HW1_sa3762

February 9, 2020

[1]:
```
import pandas as pd
from matplotlib import pyplot as plt
```

[2]:
```
df = pd.read_csv("data/fire_archive_V1_96617.csv")
df.head()
```

[2]:

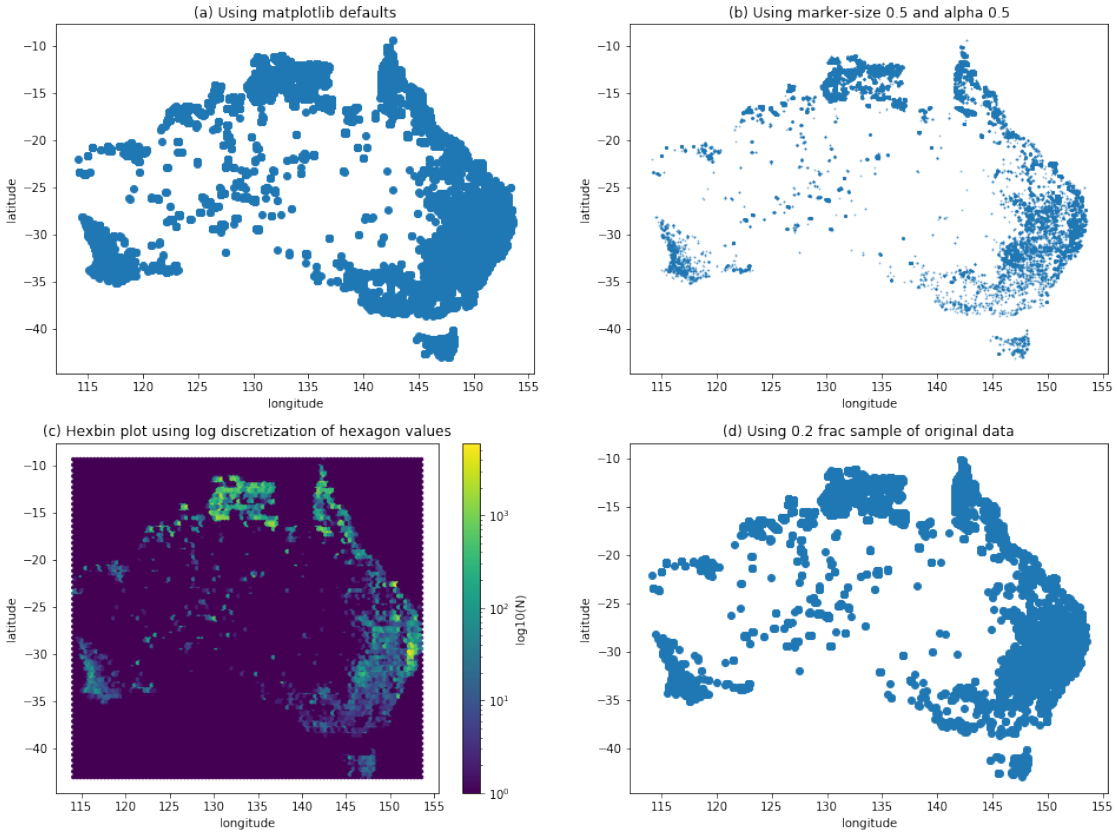
	latitude	longitude	bright_ti4	scan	track	acq_date	acq_time	satellite	instrument	confidence	version	bright_ti5	frp	type
0	-34.45902	150.88040	326.5	0.60	0.71	2019-08-01	246	N	VIIRS	n	1	290.7	5.8	3
1	-31.70724	151.07191	367.0	0.56	0.69	2019-08-01	247	N	VIIRS	h	1	291.9	10.4	0
2	-31.39626	149.65253	325.2	0.68	0.74	2019-08-01	247	N	VIIRS	n	1	292.7	5.6	0
3	-30.39774	152.06432	347.8	0.48	0.65	2019-08-01	247	N	VIIRS	n	1	287.6	9.1	0
4	-31.20248	151.89766	350.7	0.50	0.66	2019-08-01	247	N	VIIRS	n	1	292.3	9.4	0

0.1 Task 1: Density Plots

[3]:
```
fig, ax = plt.subplots(2, 2, figsize=(16, 12))

# Figure Title
fig.suptitle("(Figure 1) Various Density Plots for fire_archive_V1_96617␣
 ↪datapoints", fontsize=16)

# 1. Matplotlib defaults
ax[0, 0].set_title("(a) Using matplotlib defaults")
ax[0, 0].set_xlabel("longitude")
ax[0, 0].set_ylabel("latitude")
ax[0, 0].scatter(df.longitude, df.latitude)

# 2: Adding alpha and marker size to compensate for overplotting.
ax[0, 1].set_title("(b) Using marker-size 0.5 and alpha 0.5")
```

```
ax[0, 1].set_xlabel("longitude")
ax[0, 1].set_ylabel("latitude")
ax[0, 1].scatter(df.longitude, df.latitude, alpha=0.5, s=0.5)

# 3: Hexbin plot
ax[1, 0].set_title("(c) Hexbin plot using log discretization of hexagon values")
ax[1, 0].set_xlabel("longitude")
ax[1, 0].set_ylabel("latitude")
hb = ax[1, 0].hexbin(df.longitude, df.latitude, bins="log")
cb = fig.colorbar(hb, ax = ax[1,0])
cb.set_label('log10(N)')


# 4: Subsampling the dataset
df_sample = df.sample(frac=0.2)
ax[1, 1].set_title("(d) Using 0.2 frac sample of original data")
ax[1, 1].set_xlabel("longitude")
ax[1, 1].set_ylabel("latitude")
ax[1, 1].scatter(df_sample.longitude, df_sample.latitude)

_ = plt.show()
```

(Figure 1) Various Density Plots for fire_archive_V1_96617 datapoints



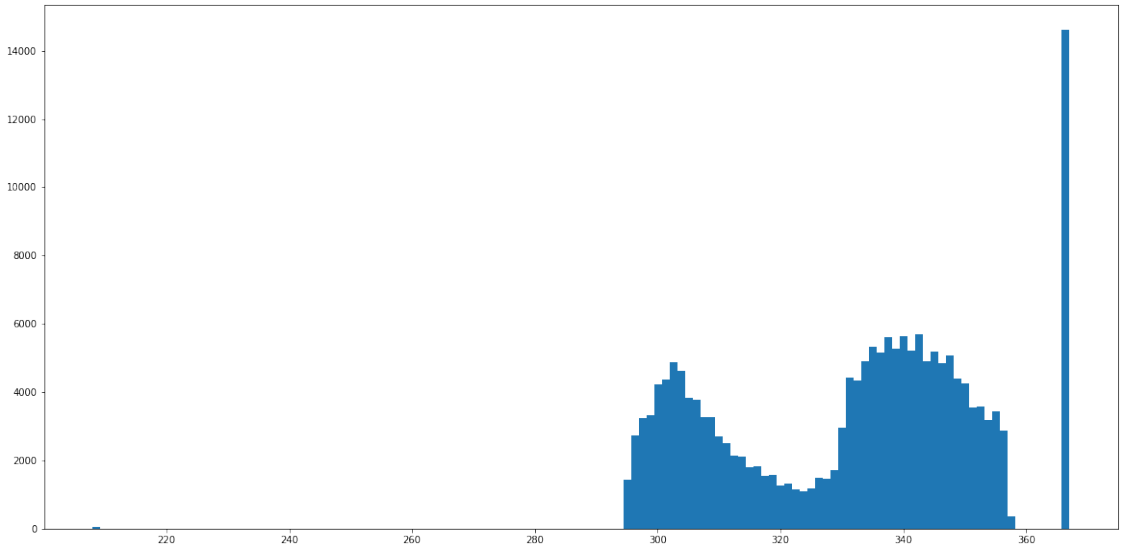
0.1.1 1.2: Most anomalous regions

From Figure 1.b and 1.c we can clearly see that most anomalies are located on **top-mid** (latitude (130-140), longitude (-17, -12)) and **right-mid** (latitude (150, 155), longitude (-35, -25)) section of Australia.

0.2 Task 2: Visualizing class membership

0.2.1 2.0 Distribution of brightness temperature I-4 as histogram

[4]:
```
fig = plt.figure(figsize=(20, 10))
hist = plt.hist(df.bright_ti4, bins="auto")
```

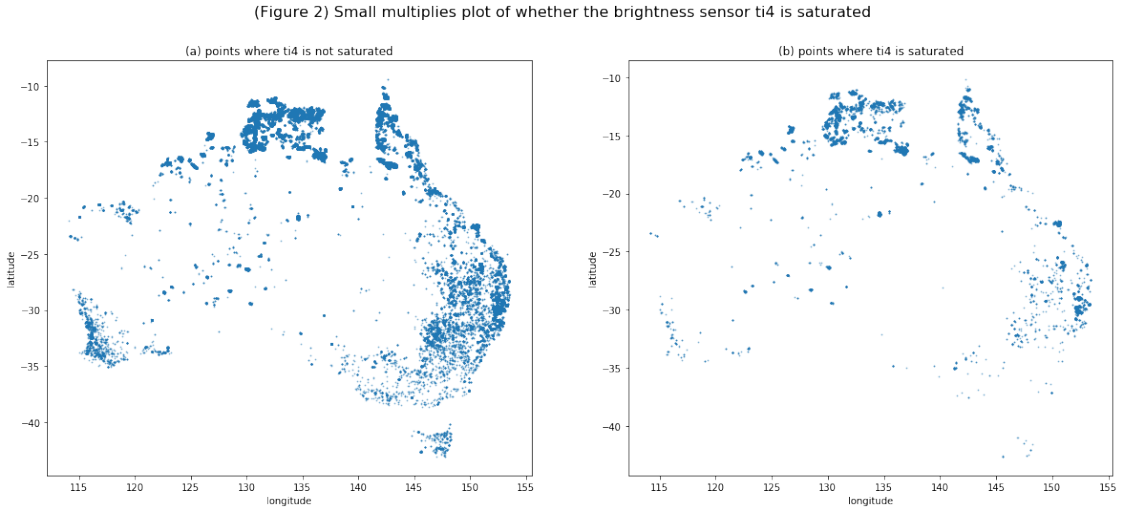


We can clearly see that the bright_ti4 value is saturated at 367 (maximum value for sensor). If we observe this value for particular location, we can be sure that there is a fire, as the sensor has reached it's maximum.

0.2.2 2.1 Small multiples plot of whether the brightness is saturated

[5]:
```
df_saturated = df.loc[df.bright_ti4 == 367, ["latitude", "longitude"]]
df_unsaturated = df.loc[df.bright_ti4 != 367, ["latitude", "longitude"]]
```

[6]:
```
fig, ax = plt.subplots(1, 2, figsize=(20, 8))
fig.suptitle("(Figure 2) Small multiplies plot of whether the brightness sensor␣
 ↪ti4 is saturated", fontsize=16)

ax[0].set_title("(a) points where ti4 is not saturated")
ax[0].set_xlabel("longitude")
ax[0].set_ylabel("latitude")
ax[0].scatter(df_unsaturated.longitude, df_unsaturated.latitude, s=0.5, alpha=0.
 ↪5)

ax[1].set_title("(b) points where ti4 is saturated")
ax[1].set_xlabel("longitude")
ax[1].set_ylabel("latitude")
ax[1].scatter(df_saturated.longitude, df_saturated.latitude, s=0.5, alpha=0.5)

_ = plt.show()
```



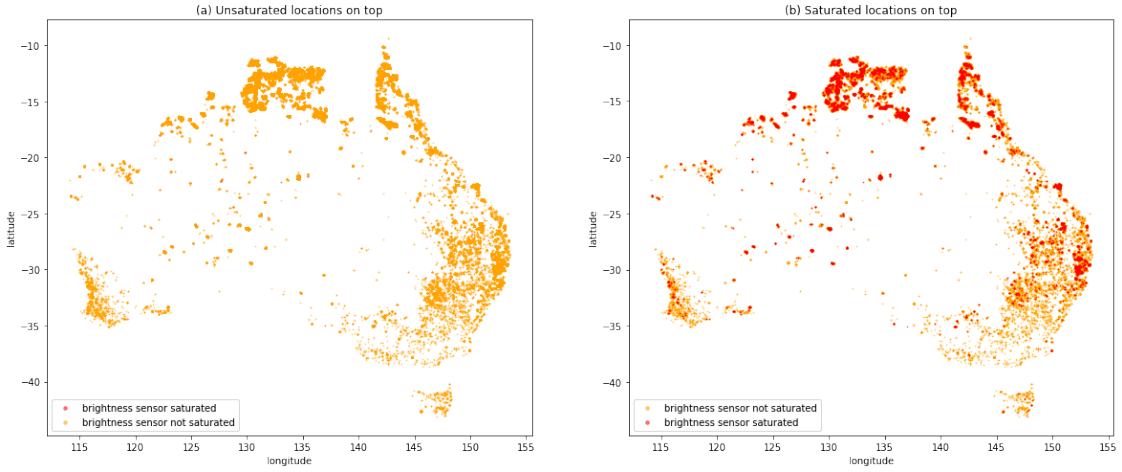
We can see from Figure 2 that a lot more points are unsaturated than saturated. We can also observe that the locations where the density of unsaturated points is high also have saturated points indicating fire.

0.2.3 2.2 Plot both groups in the same axes with different colors.

[7]:
```
fig, ax = plt.subplots(1, 2, figsize=(20, 8))
fig.suptitle("(Figure 3) Small multiplies plot of locations with unsaturated␣
 ↪and saturated brightness sensor ti4", fontsize=16)

ax[0].set_title("(a) Unsaturated locations on top")
ax[0].set_xlabel("longitude")
```

```
ax[0].set_ylabel("latitude")
ax[0].scatter(df_saturated.longitude, df_saturated.latitude, c='red',␣
 ↪label="brightness sensor saturated", s=0.5, alpha=0.5)
ax[0].scatter(df_unsaturated.longitude, df_unsaturated.latitude, c='orange',␣
 ↪label="brightness sensor not saturated", s=0.5, alpha=0.5)
ax[0].legend(markerscale=5, loc="lower left")

ax[1].set_title("(b) Saturated locations on top")
ax[1].set_xlabel("longitude")
ax[1].set_ylabel("latitude")
ax[1].scatter(df_unsaturated.longitude, df_unsaturated.latitude, c='orange',␣
 ↪label="brightness sensor not saturated", s=0.5, alpha=0.5)
ax[1].scatter(df_saturated.longitude, df_saturated.latitude, c='red',␣
 ↪label="brightness sensor saturated", s=0.5, alpha=0.5)
ax[1].legend(markerscale=5, loc="lower left")

_ = plt.show()
```

(Figure 3) Small multiplies plot of locations with unsaturated and saturated brightness sensor ti4

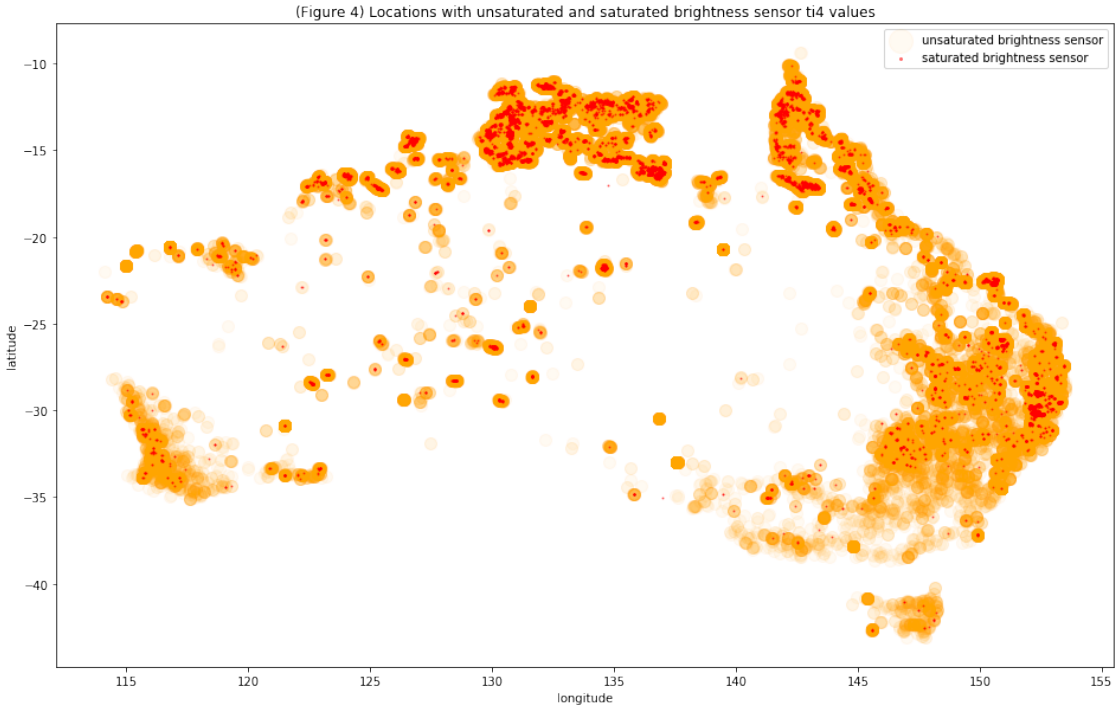


Looking at the Figure 3a, it seems like almost no locations have saturated brightness value, which is incorrect. Correct reprsentation would be Figure 3b.

0.2.4 2.3 Better way to compare two distributions

[8]:
```
fig = plt.figure(figsize=(16, 10))
plt.title("(Figure 4) Locations with unsaturated and saturated brightness␣
 ↪sensor ti4 values")
plt.xlabel("longitude")
plt.ylabel("latitude")
```

```
plt.scatter(df_unsaturated.longitude, df_unsaturated.latitude, c='orange',␣
 ↪label="unsaturated brightness sensor", s=100, alpha=0.05)
plt.scatter(df_saturated.longitude, df_saturated.latitude, c='red',␣
 ↪label="saturated brightness sensor", s=1, alpha=0.5)
plt.legend(markerscale=2)
plt.show()
```



Consider Figure 3b. If a location has similar amount of saturated and unsaturated observations, we will only see the saturated observation. In Figure 4, since the marker size of unsaturated observation is bigger, we can clearly see both the observations. Also note that, since the number of unsaturated observations is lot more than saturated observations, having smaller alpha for unsaturated makes sense.

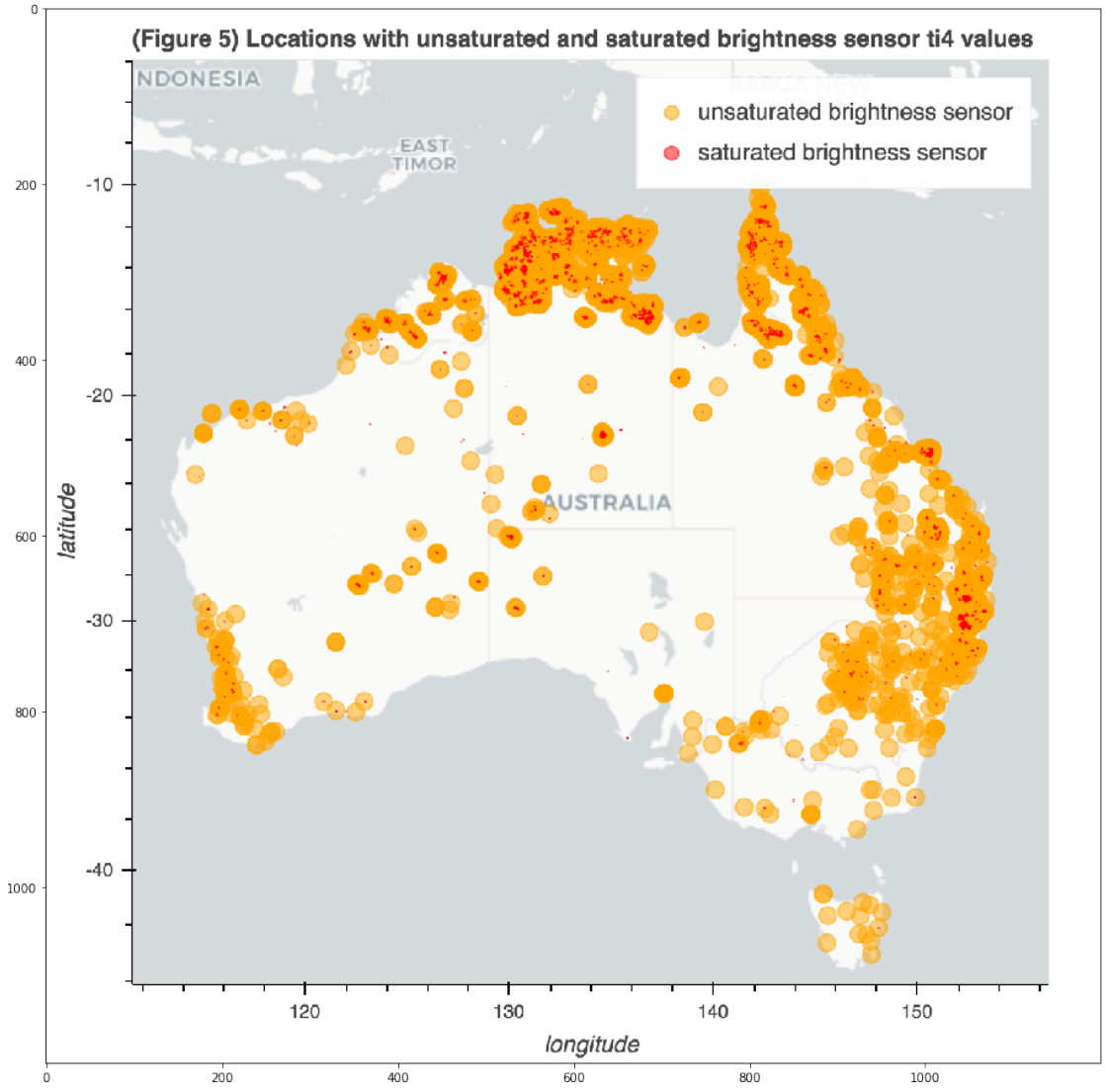
0.2.5 2.3 Better way to compare two distributions (alternative)

[9]:
```
from bokeh.plotting import figure, show, output_notebook
from bokeh.tile_providers import get_provider, Vendors
from pyproj import Proj, transform, Transformer
output_notebook()
```

[41]:
```
# Sample: Plotting a huge amount of points this way consumes a lot of RAM.␣
 ↪Better sample.
df_saturated_sample = df_saturated.sample(5000)
```

```
df_unsaturated_sample = df_unsaturated.sample(5000)

# Convert lat-long to Mercator projection (required by library)
transformer = Transformer.from_crs("EPSG:4326", "EPSG:3857", always_xy=True)
sat_long, sat_lat = transformer.transform(df_saturated_sample.longitude.values,␣
 ↪df_saturated_sample.latitude.values)
unsat_long, unsat_lat = transformer.transform(df_unsaturated_sample.longitude.
 ↪values, df_unsaturated_sample.latitude.values)

tile_provider = get_provider(Vendors.CARTODBPOSITRON)
p = figure(
    x_range=(12500000, 17500000),
    y_range=(-5000000, -1000000),
    x_axis_type="mercator",
    y_axis_type="mercator",
    title="(Figure 5) Locations with unsaturated and saturated brightness sensor␣
 ↪ti4 values",
)
p.add_tile(tile_provider)
p.xaxis.axis_label = "longitude"
p.yaxis.axis_label = "latitude"
p.circle(unsat_long, unsat_lat, size=10, color="orange", alpha=0.5,␣
 ↪legend_label="unsaturated brightness sensor")
p.circle(sat_long, sat_lat, size=0.1, color="red", alpha=0.5,␣
 ↪legend_label="saturated brightness sensor")
show(p)
# Following is an interactive plot. It might not be visible on github or in pdf␣
 ↪format
```

[40]:
```
import matplotlib.image as mpimg
img = mpimg.imread('Fig5.png')
fig = plt.figure(figsize=(16, 16))
_ = plt.imshow(img)
```


(Figure 5) Locations with unsaturated and saturated brightness sensor ti4 values
NDONESIA
EAST TIMOR
AUSTRALIA
unsaturated brightness sensor
saturated brightness sensor
latitude
longitude
-10
-20
-30
-40
120
130
140
150
0
200
400
600
800
1000