Cirrolytix Research Services

PROJECT AEDES ENHANCEMENT

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Solutions and Enhacements

PROJECT AEDES OPEN PLATFORM

FORECASTING

Predict future number of cases/deaths of vector-borne diseases

HOTSPOT DETECTION

Identify locations of possible hotspots for outbreaks

INFORM RISK MAPPING

Map out risk framework using environmental data

OPEN API

Publicly open pre-processed satellite, weather, socioeconomic and health datasets

PYTHON PACKAGE

Open-source tools used for data collection, feature engineering and automated machine learning

RISK-BASED ASSESSMENT FRAMEWORK

HAZARDS

Monitor progress of epidemic, Generate alerts

VULNERABILITIES

Prioritize areas with vulnerable groups, suggest demographic and geographic determinants of risk

LACK OF COPING CAPACITY

Prioritize areas for emergency aid, recommend infrastructure investment

IDEAL RISK-BASED ASSESSMENT FRAMEWORK

HAZARDS

Dengue Case incidence
Flood Occurrence
Temperature
Precipitation
COVID-19 Incidence
Access to water
Access to sanitation

VULNERABILITIES

Population ages 0-20
Poverty Index
Population affected by natural disasters
Population previously infected by dengue
Mortality
Land-use types
Social listening
Primary and secondary schools
PhilHealth coverage
Human mobility

LACK OF COPING CAPACITY

Presence of health centers
Presence of hospitals
Number of health workers
Health expenditure
Vaccination coverage

DPG RISK-BASED ASSESSMENT FRAMEWORK

HAZARDS

Dengue Case
Temperature
Precipitation Rate
Relative Humidity
Water Index
Distance and count of water sources
Distance and count of sanitation and waste facilities

VULNERABILITIES

Vegetation Index
Built-up Index
Soil Moisture Index
Google search trends
Distance and count of kindergartens
Distance and count of schools
Distance and count of colleges
Distance and count of universities

LACK OF COPING CAPACITY

Distance and count of clinics
Distance and count of hospitals
Distance and count of doctors

FRONT-END|BASICS

FRONT-END|FRAMEWORKS



FRONT-END|TOOLS

BACK-END


DATABASE | RDBMS

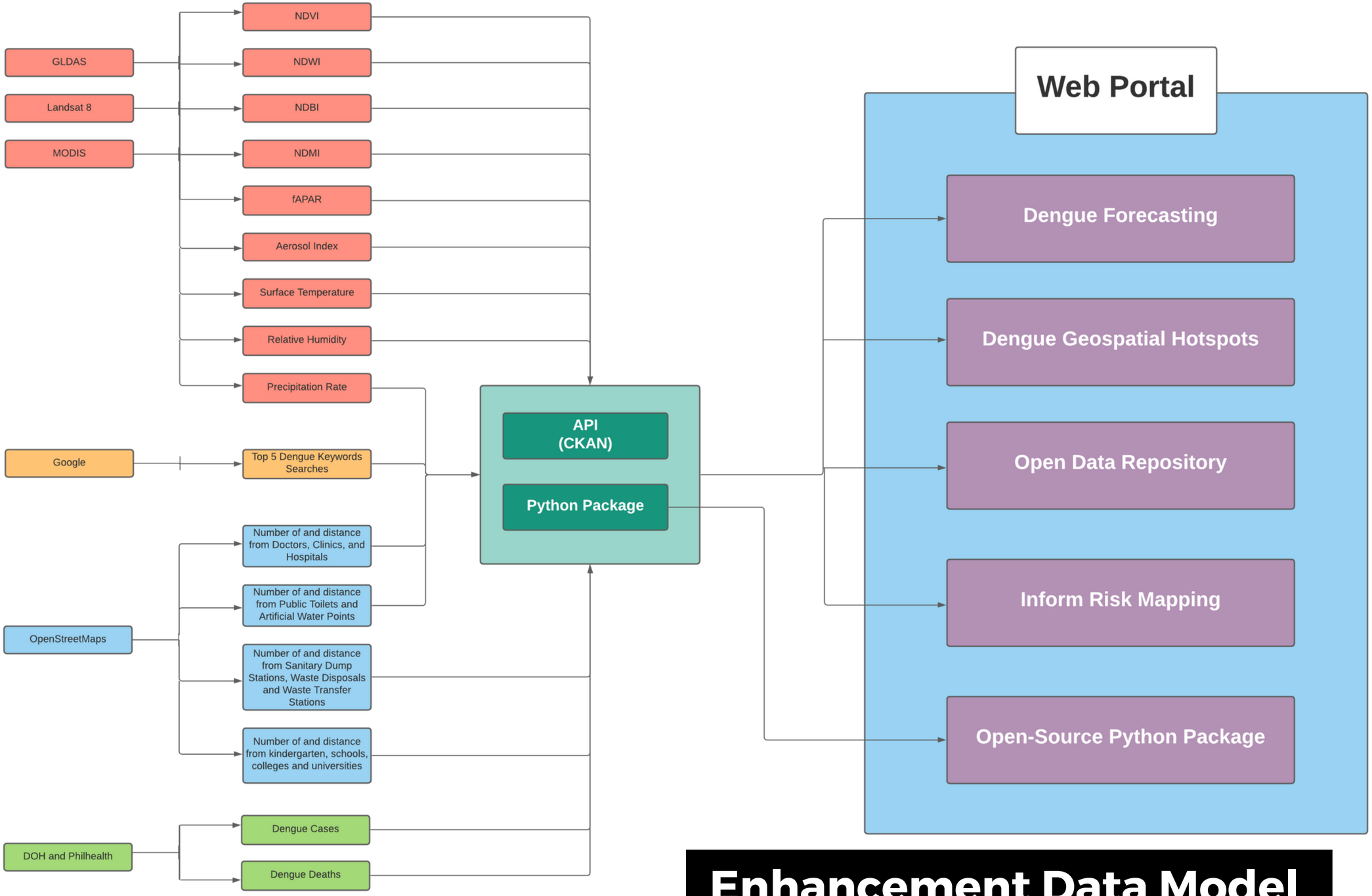
DEV-OPS|INFRASTRUCTURES

DEV-OPS|DEVELOP

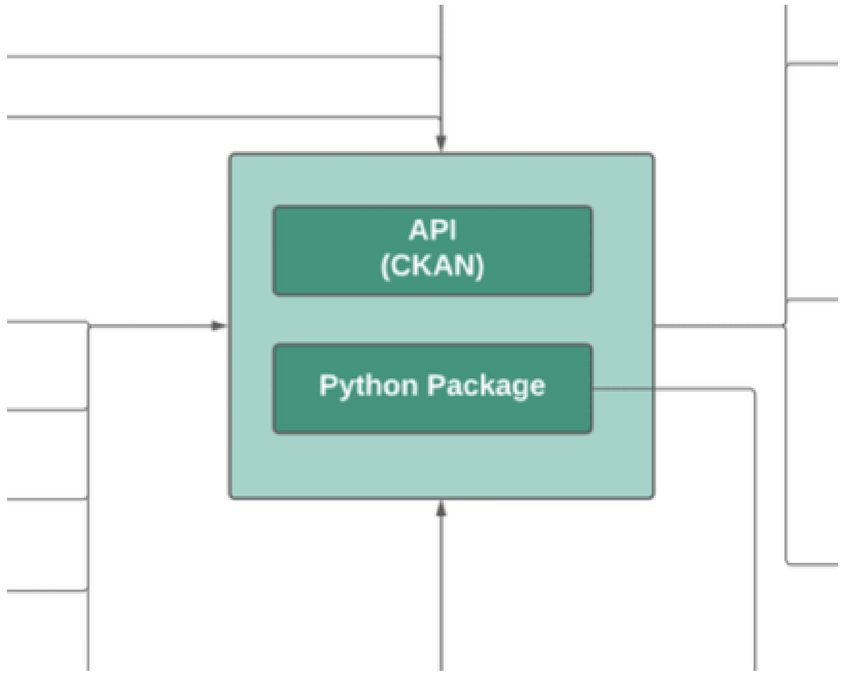
DATA SERVICES


DATA MANAGEMENT SYSTEM

ENHANCED TECH STACK



Enhancement Data Model



Data Management System

Python Package

INSERT SLIDE ON BEFORE/AFTER FOR QGIS vs AEDES PYTHON PACKAGE

INSERT SLIDE ON PROBLEMS BEING SOLVED FROM PREVIOUS ITERATION (NASA HACKATHON VS ENHANCEMENTS)

Material Dashboard 2

Dashboard

Dashboard

Search here

1

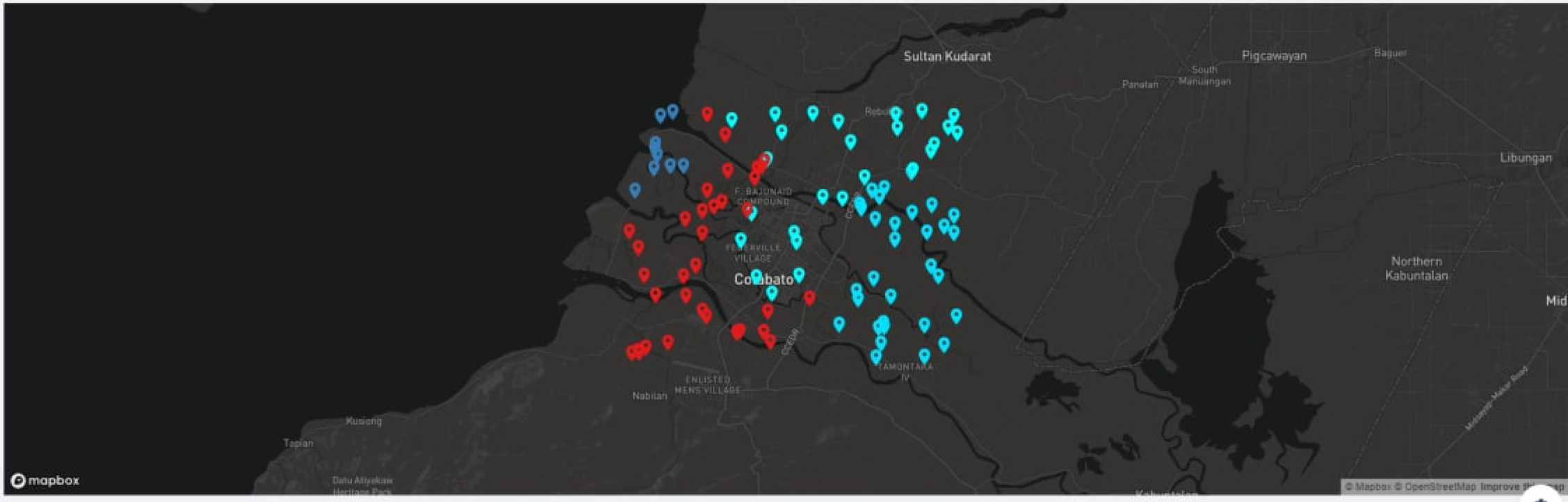
Open Data through API and Dashboard Design

https://aedes-datacatalogue-beta.xyz/

Points with Remote Sensing

ID	LONGITUDE	LATITUDE	NDVI	NDBI
1	124.23271102909972	7.2322490886052195	0.29426543772184005	-0.18135909206120807
2	124.188791024222	7.1651933675878565	0.33712953424396913	-0.17811715393663746
3	124.20985630039459	7.196758407621468	0.2525439835434753	-0.16634924621562536
4	124.19676303625263	7.2513988770380315	0.049508159867661314	-0.08317019477819493
5	124.29736612018179	7.218621620798705	0.24762520238554964	-0.1811293855035335
6	124.30661530426687	7.178069029871818	0.362507864123868	-0.2336097860415473
7	124.26744081993178	7.2416938171902725	0.3057146163256264	-0.1561891062137156
8	124.29377210327505	7.253233563803932	0.3395442103023234	-0.18009947910026575
9	124.2778049714143	7.173807474207336	0.3199756208166676	-0.2031917028784548
10	124.26291924257728	7.249400110845375	0.3182352310440857	-0.16604603124972356

1



README.md

AEDES
Python Package

PYPI: https://pypi.org/project/aedes/
repository: https://github.com/xmpuspus/aedes

Visualize on a Map

This packages also provides the capability of visualizing all the points on the map with only one line of code.

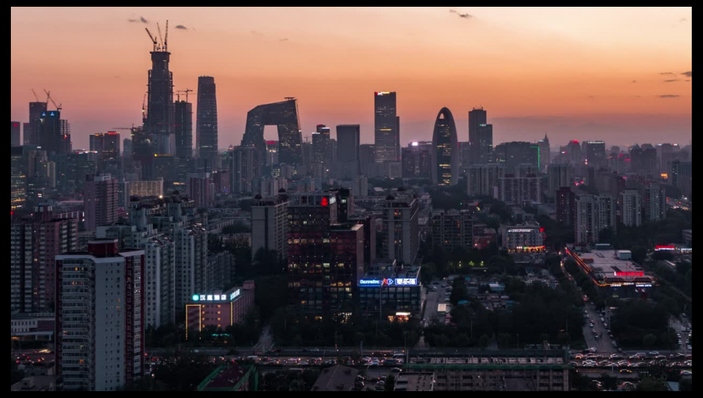
```
vizo = visualize_on_map(rev_geocode_qc_df)
vizo
```

Dengue Detection Features

COLLECTING SATELLITE DATA AT POINTS OF INTEREST

Vegetation and Water

NDWI
NDVI
FAPAR
NDMI



Urbanicity

NDBI
Aerosol Index

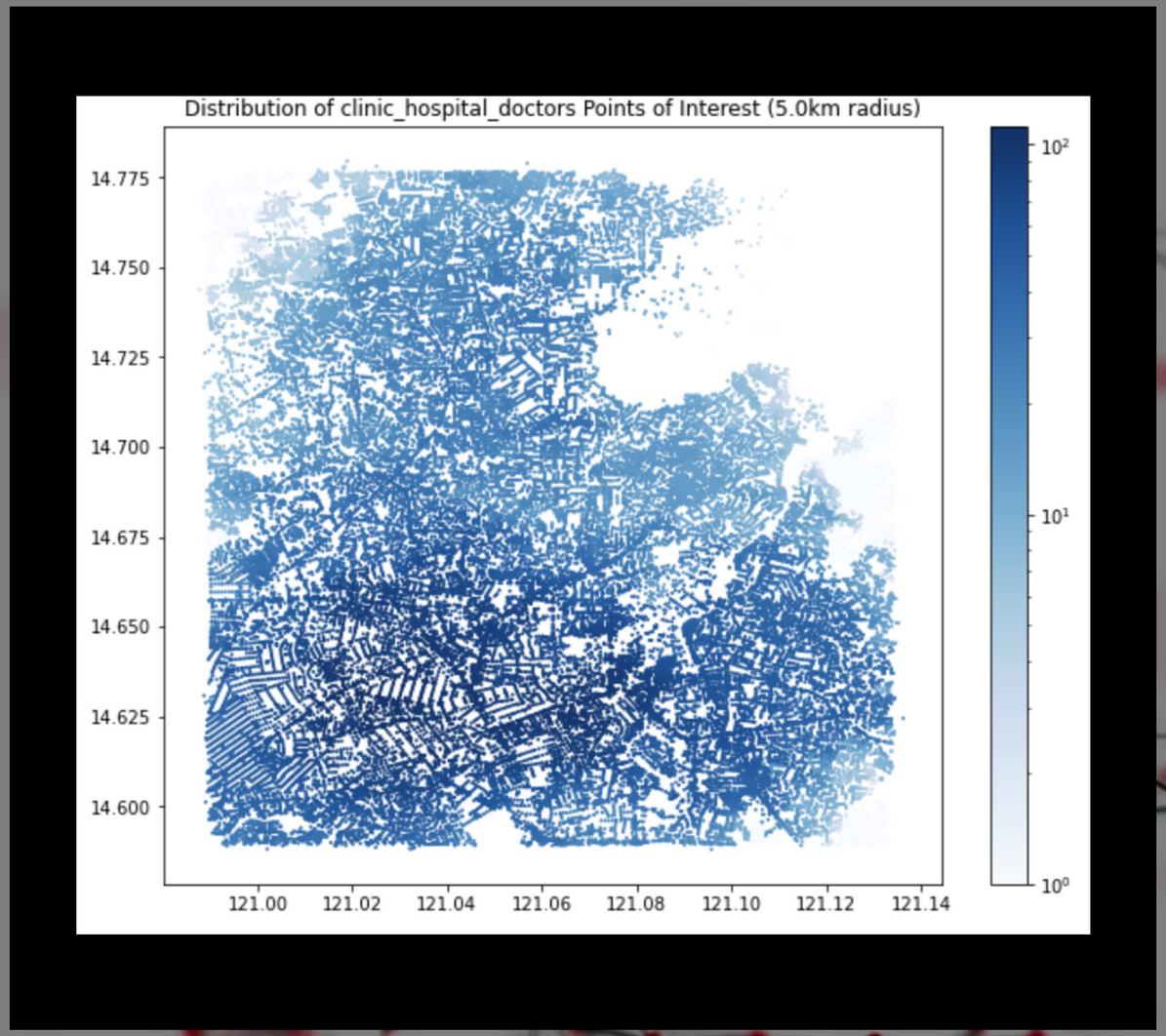
Weather

Surface Temperature
Precipitation Rate
Relative Humidity

Heathcare Capacity

DISTRIBUTION PER RADIAL BLOCK

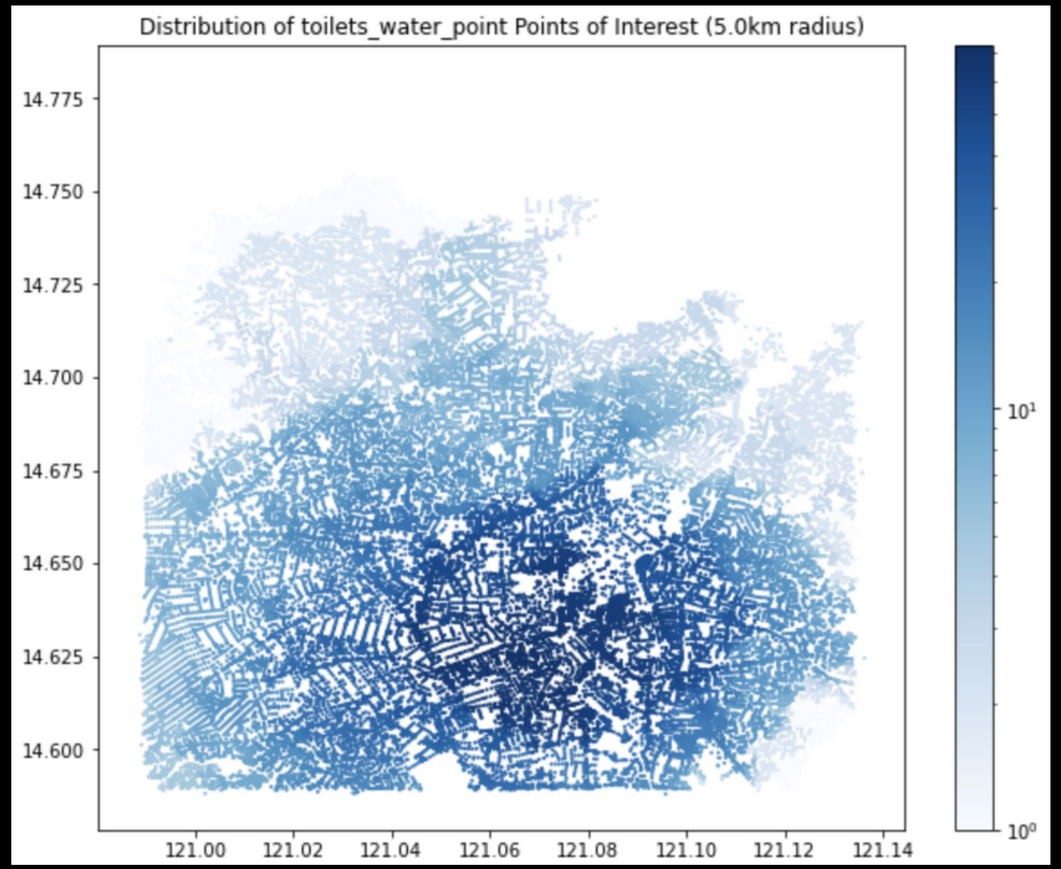
Heatmap of **accessibility to nearest clinic, and hospital**



Access to Water Sources

DISTRIBUTION PER RADIAL BLOCK

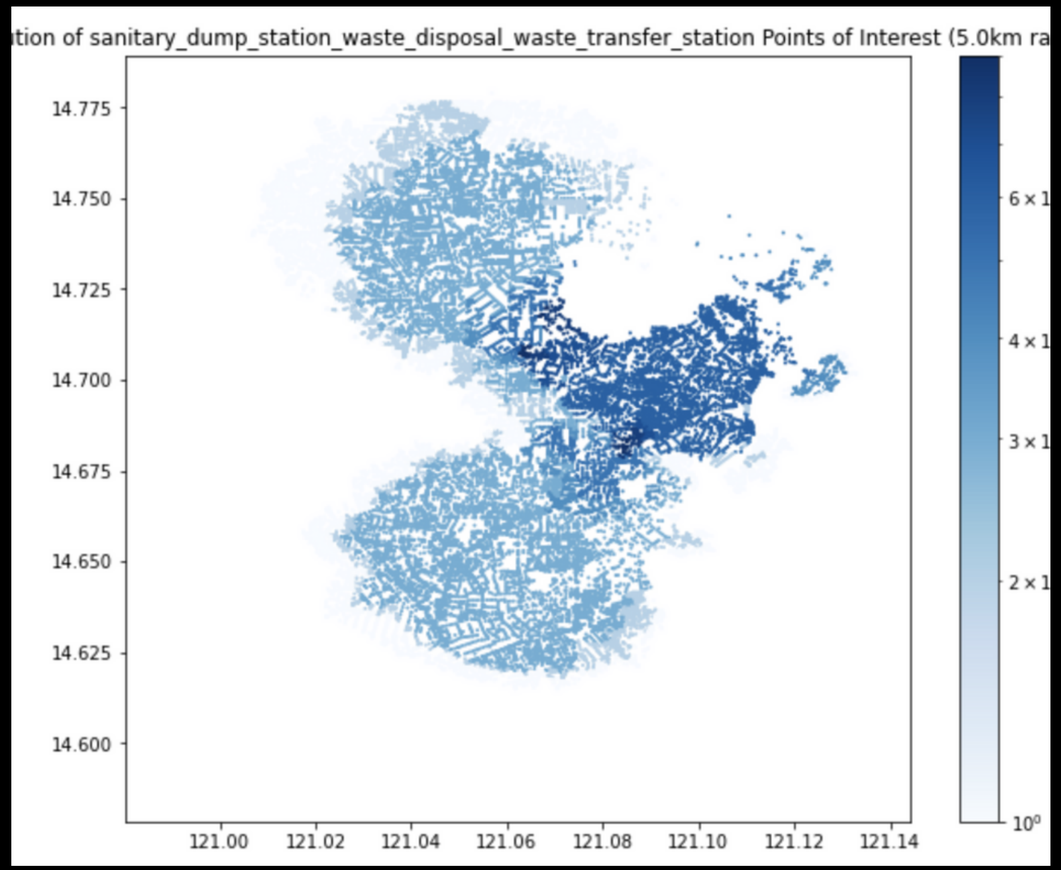
Heatmap of **accessibility to nearest toilet facility and different types of water points as defined by OSM**



Access to Sanitation

DISTRIBUTION PER RADIAL BLOCK

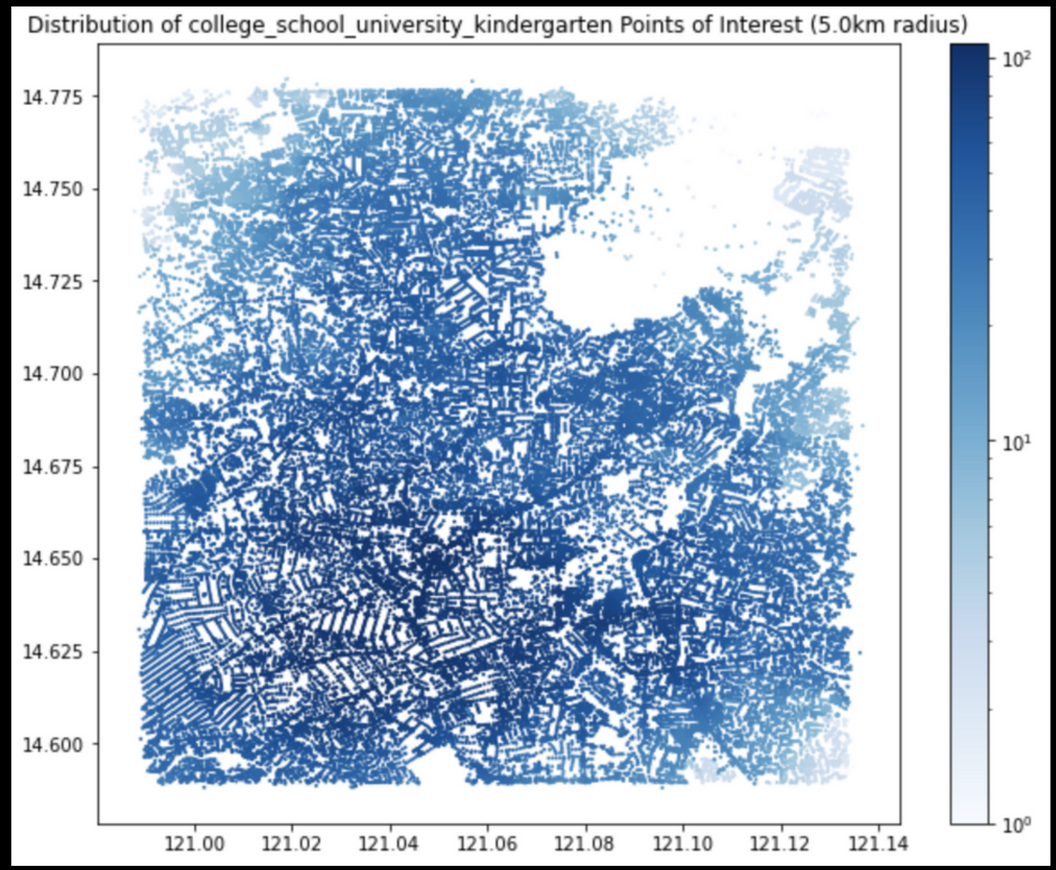
Heatmap of **accessibility to nearest sanitary dump station, waste disposal, and waste transfer stations**



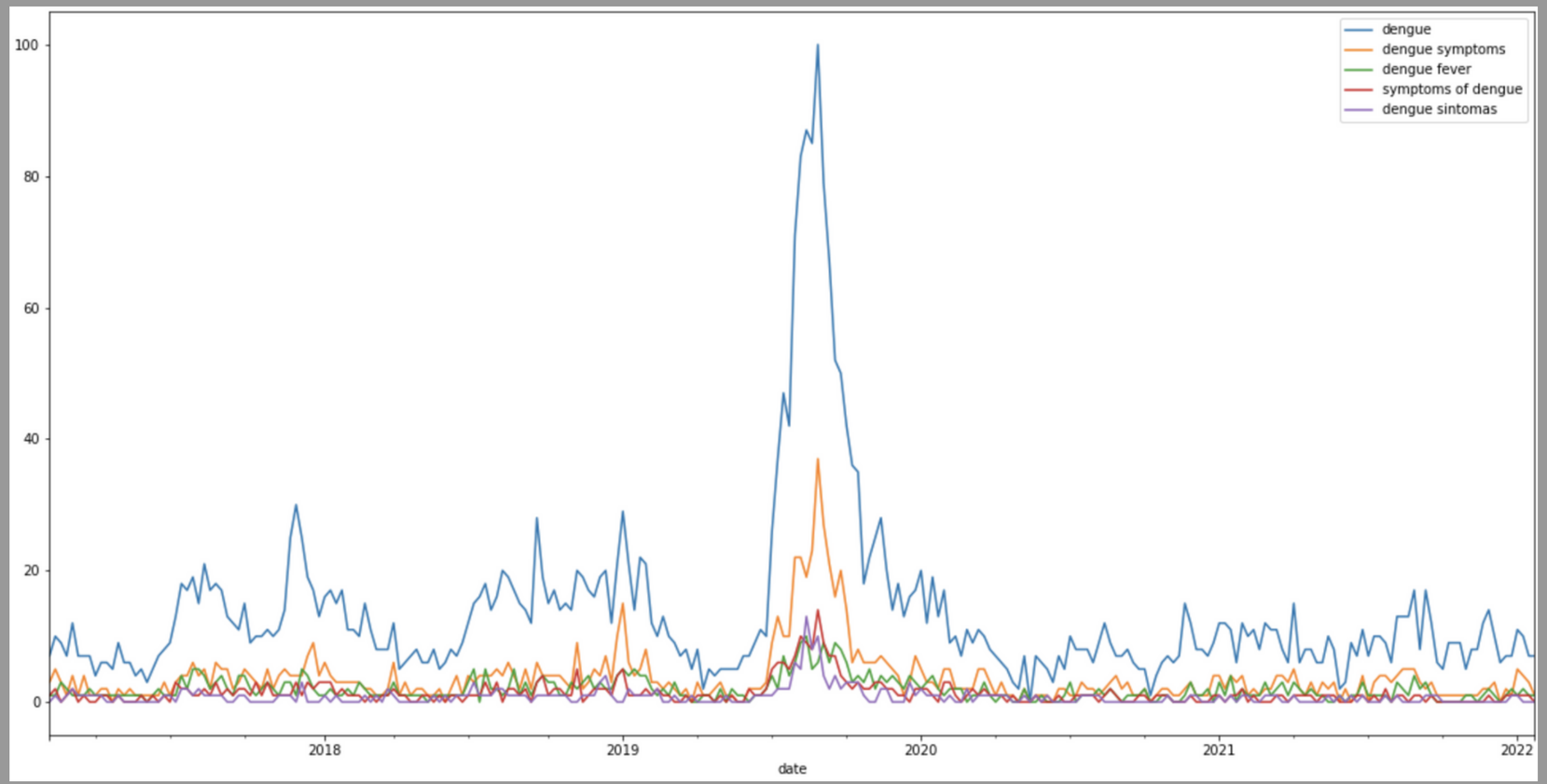
Schools

DISTRIBUTION PER RADIAL BLOCK

Heatmap of **accessibility to nearest kindergarten, schools, colleges, and universities**

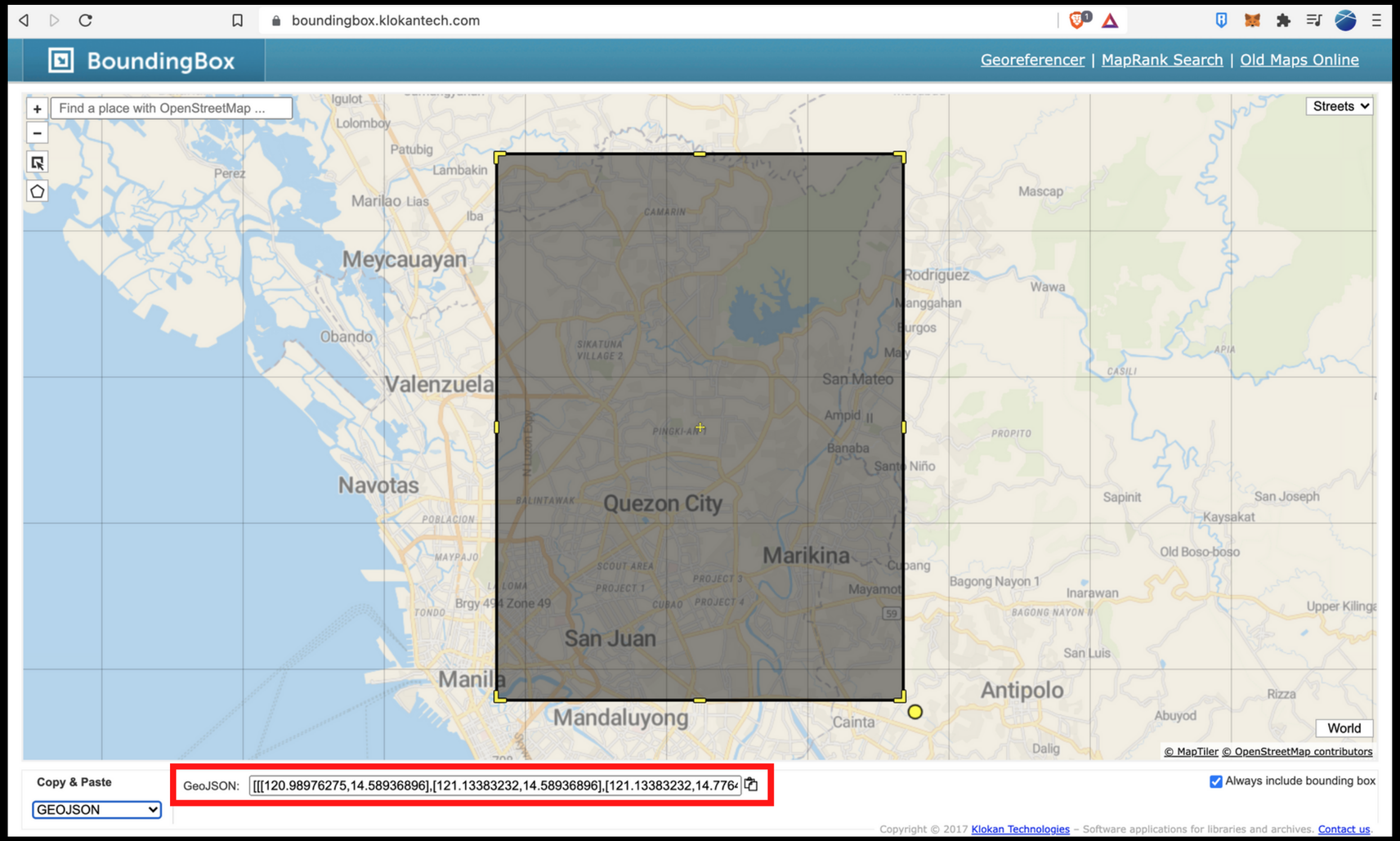


Google Search Trends



Code	Subdivision name (en)
PH-14	Autonomous Region in Muslim Mindanao[b]
PH-05	Bicol
PH-02	Cagayan Valley
PH-40	Calabarzon
PH-13	Caraga
PH-03	Central Luzon
PH-07	Central Visayas
PH-15	Cordillera Administrative Region
PH-11	Davao
PH-08	Eastern Visayas
PH-01	Ilocos
PH-41	Mimaropa
PH-00	National Capital Region
PH-10	Northern Mindanao
PH-12	Soccsksargen
PH-06	Western Visayas
PH-09	Zamboanga Peninsula

Sample Web App Data Input



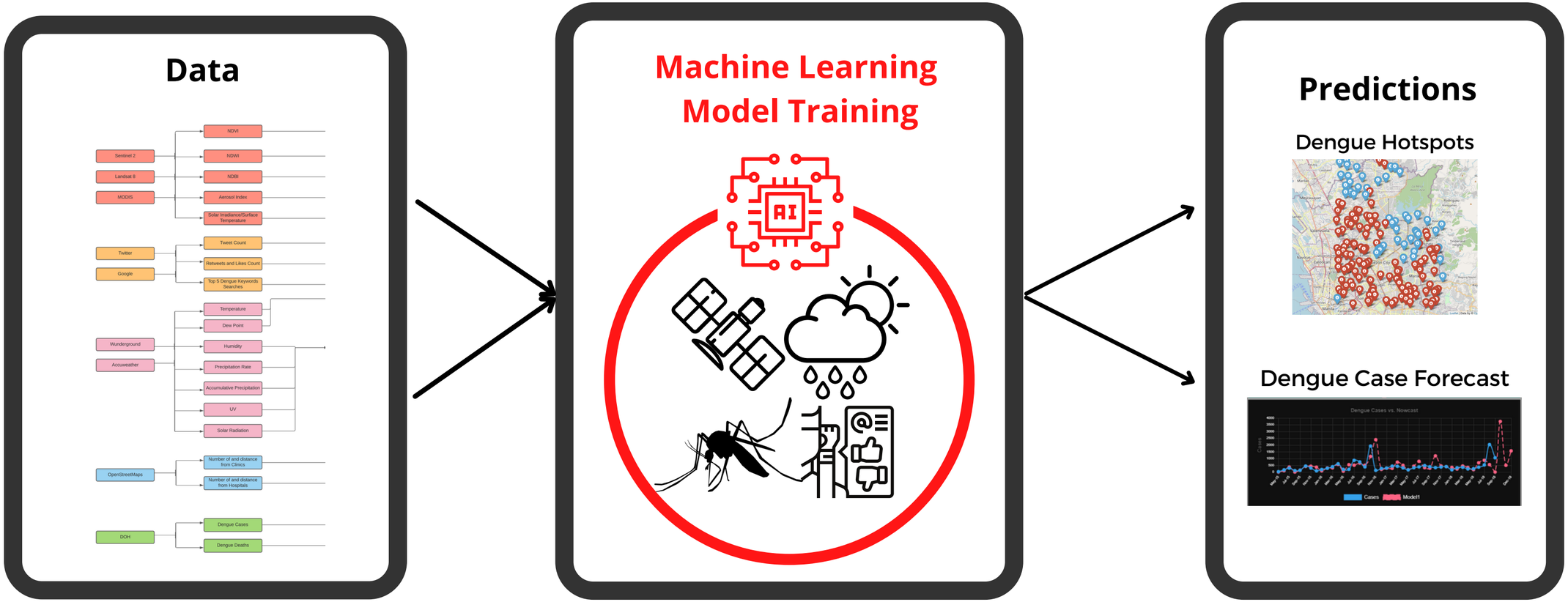
In order to collect the data and features necessary for modelling, the only input is a **bounding box geojson or a polygon**

Extracted Data Features

```
 #   Column                                                                  Non-Null Count  Dtype
---  ------                                                                  --------------  -----
 0   geometry                                                                50 non-null     geometry
 1   buffered_geometry                                                       50 non-null     object
 2   longitude                                                               50 non-null     float64
 3   latitude                                                                50 non-null     float64
 4   ndvi                                                                    50 non-null     float64
 5   fapar                                                                   50 non-null     float64
 6   ndbi                                                                    50 non-null     float64
 7   ndwi                                                                    50 non-null     float64
 8   ndmi                                                                    50 non-null     float64
 9   aerosol                                                                 50 non-null     float64
 10  surface_temperature                                                     50 non-null     float64
 11  precipitation_rate                                                      50 non-null     float64
 12  relative_humidity                                                       50 non-null     float64
 13  labels                                                                  50 non-null     int32
 14  OSM_network_id                                                          50 non-null     int64
 15  nearest_clinic_hospital_doctors_1                                       50 non-null     float64
 16  nearest_clinic_hospital_doctors_2                                       50 non-null     float64
 17  nearest_clinic_hospital_doctors_3                                       50 non-null     float64
 18  nearest_clinic_hospital_doctors_4                                       50 non-null     float64
 19  nearest_clinic_hospital_doctors_5                                       50 non-null     float64
 20  count_clinic_hospital_doctors_within_5.0km                              50 non-null     float64
 21  nearest_toilets_water_point_1                                           50 non-null     float64
 22  nearest_toilets_water_point_2                                           50 non-null     float64
 23  nearest_toilets_water_point_3                                           50 non-null     float64
 24  nearest_toilets_water_point_4                                           50 non-null     float64
 25  nearest_toilets_water_point_5                                           50 non-null     float64
 26  count_toilets_water_point_within_5.0km                                  50 non-null     float64
 27  nearest_sanitary_dump_station_waste_disposal_waste_transfer_station_1   50 non-null     float64
 28  nearest_sanitary_dump_station_waste_disposal_waste_transfer_station_2   50 non-null     float64
 29  nearest_sanitary_dump_station_waste_disposal_waste_transfer_station_3   50 non-null     float64
 30  nearest_sanitary_dump_station_waste_disposal_waste_transfer_station_4   50 non-null     float64
 31  nearest_sanitary_dump_station_waste_disposal_waste_transfer_station_5   50 non-null     float64
 32  count_sanitary_dump_station_waste_disposal_waste_transfer_station_within_5.0km  50 non-null  float64
 33  nearest_college_school_university_kindergarten_1                        50 non-null     float64
 34  nearest_college_school_university_kindergarten_2                        50 non-null     float64
 35  nearest_college_school_university_kindergarten_3                        50 non-null     float64
 36  nearest_college_school_university_kindergarten_4                        50 non-null     float64
 37  nearest_college_school_university_kindergarten_5                        50 non-null     float64
 38  count_college_school_university_kindergarten_within_5.0km               50 non-null     float64
dtypes: float64(35), geometry(1), int32(1), int64(1), object(1)
```

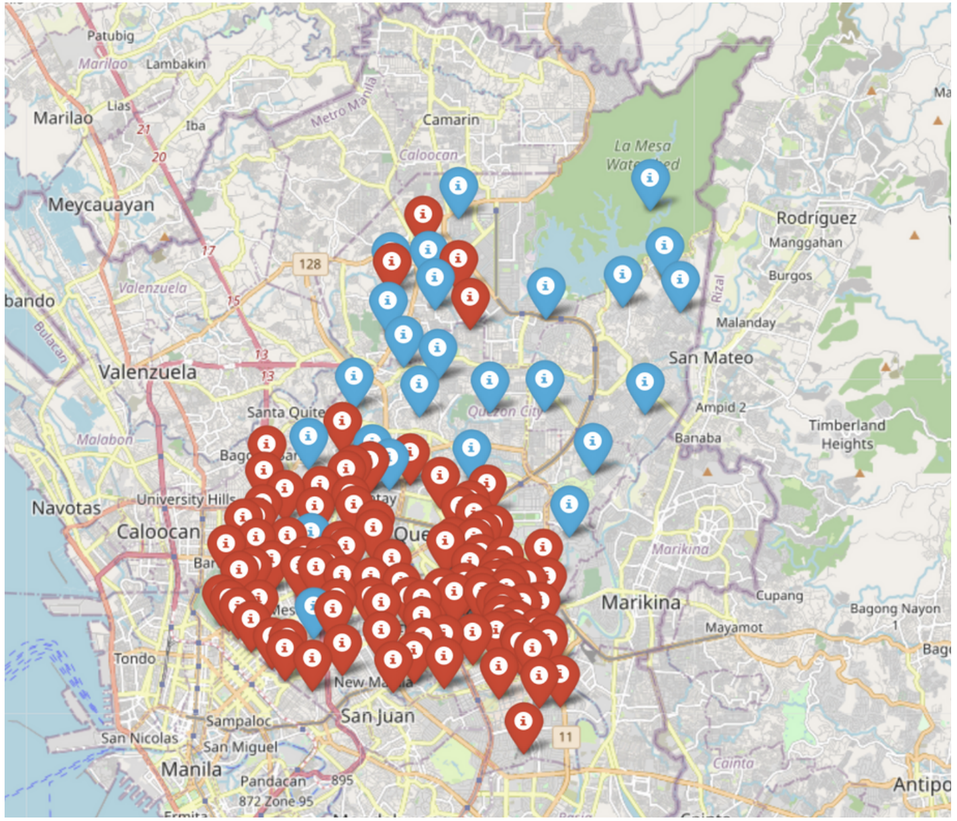
ML Model

The datasets per geolocation are feature-engineered and fed through to a machine learning model



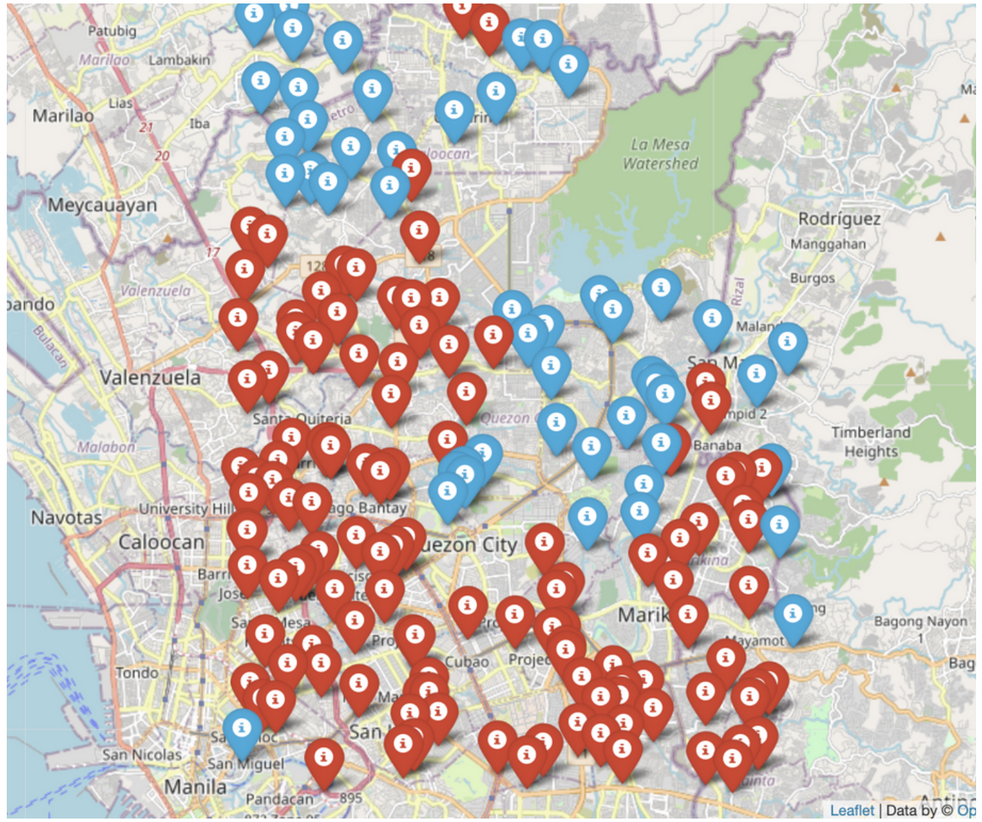
Hotspot Detection

High Risk (>20 cases)
Low Risk (at least 1 case)



Ground Truth Hotspots

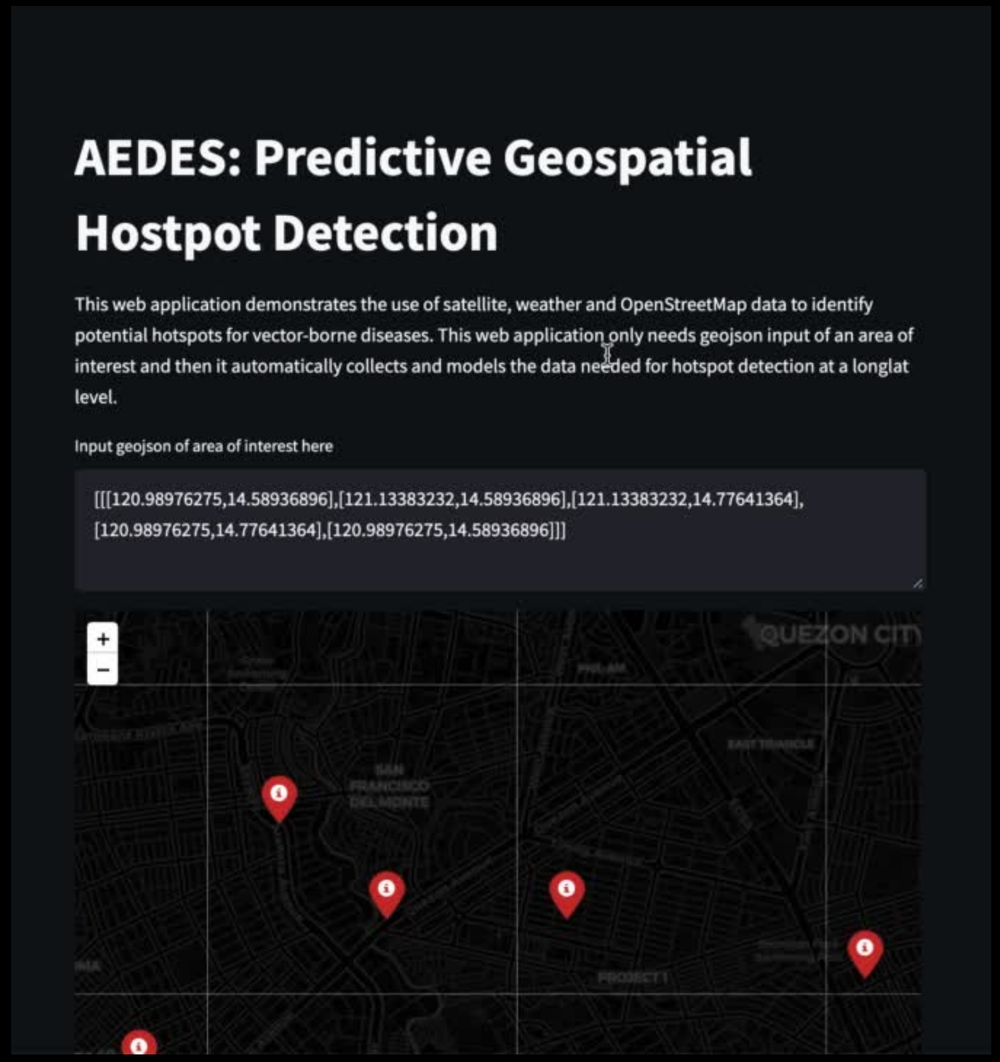
(From Philhealth (2016-2018 dengue cases in Quezon City)



Modeled Hotspots

(Using remote sensing data, vegetation index, water index, built-up index, air quality index, surface temperature)

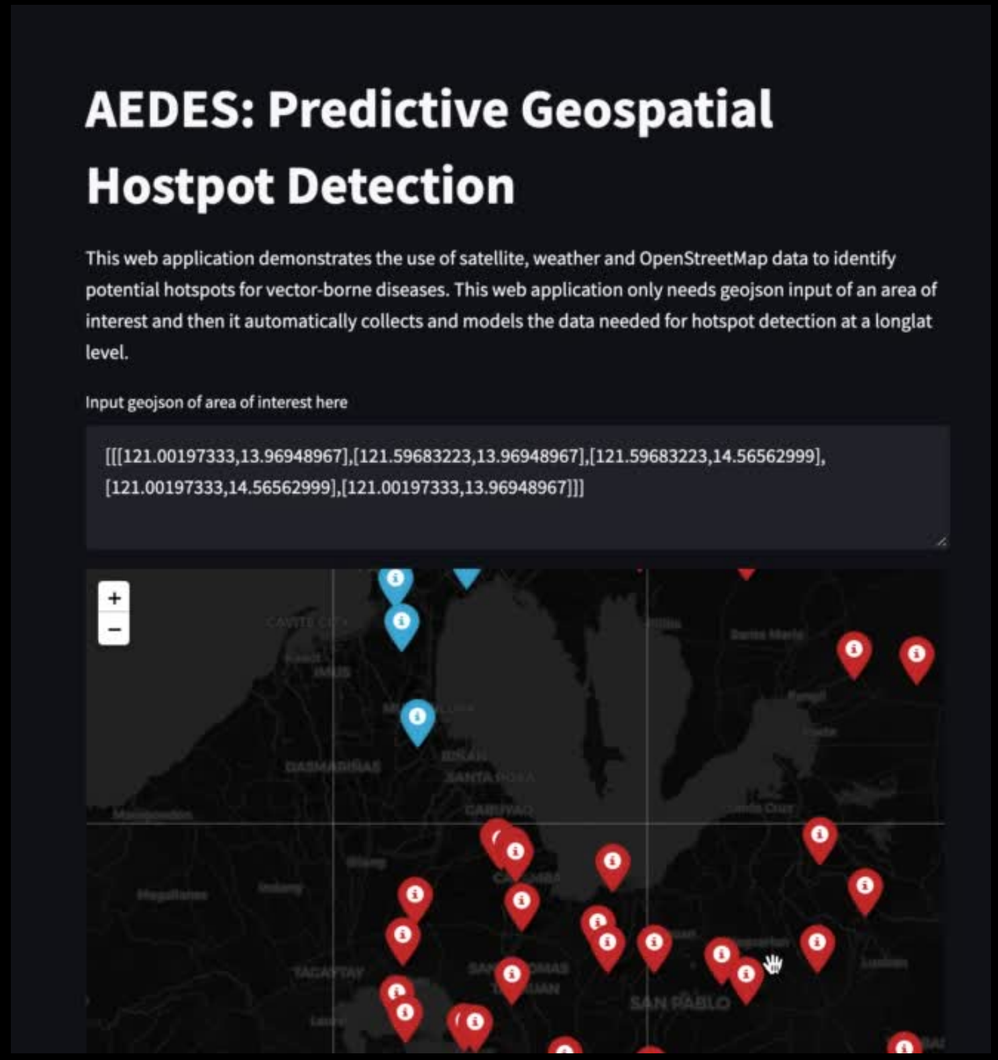
Web Application



QUEZON CITY, PHILIPPINES

From just bounding box coordinates of an area of interest, we're able to identify potential at-risk locations for dengue hotspots

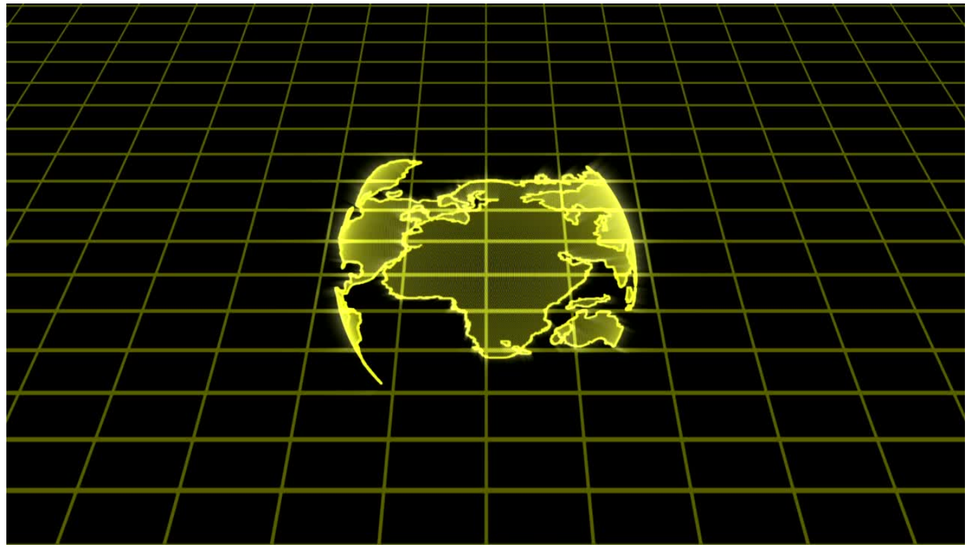
Web Application



LAGUNA, PHILIPPINES

From just bounding box coordinates of an area of interest, we're able to identify potential at-risk locations for dengue hotspots

ML Inference Input

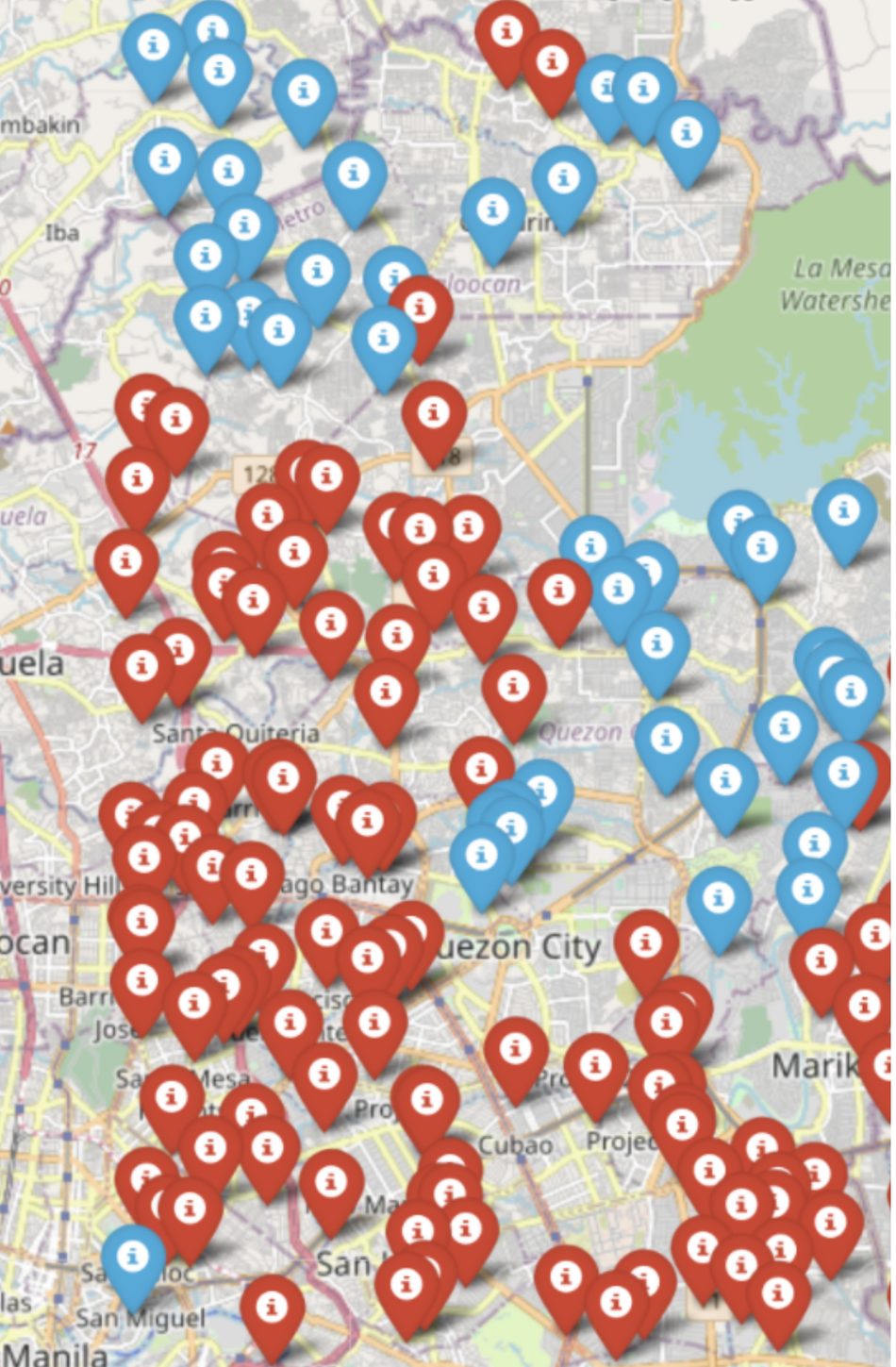


Spatial

longitude
latitude
ISO geo tag (for search)

Temporal

Year
Month
Day



DATA CONSIDERATIONS

CURRENT DATA AUTOMATION

SATELLITE DATA TAKES TIME TO QUERY

~9 hours for 4.8k data points

OSM DATA IS MEMORY INTENSIVE

Contraction hierarchies crashes a 16 GB RAM machine on 4.8k data points

PYTRENDS LOCATION ISN'T GRANULAR

ISO geo tags are used to limit search to a location

DATA BACKLOG

TWITTER DATA

As discussed with BOA, sentiment analysis and NLP are needed to make sense of tweets vs simple engagements/likes/count

NIGHT LIGHTS

Implementation is not straightforward and will be added during future enhancements

FB DATA

BOA has streaming FB data for mobility and will be added when granted access during future enhancements