

Introduction to Google Earth Engine

Developed by remote sensing specialists at the USFS Geospatial Technology and Applications Center (GTAC), located in Salt Lake City, Utah





Agenda

- Introduction to Earth Engine
- Explore the Code Editor Platform
- Show case available resources
- Register for Earth Engine account



What is Earth Engine?

- Remote Sensing Archive with petabytes of data in one location
- 2. A cloud-based geospatial processing platform for executing large-scale data analysis.





Example Applications:

- Classifying land cover conditions and change detection:
 - Video of deforestation in Brazil

https://earthengine.google.com/timelapse/?location=rondonia

Global Forest Change Map,

Hansen et al

http://earthenginepartners.appspot.com/science-2013-global-forest

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Why is it such a powerful image analysis software?

- 1. Public data catalog: vast amounts of publicly available data (you don't need to store data)
- 2. Processing power (computation engine)
- 3. Interactive development platforms
- 4. Save and share work routines



Data Catalog

- > 200 public datasets
- > 4000 new images every day
 - > 5 million images
 - > 5 petabytes of data

MODIS

250m daily

Landsat & Sentinel

10-30m, 14-day

Terra Bella

<1m daily-weekly

Terrain & Land Cover

Weather & Climate

NOAA NCEP, OMI, ...

... and many more, updating daily!



1. Earth Engine Public Data Catalog

- Imagery
- Geophysical
- Climate & Weather
- Demographic
- Vector Data (Fusion Tables)

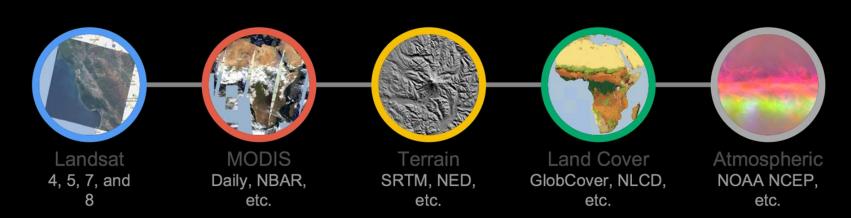


Image: Dave Thau



1. Load your own data

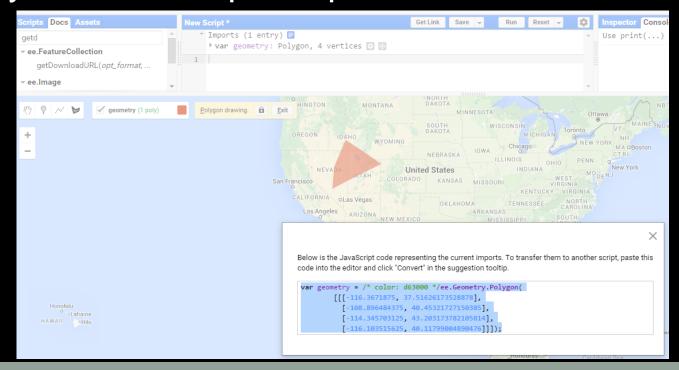
- Fusion Tables
 - Polygons in GEE come in Fusion Tables. These are in a spreadsheet format but can contain geospatial information that can be viewed in GEE





1. Make your own data in the map

- You can also digitize vector data sets (e.g., polygons) in the map window.
- These records can then be converted to code to use in your Javascript script

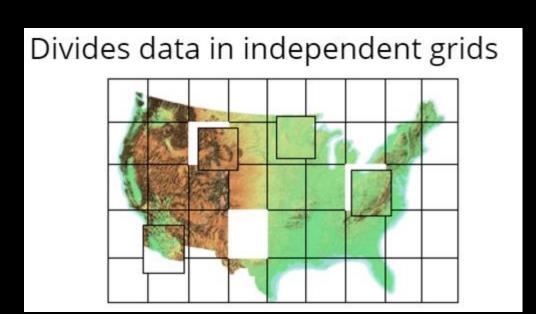




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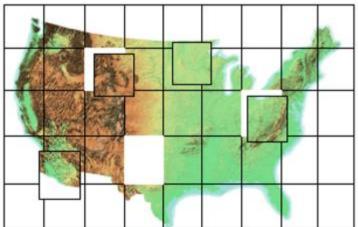
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"The computation engine is a just in time distributed computation model, ..."

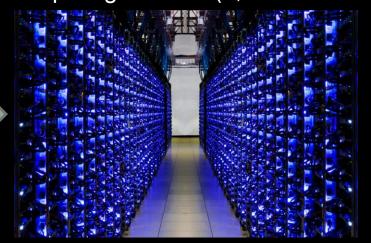


"The computation engine is a just in time distributed computation model, a cloud-based processing infrastructure that automatically parallelizes analyses on many CPUs across many computers in Google's data centers."

Divides data in independent grids

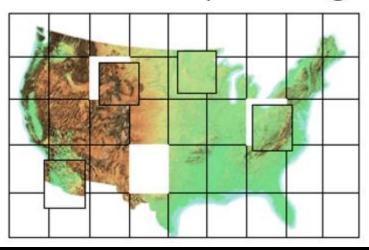


Storage Clusters (petabytes of data) Computing clusters (1,000's of CPUs

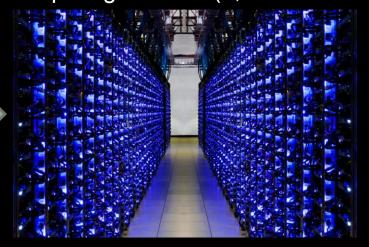


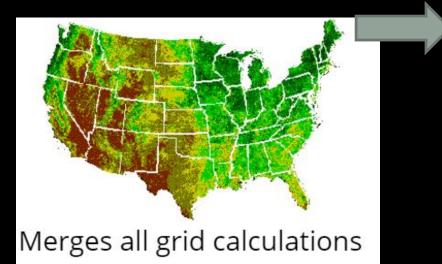


Divides data in independent grids



Storage Clusters (petabytes of data) Computing clusters (1,000's of CPUs







- Unprecedented speed: reduce processing times by orders of magnitude by using the distributed, cloud-based computing power
- Ease of use and lower costs: online platform with easy access to data, scientific algorithms, computational power.



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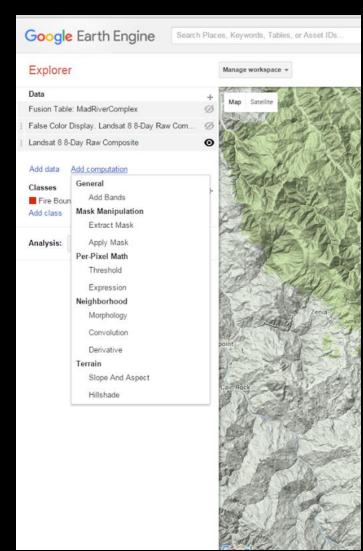
3. Two Platforms

- Graphical User Interface (Explorer)
 - https://explorer.earthengine.google.com/#workspace
 - User friendly way to begin exploring and analyzing data
- Application Program Interface (Code Editor)
 - https://code.earthengine.google.com/
 - Powerful geospatial tool to create complex custom analysis
 - Requires some programming knowledge
 - Supports both JavaScript and Python



Explorer Platform

- A point and click platform:
 - Audience: non-programmers
- Basic analysis functionality
 - Per pixel math (~ESRI's raster calculator),
 - Neighborhood algorithms,
 - Terrain algorithms, etc
- Save and share workspace
- Explore and export data

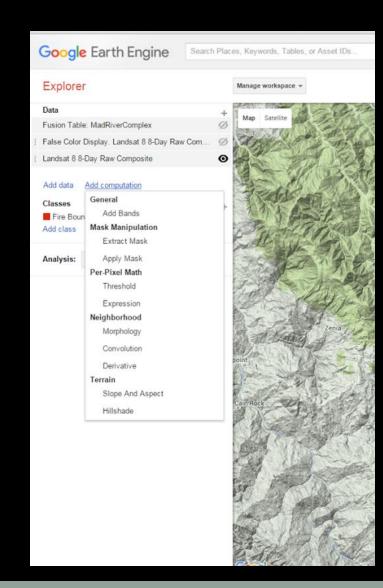




Explorer Platform

Cons:

- Limited analysis power:
 - subset of tools





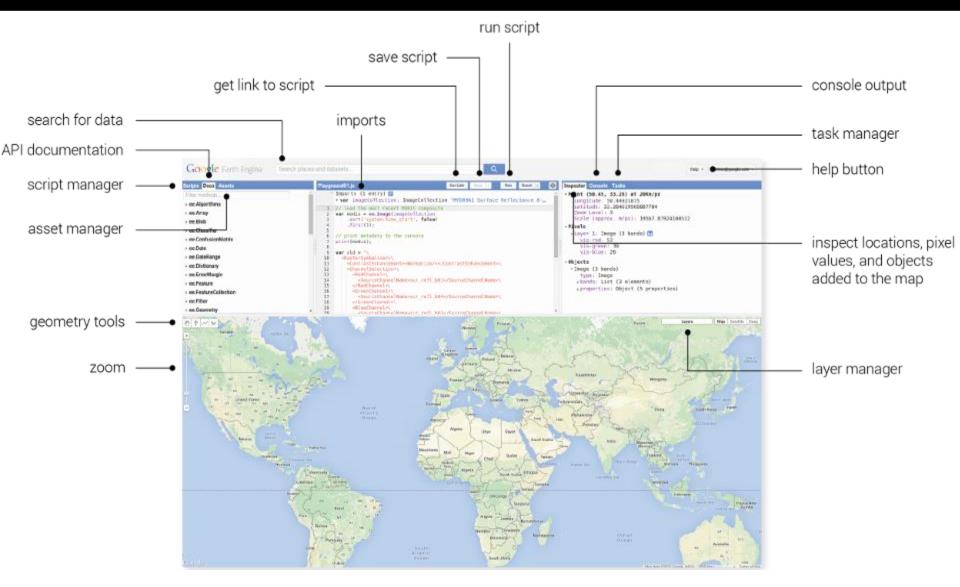
Code Editor

- What is it?
 - Web based IDE for the Earth Engine API
 - Access many pre-made geospatial tools





Code Editor Interface





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- 4. Save and share work routines (see demo)



When to use Earth Engine

EE Benefits:

Good for projects that requires:

- Data coverage for a large region
- Extensive data library
- High speed, intensive processing capacity
- Advanced raster processing tools

EE Limitations:

- Better suited to image analyses than vector-based analyses
- Analysis based on pixel spatial relations are harder to complete (because of the processing on multiple CPUS). Image segmentation and hydrologic modeling options are limited or in testing phases.



Spatial Data in GEE

- Images (raster) objects
 - ee.Image
 - An image refers to a single image (usually with multiple bands. e.g., one Landsat scene)
 - ee.ImageCollection
 - An image collection refers to a set of Earth Engine images (multiple rasters)
- Vector objects (points, lines, polygons or tables)
 - ee.Geometry or ee.Feature
 - ee.FeatureCollection (multiple features)

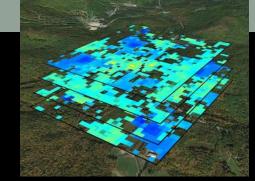


Image: Global Snow Observatory



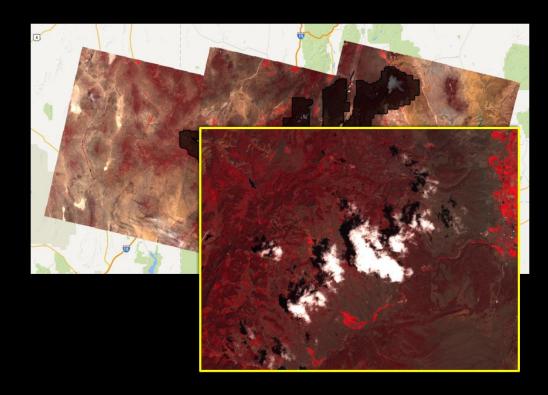
Methods and Algorithms

- Functions: are actions that can be applied to data
 - E.g., exporting image objects stored as variables
- Methods: are functions that are tailored to specific objects
 - E.g., adding numbers
- Algorithms: provide some commonly used (higher) level functions
 - E.g., Landsat specific processing



Processing & Analysis in Code Editor

- Custom functions
 - Multiple Earth
 Engine and
 JavaScript
 functions can be
 combined to
 create custom
 algorithms

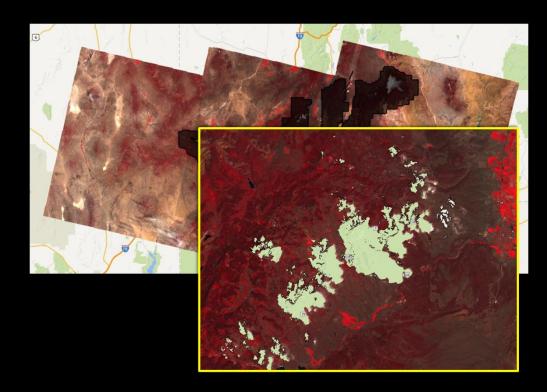


Example: use spectral and thermal values to identify and remove pixels that are likely to represent clouds and/or shadows.



Processing & Analysis with GEE

- Custom functions
 - Multiple
 Playground and
 JavaScript
 functions can be
 combined to
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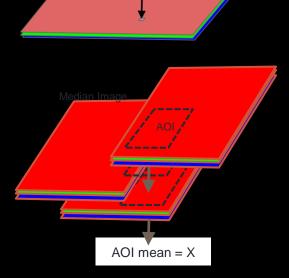


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Processing & Analysis with GEE

- Reducing collections
 - applies a reducer to all of the bands of an image.
 - the reducer must have a single input and will be called at each pixel to reduce the stack of band values.
 - the output image will have one band for each reducer output.

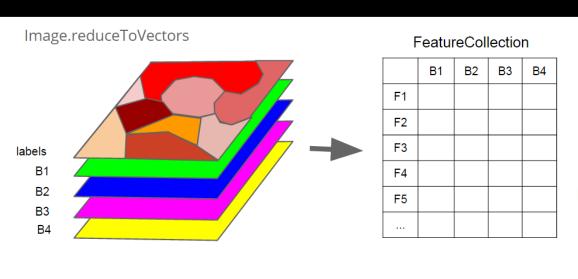


Images: Tyler Erickson



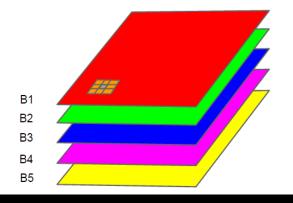
Processing & Analysis with GEE

 Reducing areas (e.g., region, neighborhood)



Images: Tyler Erickson

Image.reduceNeighborhood (reduce spatially, per band)





Registration Process

- Sign up for an Evaluator account:
 - Register here: https://earthengine.google.com/signup/
 - It may take up to one week to be granted access



Additional Learning Materials

- https://developers.google.com/earthengine/getstarted
- https://developers.google.com/earthengine/playground

If you have questions please contact
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801-975-3804

Please contact Sarah Marlay, at USFS International Programs to learn more about international training opportunities: sarahemarlay@fs.fed.us

