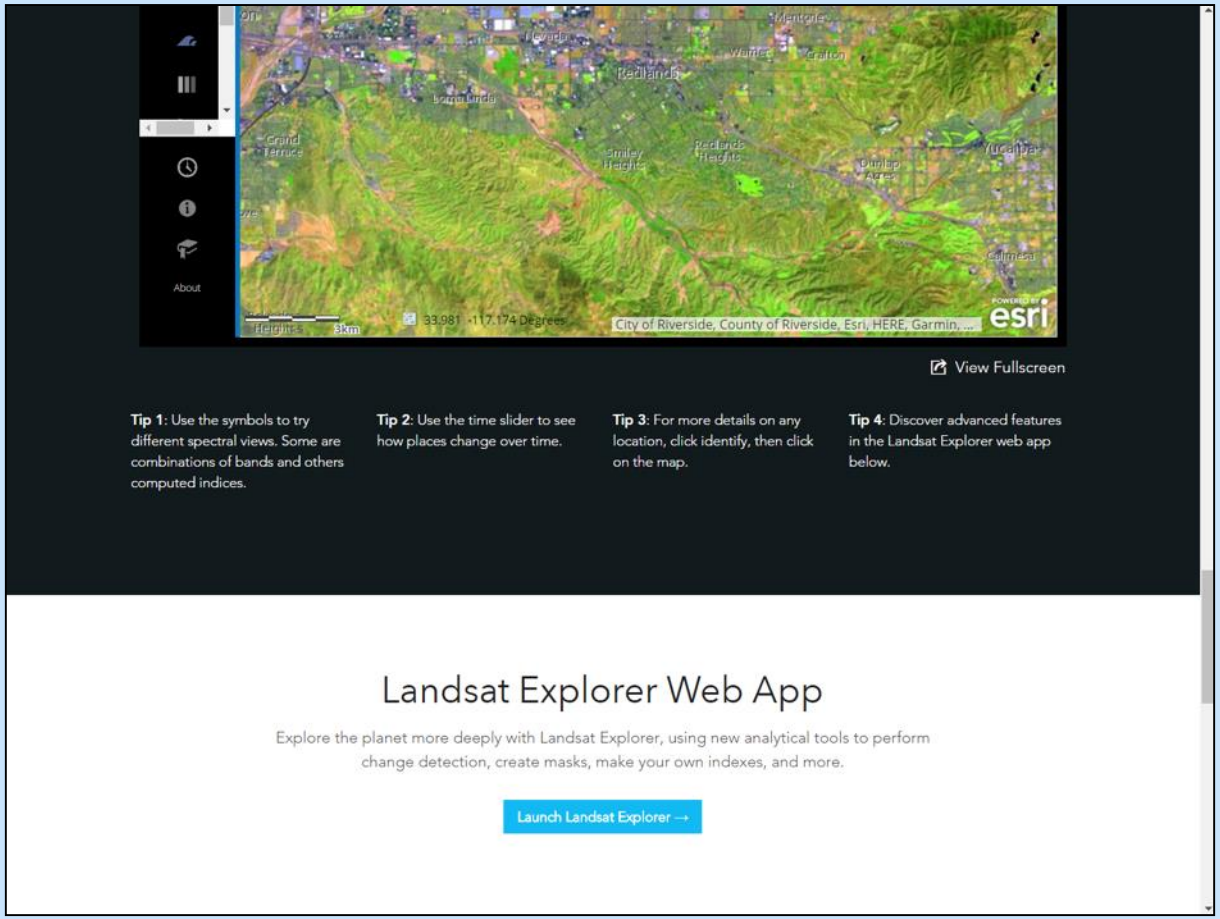
- Search on Washington, D. C.
- Use + to zoom as far as you can
  - (you will see the Capital and the National Mall
- Click on the time button



- Slide the date to change the date
- How does the scene change?
- Click on i for identify and see a spectral signature graph for a point on the map



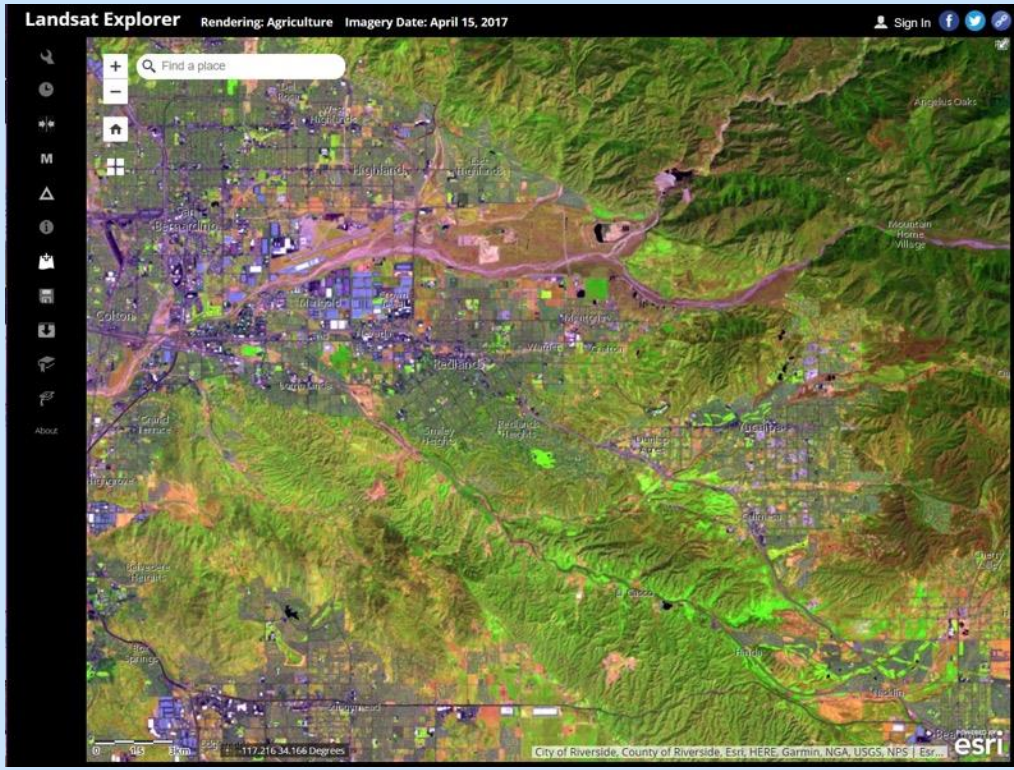
On your browser, scroll down and click on "Launch Landsat Explorer"



New buttons and capabilities

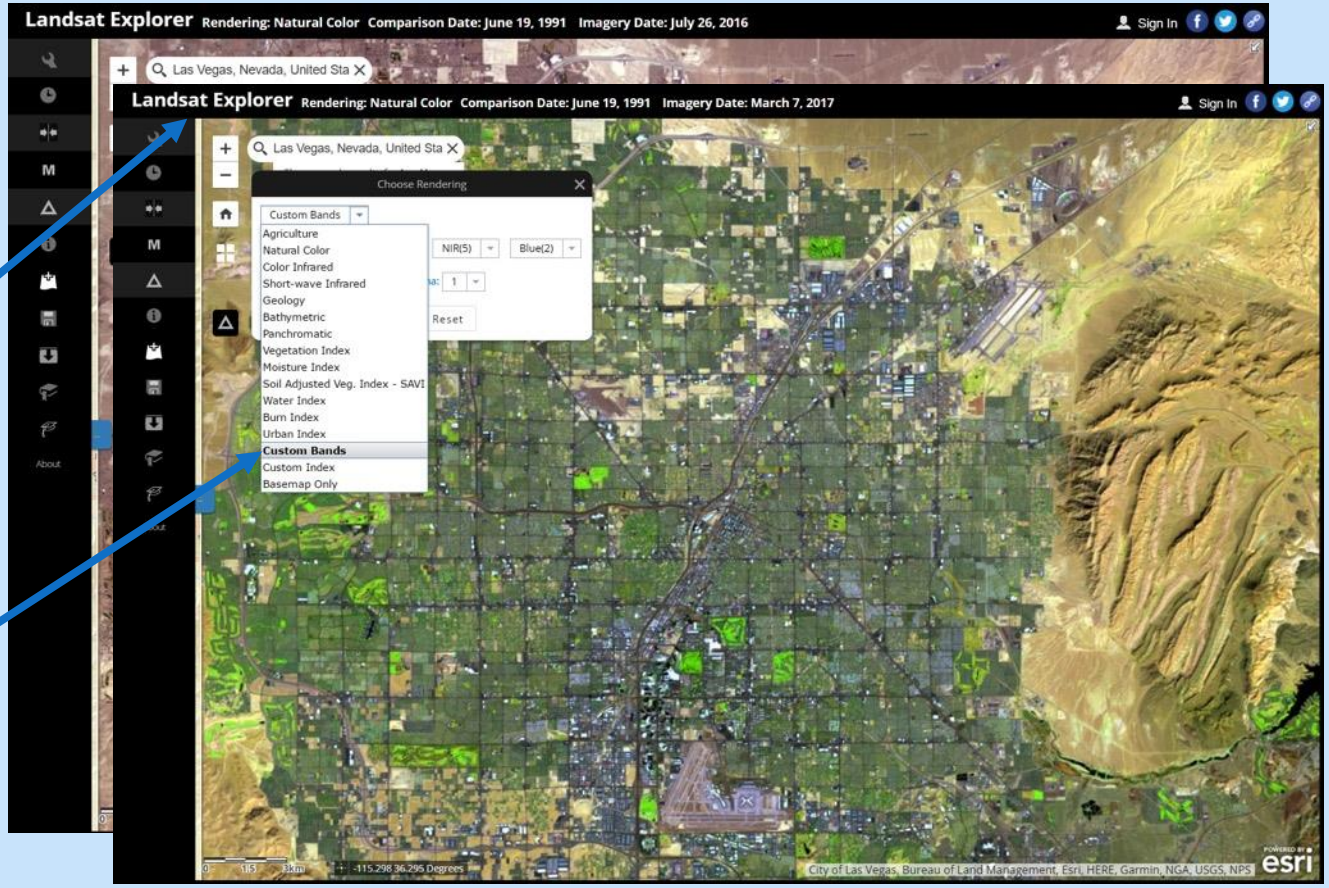
- Setting your own render (bands)
- Picking dates
- Swipe tool between two dates
- Mask
- Change Detection
- Create Spectral Signature graphs
- Add data from ArcGIS Online
- Export top layer to AGO
- Export top layer as image (tif, jpg)
- See Story Map examples
- Tutorial for Landsat Explorer
- Learn more about Landsat

Landsat Explorer – Data from many Landsat missions



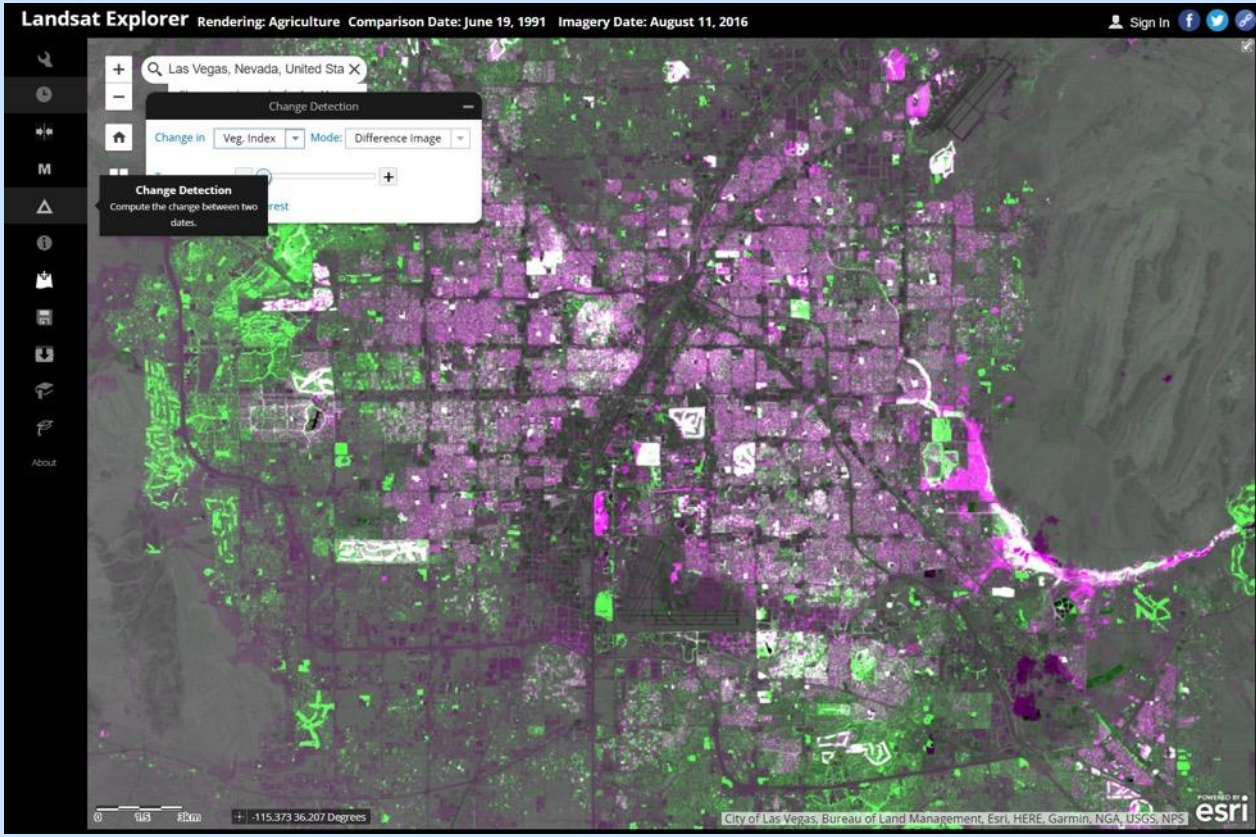
Render

- Pick one and use ? to find out more
- Select the type of composite



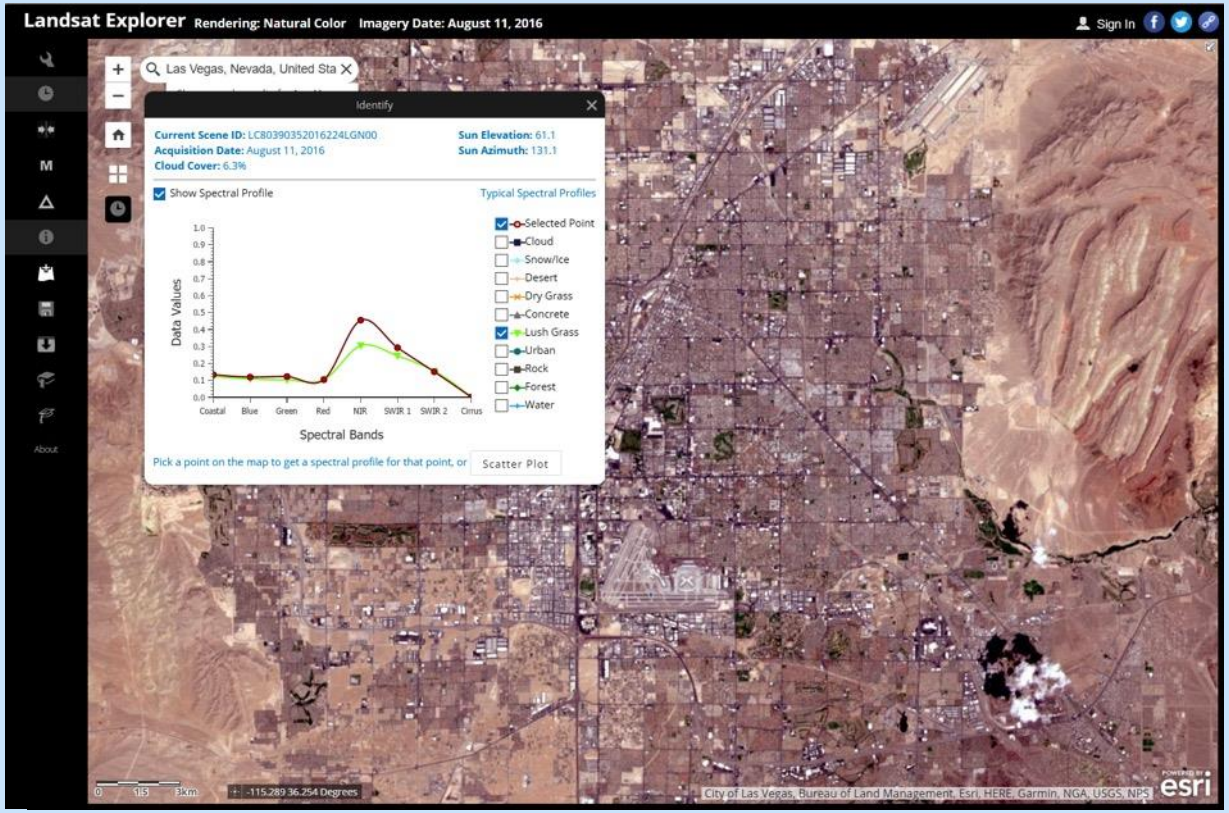
Both “Swipe” and “Change Detection” need two imagery dates

- **Note: you may need to change the render to different composite images and extents:**
  - **Use Time Slider to find early imagery date and click on “Set as Secondary Layer” button**
  - **Then Use Time Slider for a recent imagery date**
  - **Then go back to either Swipe or Change Detection**



Signature Graphs and information about an image (its Mission, Date, and other information)

- Select a render
- Click on the “i”
  - Click on a different type of Land Cover in image
    - Graph will appear with suggested land cover type



Viewing Kentucky From Space

Introduction to Remote Sensing Concepts Using Landsat Imagery

GeoTECH GEOTECHCENTER.ORG

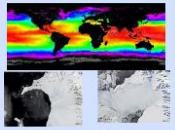
What is remote sensing?

Acquiring information about a natural feature or phenomenon, such as the Earth's surface, without actually being in contact with it. (U.S. Geological Survey Definition)

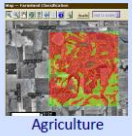
How is remote sensing used?

Land use change

Wildfires



Weather & Climate



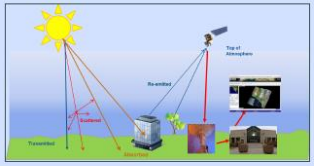
Agriculture

Two Types of Remote Sensing Sensors:

Active Remote Sensors—inputs its own energy source (LIDAR)

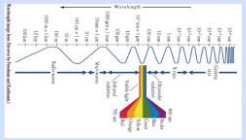
Passive Remote Sensors—uses energy from the Sun (Landsat)

Passive Remote Sensing



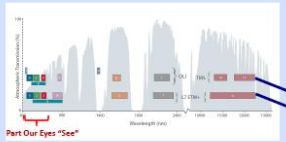
The Sun's energy can be absorbed, reflected or reemitted by objects on Earth's surface. For example, Landsat sensors collect reemitted wavelengths from discrete regions (bands) of the Electromagnetic Spectrum (EMS). Data is transmitted to ground stations, processed and made accessible on the web.

Electromagnetic Spectrum



Wavelength is measured from one crest to the next crest.

The shorter the wavelength, the greater the frequency and the higher the energy. Our eyes only visualize a small region of the EMS. Sensors can collect data from outside the visual part of the EMS.



Part Our Eyes "See"

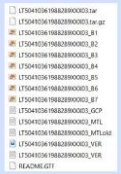
The Earth's atmosphere can block some wavelengths from reaching the satellite sensors so sensors collect in regions of the EMS where there are "atmospheric windows". The gray areas on the graph indicate those windows. Sensor bands are numbered on the graph with:

Landsat 8 (top row) and

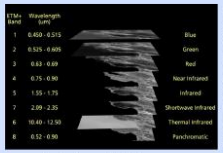
Landsat 7 (bottom row) bands.

Based on work supported by the National Science Foundation under National Geospatial Technology Center of Excellence grants Due 1304591 and 170496. Any opinions, findings, and conclusion or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

What does Landsat Band Data Look Like?

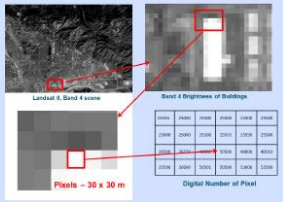


Original and unzipped bands



Landsat imagery is LARGE – Up to 1 GB!

One band's gray scale raster layer

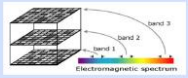


Landsat 8 Band 4 with 30 m pixels

Each band is made up of a grid of equal-sized cells or pixels. Each pixel covers a certain area on the ground and has a digital number (DN) that represents the amount of Electromagnetic energy being reflected. Higher DN values mean more reflectance and brighter pixels. Until assigned a color on a computer monitor, they are displayed in shades of gray (white to black).

Creating Visualizations of Band Data

Brightness values (DN) from three Bands are combined and assigned to either blue, green or red color guns on a computer monitor creating a Composite Image.



Landsat 8 Band Numbers

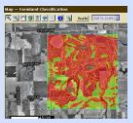
True or Natural Color Using Bands 5. 4. 3

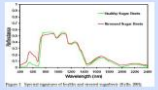
False Color Using Bands 5, 4, and 3

False or Pseudo Color Using Bands 7, 6, 4

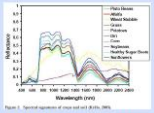
What Can A Pixel Can Tell You?

Spectral Signature graphs can be created by plotting brightness (DN) values (or reflectance) versus wavelength of bands for one individual pixel. Signature Graphs are unique for different types of surfaces (soil, vegetation, buildings, etc.). Spectral Signature graphs can also be useful in helping to identify features for land use classification analysis.





Comparison of graphs for pixels of healthy or stressed sugar beets (0 for non-reflective to 1 for maximum reflectance).



Comparing Spectral Signature graphs of reflectance for different surfaces.

Imagery Resolutions

Spatial – size of area on the ground of one pixel and area of image on the ground

Temporal – how often data (imagery) is acquired for the same location

Radiometric – the sensitivity of sensor to discriminate and collect slight differences in emitted or reflected energy (its bit depth)

Spectral – specific wavelengths of spectrum collected by sensors

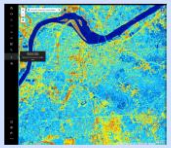
Landsat is generally 30 m resolution with collection on 16 day repeat cycles. Radiometric and Spectral resolutions vary for different Landsat missions. Other imagery sources will have different resolutions.

Esri's Landsat Apps for Louisville, KY

(http:/Esriurl.com/LandsatOnAWS Unlocking Earth's Secrets and Landsat Explorer)

True Color Landsat 8, 30 m Bands 4, 3, 2 + panchromatic 15 m Band 8, March 2017

False Color (color infrared) Landsat 8, 30 m, Bands 5,4, 3 March 2017



Moisture Index: Normalized Difference Moisture Index (NDMI) March 2017 (Band5-Band6/Band5+Band6)

Agriculture Highlighted with agriculture in bright green, Band 6, 5, 2— Image on left is from September 2000 and image in middle is September 2016. Note areas where there is urban development or other changes between those dates. Image on right highlight changes with pink indicating greening loss and green indicating gain.

Two images have Spectral Signature graphs identifying the type of surface feature at the red dot on each image (Landsat 8, Bands 7,6,4 Short Wave Infrared)

Vegetation Index: Normalized Difference Vegetation Index (NDVI) (Band5-Band4/Band5+Band4)

Can You Identify These Features?

Thanks to New Hampshire View for the idea of a remote sensing poster and to NASA for graphics and to Esri for its new Unlocking Earth's Secrets and Landsat Explorer.

V8 4/19/2017

Links to hands on Exercise and Poster (as a PDF and in Publisher) and a PPT that introduces the needed concepts will be available on the iGETT and on the GeoTech Center website.

Websites:
www.igettremotesensing.org
www.geotechcenter.org

Thanks!
Questions?

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