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# Google Earth Engine

## An Introduction

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Goodchild et al. (2012):

## Next-generation Digital Earth

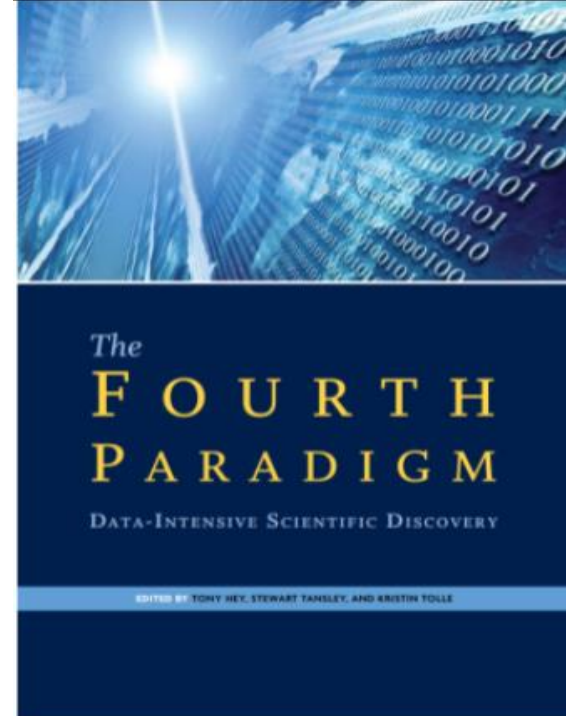
Michael F. Goodchild<sup>1,2</sup>, Huadong Guo<sup>3</sup>, Alessandro Annoni<sup>4</sup>, Ling Bian<sup>5</sup>, Kees de Bie<sup>6</sup>, Frederick Campbell<sup>7</sup>, Max Craglia<sup>8</sup>, Manfred Ehlers<sup>9</sup>, John van Genderen<sup>10</sup>, Davina Jackson<sup>11</sup>, Anthony J. Lewis<sup>12</sup>, Martino Pesaresi<sup>13</sup>, Gábor Remetey-Fülöpp<sup>14</sup>, Richard Simpson<sup>15</sup>, Andrew Skidmore<sup>16</sup>, Changlin Wang<sup>17</sup>, and Peter Woodgate<sup>18</sup>

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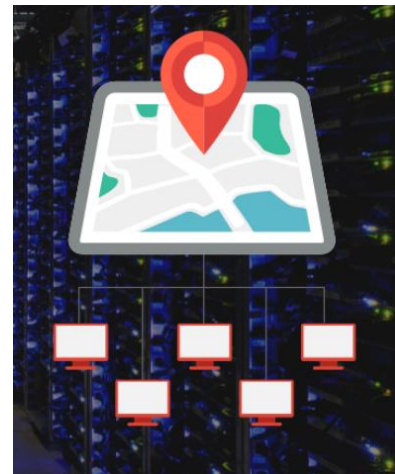
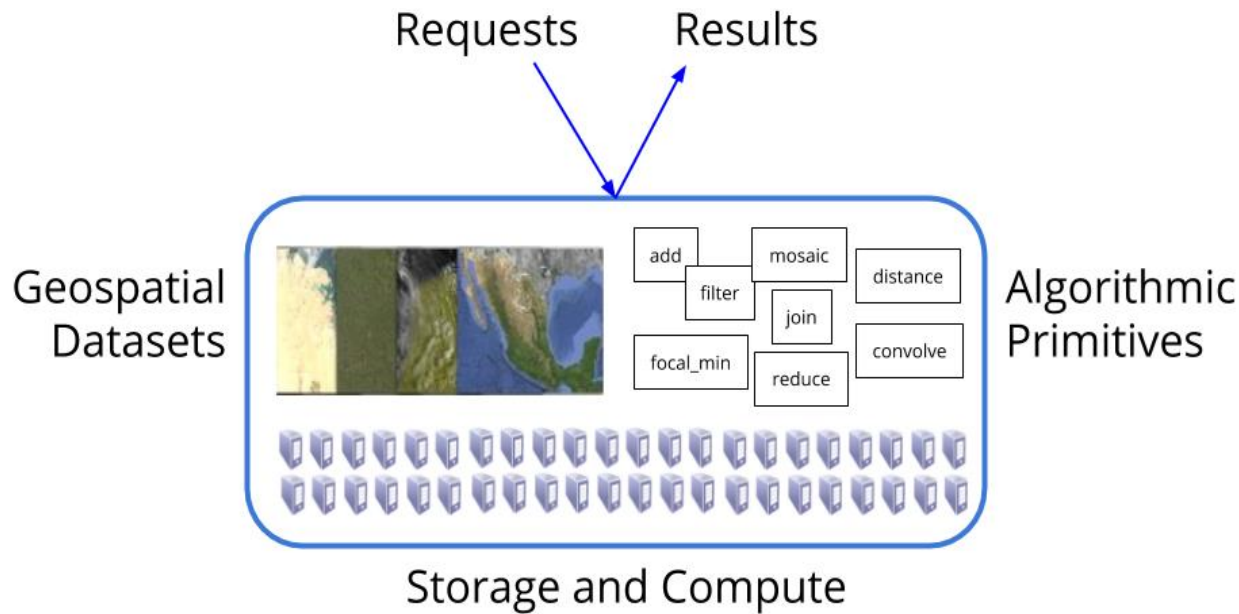
“The supply of geographic information from satellite-based and ground-based sensors has expanded rapidly, encouraging belief in a new, fourth, or “big data,” paradigm of science that emphasizes **international collaboration, data-intensive analysis, huge computing resources, and high-end visualization.**”

*“Often it turns out to be more efficient to move the questions than to move the data.”*

Jim Gray (1944-2007)



# Access Google's Cloud Resources through JavaScript Python **API's**



# Massive online public data archive

40+ years of remotely sensed data

## The Earth Engine Public Data Catalog



**Landsat and  
Sentinel**  
Raw, TOA, SR, ...



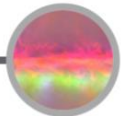
**MODIS**  
Daily, NBAR, LST, ...



**Terrain**  
SRTM, GTOPO, NED, ...



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



**Atmospheric**  
NOAA NCEP, OMI, ...

... and many more, updating daily!

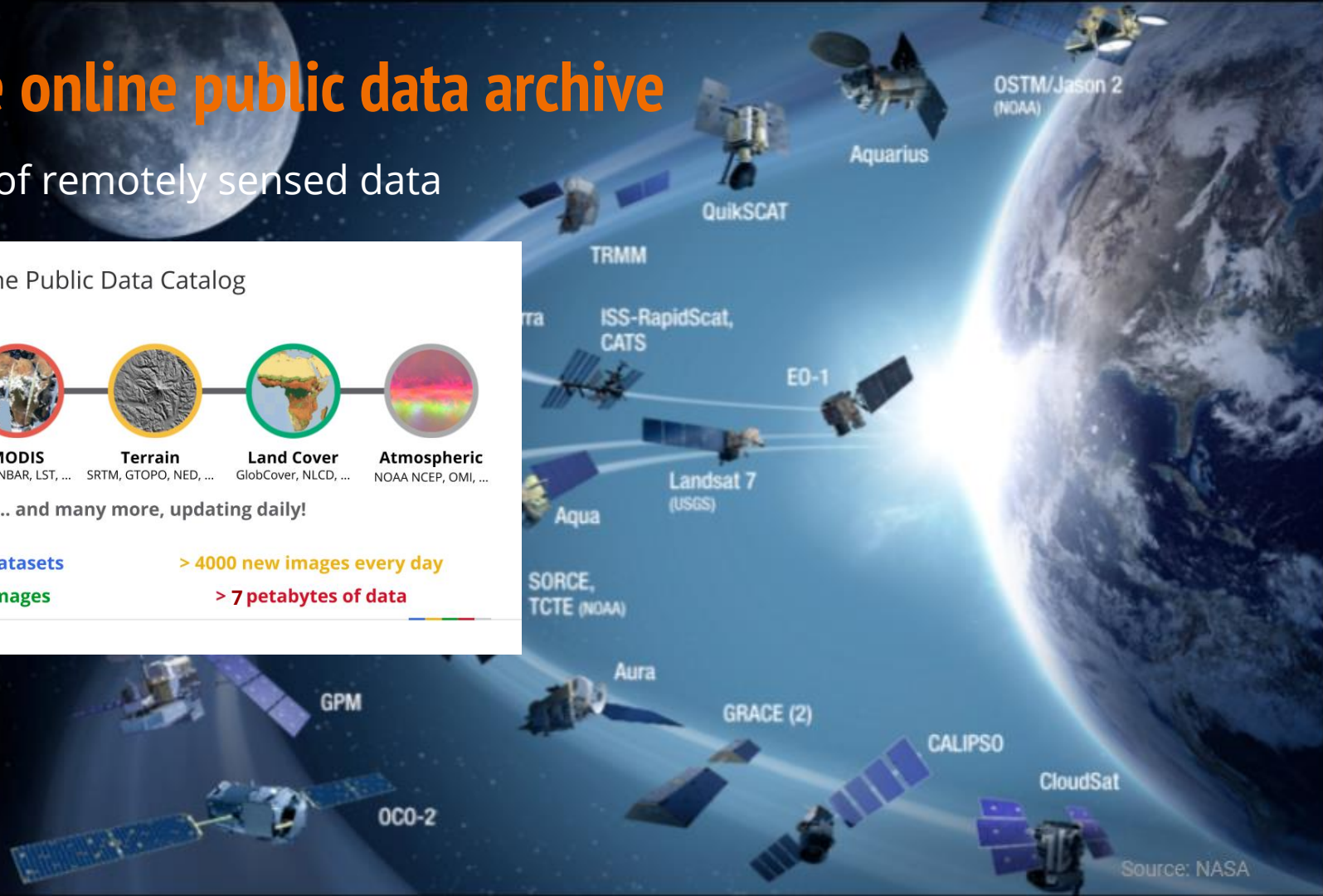
> 200 public datasets

> 5 million images

> 4000 new images every day

> 7 petabytes of data

Google Earth Engine



Source: NASA

# Data Types and Geospatial Processing Functions

**Image** - band math, clip, convolution, neighborhood, selection ...

**Image Collection** - map, aggregate, filter, mosaic, sort ...

**Feature** - buffer, centroid, intersection, union, transform ...

**Feature Collection** - aggregate, filter, flatten, merge, sort ...

**Filter** - by bounds, within distance, date, day-of-year, metadata ...

**Reducer** - mean, linearRegression, percentile, histogram ....

**Join** - simple, inner, outer, inverted ...

**Kernel** - square, circle, gaussian, sobel, kirsch ...

**Machine Learning** - CART, random forests, bayes, SVM, kmeans, cobweb ...

**Projection** - transform, translate, scale ...

over 1000 data types and operators, and growing!

# Table of Content

## Working with images

1. Loading image from image collection
2. Image information and metadata
3. Image Visualization
4. Color Composites
5. Uploading own geotiffs

## Working with image collections

1. Load Image collection data
2. Filtering image collection
3. Image Mosaicking over collection
4. Mapping over image collection
5. Visualizations

## Mathematical Operations

1. **Thresholding** a DEM
2. Using **expression** () to write complicated computations.

## Exporting GEE Image

1. Exporting as NumPy Array
2. Exporting as Geotiff file in google drive.

## Vector data and charts

1. Reduce by region operation.
2. Plot with python library: Matplotlib