

Introduction to geo-data science and remote sensing

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Agenda

1. Definitions
2. Interact with OpenStreetMap data
3. Interact with Vector data
4. Data visualization
5. Google earth engine
6. Resources / Where to go next

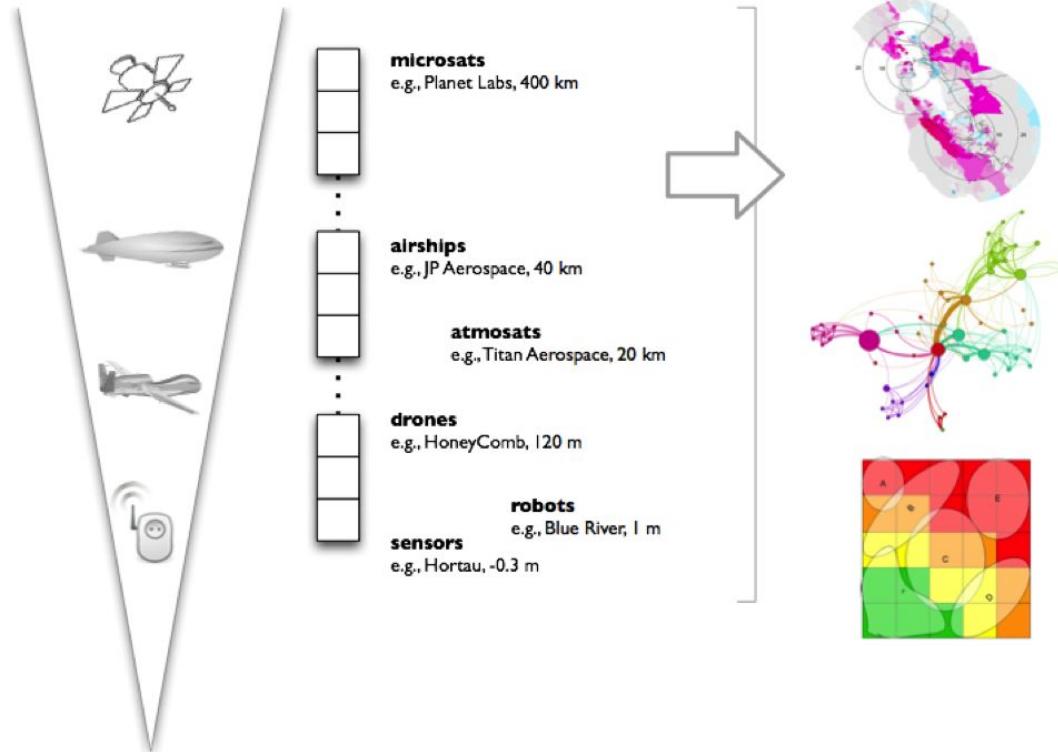
<https://github.com/kenseii/geo-myanmar-2020>

Definitions

Geo data science: is the process of extracting useful information and gaining insight from geospatial data collections.

Remote sensing: is a way of obtaining information about a place, phenomenon or an object without being around it.

Data sources



Layers of data sources (Source: Paco Nathan)

Data sources for DIY hobbyists



Geospatial data main types

01

VECTOR

Vertices and paths as points, lines and polygons.



RASTER

Raster data is made up of pixels or grid cells.



02

03

DATABASES

Geographic databases store vectors and rasters.



WEB

Data built to serve and display geographic features over the internet.

04

05

MULTITEMPORAL

Multitemporal geodata has a component of location and time.



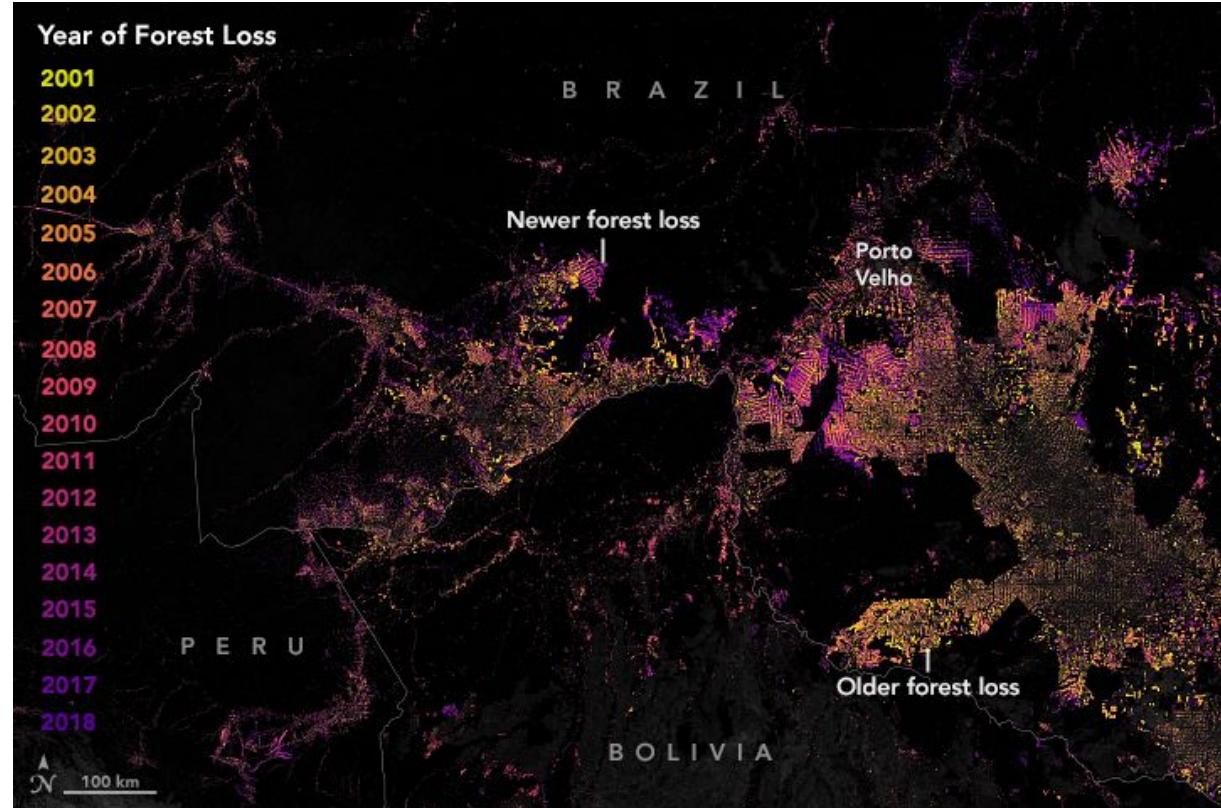
1. Points, lines and polygons (areas)
2. Pixels with a value on each pixel
3. store geographic data (1, 2) as a structured set of data/information
4. GeoJSON, GeoRSS , WMS
5. Time component and geographic component

Types of geographic data (Source: gisgeography.com)

Applications

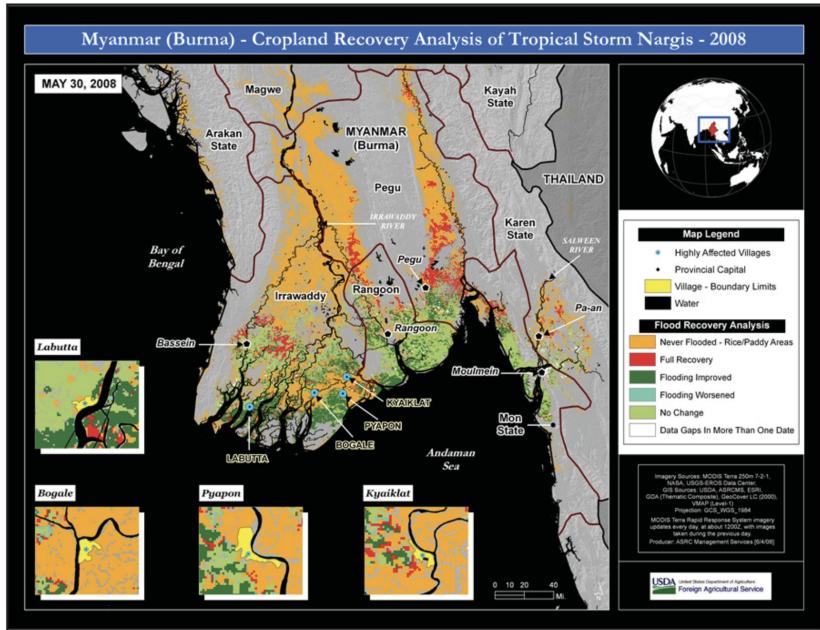


Years of amazon forest loss from aerial RGB image timelapse (Source: Nasa)

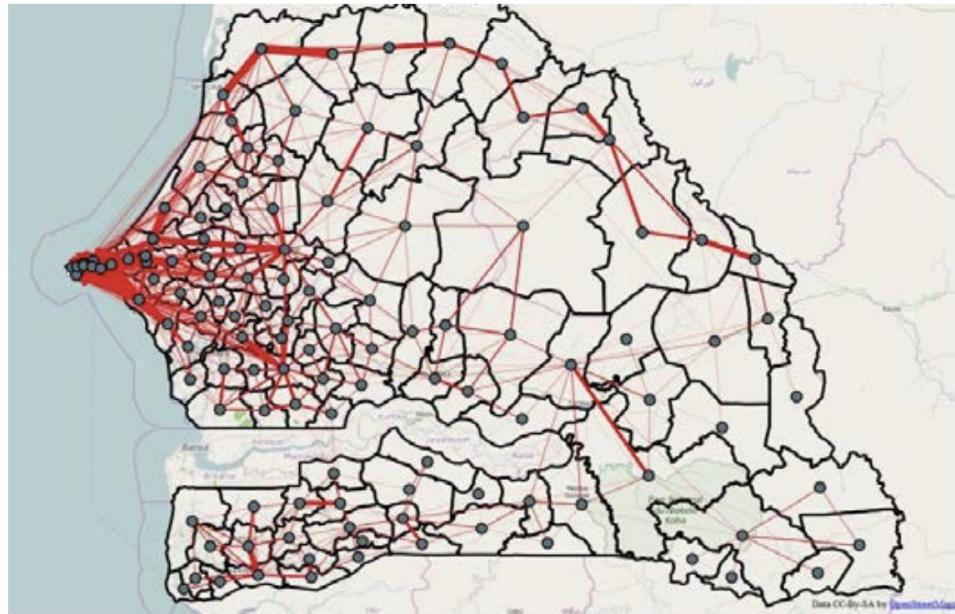


Years of amazon forest loss from SAR data (Source: Nasa)

Applications



A GIS map created 28 days after Cyclone Nargis passed through Myanmar shows the progress of the country's cropland recovery efforts.



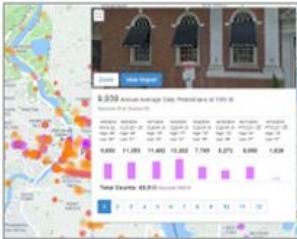
*Origin Destination demand on the level of arrondissement in Dakar, Senegal.
(Source: Linköping University)*

Fraud and Abuse



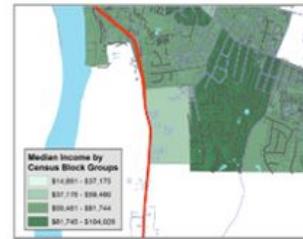
Detect patterns of fraud and collusion (e.g. claims fraud, credit card fraud)

Retail



Site selection, urban planning, foot traffic analysis

Financial Services



Economic distribution, loan risk analysis, predicting sales at retail investments

Healthcare



Identifying disease epicenters, environmental impact on health, planning care

Disaster Recovery



Flood surveys, earthquake mapping, response planning

Defense and Intel



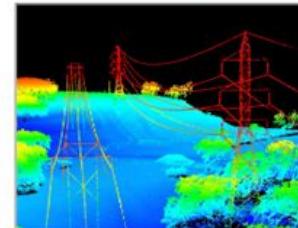
Reconnaissance, threat detection, damage assessment

Infrastructure



Transportation planning, agriculture management, housing development

Energy



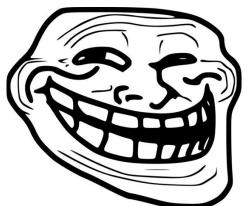
Climate change analysis, energy asset inspection, oil discovery

Applications of Geospatial data (Source: [databricks](#))

More Applications

1000 applications of GIS

Bad cartography example



Tools for this workshop

OSMNX: python package that lets you download spatial geometries and model, project, visualize, and analyze street networks and other spatial data from OpenStreetMap APIs

Shapely: python package to manipulate vector data

Geopandas: package for interacting with geospatial data especially geometric objects. Like pandas for geo data.

Kepler.gl: yet another cool geo data visualization library

Google Earth Engine: satellite image datasets + data analysis environment on scale

Workshop data sources

Myanmar 2014 census data

<https://data.opendvelopmentmekong.net/dataset/2014-myanmar-census?type=dataset>

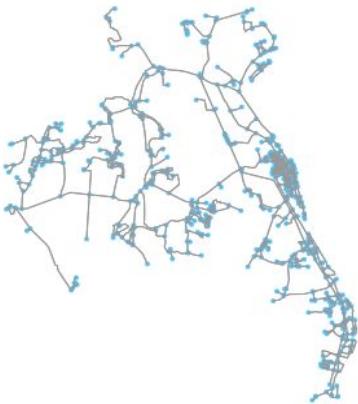
Polygons of myanmar regions

http://geonode.themimu.info/layers/geonode%3Ammr_polbnda2_adm1_250k_mimu

Polygons of Naypyitaw villages

http://geonode.themimu.info/layers/geonode%3Anaypyitaw_region_village_tract_boundaries_1

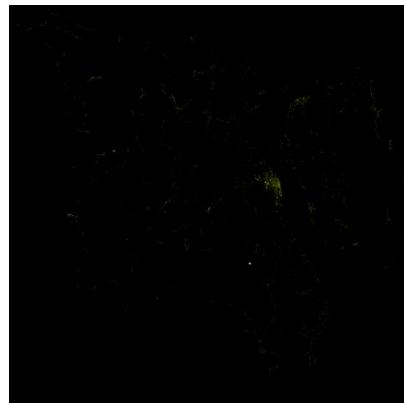
Lab 1: Interacting with openstreetmap data



Street network



Street network centrality



Building footprint



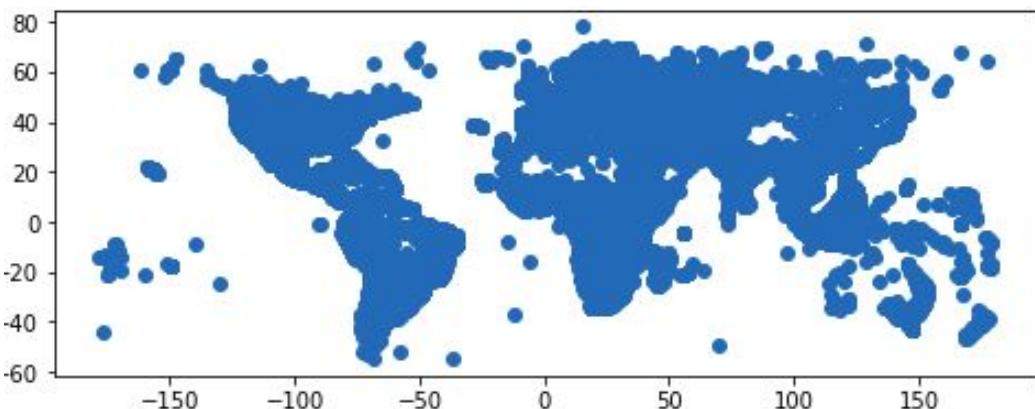
Routing

Tools: (OSMNX, Folium)

Code: <https://github.com/kenseii/geo-myanmar-2020/blob/master/1.0%20osm.ipynb>

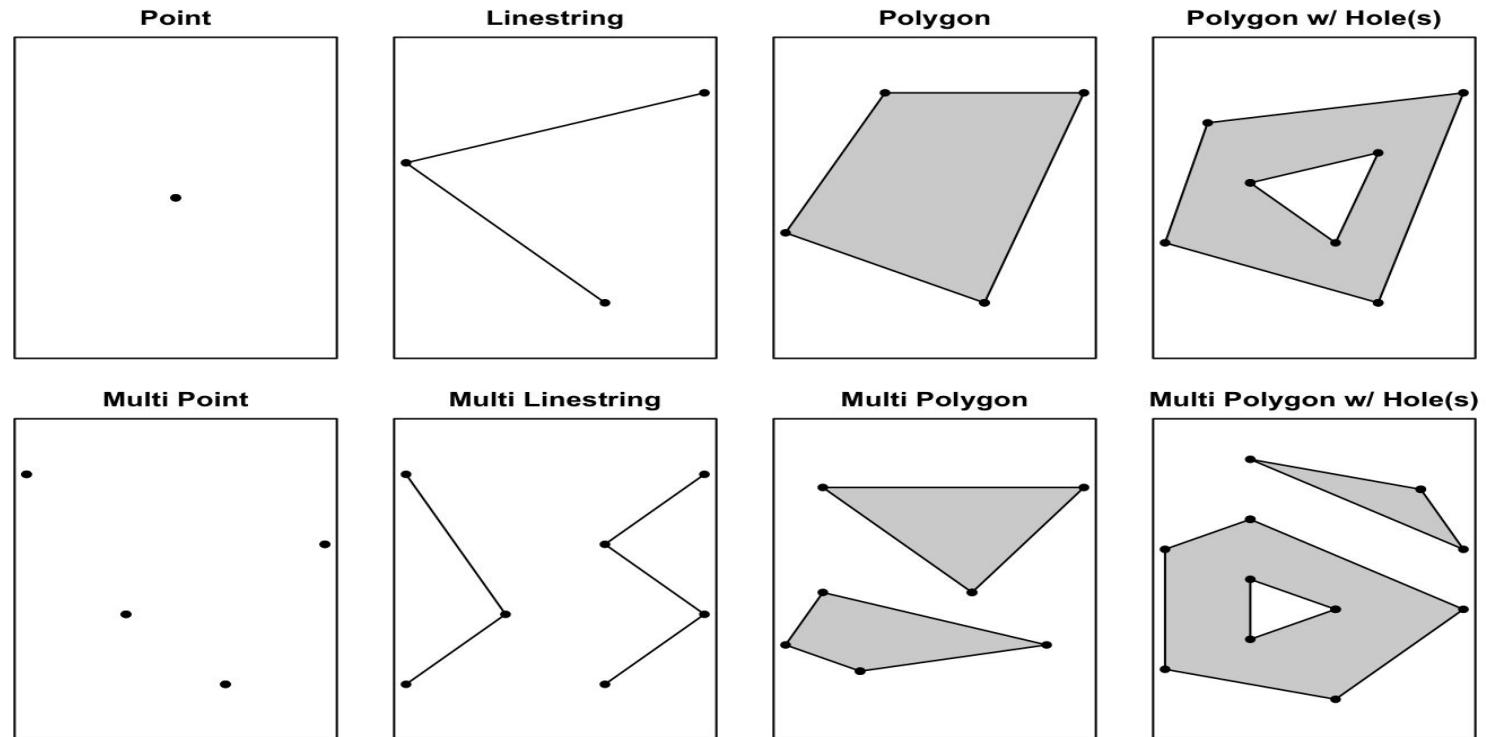
Lab 2: Vector data

	geometry	place_name	bbox_north	bbox_south	bbox_east	bbox_west
0	POLYGON ((95.35970 17.38521, 95.36551 17.38734, 95.36551 17.38734, 95.35970 17.38521, 95.35970 17.38521))	Danubyu, Maubin, Ayeyarwady, Myanmar	17.412233	17.071456	95.710730	95.359696
1	POLYGON ((95.45506 18.25110, 95.45507 18.24974, 95.45507 18.24974, 95.45506 18.25110, 95.45506 18.25110))	Gyobingauk Township, Tharrawaddy District, Western Myanmar	18.448891	18.093490	96.044565	95.455065
2	POLYGON ((95.01492 23.96159, 95.01907 23.95566, 95.01907 23.95566, 95.01492 23.96159, 95.01492 23.96159))	Katha District, Sagaing, 50204, Myanmar	24.959989	23.479209	96.665836	95.014915

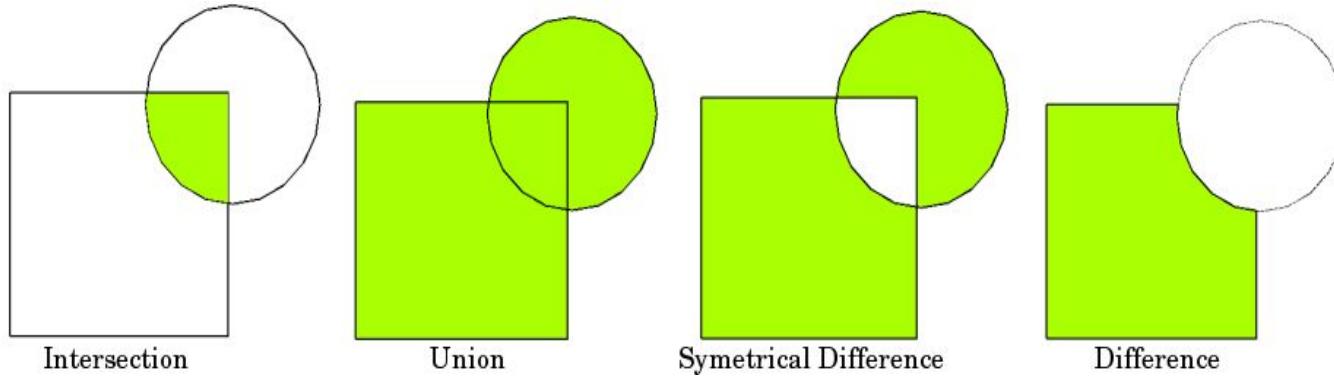


Tools: (Shapely, Folium)

Code: <https://github.com/kenseii/geo-myanmar-2020/blob/master/2.0%20vector.ipynb>

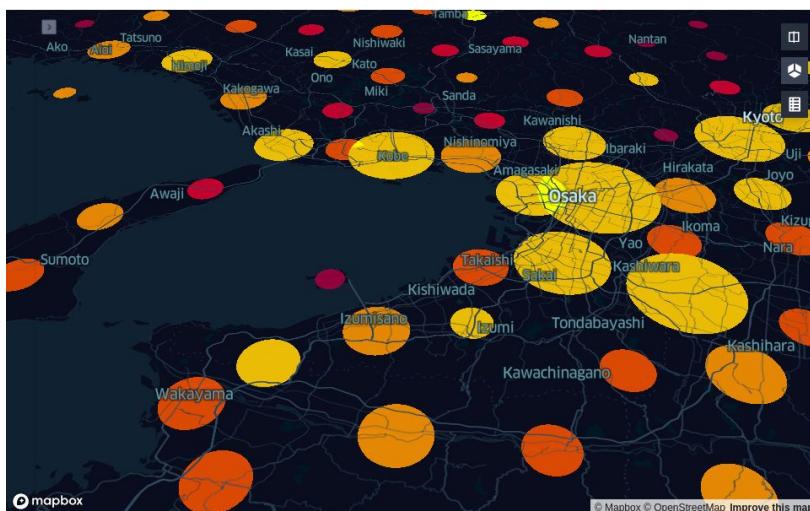
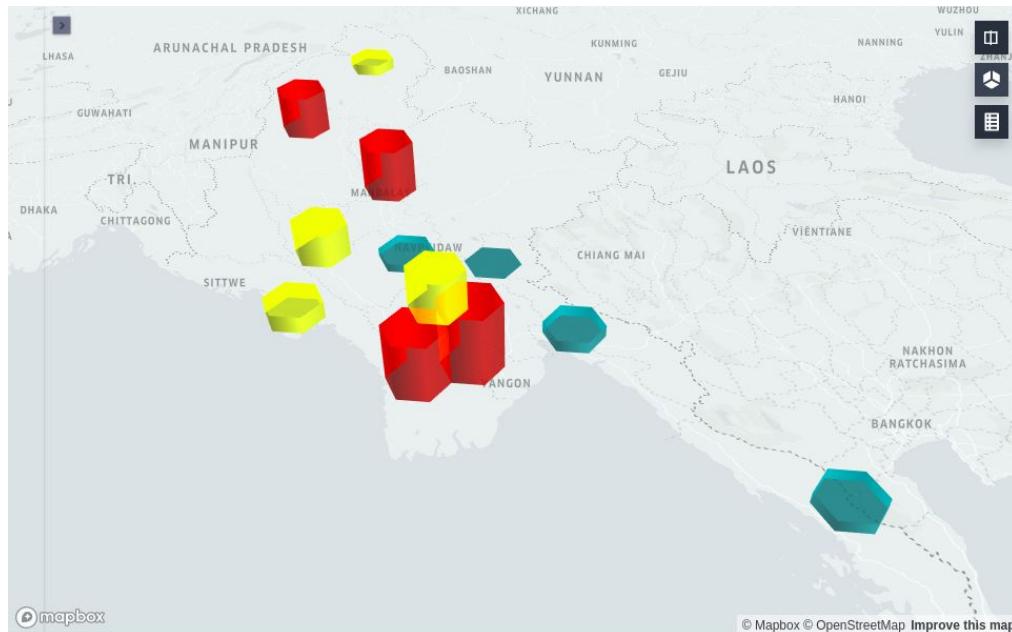


Types of geospatial objects/features (Source: <http://www2.stat.duke.edu/>)



Typical overlay operations are (source: QGIS docs)

Lab 3: Data Visualization



Tools: (CSV, Geocoding, Kepler.gl)

Code: <https://github.com/kenseii/geo-myanmar-2020/blob/master/3.0%20visualization.ipynb>

Lab 4: Basics of remote sensing

The Earth Engine Public Data Catalog



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



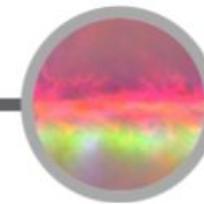
MODIS
Daily, NBAR, LST, ...



Terrain
SRTM, GTOPO, NED, ...



Land Cover
GlobCover, NLCD, ...



Atmospheric
NOAA NCEP, OMI, ...

... and many more, updating daily!

> 200 public datasets

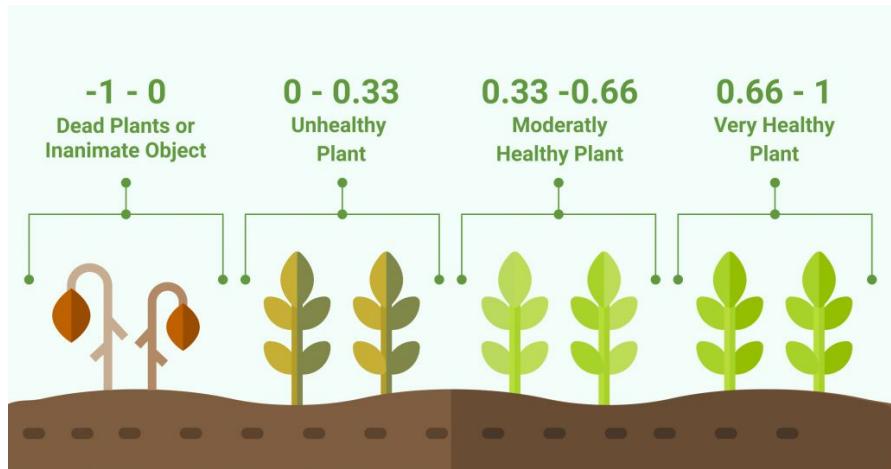
> 5 million images

> 4000 new images every day

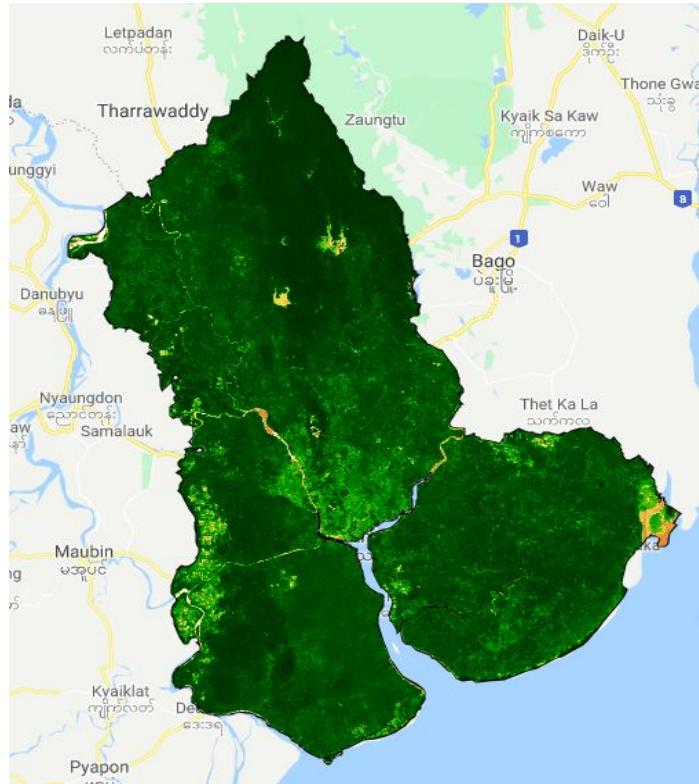
> 5 petabytes of data

Lab 4.1 Calculating NDVI over a certain area

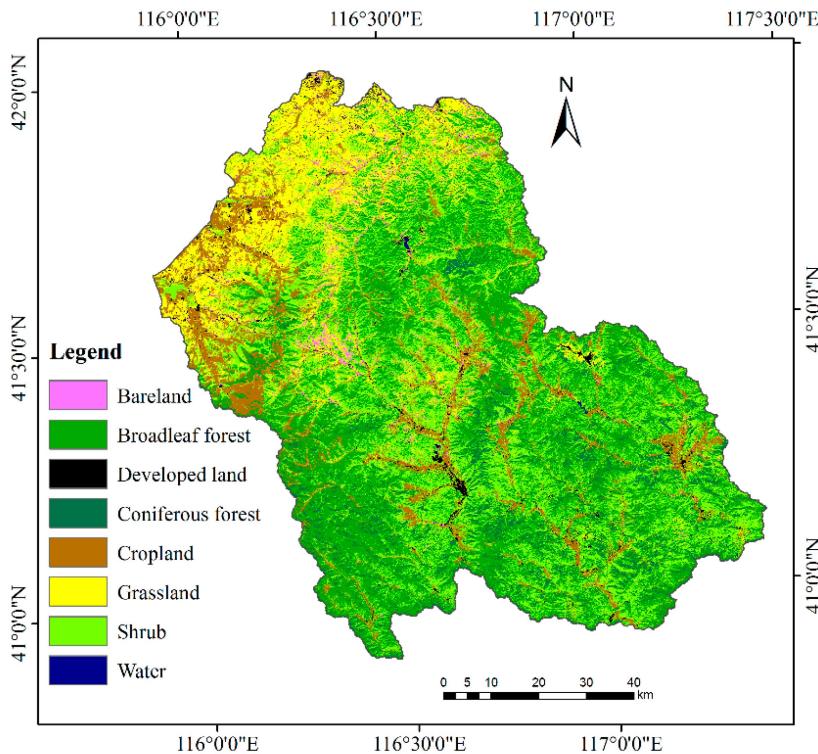
$$\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$$



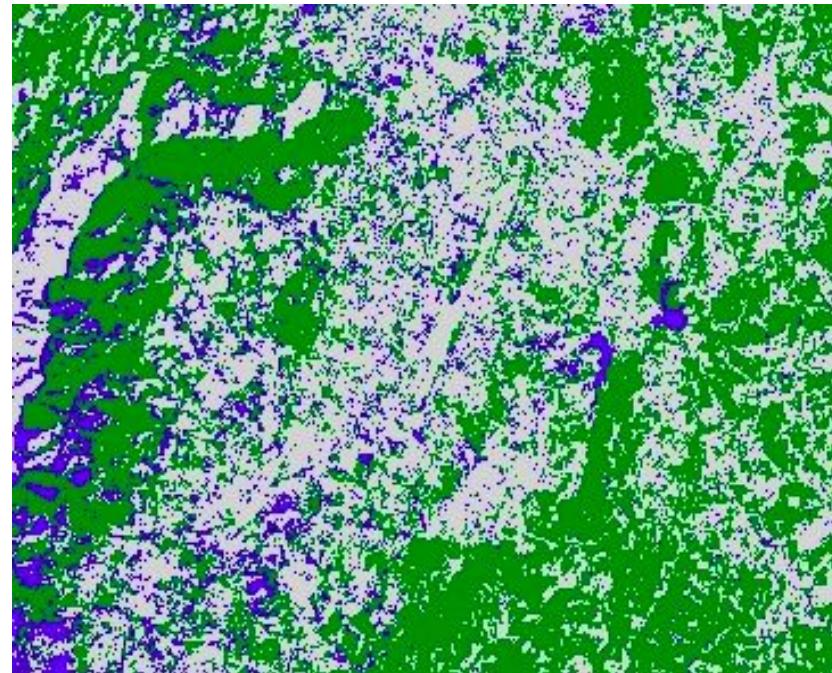
Normalized difference vegetation index, vegetation health ([More here](#))



Lab 4.2 Land cover classification with RF



Land cover classification example for Hebei Province hilly region (More [here](#))



Our Random forest classifier output

EE link <https://code.earthengine.google.com/>

Tools: (JS, Earth engine)

Code: <https://github.com/kenseii/geo-myanmar-2020/blob/master/4.0%20remote%20sensing.ipynb>

Homework: In case you are interested, you can try to use other locations as the bounds of the data and try to go through the same process again.

Naypyitaw's village boundaries: http://geonode.themimu.info/layers/geonode%3Anaypyitaw_region_village_tract_boundaries_1

Resources

[MIMU](#)

[Geopython](#)

[Automating GIS processes](#)

[Open geospatial images](#)

[Matsim](#)

[Web based matsim](#)

[Earth engine](#)

Extra Resources :-)

[Hacktoberfest](#)

[Octoverse](#)

[Mlcourse.ai](#)

[Fast.ai](#)

Thank you