LandCART:
The Landscape Cover Analysis and Reporting Tool

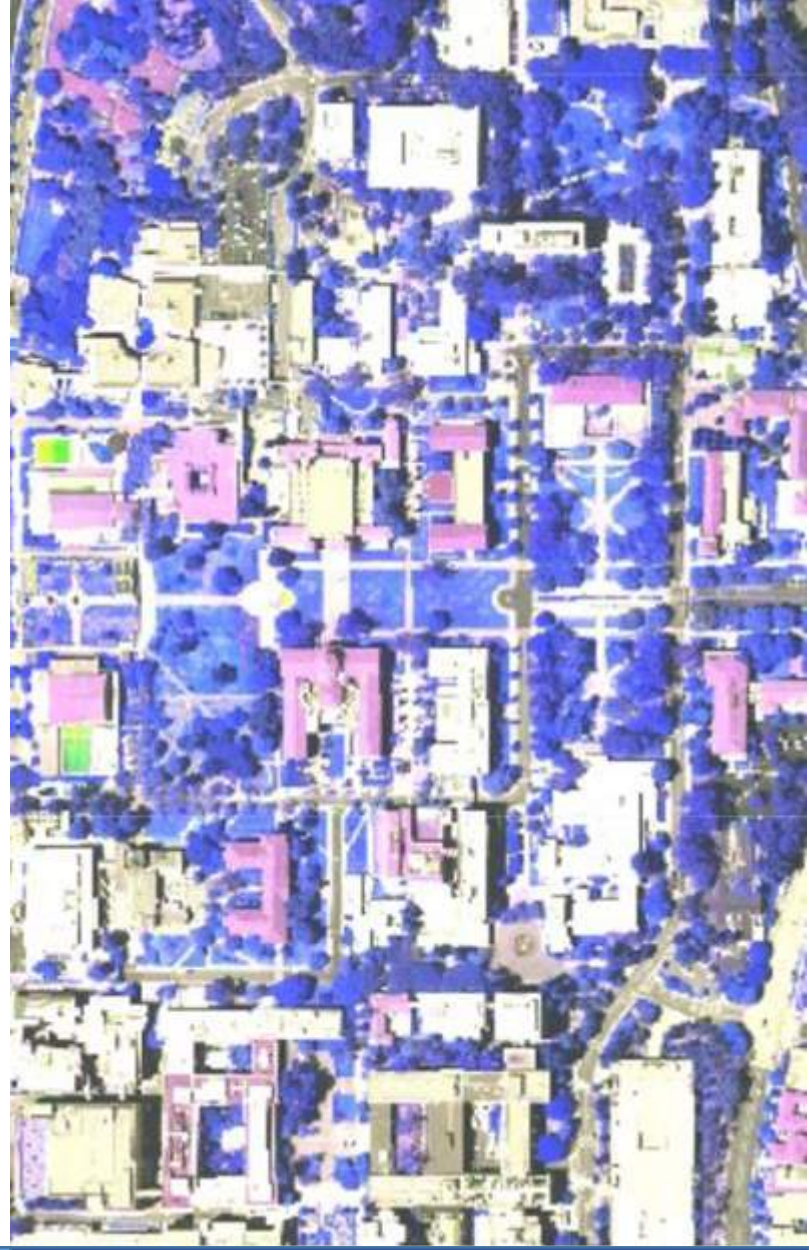
University of California, Los Angeles

Gregory Okin

Bo Zhou

Mike Duniway

US Geological Survey, Moab UT



UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

LandCART Project overview

RFP

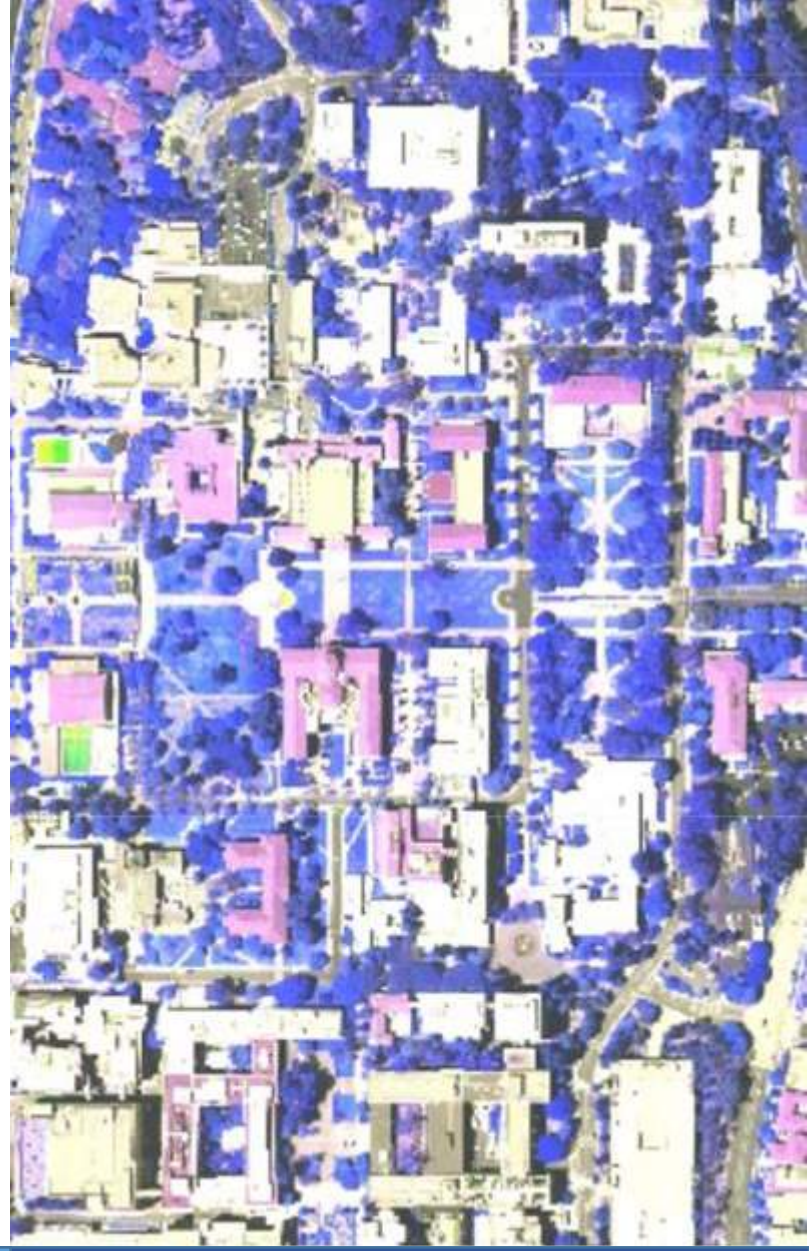
- Applied Sciences: Ecological Forecasting
  - Remote Sensing as a Catalyst for Large-scale Conservation

Proposers

- UCLA
- US Geological Survey (USGS)

Partner

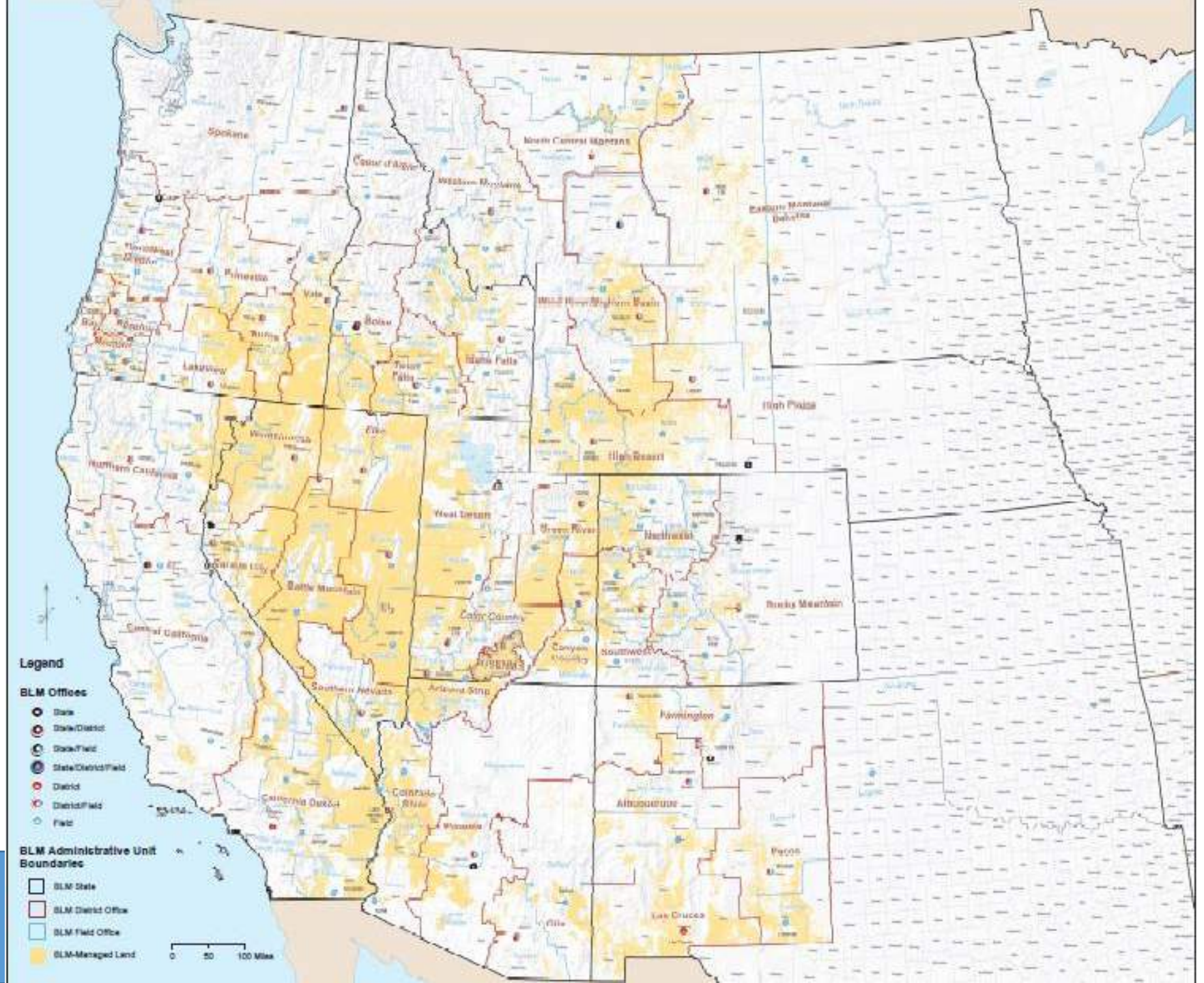
- Bureau of Land Management (BLM)



UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

BLM Lands are both working lands and native habitat

LandCART is a tool to help make real management decisions



LandCART is made to answer real questions asked by Field, District, State, and National Offices

UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

- What is the wind erosion risk in Colorado Plateau?
- Is a grazing allotment also suitable habitat for sage grouse in Wyoming?
- What is vegetation recovery on abandoned oil pads in North Dakota?
- How has release from grazing affected vegetation on grazing allotments in Nevada?

LandCART Goals

UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

- A tool that will allow BLM field offices to make legally-defensible land management decisions
  - LandCART will be available publicly on the cloud
    - Aids sustainability after NASA funding ends
    - Makes updates easy
  - LandCART will provide estimates of uncertainty
  - LandCART will allow download of results and predictors for the NEPA Administrative Record

Our Working Model

- BLM is the client, UCLA/USGS are the contractor.

Application Readiness

UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

ARL Schema – The Levels

- Pushing out versions to Alpha testers in early June
- October meeting with BLM (and other federal agency) Beta Testers
  - Specific management test cases
  - Continual updates based on user feedback
- Final Roll-out Spring, 2020
  - Trainings, Webinars, to follow
  - Further updates based on user feedback

Based on Agency Initiatives

- The Bureau of Land Management (BLM) has field work based monitoring:
  - All ing
  - LM

>20,000 Field Measurements

More every year

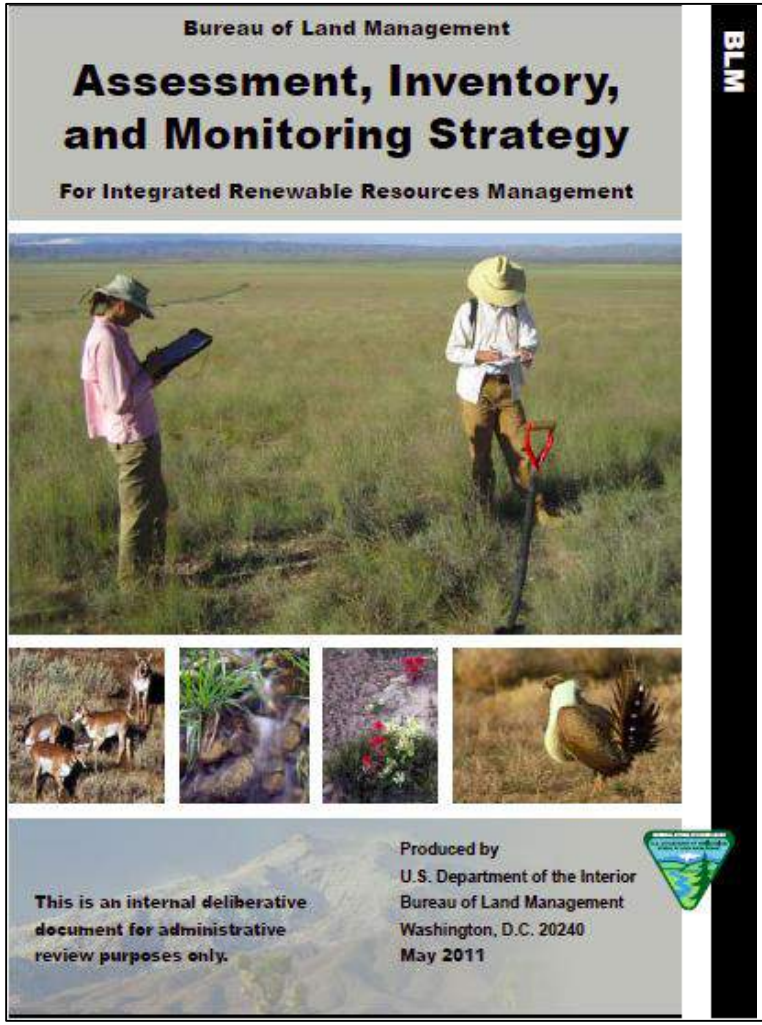
- The N RCS) also l
  - NRI: National Resources Inventory

Bureau of Land Management
Assessment, Inventory and Monitoring (AIM)

UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

- AIM was developed to allow land managers to gather data in a consistent and efficient manner, to be used at the field office, regional and national level

Indicator	Method *	Examples
Amount of bare ground, vegetation composition, non-native invasive plant species, plant species of management concern	Line-point intercept (including modifications) supplemented with plot-level species inventory	Total Foliar Cover Bare Soil Cover Cover of (Non) Invasive grasses, forbs, woody Sagebrush cover
Vegetation height	Height at selected line-point intercept points	Herbaceous Height Woody Height Sagebrush Height
Proportion of soil surface in large intercanopy gaps	Canopy gap intercept	Fraction of transect made up of bare soil gaps (25-50, 50-100, 100-200, >200 cm)



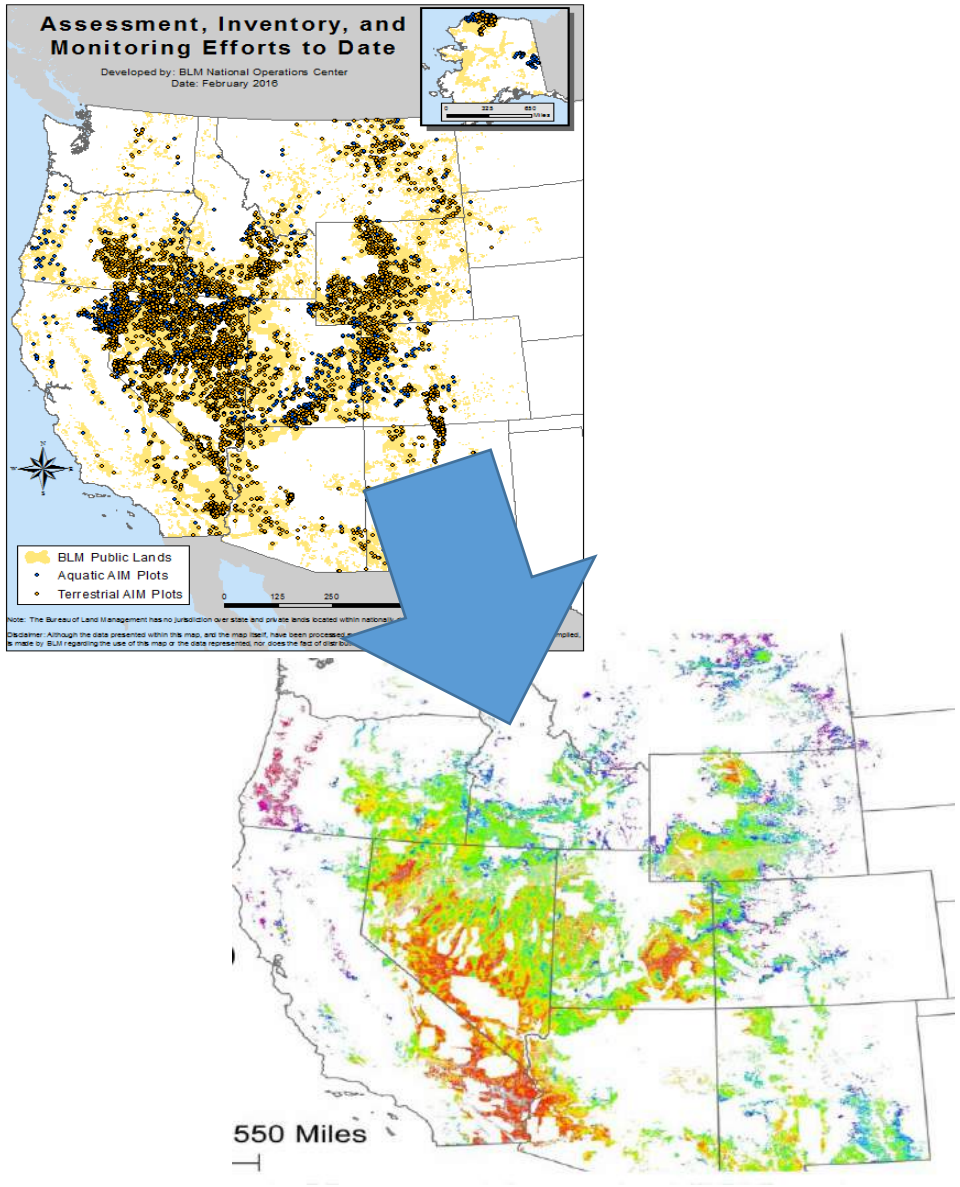
Source: http://aim.landscapetoolbox.org/

LandCART Parameters

UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

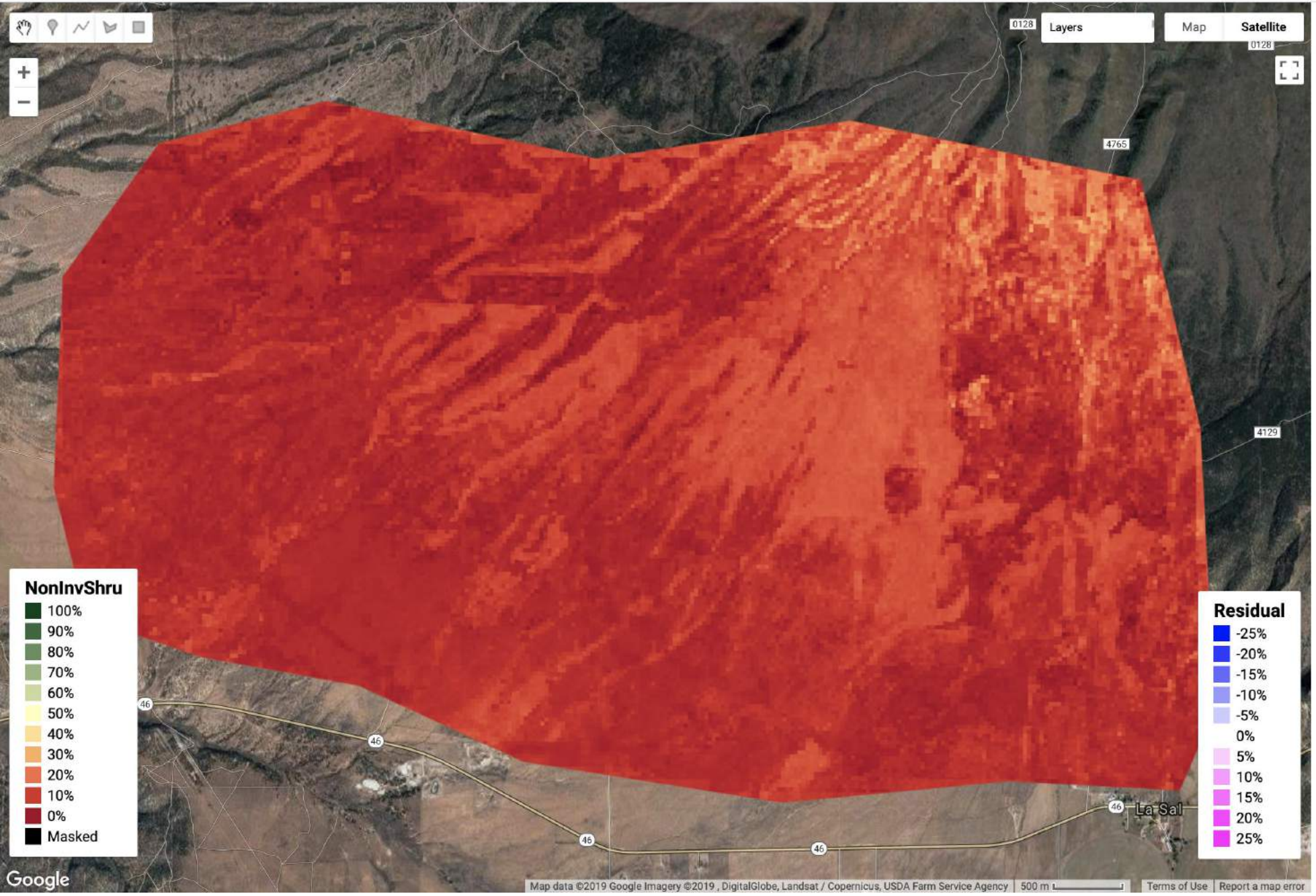
- Different Types of Users
  - Field Office
  - "Sherm"
  - Power User
- Choose Your Own Adventure Approach using Multiple Google Apps, like:
  - Making a map and getting simple statistics
  - Comparing the same area at different times, with statistical testing
  - Comparing different times in the same area , with statistical testing
  - Time Series analysis , with statistical testing
- On-the-fly machine learning (RF) model building
  - Enables immediate incorporation of new data
  - Only training data have to be archived
- Scientifically sound in using spatially and temporally dispersed field data

Google Earth Engine



Earth Engine Apps Experimental

Search places



Check the box to start drawing desired area of interest, when done click on the starting point or uncheck the box to close the polygon

I am done drawing the polygon!

Select a date range for map production

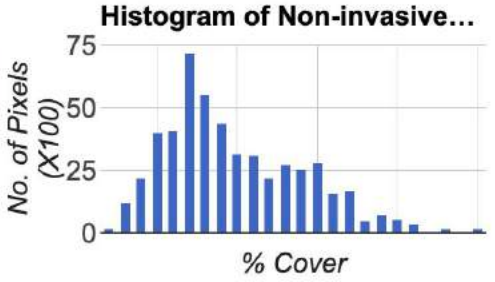
Apr Jul Oct 2009 Apr Jul Oc

May 31, 2009 - Aug 30, 2009 Jump to date

Select Indicator

Non-invasive shrub cover

Calculate

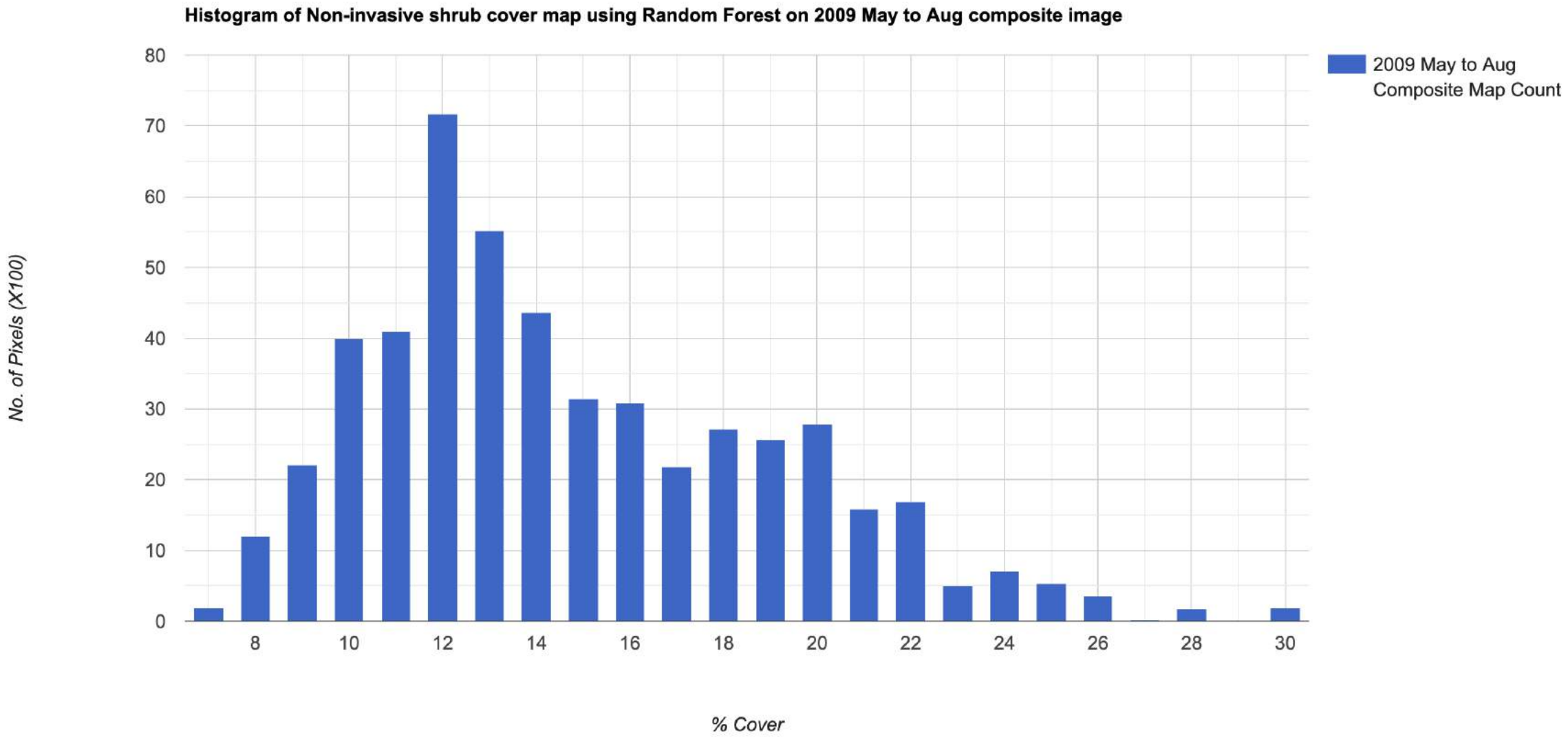


Statistics for Non-invasive shrub cover in user defined polygon

Mean: 15.31%

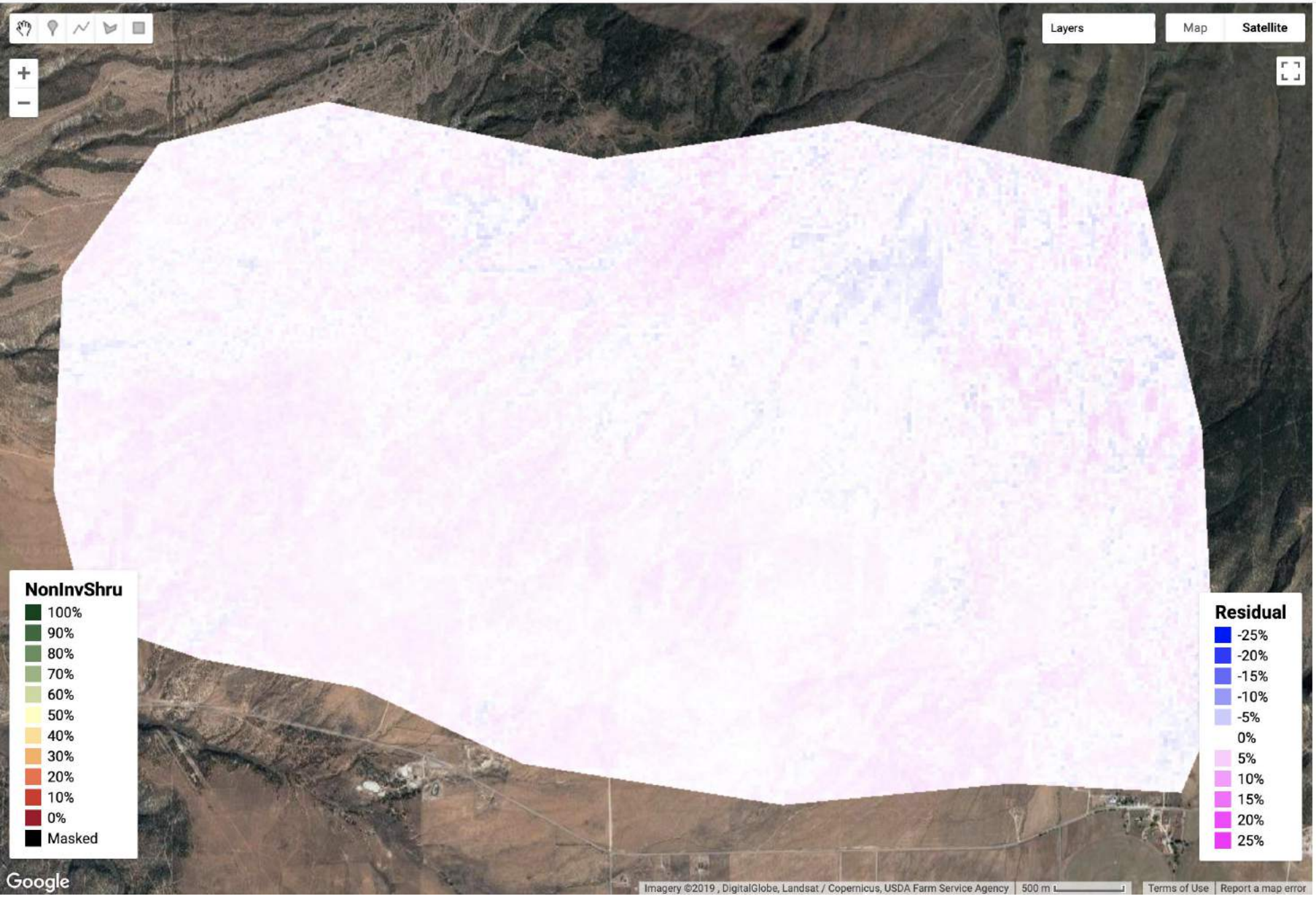
StdDev: 4.34%

Download CSV Download SVG Download PNG



Earth Engine Apps Experimental

Search places



Check the box to start drawing desired area of interest, when done click on the starting point or uncheck the box to close the polygon

I am done drawing the polygon!

Select a date range for map production

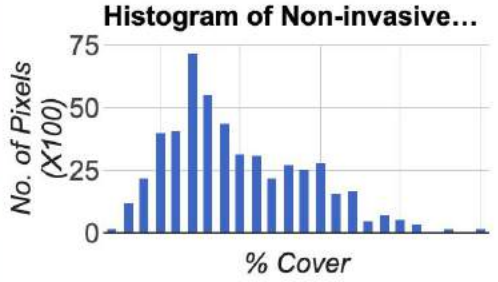
Apr Jul Oct 2009 Apr Jul Oc

May 31, 2009 - Aug 30, 2009 Jump to date

Select Indicator

Non-invasive shrub cover

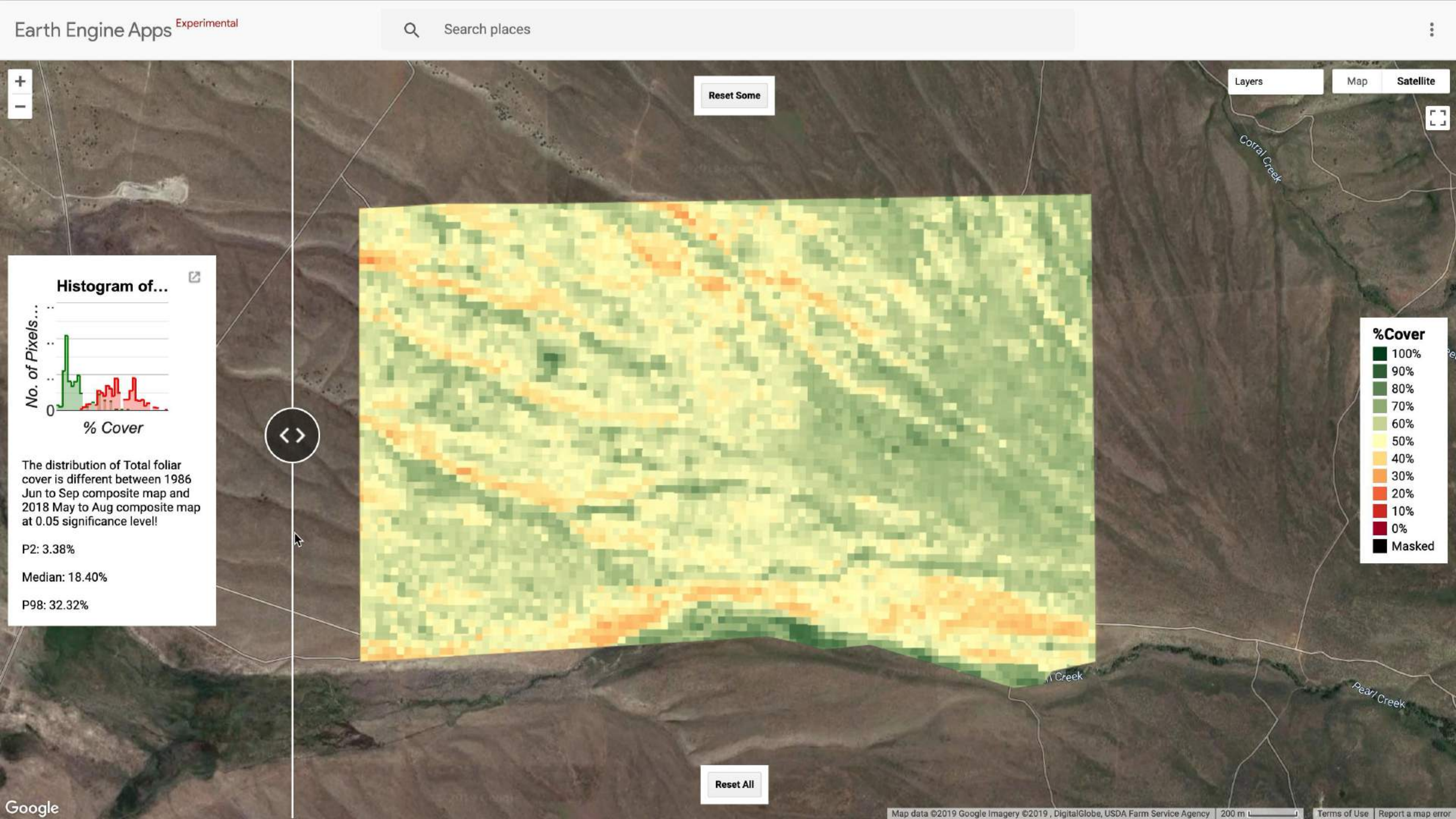
Calculate



Statistics for Non-invasive shrub cover in user defined polygon

Mean: 15.31%

StdDev: 4.34%


Earth Engine Apps
Experimental
Search places
Reset Some
Layers
Map
Satellite
Corral Creek
Histogram of...
No. of Pixels...
0
% Cover
The distribution of Total foliar cover is different between 1986 Jun to Sep composite map and 2018 May to Aug composite map at 0.05 significance level!
P2: 3.38%
Median: 18.40%
P98: 32.32%
%Cover
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Masked
Creek
Pearl Creek
Reset All
Google
Map data ©2019 Google Imagery ©2019 , DigitalGlobe, USDA Farm Service Agency
200 m
Terms of Use
Report a map error

Earth Engine Apps Experimental

Search places

Antelope

Select the start date for time series

1984 Feb Mar Apr May Jun

Apr 3, 1984 - May 4, 1984 Jump to date

Select the end data for time series

May Jun Jul Aug Sep Oct N

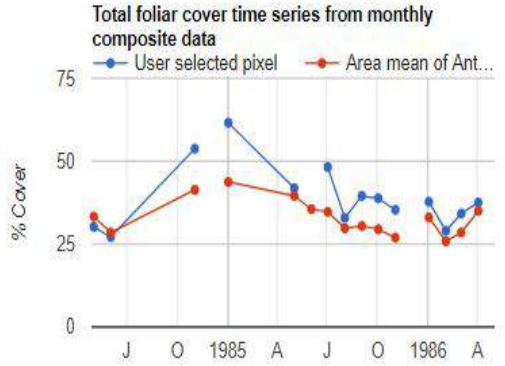
May 18, 1986 - Jun 18, 1986 Jump to date

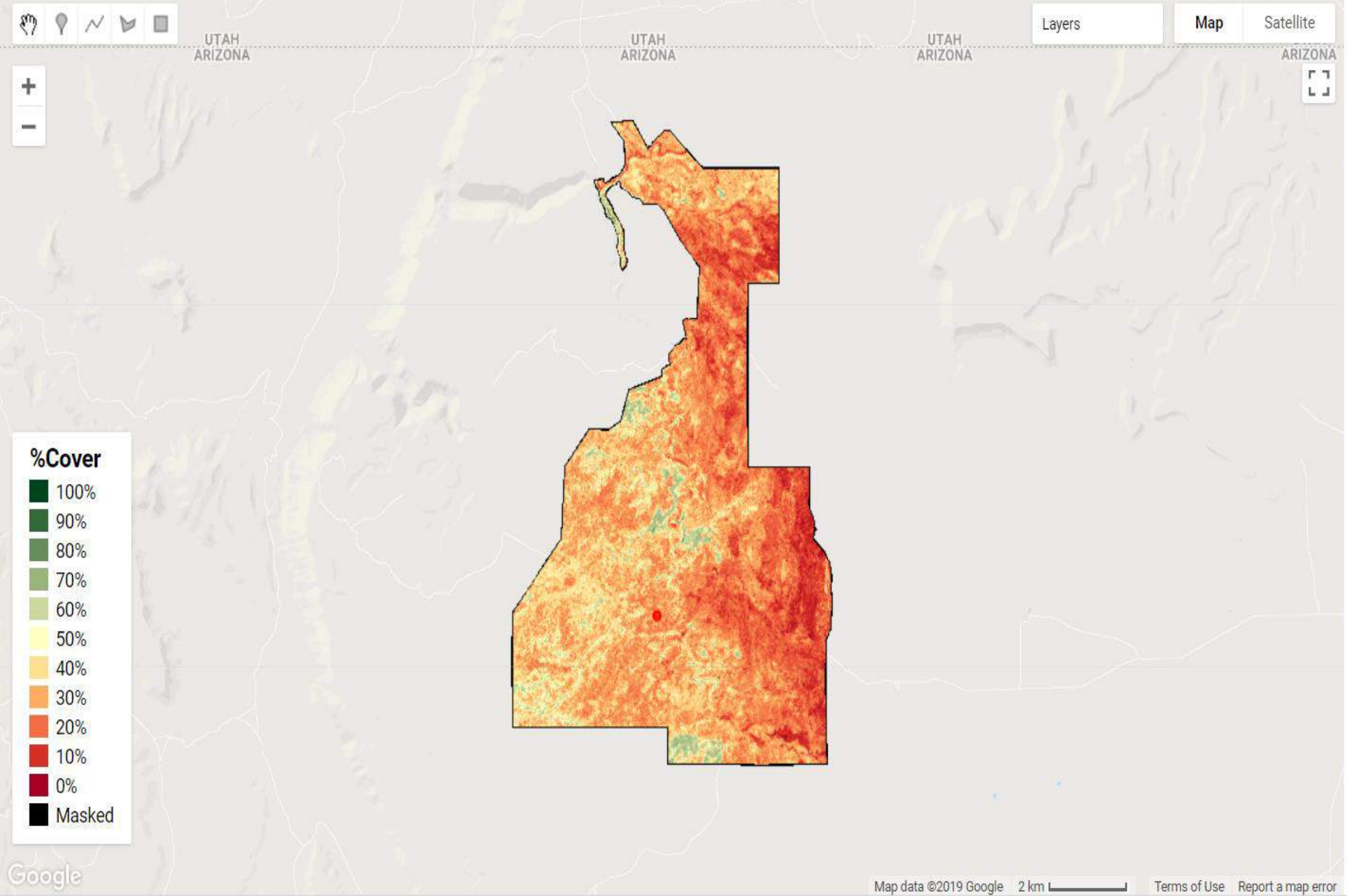
Select Indicator

Total foliar cover

Select a location within the study area to generate two time series

Calculate





"Science" Questions we're also addressing

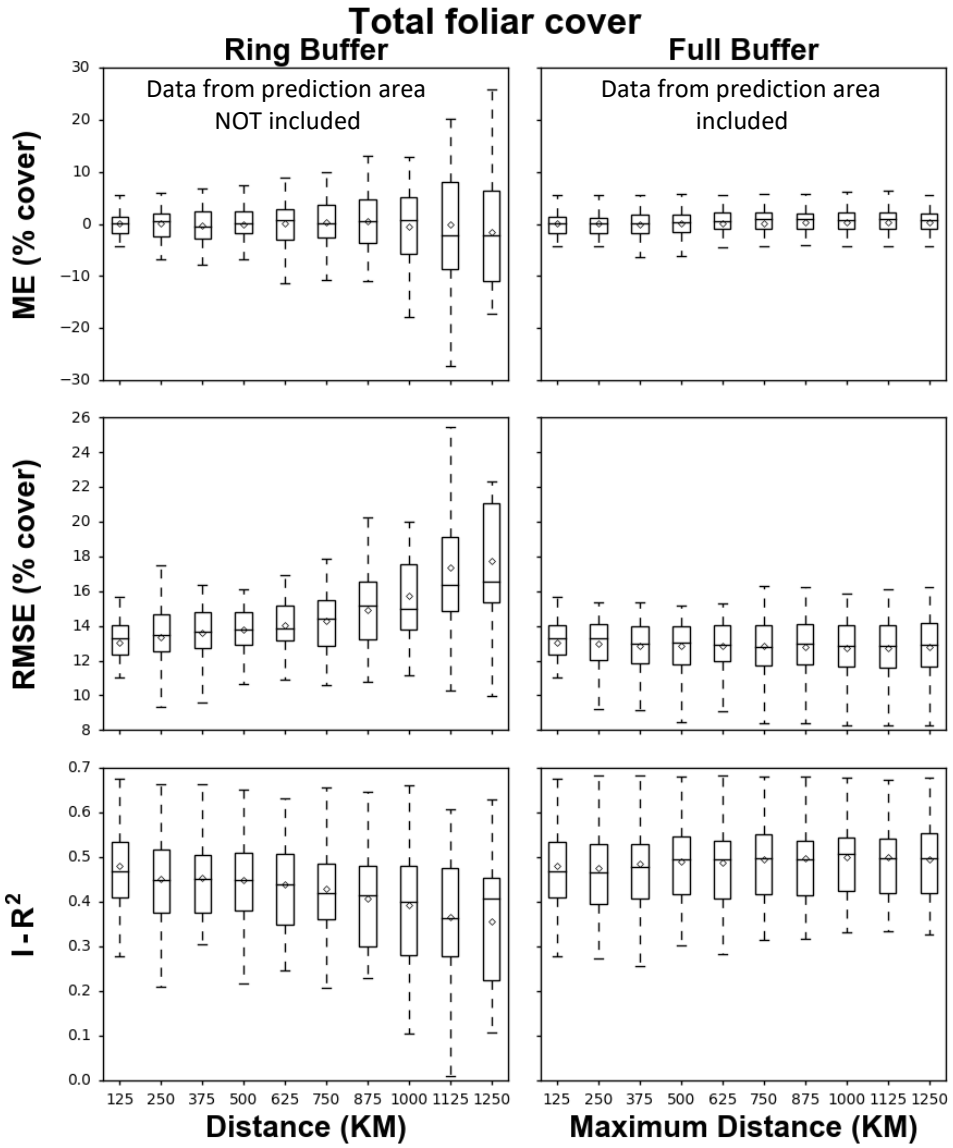
How to use the big data approach for map making?

- Should all the data be used all the time?
- Is training data from irrelevant **SPACE** and **TIME** going to help or hurt the map making in a specific space and time?
- In specific **SPACE** and **TIME** where there is no training available can we still make maps?

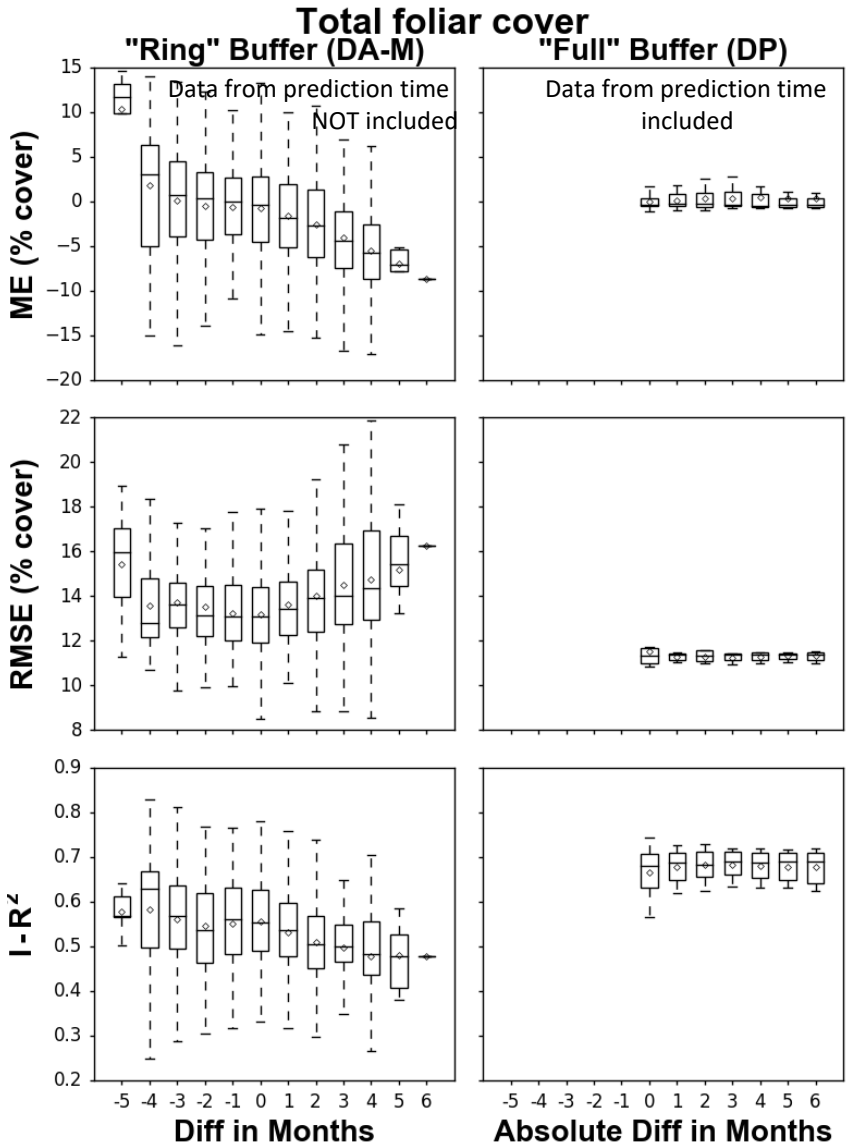
Does the "Kitchen Sink" approach work?

UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

OVER SPACE



OVER TIME



"Science" Conclusions

UCLA SOCIAL SCIENCES DIVISION | DEPARTMENT OF Geography

- **You can use data from everywhere to make a prediction anywhere**
  - The "Kitchen Sink" approach is OK in both space and time
  - Mixing relevant and irrelevant training data doesn't hurt the skill of the models

- The converse is NOT true:
  You cannot use data from anywhere to make a prediction everywhere
  - You DO need data from an area (or a time) – or at least data from similar areas (or times) to make good predictions in that area (at that time)

- Out of Bag (OOB) errors are **perfectly good** estimators of true model performance

- **Seasonality causes problems**, but performing a simple standardization reduces bias and improve the model estimates in all scenarios

- <u>Here's a head scratcher: How do you validate an estimate of uncertainty?</u>

Thanks to NASA for the support!

Thanks to our BLM Partners:
Kevin Miller
Matt Bobo
Chris Cole
Shannon Savage
Sam Litshert