paper01_eda

October 10, 2021

1 Exploratory Data Analysis.

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1.1 Reading Files

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/patsy/constraint.py:13: DeprecationWarning: Using or importing the ABCs
from 'collections' instead of from 'collections.abc' is deprecated since Python
3.3,and in 3.9 it will stop working
  from collections import Mapping
/home/jaa6766/.conda/envs/cuda/lib/python3.7/importlib/_bootstrap.py:219:
RuntimeWarning: numpy.ufunc size changed, may indicate binary incompatibility.
Expected 192 from C header, got 216 from PyObject
/home/jaa6766/.conda/envs/cuda/lib/python3.7/importlib/_bootstrap.py:219:
RuntimeWarning: numpy.ufunc size changed, may indicate binary incompatibility.
Expected 192 from C header, got 216 from PyObject
/home/jaa6766/.conda/envs/cuda/lib/python3.7/importlib/_bootstrap.py:219:
RuntimeWarning: numpy.ufunc size changed, may indicate binary incompatibility.
Expected 192 from C header, got 216 from PyObject
/home/jaa6766/.conda/envs/cuda/lib/python3.7/importlib/_bootstrap.py:219:
RuntimeWarning: numpy.ufunc size changed, may indicate binary incompatibility.
Expected 192 from C header, got 216 from PyObject
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

Listing data files from: /home/jaa6766/Documents/jorge3a/itam/deeplearning/dlfinal/data/airdata

- Loading air-20210212-060408.json.gz
- Loading air-20210212-060529.json.gz
- Loading air-20210212-060534.json.gz
- Loading air-20210212-060545.json.gz
- Loading air-20210212-153737.json.gz
- Loading air-20210212-153808.json.gz
- Loading air-20210212-153921.json.gz
- Loading air-20210218-233000.json.gz
- Loading air-20210308-213952.json.gz
- Loading air-20210308-214511.json.gz
- Loading air-20210326-110304.json.gz
- Loading air-20210520-235254.json.gz
- Loading air-20210617-141714.json.gz

- Loading air-20210415-234052.json.gz
- Loading air-20210627-224727.json.gz
- Loading air-20210723-084450.json.gz
- Loading air-20210812-211858.json.gz
- Loading air-20210822-191723.json.gz
- Loading air-20210827-131714.json.gz
- Loading air-20210828-132805.json.gz
- Loading air-20210830-121252.json.gz

Done!

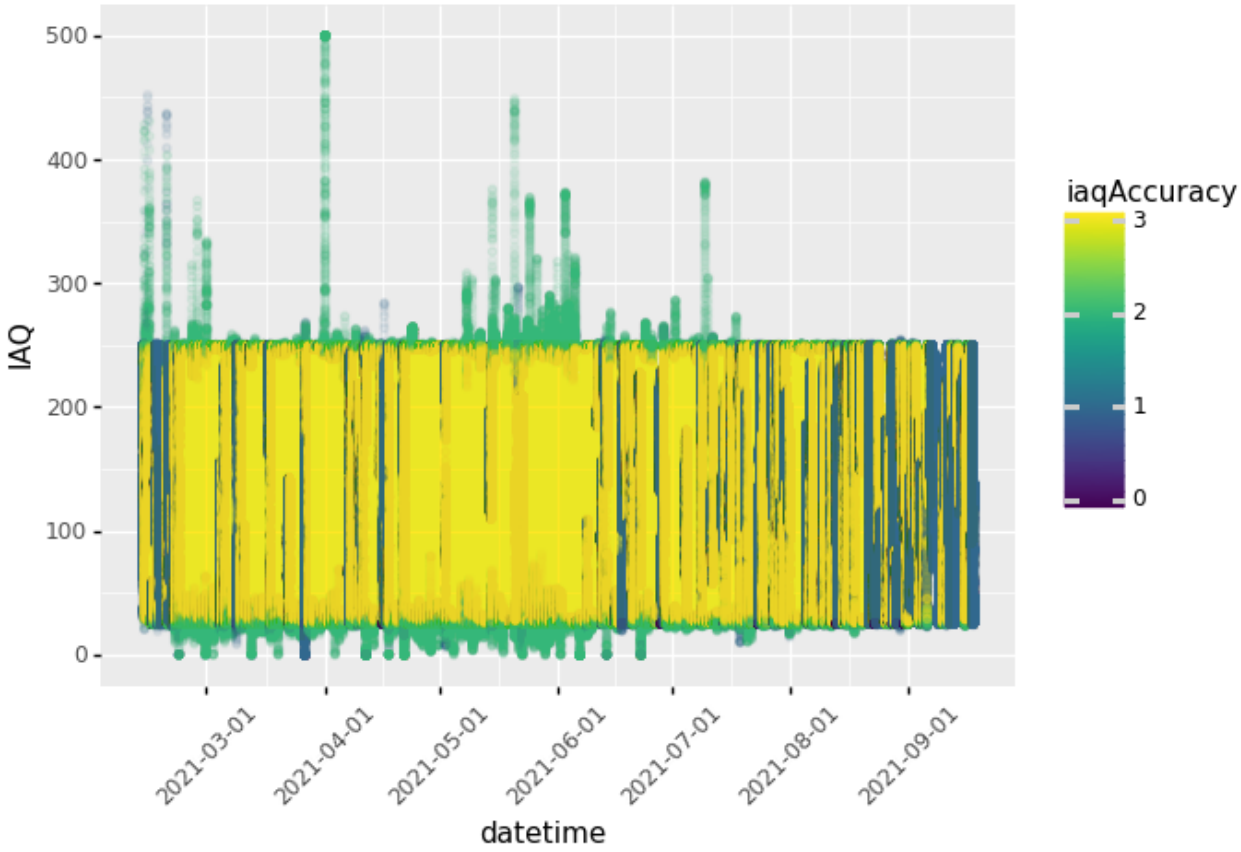
```
CPU times: user 3min 1s, sys: 3.48 s, total: 3min 4s
Wall time: 3min 4s
```

	temperature	pressure	humidity	gasResistance	IAQ	iaqAccuracy	\
0	21.54	777.41	43.93	151328	37.5	1	
1	21.56	777.41	43.89	152702	35.6	1	
2	21.53	777.41	43.97	151328	37.5	1	
3	21.51	777.41	44.03	151464	38.5	1	
4	21.51	777.41	44.05	152425	36.9	1	

	datetime	year	month	day	hour	minute
0	2021-02-12 06:04:09.089621067	2021	2	12	6	4
1	2021-02-12 06:04:12.087778807	2021	2	12	6	4
2	2021-02-12 06:04:15.072475433	2021	2	12	6	4
3	2021-02-12 06:04:18.070170164	2021	2	12	6	4
4	2021-02-12 06:04:21.061994791	2021	2	12	6	4

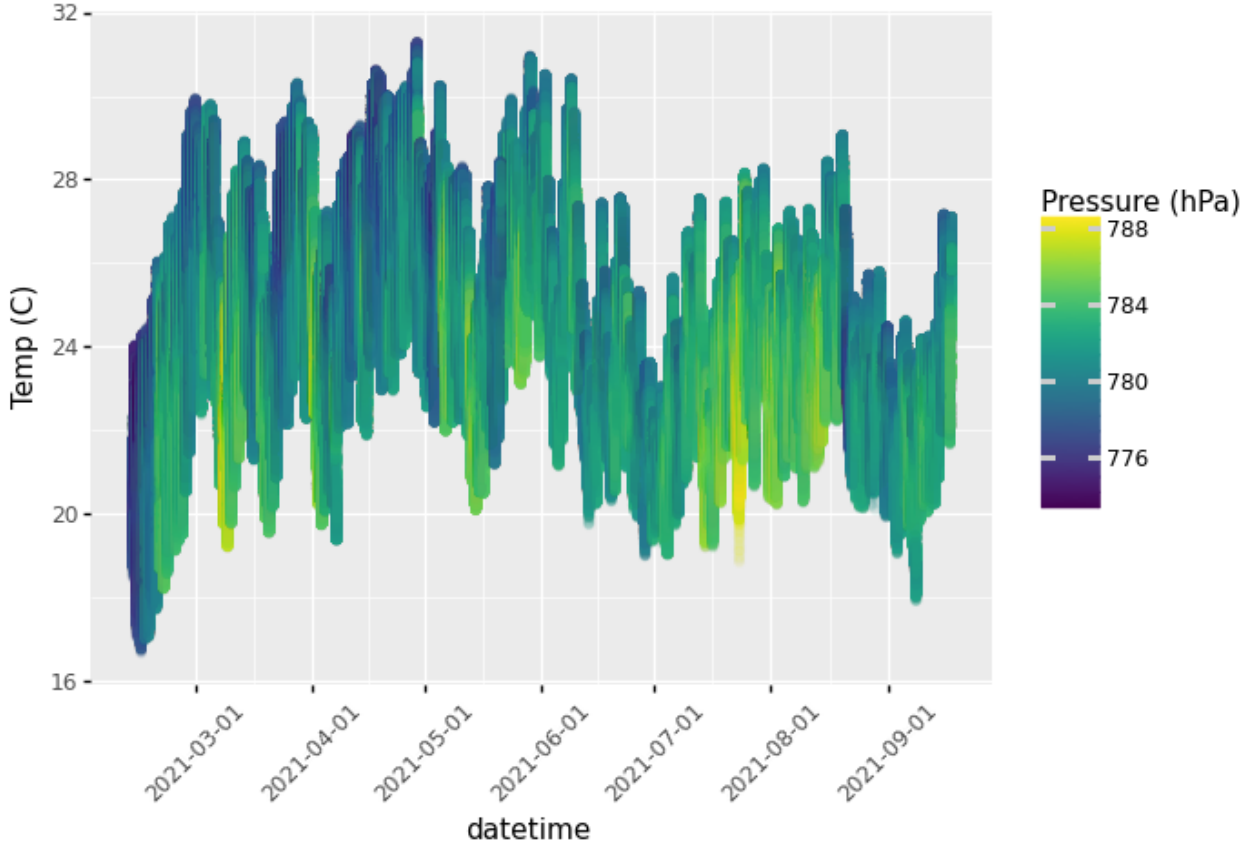
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

```
(6285103, 12)
```




```
<ggplot: (8743563467593)>
```

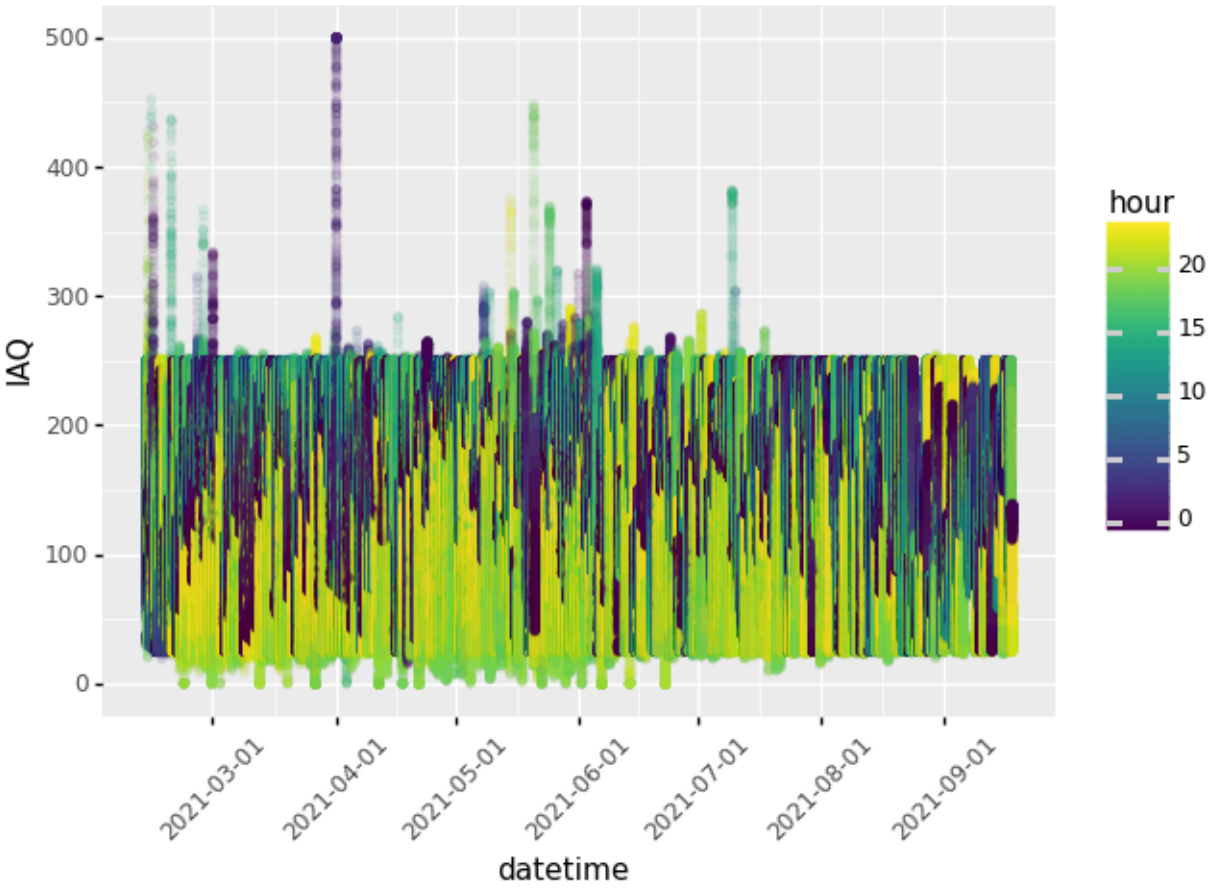
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```



<ggplot: (8743454194105)>

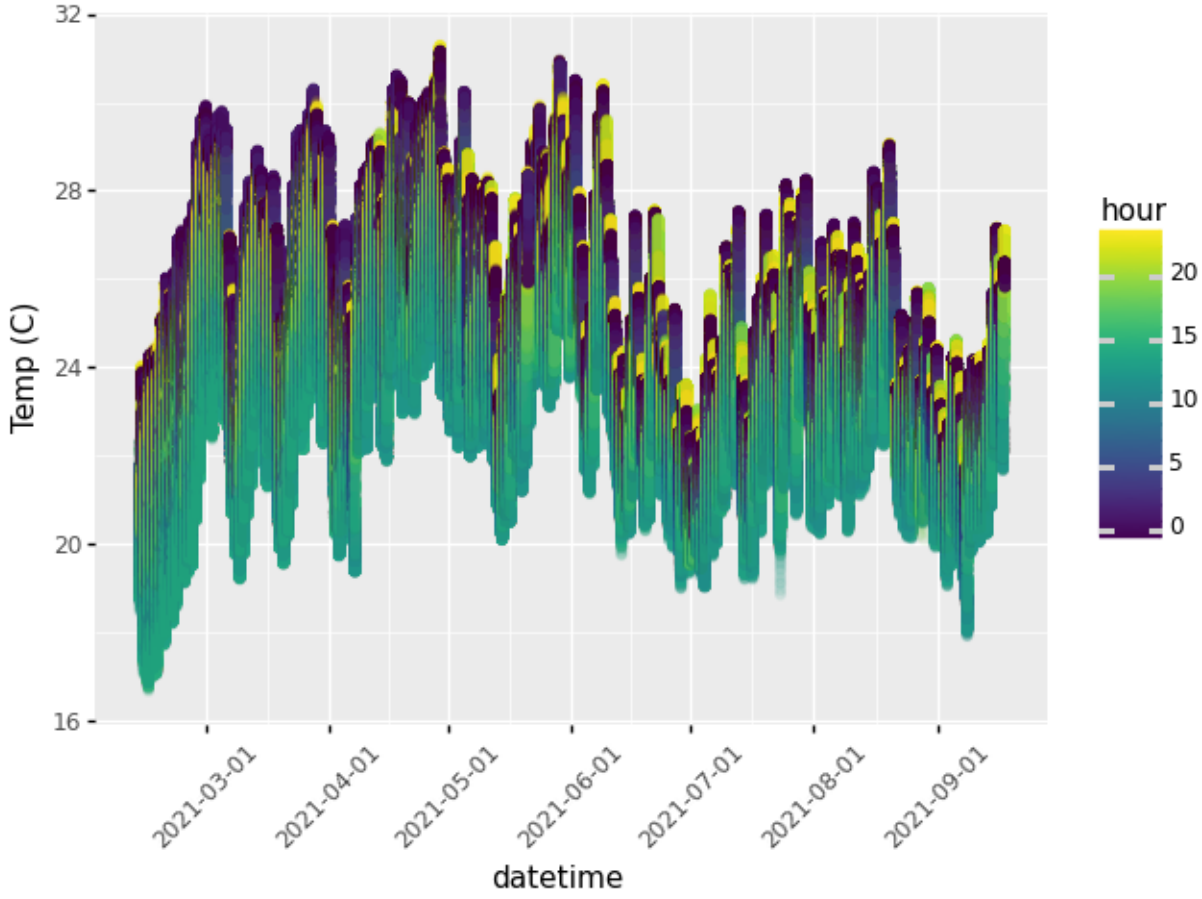
1.2 Hourly Plots

/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during thetransform in `preprocessing_exc_tuple` in IPython 7.17 and above.



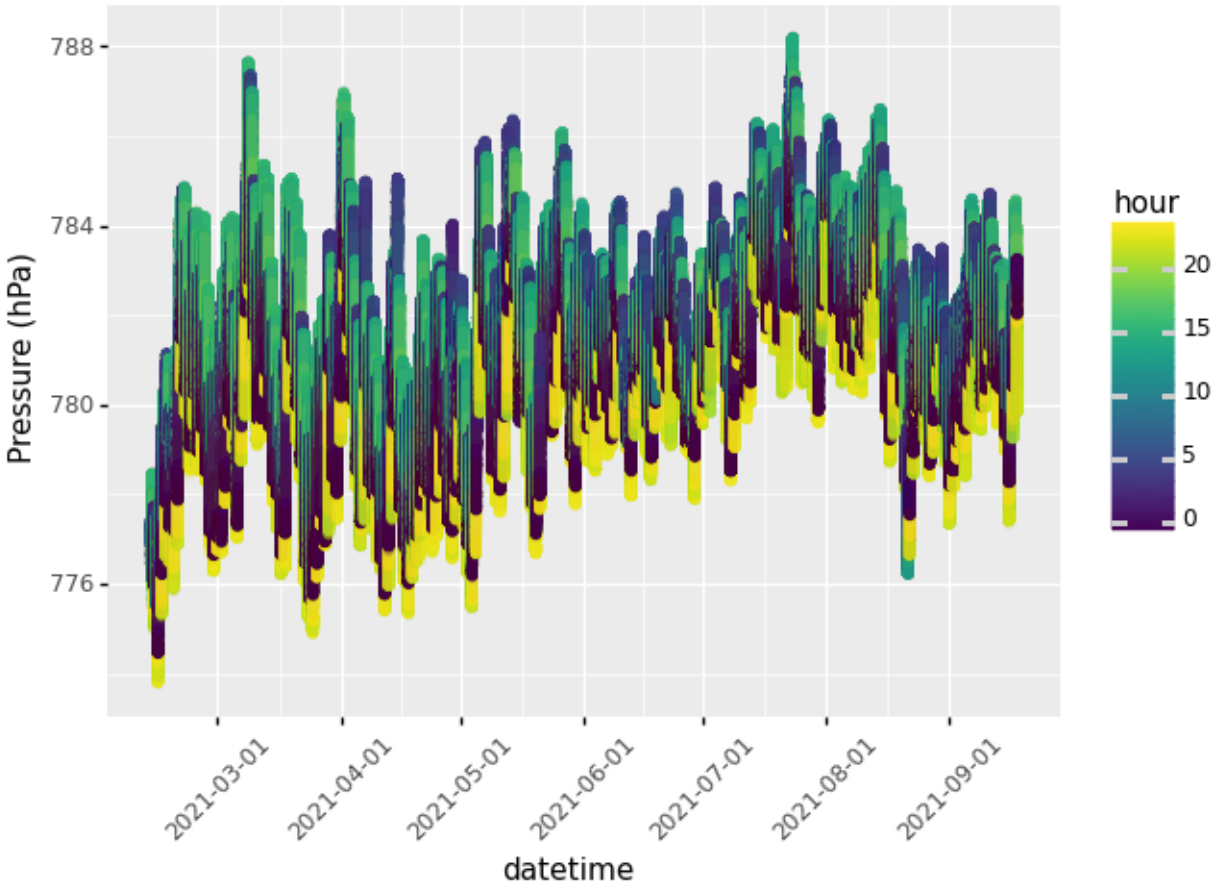

```
<ggplot: (8743477989549)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```



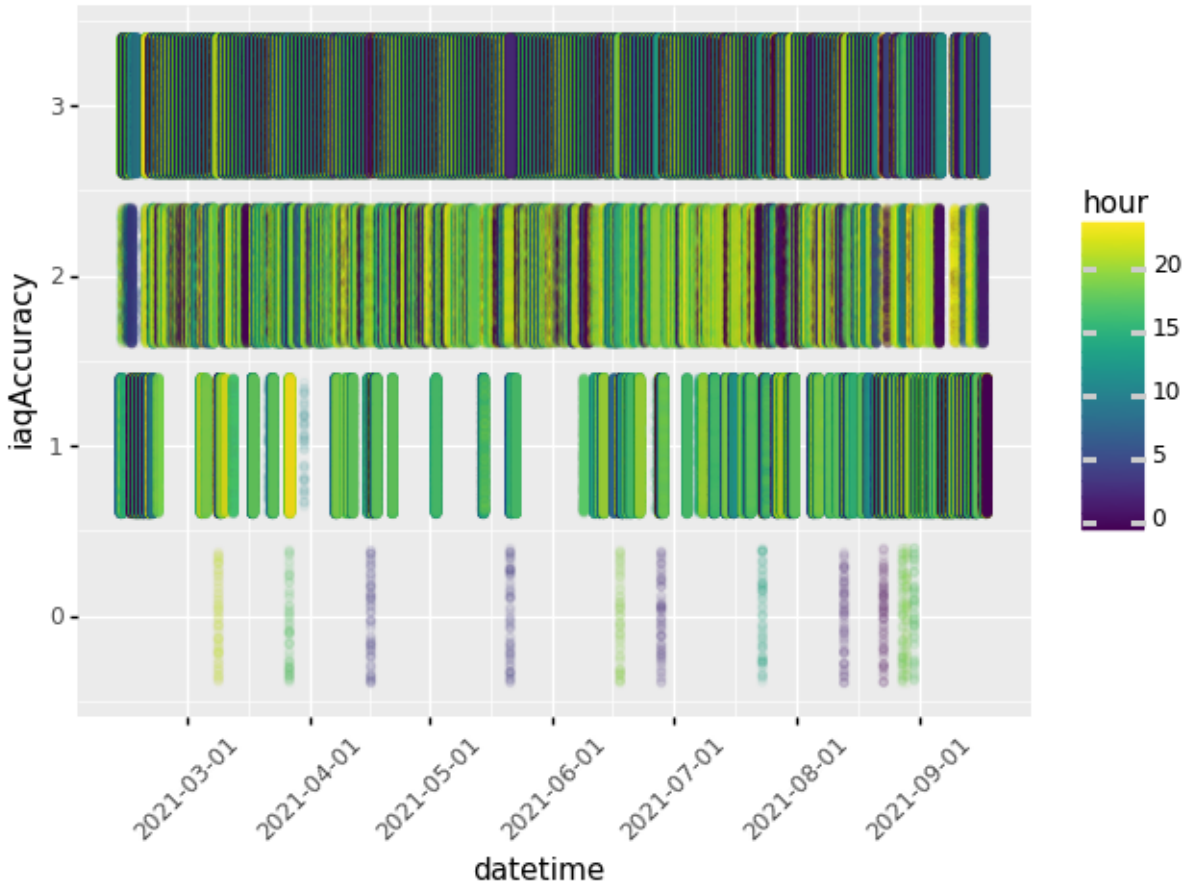

```
<ggplot: (8743477961941)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```




```
<ggplot: (8743477923849)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```




```
<ggplot: (8743477640149)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

1.3 SINAICA

Listing data files from: /home/jaa6766/Documents/jorge3a/itam/deeplearning/dlfinal/data/sinaica/...

```
Loading pickle prev data...
```

	Parámetro	Fecha	Valor	Unidad	Estacion
1	CO	2021-01-01	0.600	ppm	Camarones
1	NO	2021-01-01	0.006	ppm	Camarones
1	NO2	2021-01-01	0.029	ppm	Camarones
1	NOx	2021-01-01	0.034	ppm	Camarones
1	O3	2021-01-01	0.011	ppm	Camarones
34	SO2	2021-10-08	0.002	ppm	Merced
35	SO2	2021-10-08	0.001	ppm	Merced
36	SO2	2021-10-08	0.001	ppm	Merced
37	SO2	2021-10-08	0.000	ppm	Merced
38	SO2	2021-10-08	0.001	ppm	Merced

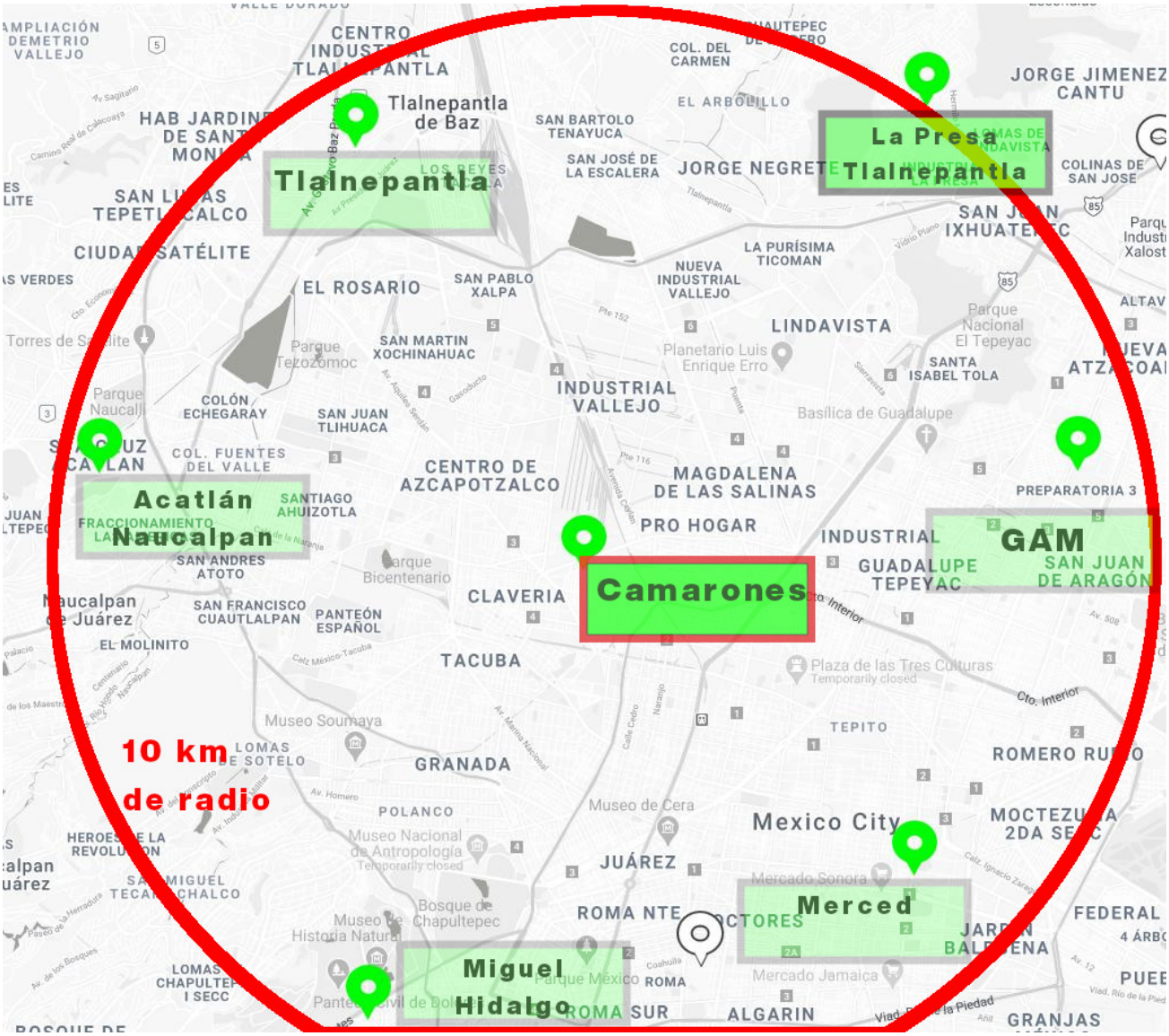
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
```

`transformed_cell` argument and any exception that happen during thetransform in `preprocessing_exc_tuple` in IPython 7.17 and above.

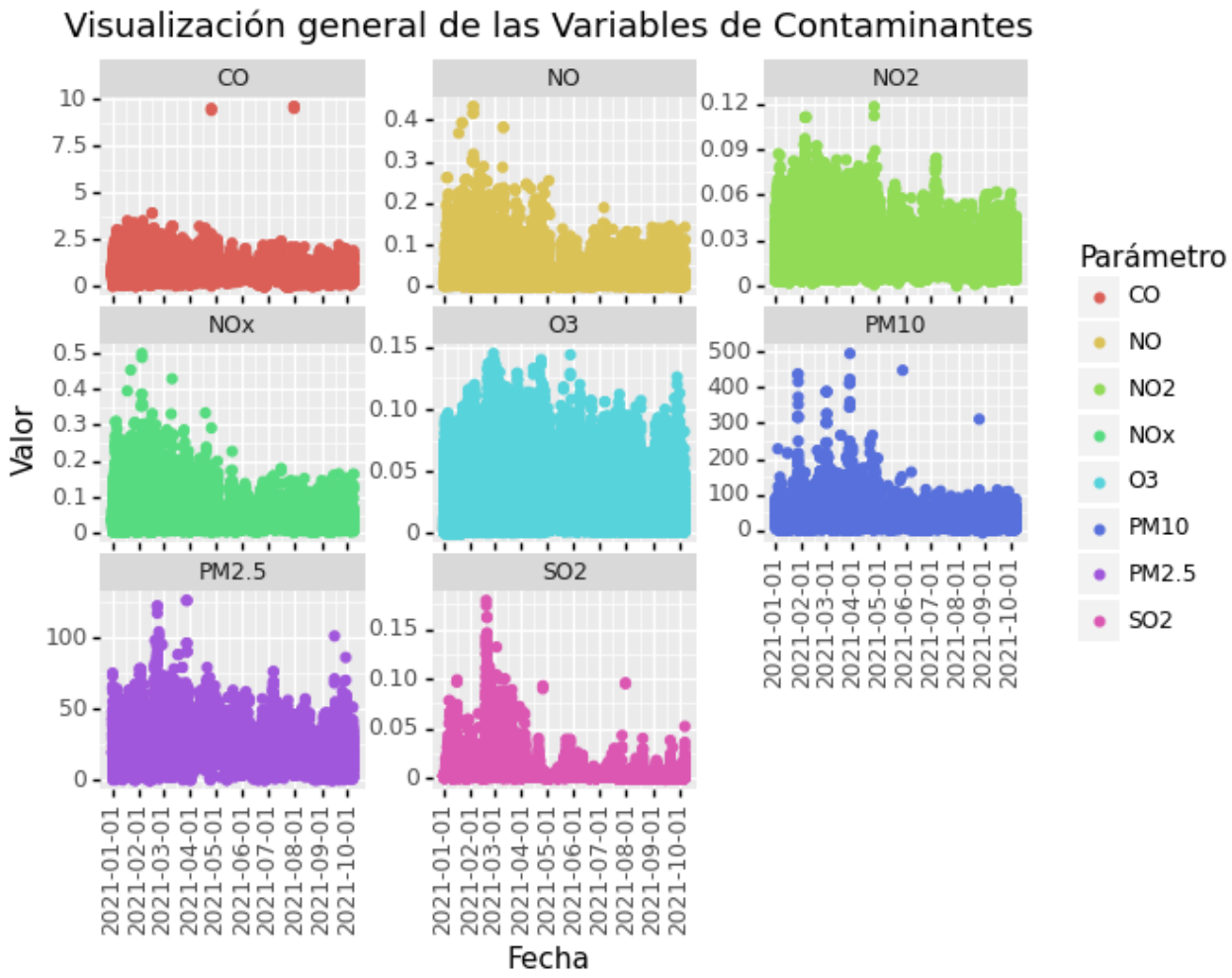
```
   Parámetro       Fecha  Valor Unidad   Estacion
1         CO  2021-01-01  0.600    ppm  Camarones
1         NO  2021-01-01  0.006    ppm  Camarones
1        NO2  2021-01-01  0.029    ppm  Camarones
1        NOx  2021-01-01  0.034    ppm  Camarones
1         O3  2021-01-01  0.011    ppm  Camarones
..       …          …    …    …        …
34       SO2  2021-10-08  0.002    ppm     Merced
35       SO2  2021-10-08  0.001    ppm     Merced
36       SO2  2021-10-08  0.001    ppm     Merced
37       SO2  2021-10-08  0.000    ppm     Merced
38       SO2  2021-10-08  0.001    ppm     Merced

[196289 rows x 5 columns]
```

1.3.1 Nearby Air Quality Monitoring Stations

These are the air quality monitoring stations that are close to "Camarones", which is the one nearby to our sensor:



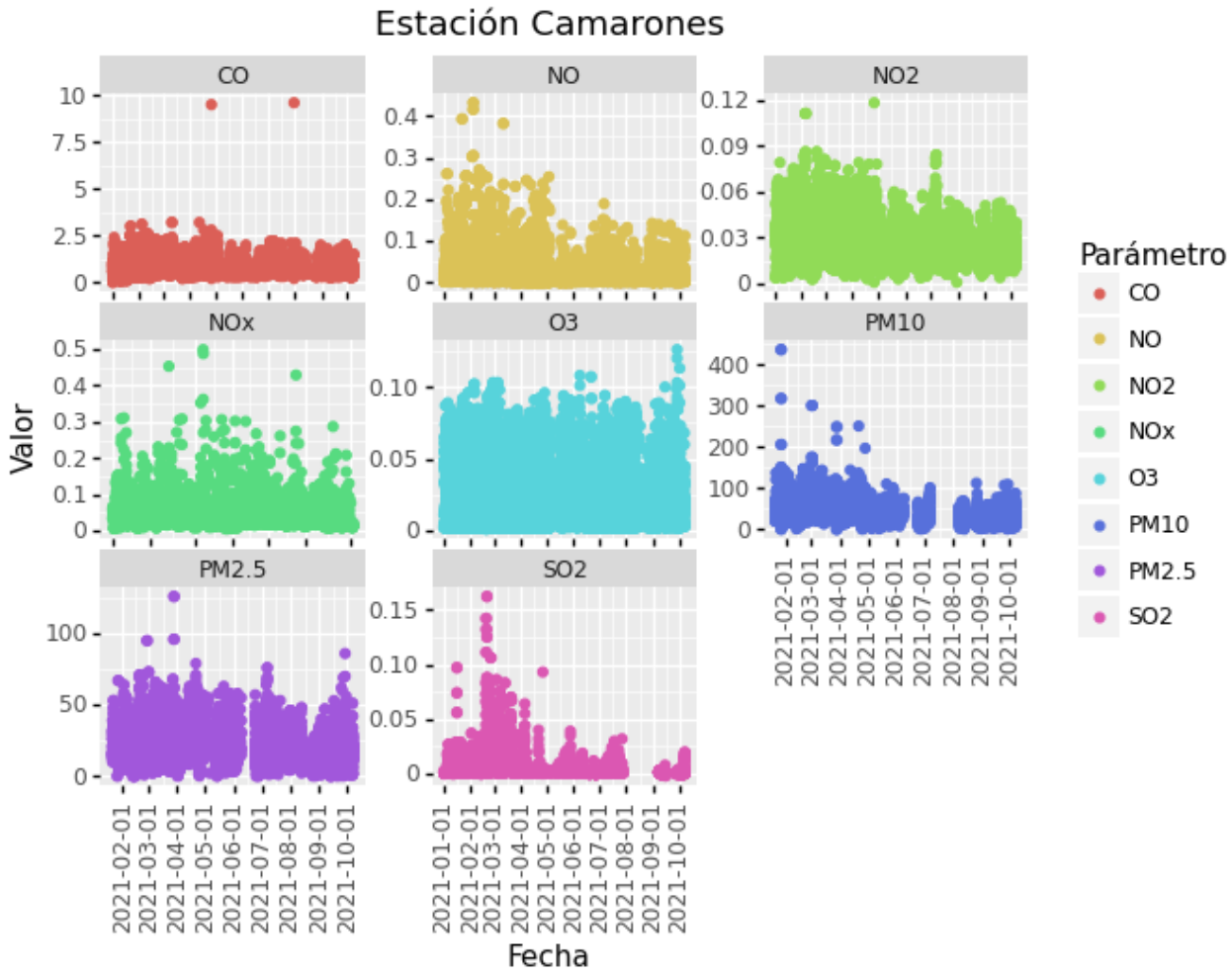
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```




```
<ggplot: (8743477165417)>
```

1.3.2 Camarones Air Quality Monitoring Station

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```




```
<ggplot: (8743477166005)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

1.4 Sensor Data

These are the hourly averages of the sensor in order to make them match the government air quality monitoring stations that report hourly vs every 3 seconds.

```
   temperature  pressure  humidity  gasResistance   IAQ  iaqAccuracy  \
0        21.54    777.41     43.93         151328  37.5            1
1        21.56    777.41     43.89         152702  35.6            1
2        21.53    777.41     43.97         151328  37.5            1
3        21.51    777.41     44.03         151464  38.5            1
4        21.51    777.41     44.05         152425  36.9            1

                       datetime  year  month  day  hour  minute
0 2021-02-12 06:04:09.089621067  2021      2   12     6       4
1 2021-02-12 06:04:12.087778807  2021      2   12     6       4
2 2021-02-12 06:04:15.072475433  2021      2   12     6       4
3 2021-02-12 06:04:18.070170164  2021      2   12     6       4
```

```
 4 2021-02-12 06:04:21.061994791  2021      2   12     6       4
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/dplython/dplython.py:196: DeprecationWarning: 'dfilter' is deprecated.
Please use 'sift' instead.
```

```
        temperature  pressure  humidity  gasResistance    IAQ  iaqAccuracy  \
490473        28.06     780.7     30.37         175863  198.1            3
490474        28.05     780.7     30.38         176417  197.7            3
490475        28.05     780.7     30.41         175313  198.0            3

                           datetime  year  month  day  hour  minute
490473 2021-03-01 06:00:01.807887316  2021      3    1     6       0
490474 2021-03-01 06:00:04.803511858  2021      3    1     6       0
490475 2021-03-01 06:00:07.798833609  2021      3    1     6       0
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

```
CPU times: user 23.6 s, sys: 3.53 s, total: 27.1 s
Wall time: 27.1 s
```

```
      year  month  day  hour  temperature    pressure   humidity  \
0     2021      2   12     6    21.557391  777.271496  44.289745
1     2021      2   12     7    21.153699  777.077872  43.183375
2     2021      2   12     8    20.653242  776.620657  42.604564
3     2021      2   12     9    20.406470  776.213214  42.223995
4     2021      2   12    10    20.051380  776.202968  42.269584
…     …    …  …   …          …          …          …
5223  2021      9   17    21    26.476714  780.191339  50.048186
5224  2021      9   17    22    26.849135  780.496165  50.588394
5225  2021      9   17    23    26.281820  782.067298  54.032219
5226  2021      9   18     0    26.222995  782.853860  55.496814
5227  2021      9   18     1    25.928134  782.818660  56.467943

      gasResistance         IAQ  iaqAccuracy
0      1.439648e+05   90.755292            1
1      1.497397e+05   81.831588            1
2      1.537118e+05   86.220615            1
3      1.491061e+05  138.266030            1
4      1.428894e+05  198.164339            1
…              …         …          …
5223   1.043343e+06   37.047504            1
5224   1.050633e+06   38.850749            1
5225   9.918547e+05   81.164589            1
5226   9.266802e+05  128.776123            1
5227   9.204316e+05  134.620335            1

[5228 rows x 10 columns]
```

Estadísticas de los valores de las lecturas

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
```

not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during thetransform in `preprocessing_exc_tuple` in IPython 7.17 and above.

```
         year        month          day         hour  temperature  \
count  5228.0  5228.000000  5228.000000  5228.000000  5228.000000
mean   2021.0     5.509946    15.633512    11.506121    24.349677
std       0.0     2.093404     8.655932     6.921888     2.489229
min    2021.0     2.000000     1.000000     0.000000    17.282542
25%    2021.0     4.000000     8.000000     6.000000    22.518177
50%    2021.0     6.000000    16.000000    12.000000    24.198175
75%    2021.0     7.000000    23.000000    18.000000    26.116874
max    2021.0     9.000000    31.000000    23.000000    31.066215

          pressure     humidity  gasResistance          IAQ  iaqAccuracy
count  5228.000000  5228.000000   5.228000e+03  5228.000000  5228.000000
mean    781.624137    43.442600   6.950943e+05   157.429759     2.551071
std       2.187106    12.554327   3.111298e+05    69.918421     0.817749
min     774.004780     8.750125   9.540458e+04    22.751331     1.000000
25%     780.216749    32.662378   5.044701e+05    98.951158     3.000000
50%     781.726205    43.999339   6.915713e+05   171.485025     3.000000
75%     783.156527    54.322785   8.638399e+05   219.580799     3.000000
max     787.963968    70.166841   2.716493e+06   255.292928     3.000000
```

1.5 Air Quality Government Data

/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during thetransform in `preprocessing_exc_tuple` in IPython 7.17 and above.

```
   Parámetro      Fecha  Valor Unidad   Estacion
1         CO 2021-01-01  0.600    ppm  Camarones
1         NO 2021-01-01  0.006    ppm  Camarones
1        NO2 2021-01-01  0.029    ppm  Camarones
1        NOx 2021-01-01  0.034    ppm  Camarones
1         O3 2021-01-01  0.011    ppm  Camarones
..       …        …    …    …        …
34       SO2 2021-10-08  0.002    ppm     Merced
35       SO2 2021-10-08  0.001    ppm     Merced
36       SO2 2021-10-08  0.001    ppm     Merced
37       SO2 2021-10-08  0.000    ppm     Merced
38       SO2 2021-10-08  0.001    ppm     Merced

[196289 rows x 5 columns]
```

/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argument and any exception that happen during thetransform in `preprocessing_exc_tuple` in IPython 7.17 and above.

```
                  Fecha  Camarones_CO  Camarones_NO  Camarones_NO2  \
0    2021-01-01 00:00:00      0.600000      0.006000       0.029000
1    2021-01-01 01:00:00      1.000000      0.021000       0.038000
2    2021-01-01 02:00:00      0.800000      0.013000       0.035000
3    2021-01-01 03:00:00      1.000000      0.031000       0.034000
4    2021-01-01 04:00:00      0.600000      0.005000       0.029000
…                    …           …           …            …
```

```
2347 2021-10-04 00:00:00      0.441667      0.008292       0.015833
2348 2021-10-05 00:00:00      0.490000      0.010000       0.017000
2349 2021-10-06 00:00:00      0.542857      0.007571       0.022571
2350 2021-10-07 00:00:00      0.582609      0.011565       0.023130
2351 2021-10-08 00:00:00      0.738889      0.023778       0.026778

      Camarones_NOx  Camarones_O3  Camarones_PM10  Camarones_PM2.5  \
0             0.034      0.011000             NaN              NaN
1             0.059      0.002000             NaN              NaN
2             0.049      0.003000             NaN              NaN
3             0.065      0.002000             NaN              NaN
4             0.034      0.005000             NaN              NaN
…               …             …               …                …
2347            NaN      0.017167       22.173913        10.952381
2348            NaN      0.013947       22.142857         8.736842
2349            NaN      0.014333       25.150000        10.150000
2350            NaN      0.021304       33.500000        15.428571
2351            NaN      0.019667       41.266667        18.800000

      Camarones_SO2  FES Acatlán_CO  …  Miguel Hidalgo_O3  \
0          0.002000        0.400000  …              0.009
1          0.002000        0.600000  …              0.006
2          0.001000        0.900000  …              0.003
3          0.001000        0.800000  …              0.004
4          0.001000        1.000000  …              0.006
…               …             …  …  …                …
2347       0.000125        0.315000  …                NaN
2348       0.000000        0.466667  …                NaN
2349       0.000000        0.347619  …                NaN
2350       0.001783        0.447826  …                NaN
2351       0.010500        0.566667  …                NaN

      Miguel Hidalgo_SO2  Tlalnepantla_CO  Tlalnepantla_NO  Tlalnepantla_NO2  \
0                  0.003              0.6              NaN             0.030
1                  0.003              0.6              NaN             0.026
2                  0.002              0.7              NaN             0.032
3                  0.002              0.7              NaN             0.033
4                  0.002              0.7              NaN             0.032
…                    …                …                …                 …
2347                 NaN              NaN              NaN               NaN
2348                 NaN              NaN              NaN               NaN
2349                 NaN              NaN              NaN               NaN
2350                 NaN              NaN              NaN               NaN
2351                 NaN              NaN              NaN               NaN

      Tlalnepantla_NOx  Tlalnepantla_O3  Tlalnepantla_PM10  \
0                0.034            0.012               37.0
1                0.029            0.013               42.0
2                0.036            0.006               58.0
3                0.039            0.004               59.0
4                0.038            0.004               64.0
…                  …                …                  …
2347               NaN              NaN                NaN
2348               NaN              NaN                NaN
2349               NaN              NaN                NaN
2350               NaN              NaN                NaN
2351               NaN              NaN                NaN

      Tlalnepantla_PM2.5  Tlalnepantla_SO2
```

```
0                   19.0             0.002
1                   29.0             0.003
2                   43.0             0.002
3                   41.0             0.002
4                   46.0             0.002
…                    …                 …
2347                 NaN               NaN
2348                 NaN               NaN
2349                 NaN               NaN
2350                 NaN               NaN
2351                 NaN               NaN

[2352 rows x 45 columns]
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

	Estacion	count	mean
Camarones_CO	Camarones_CO	2241.0	0.767037
Camarones_NO	Camarones_NO	2227.0	0.024599
Camarones_NO2	Camarones_NO2	2227.0	0.031139
Camarones_NOx	Camarones_NOx	2042.0	0.056961
Camarones_O3	Camarones_O3	2233.0	0.026094
Camarones_PM10	Camarones_PM10	1749.0	56.638261
Camarones_PM2.5	Camarones_PM2.5	1765.0	24.872841
Camarones_SO2	Camarones_SO2	2190.0	0.006284
FES Acatlán_CO	FES Acatlán_CO	2200.0	0.631953
FES Acatlán_NO	FES Acatlán_NO	1477.0	0.014508
FES Acatlán_NO2	FES Acatlán_NO2	2195.0	0.025301
FES Acatlán_NOx	FES Acatlán_NOx	2199.0	0.041105
FES Acatlán_O3	FES Acatlán_O3	2015.0	0.033841
FES Acatlán_PM10	FES Acatlán_PM10	2158.0	46.423940
FES Acatlán_SO2	FES Acatlán_SO2	2195.0	0.006255
Gustavo A. Madero_NO2	Gustavo A. Madero_NO2	2085.0	0.025859
Gustavo A. Madero_O3	Gustavo A. Madero_O3	2076.0	0.031555
Gustavo A. Madero_PM10	Gustavo A. Madero_PM10	2035.0	52.755283
Gustavo A. Madero_PM2.5	Gustavo A. Madero_PM2.5	2026.0	23.785291
La Presa_CO	La Presa_CO	2034.0	0.933628
La Presa_O3	La Presa_O3	1863.0	0.029086
La Presa_SO2	La Presa_SO2	2017.0	0.005163
Merced_CO	Merced_CO	2282.0	1.120228
Merced_NO	Merced_NO	1381.0	0.021361
Merced_NO2	Merced_NO2	2264.0	0.032059
Merced_NOx	Merced_NOx	2264.0	0.055272
Merced_O3	Merced_O3	2270.0	0.028855
Merced_PM10	Merced_PM10	2321.0	52.696149
Merced_PM2.5	Merced_PM2.5	2316.0	26.268777
Merced_SO2	Merced_SO2	2288.0	0.006037
Miguel Hidalgo_CO	Miguel Hidalgo_CO	2090.0	0.544785
Miguel Hidalgo_NO	Miguel Hidalgo_NO	2077.0	0.021710
Miguel Hidalgo_NO2	Miguel Hidalgo_NO2	2078.0	0.029400
Miguel Hidalgo_NOx	Miguel Hidalgo_NOx	2078.0	0.051113
Miguel Hidalgo_O3	Miguel Hidalgo_O3	2082.0	0.033624
Miguel Hidalgo_SO2	Miguel Hidalgo_SO2	2081.0	0.005228
Tlalnepantla_CO	Tlalnepantla_CO	2023.0	0.740287
Tlalnepantla_NO	Tlalnepantla_NO	1039.0	0.020687
Tlalnepantla_NO2	Tlalnepantla_NO2	1751.0	0.031346

Tlalnepantla_NOx	Tlalnepantla_NOx	1752.0	0.052864	
Tlalnepantla_O3	Tlalnepantla_O3	2077.0	0.027766	
Tlalnepantla_PM10	Tlalnepantla_PM10	1989.0	48.649573	
Tlalnepantla_PM2.5	Tlalnepantla_PM2.5	1973.0	22.273188	
Tlalnepantla_SO2	Tlalnepantla_SO2	2066.0	0.008569	
Fecha	Fecha	NaN	NaN	

	std	min	25%	50%	75%	\
Camarones_CO	0.412628	0.000000	0.500000	0.700000	0.9000	
Camarones_NO	0.043639	0.000000	0.003000	0.007000	0.0260	
Camarones_NO2	0.015144	0.003000	0.020000	0.029000	0.0400	
Camarones_NOx	0.054418	0.004000	0.022000	0.039000	0.0710	
Camarones_O3	0.022991	0.001000	0.005000	0.021000	0.0390	
Camarones_PM10	26.729443	0.000000	40.000000	54.000000	70.0000	
Camarones_PM2.5	12.620210	0.000000	16.000000	24.000000	32.0000	
Camarones_SO2	0.012464	-0.000048	0.001217	0.003000	0.0050	
FES Acatlán_CO	0.359163	0.100000	0.400000	0.547913	0.8000	
FES Acatlán_NO	0.023519	0.000000	0.002000	0.005000	0.0160	
FES Acatlán_NO2	0.013814	0.002000	0.015279	0.022280	0.0320	
FES Acatlán_NOx	0.034157	0.002000	0.018000	0.029000	0.0510	
FES Acatlán_O3	0.026037	0.003000	0.013000	0.027000	0.0480	
FES Acatlán_PM10	31.656199	0.000000	26.729067	41.000000	60.0000	
FES Acatlán_SO2	0.009587	0.000000	0.002000	0.003000	0.0060	
Gustavo A. Madero_NO2	0.014361	0.003000	0.013000	0.026000	0.0360	
Gustavo A. Madero_O3	0.029610	0.001000	0.004000	0.023000	0.0510	
Gustavo A. Madero_PM10	27.911189	0.000000	34.500000	50.000000	67.0000	
Gustavo A. Madero_PM2.5	13.182547	0.000000	14.000000	22.000000	31.0000	
La Presa_CO	0.513861	0.100000	0.600000	0.800000	1.1000	
La Presa_O3	0.025911	0.001000	0.006000	0.024000	0.0455	
La Presa_SO2	0.009749	0.000000	0.001000	0.002000	0.0050	
Merced_CO	0.409799	0.117391	0.852444	1.000000	1.3000	
Merced_NO	0.034552	0.000000	0.003000	0.008000	0.0220	
Merced_NO2	0.013544	0.005000	0.022000	0.031000	0.0400	
Merced_NOx	0.042945	0.006000	0.027000	0.042000	0.0670	
Merced_O3	0.027825	0.000000	0.005000	0.022000	0.0440	
Merced_PM10	24.127886	0.000000	37.000000	51.000000	66.0000	
Merced_PM2.5	12.682280	0.000000	18.000000	25.000000	33.0000	
Merced_SO2	0.009778	0.000000	0.002000	0.003000	0.0060	
Miguel Hidalgo_CO	0.343697	0.000000	0.300000	0.500000	0.7000	
Miguel Hidalgo_NO	0.038798	0.000000	0.002000	0.005000	0.0220	
Miguel Hidalgo_NO2	0.013166	0.004000	0.019000	0.028000	0.0390	
Miguel Hidalgo_NOx	0.046729	0.005000	0.022000	0.034000	0.0620	
Miguel Hidalgo_O3	0.028588	0.002000	0.009000	0.027000	0.0500	
Miguel Hidalgo_SO2	0.008925	0.000000	0.001000	0.002000	0.0050	
Tlalnepantla_CO	0.360615	0.100000	0.500000	0.600000	0.9000	
Tlalnepantla_NO	0.031055	0.000000	0.003000	0.007000	0.0220	
Tlalnepantla_NO2	0.014525	0.004000	0.021000	0.030000	0.0390	
Tlalnepantla_NOx	0.040767	0.005000	0.026000	0.039000	0.0660	
Tlalnepantla_O3	0.025335	0.000000	0.007000	0.020000	0.0430	
Tlalnepantla_PM10	27.959538	0.000000	33.000000	45.000000	59.0000	
Tlalnepantla_PM2.5	12.075484	0.000000	14.000000	21.000000	29.0000	
Tlalnepantla_SO2	0.014821	0.001000	0.002000	0.004000	0.0080	
Fecha	NaN	NaN	NaN	NaN	NaN	

	max	NAs
Camarones_CO	3.200	111.0
Camarones_NO	0.432	125.0
Camarones_NO2	0.111	125.0
Camarones_NOx	0.499	310.0

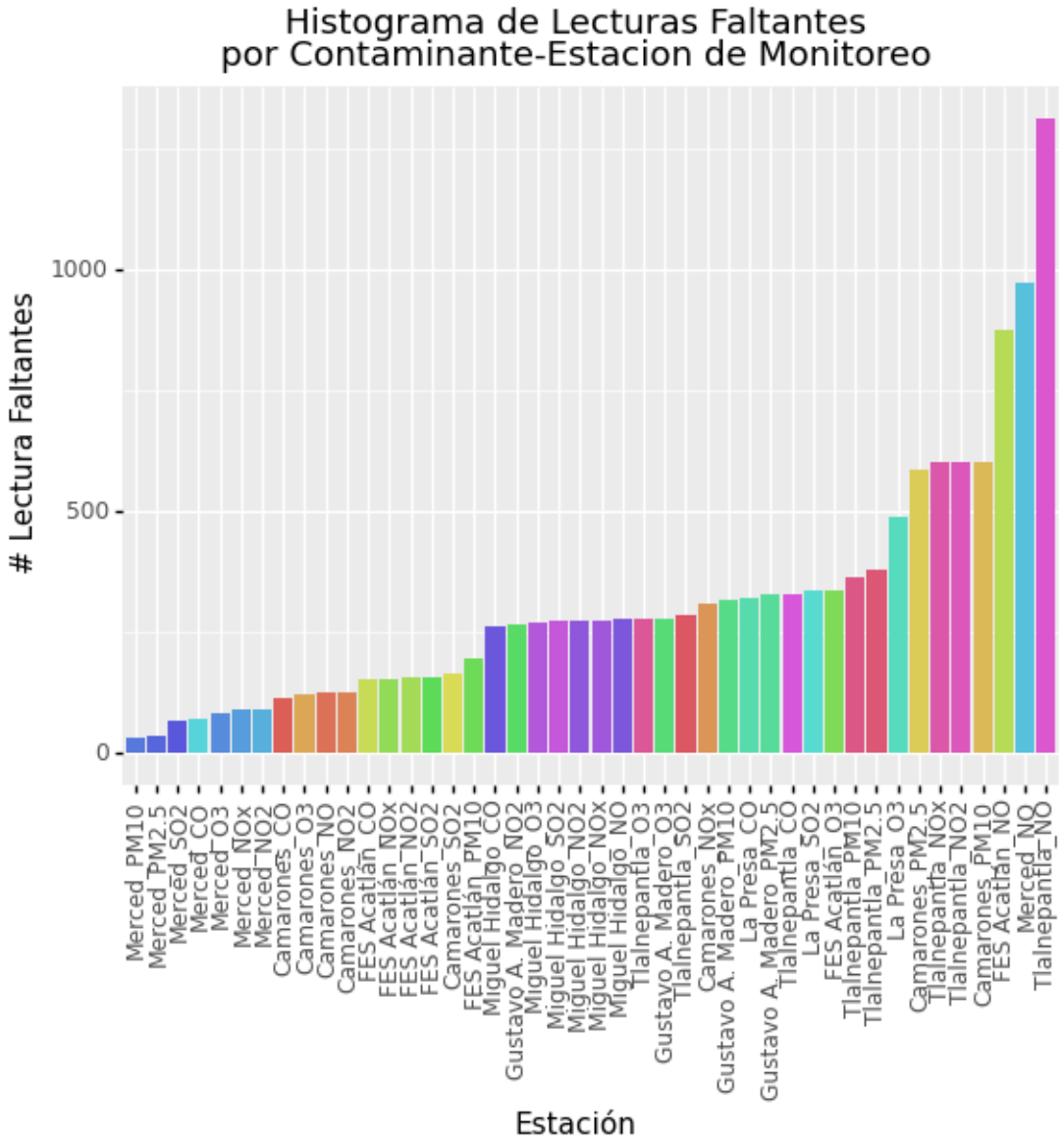
Camarones_O3	0.103	119.0
Camarones_PM10	437.000	603.0
Camarones_PM2.5	126.000	587.0
Camarones_SO2	0.162	162.0
FES Acatlán_CO	2.900	152.0
FES Acatlán_NO	0.215	875.0
FES Acatlán_NO2	0.092	157.0
FES Acatlán_NOx	0.260	153.0
FES Acatlán_O3	0.137	337.0
FES Acatlán_PM10	388.000	194.0
FES Acatlán_SO2	0.136	157.0
Gustavo A. Madero_NO2	0.081	267.0
Gustavo A. Madero_O3	0.128	276.0
Gustavo A. Madero_PM10	495.000	317.0
Gustavo A. Madero_PM2.5	117.000	326.0
La Presa_CO	3.500	318.0
La Presa_O3	0.118	489.0
La Presa_SO2	0.118	335.0
Merced_CO	3.900	70.0
Merced_NO	0.318	971.0
Merced_NO2	0.087	88.0
Merced_NOx	0.386	88.0
Merced_O3	0.140	82.0
Merced_PM10	411.000	31.0
Merced_PM2.5	122.000	36.0
Merced_SO2	0.146	64.0
Miguel Hidalgo_CO	2.600	262.0
Miguel Hidalgo_NO	0.368	275.0
Miguel Hidalgo_NO2	0.086	274.0
Miguel Hidalgo_NOx	0.395	274.0
Miguel Hidalgo_O3	0.145	270.0
Miguel Hidalgo_SO2	0.099	271.0
Tlalnepantla_CO	2.900	329.0
Tlalnepantla_NO	0.219	1313.0
Tlalnepantla_NO2	0.097	601.0
Tlalnepantla_NOx	0.274	600.0
Tlalnepantla_O3	0.125	275.0
Tlalnepantla_PM10	423.000	363.0
Tlalnepantla_PM2.5	90.000	379.0
Tlalnepantla_SO2	0.179	286.0
Fecha	NaN	0.0

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel_launcher.py:8: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

		Estacion	NAs
0	Camarones_CO	Camarones_CO	111.0
1	Camarones_NO	Camarones_NO	125.0
2	Camarones_NO2	Camarones_NO2	125.0
3	Camarones_NOx	Camarones_NOx	310.0
4	Camarones_O3	Camarones_O3	119.0

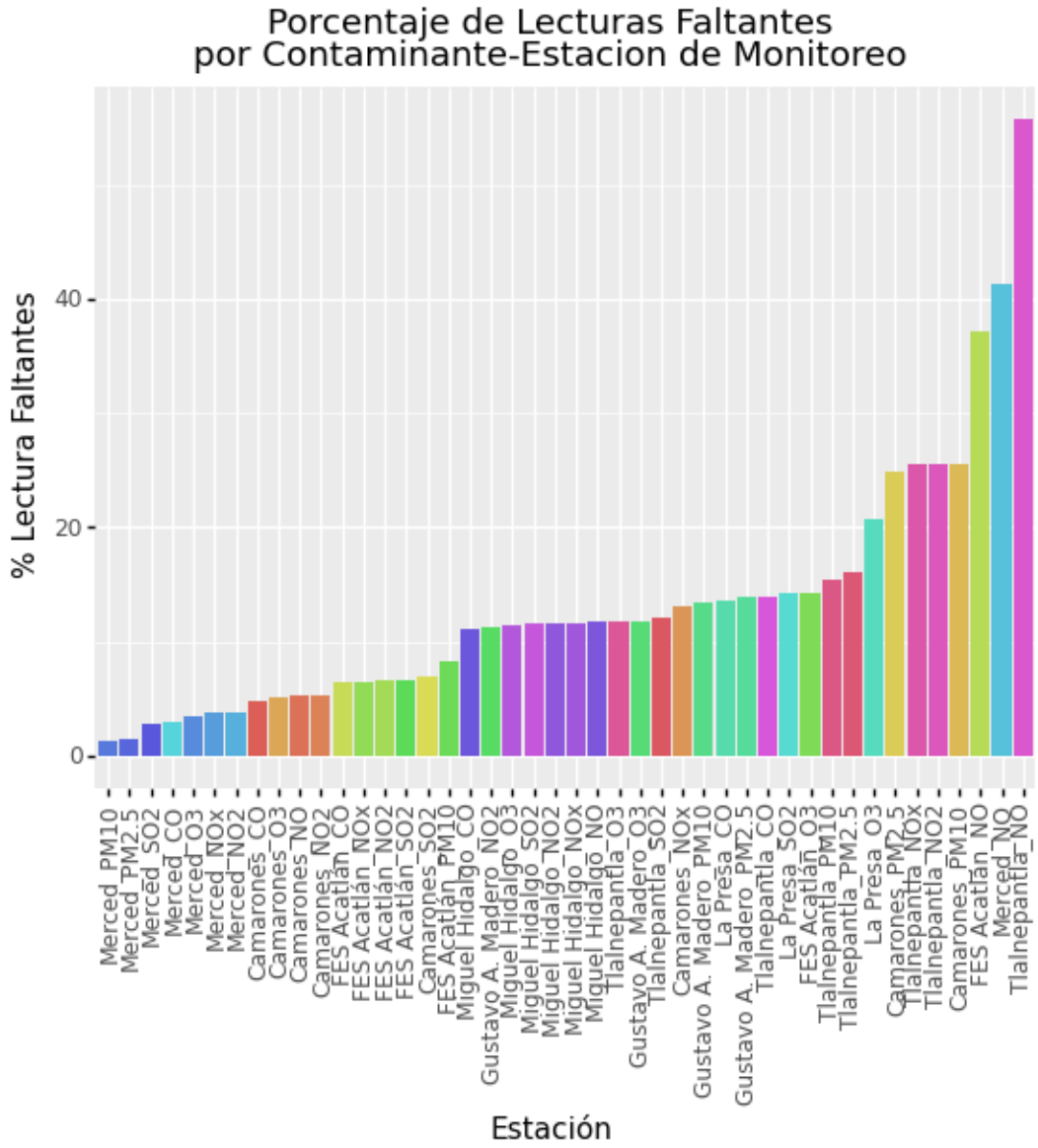
5	Camarones_PM10	Camarones_PM10	603.0
6	Camarones_PM2.5	Camarones_PM2.5	587.0
7	Camarones_SO2	Camarones_SO2	162.0
8	FES Acatlán_CO	FES Acatlán_CO	152.0
9	FES Acatlán_NO	FES Acatlán_NO	875.0
10	FES Acatlán_NO2	FES Acatlán_NO2	157.0
11	FES Acatlán_NOx	FES Acatlán_NOx	153.0
12	FES Acatlán_O3	FES Acatlán_O3	337.0
13	FES Acatlán_PM10	FES Acatlán_PM10	194.0
14	FES Acatlán_SO2	FES Acatlán_SO2	157.0
15	Gustavo A. Madero_NO2	Gustavo A. Madero_NO2	267.0
16	Gustavo A. Madero_O3	Gustavo A. Madero_O3	276.0
17	Gustavo A. Madero_PM10	Gustavo A. Madero_PM10	317.0
18	Gustavo A. Madero_PM2.5	Gustavo A. Madero_PM2.5	326.0
19	La Presa_CO	La Presa_CO	318.0
20	La Presa_O3	La Presa_O3	489.0
21	La Presa_SO2	La Presa_SO2	335.0
22	Merced_CO	Merced_CO	70.0
23	Merced_NO	Merced_NO	971.0
24	Merced_NO2	Merced_NO2	88.0
25	Merced_NOx	Merced_NOx	88.0
26	Merced_O3	Merced_O3	82.0
27	Merced_PM10	Merced_PM10	31.0
28	Merced_PM2.5	Merced_PM2.5	36.0
29	Merced_SO2	Merced_SO2	64.0
30	Miguel Hidalgo_CO	Miguel Hidalgo_CO	262.0
31	Miguel Hidalgo_NO	Miguel Hidalgo_NO	275.0
32	Miguel Hidalgo_NO2	Miguel Hidalgo_NO2	274.0
33	Miguel Hidalgo_NOx	Miguel Hidalgo_NOx	274.0
34	Miguel Hidalgo_O3	Miguel Hidalgo_O3	270.0
35	Miguel Hidalgo_SO2	Miguel Hidalgo_SO2	271.0
36	Tlalnepantla_CO	Tlalnepantla_CO	329.0
37	Tlalnepantla_NO	Tlalnepantla_NO	1313.0
38	Tlalnepantla_NO2	Tlalnepantla_NO2	601.0
39	Tlalnepantla_NOx	Tlalnepantla_NOx	600.0
40	Tlalnepantla_O3	Tlalnepantla_O3	275.0
41	Tlalnepantla_PM10	Tlalnepantla_PM10	363.0
42	Tlalnepantla_PM2.5	Tlalnepantla_PM2.5	379.0
43	Tlalnepantla_SO2	Tlalnepantla_SO2	286.0

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```



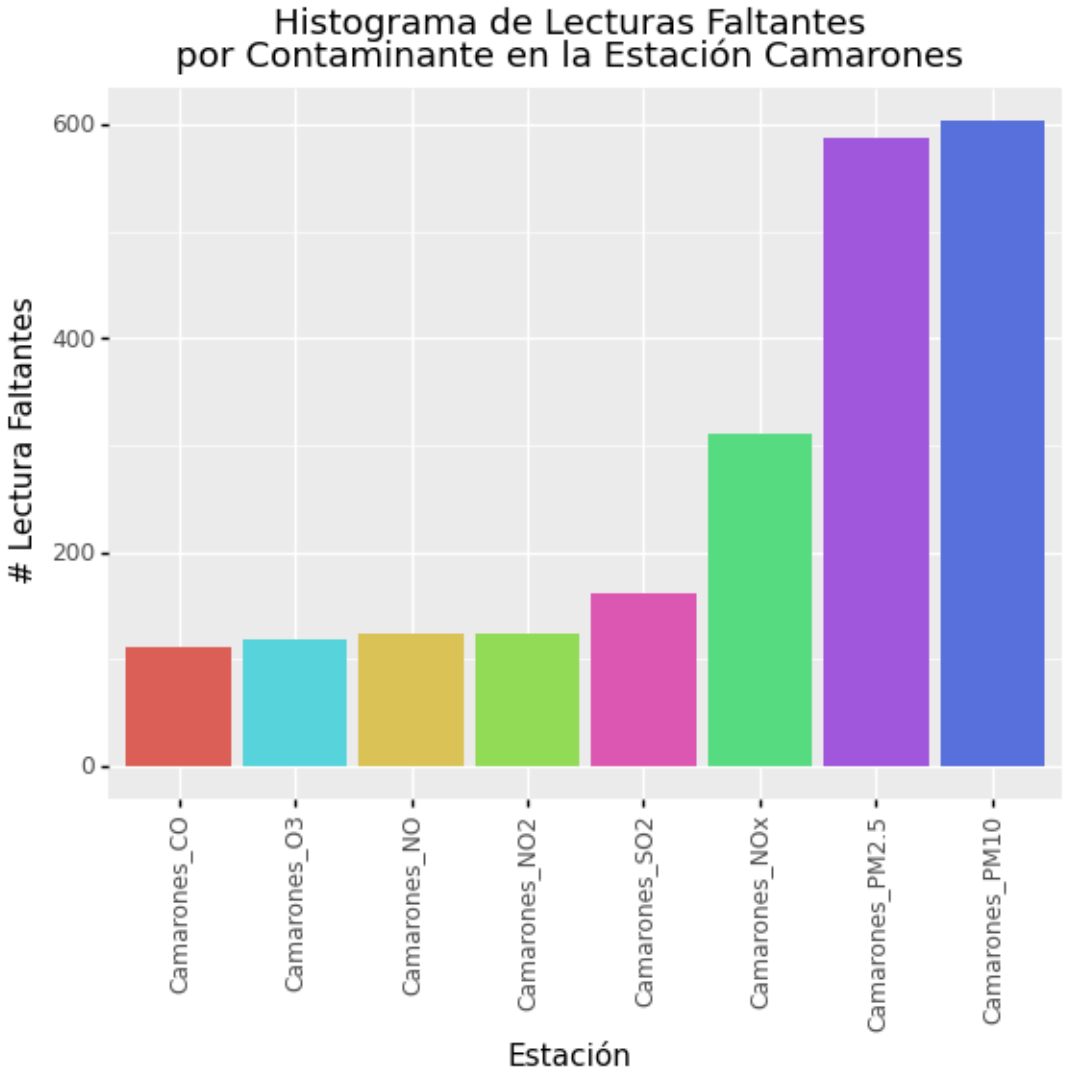

```
<ggplot: (8743371160245)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```



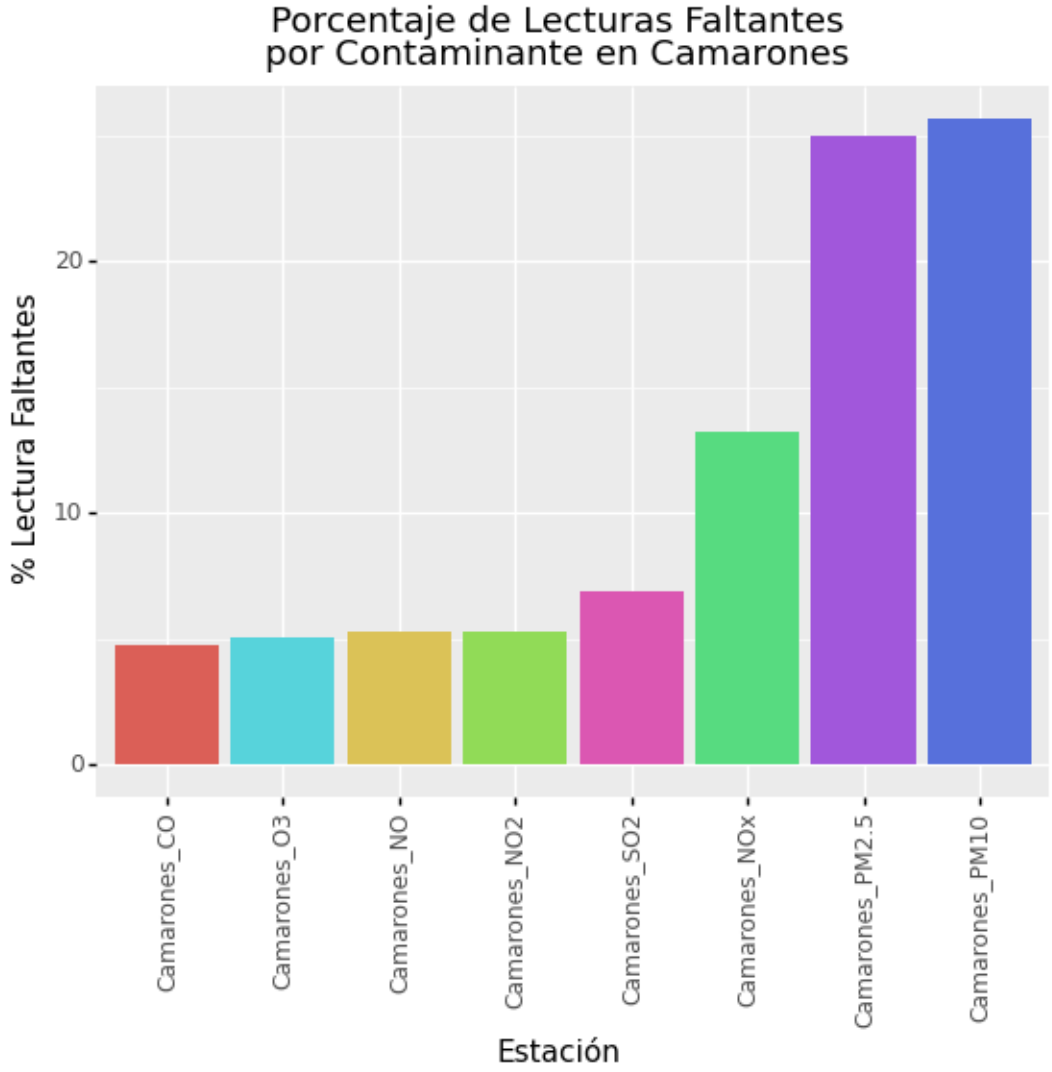

```
<ggplot: (8743371156333)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```




```
<ggplot: (8743558636525)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```




```
<ggplot: (8743477193665)>
```

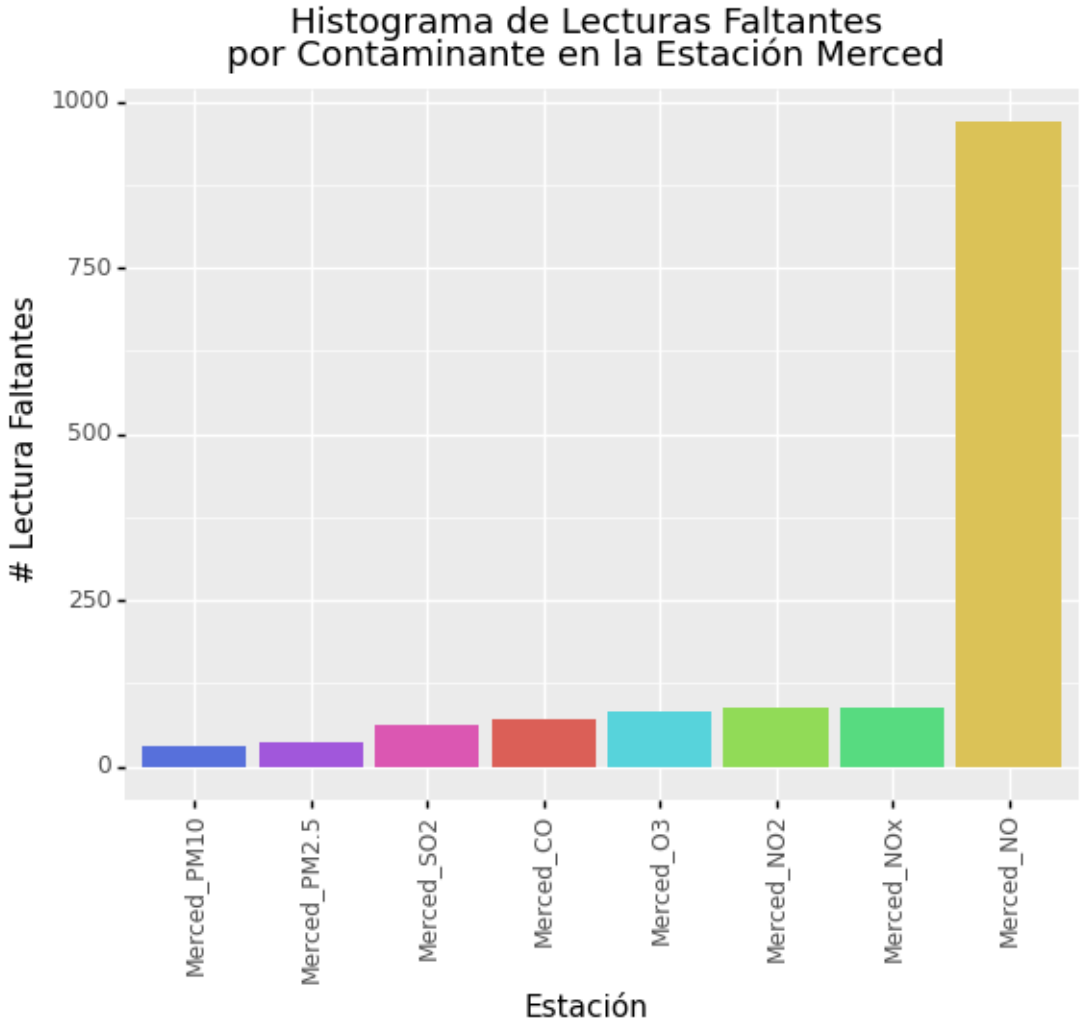
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

		Estacion	NAs
0	Camarones_CO	Camarones_CO	111.0
1	Camarones_NO	Camarones_NO	125.0
2	Camarones_NO2	Camarones_NO2	125.0
3	Camarones_NOx	Camarones_NOx	310.0
4	Camarones_O3	Camarones_O3	119.0
5	Camarones_PM10	Camarones_PM10	603.0
6	Camarones_PM2.5	Camarones_PM2.5	587.0
7	Camarones_SO2	Camarones_SO2	162.0

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

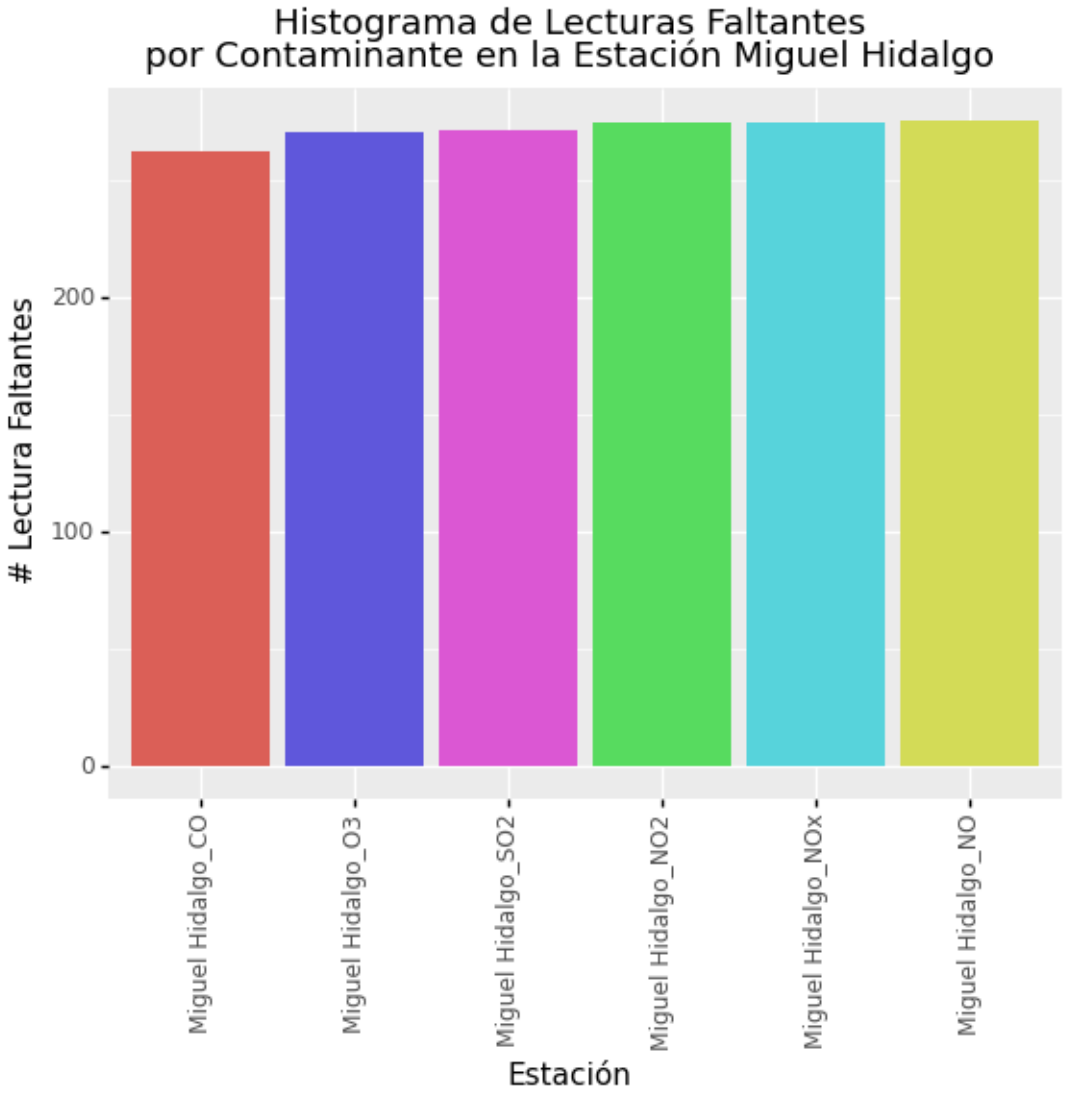
	Estacion	NAs
22	Merced_CO	70.0
23	Merced_NO	971.0
24	Merced_NO2	88.0
25	Merced_NOx	88.0
26	Merced_O3	82.0
27	Merced_PM10	31.0
28	Merced_PM2.5	36.0
29	Merced_SO2	64.0

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```




```
<ggplot: (8743477191769)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```




```
<ggplot: (8743477787409)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

1.6 Weather Data

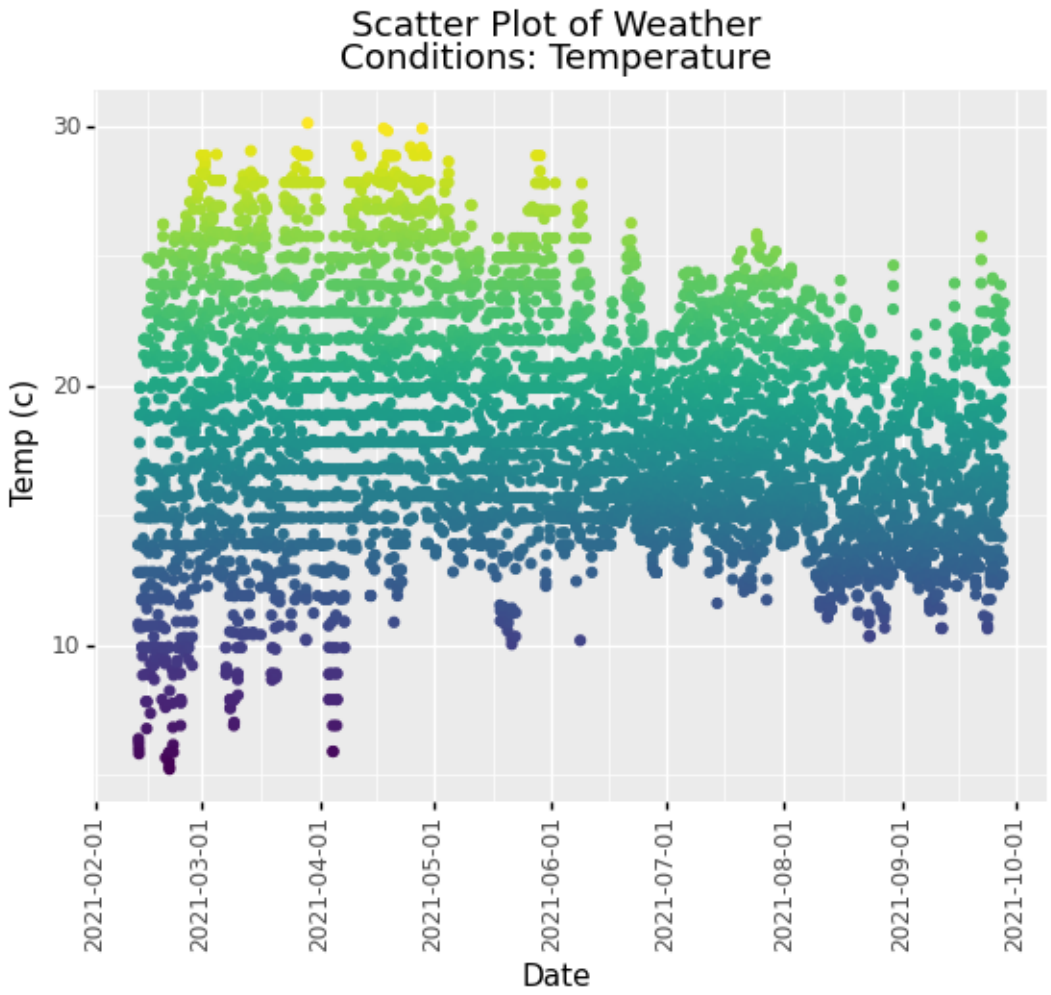
OpenWeatherMap Data

```
CPU times: user 1.02 s, sys: 176 ms, total: 1.2 s
Wall time: 1.29 s
```

```
                   dt   temp  feels_like  temp_min  temp_max  pressure  \
0 2021-02-12 07:00:00  13.87       12.46      5.21     13.92      1020
1 2021-02-12 08:00:00  12.81       11.37      4.21     12.92      1020

   humidity  wind_speed  wind_deg  rain_1h  rain_3h  clouds_all  weather_id  \
0        44         0.0         0      0.0      0.0           1         800
1        47         0.0         0      0.0      0.0           1         800
```

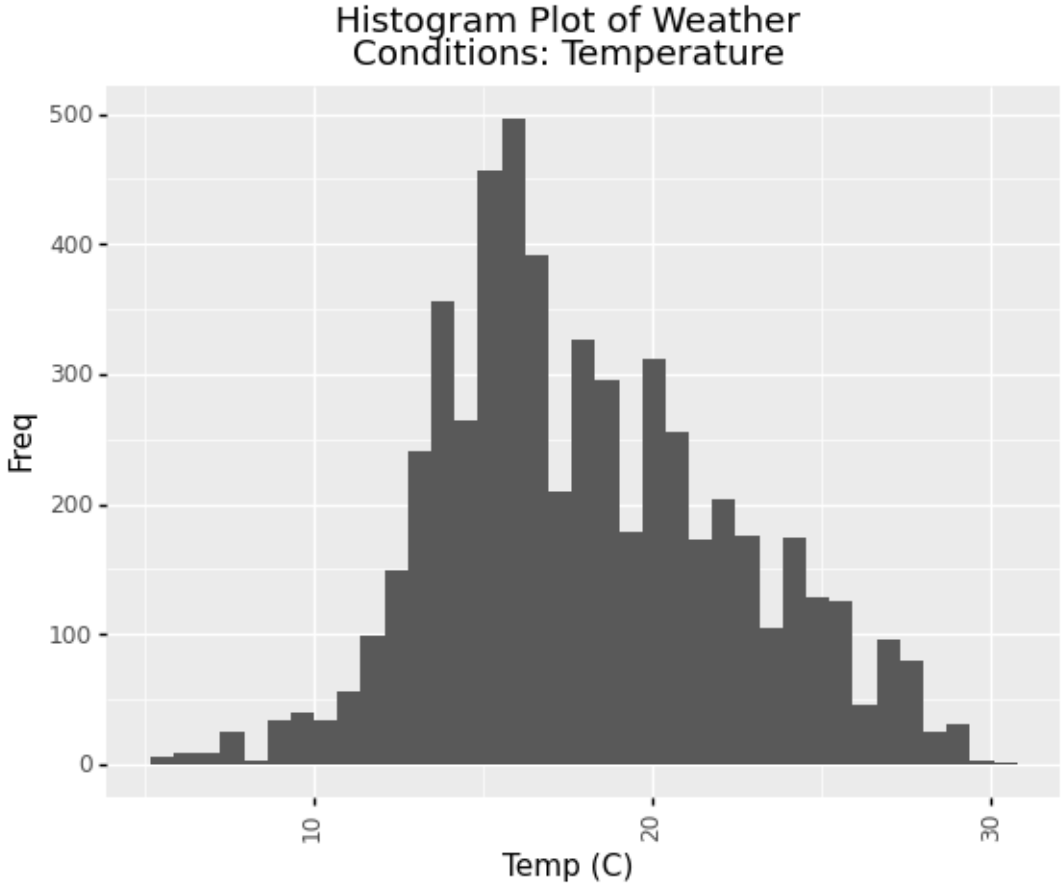
```
  weather_main
0        Clear
1        Clear
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```



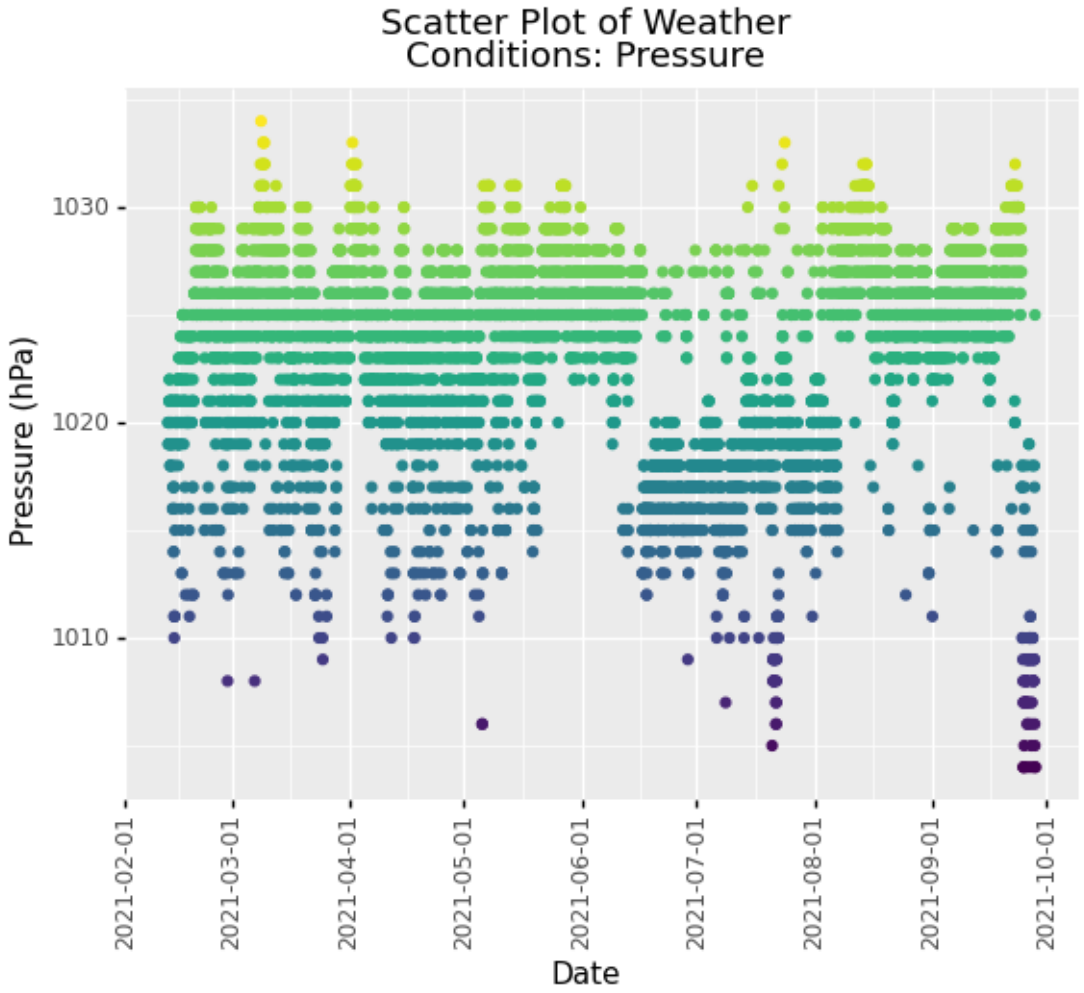

```
<ggplot: (8743477814297)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/plotnine/stats/stat_bin.py:93: PlotnineWarning: 'stat_bin()' using
'bins = 37'. Pick better value with 'binwidth'.
```



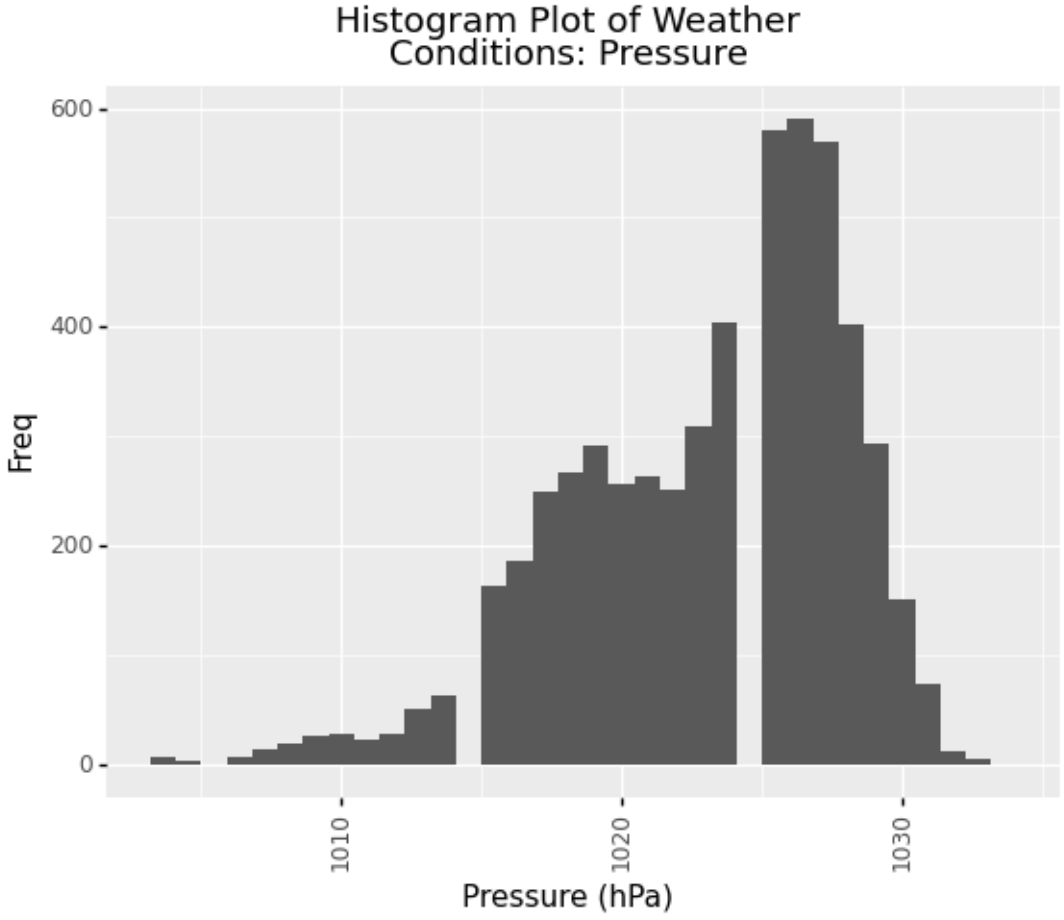

```
<ggplot: (8743477998637)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```



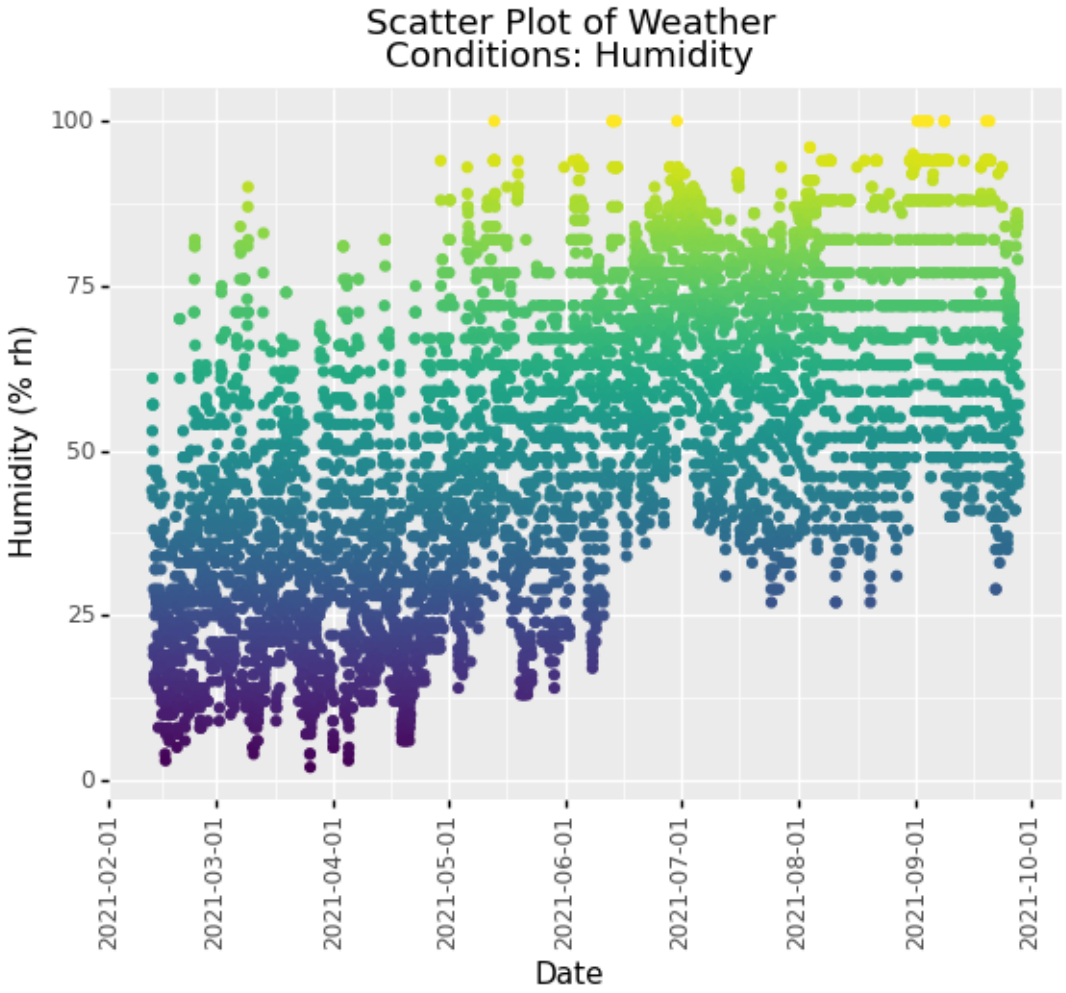

```
<ggplot: (8743477526029)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/plotnine/stats/stat_bin.py:93: PlotnineWarning: 'stat_bin()' using
'bins = 34'. Pick better value with 'binwidth'.
```



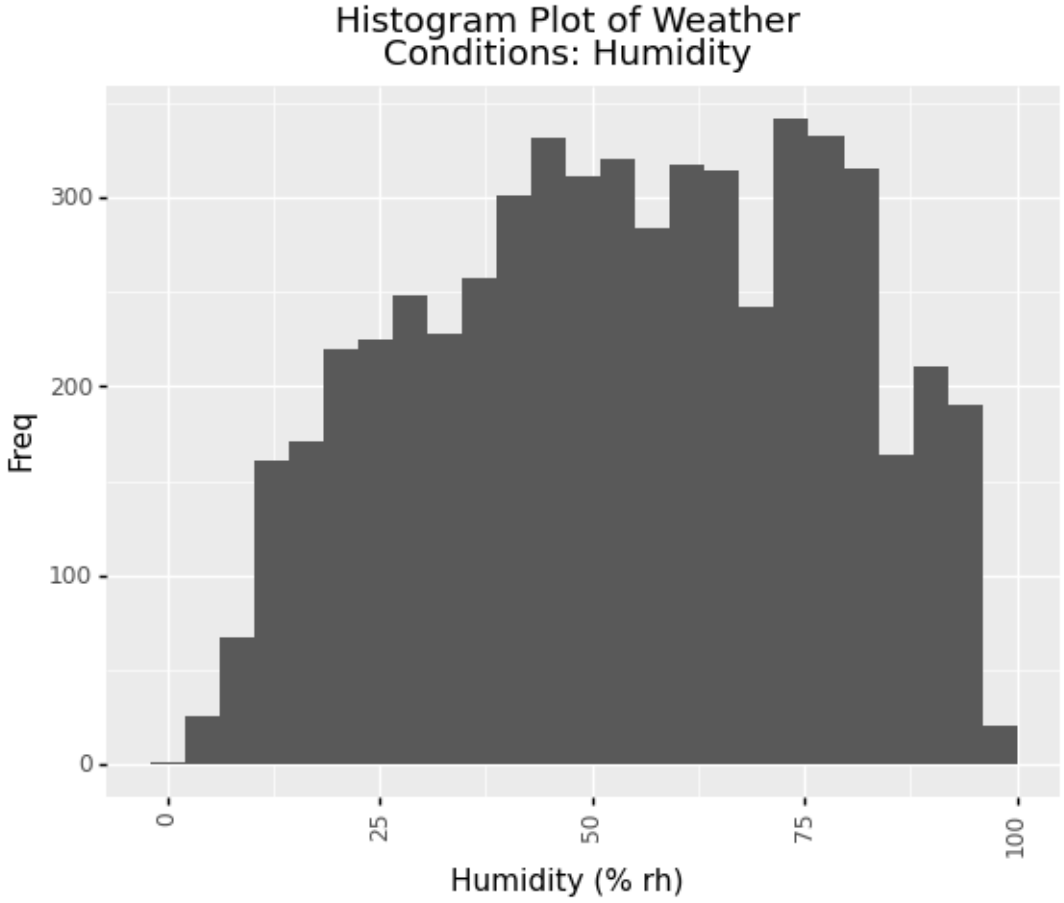

```
 <ggplot: (8743497445509)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```



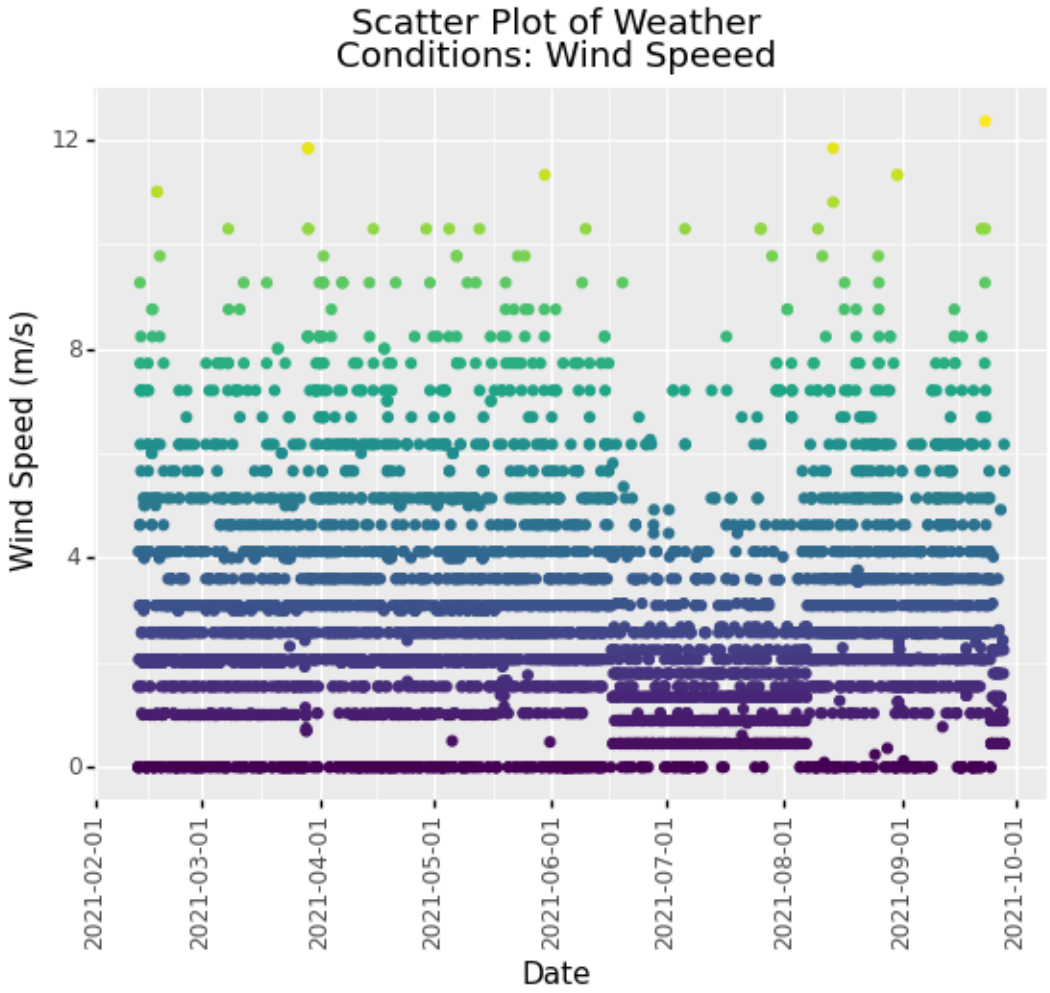

```
<ggplot: (8743348687317)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/plotnine/stats/stat_bin.py:93: PlotnineWarning: 'stat_bin()' using
'bins = 25'. Pick better value with 'binwidth'.
```



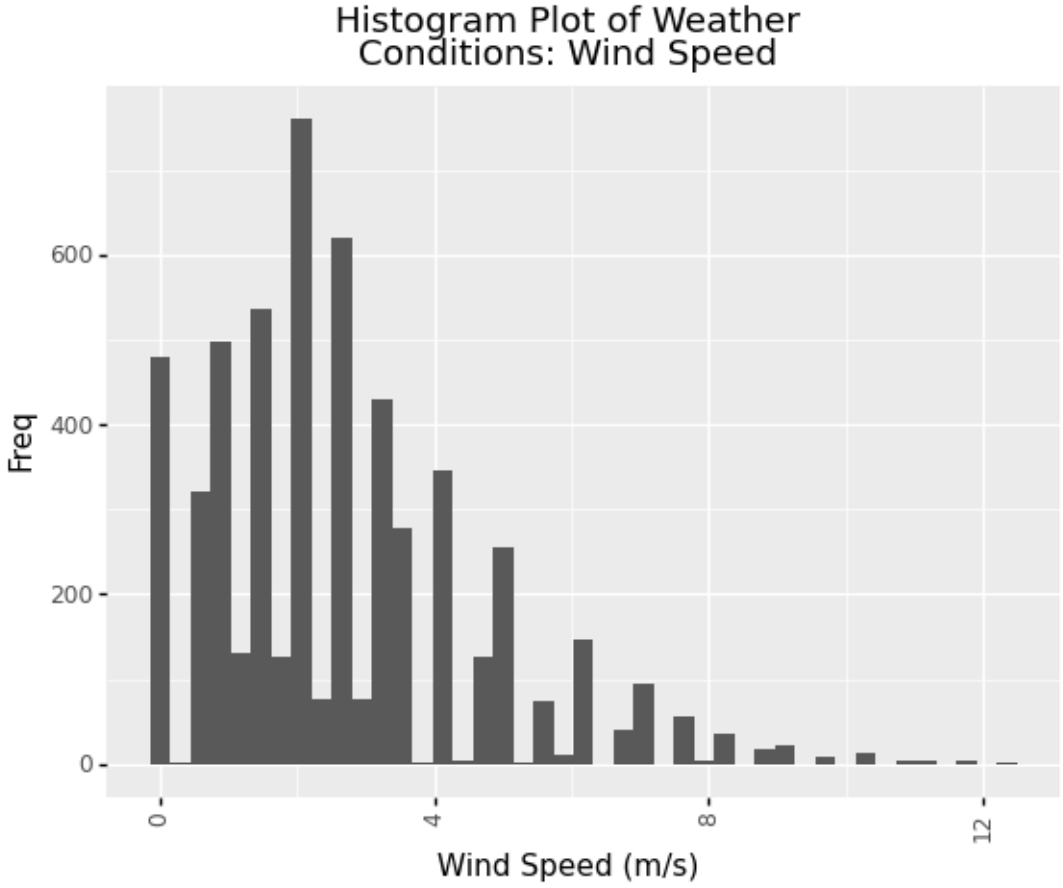

```
<ggplot: (8743456713213)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```



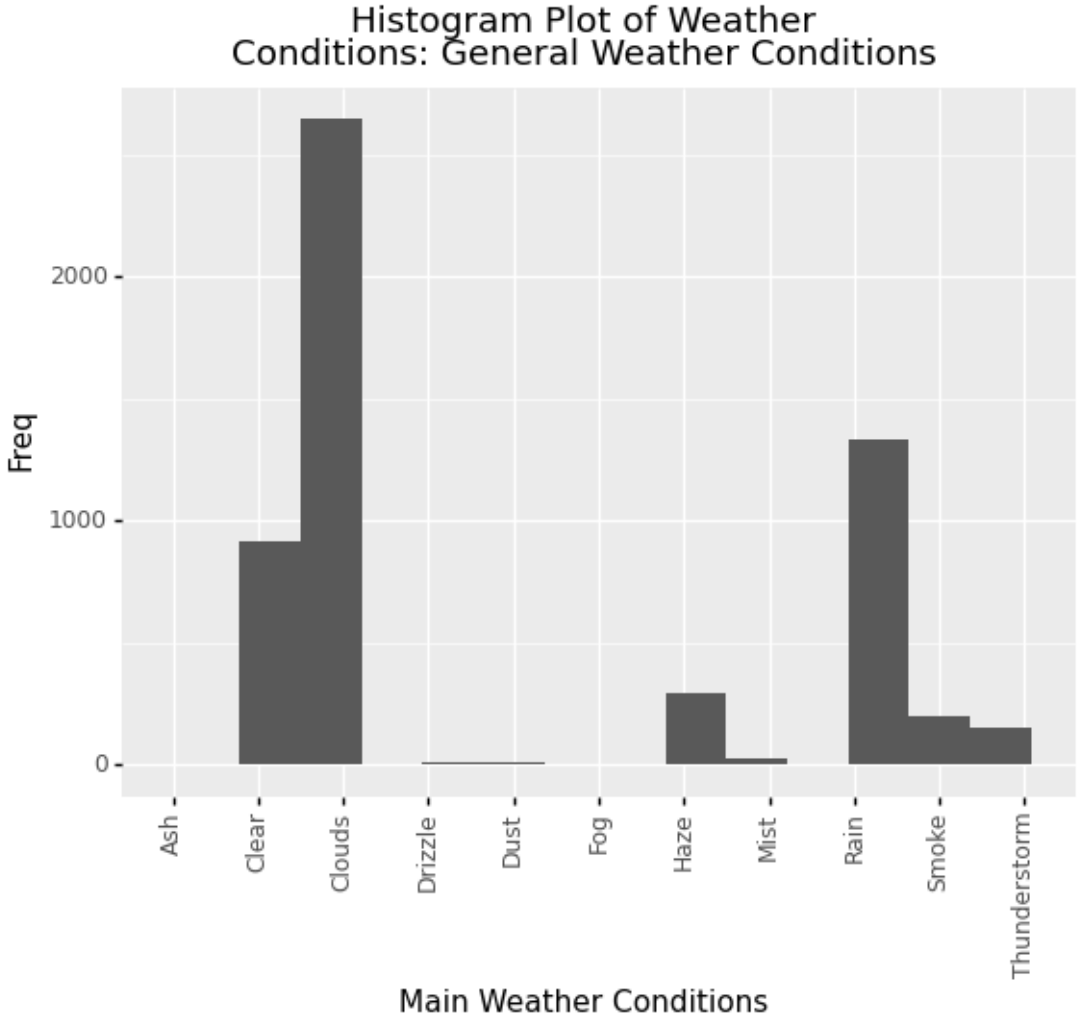

```
<ggplot: (8743563410733)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/plotnine/stats/stat_bin.py:93: PlotnineWarning: 'stat_bin()' using
'bins = 43'. Pick better value with 'binwidth'.
```




```
<ggplot: (8743555209301)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/plotnine/stats/stat_bin.py:93: PlotnineWarning: 'stat_bin()' using
'bins = 15'. Pick better value with 'binwidth'.
```




```
<ggplot: (8743466170829)>
```

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple` in IPython 7.17 and above.
```

1.7 References

- Bosch BME680 Datasheet. 2021.
- Mancuso, Daniel. Indoor Air Quality Monitor | Hackster.io. 2019.
- OpenWeatherData: History Bulk weather data Documentation