Planetary-Scale Geospatial Data Analysis with Google Earth Engine

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Earth Engine: Origins
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Earth Engine: Project Goals

1. Build the world’s most advanced geospatial data analysis platform.
Earth Engine: Project Goals

2. Turn it into an amazing Google product.
Earth Engine: Project Goals

3. Use it to help address global challenges.
Earth Engine: 2009

- Founded the Earth Engine (EE) project in Google.org
- Internal R&D and tech demos
- Announced the project’s existence and began seeking scientific partners
Earth Engine: 2010

- Built the core of the Earth Engine platform
- Experimental country-scale Landsat processing
- Launched public data browser and first web API
Earth Engine: 2011

- Supervised classification and machine learning tools
- First complete application-specific tools built by science partners using the EE API
Earth Engine: 2012

- Web-based “Playground” for analysis using JavaScript API
- Global-scale computational capability
- Began significant growth in our Trusted Tester program
2013: Cloud-Free Global Landsat Imagery in Earth & Maps
2013: Global Landsat Time-lapse Animations

- Columbia Glacier Retreat, 1984-2011
- Dubai Coastal Expansion, 1984-2012
- Las Vegas Urban Growth, 1986-2012
- Brazilian Amazon Deforestation, 1984-2012
The Earth Engine Service Architecture

- **Google Web Apps**
  (EE website and “Playground”)

- **Specialized Web Apps**
  (Typically third-party sites)

- **Scripting Libraries**
  (JavaScript / Python)

- **Web APIs**
  (REST-ish)

- **On-the-Fly Computation**

- **Batch Computation**

- **Data Storage**
  (Raster & Vector)
The Earth Engine Public Data Catalog

**Landsat**
4, 5, 7, and 8

**MODIS**
Daily, NBAR, etc.

**Terrain**
SRTM, NED, etc.

**Land Cover**
GlobCover, NLCD, etc.

**Atmospheric**
NOAA NCEP, etc.

- SPOT scenes
- GeoEye scenes
- DG scenes
- FIRMS fires
- ... and much more!
- Plus your Maps Engine data too!
The Earth Engine Playground

```javascript
// Add a band containing image date as years since 1991.
function createTimeBand(img) {
  var year = ee.Date(img.get('system:time_start')).get('year');
  return ee.Image(year).subtract(1991).byte().addBands(img);
}

// Fit a linear trend to the nighttime lights collection.
var fit = ee.ImageCollection('NOAA/DMSP-OLS/NIGHTTIME_LIGHTS')
  .select('stable_lights')
  .map(createTimeBand)
  .reduce(ee.Reducer.linearFit());

// Display trend in red/blue, brightness in green.
addToMap(fit, {min: 0, max: [0.18, 20, -0.18], bands: ['scale', 'offset', '']});
```
Center-Pivot Irrigation
Evapotranspiration (METRIC / EEFlux)

EEFlux project team (University of Nebraska-Lincoln, Desert Research Institute, University of Idaho)
Earthquake Risk Mapping

David Lallemand, Stanford Urban Resilience Initiative
Drought Monitoring

Justin Huntington and Charles Morton, Desert Research Institute
Deforestation Monitoring

And much, much more....
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