Examples of OpenStreetMap's Applications

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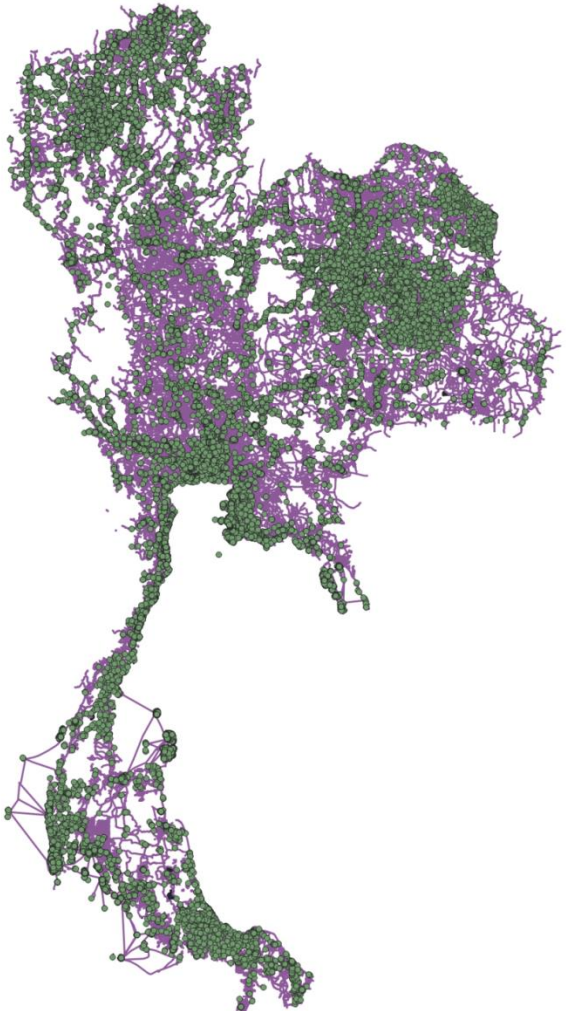
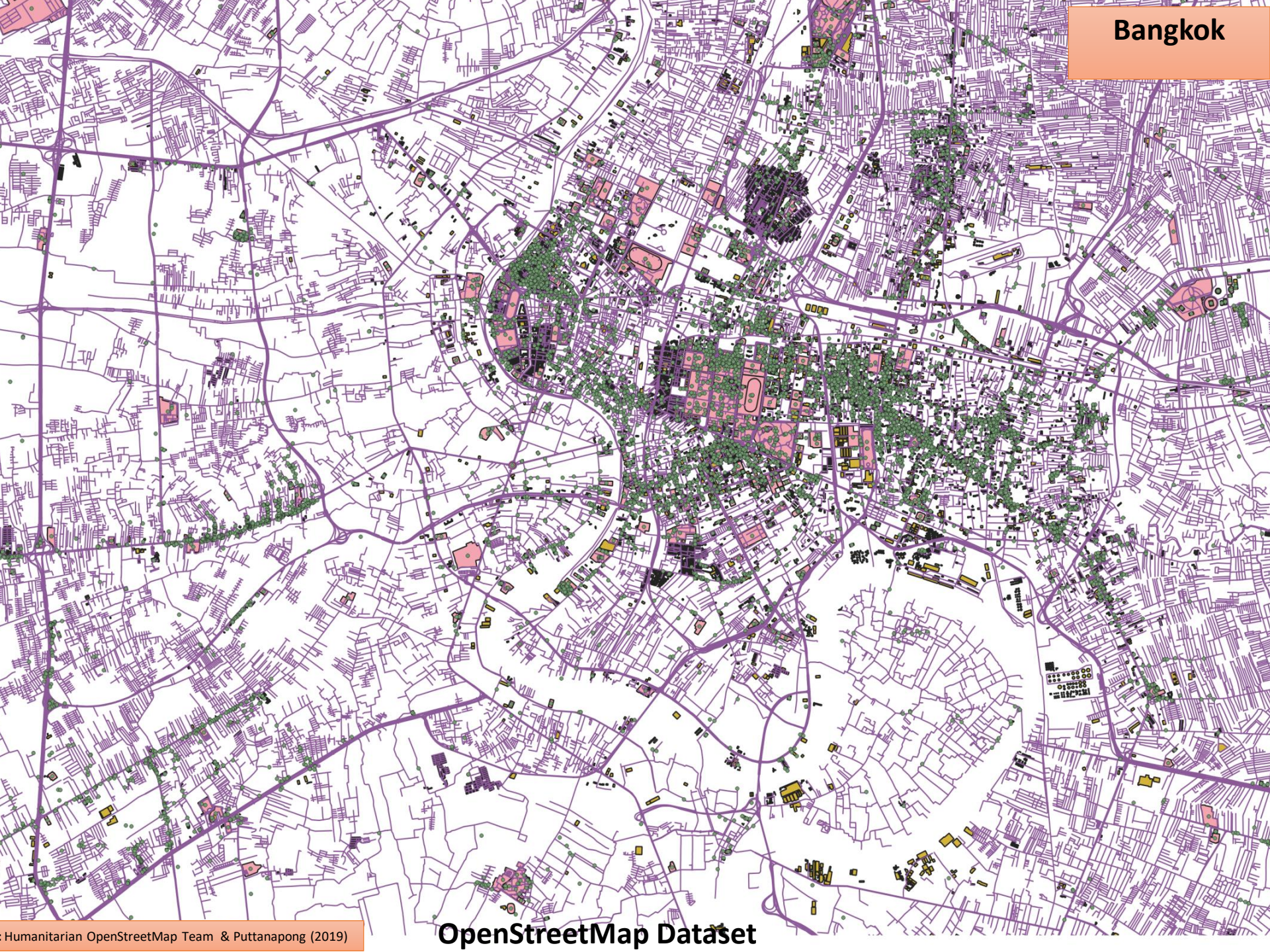
OpenStreetMap datasets

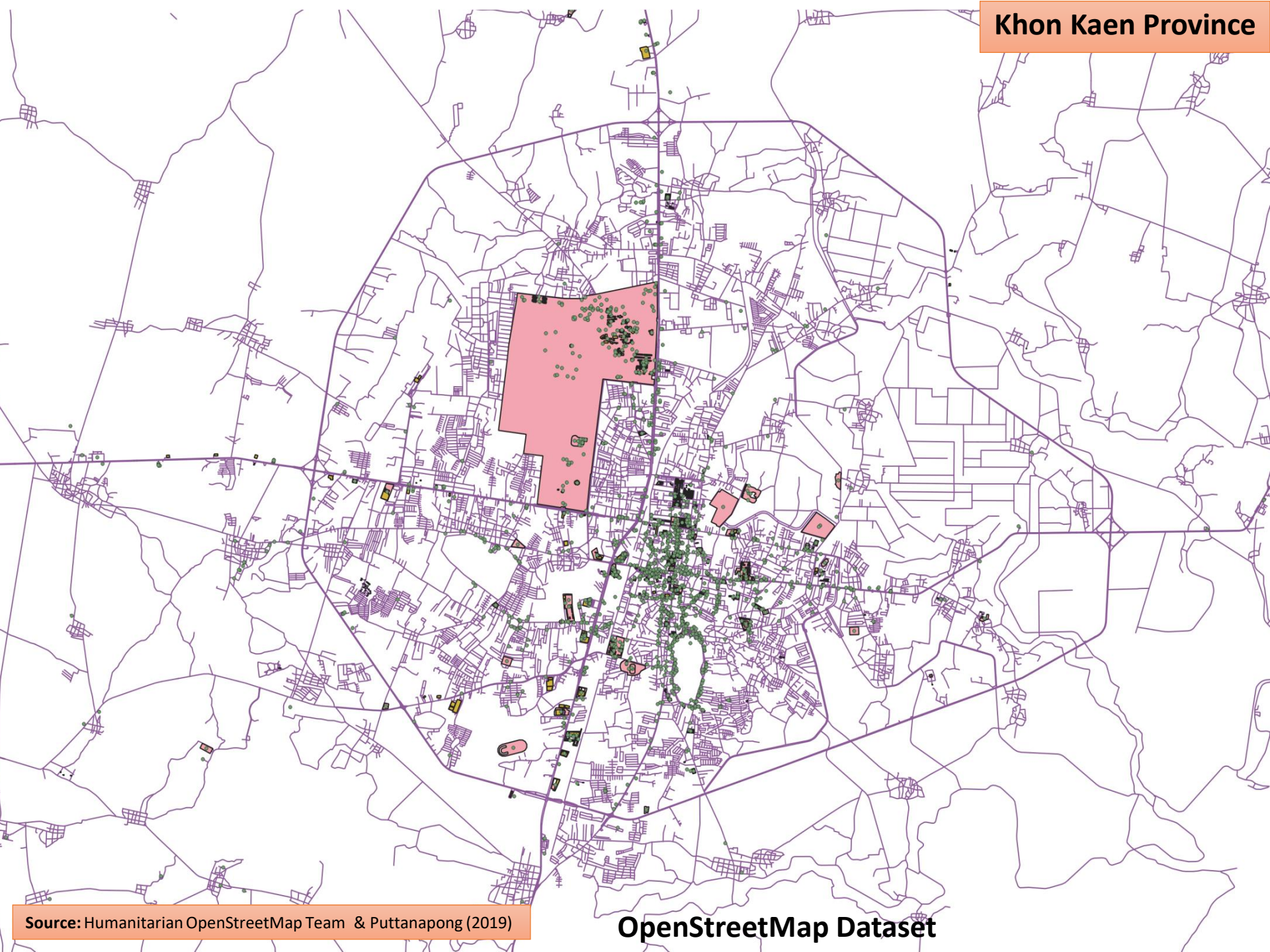
OpenStreetMap datasets

- Data of GMS countries can be obtained from Geofabrik GmbH Karlsruhe (https://www.geofabrik.de/data/download.html)



- **POI (Point of Interest)**
- **Area of building**
- **Number of building**
- **Road network**


Bangkok
: Humanitarian OpenStreetMap Team & Puttanapong (2019)
OpenStreetMap Dataset


Khon Kaen Province
Source: Humanitarian OpenStreetMap Team & Puttanapong (2019)
OpenStreetMap Dataset

Classification of POI

There are 130 types of Points of Interest (POI) and they are classified into 19 groups of POI. These 19 classifications are defined by Thailand's national account system.

NESDB Classification	Activity
1	Agriculture
2	Mining and quarrying
3	Manufacturing
4	Electricity, gas, steam and air conditioning supply
5	Water supply; sewerage, waste management and remediation activities
6	Construction
7	Wholesale and retail trade and repair of motor vehicles
8	Transportation and storage
9	Accommodation and food service activities
10	Information and communication
11	Financial and insurance activities
12	Real estate activities
13	Professional, scientific and technical activities
14	Administrative and support service activities
15	Public administration and defence; compulsory social security
16	Education
17	Human health activities
18	Arts, entertainment and recreation
19	Other service activities

1	No.	F_Class	Translated	Count (Area)	Count (Point)	NESDB_Classification
2	1	alpine_hut	Unknow	-	1	19
3	2	archaeological	แหล่งโบราณคดี	12	47	18
4	3	arts_centre	ศูษย์แสดงงานศิลปะ	3	8	18
5	4	artwork	งานศิลปะ	7	26	18
6	5	atm	ตู้กดเงินสดอัตโนมัติ (ATM)	-	855	11
7	6	attraction	สถานที่ท่องเที่ยว	182	556	18
8	7	bakery	เบเกอรี่	4	144	9
9	8	bank	ธนาคาร	79	911	11
10	9	bar	บาร์	27	1,152	9
11	10	battlefield	สถานที่ซ้อมรบ	-	1	19
12	11	beauty_shop	ร้านเสริมสวย	3	54	7
13	12	bed_and_breakfast	ที่พักพร้อมอาหารเช้า	1	1	9
14	13	bench	ที่นั่ง,ศาลา	-	98	18
15	14	beverages	ร้านขายเครื่องดื่ม	3	37	9
16	15	bicycle_rental	ร้านเช่าจักรยาน	1	42	7
17	16	bicycle_shop	ร้านขายจักรยาน	2	158	7
18	17	biergarten	ลานเบียร์ ?	2	11	9
19	18	bookshop	ร้านขายหนังสือ	6	97	7
20	19	butcher	ร้านขายหนังสือ	-	12	7
21	20	cafe	คาเฟ่	44	1,434	9
22	21	camera_surveillance	กล้องวงจรปิด	-	29	19
23	22	camp_site	ที่พักคนงาน	9	67	20
24	23	car_dealership	ตัวแทนจำหน่ายรถ	36	290	7
25	24	car_rental	ร้านเช่ารถ	1	48	8
26	25	car_repair	ร้านซ่อมรถ	-	2	7
27	26	car_wash	ร้ารล้างรถ	6	103	7
28	27	castle	ที่พัก	1	2	20
29	28	chalet	ส้วมสาธารณะ	34	125	14
30	29	chemist	โรงงานผลิตยา	1	21	3
31	30	cinema	โรงภาพยนตร์	9	43	18
32	31	clothes	ร้านขายเสื้อผ้า	6	458	7
33	32	college	วิทยาลัย	52	103	16
34	33	comms_tower	เสาส่งสัญญาณ	19	181	10
35	34	community_centre	ศาลาประชาคม	2	8	14
36	35	computer_shop	ร้านคอมพิวเตอร์	3	34	10
37	36	convenience	ร้านสะดวกซื้อ	115	2,738	7
38	37	courthouse	ที่พักตุลาการ	12	20	9
39	38	dentist	คลีนิคทันตแพทย์	3	81	17
40	39	department_store	ห้างสรรพสินค้า	20	112	7

The sum of each classification in each sub-district has been calculated.

	A	B	C	D	E	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA
1	tb_idn	Provi_NE	Amp_NE	Tamb_NE	Area	NESDB5_3	NESDB5_5	NESDB5_7	NESDB5_8	NESDB5_9	NESDB5_10	NESDB5_11	NESDB5_13	NESDB5_14	NESDB5_15	NESDB5_16	NESDB5_17	NESDB5_18	NESDB5_19	NESDB5_20	NESDB7_3	NESDB7_5	NESDB7_7	NESDB7_8	NESDB7_9	NESDB7_10
2	100101	Bangkok	Phra Nakhon	Phra Borom Ma	1550920.892	0	1	1	0	11	8	4	0	3	0	4	0	40	7	0	0	3	6	0	26	8
3	100102	Bangkok	Phra Nakhon	Wang Burapha	723891.425	0	0	39	0	13	0	3	0	0	0	0	0	5	0	0	0	0	34	0	28	0
4	100103	Bangkok	Phra Nakhon	Wat Ratchabo	208131.364	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	1	0
5	100104	Bangkok	Phra Nakhon	Samran Rat	246479.416	0	0	1	0	1	0	0	0	0	1	0	0	5	2	0	0	0	3	0	9	0
6	100105	Bangkok	Phra Nakhon	San Chaopho	150552.965	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	0
7	100106	Bangkok	Phra Nakhon	Sao Chingcha	145961.015	0	0	0	0	3	2	0	0	0	1	0	0	2	1	0	0	0	1	0	4	2
8	100107	Bangkok	Phra Nakhon	Bowon Niwet	486495.128	0	1	7	0	14	16	3	0	1	0	2	1	11	1	5	0	2	13	0	37	16
9	100108	Bangkok	Phra Nakhon	Talat Yot	180455.978	0	1	24	0	94	3	27	0	1	1	1	8	23	1	15	0	2	25	0	108	3
10	100109	Bangkok	Phra Nakhon	Chana Songkh	322863.53	0	0	15	0	57	11	15	0	2	0	2	1	17	2	37	0	0	15	0	87	11
11	100110	Bangkok	Phra Nakhon	Ban Phan Thor	413434.808	0	3	6	0	41	1	5	0	1	0	0	2	2	0	7	0	3	7	0	60	1
12	100111	Bangkok	Phra Nakhon	Bang Khun Phr	444737.396	0	4	2	0	1	0	2	0	0	0	2	0	0	0	0	0	4	4	0	8	0
13	100112	Bangkok	Phra Nakhon	Wat Sam Phra	526201.952	0	2	6	0	16	1	3	0	2	1	2	0	3	0	15	0	2	6	0	25	1
14	100201	Bangkok	Dusit	Dusit	2404299.513	0	0	1	0	2	0	3	0	0	2	8	0	10	2	0	0	0	3	0	19	1
15	100202	Bangkok	Dusit	Wachira Phaya	1175092.112	0	0	0	0	1	0	2	0	0	0	5	1	0	0	1	0	0	2	0	6	0
16	100203	Bangkok	Dusit	Suan Chit Lada	1818726.07	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	1	0	0	0
17	100204	Bangkok	Dusit	Si Yaek Maha M	353894.8	0	0	0	0	1	0	0	0	0	0	0	1	2	0	0	0	0	2	0	1	0
18	100206	Bangkok	Dusit	Thanon Nakho	5594192.031	0	0	2	0	1	1	0	0	0	0	1	0	4	0	1	0	0	8	0	2	2
19	100301	Bangkok	Nong Chok	Krathum Rai	36367544.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	100302	Bangkok	Nong Chok	Nong Chok	33784356.88	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
21	100303	Bangkok	Nong Chok	Khlong Sip	24212062.68	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
22	100304	Bangkok	Nong Chok	Khlong Sip Son	41215781.41	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
23	100305	Bangkok	Nong Chok	Khok Faet	21666220.75	0	0	2	0	2	0	0	0	0	1	3	1	12	1	0	0	0	2	0	2	0
24	100306	Bangkok	Nong Chok	Khu Fang Nuea	16408845.36	0	0	1	0	2	0	0	0	0	0	4	0	0	0	0	0	0	1	0	2	0
25	100307	Bangkok	Nong Chok	Lam Phak Chi	32114243.87	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1
26	100308	Bangkok	Nong Chok	Lam Toiting	29310771.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	100401	Bangkok	Bang Rak	Maha Phruetth	636579.283	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	8	0	8	2
28	100402	Bangkok	Bang Rak	Si Lom	768688.076	0	0	0	0	16	0	3	0	0	2	1	0	1	0	1	0	0	8	0	24	2
29	100403	Bangkok	Bang Rak	Suriyawong	1511449.142	0	0	19	0	57	5	16	0	1	3	7	3	7	0	3	0	1	34	0	127	6
30	100404	Bangkok	Bang Rak	Bang Rak	605460.129	0	2	10	0	33	0	1	0	0	0	1	1	6	0	0	0	2	25	0	61	2
31	100405	Bangkok	Bang Rak	Si Phraya	486741.412	0	0	6	0	21	3	2	0	1	2	3	0	7	1	1	0	1	8	0	27	2
32	100502	Bangkok	Bang Khen	Anusawari	18055277.98	1	0	15	0	2	1	2	0	1	3	1	0	29	0	0	1	0	20	0	7	1
33	100508	Bangkok	Bang Khen	Tha Raeng	22739565.85	0	0	2	0	0	0	1	0	0	0	1	0	1	0	0	0	0	3	0	0	0
34	100601	Bangkok	Bang Kapi	Khlong Chan	11848048.86	0	1	7	0	1	0	0	0	0	5	1	0	2	0	0	0	1	10	0	11	0
35	100608	Bangkok	Bang Kapi	Hua Mak	15735792.14	0	0	8	0	16	0	0	0	1	0	15	3	19	0	0	0	0	26	0	38	1
36	100701	Bangkok	Pathum Wan	Rong Mueang	1204845.466	0	0	1	0	4	1	0	0	0	0	0	0	0	0	0	0	1	15	0	19	3
37	100702	Bangkok	Pathum Wan	Wang Mai	1372987.362	0	0	9	0	22	2	0	0	1	3	8	1	47	0	1	0	0	22	0	54	2
38	100703	Bangkok	Pathum Wan	Pathum Wan	2097489.844	0	2	54	0	89	3	20	0	4	2	28	5	45	11	0	2	2	70	0	127	3
39	100704	Bangkok	Pathum Wan	Lumphini	3362921.498	1	6	37	1	70	5	10	2	0	13	3	2	47	14	0	5	6	57	0	127	7
40	100801	Bangkok	Pom Prap Satt	Pom Prap	612232.228	0	0	6	0	1	0	1	0	0	1	0	1	2	0	0	0	2	20	0	16	6
41	100802	Bangkok	Pom Prap Satt	Wat Thepsirin	443288.907	0	0	2	0	0	1	4	0	0	1	0	0	1	0	0	0	0	4	0	4	1
42	100803	Bangkok	Pom Prap Satt	Khlong Mahana	577715.679	0	0	0	0	3	2	0	0	0	0	0	1	0	0	0	0	0	2	0	9	3
43	100804	Bangkok	Pom Prap Satt	Ban Bat	401744.636	0	0	1	0	0	1	0	0	1	0	0	0	6	3	0	0	2	3	0	2	1
44	100805	Bangkok	Pom Prap Satt	Wat Somman	458447.661	0	0	2	0	1	0	0	0	0	1	0	0	2	0	0	0	0	4	0	2	0
45	100905	Bangkok	Phra Khanong	Bang Chak	13434443.1	0	0	4	0	12	0	6	0	0	1	0	0	2	2	0	0	0	27	0	27	0
46	101001	Bangkok	Min Buri	Min Buri	24988802.7	0	0	5	0	2	2	0	0	0	3	4	1	4	0	0	0	0	8	0	3	2
47	101002	Bangkok	Min Buri	Saen Saep	36119644.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0
48	101101	Bangkok	Lat Krabang	Lat Krabang	10924607.06	0	0	3	0	15	0	0	0	0	1	5	0	9	2	0	0	0	16	1	49	0
49	101102	Bangkok	Lat Krabang	Khlong Song T	16164158.37	0	0	0	0	2	0	0	0	0	0	0	0	9	4	0	0	1	2	0	4	0
50	101103	Bangkok	Lat Krabang	Khlong Sam Pr	17680795.98	0	0	2	0	2	0	1	0	0	0	1	0	0	0	0	0	0	3	0	2	0
51	101104	Bangkok	Lat Krabang	Lam Pla Thio	32710412.39	0	0	0	0	4	0	2	0	0	0	1	0	2	0	0	0	2	2	0	4	1
52	101105	Bangkok	Lat Krabang	Thap Yao	23469832.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
53	101106	Bangkok	Lat Krabang	Khum Thong	23858077.93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	101203	Bangkok	Yannawa	Chong Nonsi	5406345.063	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8	0	6	0
55	101204	Bangkok	Yannawa	Bang Phongph	7053864.752	0	0	5	0	5	0	0	0	2	1	4	0	7	0	0	0	0	22	0	14	2

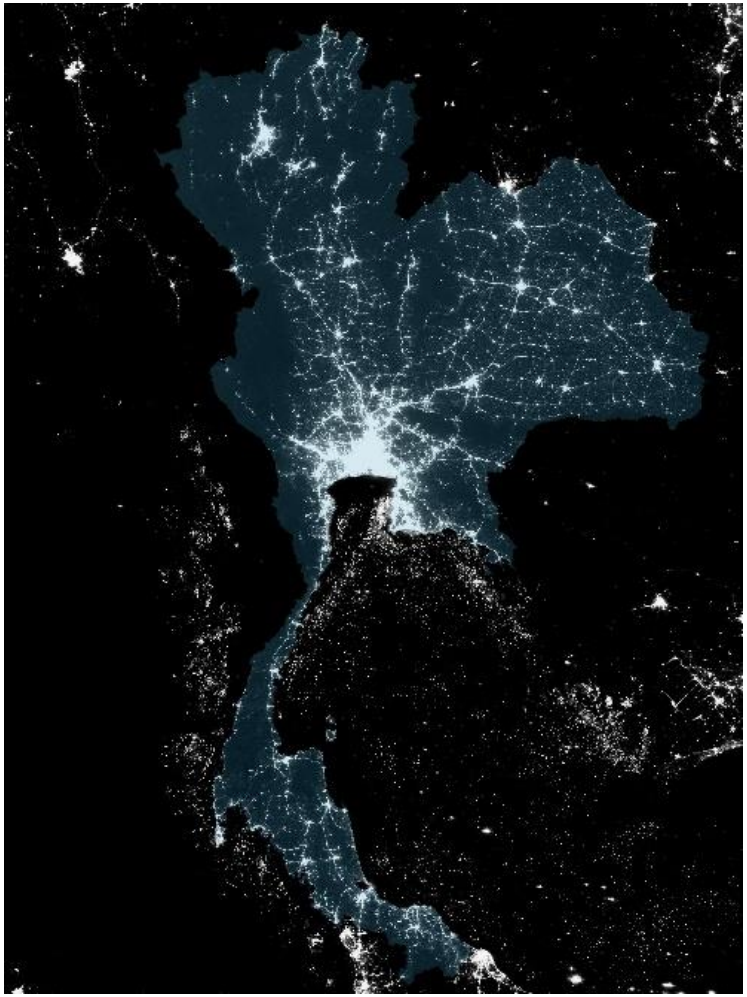
Example 1:
Regression analysis of poverty in Thailand

This example is the regression analysis in the case of Thailand. The **poverty headcount** of each subdistrict is the **dependent variable**. All independent variables are remote-sensing and OSM data.

Models' specification

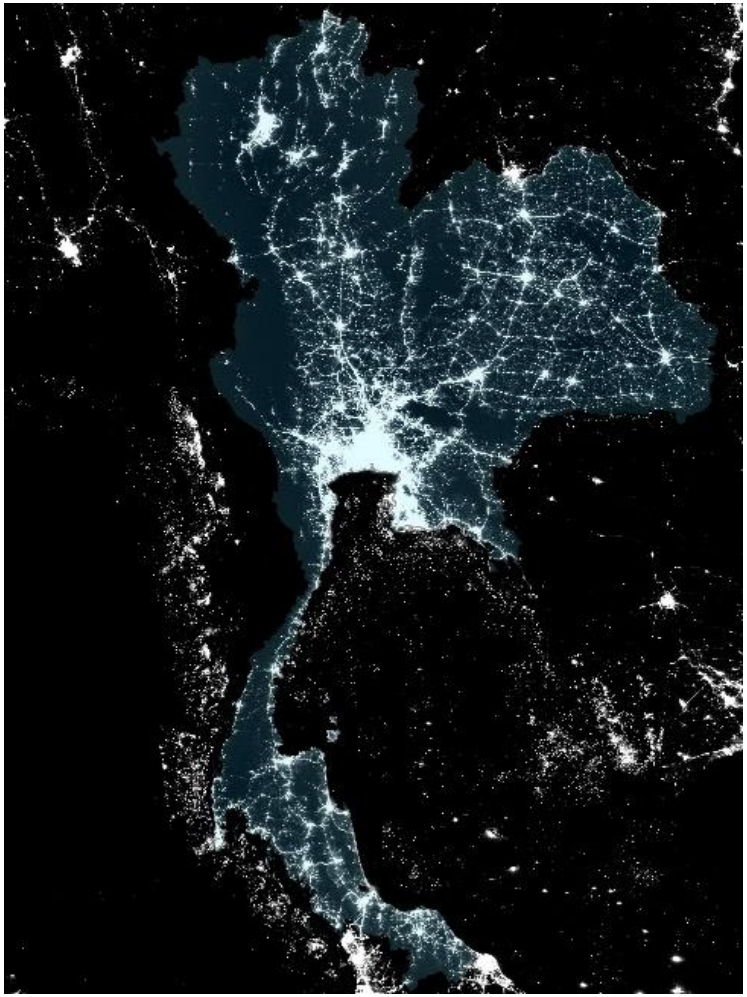
$$Log\_poverty_i = a + \beta_1 * log\_VIIRS\_density_i + \beta_2 * log\_house\_density_i + \beta_3 * log\_NDVI\_density_i + \beta_4 * log\_building\_density_i + e_i$$

VIIRS Nighttime Light of 2015



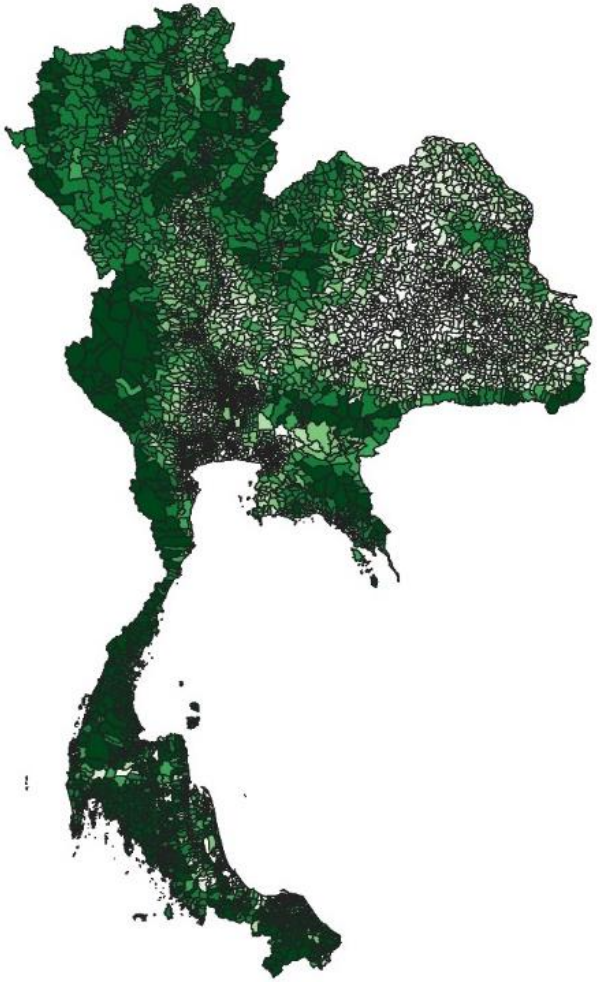
Source: NASA and author's computation

VIIRS Nighttime Light of 2017



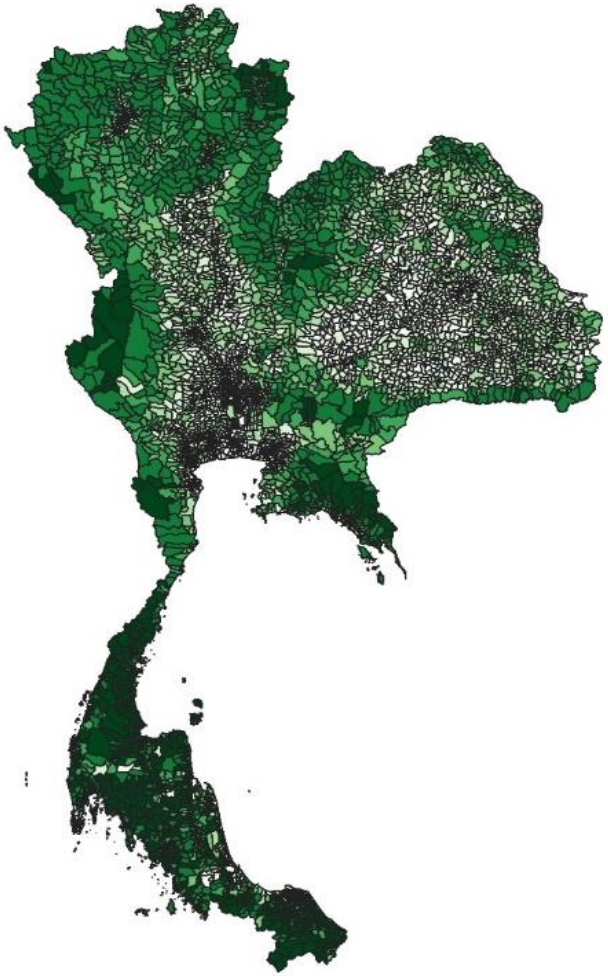
Source: NASA and author's computation

NDVI of 2015



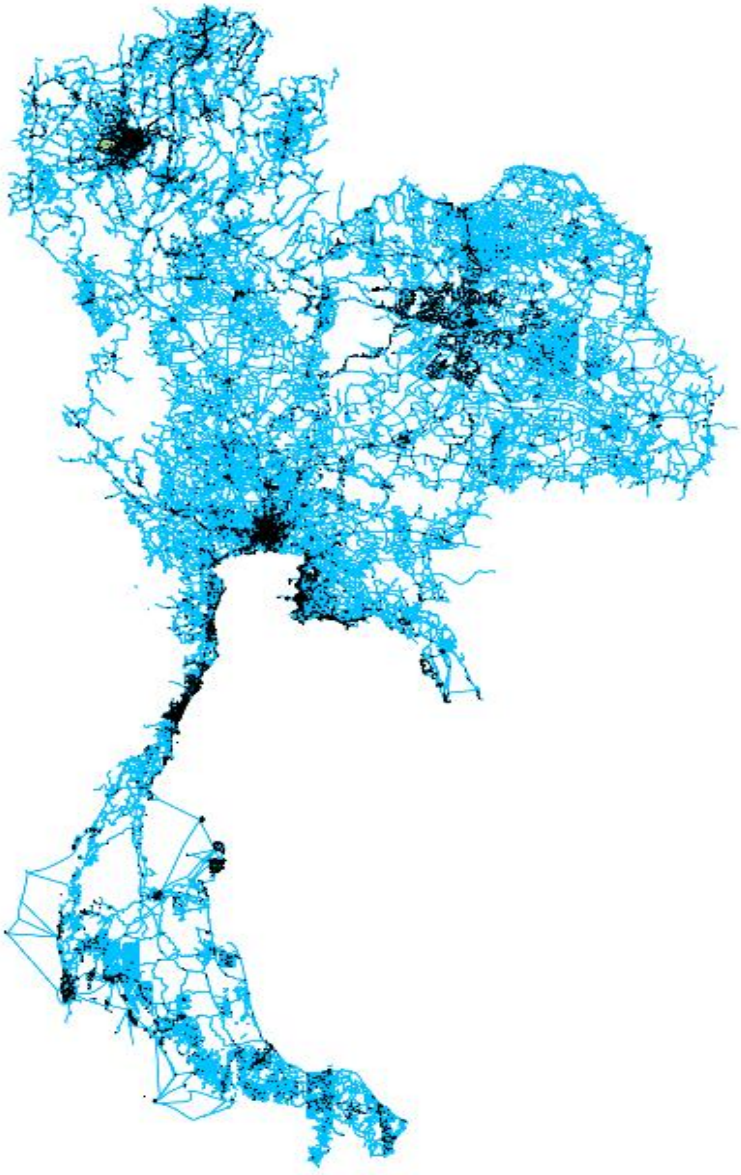
Source: Google Earth Engine and author's computation

NDVI of 2017

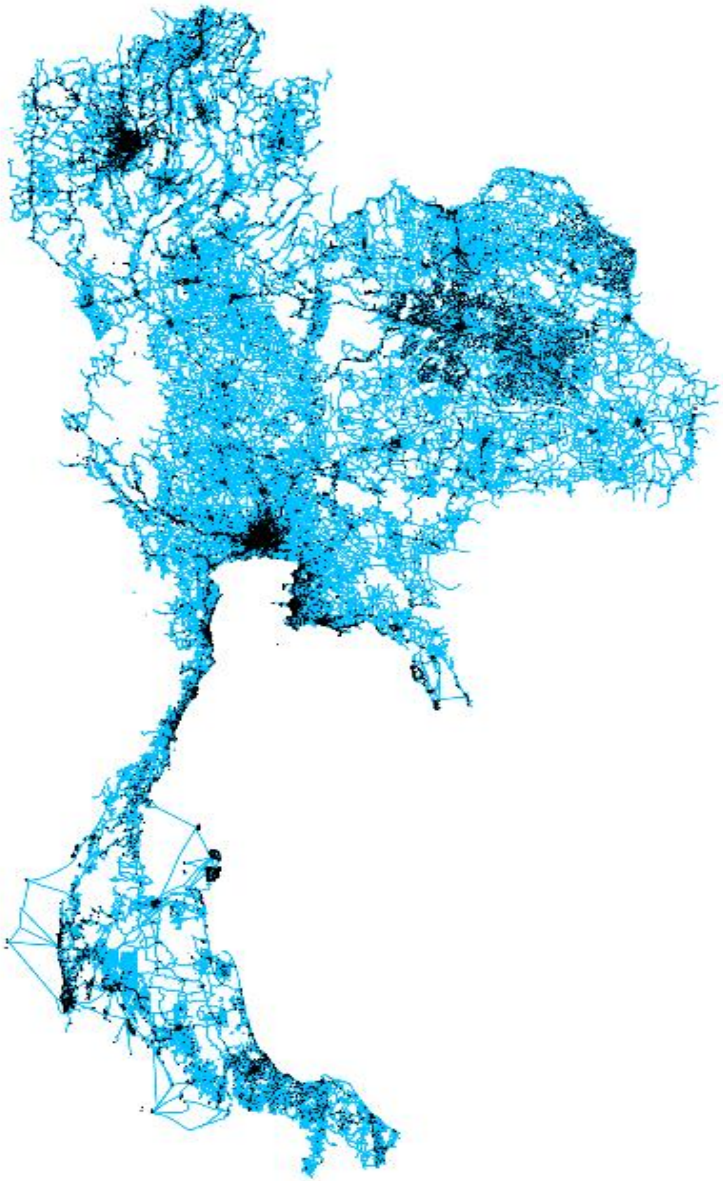


Source: Google Earth Engine and author's computation

OSM data of Thailand 2015



OSM data of Thailand 2017



Poverty headcount in 2015

```
. reg log_pov_m2015 log_VIIRS_density_2015 log_House_density_2015  log_NDVI_density_2015
log_F
> 2015_Buil_Density

      Source |       SS           df       MS      Number of obs   =     1,032
-------------+----------------------------------   F(4, 1027)      =     53.68
       Model |  185.255465         4  46.3138664   Prob > F        =    0.0000
    Residual |  886.126214     1,027  .862829809   R-squared       =    0.1729
-------------+----------------------------------   Adj R-squared   =    0.1697
       Total |  1071.38168     1,031  1.03916749   Root MSE        =    .92889

------------------------------------------------------------------------------
        log_pov_m2015 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------+-------------------------------------------------------------
log_VIIRS_density_2015 |  -.3354808   .0274073   -12.24   0.000    -.3892616   -.2817001
log_House_density_2015 |  -.0004255   .0122336    -0.03   0.972    -.0244313    .0235803
 log_NDVI_density_2015 |   .4725589    .056389     8.38   0.000      .361908    .5832097
log_F2015_Buil_Density |    .036147   .0138608     2.61   0.009     .0089483    .0633457
                 _cons |    2.44245   .2066359    11.82   0.000     2.036974    2.847927
------------------------------------------------------------------------------
```

The same specification was applied to the case of 2017.

$Log\_poverty_i = a + \beta_1 * log\_VIIRS\_density_i + \beta_2 * log\_house\_density_i + \beta_3 * log\_NDVI\_density_i + \beta_4 * log\_building\_density_i + e_i$

Poverty headcount in 2017

```
.reg log_pov_nm2017 log_VIIRS_density_2017 log_House_density_2017  log_NDVI_density_2017
log_F2017_Buil_Density

      Source |       SS           df       MS      Number of obs   =     2,022
-------------+----------------------------------   F(4, 2017)      =    107.02
       Model |  398.419678         4  99.6049194   Prob > F        =    0.0000
    Residual |  1877.20449     2,017   .93069137   R-squared       =    0.1751
-------------+----------------------------------   Adj R-squared   =    0.1734
       Total |  2275.62417     2,021   1.1259892   Root MSE        =    .96472

------------------------------------------------------------------------------
       log_pov_nm2017 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------+-------------------------------------------------------------
log_VIIRS_density_2017 |  -.2333889   .0317492    -7.35   0.000    -.2956537   -.1711242
log_House_density_2017 |  -.0684635   .0383538    -1.79   0.074    -.1436807    .0067537
 log_NDVI_density_2017 |   .2049945   .0517804     3.96   0.000     .1034458    .3065432
log_F2017_Buil_Density |  -.0401964   .0099835    -4.03   0.000    -.0597754   -.0206173
                 _cons |   .1760788   .3376755     0.52   0.602    -.4861505    .8383081
------------------------------------------------------------------------------
```

Example 2:
Road network and degree of connectivity in Phnom Penh

Computational Method

Step 1: Extract the road network in Phnom Penh from OpenStreetMap database

Step 2: Randomize 100 locations in the city

Step 3: Compute the distance of each location to the main road

RStudio

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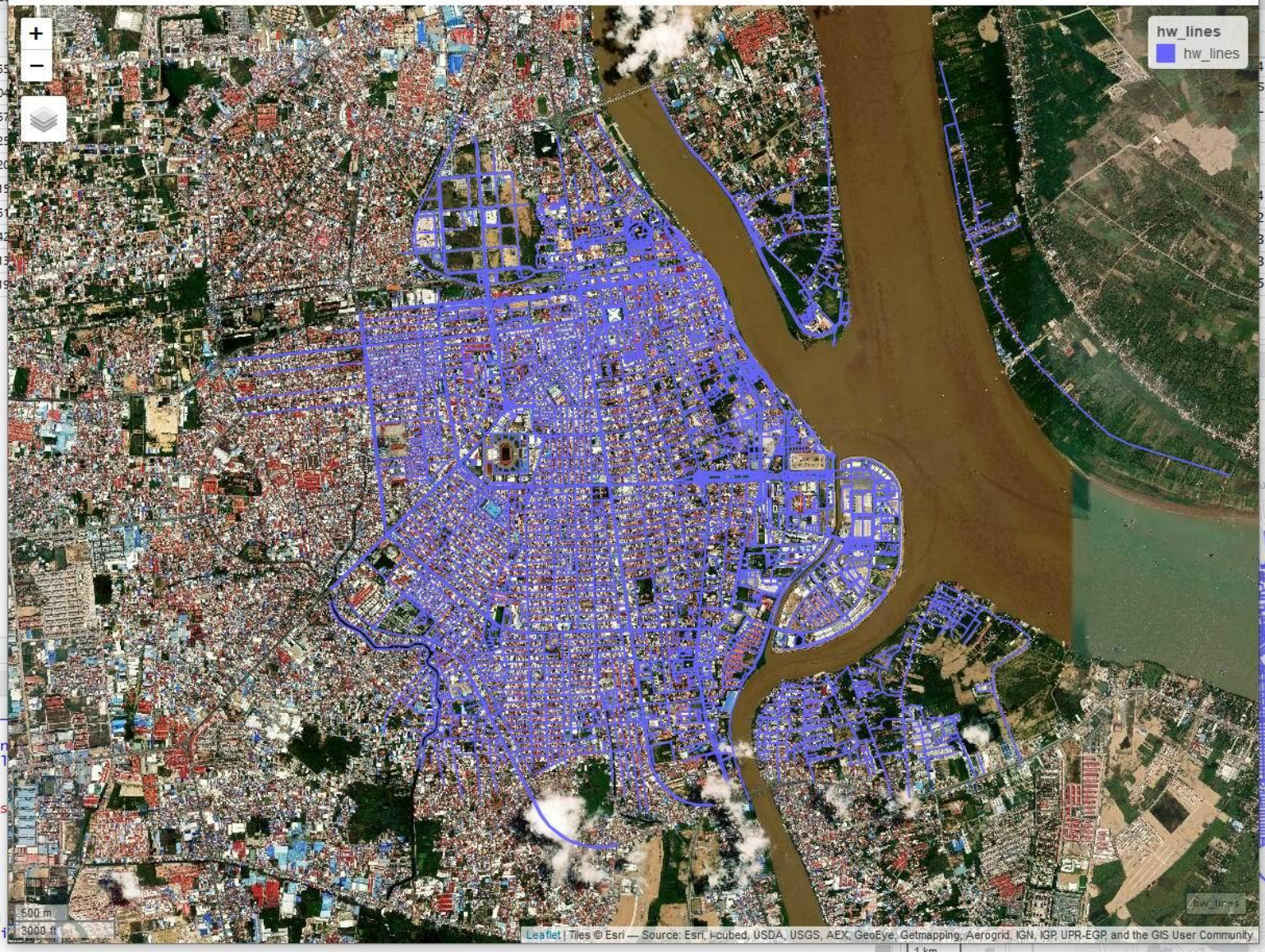
Data_for_R_2017 | Filter

	distance	lon
1	4.888907e-06	104.905
2	1.481650e-06	104.920
3	2.813708e-06	104.925
4	1.628590e-05	104.912
5	8.472618e-06	104.902
6	3.638430e-04	104.911
7	1.609401e-06	104.945
8	9.212858e-07	104.924
9	8.541152e-06	104.951
10	2.266609e-04	104.891

Showing 1 to 10 of 10 entries

Viewer Zoom



Console Terminal

```
> # Make a random poin
> gpsPoints <- spsampl
warning message:
In .local(x, n, type,
  working under the as
> # Plot points
> plot(hw_lines, xlab
> plot(gpsPoints, add
> box()
> # Distances between
> distances <- dist2Li
```

```
4] 4.89e-06 1.48
SpatialPoints
LinesDataFrame (
42 elements, 16.
29 elements, 16.
3 elements, 7.4
3 elements, 3.5
5 variables
variables
```

1 km
1 mi

Type here to search

A map of 100 randomized locations in the city

Average distance to main roads

Example of computed result

Location	Longitude	Latitude	Average distance to main roads (km.)
1	104.9055	11.5491	0.488889
2	104.9204	11.5571	0.148165
3	104.9257	11.5310	0.281371
4	104.9125	11.5338	0.162859
5	104.9021	11.5539	0.847261
6	104.9115	11.5359	0.363843
7	104.9451	11.5335	0.160941
8	104.9242	11.5879	0.921285
9	104.9513	11.5730	0.854115
10	104.8919	11.5661	0.226661
…	…	…	…