WeatherPy-Midlomarie

August 26, 2019

0.0.1   UR Bootcamp student: Midlo-Marie

0.0.2   Homework #6: Oneweathermapy API wrapper

0.1   *Global distribution of basic weather variables*

0.1.1   Problem Statement:

In this study, the Openweathermapy API is used to access basic weather information at a randomly selected set of at least 500 cities evenly distributed across the globe. The objective is to build a series of scatter plots to evaluate and provide three observations about the following physical relationships:

- Temperature (F) vs. Latitude
- Humidity (%) vs. Latitude
- Cloudiness (%) vs. Latitude
- Wind Speed (mph) vs. Latitude

0.1.2   About Openweathermapy

Openweathermap is a small IT company established in 2014 by a group of engineers and experts in Big Data, data processing, and satellite imagery processing, headquarters is in the UK, with an office in the US, and the development team in Latvia (EU). The company now has over 1.2 million users and get 1500 new users every day and are a partner with Google. They have a range of weather products from current conditions to 16 day forecast products.

Openweather claims that their API is the easiest one for working with weather data. After registering your credentials at openweathermap.org, the API key is sent via email in about 2 hours. There are 16 APIs available for each of their product types. For this exercise, we will access the current weather data from their "Weather Stations" API with city name, id, geographic coordinates or zip code as endpoints. (The JSON structure it responds with will be shown in the exercise results below)

0.2   Analysis Results

Note: The following figures are transposed from the example plots and have latitude as the y-axis, per standard mapping conventions.

0.2.1 Figure 1. Temperature v. Latitude

As expected, there is a strong relationship between latitude and surface air temperatures, with temperatures decreasing towards the poles. The midpoint of the calendar year 2019 was July 2, such that the current temperature curve is nearly balanced between northern and southern hemispheres with minimum temperatures in populated cities being about equal 40 deg F at +/- 60 deg lat. More points in the northern hemisphere are due to increased land mass and livable areas.

0.2.2 Figure 2. Relative Humidity v. Latitude

Relative humidity at a specific place is highly variable on a daily basis as evidenced in this plot, but the majority of values are above 70%. Very dry areas are noted in high latitudes where there are also colder air temperatures.

0.2.3 Figure 3. Cloud amount v. Latitude

Atmospheric moisture as indicated by cloud amount is the most variable parameter and ranges from 0 to 100% cloud cover at all latitudes on a given day. The "stacking" of data points at specific cloud amount values appears to be a quantization artifact in the data, by which cloud amount is reported in standard increments.

0.2.4 Figure 4. Wind speed v. Latitude

Instantaneous wind speed over these 500 cities is skewed towards lower values which is consistent with the known Weibull global wind speed probability distribution which has a peak around 10 kts and tapers off rapidly over 25 kt.

0.2.5 ADDTIONAL WORK: Geographic locations of data sites and representativeness of global conditions

0.2.6 Global map of data station positions

Placing the city locations on the Google map shows how sparse this data set is as compared to the size of the globe. Most importantly the vast ocean areas do not have reported values, except for a few island locations.

0.3 Conclusions.

1. Without full coverage of land and ocean areas, and many additional samples, it is difficult to see the climotological patterns in clouds and winds that have been known for centuries by scientists, farmers, and mariners.
2. Temperature variations with latitude have the clearest signal, as a first order variable in direction correlation with solar heating.

3. Atmospheric moisture parameters daily variation with latitude are more noisy in comparison to temperature unless averaged over greater time periods and latitudinal bands. There are long climotologies of cloud distributions that show distinct patterns of cloud activity in specific zonal (latitudinal) bands.
4. Wind speed distributions are consistent with the known Weibull distribution of global values. However, wind direction is not reported at most of the data stations, nor measured over a long enough period, which precludes comparison prevailing "trade" wind patterns that vary with latitude.

```python
[3]: # Dependencies and Setup
     import openweathermapy.core as owm
     import matplotlib.pyplot as plt
     import gmaps

     import pandas as pd
     import numpy as np
     import requests
     import time
     import json

     from time import gmtime, strftime

     # Import API key
     from api_keys import api_key

     # Google developer API key
     from api_keys import gkey
     gmaps.configure(api_key=gkey)

     # Incorporated citipy to determine city based on latitude and longitude
     from citipy import citipy

     # Output File (CSV)
     output_data_file = "output_data/cities.csv"

     # Range of latitudes and longitudes
     lat_range = (-90, 90)
     lng_range = (-180, 180)
```

0.4 Generate Cities

Create a list of lat/long pairs of coordinates from a random, uniform distribution of latitudes and longitudes. Use citipy API from Python to find the nearest city of more than 500 people to each lat/long coordinate. Store the cities in a list, as well as the initial coordinates to ensure that we have looked across the globe.

```
[4]:   # List for holding lat_lngs and cities
       lat_lngs = []
       cities = []

       # Create a set of random lat and lng combinations
       lats = np.random.uniform(low=-90.000, high=90.000, size=1500)
       lngs = np.random.uniform(low=-180.000, high=180.000, size=1500)

       lat_lngs = zip(lats, lngs)

       lat1=[]
       lon1=[]

       # Identify nearest city for each lat, lng combination
       for lat_lng in lat_lngs:
           city = citipy.nearest_city(lat_lng[0], lat_lng[1]).city_name

           # If the city is unique, then add it to a our cities list
           if city not in cities:
               cities.append(city)
               lat1.append(lat_lng[0])
               lon1.append(lat_lng[1])

       # Print the city count to confirm sufficient count
       print(len(cities))
       print(cities[0])
       # print(lat1[0],lon1[0])
       # print(max(lat1),min(lon1))
```
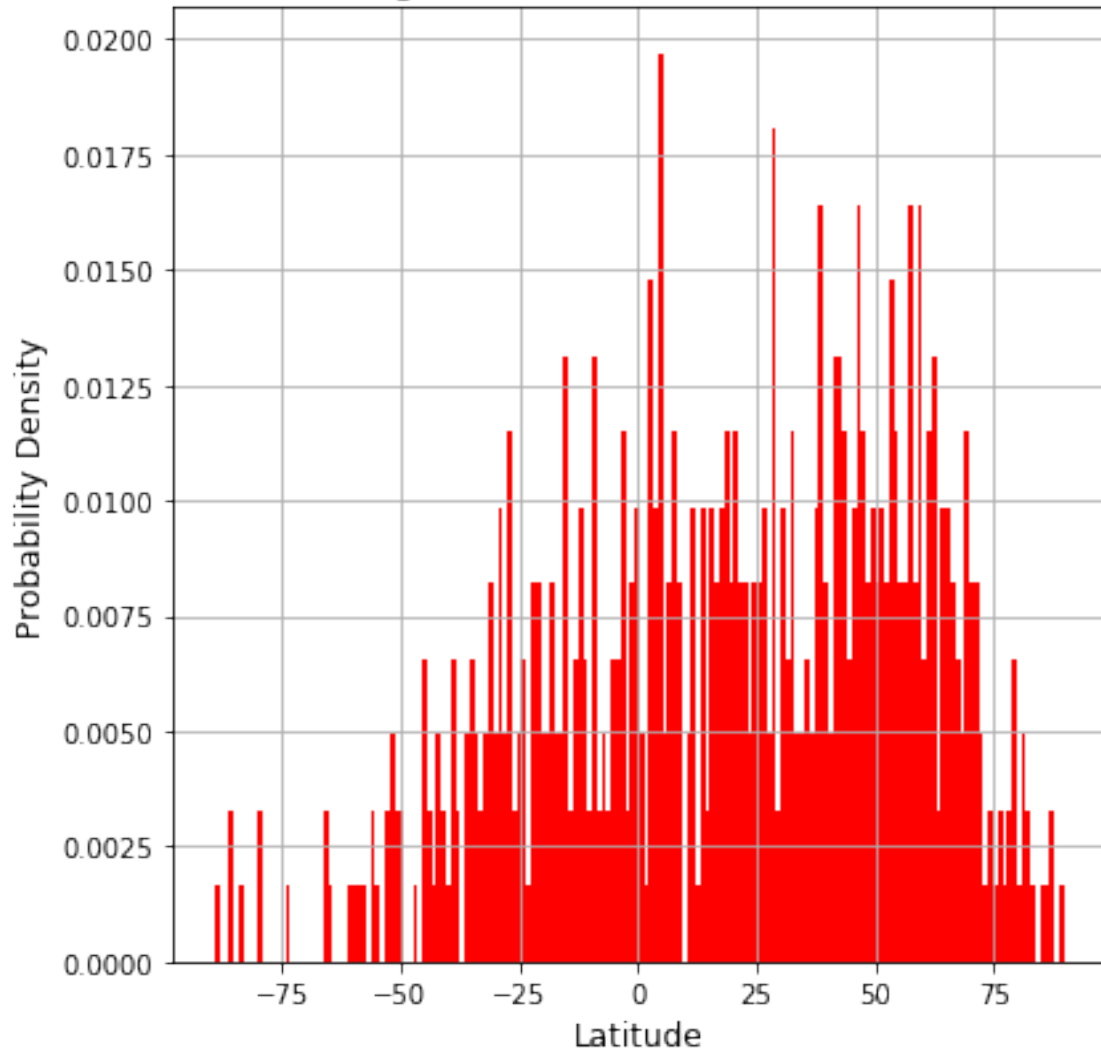
```
613
thompson
```

Following three plots are not part of the assignment but have been included to verify global geographic distributions of city latitudes and longitudes after reduction of random values by nearest city. The histograms of latitude and longitude and scatter of lat and long pairs show there are samples from the full range of populated areas, even though the sample size of 613 does not provide sufficient data to compute data averages from which overall patterns are readily seen. Also with the data skewed towards the northern hemisphere due to greater land mass and populations, the southern hemisphere data are underrepresented.

```
[83]:   plt.figure(figsize=(6,6))
        plt.title('Figure 5. Latitude distribution', fontsize=14)
        plt.xlabel('Latitude', fontsize=12)
        plt.ylabel('Probability Density', fontsize=12)
        plt.grid()
        plt.hist(lat1, 180 , density=True, color='r')
        # Save the Figure
```

```
plt.tight_layout()
plt.savefig("./LatitudeDistro.pdf")
plt.show()
```
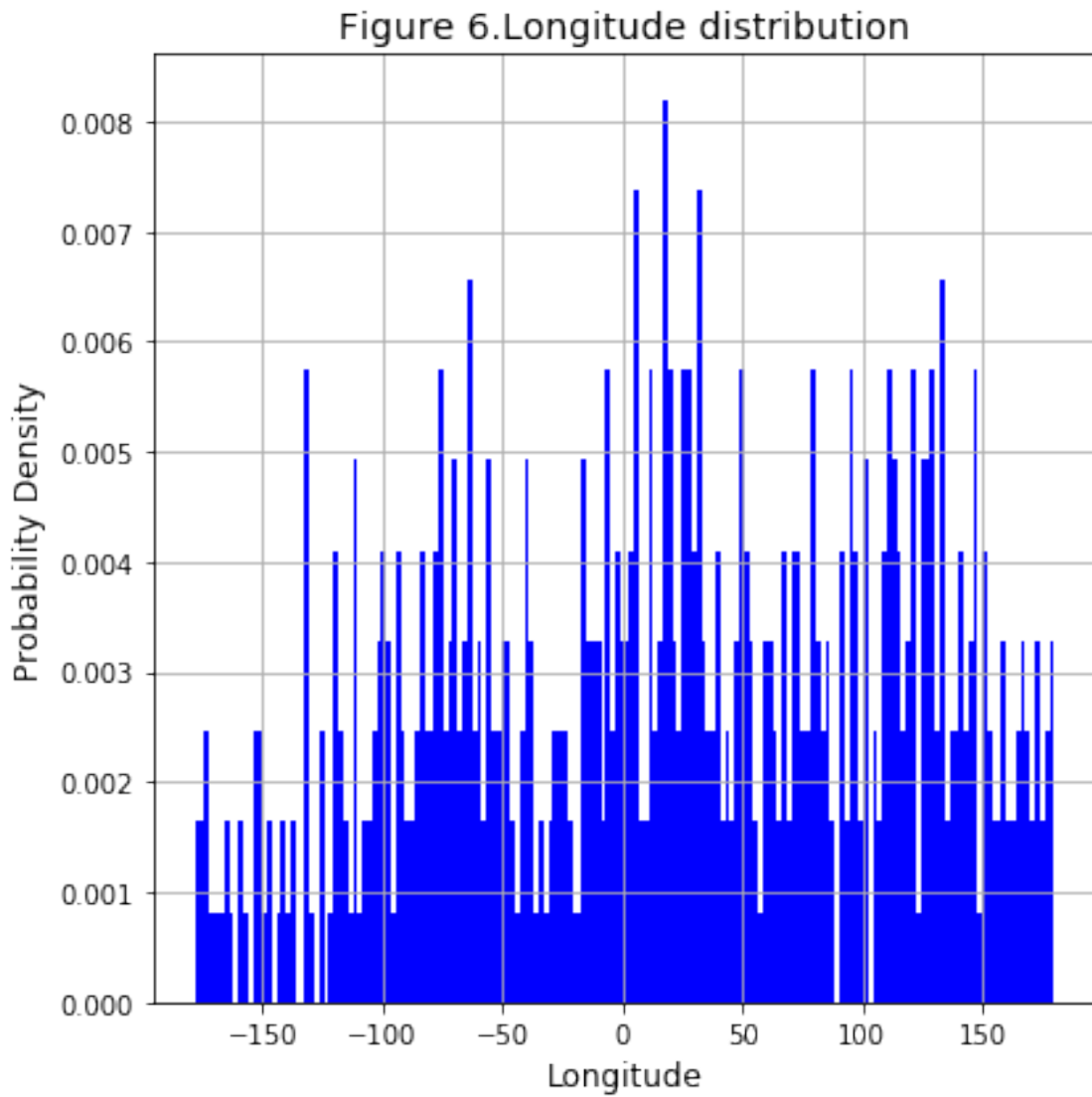

Figure 5. Latitude distribution

```
[84]: plt.figure(figsize=(6,6))
plt.title('Figure 6.Longitude distribution', fontsize=14)
plt.xlabel('Longitude', fontsize=12)
plt.ylabel('Probability Density', fontsize=12)
plt.grid()
plt.hist(lon1, 180, density=True, color='b')

# Save the Figure
plt.tight_layout()
```
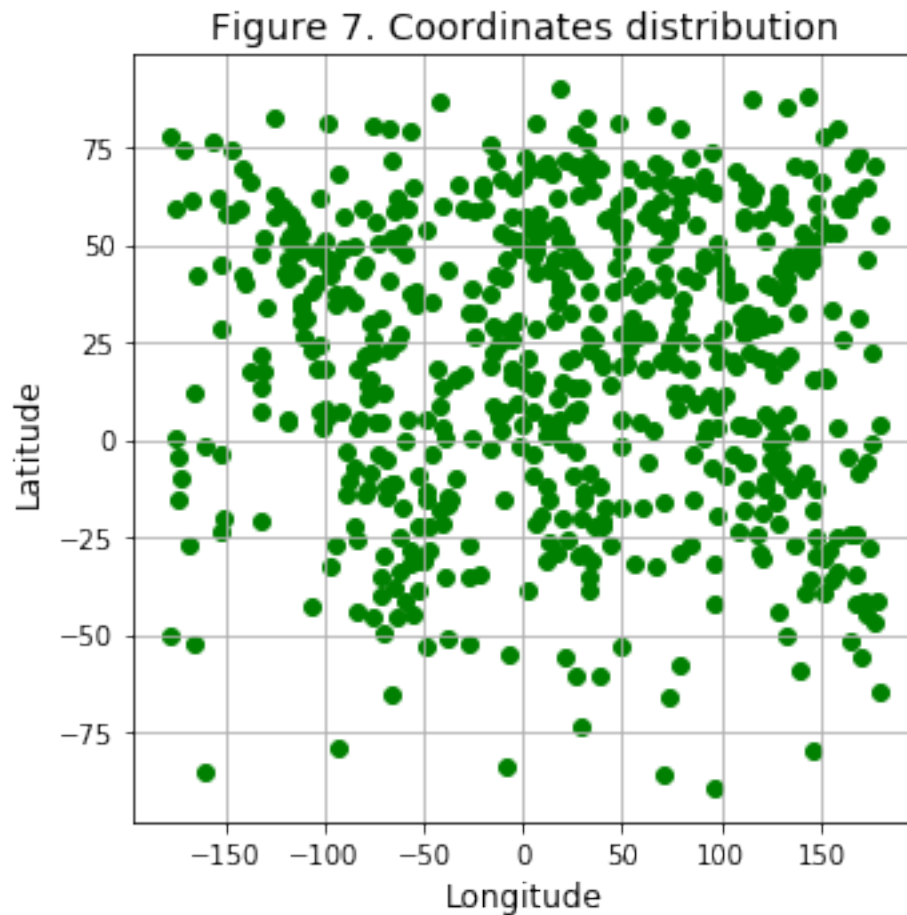
```
plt.savefig("./LongitudeDistro.pdf")
plt.show()
```


Figure 6.Longitude distribution

```
[85]: plt.figure(figsize=(5,5))
      plt.title('Figure 7. Coordinates distribution', fontsize=14)
      plt.xlabel('Longitude', fontsize=12)
      plt.ylabel('Latitude', fontsize=12)
      plt.grid()
       # Build a scatter plot for each data type
      plt.scatter(lon1, lat1, marker="o", color='green')
      # Save the Figure
      plt.tight_layout()
      plt.savefig("./CoordsDistro.pdf")
```

```
plt.show()
```


Figure 7. Coordinates distribution

0.4.1 Perform API Calls

Having verified reasonable distributions of city locations, perform a weather check on each city using a successive API calls.

- Using the city names, query the Openweathermapy API to get current weather information and basic meteorological parameters for all of the cities in the list.
- Include a print log of each city as it is being processed.
- Also, store latitude and longitudes to plot on a map for insight into where the data are being measured.

[10]:
```
# Test run the query to examine the structure of the data that are returned␣
↪from the API
base_url = "http://api.openweathermap.org/data/2.5/weather?"
units = "imperial"
# Build partial query URL
```

7

```python
query_url = f"{base_url}appid={api_key}&units={units}&q="

city = "Tampa"

# Get weather data
weather_response = requests.get(query_url+city)
weather_json = weather_response.json()
print(json.dumps(weather_json, indent=4))
```

```
{
    "coord": {
        "lon": -82.46,
        "lat": 27.95
    },
    "weather": [
        {
            "id": 500,
            "main": "Rain",
            "description": "light rain",
            "icon": "10d"
        }
    ],
    "base": "stations",
    "main": {
        "temp": 90.86,
        "pressure": 1015,
        "humidity": 66,
        "temp_min": 87.01,
        "temp_max": 95
    },
    "visibility": 16093,
    "wind": {
        "speed": 9.17,
        "deg": 200
    },
    "clouds": {
        "all": 75
    },
    "dt": 1566840041,
    "sys": {
        "type": 1,
        "id": 6057,
        "message": 0.0133,
        "country": "US",
        "sunrise": 1566817539,
        "sunset": 1566863891
    },
```

```
        "timezone": -14400,
        "id": 4174757,
        "name": "Tampa",
        "cod": 200
    }
```

[11]:
```python
# Now run the queries over partial (testing), then full list of the cities

# Set up lists to hold the response and store relevant data in the order they␣
 ↪appear in the dictionary
long=[]
lat=[]
sfc_temp=[]
sfc_press=[]
rel_humidity=[]
wind_speed=[]
all_clouds=[]
city_id=[]
city_name=[]
country=[]

base_url = "http://api.openweathermap.org/data/2.5/weather?"
units = "imperial"
# Build partial query URL, append city name in for loop
query_url = f"{base_url}appid={api_key}&units={units}&q="

start_time = strftime("%Y -%m -%d %H:%M:%S", gmtime())
print(f"\t\tINITIATE Openweathermapy QUERIES\n")
print(f"\t\t{start_time}")
print(f"***********************************************\n")

# use this subsample for testing routines: cities_shortlist = cities[0:10]
count = 0
for city in cities:

    # Use exception handling construct to avoid crashing on null response

    try:
        weather_response = requests.get(query_url+city)
        weather_json = weather_response.json()

        long.append(weather_json["coord"]["lon"])
        lat.append(weather_json["coord"]["lat"])
        sfc_temp.append(weather_json["main"]["temp"])
        sfc_press.append(weather_json["main"]["pressure"])
        rel_humidity.append(weather_json["main"]["humidity"])
        wind_speed.append(weather_json["wind"]["speed"])
```

```python
        all_clouds.append(weather_json["clouds"]["all"])
        city_id.append(weather_json["id"])
        city_name.append(weather_json["name"])
        country.append(weather_json["sys"]["country"])
        print(f"Retrieving record {count} for {city_id[count]} |␣
↪{city_name[count]}" )
        count +=1
    except:
        print(f"\n{city} NOT found.  Moving to next record\n")
    continue


print(f"**************************************************\n")
print(f"\t\tCOMPLETED Openweathermapy QUERIES\n")
end_time = strftime ("%Y -%m -%d %H:%M:%S", gmtime())
print(f"\t\t{end_time}")
print(f"**************************************************\n")
```

```
                INITIATE Openweathermapy QUERIES


                2019 -08 -26 17:42:16
**************************************************

Retrieving record 0 for 6165406 | Thompson
Retrieving record 1 for 2069194 | Jamestown
Retrieving record 2 for 3372760 | Praia da Vitoria
Retrieving record 3 for 2310547 | Aconibe
Retrieving record 4 for 4030556 | Rikitea
Retrieving record 5 for 2075265 | Busselton
Retrieving record 6 for 2175403 | Bluff
Retrieving record 7 for 3587498 | Acajutla
Retrieving record 8 for 962367 | Richards Bay
Retrieving record 9 for 2094342 | Kavieng
Retrieving record 10 for 3874787 | Punta Arenas
Retrieving record 11 for 3141667 | Roald
Retrieving record 12 for 4863349 | Basco
Retrieving record 13 for 1273574 | Vaini
Retrieving record 14 for 1006984 | East London
Retrieving record 15 for 264371 | Athens
Retrieving record 16 for 3698359 | Chicama
Retrieving record 17 for 2396518 | Port-Gentil
Retrieving record 18 for 3696183 | Iquitos
Retrieving record 19 for 1486321 | Yar-Sale
Retrieving record 20 for 5880568 | Bethel
Retrieving record 21 for 2147756 | Swan Hill
Retrieving record 22 for 2092164 | Lorengau
Retrieving record 23 for 5848280 | Kapaa
Retrieving record 24 for 5855927 | Hilo
```

```
Retrieving record 25 for 2121909 | Poronaysk

grand river south east NOT found.  Moving to next record

Retrieving record 26 for 2654970 | Brae
Retrieving record 27 for 2270385 | Camacha
Retrieving record 28 for 3369157 | Cape Town

attawapiskat NOT found.  Moving to next record

Retrieving record 29 for 3471451 | Arraial do Cabo
Retrieving record 30 for 6201424 | Mataura
Retrieving record 31 for 5785243 | Aberdeen
Retrieving record 32 for 2850132 | Ratzeburg
Retrieving record 33 for 1270759 | Gulaothi
Retrieving record 34 for 4267710 | Sitka

skalistyy NOT found.  Moving to next record

Retrieving record 35 for 5106834 | Albany
Retrieving record 36 for 2729907 | Longyearbyen
Retrieving record 37 for 5367788 | Lompoc
Retrieving record 38 for 3354071 | Oranjemund
Retrieving record 39 for 3423146 | Ilulissat
Retrieving record 40 for 3833367 | Ushuaia
Retrieving record 41 for 6185377 | Yellowknife

umzimvubu NOT found.  Moving to next record

Retrieving record 42 for 214575 | Kampene
Retrieving record 43 for 5983720 | Iqaluit
Retrieving record 44 for 909887 | Luangwa
Retrieving record 45 for 4035715 | Avarua
Retrieving record 46 for 53654 | Mogadishu
Retrieving record 47 for 1641899 | Labuhan
Retrieving record 48 for 3437029 | San Patricio
Retrieving record 49 for 2037252 | Genhe
Retrieving record 50 for 1015776 | Bredasdorp
Retrieving record 51 for 2155415 | New Norfolk
Retrieving record 52 for 2294915 | Takoradi
Retrieving record 53 for 2071860 | Esperance

bousso NOT found.  Moving to next record

Retrieving record 54 for 2656067 | Broome
Retrieving record 55 for 2022572 | Khatanga
Retrieving record 56 for 6148373 | Sioux Lookout
Retrieving record 57 for 4020109 | Atuona
```

```
Retrieving record 58 for 2381334 | Atar
Retrieving record 59 for 2163355 | Hobart
Retrieving record 60 for 2208248 | Kaitangata
Retrieving record 61 for 1244926 | Hambantota

krasnoselkup NOT found.  Moving to next record

Retrieving record 62 for 2277060 | Gbarnga
Retrieving record 63 for 1488414 | Urengoy
Retrieving record 64 for 6089245 | Norman Wells

belushya guba NOT found.  Moving to next record


lolua NOT found.  Moving to next record

Retrieving record 65 for 1501377 | Kungurtug
Retrieving record 66 for 286245 | Sur
Retrieving record 67 for 2972350 | Toul
Retrieving record 68 for 3366880 | Hermanus
Retrieving record 69 for 3010153 | Le Pradet
Retrieving record 70 for 1490796 | Strezhevoy
Retrieving record 71 for 3082756 | Ustka
Retrieving record 72 for 3691954 | Sechura
Retrieving record 73 for 3382160 | Cayenne
Retrieving record 74 for 1045114 | Inhambane
Retrieving record 75 for 6355222 | Yulara
Retrieving record 76 for 3424607 | Tasiilaq
Retrieving record 77 for 2025456 | Chernyshevskiy
Retrieving record 78 for 780687 | Berlevag

illoqqortoormiut NOT found.  Moving to next record

Retrieving record 79 for 1507390 | Dikson
Retrieving record 80 for 3863379 | Mar del Plata
Retrieving record 81 for 6121621 | Revelstoke
Retrieving record 82 for 3347762 | Lubango
Retrieving record 83 for 2013279 | Vostok
Retrieving record 84 for 2126199 | Cherskiy
Retrieving record 85 for 5969025 | Haines Junction
Retrieving record 86 for 5713587 | Bend
Retrieving record 87 for 4031574 | Provideniya
Retrieving record 88 for 5919850 | Chapais
Retrieving record 89 for 5808201 | Republic
Retrieving record 90 for 292968 | Abu Dhabi
Retrieving record 91 for 515873 | Oktyabrskiy
Retrieving record 92 for 986717 | Kruisfontein
Retrieving record 93 for 2110227 | Butaritari
```

```
Retrieving record 94 for 3931275 | Putina

barentsburg NOT found.  Moving to next record

Retrieving record 95 for 1807339 | Huangmei

taolanaro NOT found.  Moving to next record

Retrieving record 96 for 5563839 | Fortuna
Retrieving record 97 for 3372472 | Vila Franca do Campo
Retrieving record 98 for 3378644 | Georgetown
Retrieving record 99 for 3896218 | Castro
Retrieving record 100 for 3899695 | Ancud
Retrieving record 101 for 3666226 | Venadillo
Retrieving record 102 for 2162683 | Innisfail
Retrieving record 103 for 2139521 | Noumea

mys shmidta NOT found.  Moving to next record

Retrieving record 104 for 3533462 | Acapulco
Retrieving record 105 for 2457163 | Gao
Retrieving record 106 for 124274 | Mehriz
Retrieving record 107 for 1257698 | Bage
Retrieving record 108 for 244878 | Biltine
Retrieving record 109 for 3421719 | Narsaq
Retrieving record 110 for 2377457 | Nouadhibou
Retrieving record 111 for 1512019 | Aksarka
Retrieving record 112 for 3652764 | Puerto Ayora
Retrieving record 113 for 1510689 | Baykit
Retrieving record 114 for 6167817 | Torbay
Retrieving record 115 for 1529651 | Altay
Retrieving record 116 for 2156643 | Mount Gambier
Retrieving record 117 for 113646 | Tabriz
Retrieving record 118 for 3037899 | Ambon
Retrieving record 119 for 1640972 | Katobu
Retrieving record 120 for 1067565 | Beloha
Retrieving record 121 for 5847411 | Kahului

palabuhanratu NOT found.  Moving to next record

Retrieving record 122 for 2642302 | Montrose
Retrieving record 123 for 1733782 | Victoria
Retrieving record 124 for 3602137 | San Jose
Retrieving record 125 for 4231997 | Avera

amderma NOT found.  Moving to next record

Retrieving record 126 for 3932145 | Pisco
```

```
Retrieving record 127 for 5046001 | Sartell
Retrieving record 128 for 2514651 | Los Llanos de Aridane
Retrieving record 129 for 2180815 | Tuatapere
Retrieving record 130 for 3412093 | Vestmannaeyjar
Retrieving record 131 for 2450849 | Sokolo
Retrieving record 132 for 2185329 | Otane
Retrieving record 133 for 2450173 | Taoudenni
Retrieving record 134 for 2630299 | Hofn
Retrieving record 135 for 3985710 | Cabo San Lucas

samusu NOT found.  Moving to next record

Retrieving record 136 for 3461888 | Guarapari

olafsvik NOT found.  Moving to next record

Retrieving record 137 for 2068110 | Kununurra
Retrieving record 138 for 1511330 | Asbest
Retrieving record 139 for 3936456 | Lima

kyle of lochalsh NOT found.  Moving to next record

Retrieving record 140 for 3831208 | Qaanaaq
Retrieving record 141 for 2014624 | Udachnyy

bossembele NOT found.  Moving to next record

Retrieving record 142 for 6170031 | Tuktoyaktuk

saleaula NOT found.  Moving to next record

Retrieving record 143 for 6086673 | Neepawa
Retrieving record 144 for 3520994 | Puerto Escondido
Retrieving record 145 for 6620339 | Karratha
Retrieving record 146 for 3601402 | Savannah Bight
Retrieving record 147 for 2337542 | Naze
Retrieving record 148 for 2122850 | Nikolayevsk-na-amure
Retrieving record 149 for 2027296 | Aykhal

vaitupu NOT found.  Moving to next record

Retrieving record 150 for 2019488 | Namtsy
Retrieving record 151 for 6068416 | Mayo
Retrieving record 152 for 555111 | Ivanteyevka
Retrieving record 153 for 1626542 | Sorong
Retrieving record 154 for 3430443 | Necochea
Retrieving record 155 for 2088122 | Port Moresby
Retrieving record 156 for 3356832 | Henties Bay
```

```
Retrieving record 157 for 2017155 | Saskylakh

karamea NOT found.  Moving to next record

Retrieving record 158 for 964432 | Port Alfred
Retrieving record 159 for 3027484 | Chalon-sur-Saone
Retrieving record 160 for 2126123 | Chokurdakh
Retrieving record 161 for 286621 | Salalah
Retrieving record 162 for 4034551 | Faanui
Retrieving record 163 for 2122090 | Pevek
Retrieving record 164 for 3839307 | Rawson
Retrieving record 165 for 3996322 | Mazatlan
Retrieving record 166 for 588365 | Vao
Retrieving record 167 for 3021351 | Dinard
Retrieving record 168 for 4776222 | Norfolk
Retrieving record 169 for 103630 | Najran
Retrieving record 170 for 2127060 | Arman
Retrieving record 171 for 4407665 | Kodiak
Retrieving record 172 for 64814 | Bandarbeyla
Retrieving record 173 for 3441894 | Maldonado
Retrieving record 174 for 4732862 | Nome
Retrieving record 175 for 1505579 | Inta
Retrieving record 176 for 1818051 | Anjiang
Retrieving record 177 for 6138908 | Saint-Philippe
Retrieving record 178 for 2460954 | Araouane

louisbourg NOT found.  Moving to next record


nizhneyansk NOT found.  Moving to next record

Retrieving record 179 for 1242110 | Kalmunai
Retrieving record 180 for 7626370 | Bud
Retrieving record 181 for 1800163 | Nanchang
Retrieving record 182 for 1282256 | Hithadhoo
Retrieving record 183 for 2259655 | Impfondo
Retrieving record 184 for 5859699 | College
Retrieving record 185 for 3083921 | Sycow
Retrieving record 186 for 2742765 | Areosa
Retrieving record 187 for 2447416 | Ayorou
Retrieving record 188 for 3691324 | Tocache
Retrieving record 189 for 3372783 | Ponta Delgada

hihifo NOT found.  Moving to next record

Retrieving record 190 for 1529484 | Hami
Retrieving record 191 for 3372707 | Ribeira Grande
Retrieving record 192 for 3413604 | Selfoss
```

```
Retrieving record 193 for 57000 | Hobyo
Retrieving record 194 for 1014034 | Carnarvon
Retrieving record 195 for 2121385 | Severo-Kurilsk

gorno-chuyskiy NOT found.  Moving to next record

Retrieving record 196 for 2449893 | Tessalit
Retrieving record 197 for 934322 | Mahebourg
Retrieving record 198 for 577922 | Belomorsk
Retrieving record 199 for 6096551 | Pangnirtung
Retrieving record 200 for 359792 | Aswan
Retrieving record 201 for 2022129 | Kichera
Retrieving record 202 for 1259385 | Port Blair
Retrieving record 203 for 4501427 | Port Elizabeth

bengkulu NOT found.  Moving to next record

Retrieving record 204 for 4048662 | Paducah
Retrieving record 205 for 3833859 | Barrow
Retrieving record 206 for 5919815 | Channel-Port aux Basques
Retrieving record 207 for 3577430 | Road Town
Retrieving record 208 for 2302357 | Cape Coast

tsihombe NOT found.  Moving to next record

Retrieving record 209 for 3556334 | Jatibonico
Retrieving record 210 for 2523660 | Racale
Retrieving record 211 for 380348 | Abu Zabad

tsentralnyy NOT found.  Moving to next record


sentyabrskiy NOT found.  Moving to next record

Retrieving record 212 for 1709108 | Katubao
Retrieving record 213 for 2737599 | Saldanha
Retrieving record 214 for 4031637 | Lavrentiya
Retrieving record 215 for 3446621 | Teofilo Otoni
Retrieving record 216 for 1899102 | Nagato
Retrieving record 217 for 3354077 | Opuwo
Retrieving record 218 for 1651810 | Airai
Retrieving record 219 for 1214488 | Meulaboh

tabukiniberu NOT found.  Moving to next record


sataua NOT found.  Moving to next record
```

```
Retrieving record 220 for 5554072 | Douglas
Retrieving record 221 for 3393692 | Itarema
Retrieving record 222 for 3418910 | Upernavik
Retrieving record 223 for 3115824 | Muros
Retrieving record 224 for 546105 | Nikolskoye
Retrieving record 225 for 6095751 | Oxbow
Retrieving record 226 for 5295177 | Fountain Hills
Retrieving record 227 for 6174254 | Viking
Retrieving record 228 for 2618795 | Klaksvik
Retrieving record 229 for 2077895 | Alice Springs
Retrieving record 230 for 1502526 | Kormilovka
Retrieving record 231 for 5961417 | Husavik

kamenskoye NOT found.  Moving to next record

Retrieving record 232 for 1538641 | Kedrovyy
Retrieving record 233 for 898912 | Serenje
Retrieving record 234 for 2015306 | Tiksi

ilinsko-podomskoye NOT found.  Moving to next record

Retrieving record 235 for 4021858 | Guerrero Negro
Retrieving record 236 for 5883074 | Albanel
Retrieving record 237 for 3654870 | Santa Ines
Retrieving record 238 for 3653967 | Muisne
Retrieving record 239 for 4068590 | Huntsville
Retrieving record 240 for 3137469 | Sorland
Retrieving record 241 for 553190 | Kandalaksha
Retrieving record 242 for 3489440 | Morant Bay
Retrieving record 243 for 5924351 | Clyde River
Retrieving record 244 for 5977046 | Hornepayne
Retrieving record 245 for 1260232 | Partapur

waw NOT found.  Moving to next record

Retrieving record 246 for 1698289 | Pundaguitan
Retrieving record 247 for 1496511 | Novyy Urengoy
Retrieving record 248 for 87205 | Darnah
Retrieving record 249 for 1808722 | Hefei
Retrieving record 250 for 779554 | Honningsvag
Retrieving record 251 for 1853483 | Oyama
Retrieving record 252 for 2225457 | Nanga Eboko
Retrieving record 253 for 2146219 | Hervey Bay
Retrieving record 254 for 3893629 | Coquimbo
Retrieving record 255 for 2015852 | Svetlaya
Retrieving record 256 for 371745 | Kutum
Retrieving record 257 for 3421765 | Nanortalik
Retrieving record 258 for 2339937 | Auki
```

```
Retrieving record 259 for 3576994 | Cockburn Town
Retrieving record 260 for 1259784 | Phek
Retrieving record 261 for 1582886 | Dong Hoi
Retrieving record 262 for 3694112 | Paita
Retrieving record 263 for 2067070 | Palmer
Retrieving record 264 for 3170075 | Porto Recanati
Retrieving record 265 for 2194098 | Ahipara
Retrieving record 266 for 2236967 | Soyo
Retrieving record 267 for 2090021 | Namatanai
Retrieving record 268 for 1785462 | Zaoyang
Retrieving record 269 for 2448245 | Abalak
Retrieving record 270 for 2449067 | Timbuktu

korla NOT found.  Moving to next record

Retrieving record 271 for 1052944 | Angoche
Retrieving record 272 for 1263997 | Mamallapuram
Retrieving record 273 for 3443061 | Chuy
Retrieving record 274 for 5866063 | Kenai
Retrieving record 275 for 544397 | Kortkeros
Retrieving record 276 for 6320062 | Vila Velha
Retrieving record 277 for 3455461 | Palmares do Sul
Retrieving record 278 for 1817240 | Baiyin
Retrieving record 279 for 6535956 | Aguai
Retrieving record 280 for 2112802 | Hasaki
Retrieving record 281 for 2084442 | Vanimo
Retrieving record 282 for 868355 | Kochubey
Retrieving record 283 for 1811720 | Enshi
Retrieving record 284 for 4470244 | Havelock

marcona NOT found.  Moving to next record

Retrieving record 285 for 1215502 | Banda Aceh
Retrieving record 286 for 1714733 | Dingle
Retrieving record 287 for 5960603 | Geraldton
Retrieving record 288 for 6149374 | Slave Lake
Retrieving record 289 for 3571592 | Rock Sound
Retrieving record 290 for 5864145 | Homer
Retrieving record 291 for 3355672 | Luderitz
Retrieving record 292 for 7671223 | Kloulklubed
Retrieving record 293 for 2635762 | Tiverton
Retrieving record 294 for 3147822 | Gravdal
Retrieving record 295 for 3453439 | Ponta do Sol
Retrieving record 296 for 1737486 | Bintulu
Retrieving record 297 for 2063036 | Port Lincoln
Retrieving record 298 for 1163054 | Turbat
Retrieving record 299 for 3832899 | Viedma
Retrieving record 300 for 3938531 | Iberia
```

```
Retrieving record 301 for 2384770 | Mbaiki
Retrieving record 302 for 2165087 | Gold Coast
Retrieving record 303 for 3395458 | Maragogi
Retrieving record 304 for 3031871 | Veraval
Retrieving record 305 for 262462 | Saint George
Retrieving record 306 for 3448903 | Sao Joao da Barra
Retrieving record 307 for 4034188 | Moerai
Retrieving record 308 for 1054035 | Vohibinany
Retrieving record 309 for 1269873 | Hunsur
Retrieving record 310 for 2017824 | Pokrovsk

tarudant NOT found.  Moving to next record

Retrieving record 311 for 3351663 | Benguela
Retrieving record 312 for 306571 | Konya

galiwinku NOT found.  Moving to next record

Retrieving record 313 for 2189343 | Kaeo
Retrieving record 314 for 1637001 | Luwuk
Retrieving record 315 for 2278158 | Buchanan
Retrieving record 316 for 3453014 | Porangatu
Retrieving record 317 for 3833062 | Venado Tuerto

tungkang NOT found.  Moving to next record

Retrieving record 318 for 2167426 | Emerald
Retrieving record 319 for 4975802 | Portland
Retrieving record 320 for 5062355 | Wahpeton

arrecife NOT found.  Moving to next record

Retrieving record 321 for 3402648 | Carutapera
Retrieving record 322 for 3092472 | Malbork
Retrieving record 323 for 2757220 | Den Helder
Retrieving record 324 for 1688687 | San Quintin
Retrieving record 325 for 1621313 | Ambulu
Retrieving record 326 for 5969785 | Hamilton
Retrieving record 327 for 1257277 | Sarahan

raga NOT found.  Moving to next record

Retrieving record 328 for 1651591 | Amahai
Retrieving record 329 for 3449340 | Sao Borja
Retrieving record 330 for 5906757 | Bow Island
Retrieving record 331 for 2123814 | Leningradskiy
Retrieving record 332 for 262462 | Chara
Retrieving record 333 for 490040 | Sovetskiy
```

```
Retrieving record 334 for 2015179 | Tommot

nguiu NOT found.  Moving to next record

Retrieving record 335 for 3421319 | Nuuk
Retrieving record 336 for 5972291 | Havre-Saint-Pierre
Retrieving record 337 for 3667983 | Las Palmas
Retrieving record 338 for 777682 | Skjervoy
Retrieving record 339 for 7071576 | Wuning
Retrieving record 340 for 536466 | Lebyazhye
Retrieving record 341 for 1850144 | Nishihara
Retrieving record 342 for 1607017 | Rayong
Retrieving record 343 for 1506268 | Gornopravdinsk
Retrieving record 344 for 934479 | Grand Gaube
Retrieving record 345 for 684870 | Bilbor
Retrieving record 346 for 4301307 | Morehead
Retrieving record 347 for 2037886 | Dandong
Retrieving record 348 for 1861280 | Itoman
Retrieving record 349 for 2171465 | Clarence Town
Retrieving record 350 for 344979 | Lebu
Retrieving record 351 for 1524298 | Aksu
Retrieving record 352 for 3446625 | Teodoro Sampaio
Retrieving record 353 for 5354943 | Half Moon Bay
Retrieving record 354 for 553389 | Kameshkovo
Retrieving record 355 for 3835994 | Santa Rosa
Retrieving record 356 for 2152659 | Port Macquarie
Retrieving record 357 for 5654391 | Glendive
Retrieving record 358 for 583683 | Aksarayskiy

toliary NOT found.  Moving to next record

Retrieving record 359 for 3388847 | Sao Felix do Xingu
Retrieving record 360 for 667245 | Sicula
Retrieving record 361 for 1853174 | Sakaiminato
Retrieving record 362 for 1633442 | Paciran
Retrieving record 363 for 2122389 | Ossora
Retrieving record 364 for 1258270 | Razam
Retrieving record 365 for 2062276 | Roebourne

karaul NOT found.  Moving to next record

Retrieving record 366 for 2377450 | Nouakchott
Retrieving record 367 for 2122262 | Palana
Retrieving record 368 for 3984717 | Santa Ana
Retrieving record 369 for 2098329 | Daru
Retrieving record 370 for 3416888 | Grindavik
Retrieving record 371 for 3838859 | Rio Gallegos
Retrieving record 372 for 1160571 | Khash
```

```
Retrieving record 373 for 1151464 | Phangnga
Retrieving record 374 for 866062 | Iskateley
Retrieving record 375 for 3386213 | Touros
Retrieving record 376 for 2123688 | Lososina
Retrieving record 377 for 2155742 | Narrabri

karakendzha NOT found.  Moving to next record

Retrieving record 378 for 3577154 | Oranjestad
Retrieving record 379 for 5888001 | Atikokan
Retrieving record 380 for 1488933 | Turinsk
Retrieving record 381 for 1574023 | Thanh Hoa
Retrieving record 382 for 2018735 | Nyurba

pemangkat NOT found.  Moving to next record

Retrieving record 383 for 1488903 | Turukhansk

rungata NOT found.  Moving to next record

Retrieving record 384 for 2349431 | Sabla
Retrieving record 385 for 3026644 | Souillac
Retrieving record 386 for 3581398 | Laguna
Retrieving record 387 for 1260228 | Partur

kollumerland NOT found.  Moving to next record


blonduos NOT found.  Moving to next record

Retrieving record 388 for 2995603 | Saint-Pierre
Retrieving record 389 for 5882953 | Aklavik
Retrieving record 390 for 2126710 | Beringovskiy
Retrieving record 391 for 5806298 | Pasco
Retrieving record 392 for 6144312 | Sept-Iles
Retrieving record 393 for 3192144 | Radece
Retrieving record 394 for 3517970 | Pochutla
Retrieving record 395 for 350550 | Qena
Retrieving record 396 for 6111862 | Port Hardy
Retrieving record 397 for 2119538 | Yelizovo
Retrieving record 398 for 1516905 | Taraz
Retrieving record 399 for 932987 | Tsabong
Retrieving record 400 for 3671497 | Puerto Colombia
Retrieving record 401 for 4036284 | Alofi
Retrieving record 402 for 1633070 | Palembang
Retrieving record 403 for 2034221 | Wangqing
Retrieving record 404 for 3388869 | Jutai
Retrieving record 405 for 1805733 | Jinchang
```

```
Retrieving record 406 for 3665210 | Rodrigues Alves
Retrieving record 407 for 100926 | Umm Lajj
Retrieving record 408 for 3663517 | Manaus
Retrieving record 409 for 2064550 | Northam
Retrieving record 410 for 5905393 | Bonavista
Retrieving record 411 for 5294810 | Flagstaff
Retrieving record 412 for 1622318 | Waingapu
Retrieving record 413 for 1516589 | Zhezkazgan
Retrieving record 414 for 3461370 | Imbituba
Retrieving record 415 for 3438834 | Loreto
Retrieving record 416 for 5955902 | Fort Nelson
Retrieving record 417 for 4372777 | Vardo

vicuna NOT found.  Moving to next record

Retrieving record 418 for 759603 | Sandomierz
Retrieving record 419 for 933644 | Ghanzi
Retrieving record 420 for 3440034 | Tacuarembo

yanan NOT found.  Moving to next record

Retrieving record 421 for 2123979 | Kurilsk
Retrieving record 422 for 2031533 | Mandal
Retrieving record 423 for 2052479 | Zhuhai
Retrieving record 424 for 3934055 | Chilca
Retrieving record 425 for 4944903 | Nantucket
Retrieving record 426 for 1715015 | Dicabisagan
Retrieving record 427 for 5975004 | High Level
Retrieving record 428 for 5391791 | San Clemente
Retrieving record 429 for 584051 | Svetlogorsk
Retrieving record 430 for 6539213 | Pachino
Retrieving record 431 for 2322911 | Sokoto
Retrieving record 432 for 3461408 | Ilheus

gurgan NOT found.  Moving to next record

Retrieving record 433 for 3469169 | Cervo
Retrieving record 434 for 6301965 | Palmerston
Retrieving record 435 for 2155562 | Nelson Bay
Retrieving record 436 for 2038446 | Baoqing
Retrieving record 437 for 1715775 | Lantawan

ituni NOT found.  Moving to next record

Retrieving record 438 for 1106643 | Quatre Cocos
Retrieving record 439 for 2181625 | Te Anau
Retrieving record 440 for 894701 | Bulawayo
Retrieving record 441 for 1690438 | San Andres
```

```
Retrieving record 442 for 1152222 | Mae Hong Son
Retrieving record 443 for 119115 | Quchan
Retrieving record 444 for 154380 | Mbeya
Retrieving record 445 for 556268 | Ostrovnoy
Retrieving record 446 for 2448024 | Seydi
Retrieving record 447 for 2422465 | Conakry
Retrieving record 448 for 5946820 | Edson

jiddah NOT found.  Moving to next record

Retrieving record 449 for 5710360 | Winnemucca
Retrieving record 450 for 6295855 | Saint-Georges
Retrieving record 451 for 699328 | Novopokrovka
Retrieving record 452 for 516716 | Nurlat
Retrieving record 453 for 650225 | Kuopio
Retrieving record 454 for 3894426 | Coihaique
Retrieving record 455 for 3673536 | Orocue

ayios matthaios NOT found.  Moving to next record

Retrieving record 456 for 932183 | Quthing
Retrieving record 457 for 7647007 | San Carlos de Bariloche
Retrieving record 458 for 7626384 | Hovd
Retrieving record 459 for 3421982 | Maniitsoq
Retrieving record 460 for 2126682 | Bilibino
Retrieving record 461 for 1682474 | Ternate
Retrieving record 462 for 4111410 | Fort Smith
Retrieving record 463 for 1314759 | Lashio
Retrieving record 464 for 1804451 | Lianyuan
Retrieving record 465 for 2026696 | Bikin

padre bernardo NOT found.  Moving to next record

Retrieving record 466 for 3906466 | Riberalta
Retrieving record 467 for 2290849 | Bouna
Retrieving record 468 for 667306 | Sfantu Gheorghe
Retrieving record 469 for 2347470 | Miri
Retrieving record 470 for 666309 | Stancuta
Retrieving record 471 for 4951594 | Southbridge
Retrieving record 472 for 2125693 | Evensk
Retrieving record 473 for 3037456 | Saint-Joseph
Retrieving record 474 for 236950 | Obo
Retrieving record 475 for 1253628 | Lata
Retrieving record 476 for 3427761 | Tigre
Retrieving record 477 for 2964492 | Dunmore East
Retrieving record 478 for 3466165 | Cidreira
Retrieving record 479 for 110690 | Faya
Retrieving record 480 for 6138501 | Saint-Augustin
```

```
Retrieving record 481 for 101312 | Turayf
Retrieving record 482 for 3380290 | Sinnamary
Retrieving record 483 for 2210554 | Surt
Retrieving record 484 for 2325314 | Owo
Retrieving record 485 for 2033630 | Xiongyue

kadykchan NOT found.  Moving to next record

Retrieving record 486 for 1264976 | Leh
Retrieving record 487 for 364933 | Umm Kaddadah
Retrieving record 488 for 2654728 | Bridlington
Retrieving record 489 for 1525376 | Bestobe
Retrieving record 490 for 2508813 | Adrar
Retrieving record 491 for 5577158 | Fort Morgan
Retrieving record 492 for 3981460 | Coahuayana
Retrieving record 493 for 2274275 | Robertsport

tawkar NOT found.  Moving to next record


shkotovo-26 NOT found.  Moving to next record

Retrieving record 494 for 610298 | Beyneu
Retrieving record 495 for 1254241 | Tonk

stamsund NOT found.  Moving to next record

Retrieving record 496 for 3687505 | La Palma
Retrieving record 497 for 1789647 | Xichang

acarau NOT found.  Moving to next record

Retrieving record 498 for 2119283 | Zyryanka

warqla NOT found.  Moving to next record

Retrieving record 499 for 2013921 | Ust-Kuyga
Retrieving record 500 for 1486910 | Komsomolskiy
Retrieving record 501 for 2177671 | Armidale
Retrieving record 502 for 1000006 | Greytown
Retrieving record 503 for 3609418 | San Cristobal
Retrieving record 504 for 5660340 | Kalispell
Retrieving record 505 for 878054 | Masuguru
Retrieving record 506 for 2160735 | Lakes Entrance

chagda NOT found.  Moving to next record

Retrieving record 507 for 3361142 | Springbok
```

```
Retrieving record 508 for 1276371 | Bhabua
Retrieving record 509 for 3428576 | San Pedro
Retrieving record 510 for 3720455 | Moron

jahrom NOT found.  Moving to next record

Retrieving record 511 for 480884 | Bolshoye Nagatkino
Retrieving record 512 for 254698 | Preveza
Retrieving record 513 for 7176038 | Jerome
Retrieving record 514 for 1058381 | Morondava
Retrieving record 515 for 543494 | Kovernino
Retrieving record 516 for 1526041 | Atasu
Retrieving record 517 for 1337607 | Kudahuvadhoo
Retrieving record 518 for 8142546 | Lasem
Retrieving record 519 for 779261 | Kjollefjord
Retrieving record 520 for 5954718 | Flin Flon
Retrieving record 521 for 3571913 | Marsh Harbour
Retrieving record 522 for 6113406 | Prince Rupert
Retrieving record 523 for 6149996 | Smithers
Retrieving record 524 for 4013039 | Concepcion del Oro
Retrieving record 525 for 1735634 | Kuching
Retrieving record 526 for 4018320 | Arcelia
Retrieving record 527 for 1263942 | Manavalakurichi
Retrieving record 528 for 3450288 | Santa Cruz Cabralia

safwah NOT found.  Moving to next record

Retrieving record 529 for 123941 | Minab

khonuu NOT found.  Moving to next record

Retrieving record 530 for 2670781 | Sundsvall
Retrieving record 531 for 214614 | Kamina
Retrieving record 532 for 2192362 | Christchurch
Retrieving record 533 for 1106677 | Bambous Virieux
Retrieving record 534 for 3171786 | Ostuni
Retrieving record 535 for 2130332 | Fukagawa
Retrieving record 536 for 1214965 | Kabanjahe
Retrieving record 537 for 2959989 | Weiswampach
Retrieving record 538 for 6322184 | Porto Novo
Retrieving record 539 for 2078025 | Peterhead
Retrieving record 540 for 8010472 | Belmonte
Retrieving record 541 for 74185 | Jiblah
Retrieving record 542 for 492860 | Sindor
Retrieving record 543 for 1785036 | Zhangye
Retrieving record 544 for 2315417 | Inongo
Retrieving record 545 for 582447 | Almaznyy
Retrieving record 546 for 2057087 | Kupang
```

```
        **************************************************

                    COMPLETED Openweathermapy QUERIES

                        2019 -08 -26 17:44:09
        **************************************************
```

0.4.2 Convert Raw Data to DataFrame

- Export the city data into a .csv.
- Display the DataFrame

```python
[30]: # Create a dictionary, then DataFrame from the stored variables

      weather_dict = {
          "City": city_name,
          "City_id": city_id,
          "Country":country,
          "Lat": lat,
          "Lon": long,
          "Sfc_temp_F": sfc_temp,
          "Sfc_press_mb": sfc_press,
          "Rel_humidity_pct":rel_humidity,
          "Wind_speed_kts": wind_speed,
          "Clouds_pct": all_clouds
      }

      weather_city_df = pd.DataFrame(weather_dict)
      weather_city_df.count()
```

```
[30]: City                547
      City_id             547
      Country             547
      Lat                 547
      Lon                 547
      Sfc_temp_F          547
      Sfc_press_mb        547
      Rel_humidity_pct    547
      Wind_speed_kts      547
      Clouds_pct          547
      dtype: int64
```

```python
[91]: # Export & Save Data Into a .csv.
      weather_city_df.to_csv("./weather_city_df.csv")

      weather_city_df.head(11)
```

```
[91]:               City  City_id Country    Lat     Lon  Sfc_temp_F  \
      0          Thompson  6165406      CA   55.74  -97.86       51.80
      1         Jamestown  2069194      AU  -33.21  138.60       38.35
      2   Praia da Vitoria 3372760      PT   38.73  -27.07       73.40
      3           Aconibe  2310547      GQ    1.29   10.94       68.23
      4           Rikitea  4030556      PF  -23.12 -134.97       68.77
      5         Busselton  2075265      AU  -33.64  115.35       40.95
      6             Bluff  2175403      AU  -23.58  149.07       57.43
      7          Acajutla  3587498      SV   13.59  -89.83       84.25
      8      Richards Bay   962367      ZA  -28.77   32.06       68.95
      9           Kavieng  2094342      PG   -2.57  150.80       83.35
      10     Punta Arenas  3874787      CL  -53.16  -70.91       42.53

          Sfc_press_mb  Rel_humidity_pct  Wind_speed_kts  Clouds_pct
      0        1005.00                93           14.99          90
      1        1027.21                85            2.10          44
      2        1022.00                73            3.67          75
      3        1014.55                98            2.82         100
      4        1019.11                63           11.18           6
      5        1016.00                61           11.32          31
      6        1018.32                81            5.21          18
      7        1010.94                65            4.79           0
      8        1018.14                83            5.97           0
      9        1008.35                68            1.68          50
      10        985.00                70           24.16           0
```

0.4.3 Plotting the Data

- Save the plotted figures

```python
# Plot cities on a map to see distribution and locations to show the small
# sample size

figure_layout = {

    'width': '800px',
    'height': '600px',
    'border': '1px solid black',
    'padding': '1px',
    'margin': '0 auto 0 auto'
}

fig = gmaps.figure(layout=figure_layout)

coord2 = pd.DataFrame({"lat":lat, "lon":long})
# coord2.head(11)
```

```
locations = coord2[["lat", "lon"]]
#print(locations[0:10])

cities_layer = gmaps.symbol_layer(
    locations, fill_color="green", stroke_color="green", scale=1 )

fig.add_layer(cities_layer)
fig
```
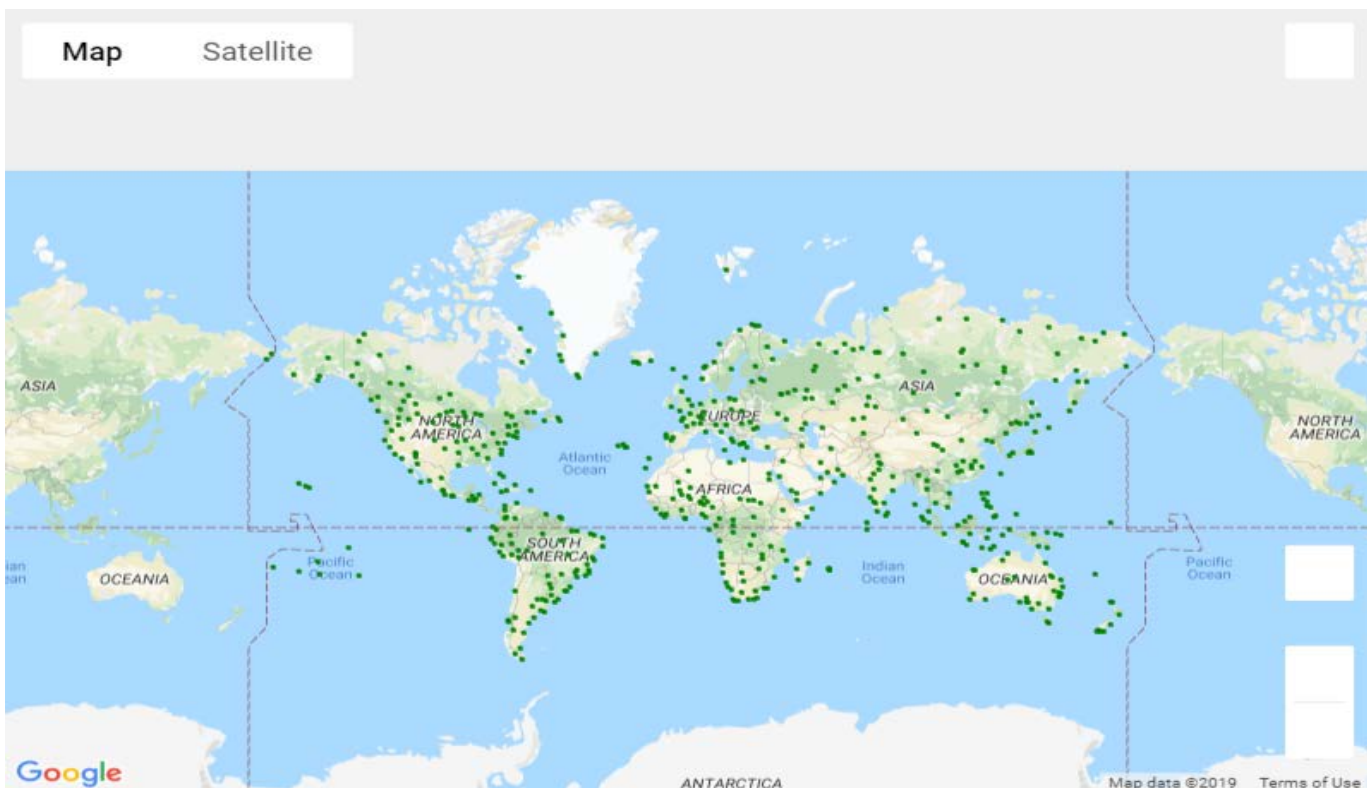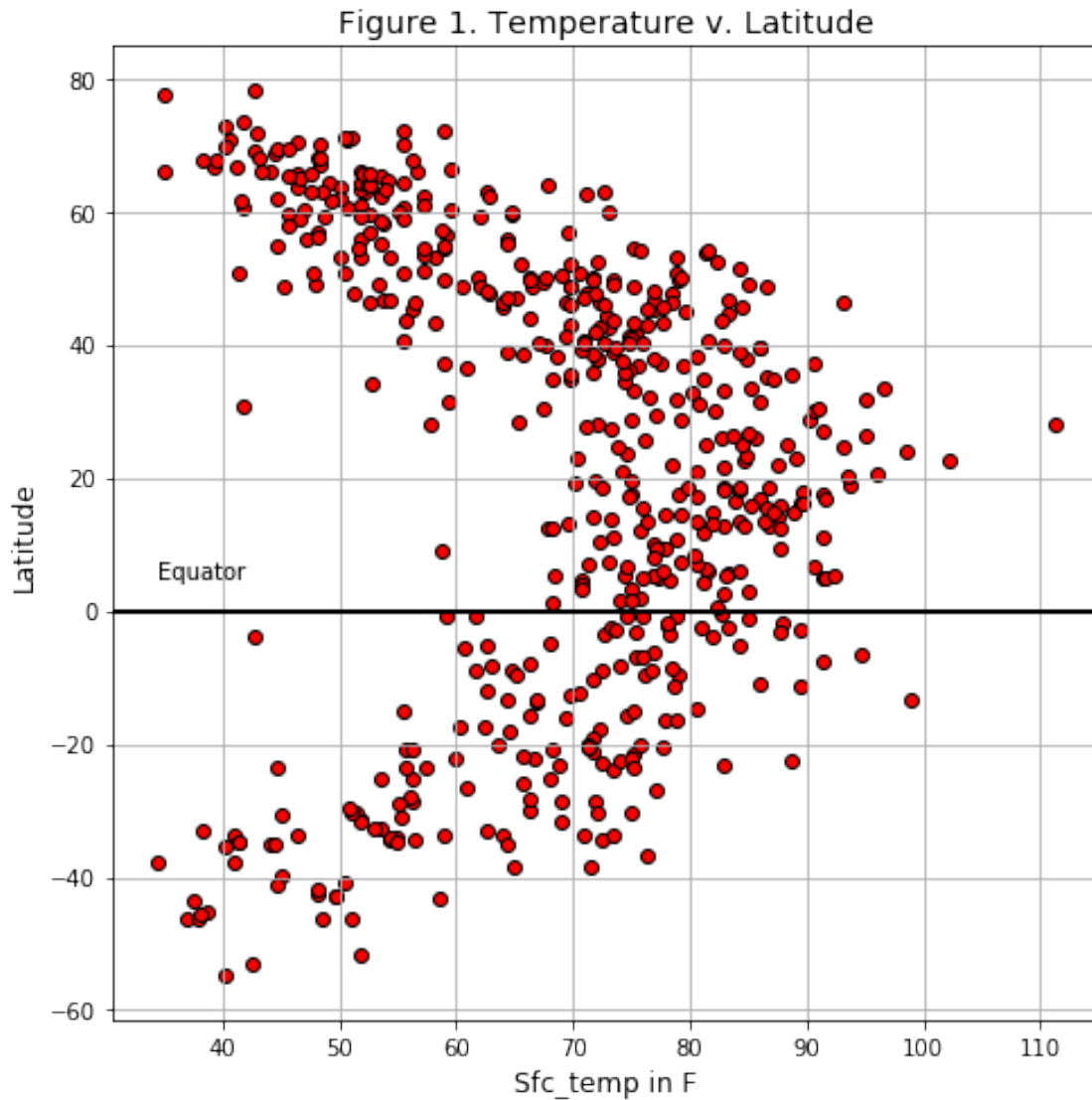
Latitude vs. Temperature Plot

[86]:
```
# Build Scatter Plot for Each Data Type
plt.figure(figsize=(7,7))
plt.title('Figure 1. Temperature v. Latitude', fontsize=14)
plt.xlabel('Sfc_temp in F', fontsize=12)
plt.ylabel('Latitude', fontsize=12)
plt.grid()
plt.scatter(weather_city_df["Sfc_temp_F"], weather_city_df["Lat"],␣
  ↪facecolors="red", marker="o", edgecolor="black")
plt.axhline(y=0, color='black', linewidth=2)
plt.text(min(weather_city_df["Sfc_temp_F"]), 5, "Equator", color='black')
# Save the Figure
plt.tight_layout()
plt.savefig("./temp_lat.pdf")
plt.show()
```

Figure 1. Temperature v. Latitude

Latitude vs. Humidity Plot

```
[87]:  # Build Scatter Plot for Each Data Type

       RH = weather_city_df["Rel_humidity_pct"]
       lat3 = weather_city_df["Lat"]
       RHgood = RH[np.abs(RH)<=100]
       latgood = lat3[np.abs(RH)<=100]

       plt.figure(figsize=(7,7))
       plt.title('Figure 2. Humidity v. Latitude', fontsize=14)
       plt.xlabel('Percent Relative Humidity', fontsize=12)
       plt.ylabel('Latitude', fontsize=12)
```
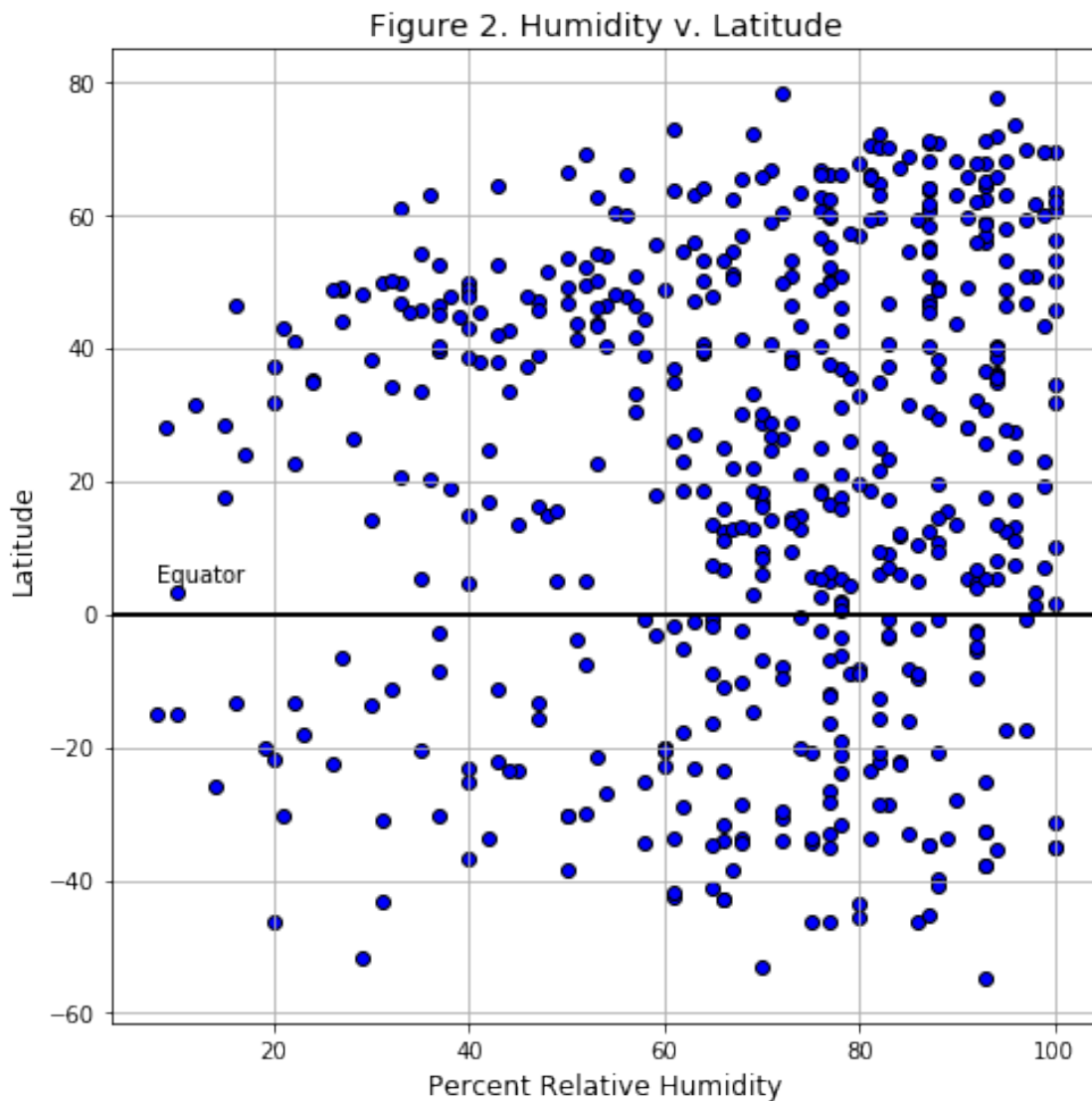
```
plt.grid()
plt.scatter(RHgood, latgood, facecolors="blue", marker="o", edgecolor="black")

plt.axhline(y=0, color='black', linewidth=2)
plt.text(min(weather_city_df["Rel_humidity_pct"]), 5, "Equator", color='black')
# Save the Figure
plt.tight_layout()
plt.savefig("./RH_lat.pdf")
plt.show
```
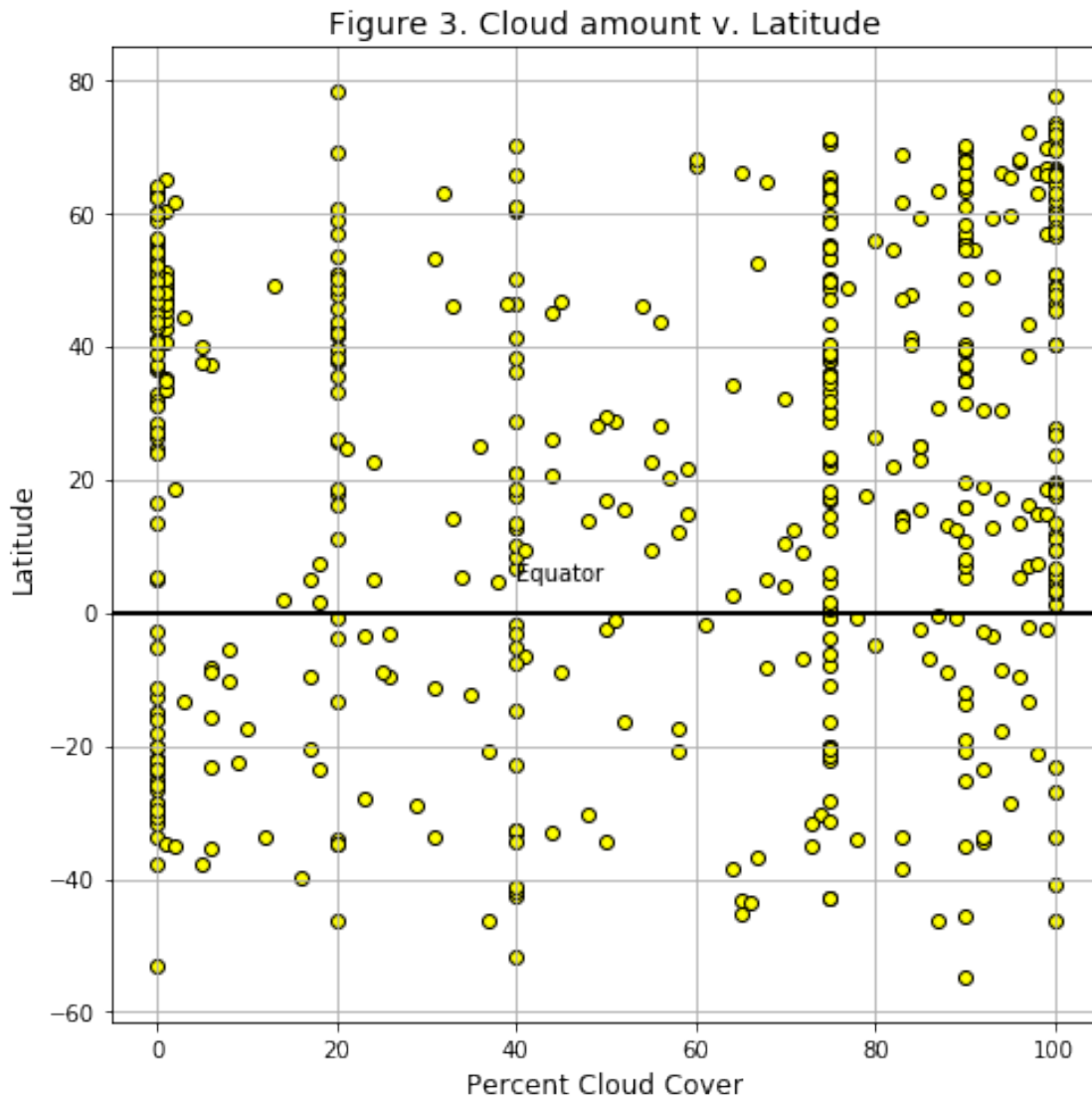
[87]: `<function matplotlib.pyplot.show(*args, **kw)>`

Figure 2. Humidity v. Latitude

Latitude vs. Cloudiness Plot

```
[88]: # Build Scatter Plot for Each Data Type

      plt.figure(figsize=(7,7))
      plt.title('Figure 3. Cloud amount v. Latitude', fontsize=14)
      plt.xlabel('Percent Cloud Cover', fontsize=12)
      plt.ylabel('Latitude', fontsize=12)
      plt.grid()
      plt.scatter(weather_city_df["Clouds_pct"], weather_city_df["Lat"],␣
       ↪facecolors="yellow", marker="o", edgecolor="black")
      plt.axhline(y=0, color='black', linewidth=2)
      plt.text(min(weather_city_df["Clouds_pct"]+40), 5, "Equator", color='black')
      # Save the Figure
      plt.tight_layout()
      plt.savefig("./cloud_lat.pdf")
      plt.show()
```
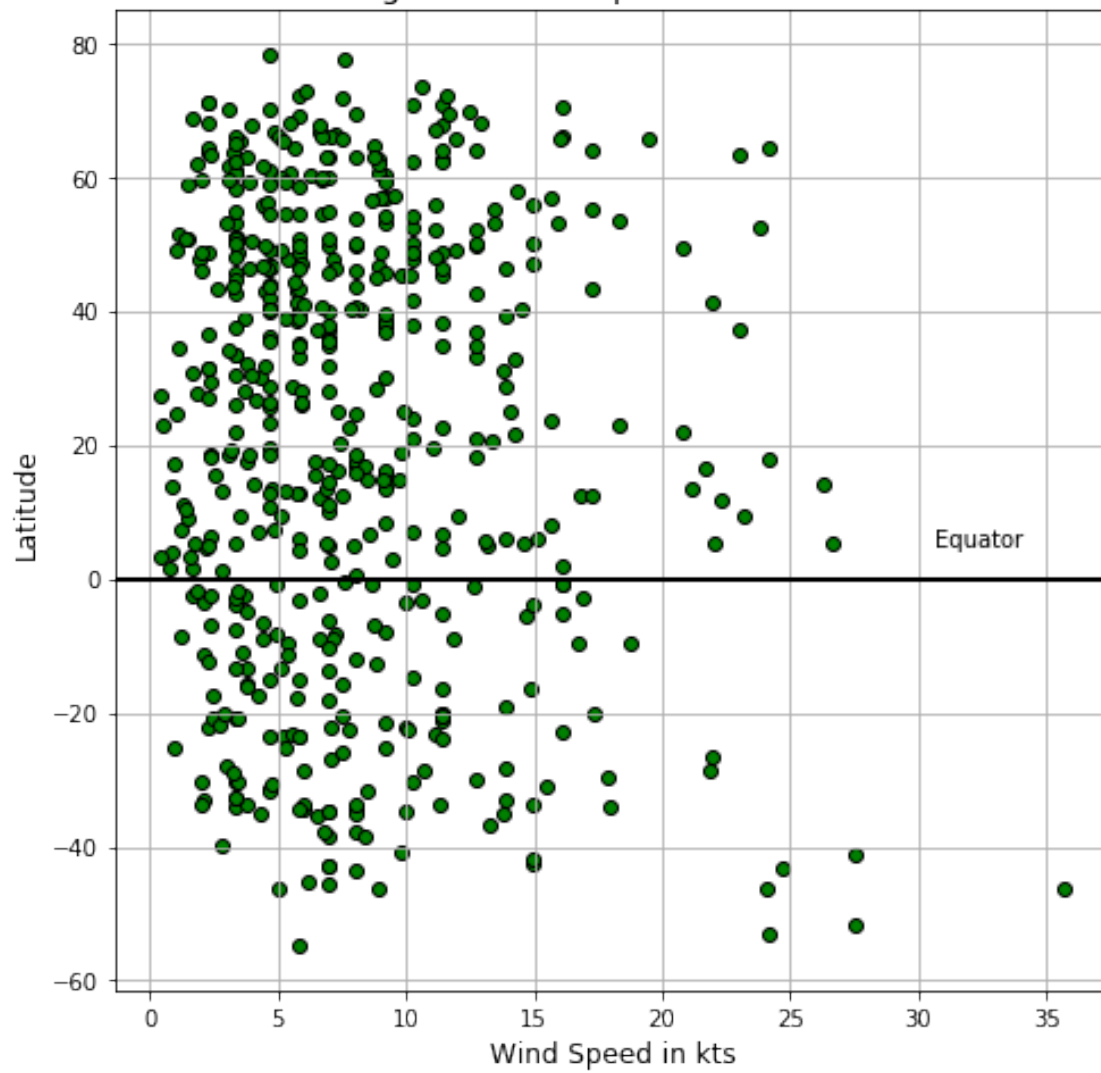

Figure 3. Cloud amount v. Latitude

Latitude vs. Wind Speed Plot

```python
[89]:  plt.figure(figsize=(7,7))
       plt.title('Figure 4. Wind speed v. Latitude', fontsize=14)
       plt.xlabel('Wind Speed in kts', fontsize=12)
       plt.ylabel('Latitude', fontsize=12)
       plt.grid()
       plt.scatter(weather_city_df["Wind_speed_kts"], weather_city_df["Lat"],␣
        ↪facecolors="green", marker="o", edgecolor="black")
       plt.axhline(y=0, color='black', linewidth=2)
       plt.text(max(weather_city_df["Wind_speed_kts"]-5), 5, "Equator", color='black')
       # Save the Figure
       plt.tight_layout()
       plt.savefig("./windspeed_lat.pdf")
       plt.show()
```

Figure 4. Wind speed v. Latitude

[ ]: