



# *Mapping and Informatics Skill Development Workshop*



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

November 12<sup>th</sup>, 2015

Sean Hogan, [sdhogan@ucanr.edu](mailto:sdhogan@ucanr.edu)

Shane Feirer, [stfeirer@ucanr.edu](mailto:stfeirer@ucanr.edu)



**University of California**

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# 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



**University of California**

Agriculture and Natural Resources

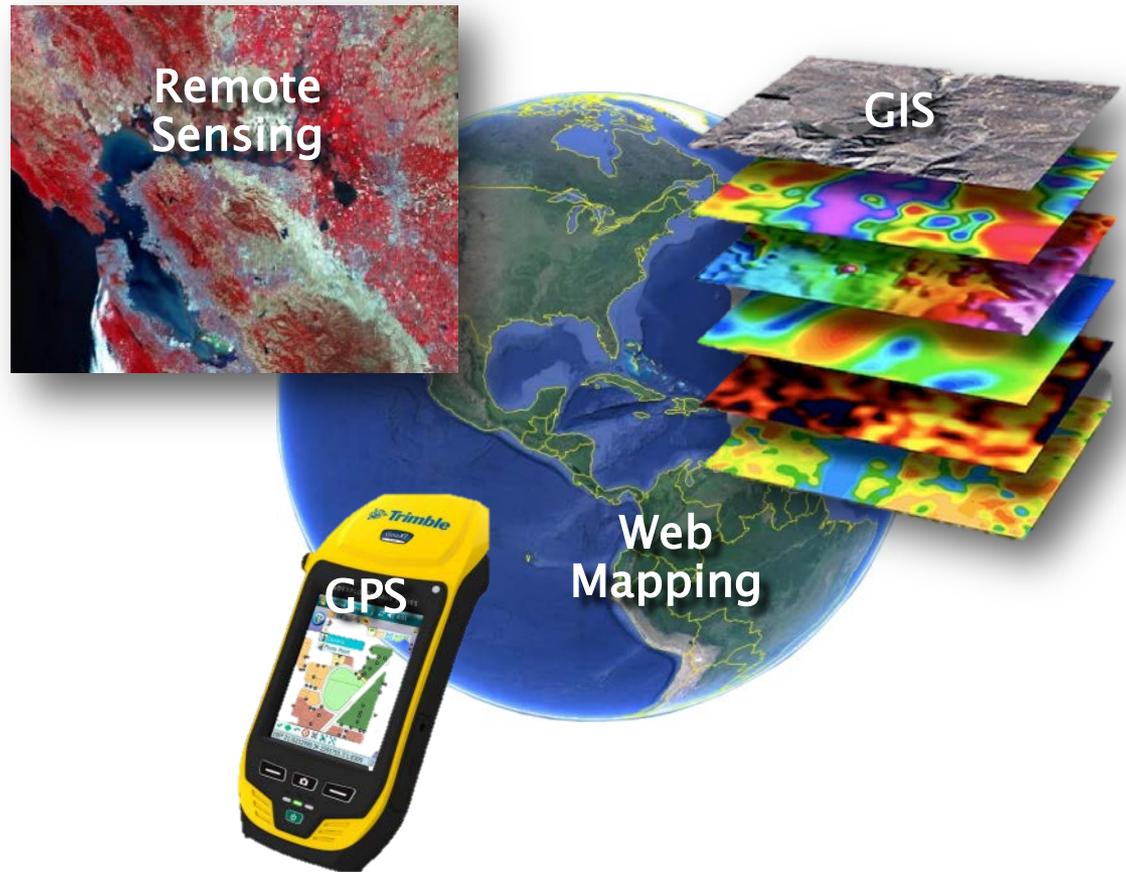
InformatICS and GIS Statewide Program

# Integrated Geospatial Technologies

Support:

- research,
- management, and
- outreach

Through analysis and visualization of agriculture and natural resources



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

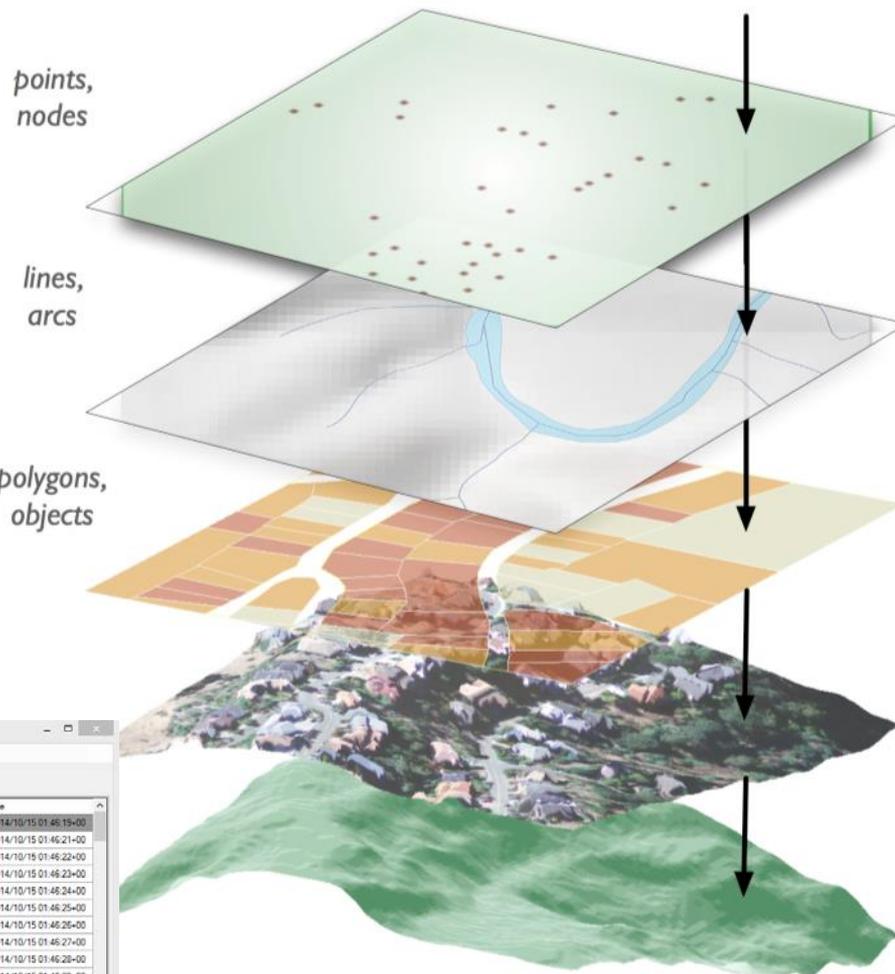
# Geographical Information Systems

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.

( $x, y, z$ ):  
(longitude, latitude, attribute)



| type      | ident                     | ident | Latitude    | Longitude     | y_pmg       | x_pmg         | comment | new_kk | new_pmg | display | color | altitude | depth | temp | time                   |
|-----------|---------------------------|-------|-------------|---------------|-------------|---------------|---------|--------|---------|---------|-------|----------|-------|------|------------------------|
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54218551 | -121.71345436 | 38.54218551 | -121.71345436 |         | True   | True    |         |       | 32.08    |       |      | 2014/10/15 01:46:19+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54218288 | -121.71346708 | 38.54218288 | -121.71346708 |         | False  | False   |         |       | 32.18    |       |      | 2014/10/15 01:46:21+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54209041 | -121.71338884 | 38.54209041 | -121.71338884 |         | False  | False   |         |       | 27.53    |       |      | 2014/10/15 01:46:22+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.5419754  | -121.7134213  | 38.5419754  | -121.7134213  |         | False  | False   |         |       | 25.31    |       |      | 2014/10/15 01:46:23+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54193388 | -121.71341541 | 38.54193388 | -121.71341541 |         | False  | False   |         |       | 26.74    |       |      | 2014/10/15 01:46:24+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54192333 | -121.71341278 | 38.54192333 | -121.71341278 |         | False  | False   |         |       | 28.11    |       |      | 2014/10/15 01:46:25+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54194308 | -121.71342544 | 38.54194308 | -121.71342544 |         | False  | False   |         |       | 28.6     |       |      | 2014/10/15 01:46:26+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54200742 | -121.71346012 | 38.54200742 | -121.71346012 |         | False  | False   |         |       | 29.29    |       |      | 2014/10/15 01:46:27+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.5420316  | -121.71347002 | 38.5420316  | -121.71347002 |         | False  | False   |         |       | 31.53    |       |      | 2014/10/15 01:46:28+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54203658 | -121.71347144 | 38.54203658 | -121.71347144 |         | False  | False   |         |       | 32.51    |       |      | 2014/10/15 01:46:29+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54205902 | -121.71347064 | 38.54205902 | -121.71347064 |         | False  | False   |         |       | 32.38    |       |      | 2014/10/15 01:46:30+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54206777 | -121.71347604 | 38.54206777 | -121.71347604 |         | False  | False   |         |       | 32.39    |       |      | 2014/10/15 01:46:31+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54207682 | -121.71346557 | 38.54207682 | -121.71346557 |         | False  | False   |         |       | 31.48    |       |      | 2014/10/15 01:46:32+00 |
| Undefined | 2014-10-14 18:44 practice | T1    | 38.54208498 | -121.71346584 | 38.54208498 | -121.71346584 |         | False  | False   |         |       | 31.08    |       |      | 2014/10/15 01:46:33+00 |

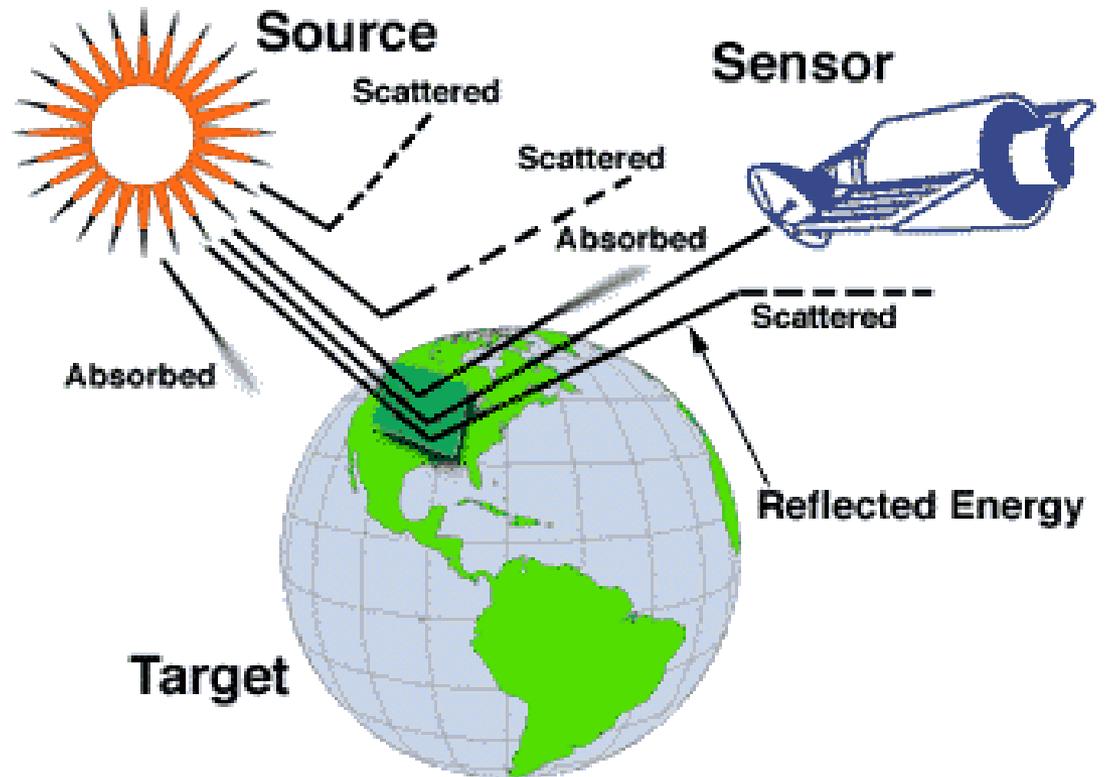


University of California

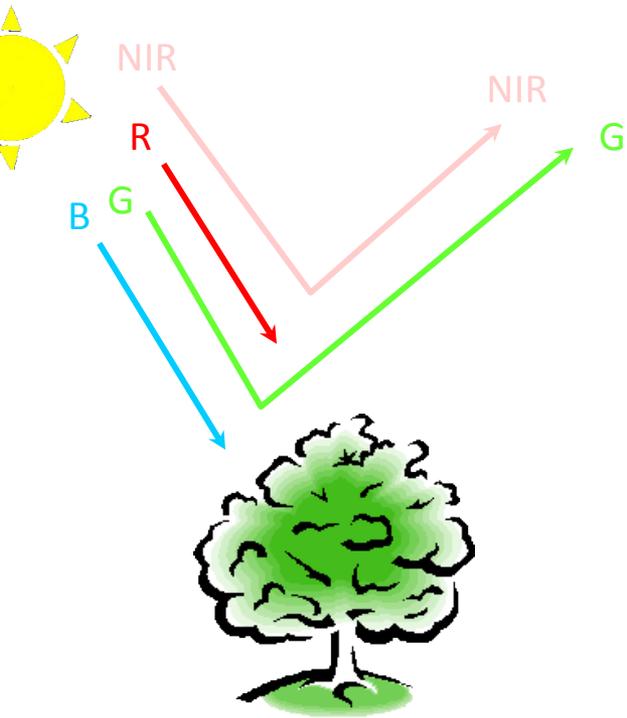
Agriculture and Natural Resources

Informatics and GIS Statewide Program

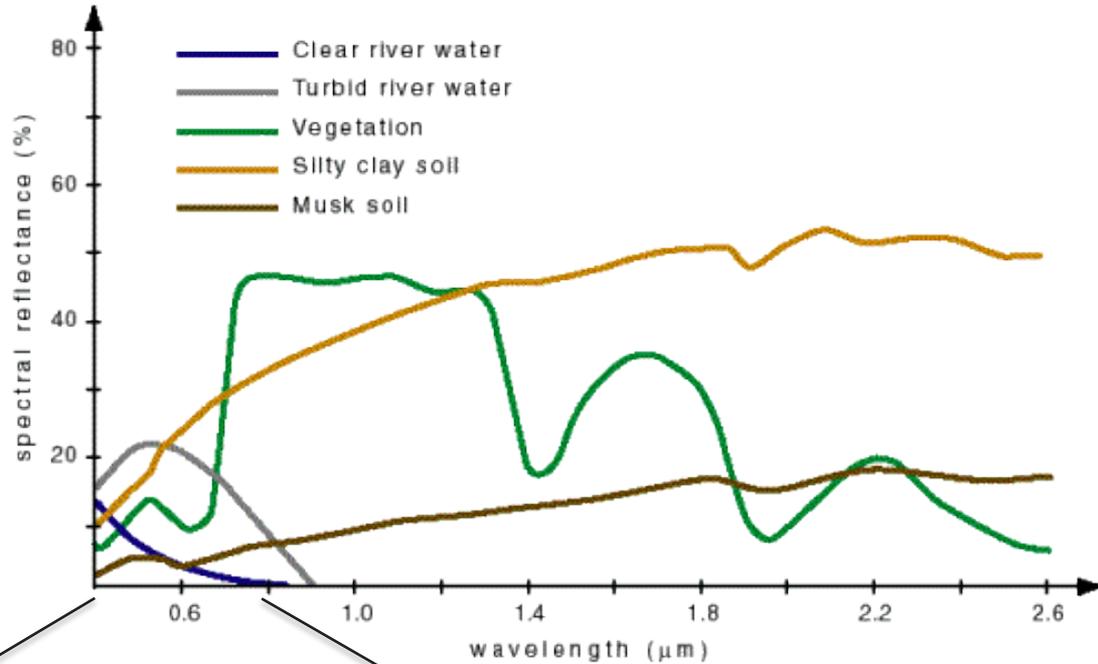
# Basics of Remote Sensing



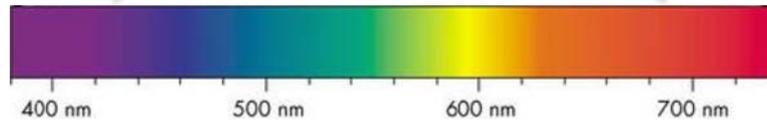
# Remote Sensing of Vegetation



Light reflecting from vegetation...



Visible Light

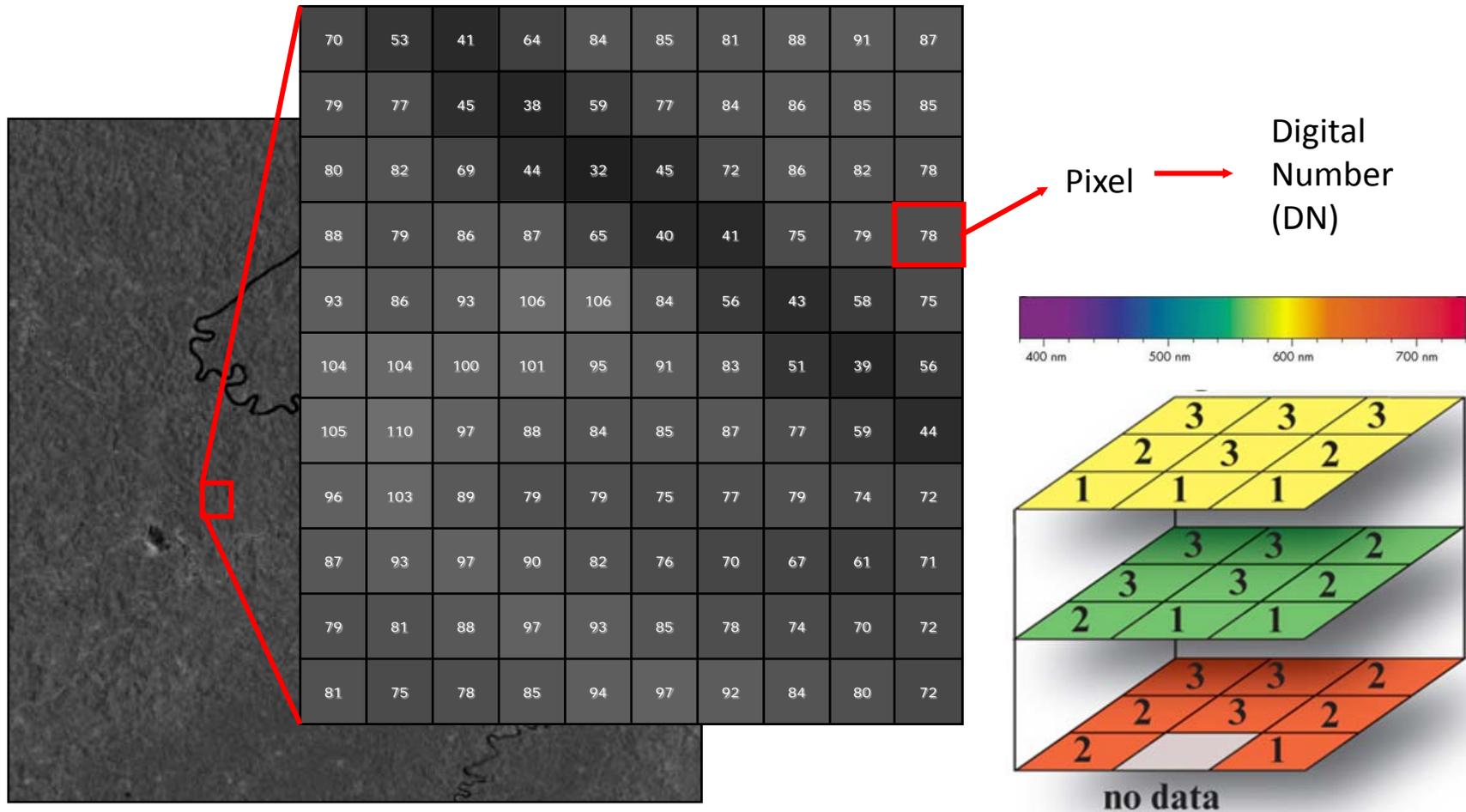


University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Remote Sensing Imagery & Bands



# GPS: Global Positioning Systems

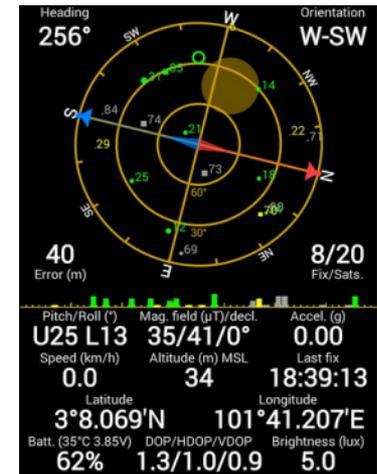
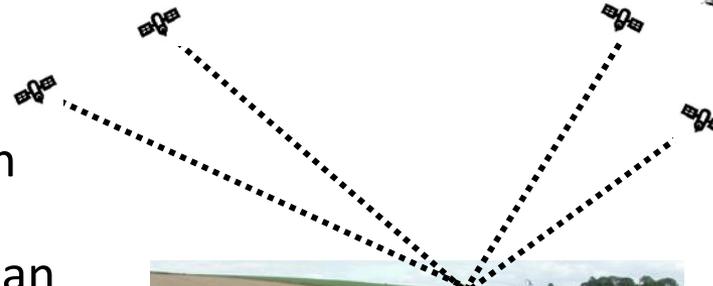
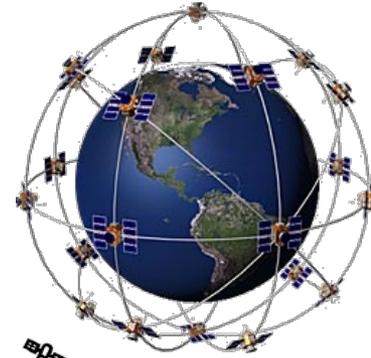
24 -32 active satellites make up civilian GPS

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**



University of California

Agriculture and Natural Resources

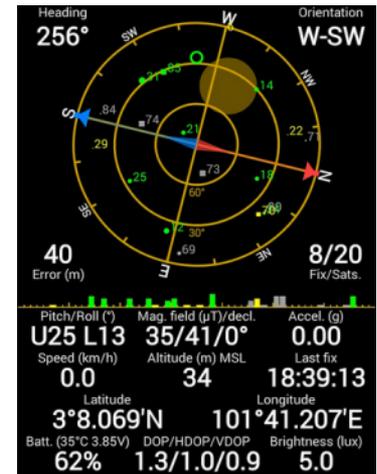
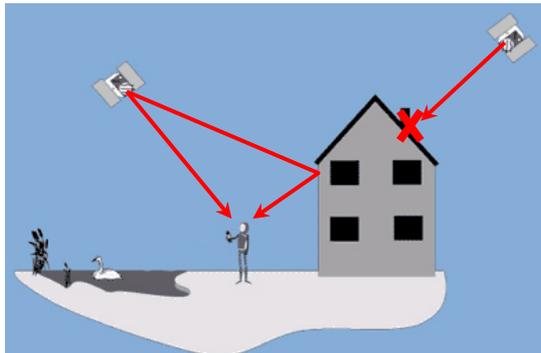
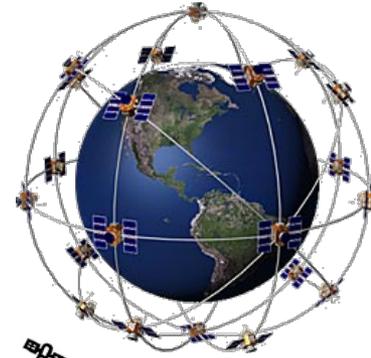
Informatics and GIS Statewide Program

# 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



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# GPS Devices

Recreational-grade

Mapping-grade

Survey-grade

**GARMIN**

 **DELORME**

 **Trimble**



**TOMTOM**



**MAGELLAN**



| 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



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Survey123

## HOW IT WORKS

Survey123 for ArcGIS is about you allowing everyday people to collect data efficiently in the field and using that information to make better decisions.

Here's how it works:

# 1

### Ask Questions

Design surveys in a spreadsheet. Use Survey123 Connect to upload your surveys to ArcGIS.

# 2

### Get the Answers

Get the Survey123 for ArcGIS mobile app from the [Google Play](#) and [Apple App Store](#), download surveys and start collecting data.

# 3

### Make the Best Decisions

Use the power of maps and ArcGIS to analyze facts from the field, gain insights, and make your best calls.

<http://survey123.esri.com/>

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

The screenshot shows the Survey123 mobile app interface for a 'Workshop Survey'. The background is a photograph of a tree trunk. The interface includes the following elements:

- Project Name:** A text input field containing 'Oak Symposium'.
- Unique ID:** A text input field containing '111'.
- Was this site burned?:** Radio button options for 'Yes' and 'No', with 'No' selected.
- Type of land cover at this site?:** A list of checkboxes for 'Coniferous Forest', 'Mixed Hardwood', 'Grassland', 'Wetland', and 'Built Structures', all of which are currently unchecked.
- Click and drag to adjust the survey position:** A text instruction above a map.
- GPS coordinates can only be collected when outside.** A text instruction above the map.
- Map:** A map showing the current location in Eureka, CA, with a red pin and a green compass icon. The map displays coordinates: Lat 40.801°N Lon 124.149°S ± 60 m.
- Take a Picture:** A button at the bottom of the screen.

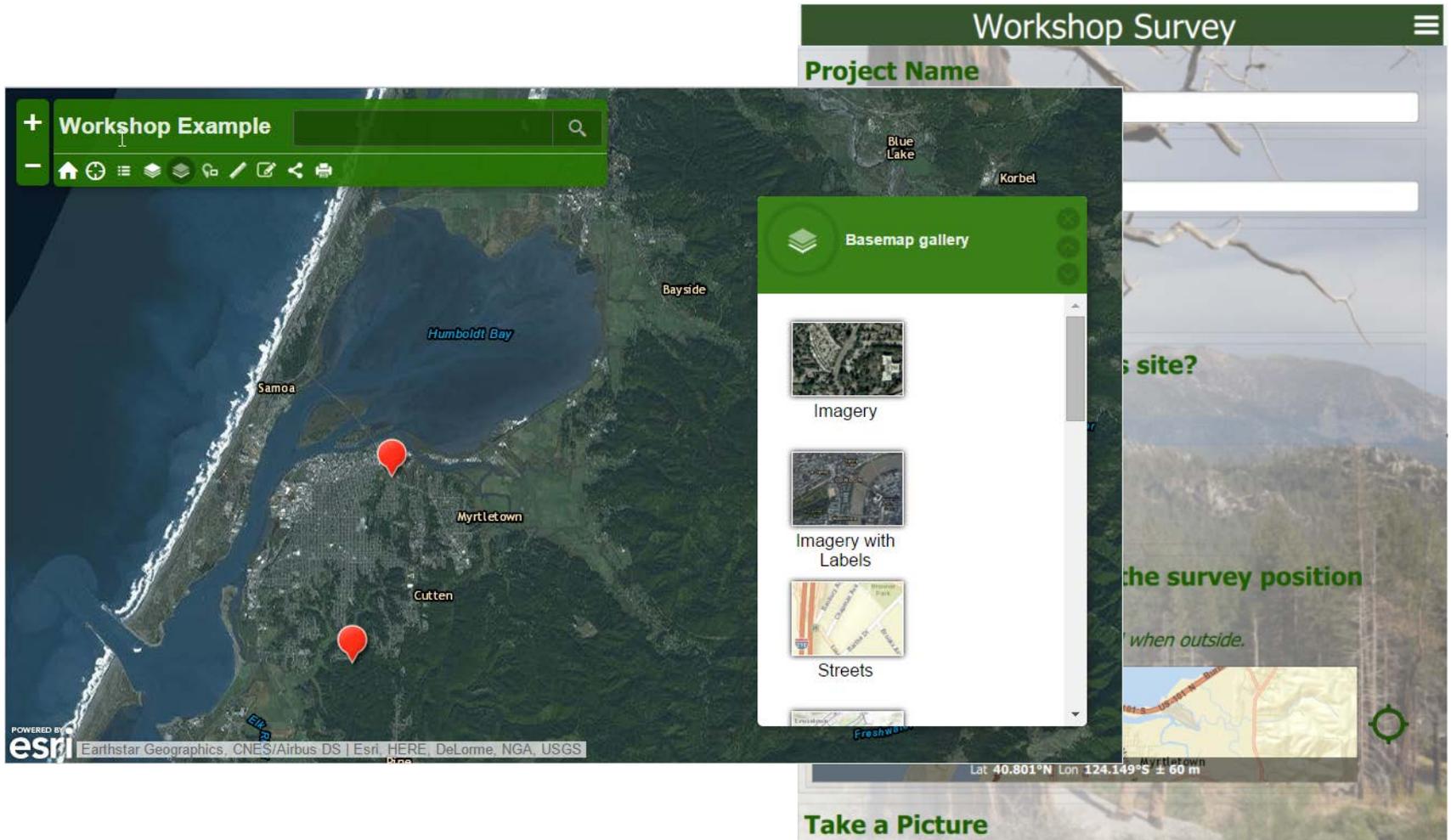


University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Survey123



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# 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

**Google Maps JavaScript API Example: Reverse Geocoder - Mozilla Firefox**  
http://code.google.com/apis/maps/documentation/

orig latlng:40.732104,-73.995624  
latlng:-73.9957087,40.7319885  
Status Code:200  
Status Request:geocode  
Address:1-27 E 8th St, New York, NY 10003, US  
Accuracy:8  
Country code:US

**California Naturalist Maps**  
ucanr.maps.arcgis.com/home/webmap/viewer.html?webmap=29a60965

**PLUMAS COUNTY FIRE SAFE COUN...**  
ucanr.maps.arcgis.com/home/webmap/viewer.html?webmap=268703ec4

**TEMPERATURE: DECADAL AVERAGES MAP**  
cal-adapt.org/temperatures/decadal

**REC Mobile App Beta 2**  
ucanr.maps.arcgis.com/apps/viewer/index.html?appid=c8550989670493c9d73c68e32716084

**HOTS**  
cal-adapt.org/tools/farmcheck

**Counties: Lassen County**  
FORMALNAME Lassen County  
NAME\_UCASE LASSEN  
ABBREV LAS  
STATE CA  
FPS 035  
ABCODE c018  
NUM 18

**WUI Boundaries (2011)**  
**Communities At Risk**  
**California Map (Web Mercator)**  
Red: Band\_1  
Green: Band\_2  
Blue: Band\_3

**Legend**  
Bioregions  
BAY AREA/Delta  
CENTRAL COAST  
COLORADO DESERT  
Klamath/NORTH COAST  
MODOC  
MOSIAVE  
SACRAMENTO VALLEY  
SAN JOAQUIN VALLEY  
SIERRA  
SOUTH CO

**Legend**  
WUI Boundaries (2011)  
Communities At Risk  
California Map (Web Mercator)  
Red: Band\_1  
Green: Band\_2  
Blue: Band\_3

**Legend**  
Tubere County Area  
Tubere County Area  
Tubere County Area  
Tubere County Area

**Legend**  
WUI Boundaries (2011)  
Communities At Risk  
California Map (Web Mercator)  
Red: Band\_1  
Green: Band\_2  
Blue: Band\_3

**Legend**  
WUI Boundaries (2011)  
Communities At Risk  
California Map (Web Mercator)  
Red: Band\_1  
Green: Band\_2  
Blue: Band\_3

**Legend**  
WUI Boundaries (2011)  
Communities At Risk  
California Map (Web Mercator)  
Red: Band\_1  
Green: Band\_2  
Blue: Band\_3



# WebGIS Development

## “Open Source” or Free

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



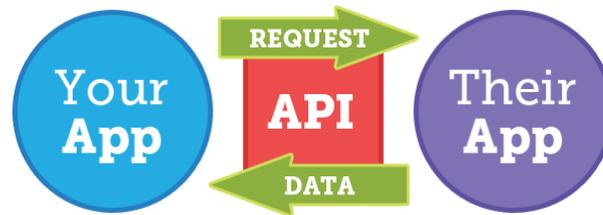
## Proprietary

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



# APIs: Application Programming Interface

An **A**pplication **P**rogramming **I**nterface 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).



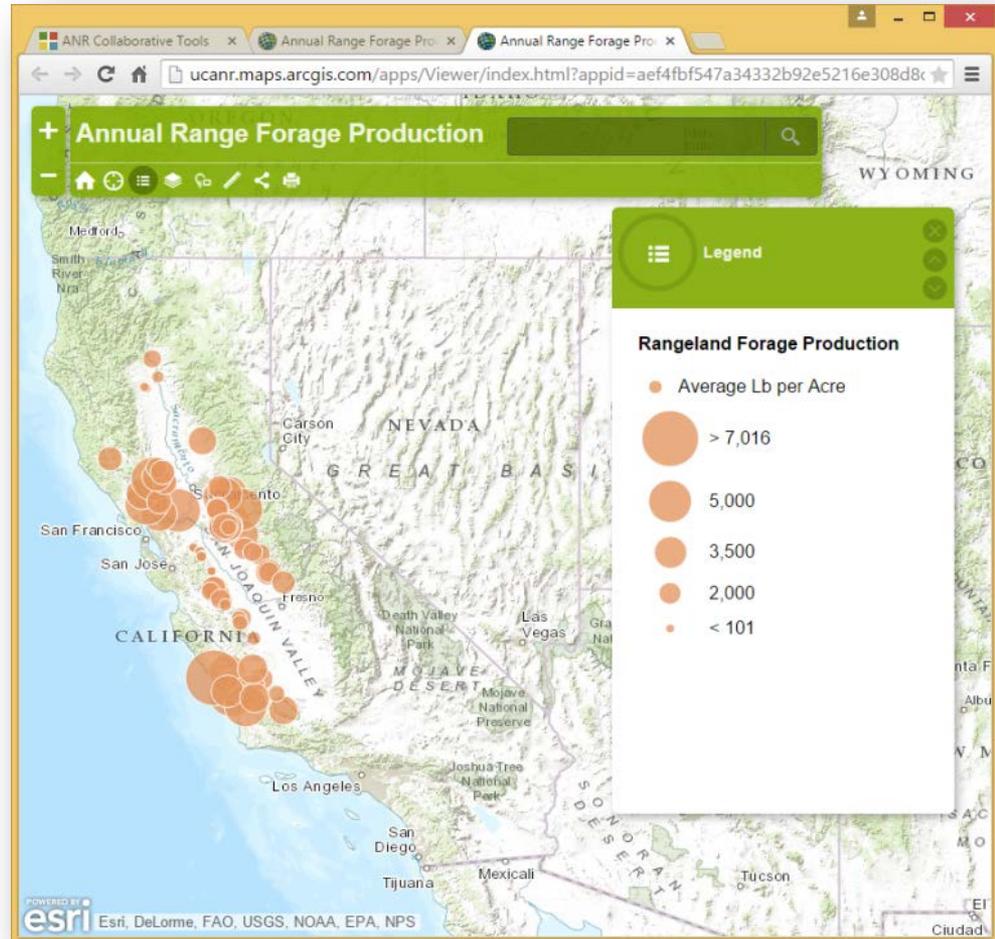
Examples:

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

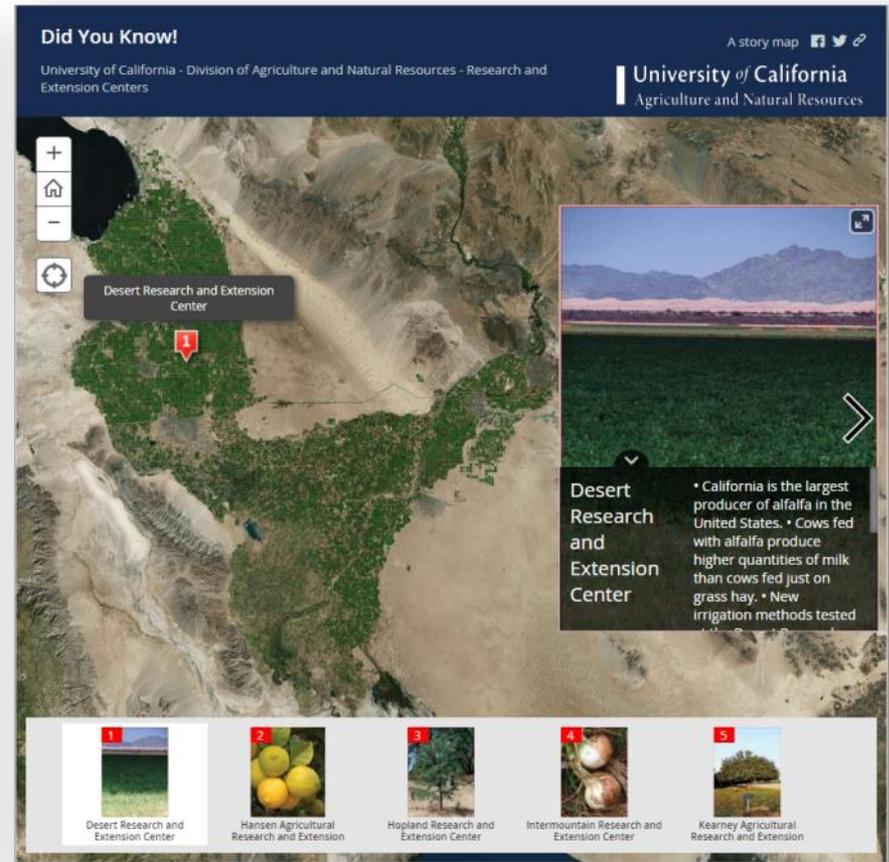
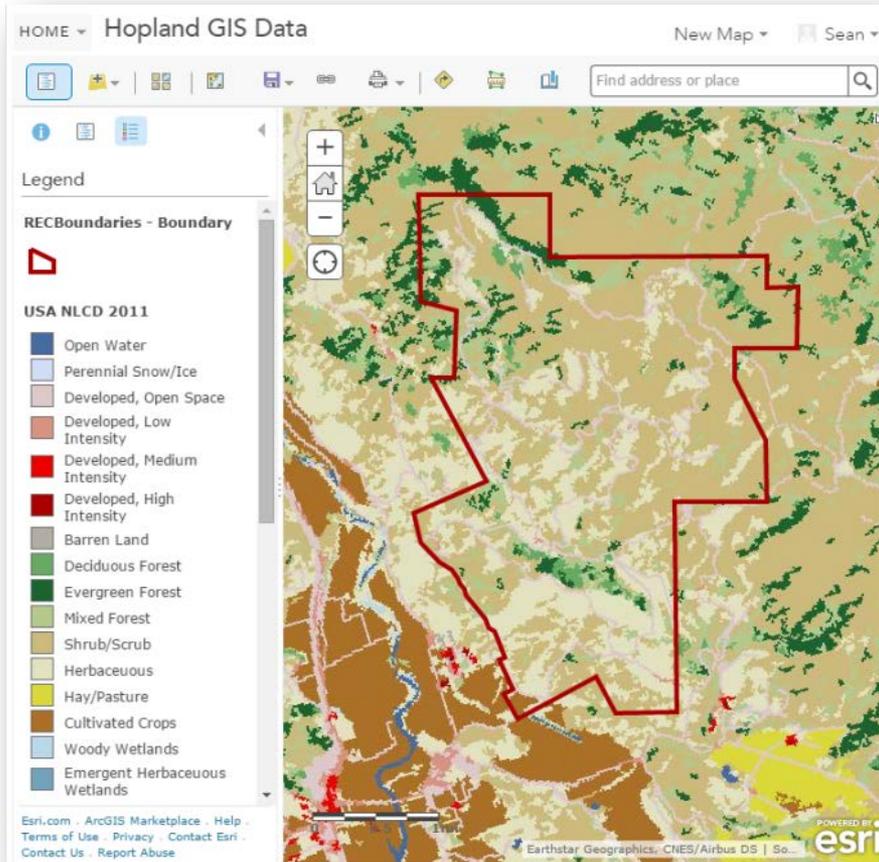


# ArcGIS Online

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



# ArcGIS Online



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

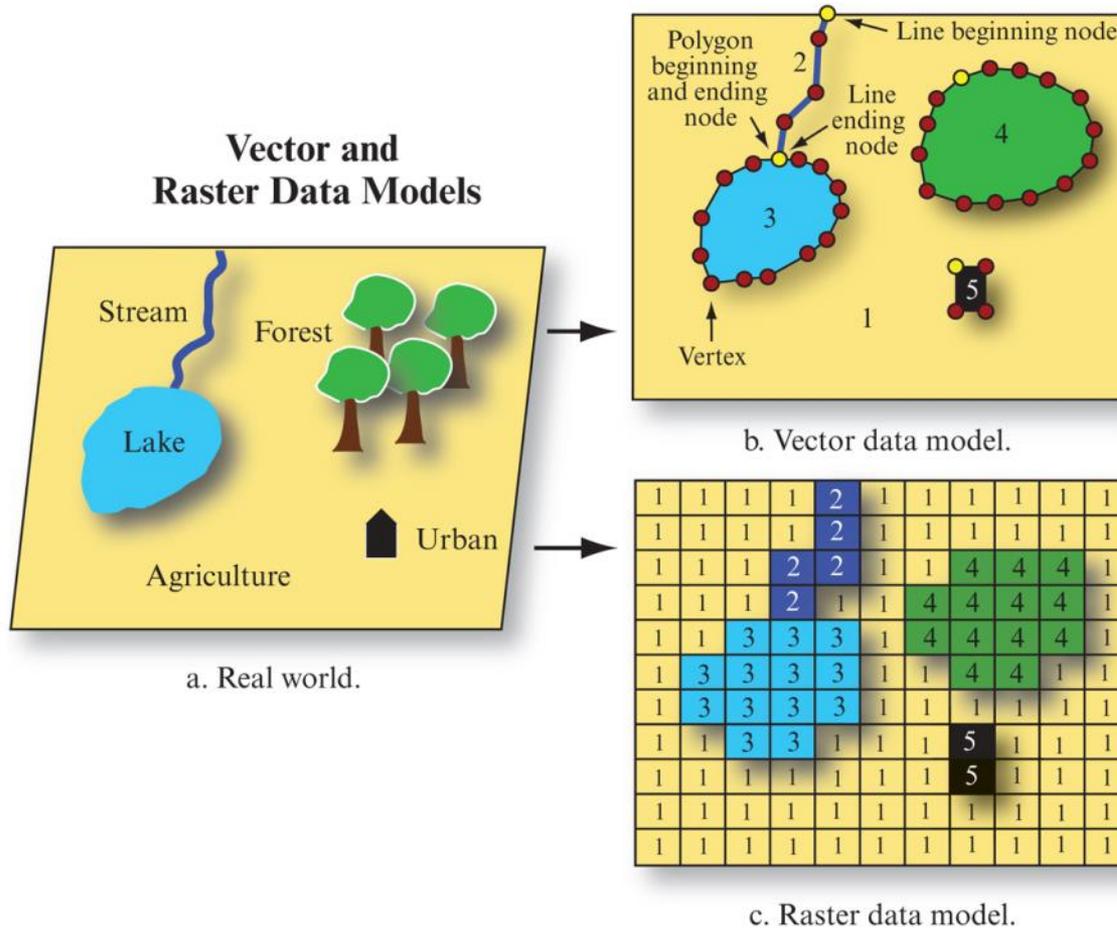
# Part 2: Spatial Data Basics



**University of California**

Agriculture and Natural Resources | InformatICS and GIS Statewide Program

# Types of GIS Data



© 2013 Pearson Education, Inc.



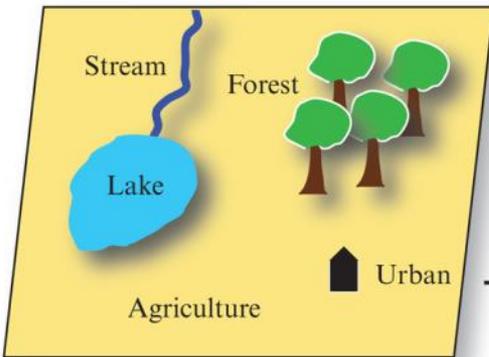
University of California

Agriculture and Natural Resources

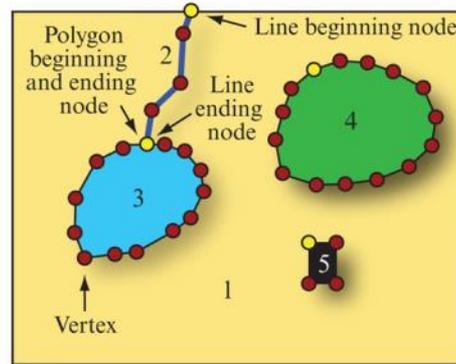
Informatics and GIS Statewide Program

# Types of GIS Data

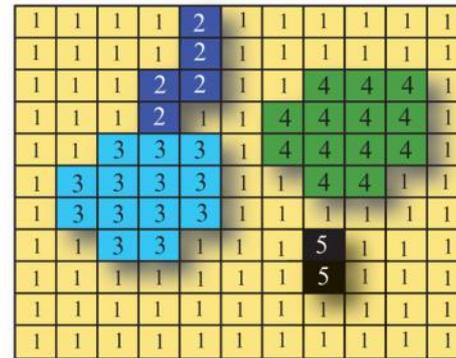
## Vector and Raster Data Models



a. Real world.



b. Vector data model.



c. Raster data model.

## Vector Data:

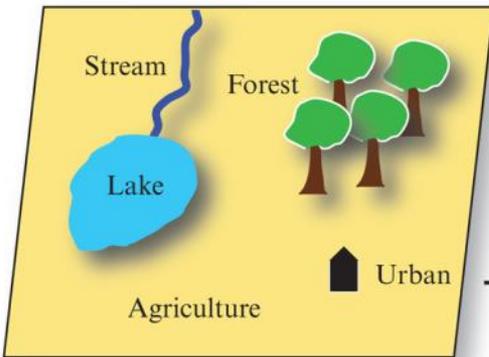
- x,y or x,y,z coordinates that are used to create points, lines and polygons
- Spatial information is linked to attribute table by relational databases

Screenshot of a GPS application showing a table of waypoints.

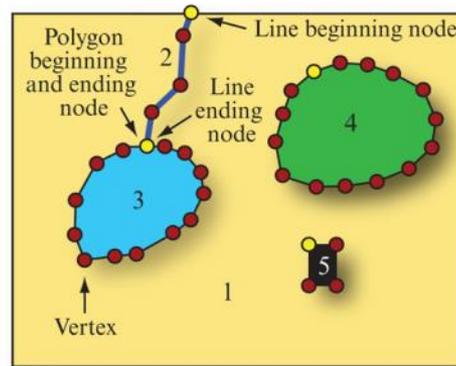
| Type      | Name                      | id | Latitude    | Longitude     | z_pos       | z_pos         | comment | new_xk | new_arp | display | color | altitude | depth | temp | time                   |
|-----------|---------------------------|----|-------------|---------------|-------------|---------------|---------|--------|---------|---------|-------|----------|-------|------|------------------------|
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54218258 | -121.71346436 | 38.54218258 | -121.71346436 | True    | True   |         |         |       | 32.08    |       |      | 2014/10/15 01:46:21-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54218258 | -121.71346708 | 38.54218258 | -121.71346708 | False   | False  |         |         |       | 32.18    |       |      | 2014/10/15 01:46:21-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54205041 | -121.71338884 | 38.54205041 | -121.71338884 | False   | False  |         |         |       | 27.53    |       |      | 2014/10/15 01:46:22-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.5419754  | -121.7134213  | 38.5419754  | -121.7134213  | False   | False  |         |         |       | 25.31    |       |      | 2014/10/15 01:46:23-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54193388 | -121.71341541 | 38.54193388 | -121.71341541 | False   | False  |         |         |       | 26.74    |       |      | 2014/10/15 01:46:24-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54193393 | -121.71341278 | 38.54193393 | -121.71341278 | False   | False  |         |         |       | 28.11    |       |      | 2014/10/15 01:46:25-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54194308 | -121.71342844 | 38.54194308 | -121.71342844 | False   | False  |         |         |       | 28.6     |       |      | 2014/10/15 01:46:26-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54207042 | -121.71348912 | 38.54207042 | -121.71348912 | False   | False  |         |         |       | 28.29    |       |      | 2014/10/15 01:46:27-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54203176 | -121.71347022 | 38.54203176 | -121.71347022 | False   | False  |         |         |       | 31.53    |       |      | 2014/10/15 01:46:28-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54202068 | -121.71347144 | 38.54202068 | -121.71347144 | False   | False  |         |         |       | 32.51    |       |      | 2014/10/15 01:46:29-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54205902 | -121.71347064 | 38.54205902 | -121.71347064 | False   | False  |         |         |       | 32.39    |       |      | 2014/10/15 01:46:30-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.5420677  | -121.71347064 | 38.5420677  | -121.71347064 | False   | False  |         |         |       | 32.39    |       |      | 2014/10/15 01:46:31-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54207682 | -121.71346957 | 38.54207682 | -121.71346957 | False   | False  |         |         |       | 31.48    |       |      | 2014/10/15 01:46:32-00 |
| Undefined | 2014-10-14 10:44 practice | T1 | 38.54208498 | -121.71346584 | 38.54208498 | -121.71346584 | False   | False  |         |         |       | 31.08    |       |      | 2014/10/15 01:46:33-00 |

# Types of GIS Data

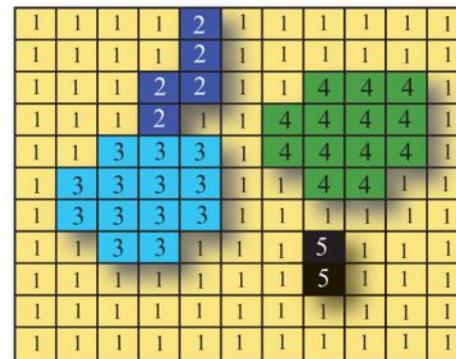
## Vector and Raster Data Models



a. Real world.



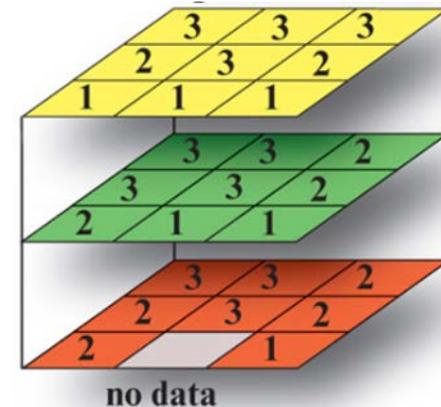
b. Vector data model.



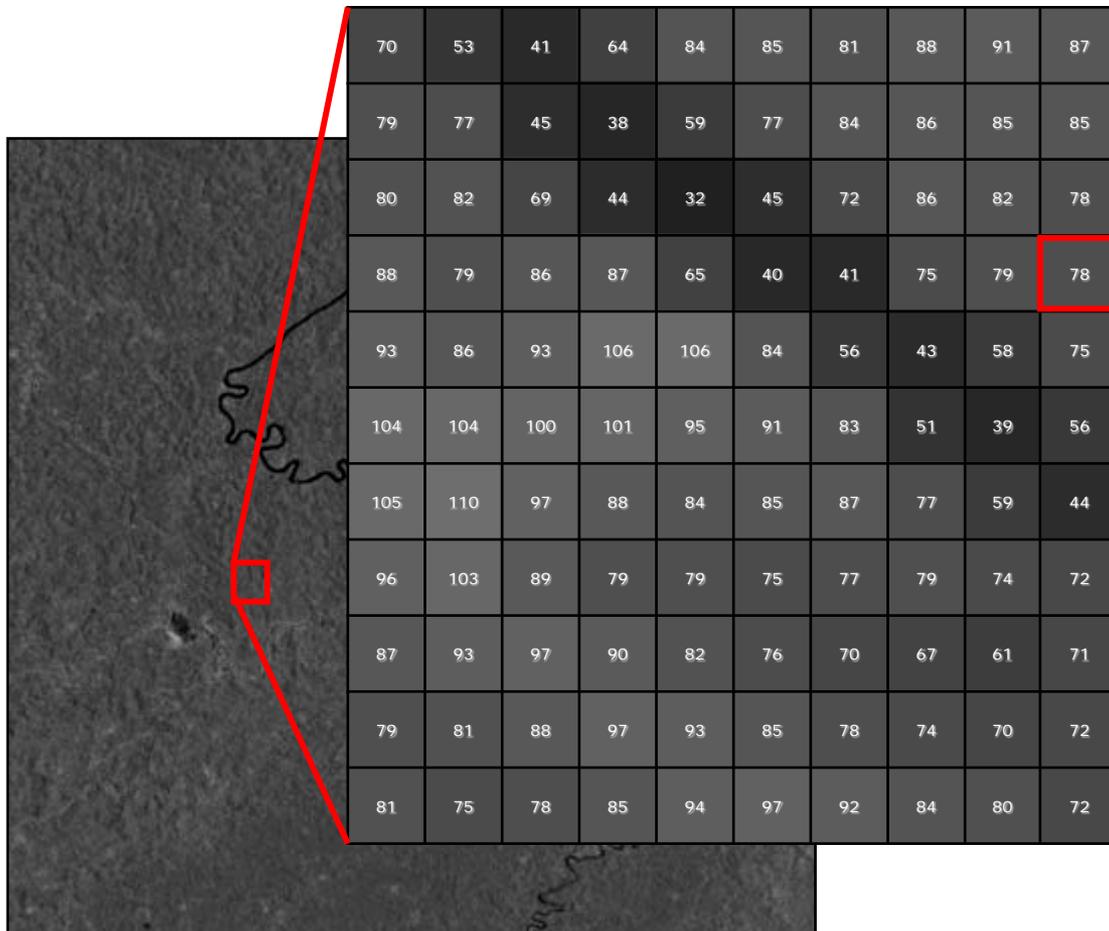
c. Raster data model.

## Raster Data:

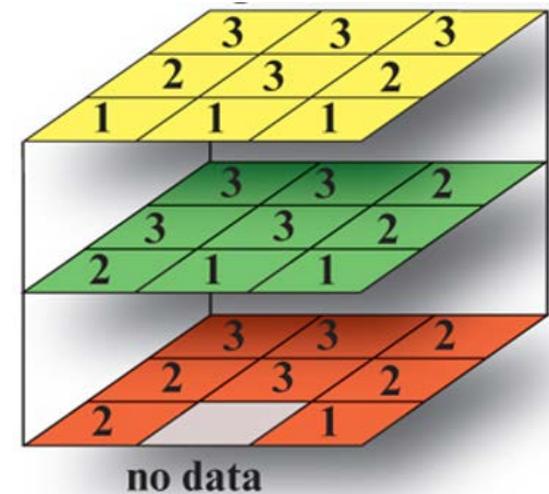
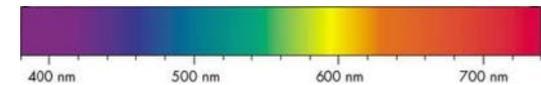
- Comprised of a grid of cells often referred to as pixels
- Spatial information is implicitly related to a reference point and the size of the pixels



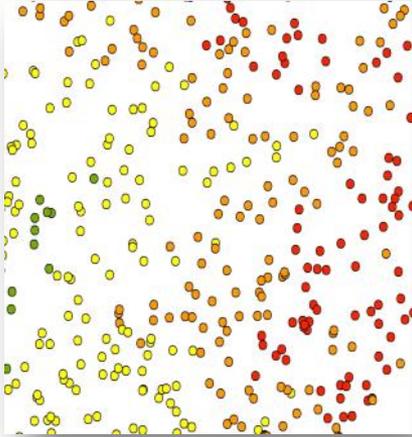
# Raster Data



Pixel → Digital Number (DN)



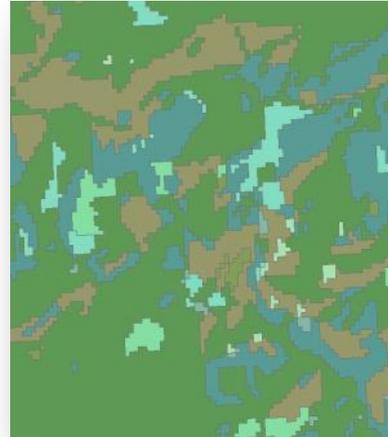
# Vector Examples



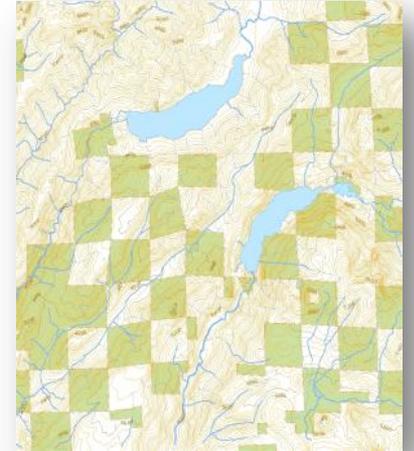
Points: Sample locations, trees, addresses,



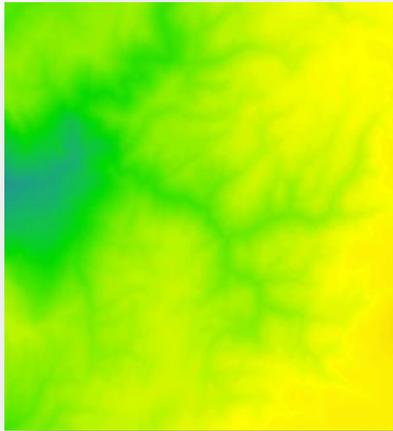
Lines: Roads, hydrography, contours, transects,



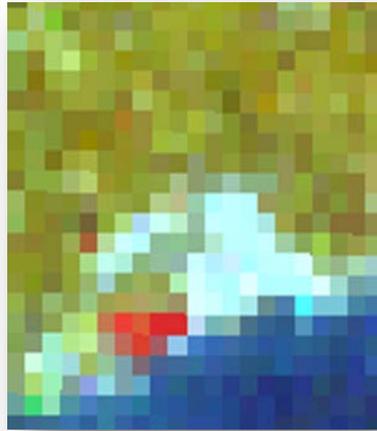
Polygons & Boundaries: Land Use & Land Cover, census, fire perimeters, states, counties, ownership, parcels



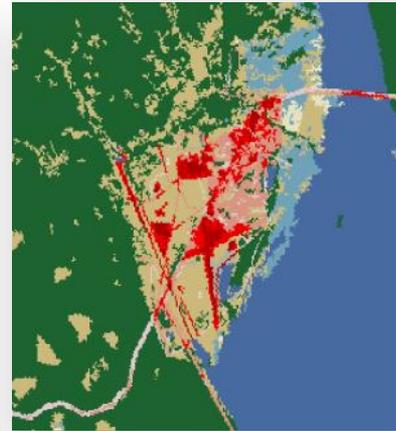
# Raster Examples



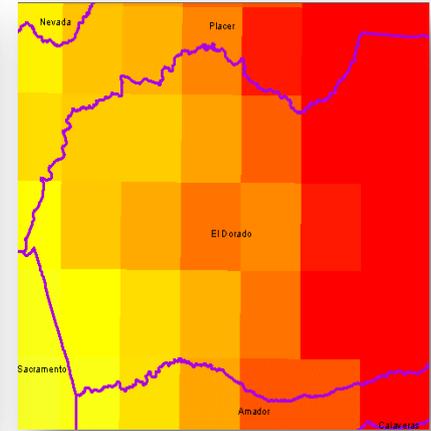
DEM: Digital  
Elevation Models  
Resolution:  
1m-1km  
(e.g. USGS NED)



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



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



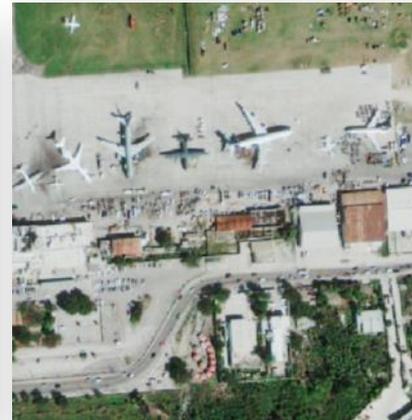
Climate  
Downscaled  
Resolution:  
270m-12km  
(e.g. Cal Adapt)

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

## GeoEye

4 bands (+Pan)

3 days

0.4-1.6m

## WorldView3

8 bands (+Pan)

Daily

0.3-1.2 m

IKONOS and Quickbird decommissioned in 2015



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# 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



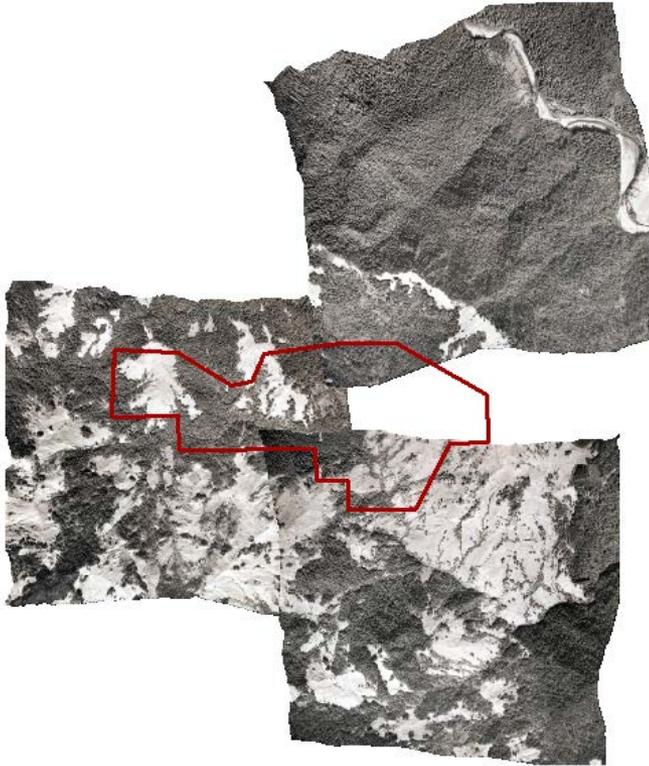
**SPOT**  
3 bands (+1Pan)  
Daily  
10-20m



# 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

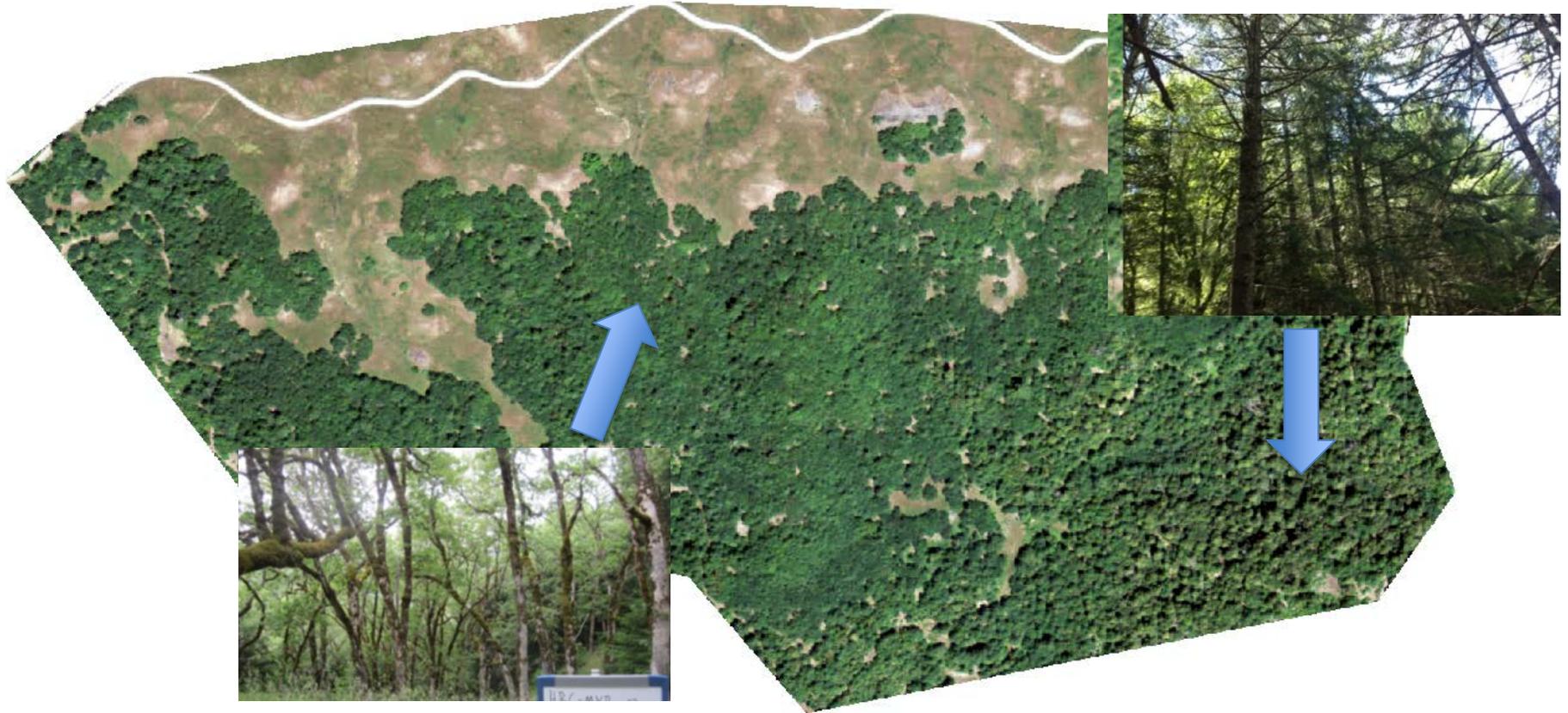


Current: National Agricultural Imagery Program (NAIP)

- 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



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

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



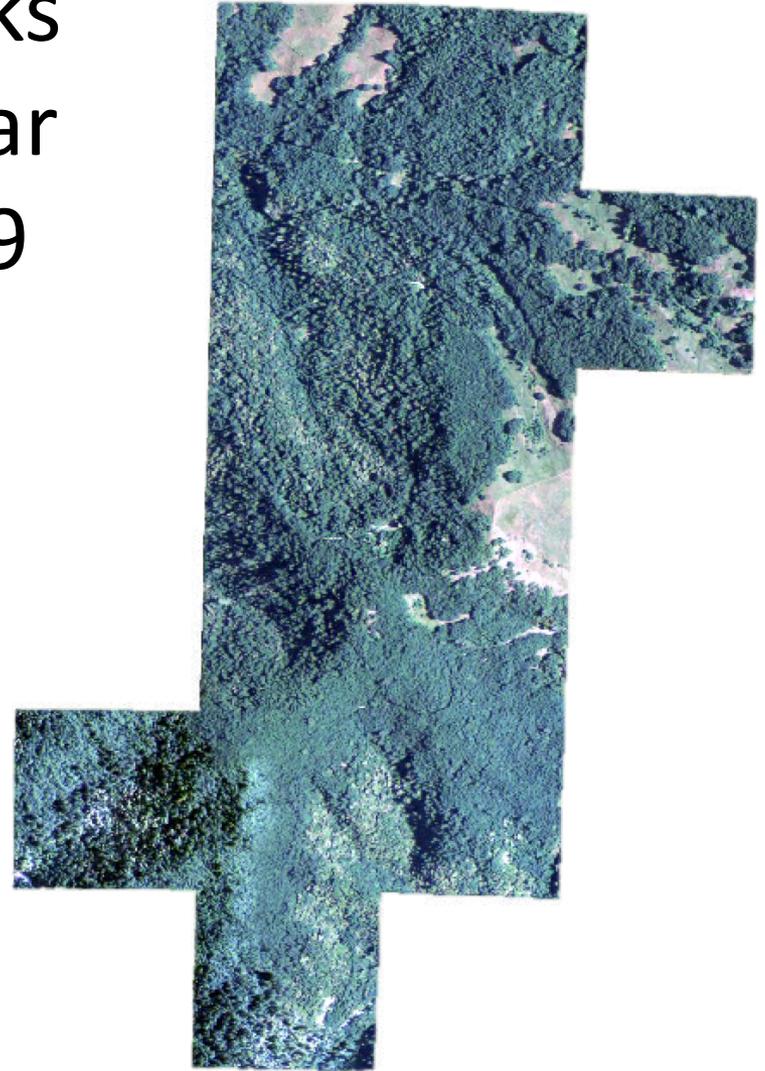
**University of California**

Agriculture and Natural Resources

Informatics and GIS Statewide Program

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

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



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Part 3: Available Imagery and Other GIS Data Resources



**University of California**

Agriculture and Natural Resources

InformatICS and GIS Statewide Program

# 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.

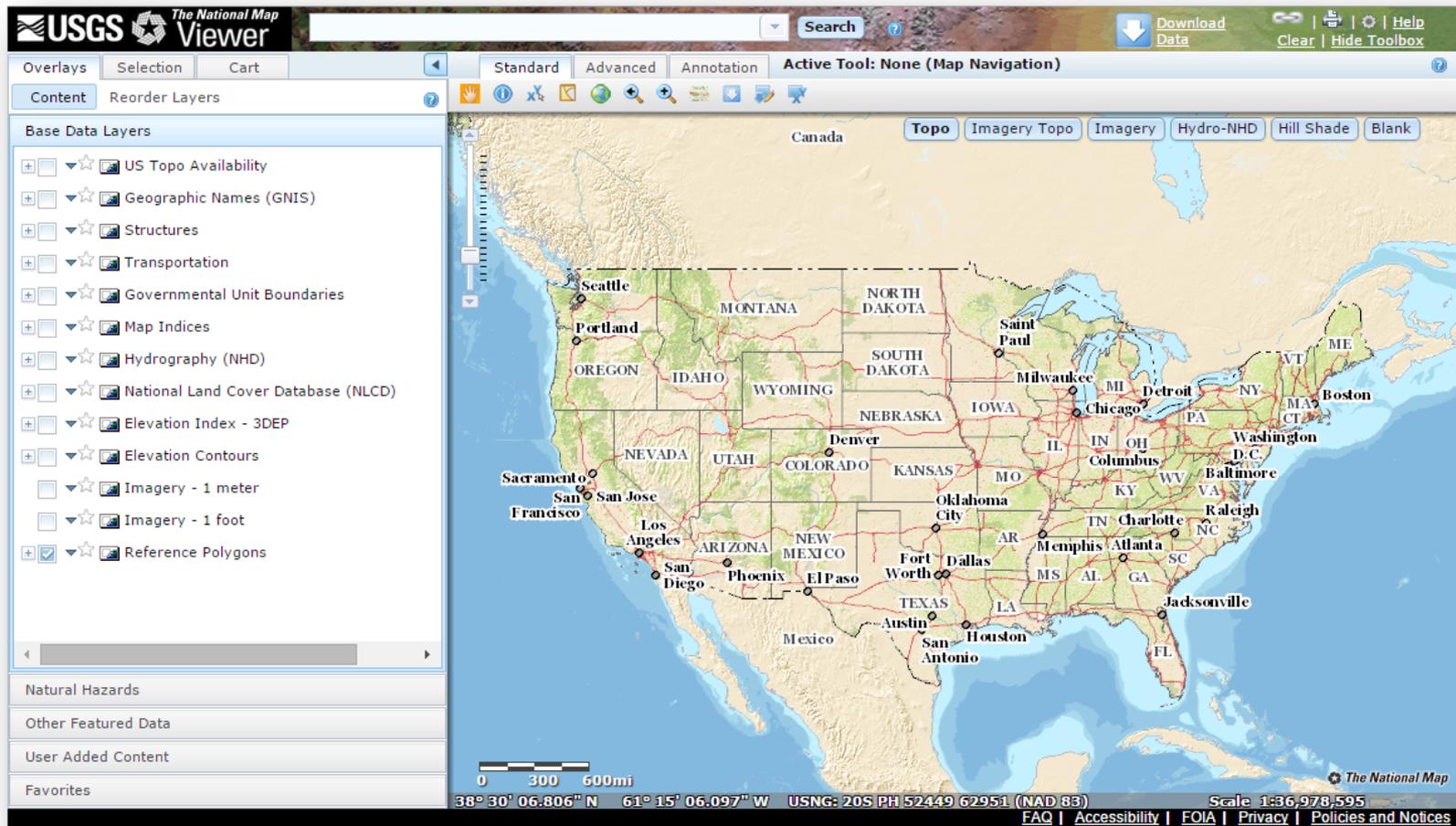


**University of California**

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# USGS National Map Viewer



<http://viewer.nationalmap.gov/viewer/>



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# USGS Earth Explorer

**USGS**  
science for a changing world

USGS Home  
Contact USGS  
Search USGS

EarthExplorer Page Expires In 1:56:38

Home 1 New System Message Login Register **SV** **RSS** Feedback Help

Search Criteria **Data Sets** Additional Criteria Results

**2. Select Your Data Set(s)**  
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.

Use Data Set Prefilter [\(What's This?\)](#)

Data Set Search:

- Aerial Imagery
  - Aerial Photo Mosaics
  - Aerial Photo Single Frames
  - Aircraft Scanners
  - Antarctic Flight Line Maps
  - Antarctic Single Frames
  - ASAS
  - DOQ
  - High Resolution Orthoimagery
  - NAIP.JPG2000
  - NAPP
  - NHAP
  - PAO Image Gallery
  - SD NRCS Section Photos
  - SLAR
  - Space Acquired Photography
- AVHRR
- CEOS Legacy
- Commercial Satellites
- Declassified Data
- Digital Elevation
- Digital Line Graphs

**Search Criteria Summary (Show)** **Clear Criteria**

(39° 41' 25" N, 112° 08' 54" W) Options Overlays Map Satellite

Map showing California and Nevada with cities like Medford, Redding, Reno, Sacramento, San Francisco, Palo Alto, San Jose, Fresno, San Luis Obispo, Los Angeles, Anaheim, Long Beach, San Diego, Tijuana, and Mexico. Geographical features like Death Valley National Park and Humboldt-Toiyabe National Forest are also visible.

<http://earthexplorer.usgs.gov/>



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# ArcGIS Online

**The Mapping Platform for Your Organization**

Create interactive maps and apps and share them with the rest of your organization. Be productive right away with ready-to-use content available for the web, smartphones, and tablets.

**30 DAY FREE TRIAL**

HOME - Workshop Example

**Browse Living Atlas Layers**

All Categories

Show Esri Layers Only

**Select a basemap**

Imagery, Imagery with Labels, Streets, Topographic, National Geographic, OpenStreetMap

**Gallery**

UC Agriculture and Natural Resources Featured Content

Asian Citrus Psyllid, PSHB/FD Distribution Map, Counties, Backyard Poultry (Aves De Corral)

**www.ArcGISonline.com**

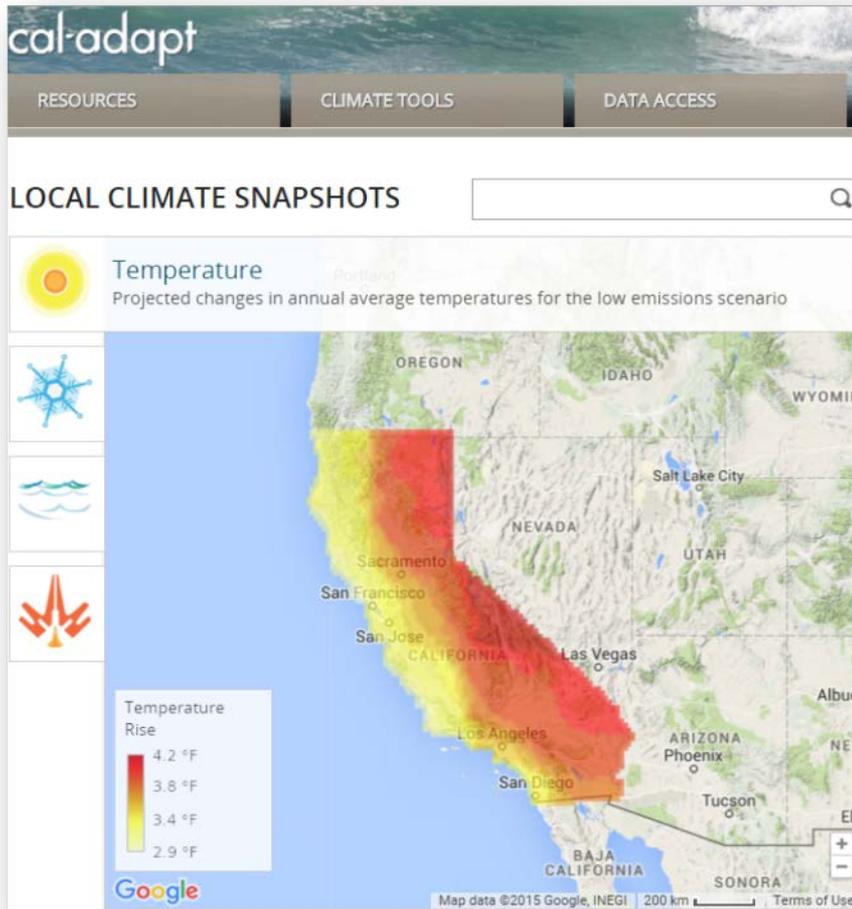


University of California

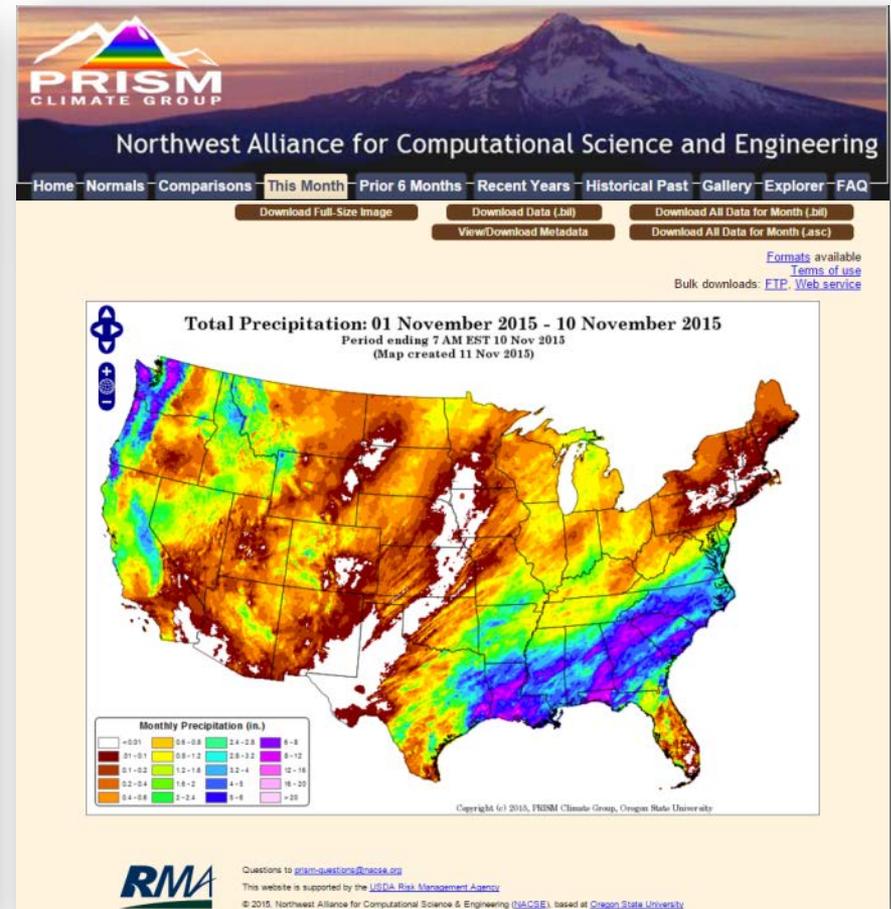
Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Climate Data



<http://cal-adapt.org/>



# 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)



GRASS GIS



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# 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    OS X 

\* Online Capabilities Only



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Web Mapping Resources

## Google

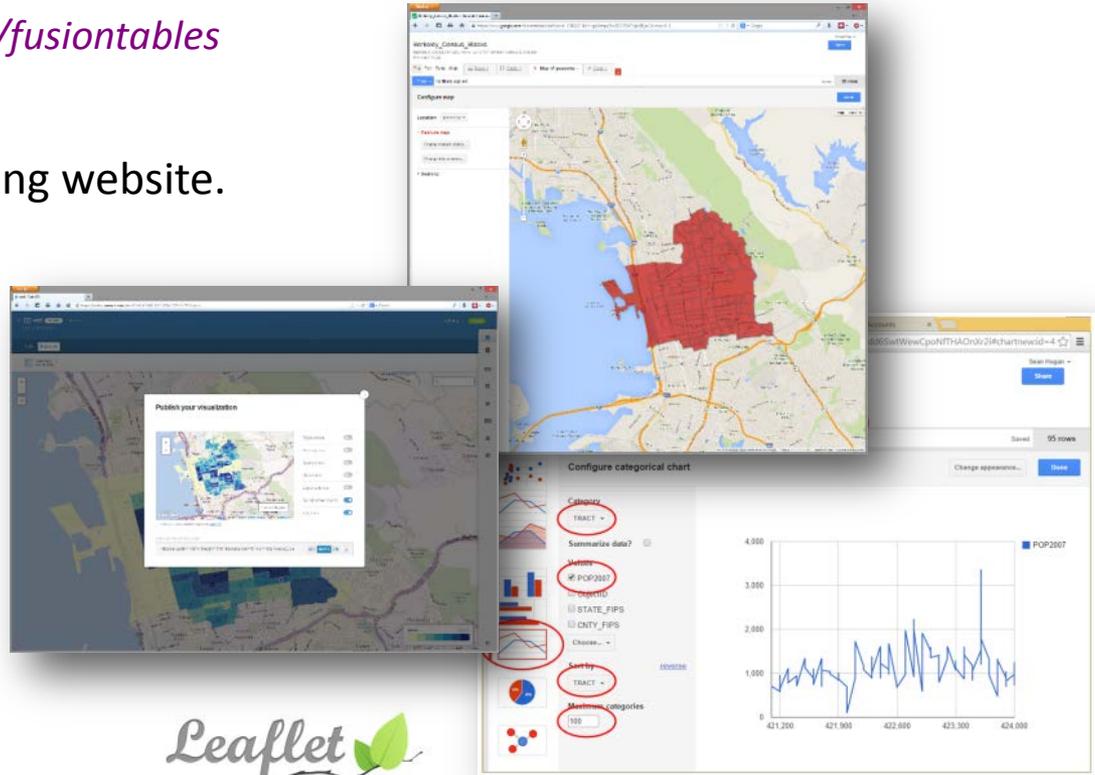
- Google Fusion Tables  
<http://www.google.com/fusiontables>

## 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/>



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# 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)



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Part 4: Future Technology



**University of California**

Agriculture and Natural Resources | InformatICS and GIS Statewide Program

# Future Technology: Drones/UAVs



Photo credit: Will Suckow, UC ANR



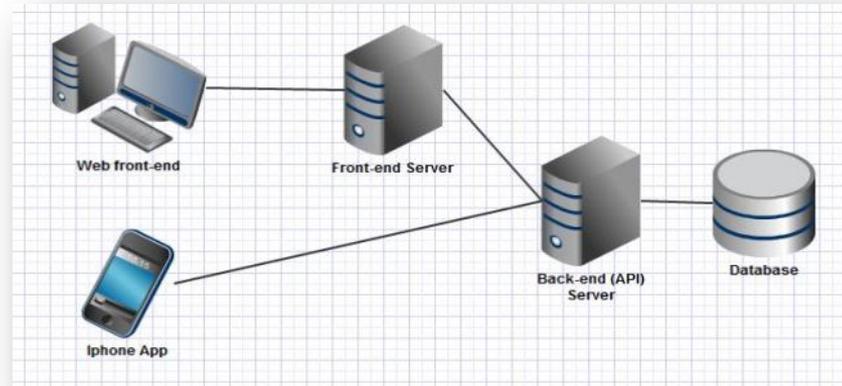
University of California

Agriculture and Natural Resources

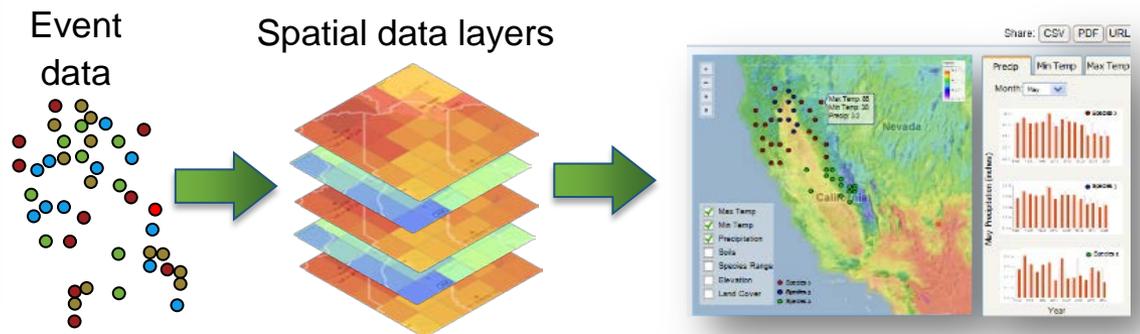
Informatics and GIS Statewide Program

<http://agribotix.com/>

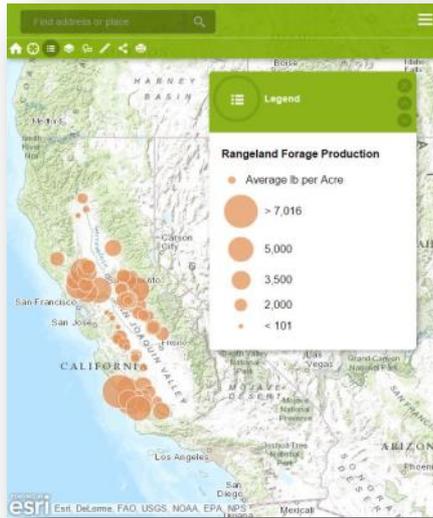
# Future Technology: Integration via APIs



## Data Integration



# Future Technology: Cloud Computing



# Future Technologies: Google Earth Engine & Distributed Cloud Computing



University of California

Agriculture and Natural Resources

InformatICS and GIS Statewide Program

# Future Technologies: Google Earth Engine Playground

The image shows a screenshot of the Google Earth Engine Playground interface. The interface is divided into several sections:

- Script manager**: Located at the top left, it contains **API documentation**, **Search for data**, and **Imports**.
- Code Editor**: The central area where a JavaScript script is written. The script includes comments and code for loading data, creating a task, and running it.
- Task manager**: Located at the top right, it shows a list of tasks, including one named "Import Canada Tasks".
- Console output**: Located at the bottom right, it displays the output of the script, including coordinates and object information.
- Inspect locations, pixel values, objects added to the map**: A label pointing to the console output.
- Layer manager**: Located at the bottom right, it shows a list of layers added to the map.
- Asset Manager**: Located on the left side, it shows a list of assets.
- Geometry Tools**: Located on the left side, it shows various tools for drawing and editing geometry.
- Zoom**: Located on the left side, it shows the zoom controls for the map.
- Map**: The main map area at the bottom, showing a world map with a red location marker.

Arrows point from the labels to the corresponding parts of the interface. The text "Code Editor" and "Map" are prominently displayed in the center of the interface.



# Future Technologies: Mobile Apps



University of California

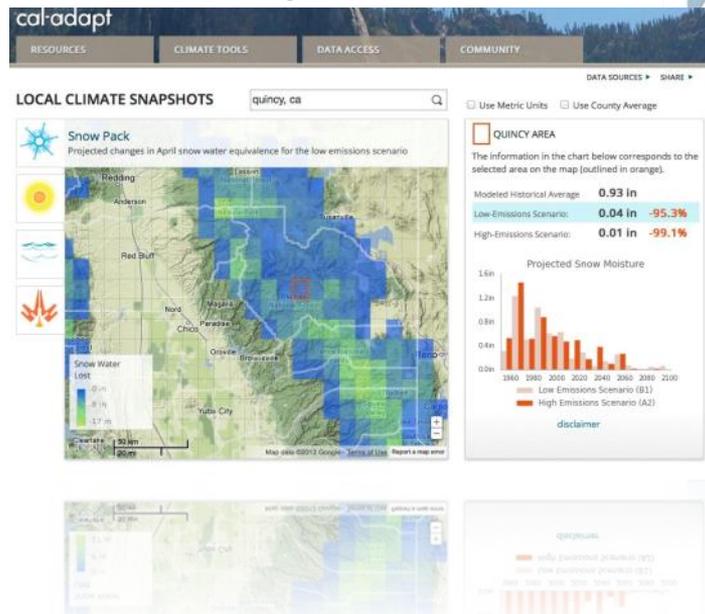
Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Future Technologies: More Public Participation

*disaster response*

*web mapping/visualization*



*citizen involvement*



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Part 5: On-line Exercise for Mapping Your Property

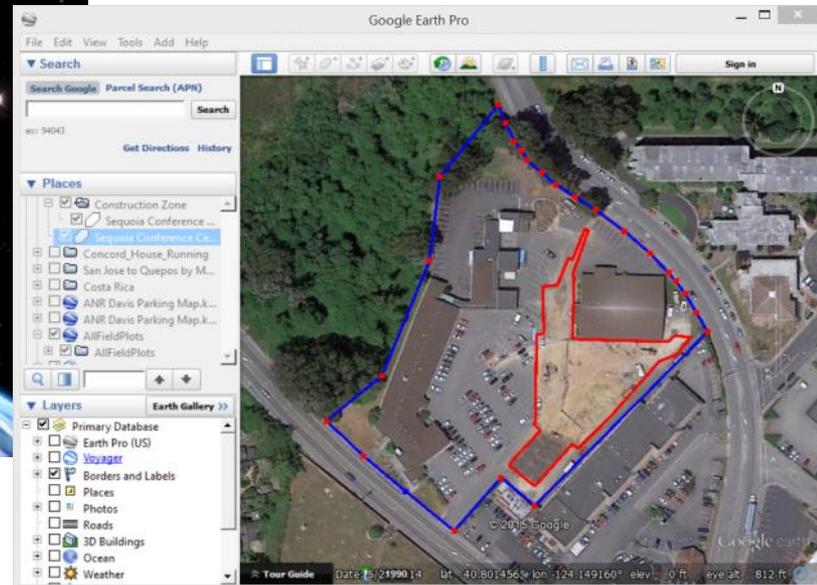


**University of California**

Agriculture and Natural Resources | InformatiCS and GIS Statewide Program

# 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)



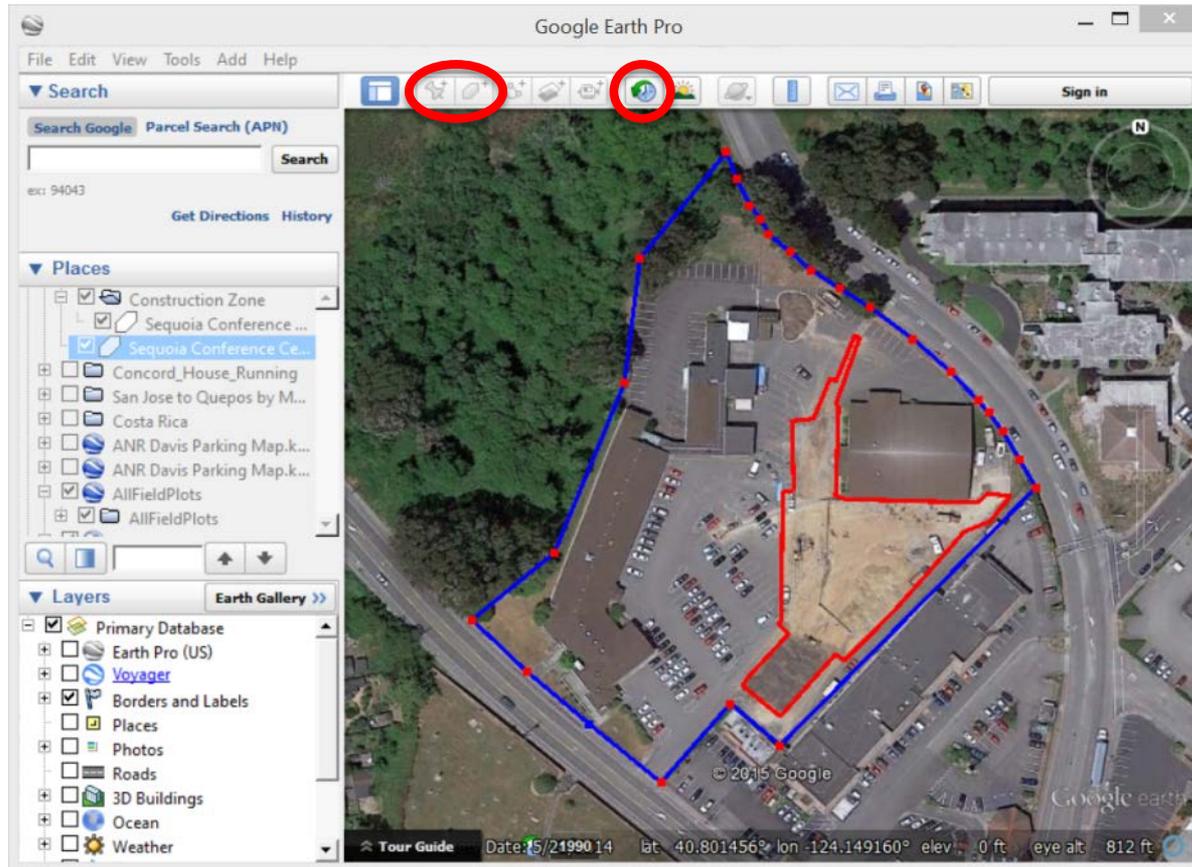
University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

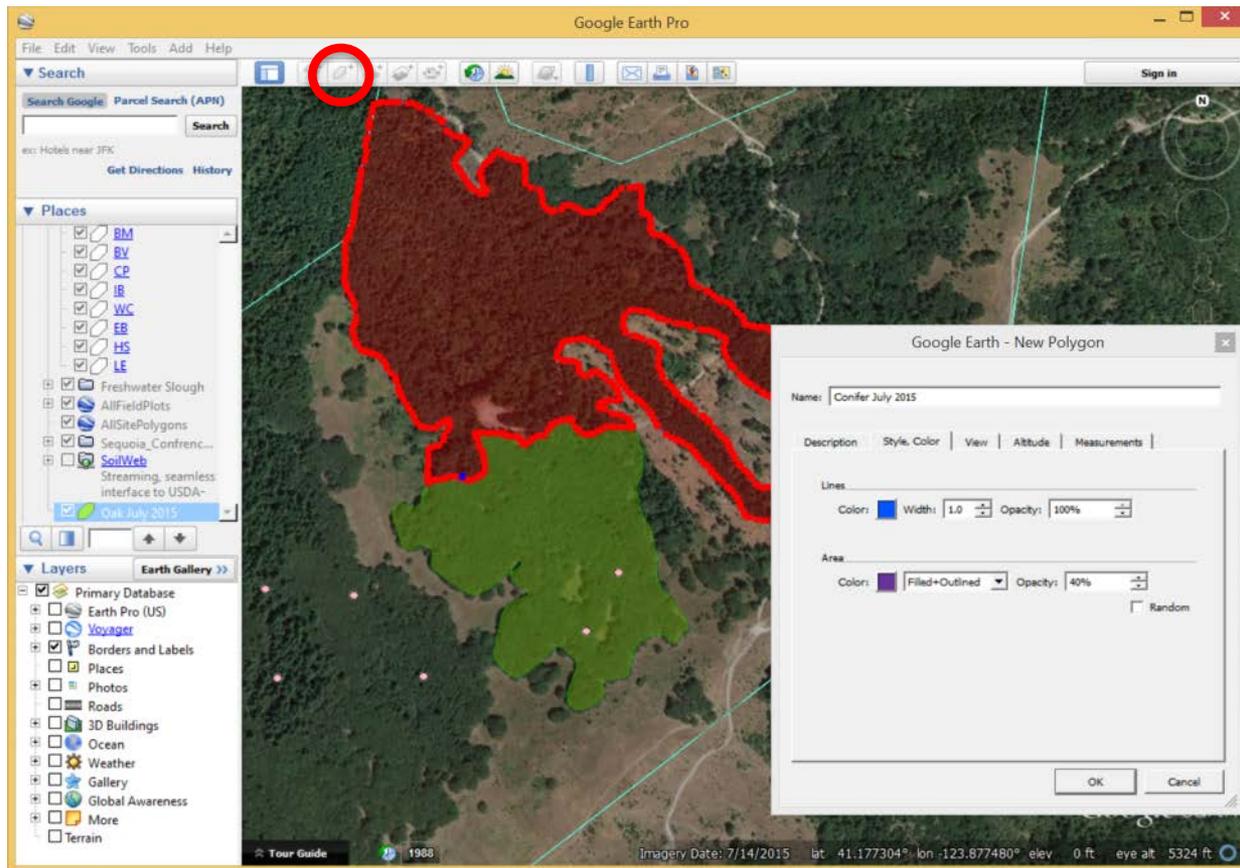
# Free Mapping of Your Property

## Digitizing and Time Slider Options



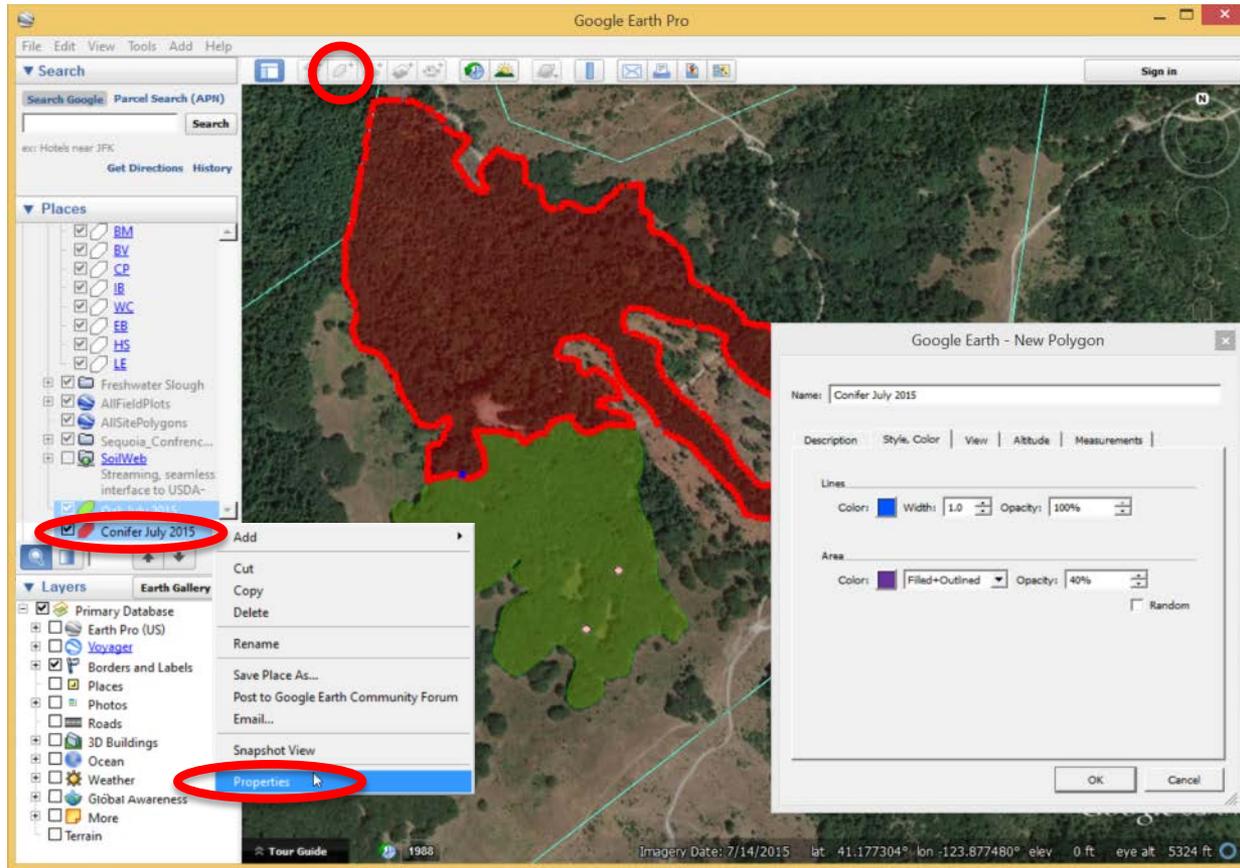
# Free Mapping of Your Property

## Digitizing and Time Slider Options



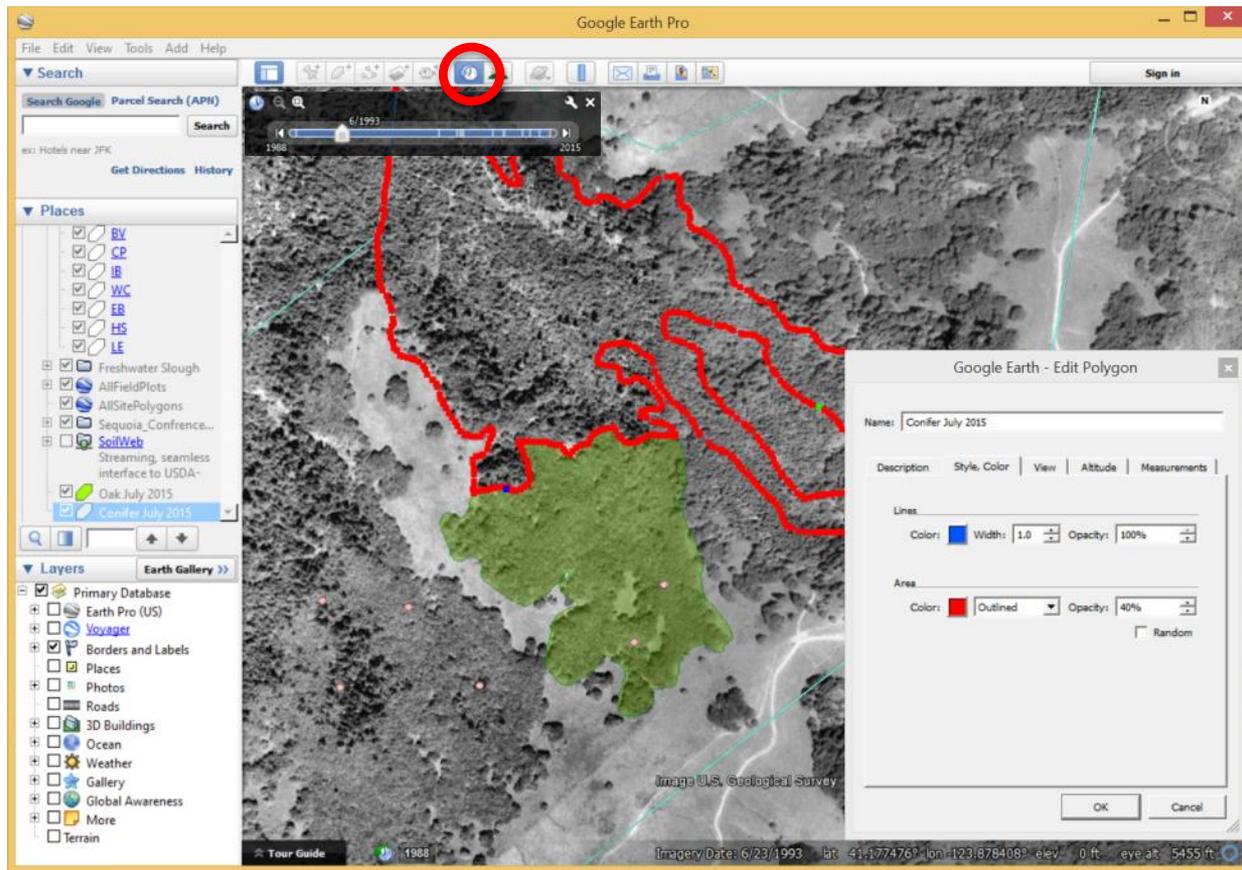
# Free Mapping of Your Property

## Digitizing and Time Slider Options



# Free Mapping of Your Property

## Digitizing and Time Slider Options



# Where to Find More Information



**University of California**

Agriculture and Natural Resources | InformatiCS and GIS Statewide Program

# More Information on the IGIS Program

<http://igis.ucanr.edu/>



The screenshot shows the IGIS website homepage. At the top, there is a navigation bar with the IGIS logo, the text "University of California, Division of Agriculture and Natural Resources", and the main title "Informatics and GIS Program". To the right of the title are links for "SHARE", "EMAIL", "PRINT", "SITE MAP", and a search box labeled "Enter Search Terms". Below the navigation bar is a large satellite map of a river valley. Underneath the map is a horizontal menu with the following items: "IGIS Statewide Program", "IGIS Training", "Service Center Request", "InfoBase Portal", "ANR-Flux Network", "GIS Resources", and "ANR RECS". The main content area is titled "Welcome" and contains the following text: "IGIS is a new ANR Program established in 2012 to provide GIS support, software, data and training to ANR." Below this are two links: "[Click here](#) for more information on the components of IGIS: Training, ANR-Flux, InfoBase & Service Center." and "[Click here](#) for upcoming IGIS training workshops." To the right of the text is a "MAKE A GIFT" button with the subtext "ANR Informatics and GIS Fund". Below the welcome text is a section titled "IGIS Project Gallery" which features a thumbnail image of a web mapping application and a text box titled "REC Mapper" describing the application. To the right of the gallery is a "Blog" section with a link to "Reno UAS conference and the Micasense multispectral camera" and a short paragraph of text.



University of California

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Upcoming IGIS Training

**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

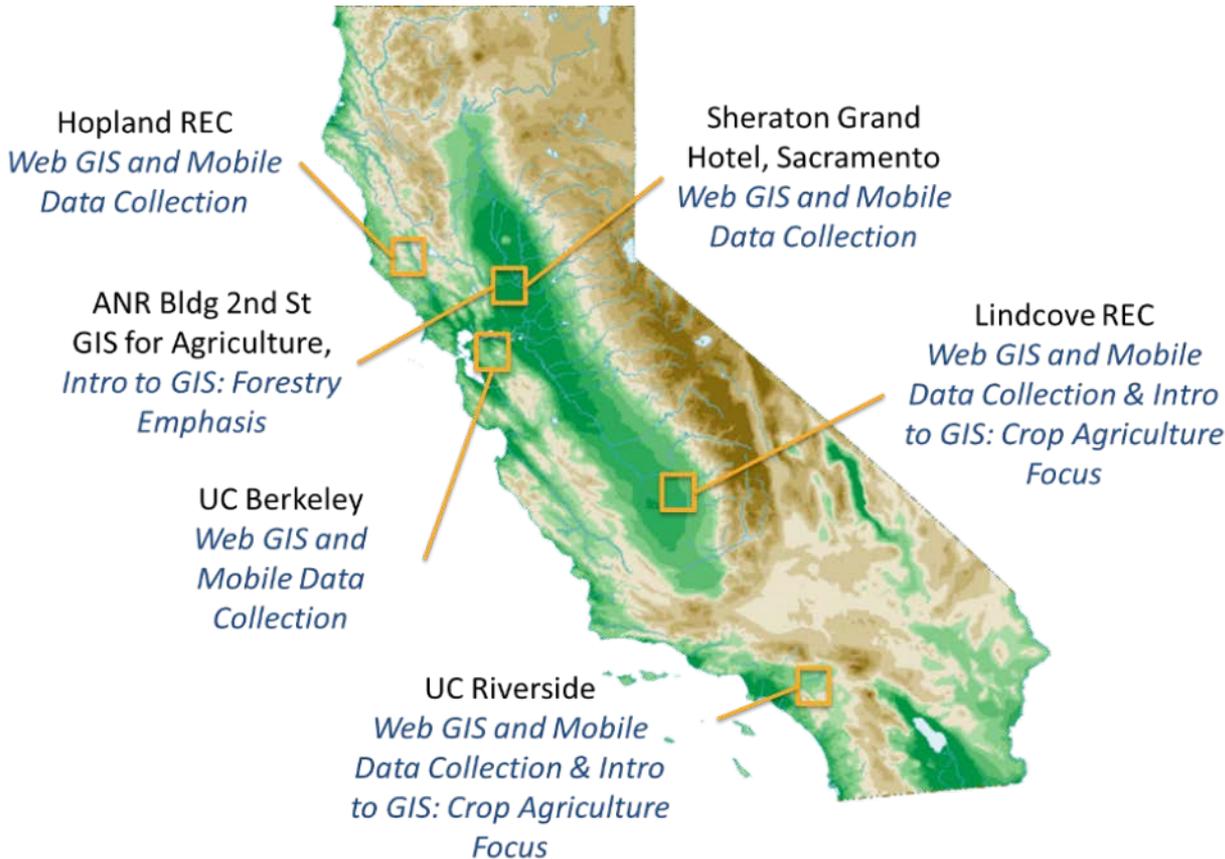
*Intro to GIS: Crop Agriculture Focus*

**Fri, Jan 22**

10am-3pm

Lindcove Research and Extension Center

*Web GIS and Mobile Data Collection*



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



**University of California**

Agriculture and Natural Resources

Informatics and GIS Statewide Program

# Thanks!

Sean Hogan, [sdhogan@ucanr.edu](mailto:sdhogan@ucanr.edu)

Shane Feirer, [stfeirer@ucanr.edu](mailto:stfeirer@ucanr.edu)

<http://igis.ucanr.edu/>



**University of California**

Agriculture and Natural Resources

Informatics and GIS Statewide Program