Mapping and Informatics Skill Development Workshop

California black oak and Oregon white oak woodland ecology and management Conference

November 12th, 2015

Sean Hogan, sdhogan@ucanr.edu
Shane Feirer, stfeirer@ucanr.edu

Workshop: Mapping and Informatics Skill Development

- Have you ever wondered how to use mapping technologies to manage your property?
- Have you been confused about the options of imagery and spatial data out there?

If so, this workshop is for you!

- We will review ways to use on-line mapping tools to find and use spatial data to study your sites.

Workshop Agenda

1. Background on Geospatial Technologies: GIS, Remote Sensing, GPS, and WebGIS
2. Spatial Data Basics
3. Available Imagery and Other GIS Data Resources
4. Future Technology
5. On-line Exercise for Mapping Your Property

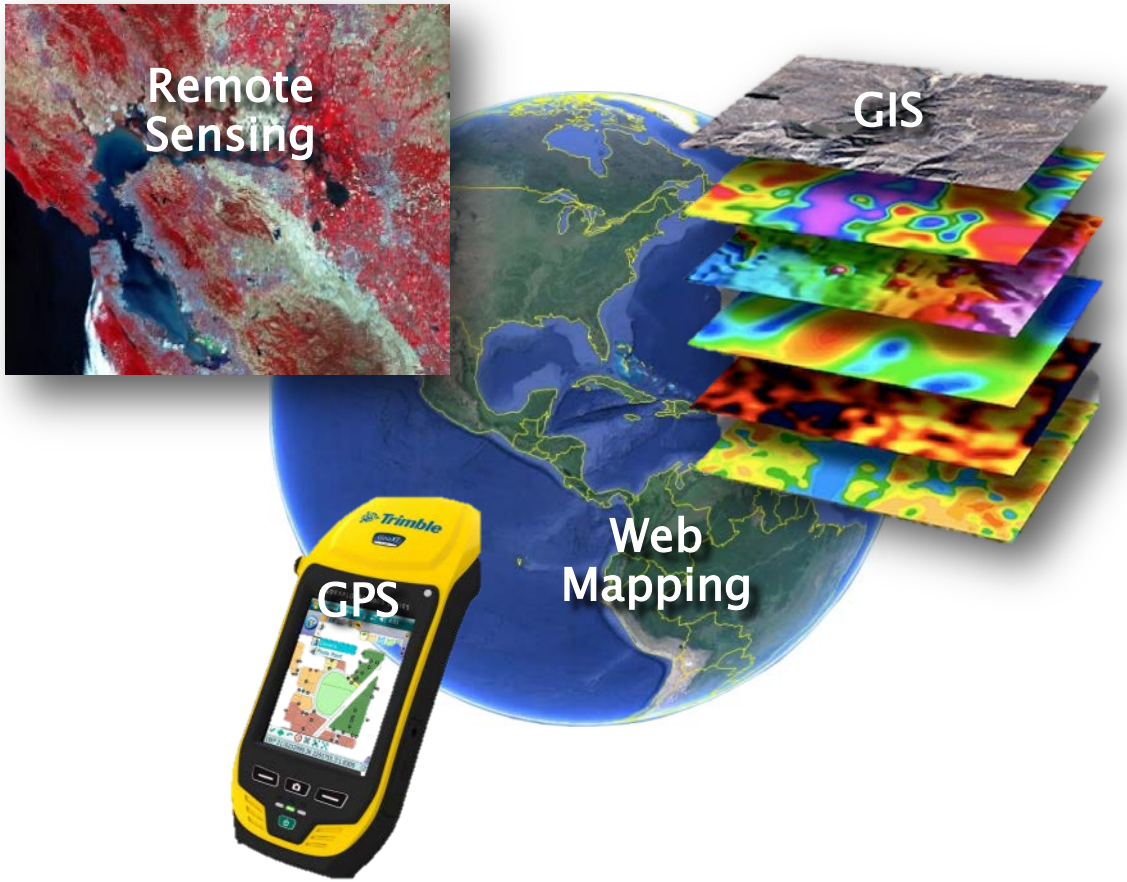
Part 1: Geospatial Technologies: GIS, Remote Sensing, GPS, and WebGIS

Integrated Geospatial Technologies

Support:

- research,
- management, and
- outreach

Through analysis and visualization of agriculture and natural resources

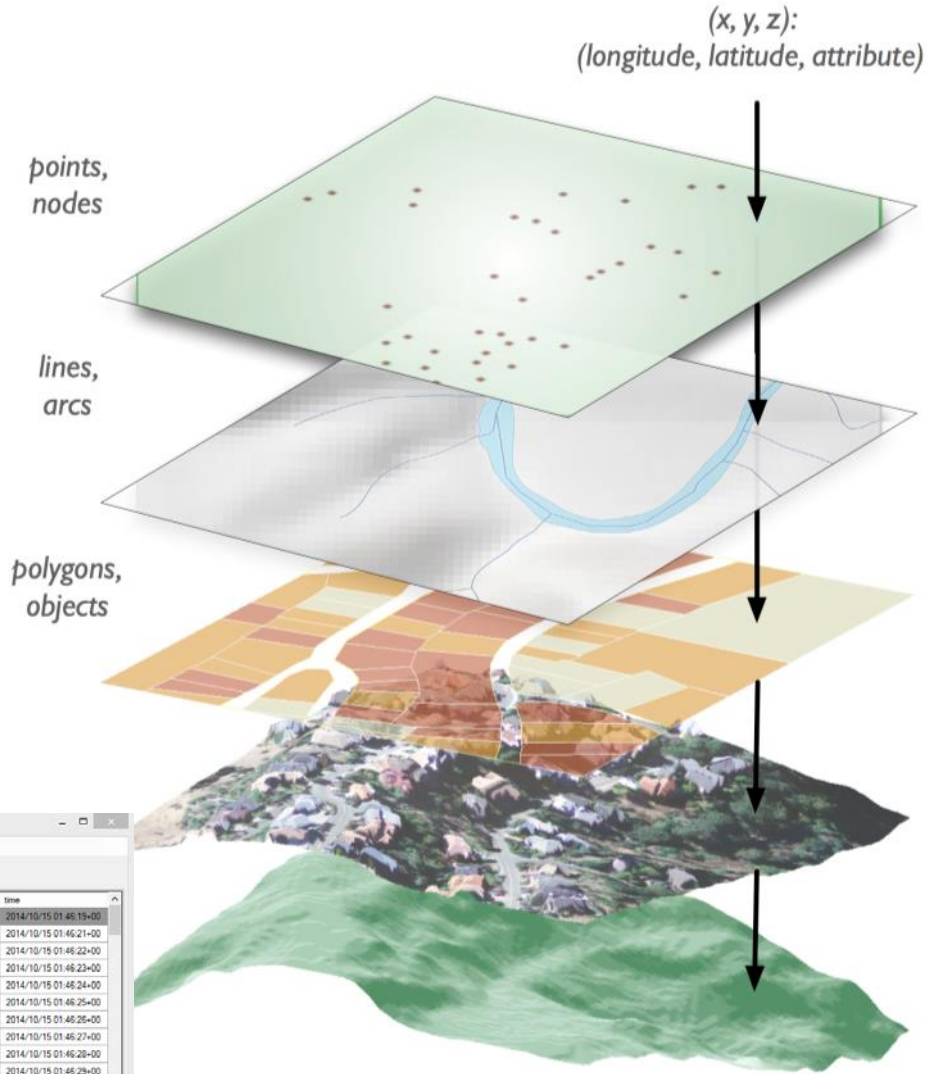


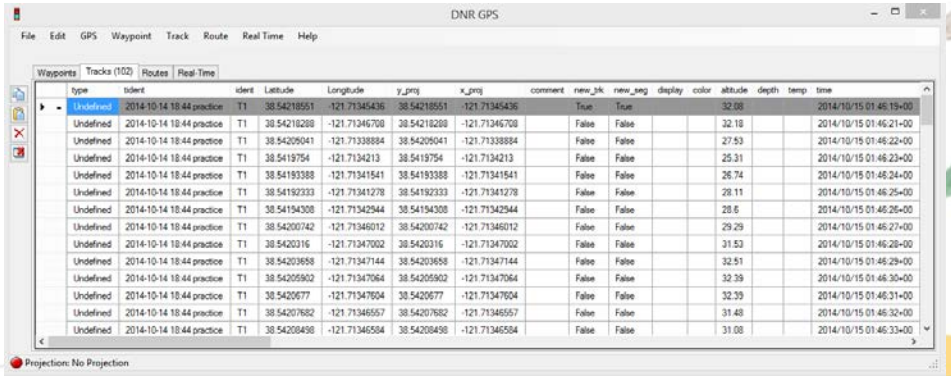
Geographical Information Systems

Geographical Information Systems are systems for positioning, acquisition, analysis, and dissemination of geospatial data.

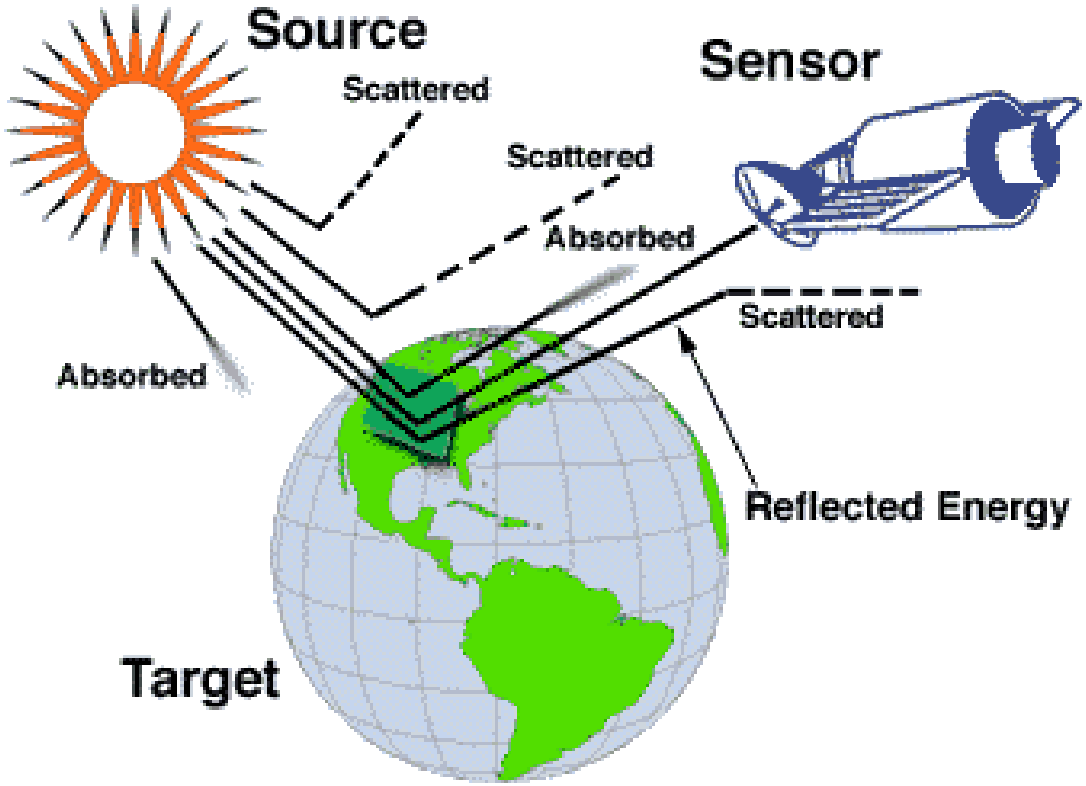
Made possible (and powerful) from the coincidence of spatial data features: *georeferenced data.*

Spatial data are a *representation* of reality.

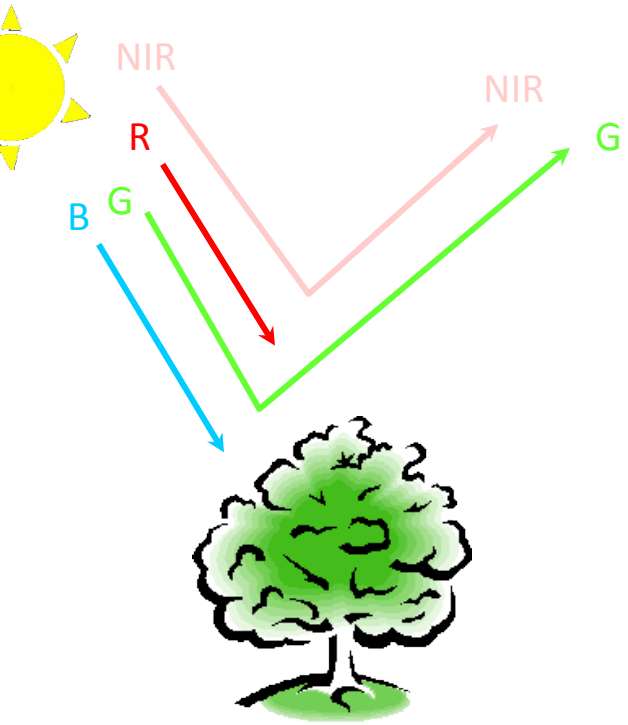




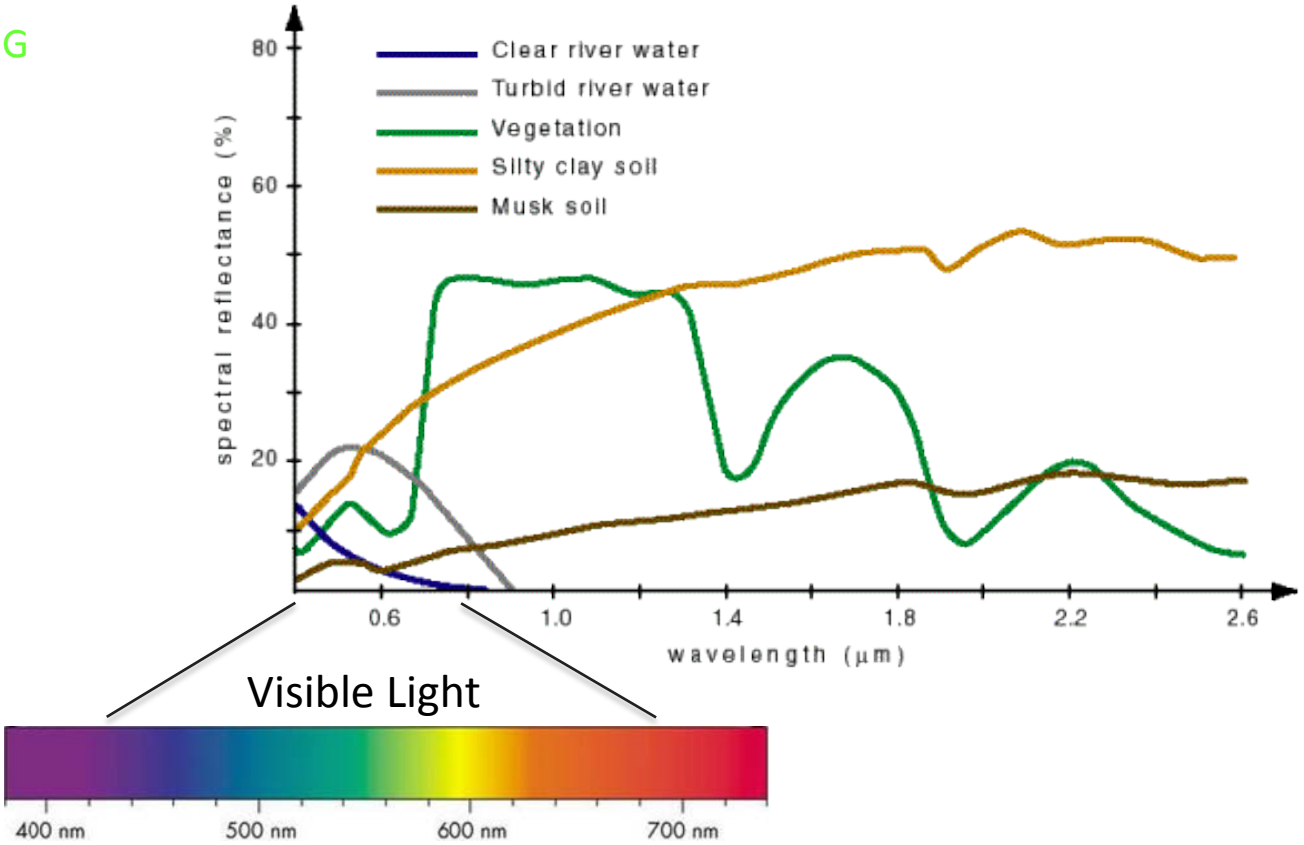
Basics of Remote Sensing



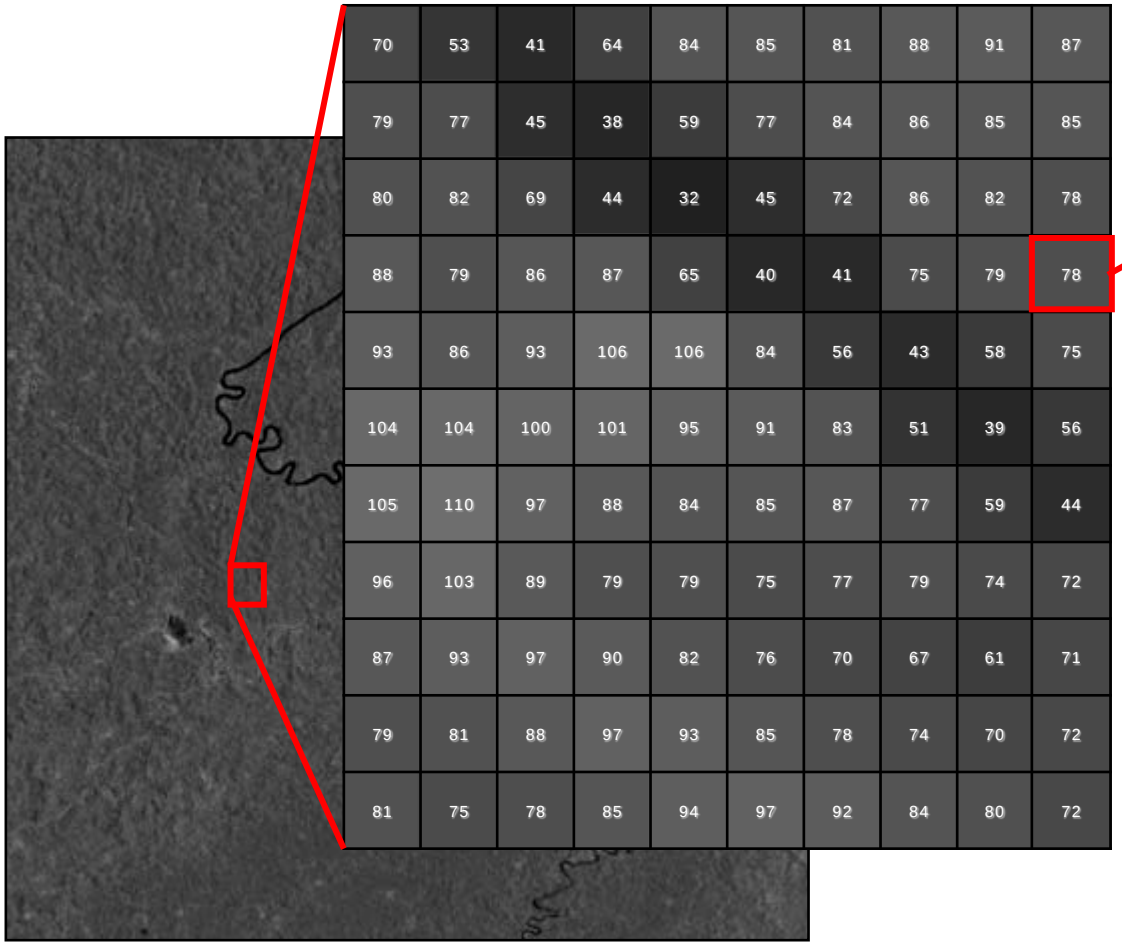
Remote Sensing of Vegetation



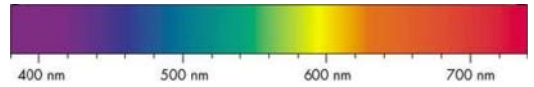
Light reflecting from vegetation…

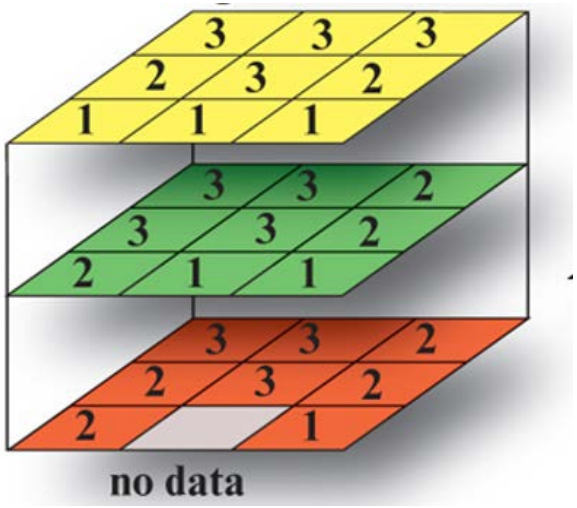


Remote Sensing Imagery & Bands



Pixel → Digital Number (DN)



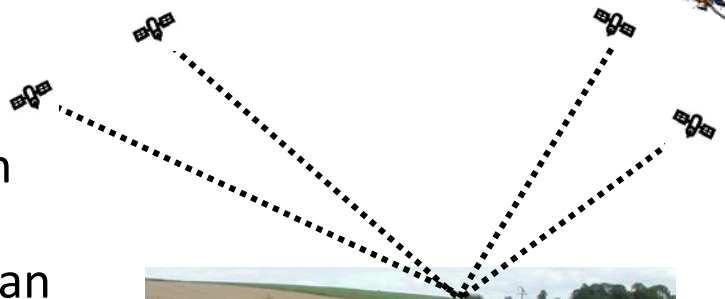


GPS: Global Positioning Systems

24 -32 active satellites make up civilian GPS

With 6 orbit planes, each with 4 operational satellites in each, at least 6 satellites are visible from any spot on Earth,

Orbiting 12,500 miles above earth at ~ 7,000 mph



2 complete orbits in less than 24 hours

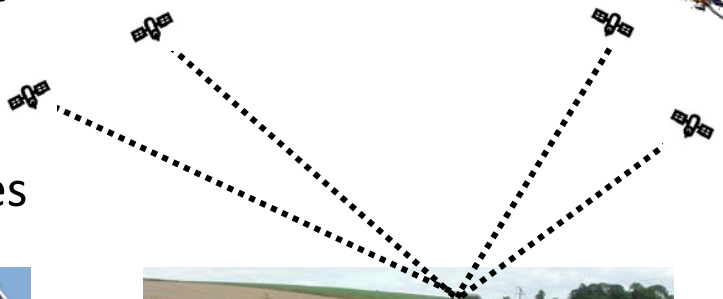
4 or more GPS satellites used to compute X, Y, and Z

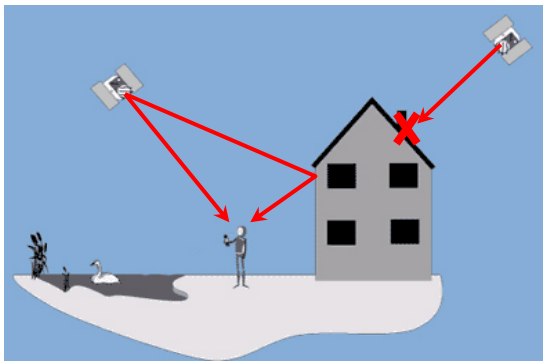
GPS: Global Positioning Systems

Signals travel by line of sight:

Will pass through clouds, glass, & plastic

Will not pass through most solid objects, such as buildings, mountains and occasionally forest canopies





GPS Devices

Recreational-grade

Mapping-grade

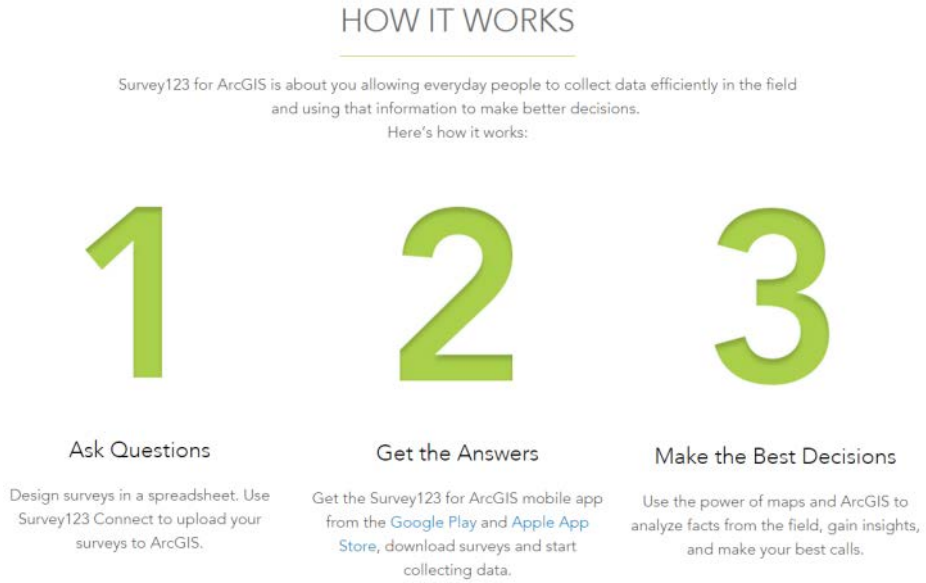
Survey-grade

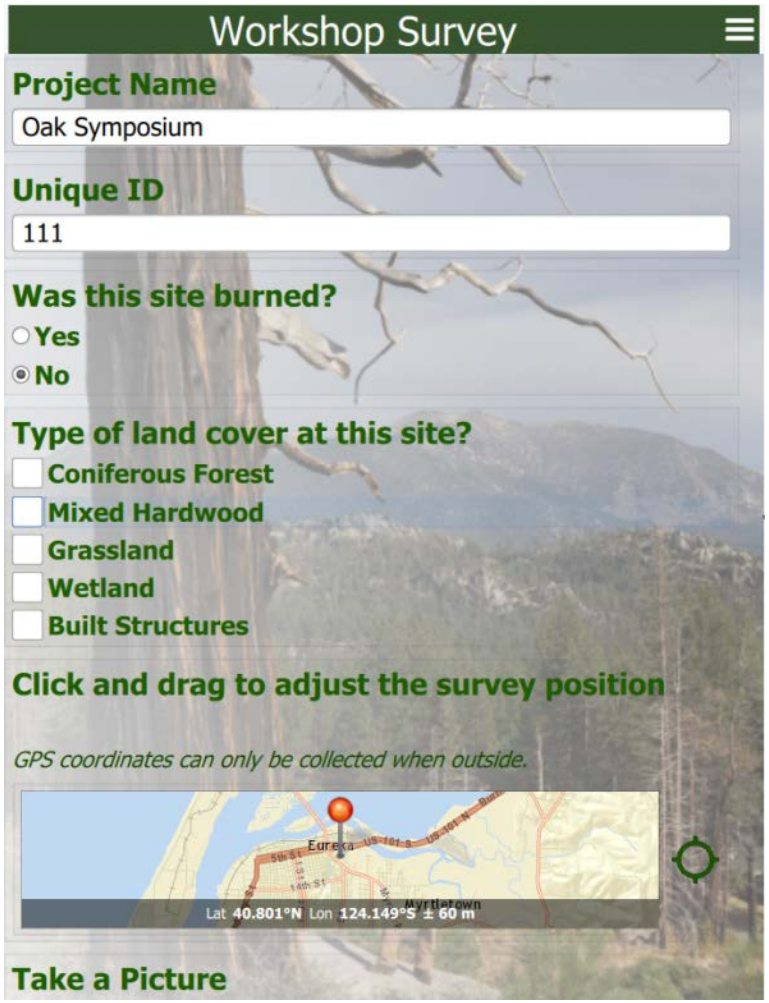
GRADE	ACCURACY	AVG. COST
Recreation	3-10 m	$400
Mapping	1 m	$5,000
	Sub-meter	$10,000
Survey	0.1 m	$20,000

Smartphone GPS Apps

Comparable accuracy to recreational GPS units

Survey123

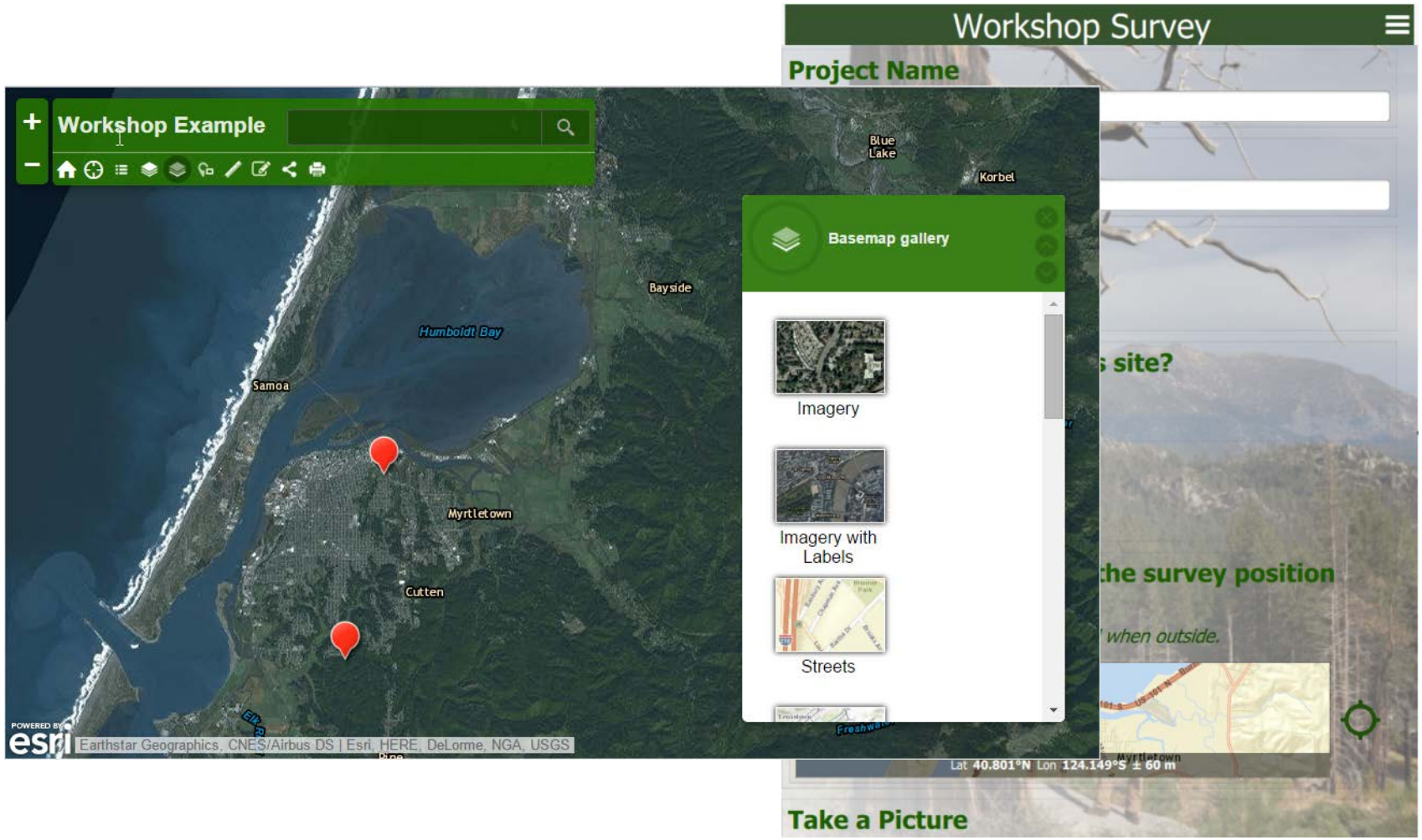




http://survey123.esri.com/

Based upon the Open Data Kit (ODK) https://opendatakit.org/
XLS Forms tool

Survey123

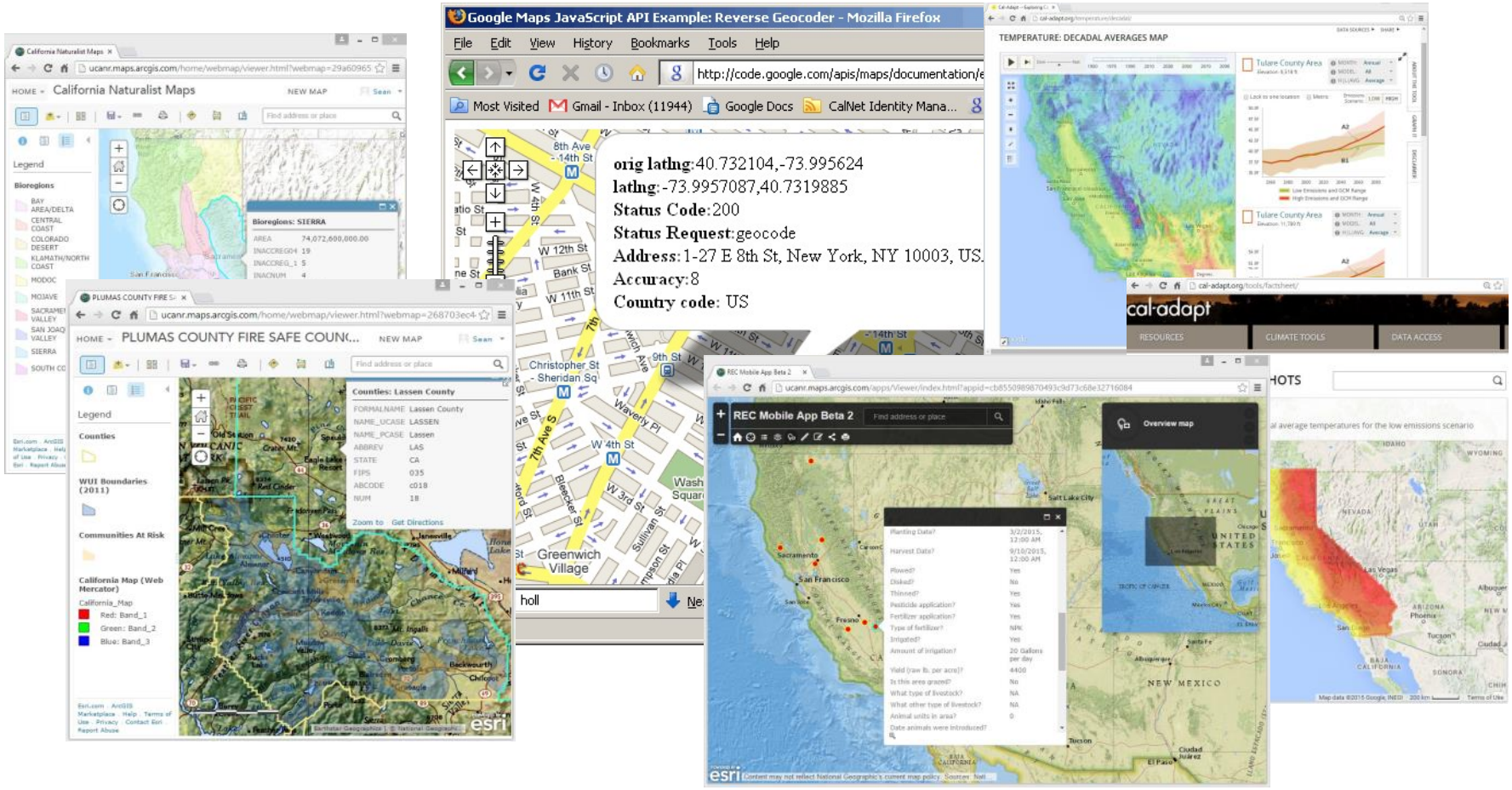

Workshop Survey
Project Name
Workshop Example
Basemap gallery
Imagery
Imagery with Labels
Streets
Humboldt Bay
Samoa
Myrtletown
Cutten
Bayside
Blue Lake
Korbel
Earthstar Geographics, CNES/Airbus DS | Esri, HERE, DeLorme, NGA, USGS
Lat 40.801°N Lon 124.149°S ± 60 m
Take a Picture

What is a WebGIS?

A GIS application on the Internet

- Powerful, interactive tool for communicating, collecting data
- Allows access to data by viewing, searching, querying, and exporting data and maps
- Generally designed for users who are not GIS experts
- Public / mass participation enabled

WebGIS – Web Mapping



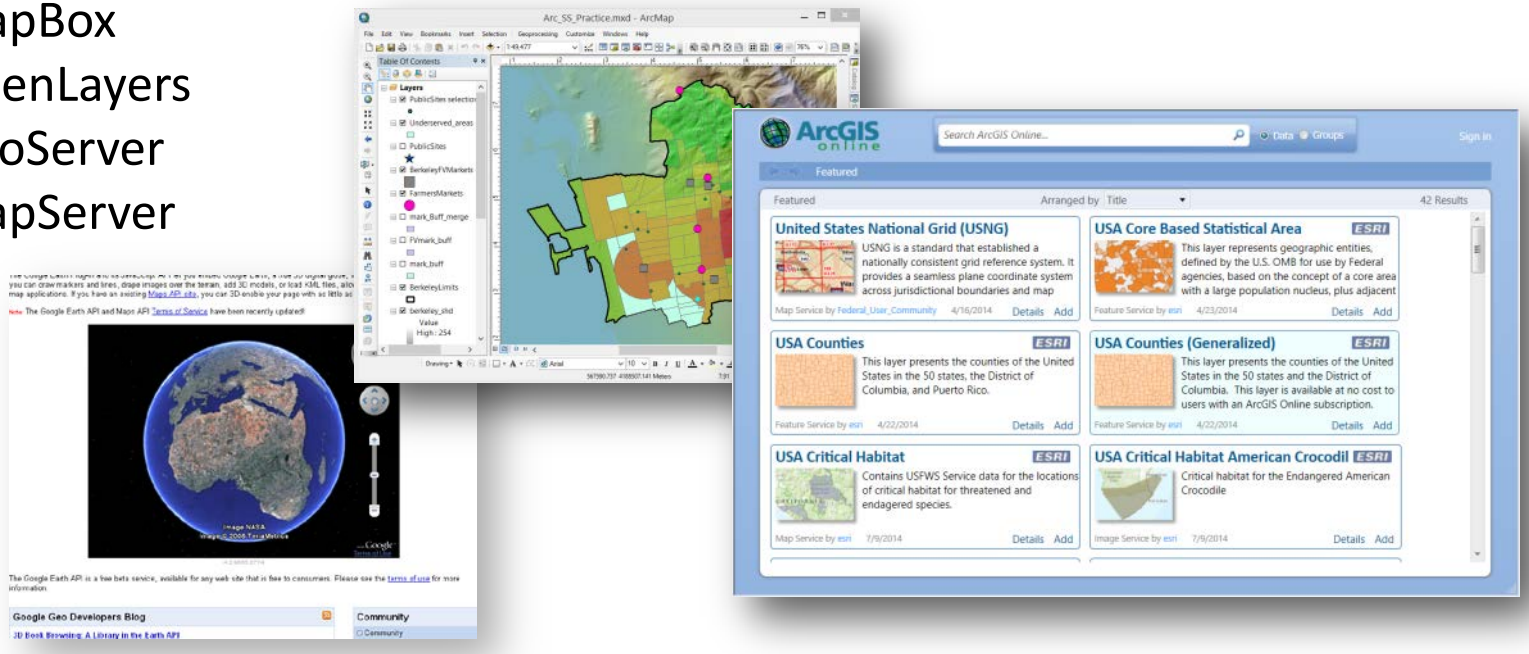
WebGIS Development

“Open Source” or Free

- Google Maps API
- CartoDB
- Leaflet
- MapBox
- OpenLayers
- GeoServer
- MapServer

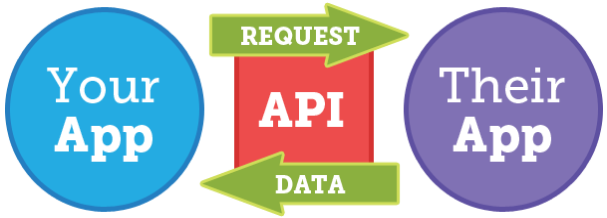
Proprietary

- ArcGIS.com
- Intergraph (CAD/CAM)
- GeoMedia WebMap



APIs: Application Programming Interface

An Application Programming Interface is typically a set of computer functions, procedures, methods, classes or protocols made available for public use, usually by a third party. APIs are generally associated with “open source”, as they allow any user to customize an application (or at least use its features in a custom manner).

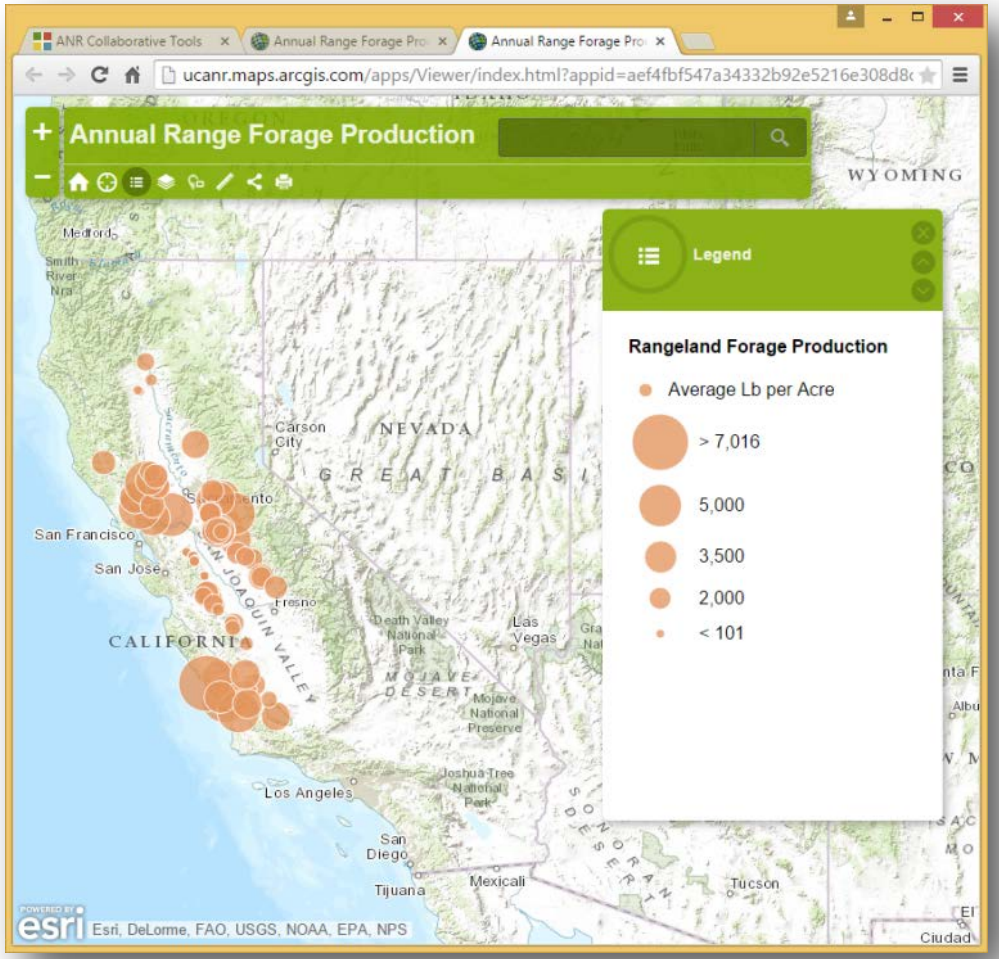


Examples:

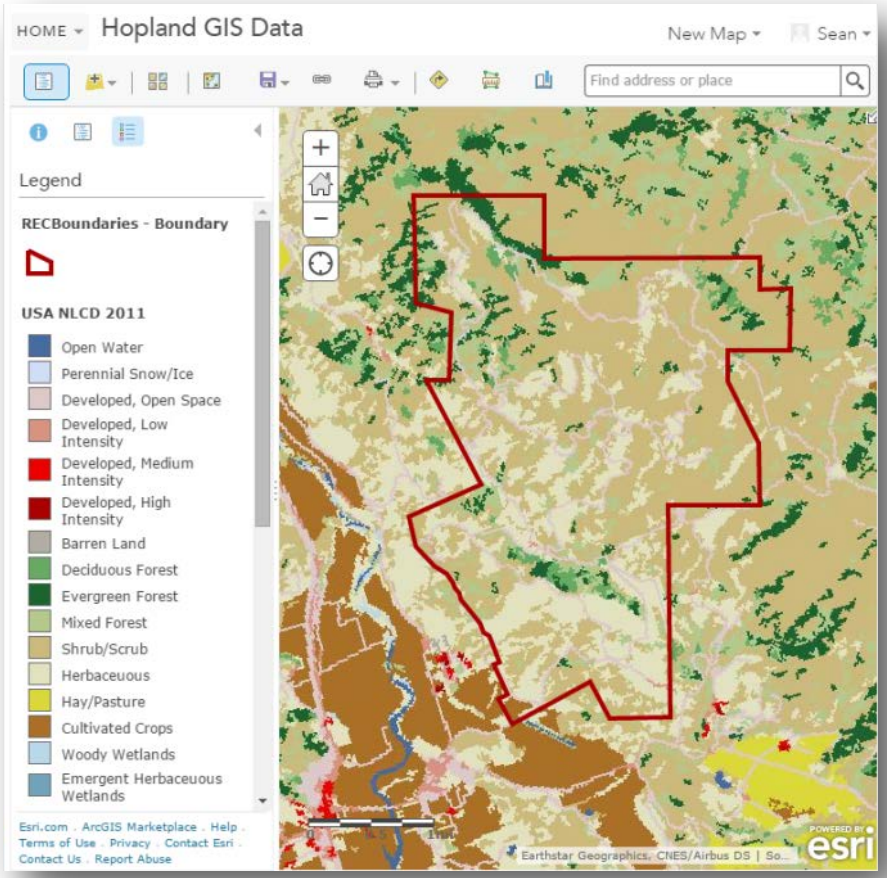
- iPhone API – customize mobile apps for Apple’s iPhone
- Google Maps API – build geospatial web apps

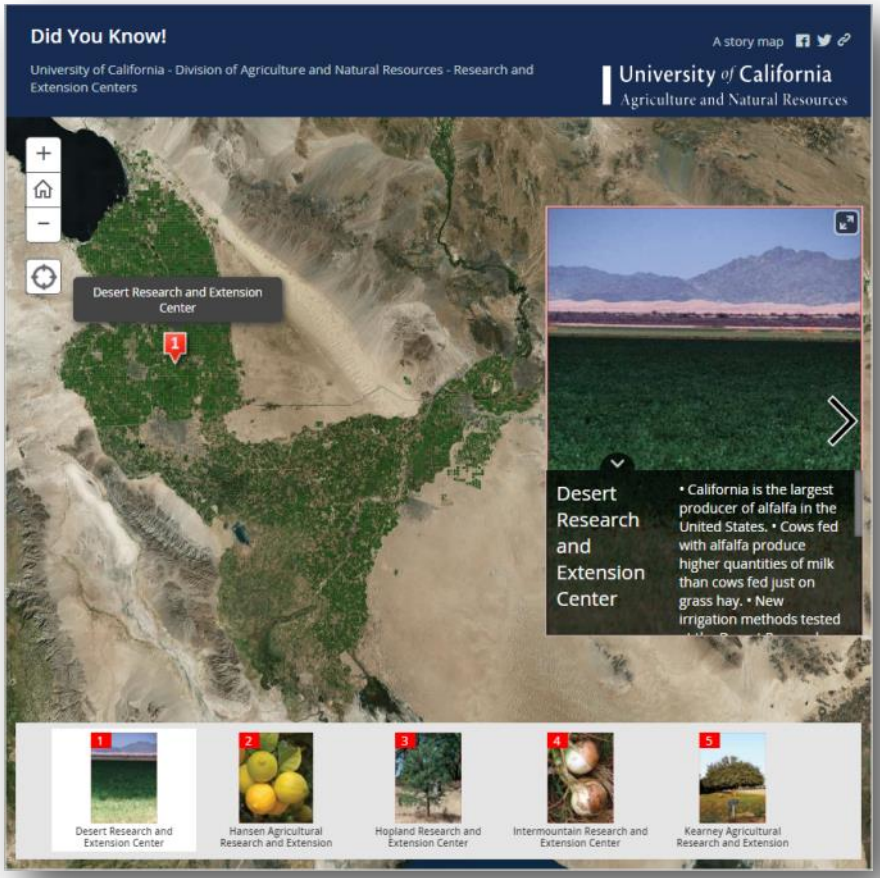
ArcGIS Online

- In the Cloud
- Organizational and other publically available data
- Can be used in GIS software and on webmaps



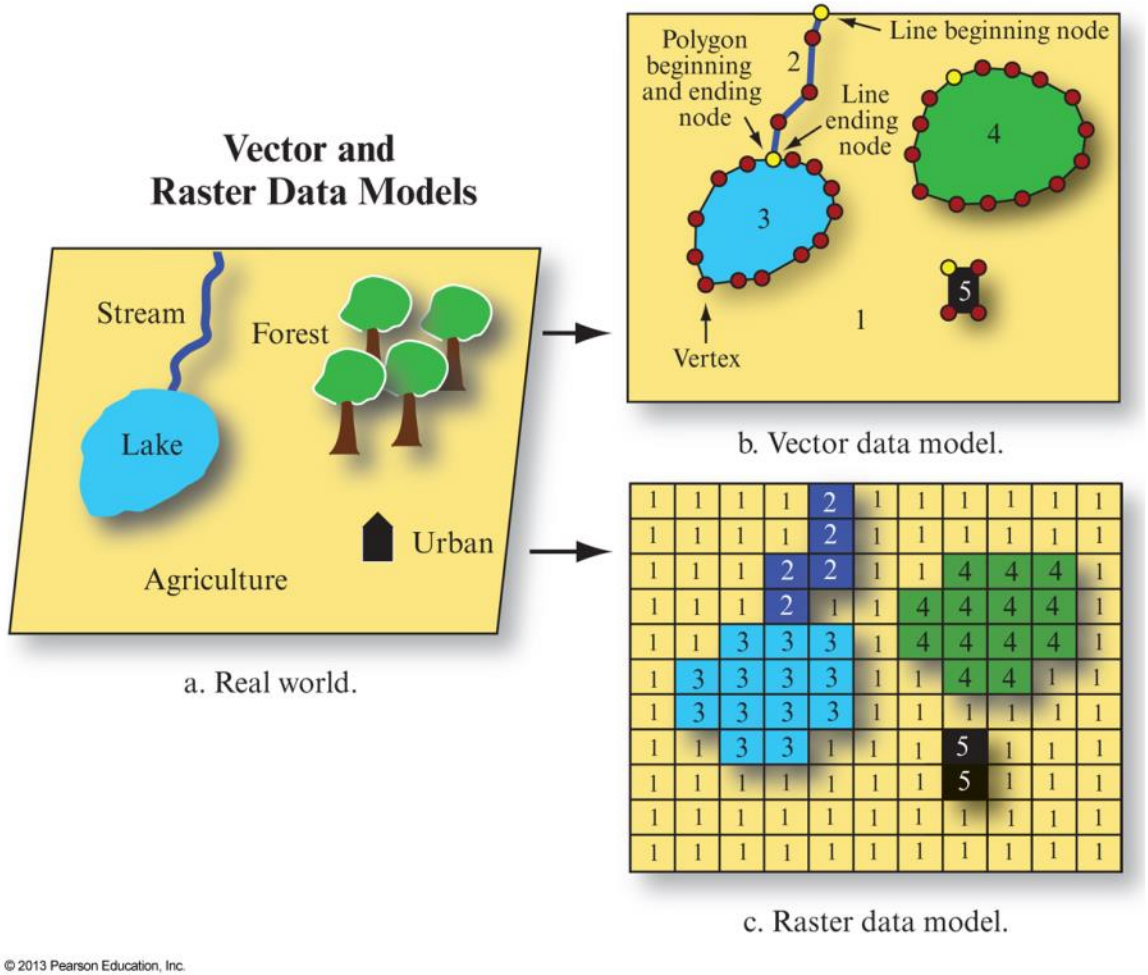
ArcGIS Online



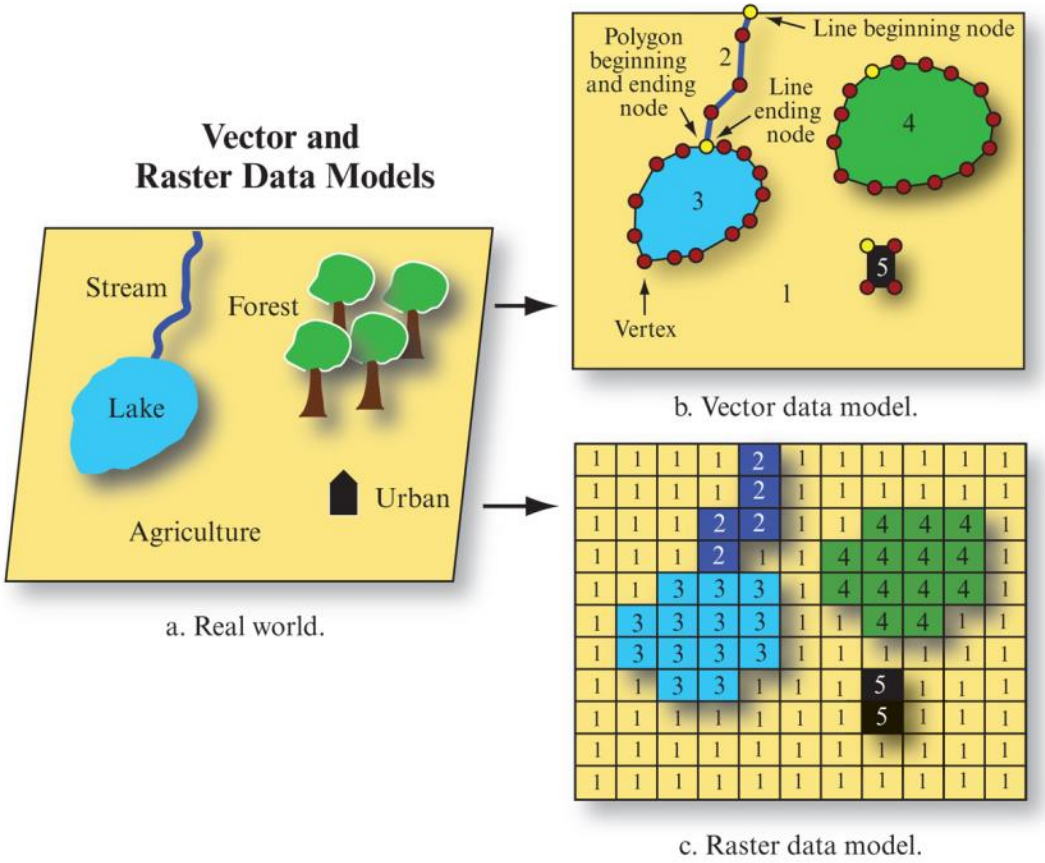


Part 2: Spatial Data Basics

Types of GIS Data

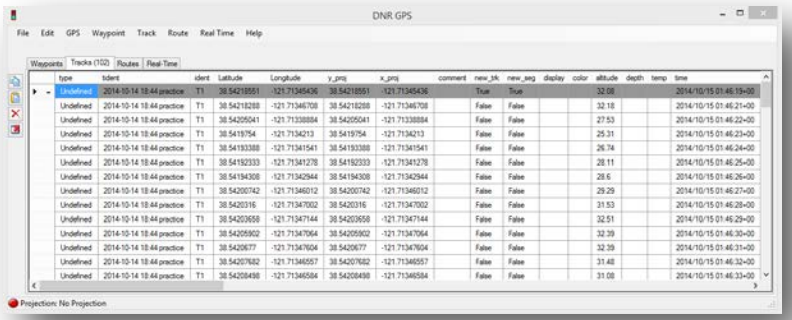


Types of GIS Data

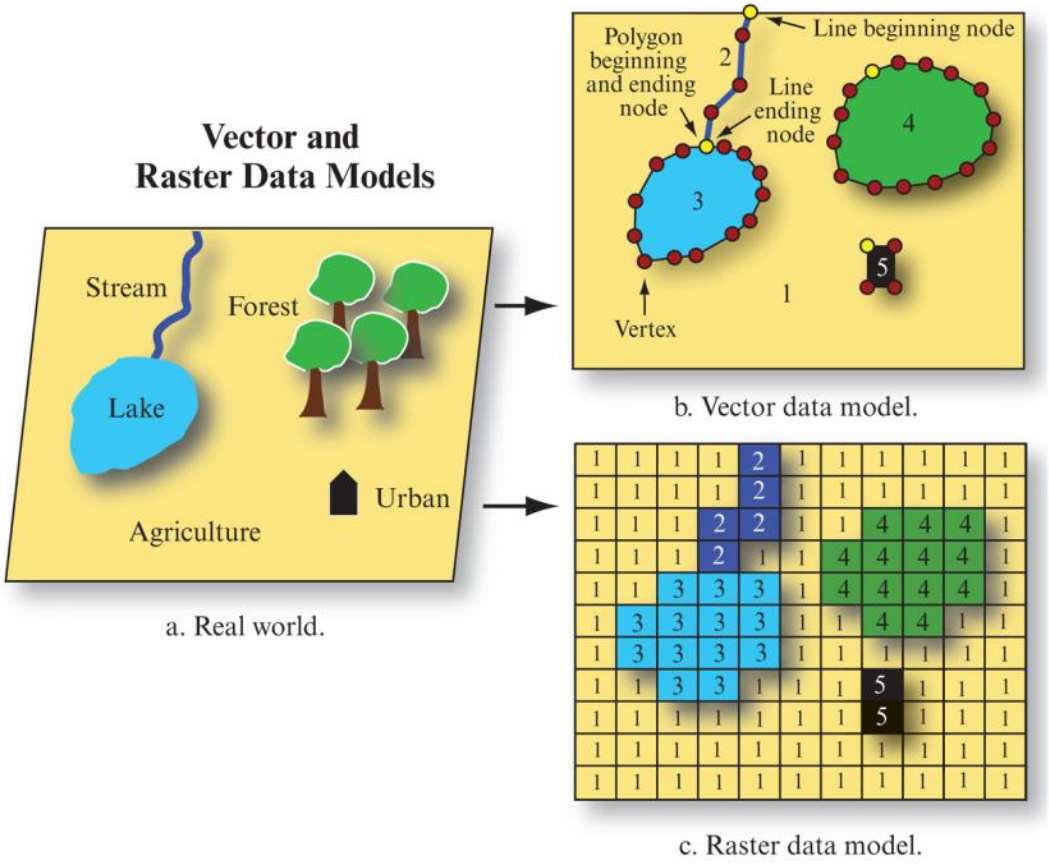


Vector Data:

- x,y or x,y,z coordinates that are used to create points, lines and polygons
- Spatial information is linked to attribute table by relational databases

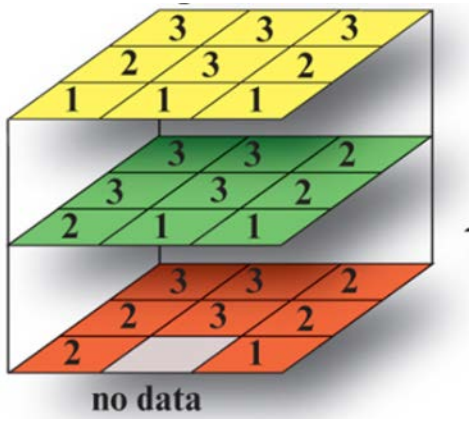


Types of GIS Data

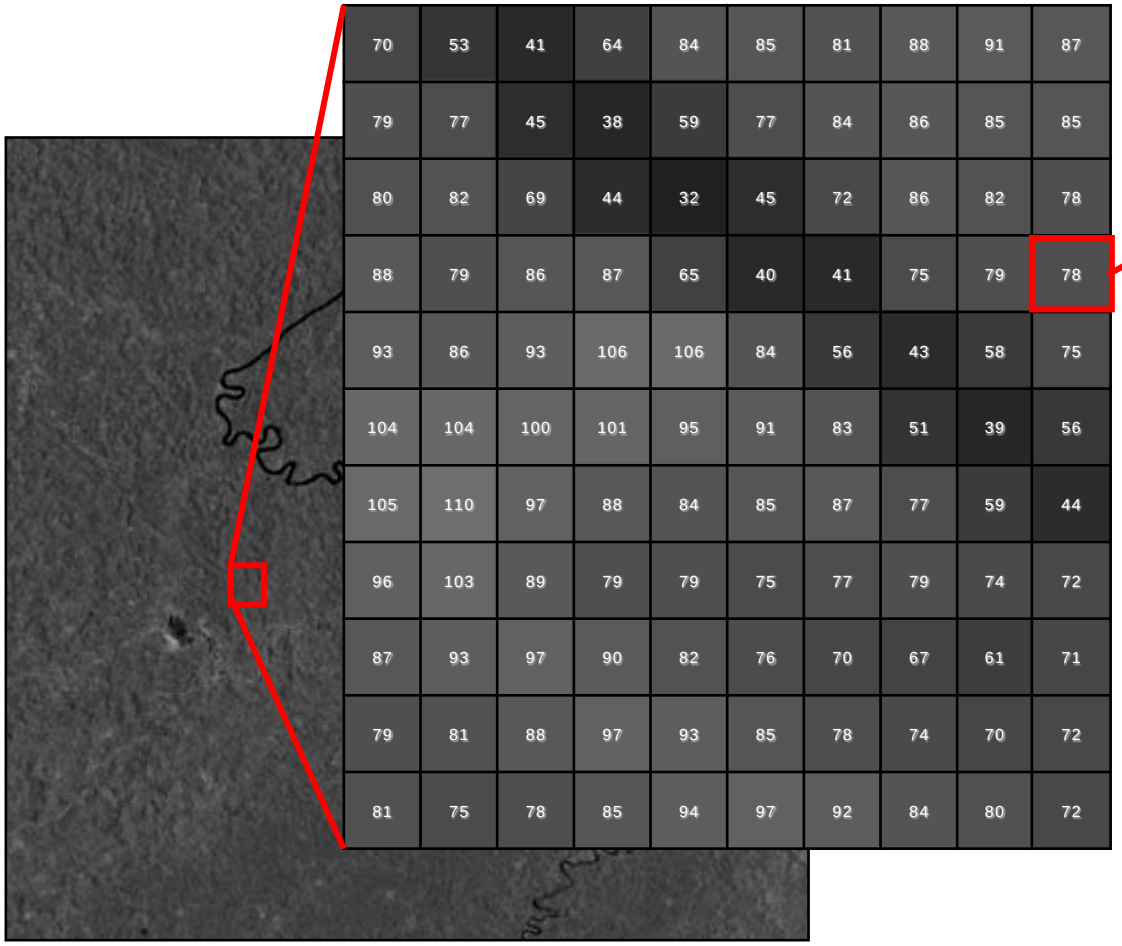


Raster Data:

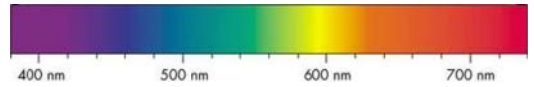
- Comprised of a grid of cells often referred to as pixels
- Spatial information is implicitly related to a reference point and the size of the pixels

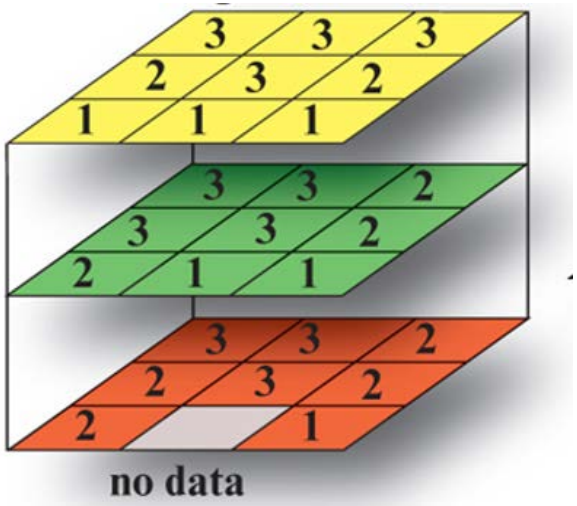


Raster Data

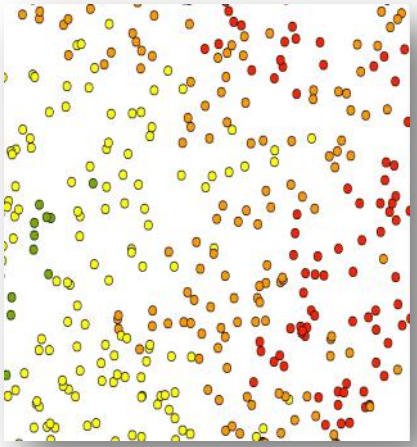


Pixel → Digital Number (DN)

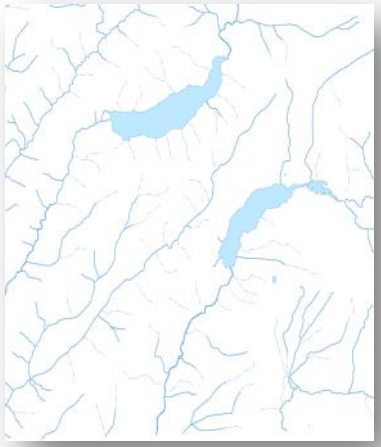




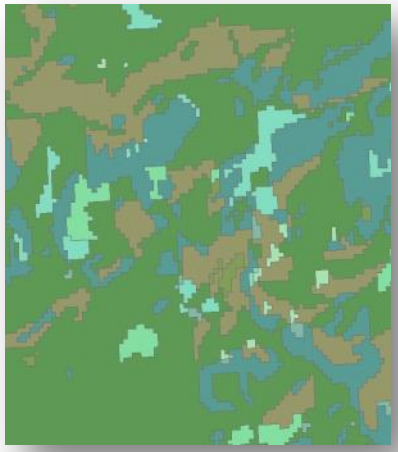
Vector Examples



Points: Sample locations, trees, addresses,

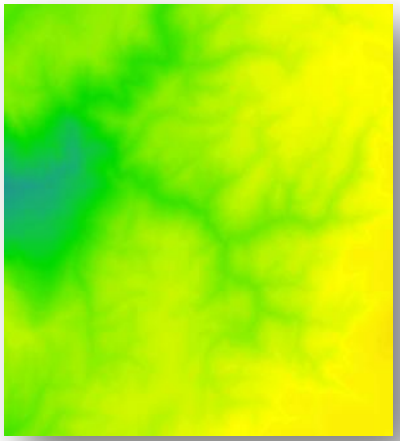


Lines: Roads, hydrography, contours, transects,

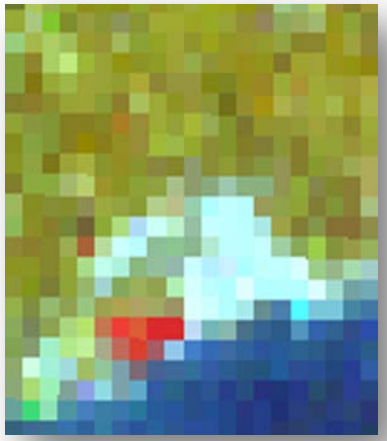


Polygons & Boundaries: Land Use & Land Cover, census, fire perimeters, states, counties, ownership, parcels

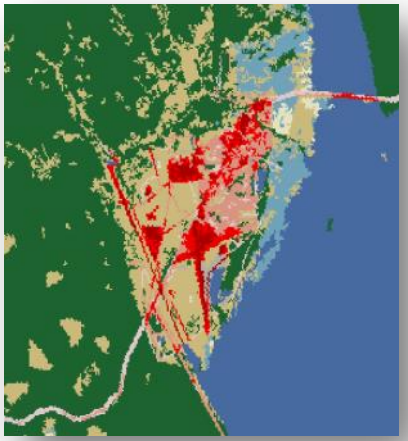
Raster Examples



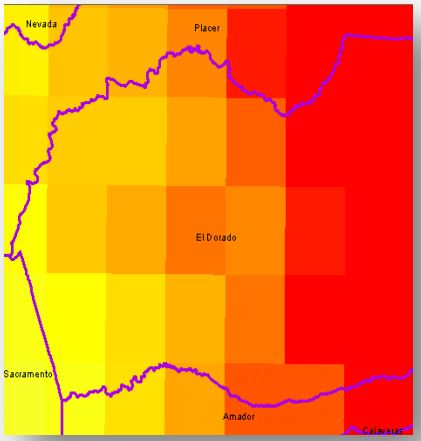
DEM: Digital Elevation Models
Resolution:
1m-1km
(e.g. USGS NED)



Remote Sensing:
Resolution:
0.3m-1km
(e.g. Landsat)



Land Use & Land Cover (raster)
Resolution:
30m-1km
(e.g. GAP Analysis)

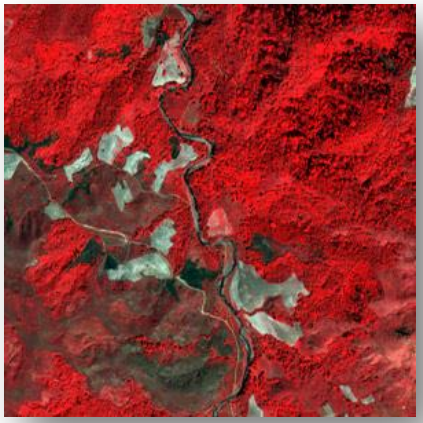


Climate Downscaled
Resolution:
270m-12km
(e.g. Cal Adapt)

Also: Digital Raster Graphics (DRGs); Scanned imagery; Scanned maps

High Spatial Resolution Imagery by Digital Globe

Commissioned for Google Applications



IKONOS
4 bands (+Pan)
3-5 days
1-4m

Quickbird
4 bands (+Pan)
3-5 days
0.7-2.5m

IKONOS and Quickbird decommissioned in 2015

GeoEye
4 bands (+Pan)
3 days
0.4-1.6m

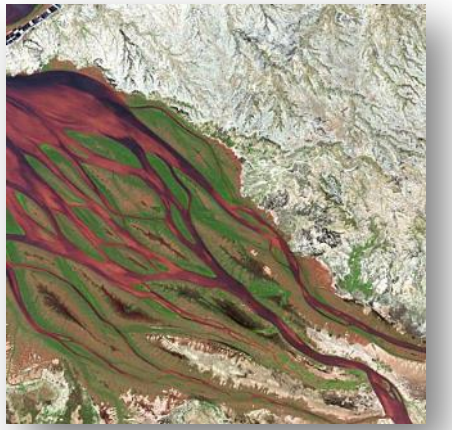
WorldView3
8 bands (+Pan)
Daily
0.3-1.2 m

Sensors: Course Resolution Multispectral

NAIP
4 bands
5 yr return
1m

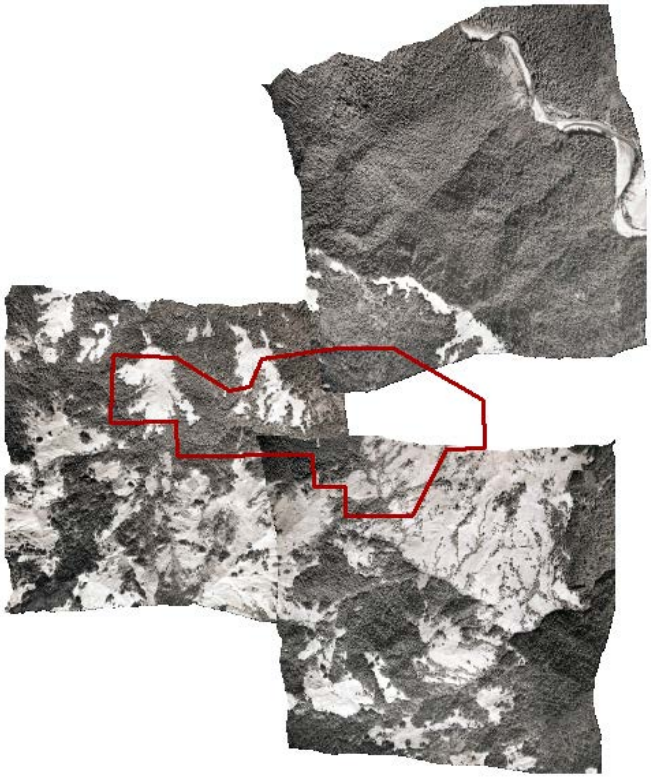
Landsat
6 bands
16-day return
30m,
40 yr record

MODIS
7 bands
Daily
250-500m



SPOT
3 bands (+1Pan)
Daily
10-20m

Historic Imagery



Can be difficult:

- *Location* (finding your study area, and finding imagery to cover it)
- *Georegistration* (located and brought into a GIS)
- *Orthorectify* (corrected for lens distortion and topography)
- *Mosaic* (taking multiple images and assembling them together to cover study area)

Historical and Current Imagery

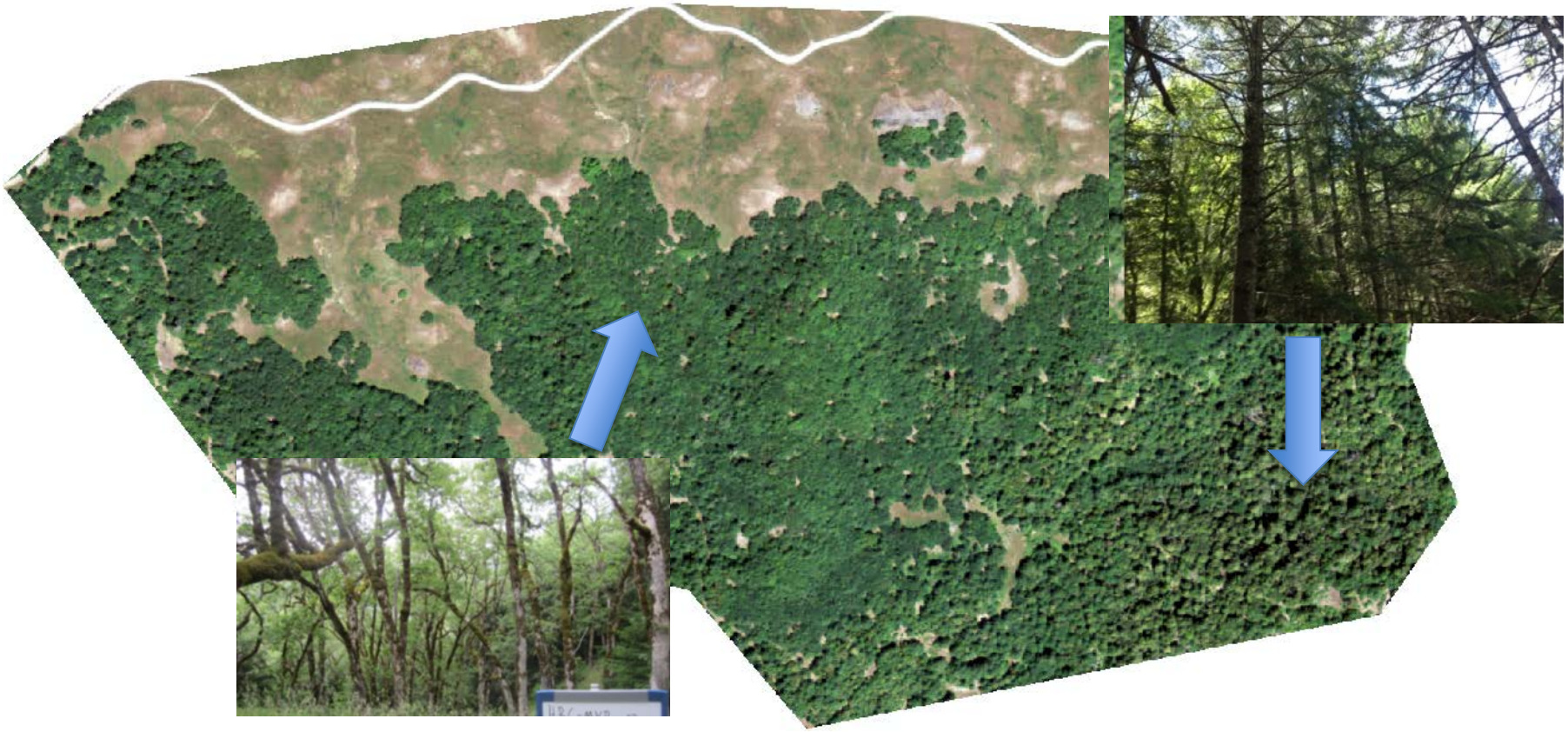
Historic: 1947-1948, flown for the USFS

- Black and white
- Scanned; resulting resolution < 1 meter
- Likely needs lots of preprocessing

Current: National Agricultural Imagery Program (NAIP)

- From 2009, 2012, 2014 (USDA program)
- 4 bands: RGB and infrared
- 1-meter resolution
- Already georegistered and orthorectified

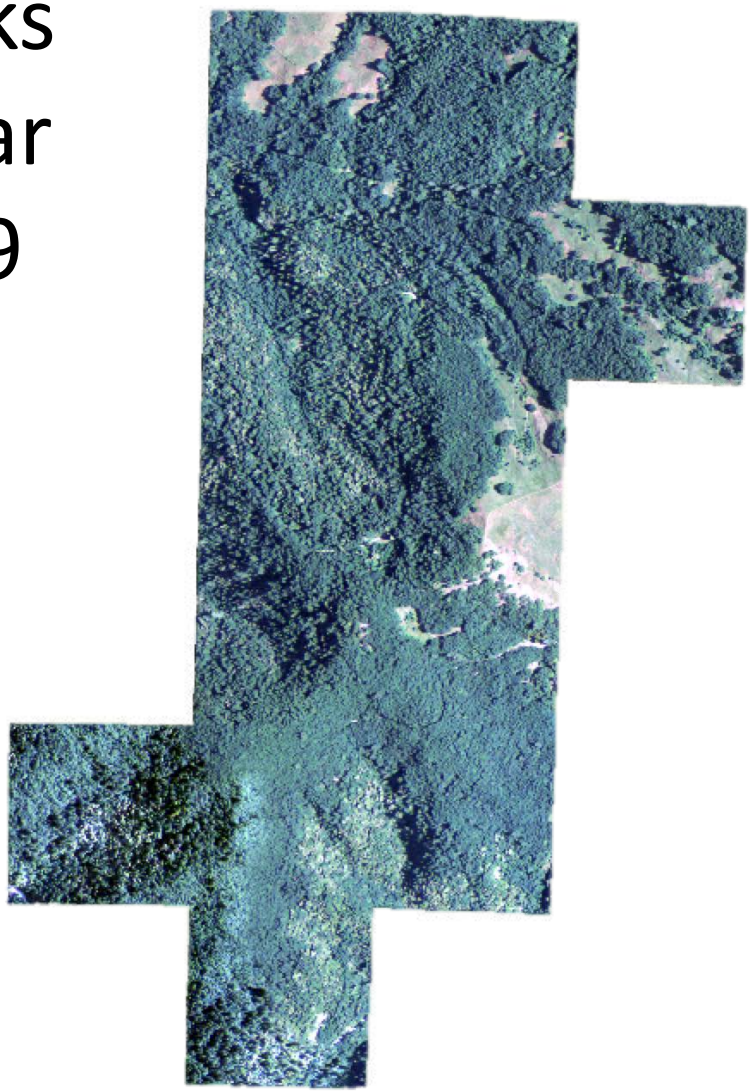
Identifying Vegetation on Historical (and Modern Imagery) can be Challenging



Difference between Oaks and Conifers is Clear Between 1948 and 2009

Difference between Oaks and Conifers is Less Clear Between 1948 and 2009

Part of this is due to shadowing, lighting, and dense canopy



Part 3: Available Imagery and Other GIS Data Resources

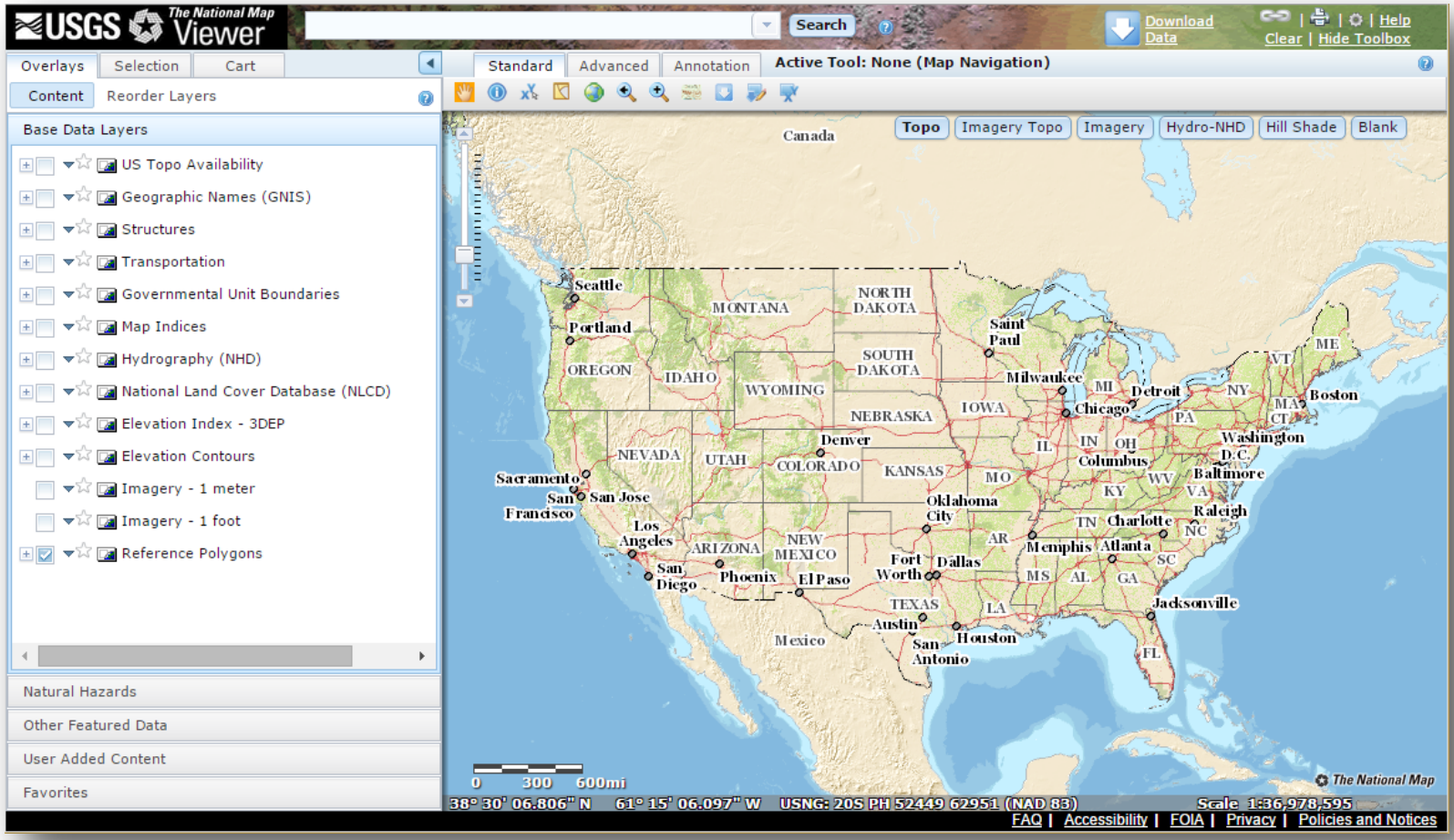
Remote Sensing Imagery and GIS Data

The IGIS Data Resources page:

http://igis.ucanr.edu/Resources/

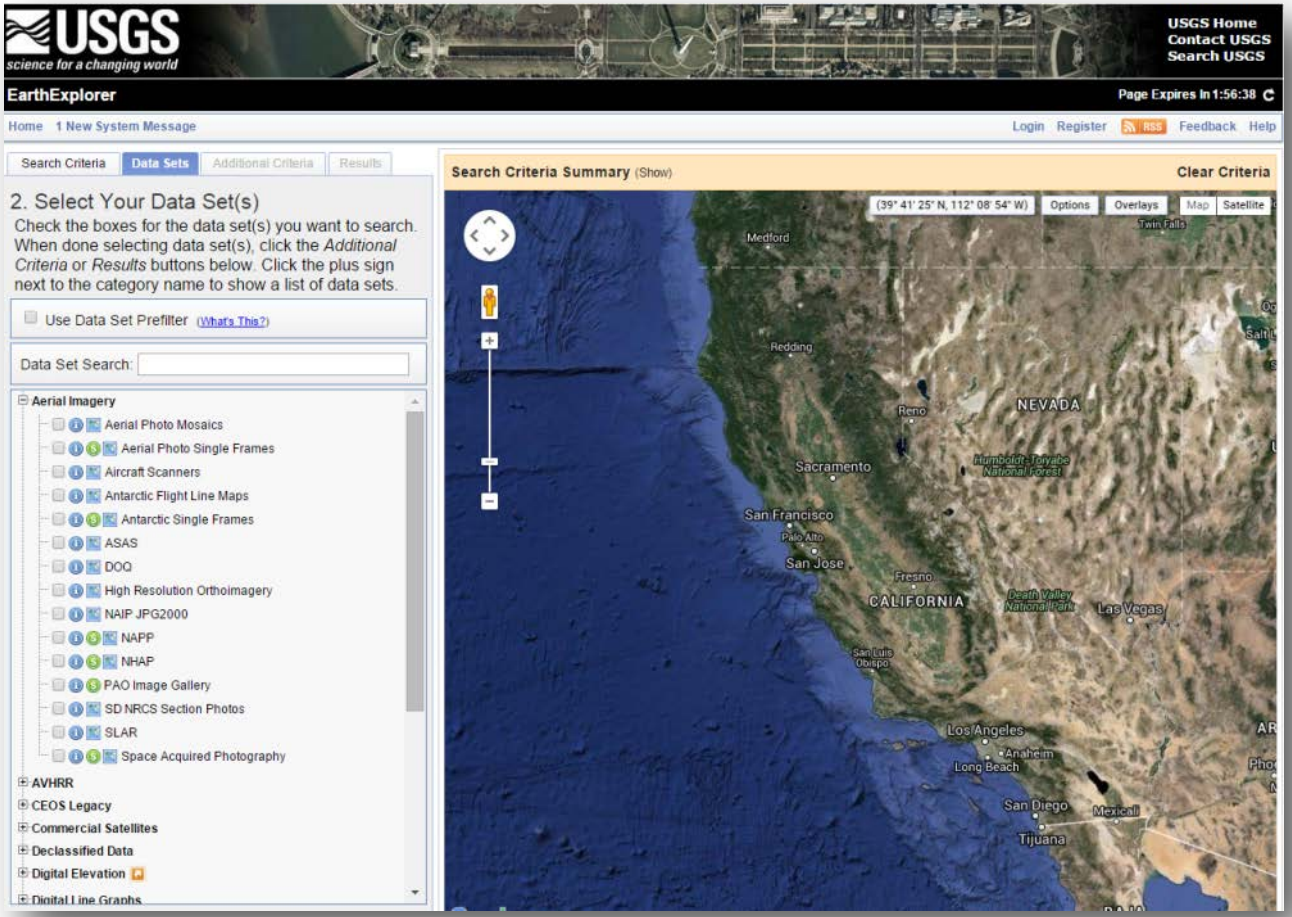
Note that there have been many missions flown in California since the 1940s; however these are not all easy to find.

USGS National Map Viewer



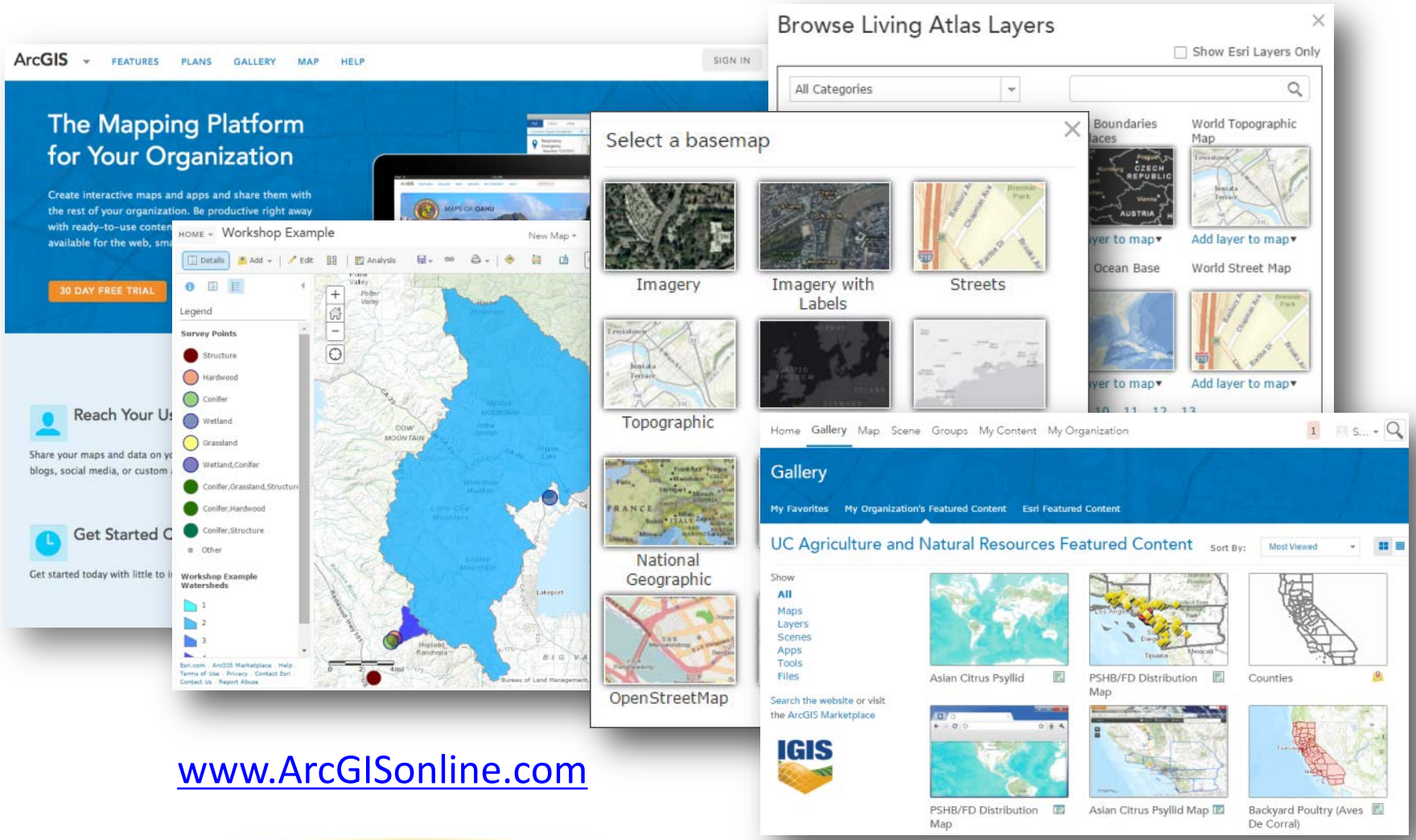
http://viewer.nationalmap.gov/viewer/

USGS Earth Explorer



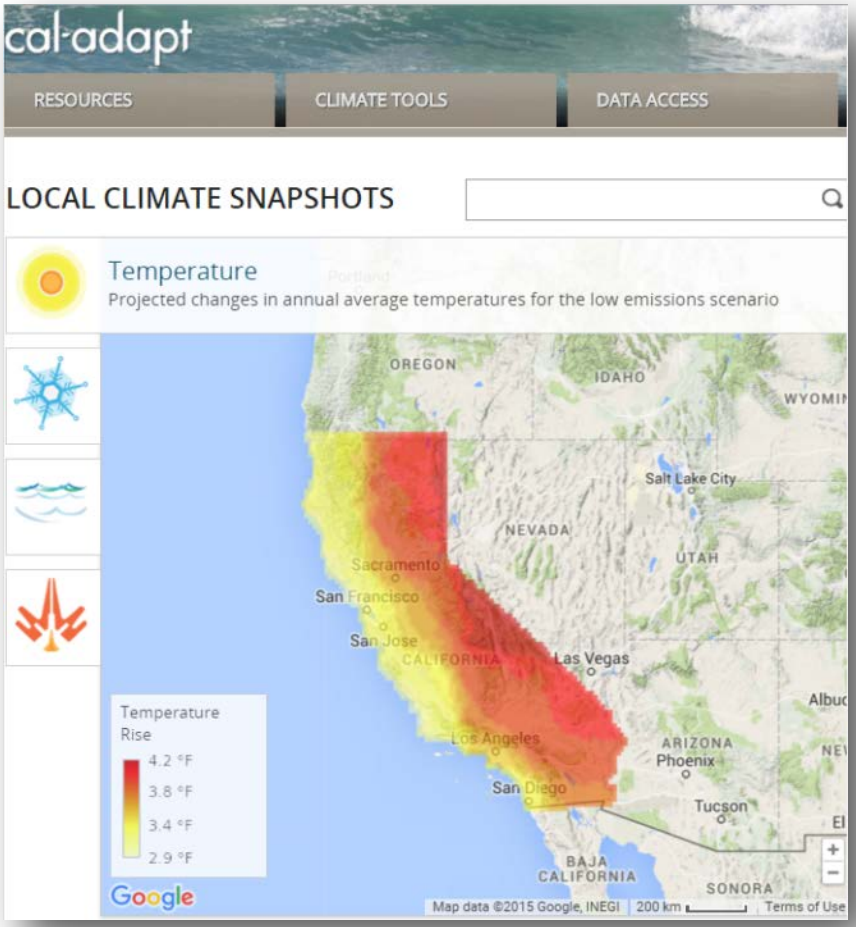
http://earthexplorer.usgs.gov/

ArcGIS Online

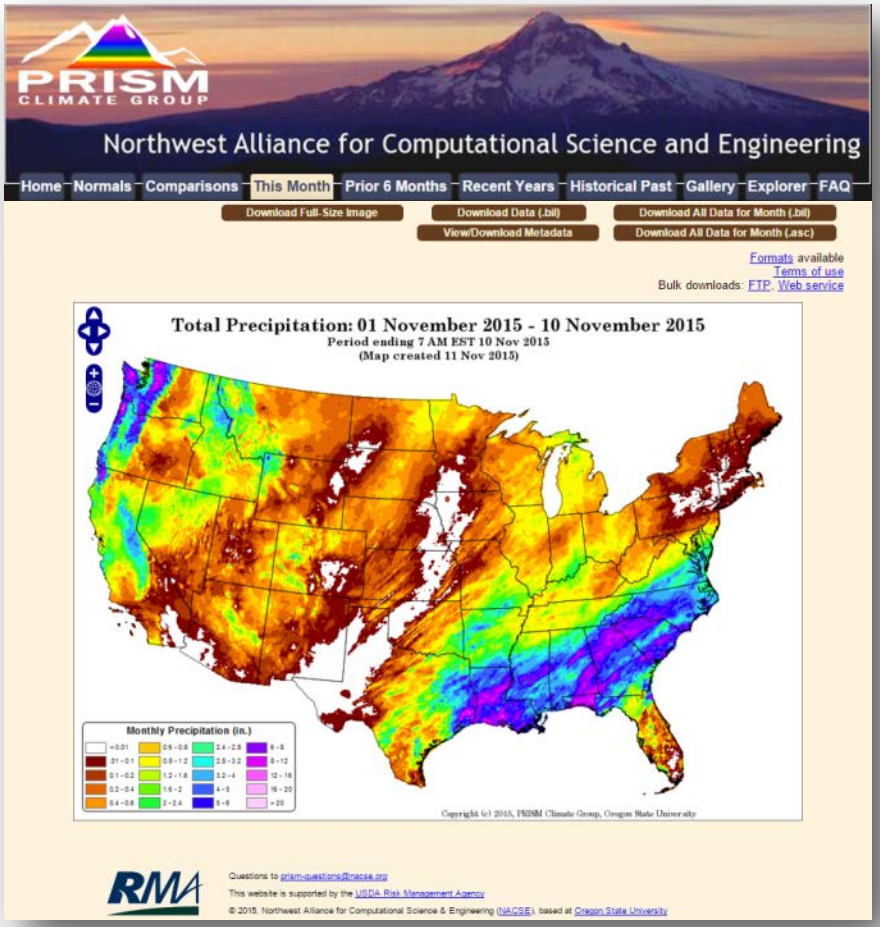


www.ArcGISonline.com

Climate Data



http://cal-adapt.org/



http://www.prism.oregonstate.edu/

Software - GIS & Spatial Analysis

Proprietary: ESRI ArcGIS Desktop, MapInfo, IDRISI, Manifold (low cost)

Open Source Desktop: QGIS, Grass, uDig, SAGA, gvSIG, GMT, R Spatial Packages

Web-based: MapGuide (open source), CartoDB (limited free edition)

Mobile Data Collection

- Orux Maps for Android http://www.oruxmaps.com/
- MotionX GPS for iPhone http://gps.motionx.com/
- ArcGIS Collector App http://doc.arcgis.com/en/collector/
- ArcGIS Survey 123 http://survey123.esri.com/#/home
- ArcGIS Online WebMaps* and WebApps*
  - ArcGIS Geoform* - an ArcGIS Online Web Mapping Application
- Open Data Kit (ODK) https://opendatakit.org/
- GeoODK http://www.geoodk.com/
- AmigoCloud https://www.amigocloud.com/homepage/index
- QGIS for Android
- Avenza's PDF maps: http://www.avenza.com/pdf-maps
- Apps created with AppStudio for ArcGIS

* Online Capabilities Only

Web Mapping Resources

Google

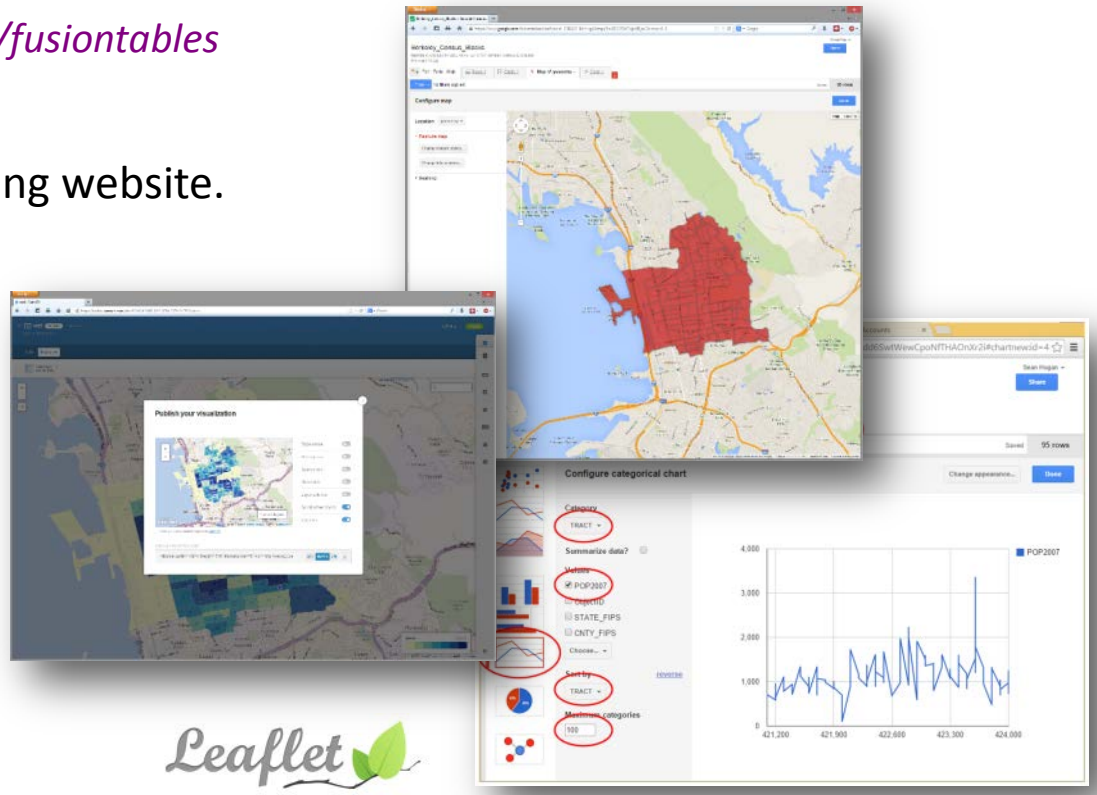
- Google Fusion Tables
  http://www.google.com/fusiontables

ESRI

- ESRI's interactive mapping website.
  http://arcgis.com

Open Source

- CartoDB
  http://cartodb.com/
- MapBox
  http://mapbox.com/
- MapServer API
  http://mapserver.org/
- Leaflet
  http://leafletjs.com/
- Batchgeo
  http://batchgeo.com/features/google-earth-kml/



Software - Remote Sensing

Proprietary: ENVI, ERDAS Imagine, PCI Geomatica, Ecognition, IDRISI, ESRI ArcDesktop

Open Source Remote Sensing Tools:

Orfeo Toolbox, Grass, R, SAGA, QGIS, Opticks, OSSIM, ILWIS, Python packages (Rasterio, scikit-learn, scikit-image)

Free (but not open source) Remote Sensing Tools:

Web-based: Google Earth Engine (currently free to Trusted Testers)

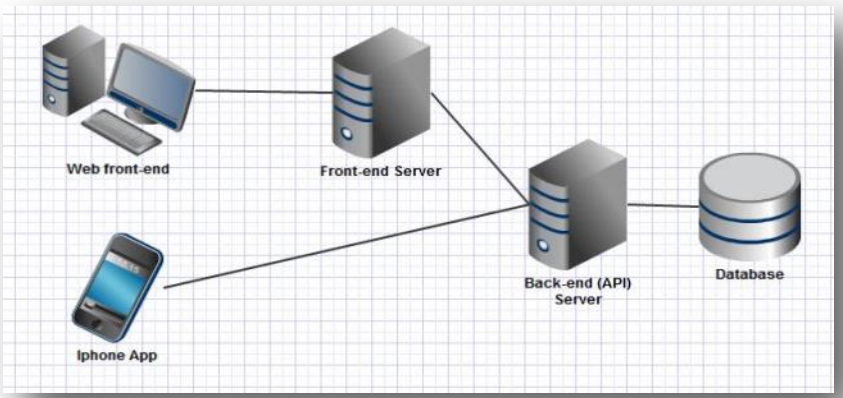
Part 4: Future Technology

Future Technology: Drones/UAVs

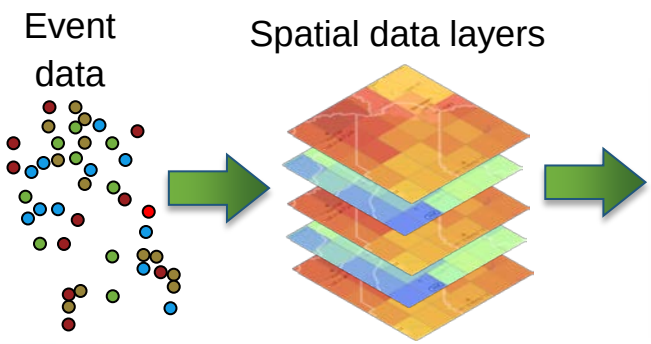
Photo credit: Will Suckow, UC ANR

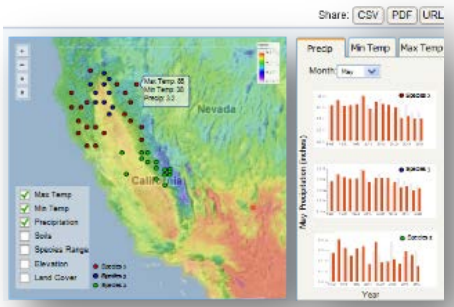
http://agribotix.com/

Future Technology: Integration via APIs

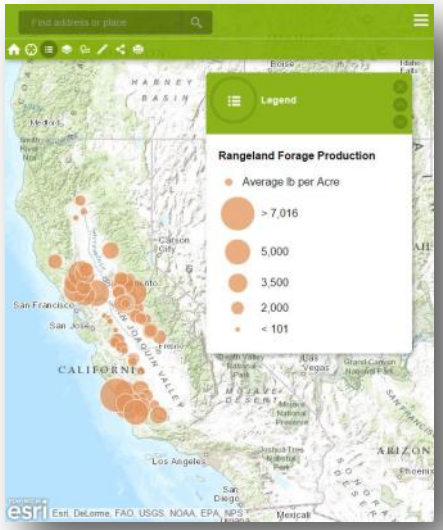


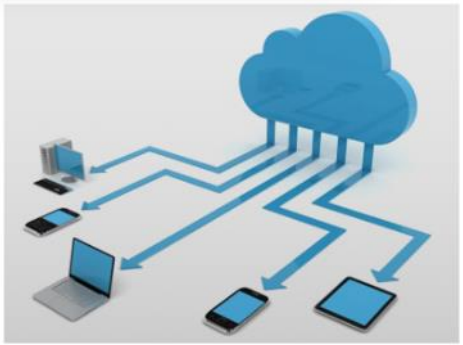
Data Integration





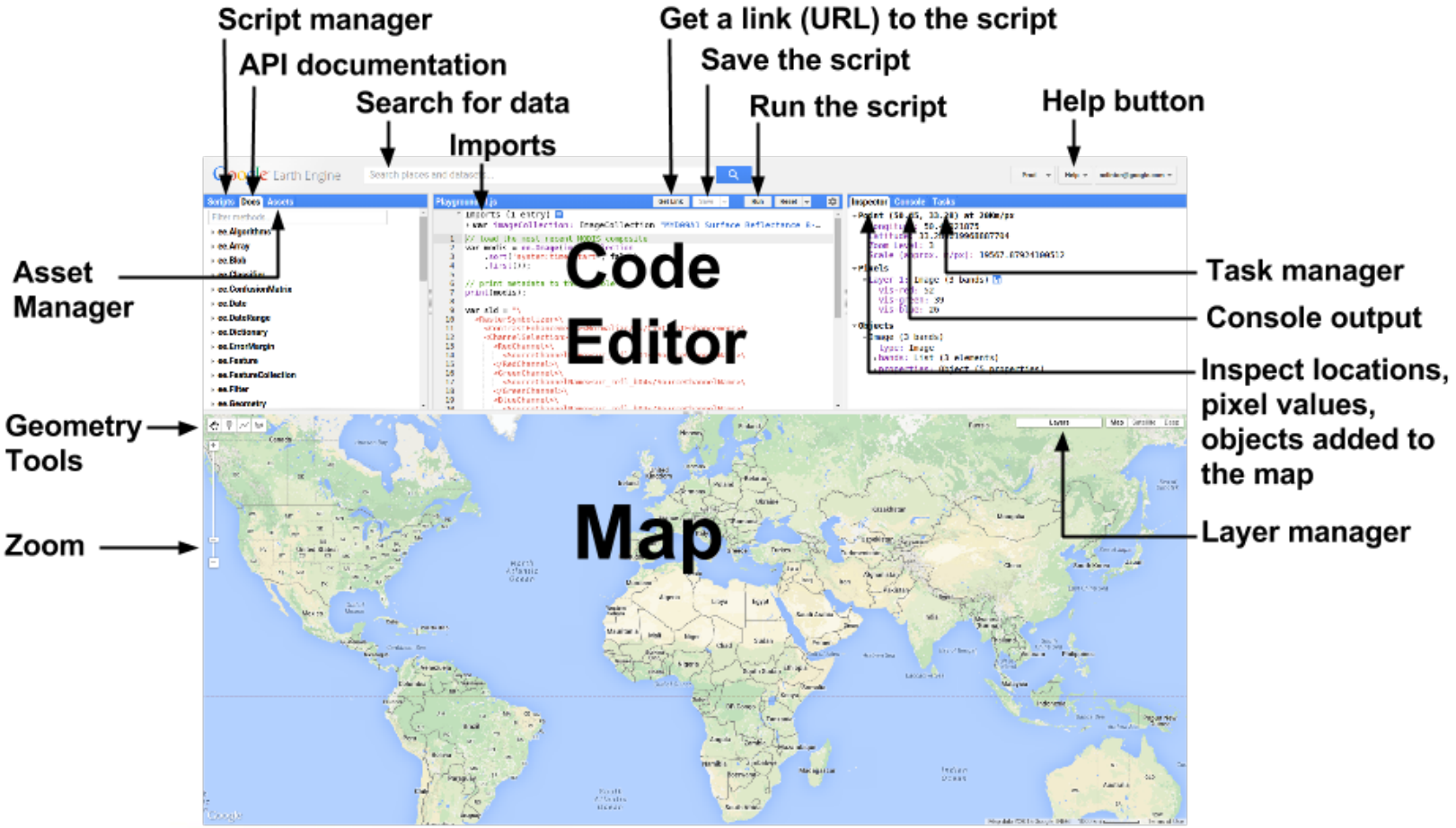
Future Technology: Cloud Computing





Future Technologies: Google Earth Engine & Distributed Cloud Computing

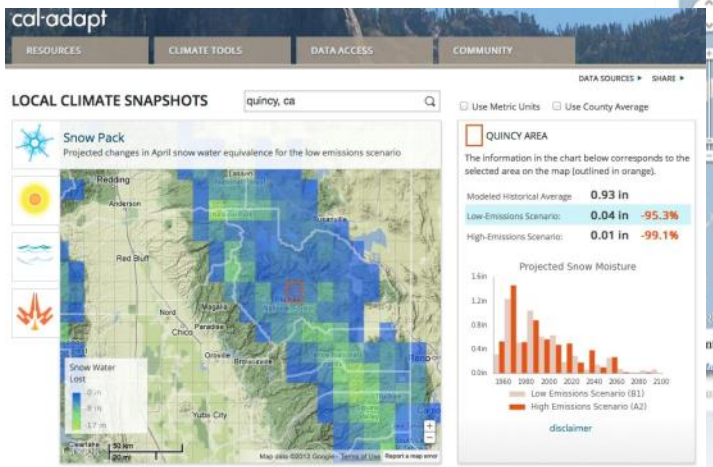
Future Technologies: Google Earth Engine Playground



Future Technologies: Mobile Apps

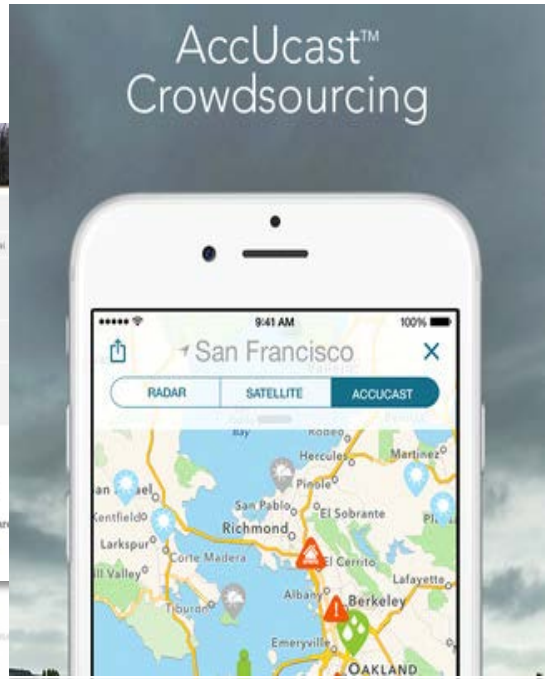
Future Technologies: More Public Participation

web mapping/visualization



citizen involvement

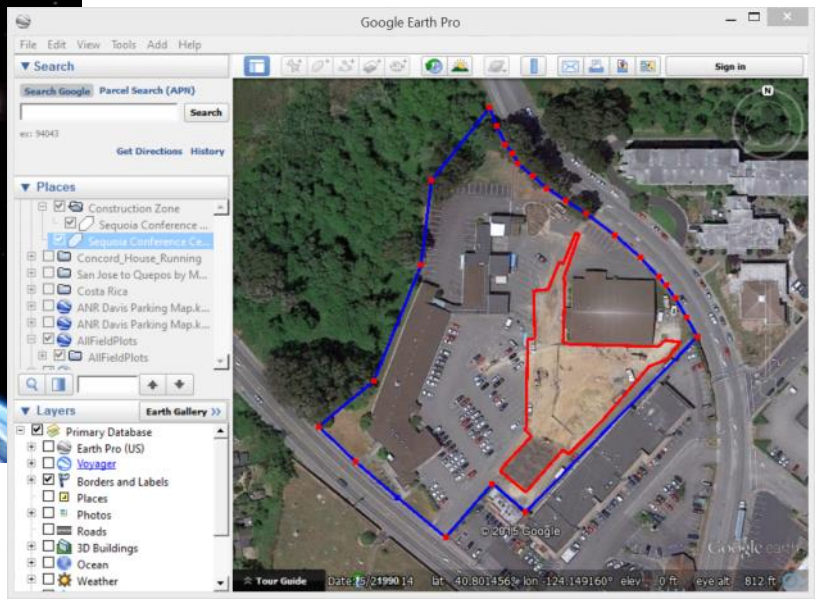
disaster response



Part 5: On-line Exercise for Mapping Your Property

Free Mapping of Your Property

The best option is likely going to be Google Earth, using the Time Slider Option

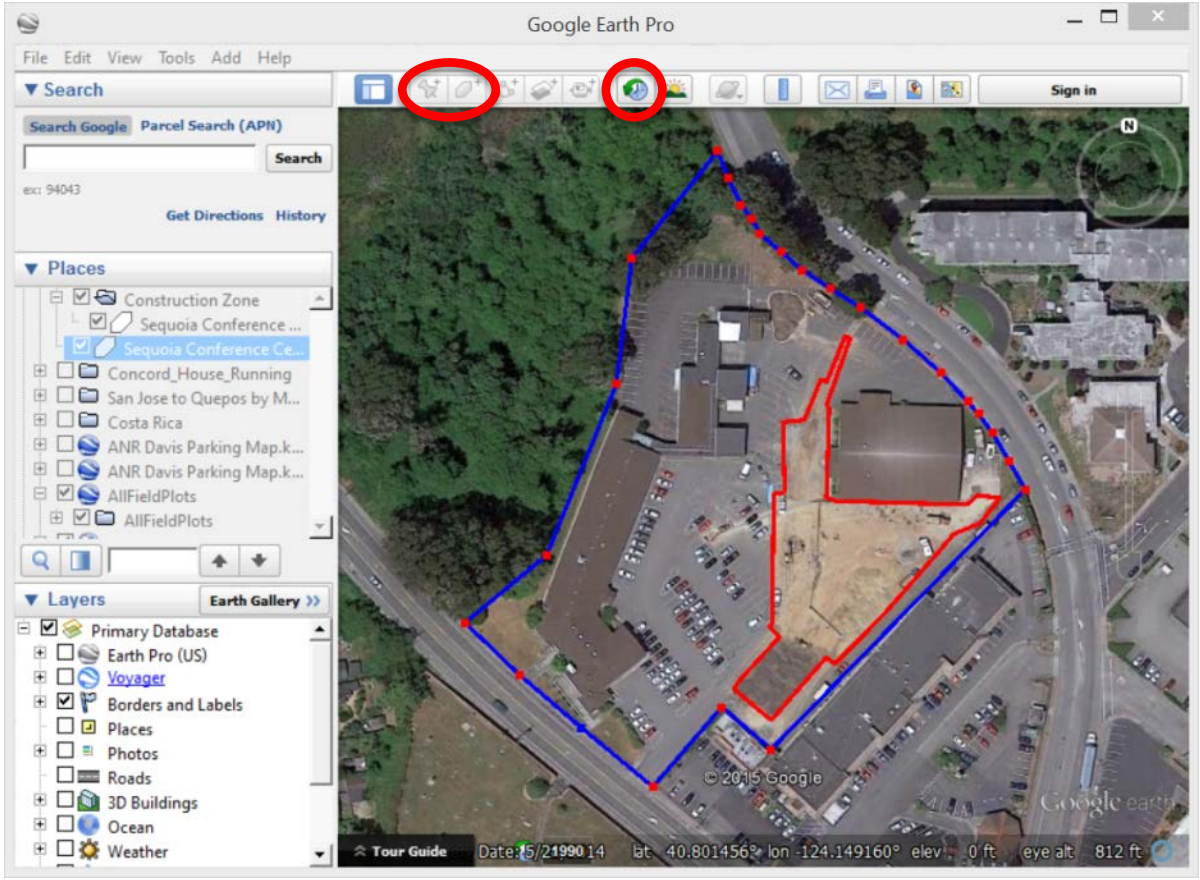


https://support.google.com/earth/answer/176160?hl=en (Download)

https://support.google.com/earth/answer/176576?hl=en (Tutorial)

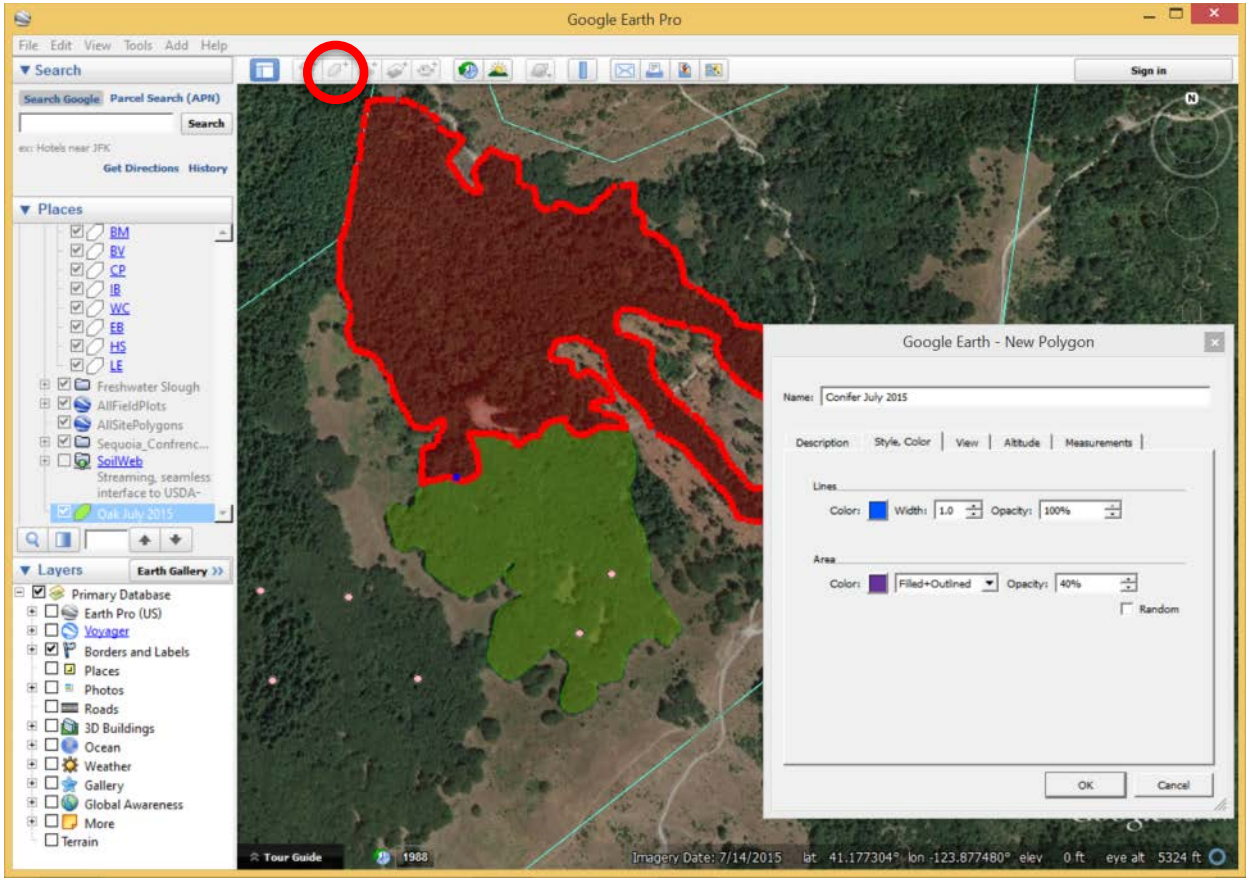
Free Mapping of Your Property

Digitizing and Time Slider Options



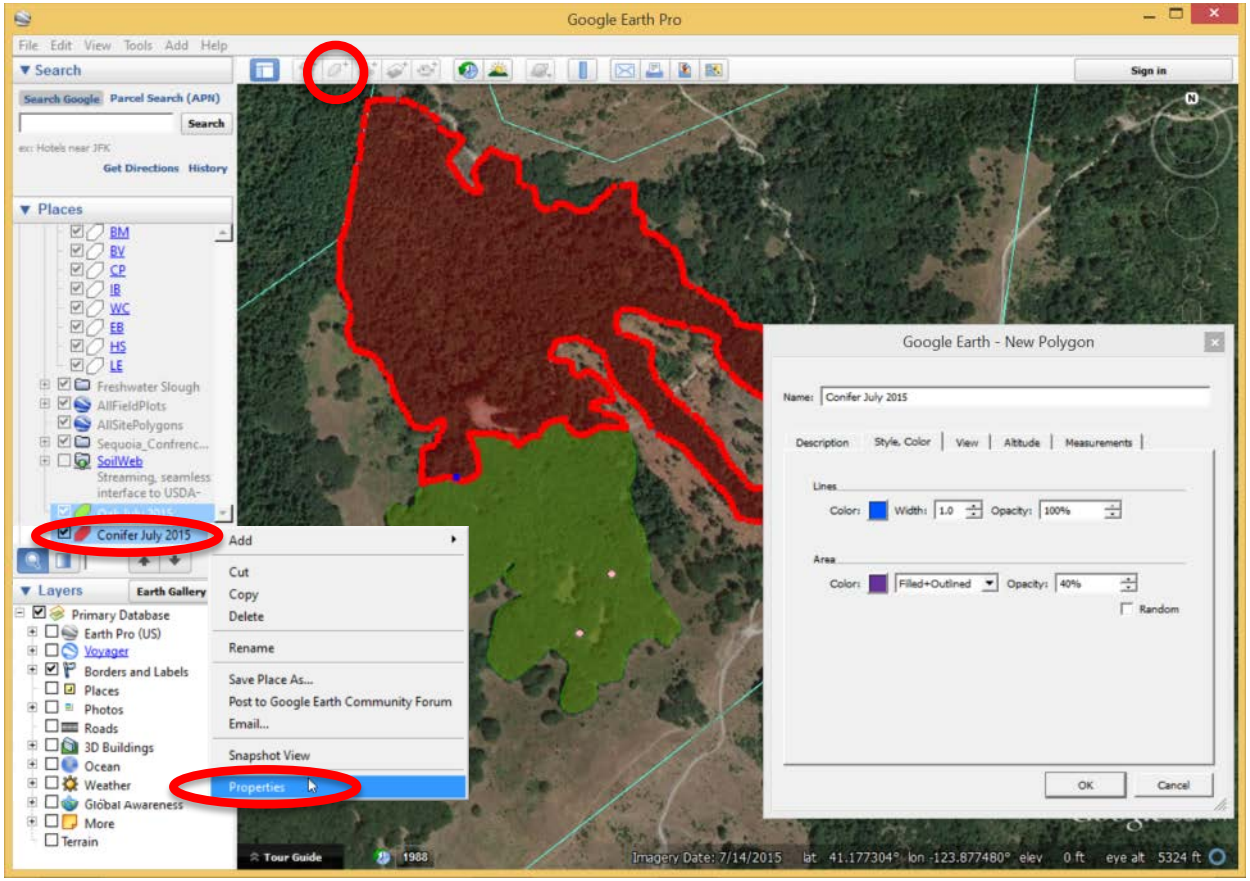
Free Mapping of Your Property

Digitizing and Time Slider Options



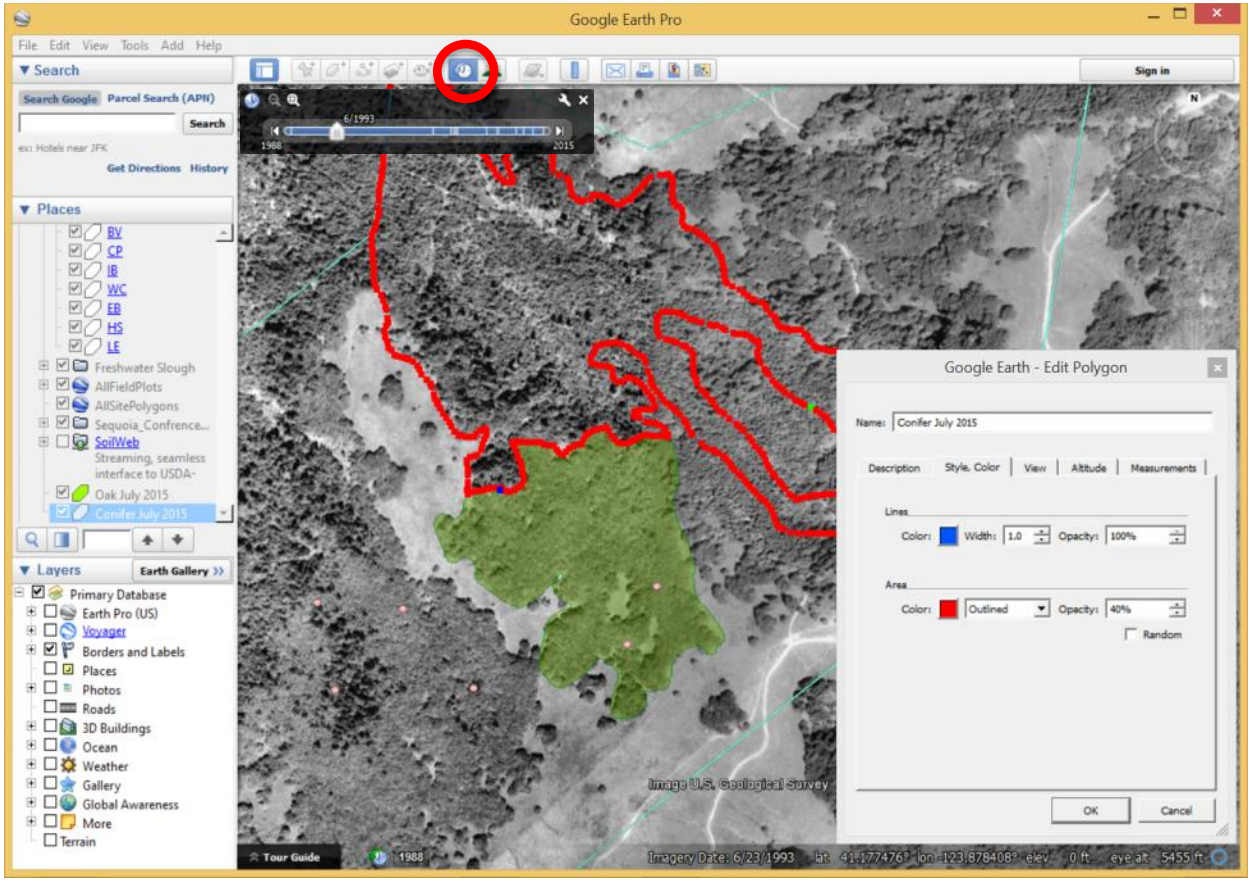
Free Mapping of Your Property

Digitizing and Time Slider Options



Free Mapping of Your Property

Digitizing and Time Slider Options

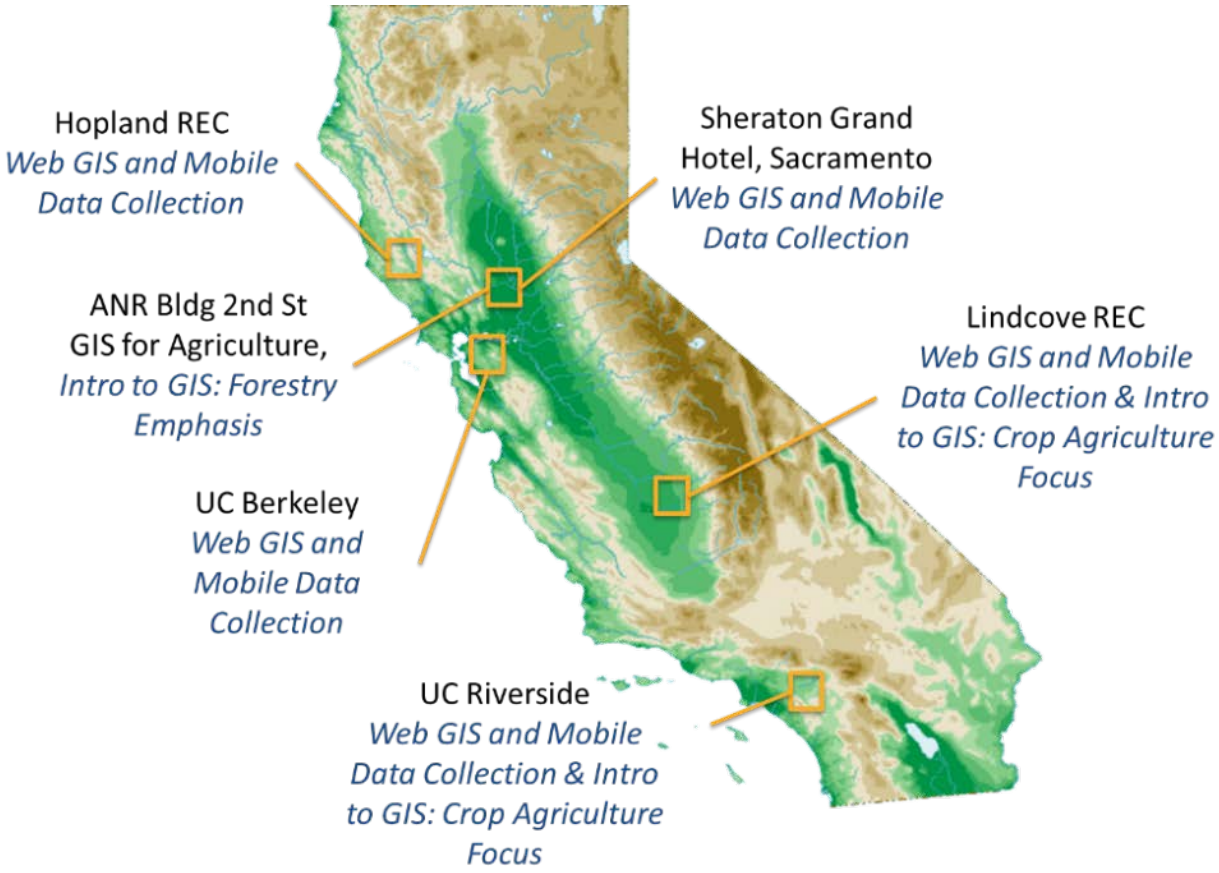


Where to Find More Information

More Information on the IGIS Program

http://igis.ucanr.edu/

Upcoming IGIS Training



http://igis.ucanr.edu/IGISTraining/

Fri, Nov 20
10am-4pm
UC ANR Building, Davis
WebGIS and Mobile Data Collection

Fri, Dec 4
1pm-5pm
UC Berkeley
WebGIS and Mobile Data Collection

Thur, Jan 21
11am-4pm
Lindcove Research and Extension Center
Intro to GIS: Crop Agriculture Focus

Fri, Jan 22
10am-3pm
Lindcove Research and Extension Center
Web GIS and Mobile Data Collection

Thanks!

Sean Hogan, sdhogan@ucanr.edu
Shane Feirer, stfeirer@ucanr.edu

http://igis.ucanr.edu/