Google Earth Engine

What is Google Earth Engine?

Nick Clinton, nclinton@google.com
Earth Engine Developer Relations

http://bit.ly/2CbjA6n

Goodchild et al. (2012):

Next-generation Digital Earth

Michael F. Goodchild[a,1], Huadong Guo[b], Alessandro Annoni[c], Ling Bian[d], Kees de Bie[e], Frederick Campbell[f], Max Craglia[c], Manfred Ehlers[g], John van Genderen[e], Davina Jackson[h], Anthony J. Lewis[i], Martino Pesaresi[c], Gábor Remetey-Fülöpp[j], Richard Simpson[k], Andrew Skidmore[f], Changlin Wang[b], and Peter Woodgate[l]

[a]Department of Geography, University of California, Santa Barbara, CA 93106; [b]Center for Earth Observation and Digital Earth, Chinese Academy of Sciences, Beijing 100094, China; [c]Joint Research Centre of the European Commission, 21027 Ispra, Italy; [d]Department of Geography, University at Buffalo, State University of New York, Buffalo, NY 14261; [e]Faculty of Geo-Information Science and Earth Observation, University of Twente, 7500 AE, Enschede, The Netherlands; [f]Fred Campbell Consulting, Ottawa, ON, Canada K2H 5G8; [g]Institute for Geoinformatics and Remote Sensing, University of Osnabrück, 49076 Osnabrück, Germany; [h]D_City Network, Newtown 2042, Australia; [i]Department of Geography and Anthropology, Louisiana State University, Baton Rouge, LA 70803; [j]Hungarian Association for Geo-Information, H-1122, Budapest, Hungary; [k]Nextspace, Auckland 1542, New Zealand; and [l]Cooperative Research Center for Spatial Information, Carlton South 3053, Australia

"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.**"


OSTM/Jason 2
(NOAA)
Aquarius
QuikSCAT
TRMM
Terra
ISS-RapidScat,
CATS
EO-1
Landsat 7
(USGS)
SMAP
Aqua
Suomi NPP
(NOAA)
Landsat 8
(USGS)
SORCE,
TCTE (NOAA)
Aura
GRACE (2)
GPM
CALIPSO
CloudSat
OCO-2
Source: NASA

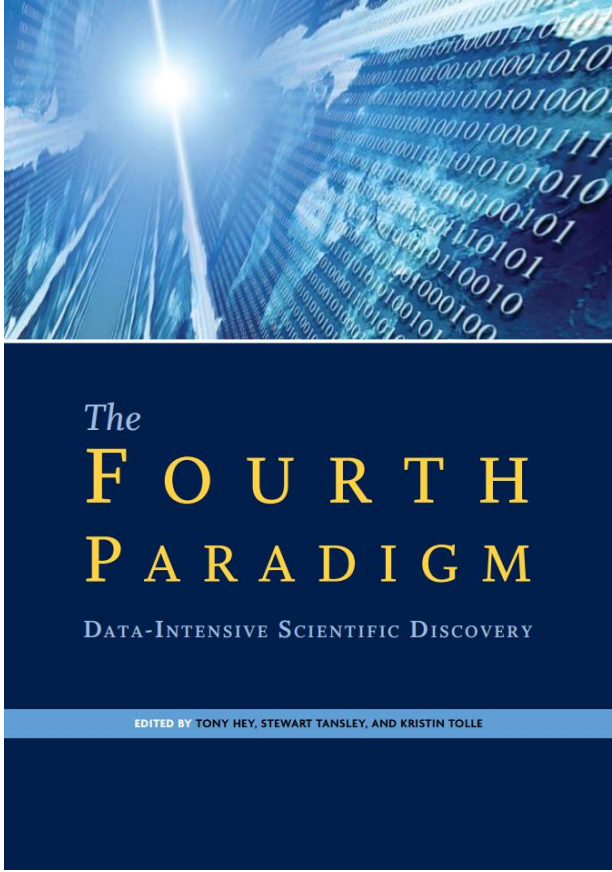
Google Mission Statement

"To organize the world's information and make it universally accessible and useful."

https://www.google.com/about/company/

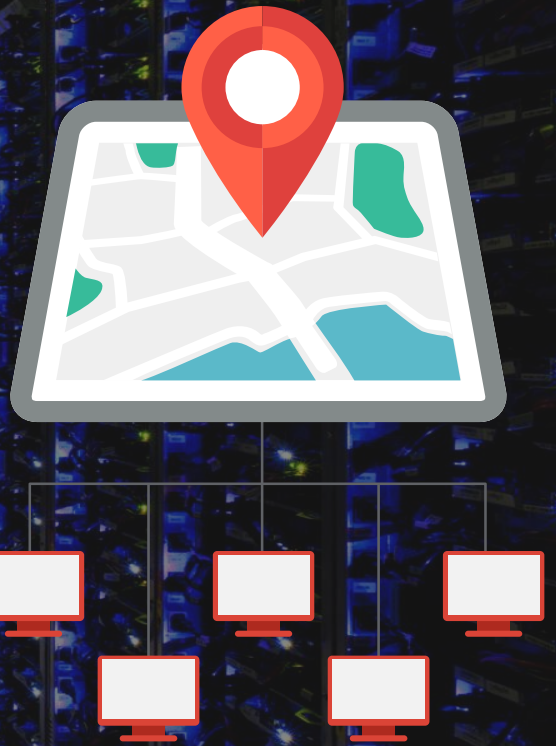
"Often it turns out to be more efficient to move the questions than to move the data."

-Jim Gray (1944-2007)



> 20 Petabytes of Earth observation data (imagery, weather, etc.)

Google computational infrastructure



https://earthengine.google.com/timelapse/

Data Catalog

Google Earth Engine

The Earth Engine Data Catalog

Landsat & Sentinel 1, 2
10-30m, weekly

MODIS
250m daily

Vector Data
WDPA, Tiger

Terrain & Land Cover

Weather & Climate
NOAA NCEP, OMI, ...

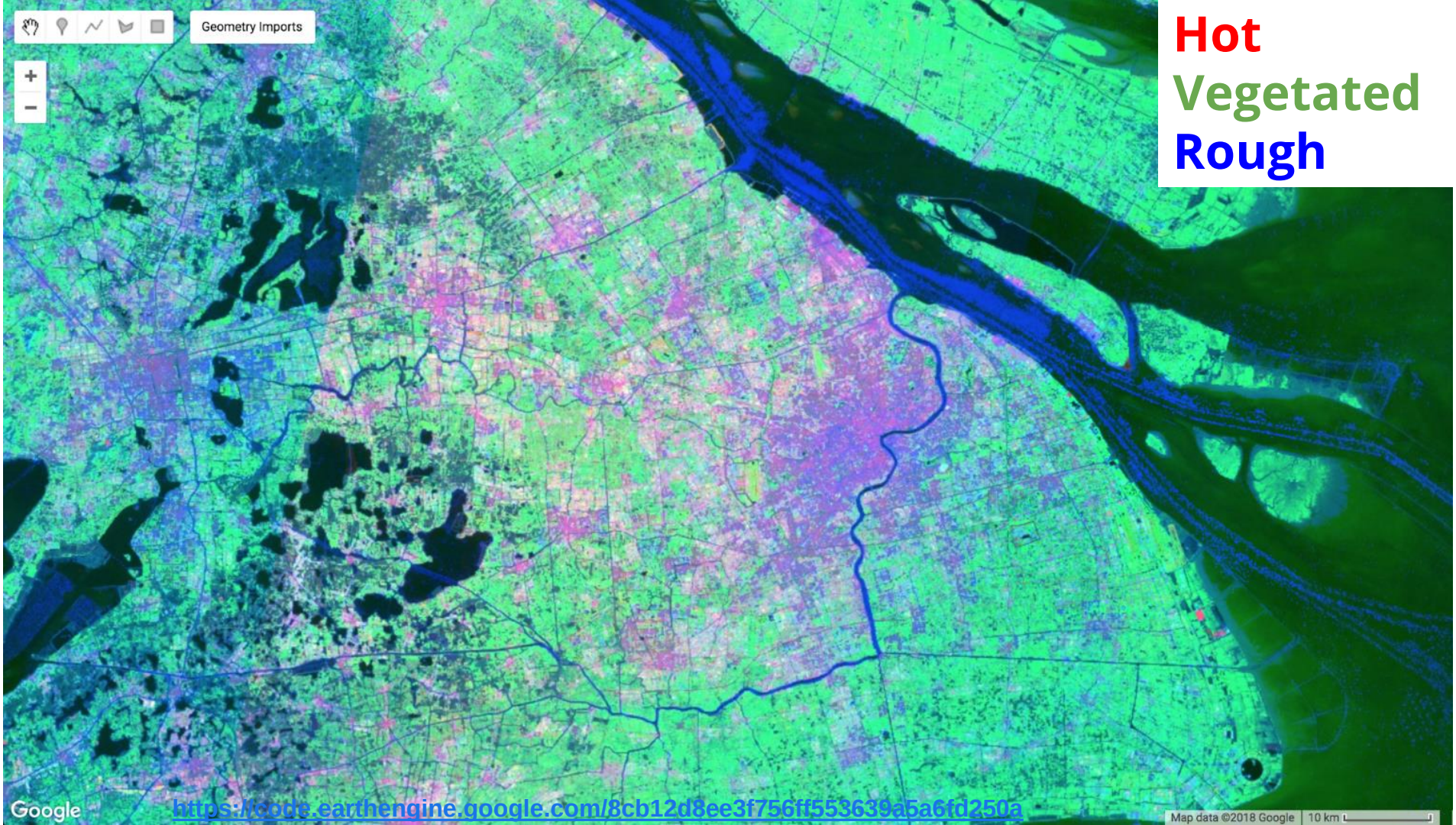
... and upload your own vectors and rasters

> 200 public datasets

> 5 million images

> 4000 new images every day

> 7 petabytes of data


Geometry Imports
Hot
Vegetated
Rough
https://code.earthengine.google.com/8cb12d8ee3f756ff553639a5a6fd250a
Google
Map data ©2018 Google
10 km

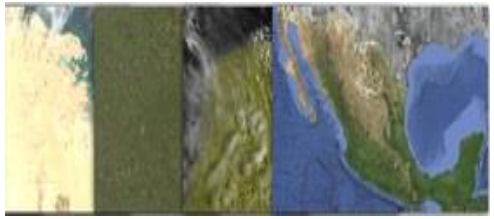
Compute

Google Earth Engine

Requests

Results

Geospatial Datasets



add

mosaic

distance

filter

join

convolve

focal_min

reduce

Algorithmic Primitives

Storage and Compute

Contents lists available at ScienceDirect

Remote Sensing of Environment

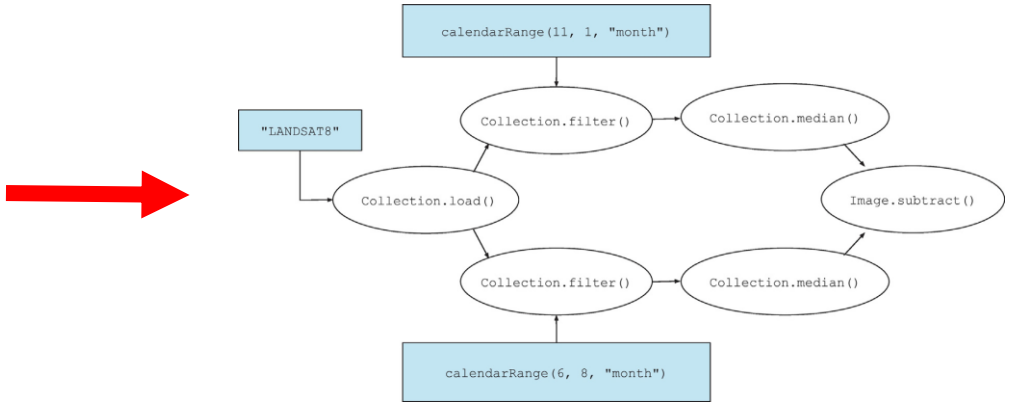
journal homepage: www.elsevier.com/locate/rse

Google Earth Engine: Planetary-scale geospatial analysis for everyone

Noel Gorelick [a,*], Matt Hancher [b], Mike Dixon [b], Simon Ilyushchenko [b], David Thau [b], Rebecca Moore [b]

https://www.sciencedirect.com/science/article/pii/S0034425717302900

```
collection = ee.ImageCollection("LANDSAT8")
winter = collection.filter(ee.Filter.calendarRange(11, 1, "month"))
summer = collection.filter(ee.Filter.calendarRange(6, 8, "month"))
diff = summer.median().subtract(winter.median())
```



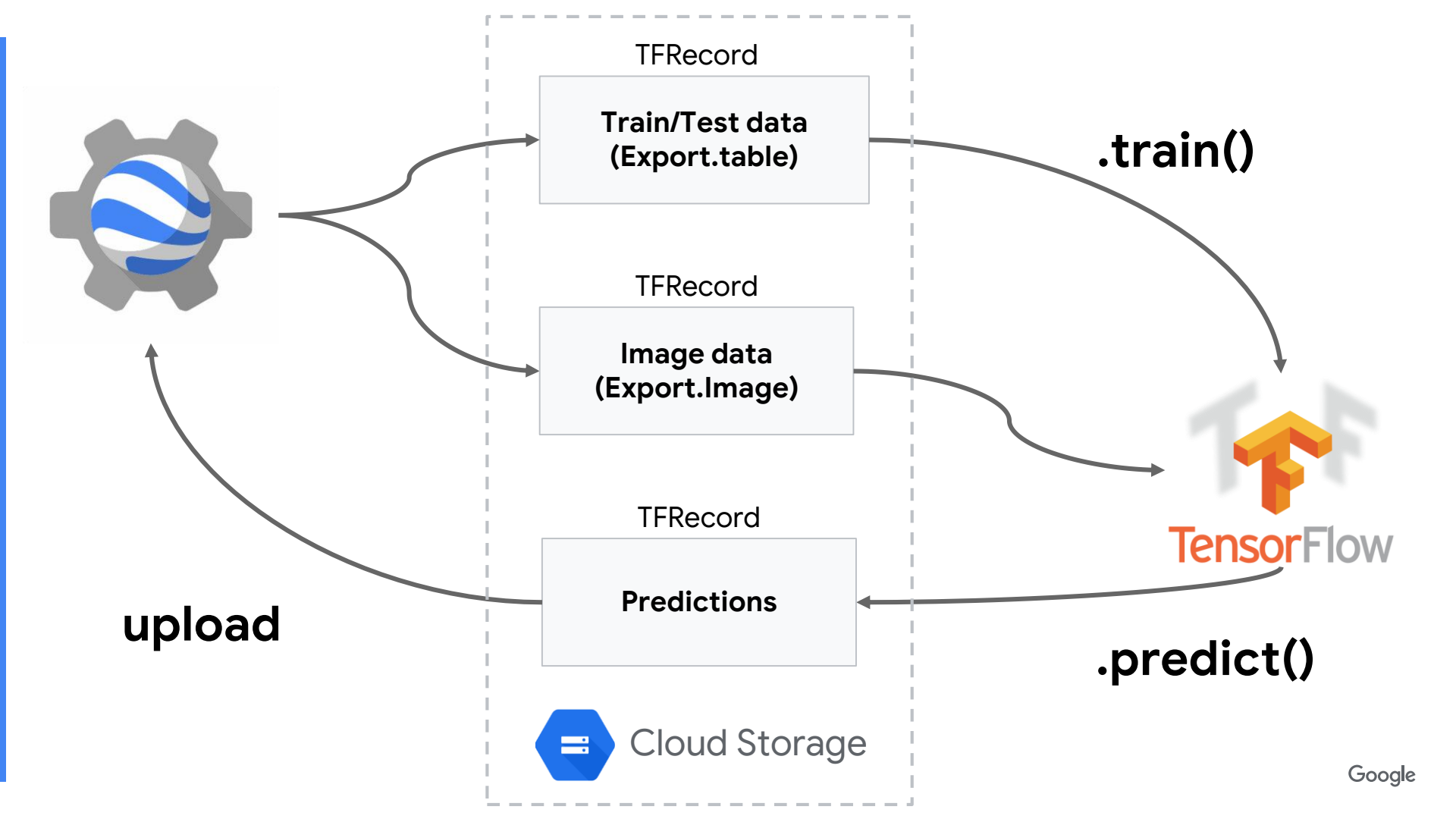
API

Machine learning

```
var classifier = ee.Classifier.cart().train({
  features: training,
  classProperty: 'landcover',
  inputProperties: bands
});

var classified = image.select(bands).classify(classifier);

Map.addLayer(classified, ...);
```

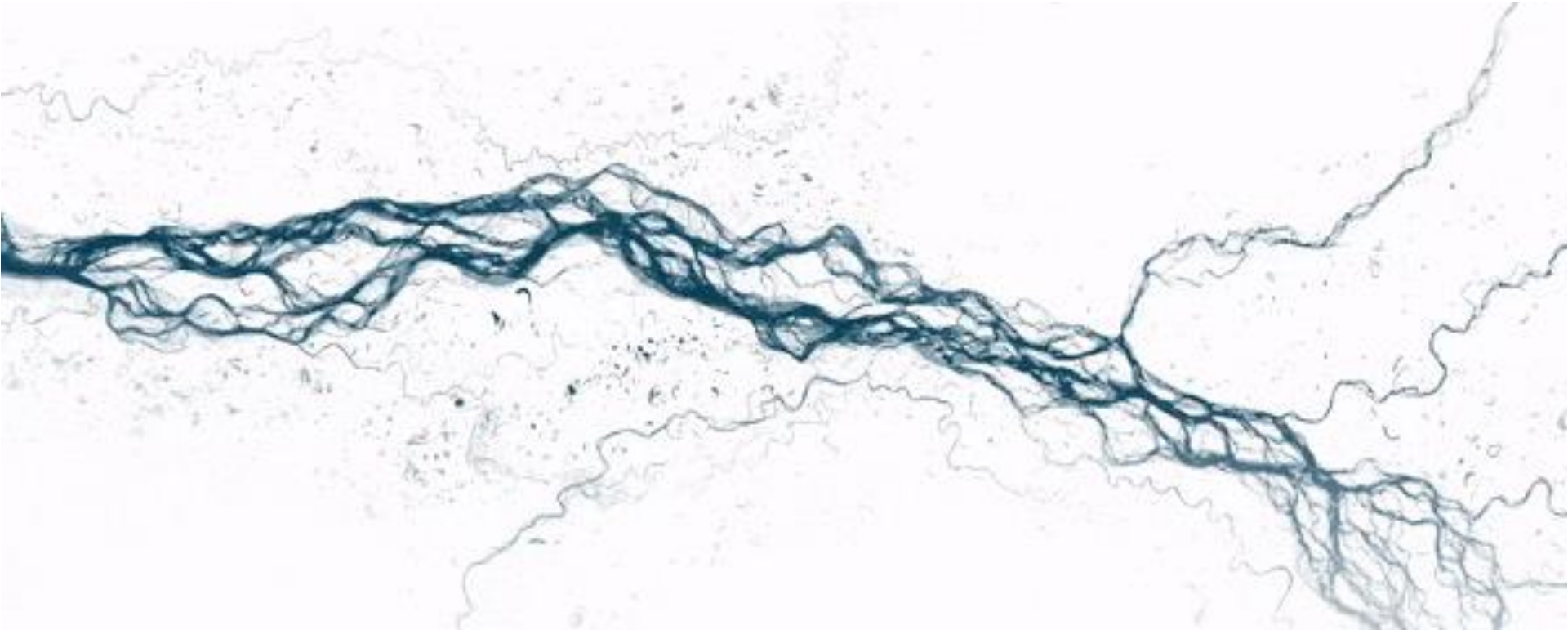

TFRecord
Train/Test data
(Export.table)
.train()
TFRecord
Image data
(Export.Image)
TensorFlow
TFRecord
Predictions
upload
.predict()
Cloud Storage

Applications

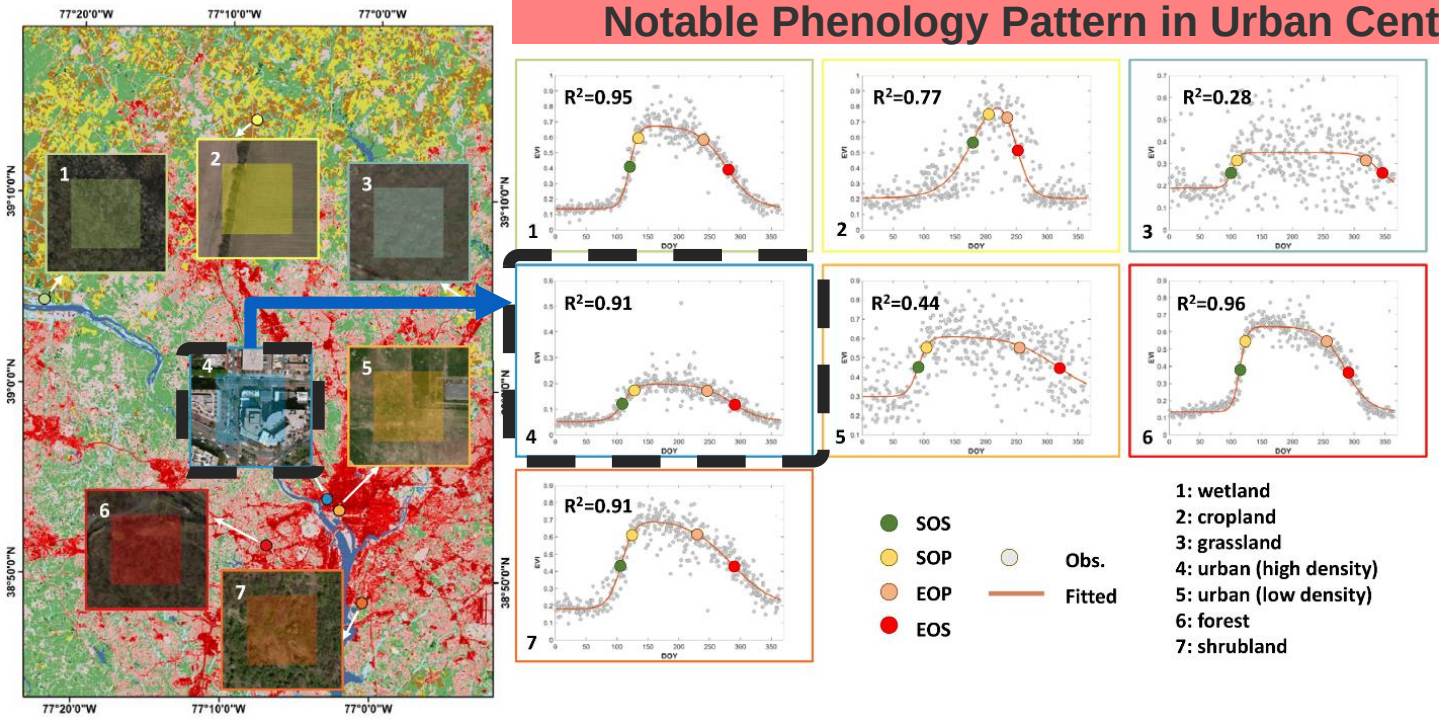
High-resolution mapping of global surface water and its long-term changes

Jean-Francois Pekel[1], Andrew Cottam[1], Noel Gorelick[2] & Alan S. Belward[1]

doi:10.1038/nature20584



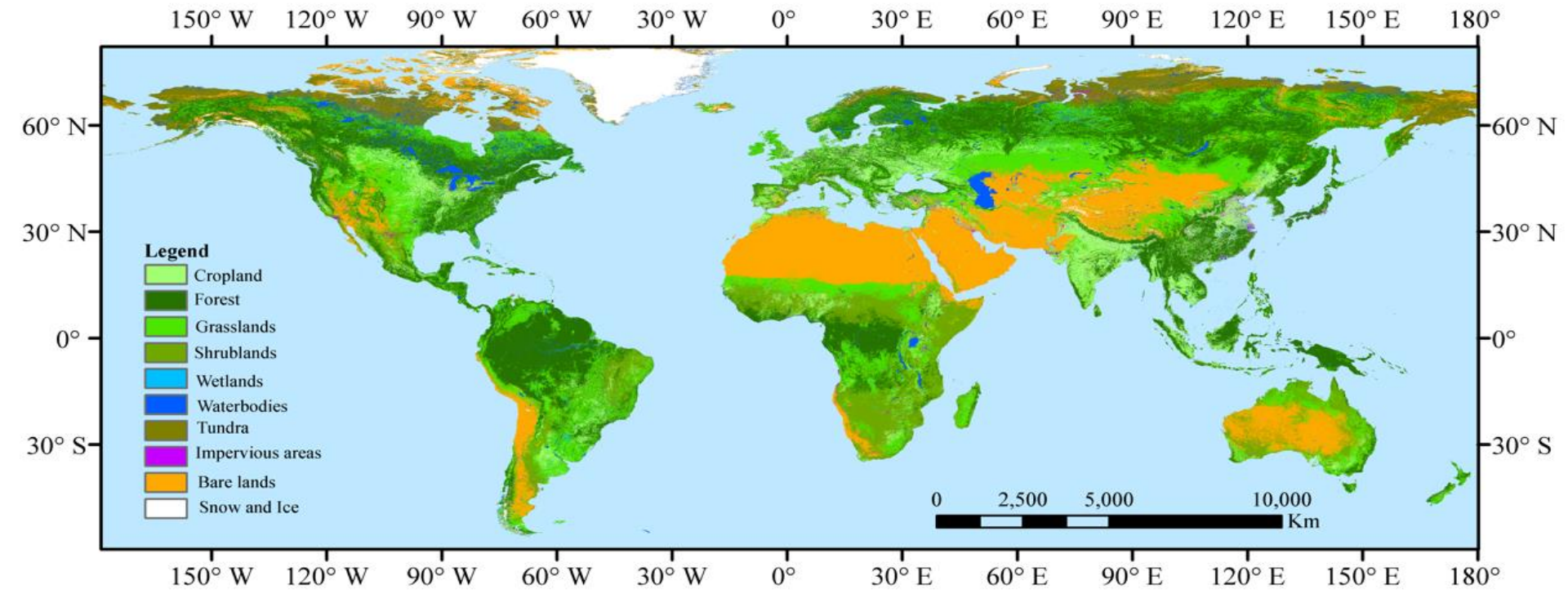
Phenology patterns in urban areas



Li, X., **Y. Zhou***, G. R. Asrar and L. Meng (2017). Characterizing spatiotemporal dynamics in phenology of urban ecosystems based on Landsat data. Science of the Total Environment 605-606: 721-734.

2018 The first 10 m resolution global land cover map - FROM-GLC10-2016，2017，2018

Tsinghua University 清华大学
DEPARTMENT OF EARTH SYSTEM SCIENCE, TSINGHUA UNIVERSITY
清华大学地球系统科学系



Gong, P., et al., *Stable classification with limited sample: transferring a 30-m resolution sample set collected in 2015 to mapping 10-m resolution global land cover in 2017.* Submitted, 2019

https://signup.earthengine.google.com