Google Earth Engine: A New Platform for Global-Scale Disaster Risk Resilience
Rebecca Moore, Google

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Google Earth Engine:
Deriving information from earth data at scale

Monitor a changing planet
One Landsat 8 image:
- 64M pixels (30m resolution)
- 10 spectral bands
- 12 bits/band
- 600 images/day

MORE THAN 4M IMAGES FROM 42 YEARS OF LANDSAT.

Many other satellites with different combinations of spatial resolution, spectral bands, collection frequency.
Earth Observation Data Archives

4M+ Landsat images
(1972-2015)
More than a petabyte stored on tapes at USGS
Operating NASA Earth Science Missions

Source: NASA
Now at Google Scale
After
Global 15M Cloud-Free Imagery
Launched June 26, 2013 in Google Earth and Maps
29 years of satellite data

2,068,467 landsat scenes analyzed

909 terabytes of data

More than 2M hours of computation over 66,000 computers

Elapsed Time: ~1.5 days to build Timelapse
Global Forests: Map, Measure, Monitor
High-Resolution Global Maps of 21st-Century Forest Cover Change


ABSTRACT

Quantification of global forest change has been lacking despite the recognized importance of forest ecosystem services. In this study, Earth observation satellite data were used to map global forest loss (2.3 million square kilometers) and gain (0.8 million square kilometers) from 2000 to 2012 at a spatial resolution of 30 meters. The tropics were the only climate domain to exhibit a trend, with forest loss increasing by 2101 square kilometers per year. Brazil’s well-documented reduction in deforestation was offset by increasing forest loss in Indonesia, Malaysia, Paraguay, Bolivia, Zambia, Angola, and elsewhere. Intensive forestry practiced within subtropical forests resulted in the highest rates of forest change globally. Boreal forest loss due largely to fire and forestry was second to that in the tropics in absolute and proportional terms. These results depict a globally consistent and locally relevant record of forest change.
<table>
<thead>
<tr>
<th>Data Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landsat Scenes</td>
<td>654,178</td>
</tr>
<tr>
<td>Terapixels of Data</td>
<td>700</td>
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<tr>
<td>Hours of Computation</td>
<td>1,000,000</td>
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<tr>
<td>CPUs Used</td>
<td>10,000</td>
</tr>
<tr>
<td>Days to Complete</td>
<td>4</td>
</tr>
</tbody>
</table>
Find out what is happening in forests right now

Globalforestwatch.org

Join the community
Analysis tool
Stay updated
Globalforestwatch.org

UMD/Google tree cover loss (zoom in for most accurate viewing)

TOTAL SELECTED AREA
18,309,579.848 ha

LOSS 2001-2012 with >10% canopy density
3,432,117.444 ha

GAIN 2001-2012
1,990,404.275 ha

This algorithm approximates the results by sampling the selected area. Results are more accurate at closer zoom levels.

Download entire data set at project website
Google Earth Engine Brings Big Data to Environmental Activism

A new forest-mapping tool relies on unprecedented data crunching

By Eliza Strickland
Posted 16 Apr 2014 | 16:09 GMT

When a tree falls in the forest these days, it doesn’t just make a sound—it causes a computer program to generate an alert that’s sent out to activists, researchers, and environmental policymakers around the planet. An online tool to map deforestation is applying big-data processing techniques to massive troves of satellite imagery, and in the process it is making possible a new kind of environmental activism.
Under the Hood
The Earth Engine Public Data Catalog

- Landsat 4, 5, 7, 8
  Raw, TOA, SR, ...
- MODIS
  Daily, NBAR, LST, ...
- Terrain
  SRTM, GTOPO, NED, ...
- Land Cover
  GlobCover, NLCD, ...
- Atmospheric
  NOAA NCEP, OMI, ...

... and many more, updating daily!

> 200 public datasets
> 5 million images
> 4000 new images every day
> 5 petabytes of data
Massive scale of Cloud-computation

Parallel-processing on thousands of CPUs
Original Image
is divided into 256px sub-units.
Sub-units are distributed
Sub-units are distributed to separate machines where they can be processed in parallel.
Thousands can be processed simultaneously.
Result is reassembled
Result is reassembled into a finished image.
// Make a median composite from 2 years of Landsat 7.

// Get the image collection.
var collection = ee.ImageCollection('LE7_L1T');

// Filter it down to 2011 and 2012.
var filtered = collection.filterDate('2011-01-01', '2012-12-31');

// For each pixel, for each band, calculate the median and make an image
// of the result. The median tends to remove clouds, shadows, data gaps.
var medianImage = filtered.median();

// Add the image to a map.
addToMap(medianImage,
   {bands:['B3', 'B2', 'B1'], min:35, max:170, gamma:2},
   'L7 Composite Median: 2011-2012'});
Earth Engine Applications for Disaster Risk Resilience
Earthquake Risk: Predicted Ground Acceleration

Stanford Urban Resilience Initiative
David Lallemant
Flood Risk Due to Sea-level Rise
The Vanuatu high resolution elevation data (Lidar) surveys were a partnership between the Vanuatu and Australian Governments, with funding from Australia’s Pacific-Australia Climate Change Science and Adaptation Planning (PACSSAP) program.
Climate Engine

Cloud Computing and Visualization of Climate and Remote Sensing Data

Median Land Surface Temperature during Day Difference from Climatology

Source: MODIS 8-day LST_Day, Year from 2012-01-01 to 2012-03-22

Note: Website developed using Chrome internet browser. Use other browsers at your own risk.
Combining Social and Biophysical Vulnerability Data in Google Earth Engine

Beth Tellman
Arizona State School of Geographical Sciences
Bessie Schwarz
Yale Project on Climate Change Communication
The Hazards-of-Place Model of Vulnerability (Modified from Cutter, 1996)
1. Low Elevation
2. Low Slope
3. High % Impervious Surface
4. High Topographic Index ln (contributing area/tan slope)
1. High percentage of very young
2. High percentage of very old
3. High Poverty
4. Low Community cohesion
5. High Population Density
Within the Lower Hudson Watershed, where is it likely to flood, how many people live there, and who might be most vulnerable?
Socio-physical High Risk Area

Flood Risk area

2014
2050
2100
Physical Vulnerability to Flooding in Senegal. The sections of Senegal’s total floodplain area that is most likely to be flooded by river is pictured here in black (top 10% most vulnerable).

782 square Kilometers of the country to be at high risk from flooding 242,739 total Senegalese are highly exposed to potential flooding and 91,732 of these Senegalese are highly socially vulnerable.
Our goal is to turbo-charge the best science on massive data to create novel insights and drive action.

FORTUNE

Big Data's Biggest Challenge, Climate Change
Questions?

Sign up to be a beta tester: earthengine.google.org/signup

Rebecca Moore, Google rmoore@google.com