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!

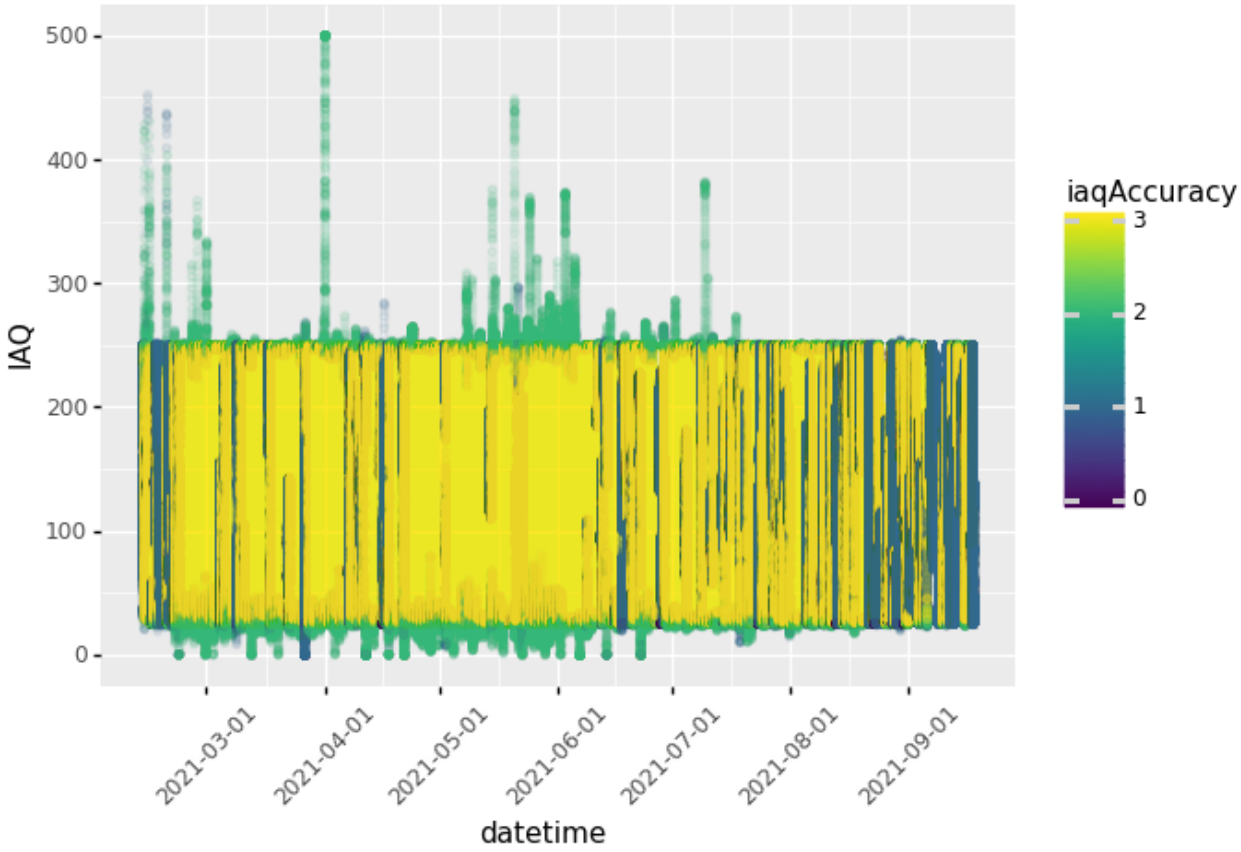
```
CPU times: user 2min 55s, sys: 5.54 s, total: 3min 1s
Wall time: 3min 1s
```

	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

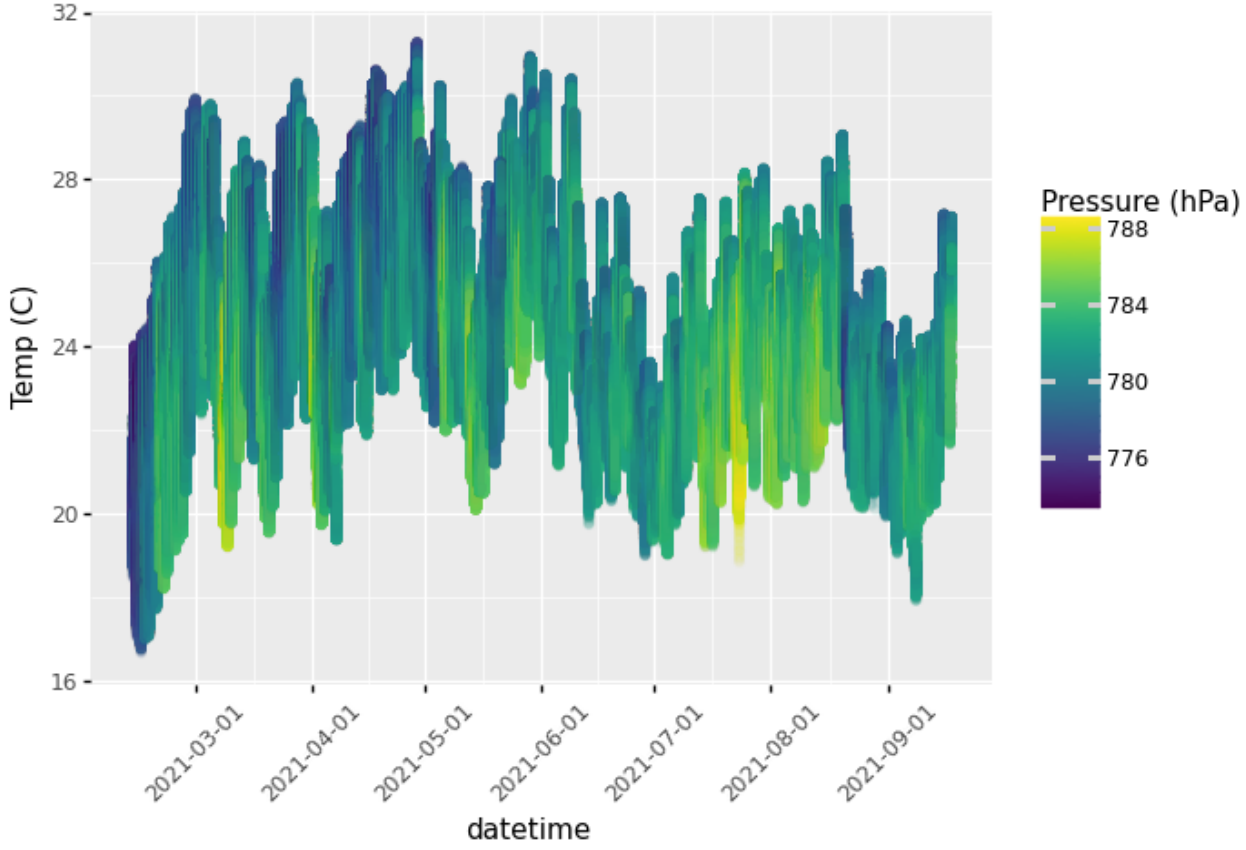
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple`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

```
(6285103, 12)
```




```
<ggplot: (8759878048277)>
```

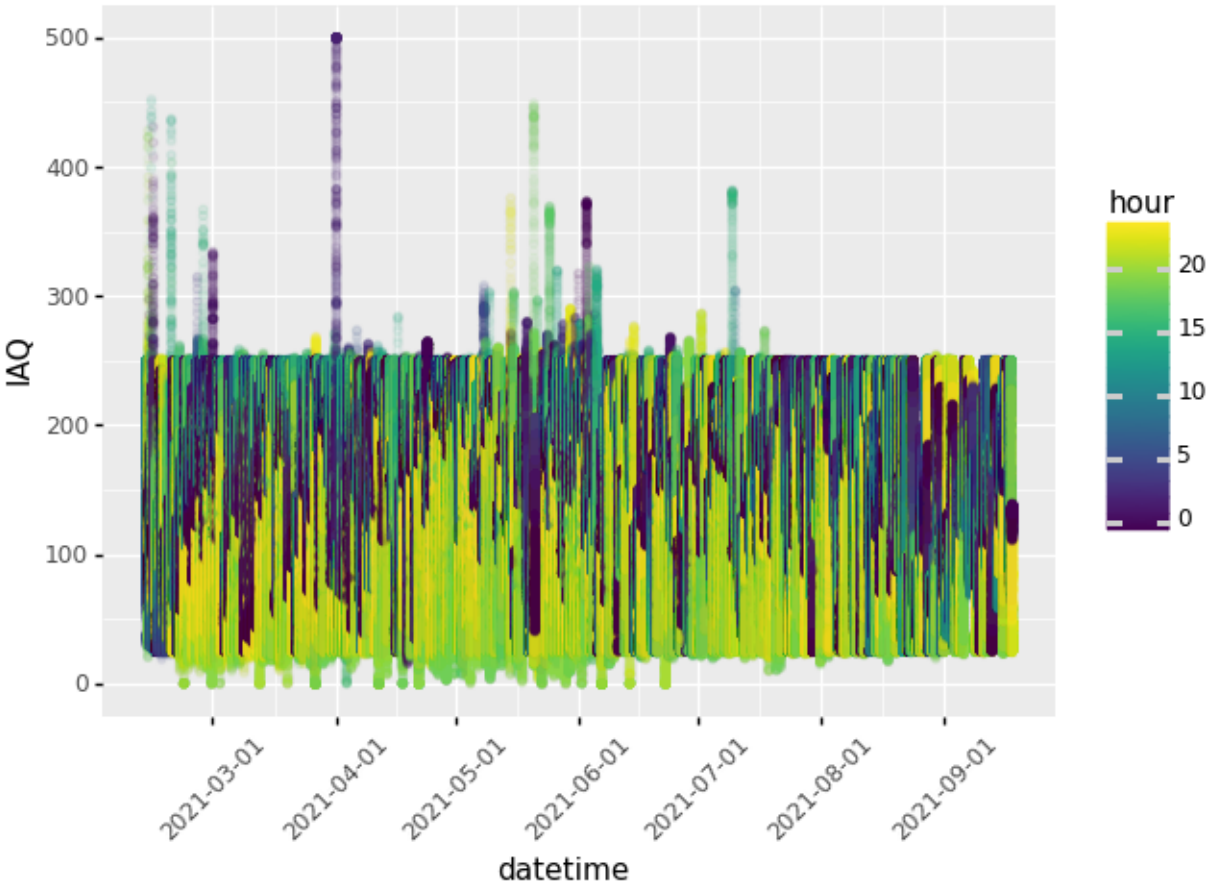
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple`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




```
<ggplot: (8759869828161)>
```

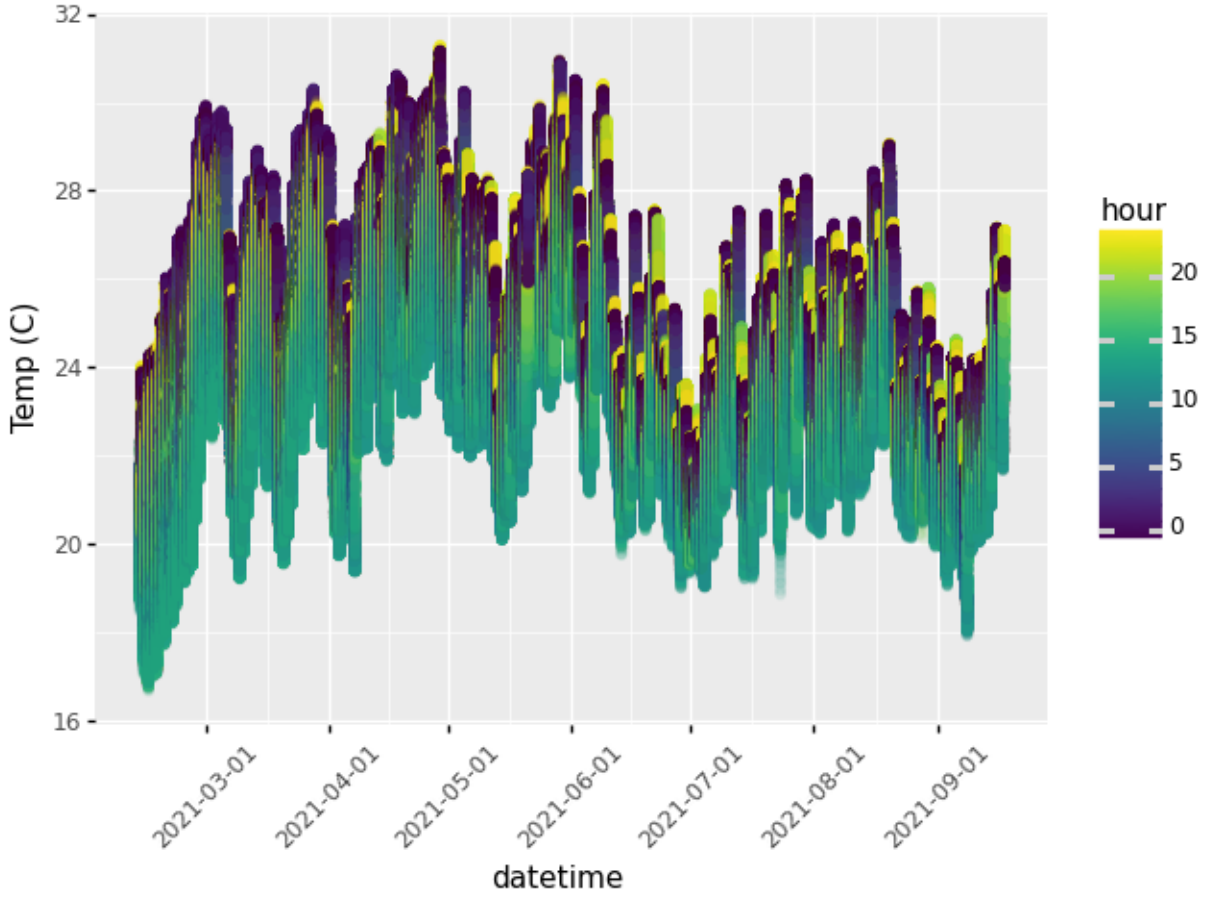
1.2 Hourly Plots

```
/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.
```



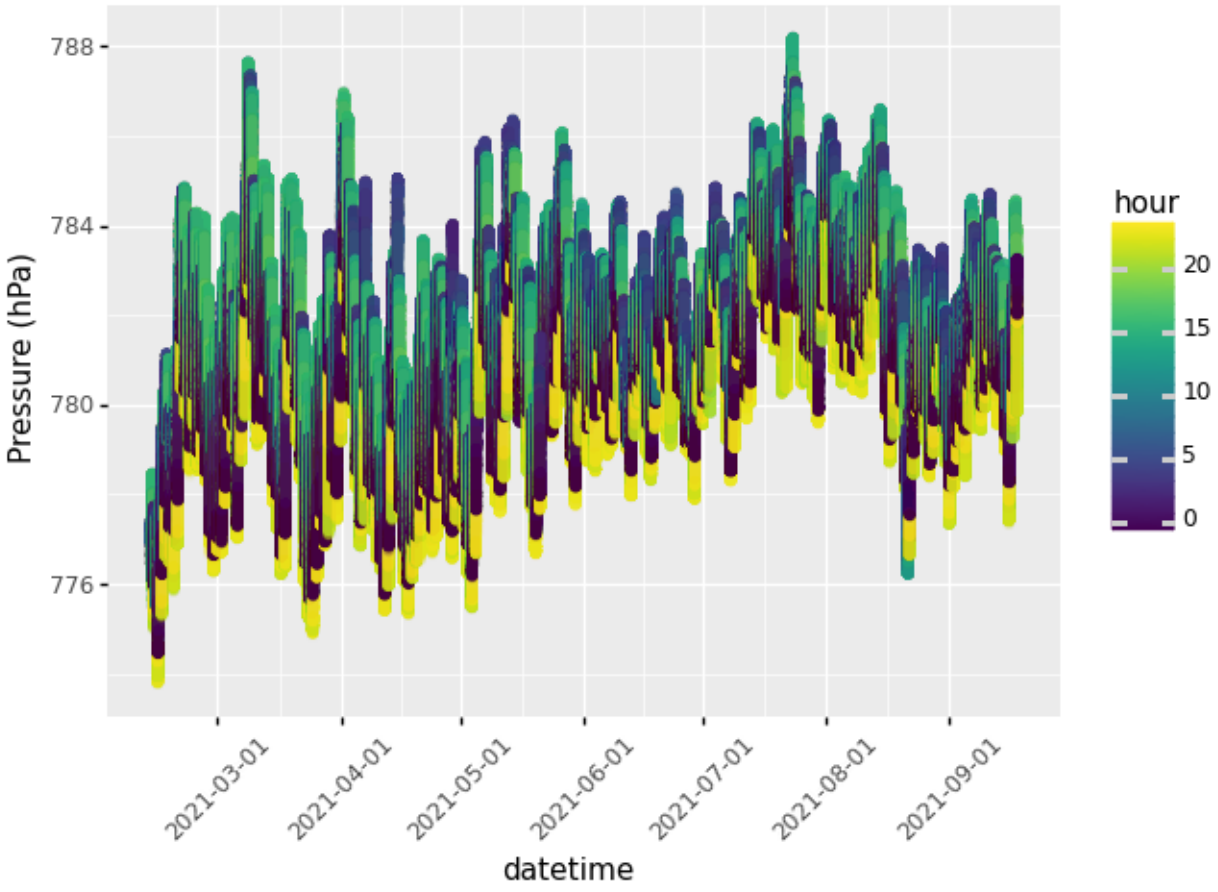

```
<ggplot: (8759792563449)>
```

```
/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.
```



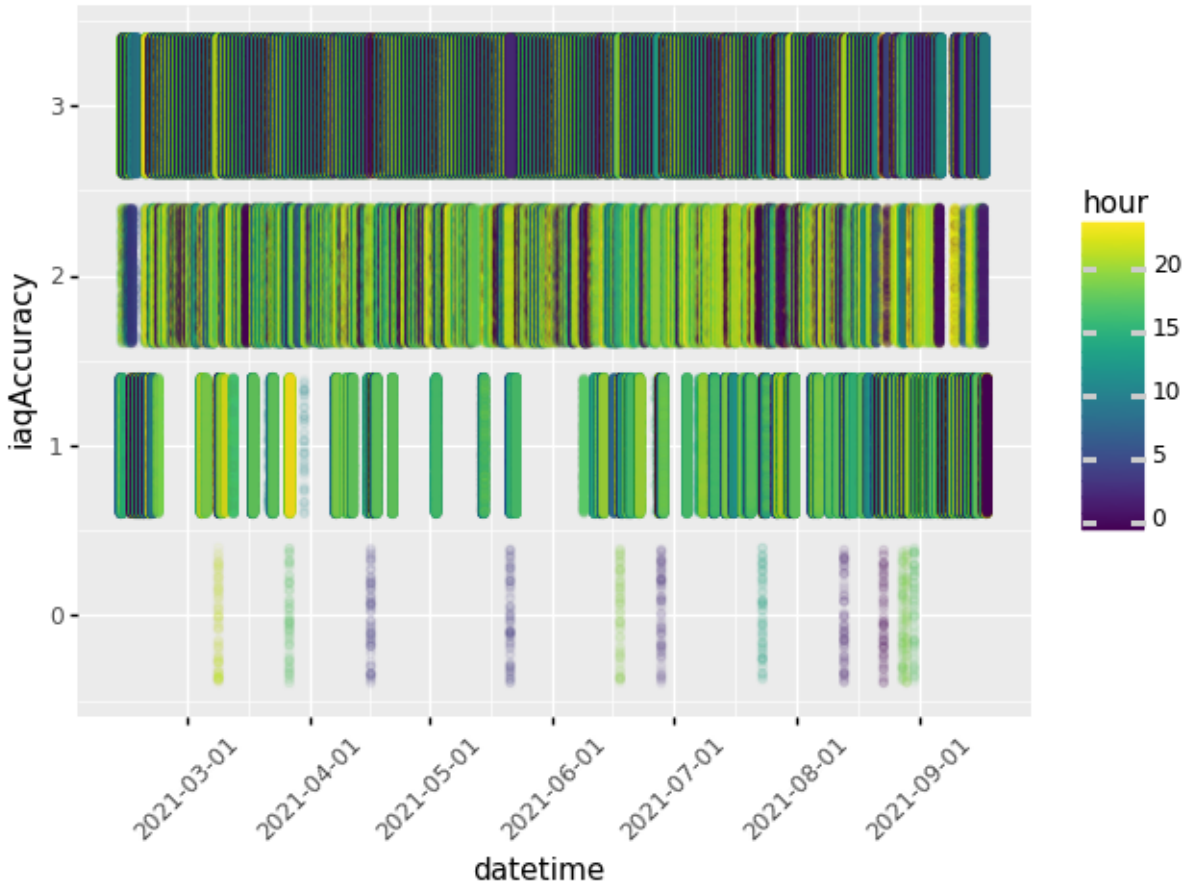
<ggplot: (8759792572893)>

/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: (8759792567581)>
```

```
/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: (8759792217949)>
```

```
/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

```
/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/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

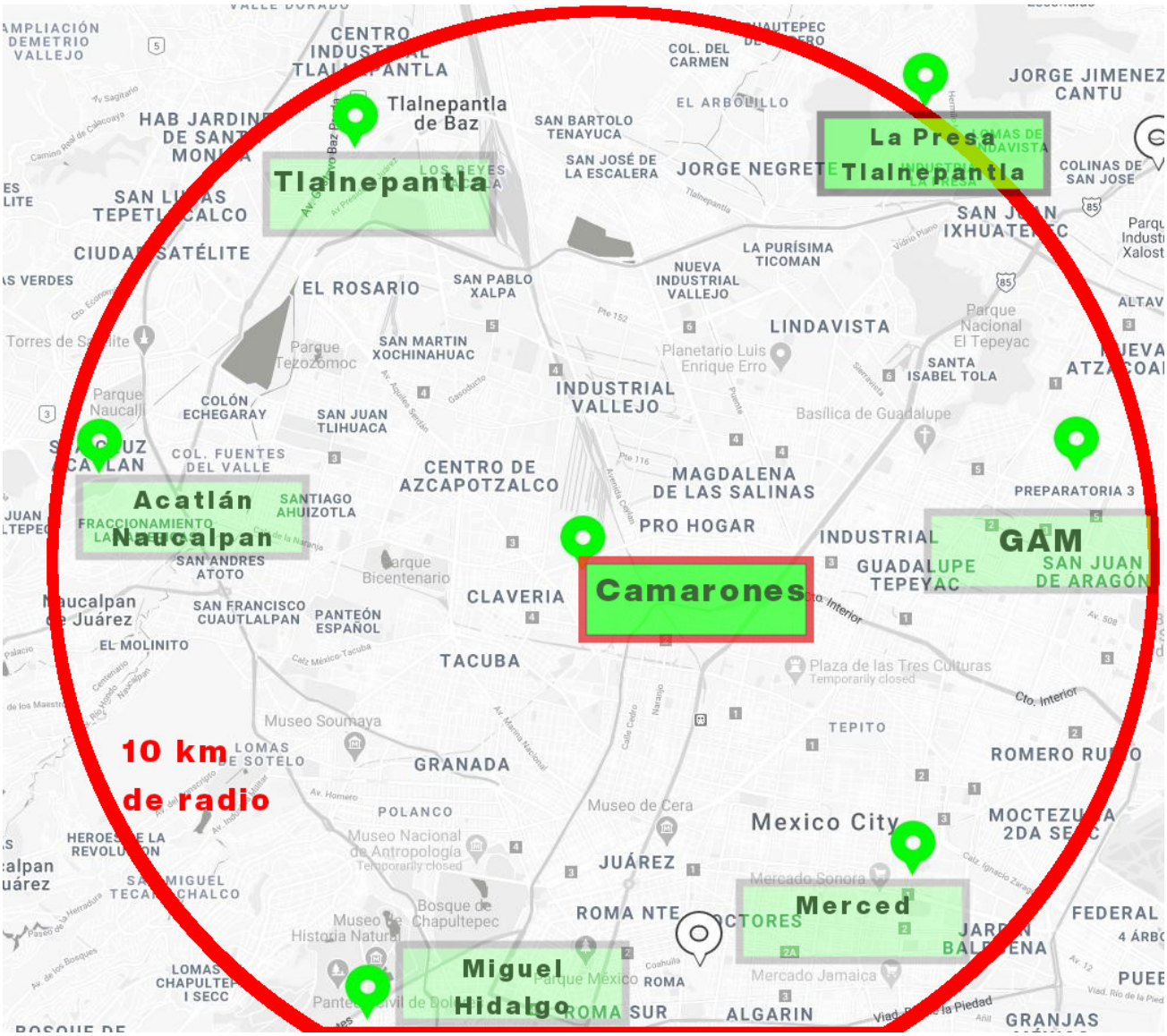
```
37       SO2 2021-10-08  0.000    ppm     Merced
38       SO2 2021-10-08  0.001    ppm     Merced
```

```
/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.
```

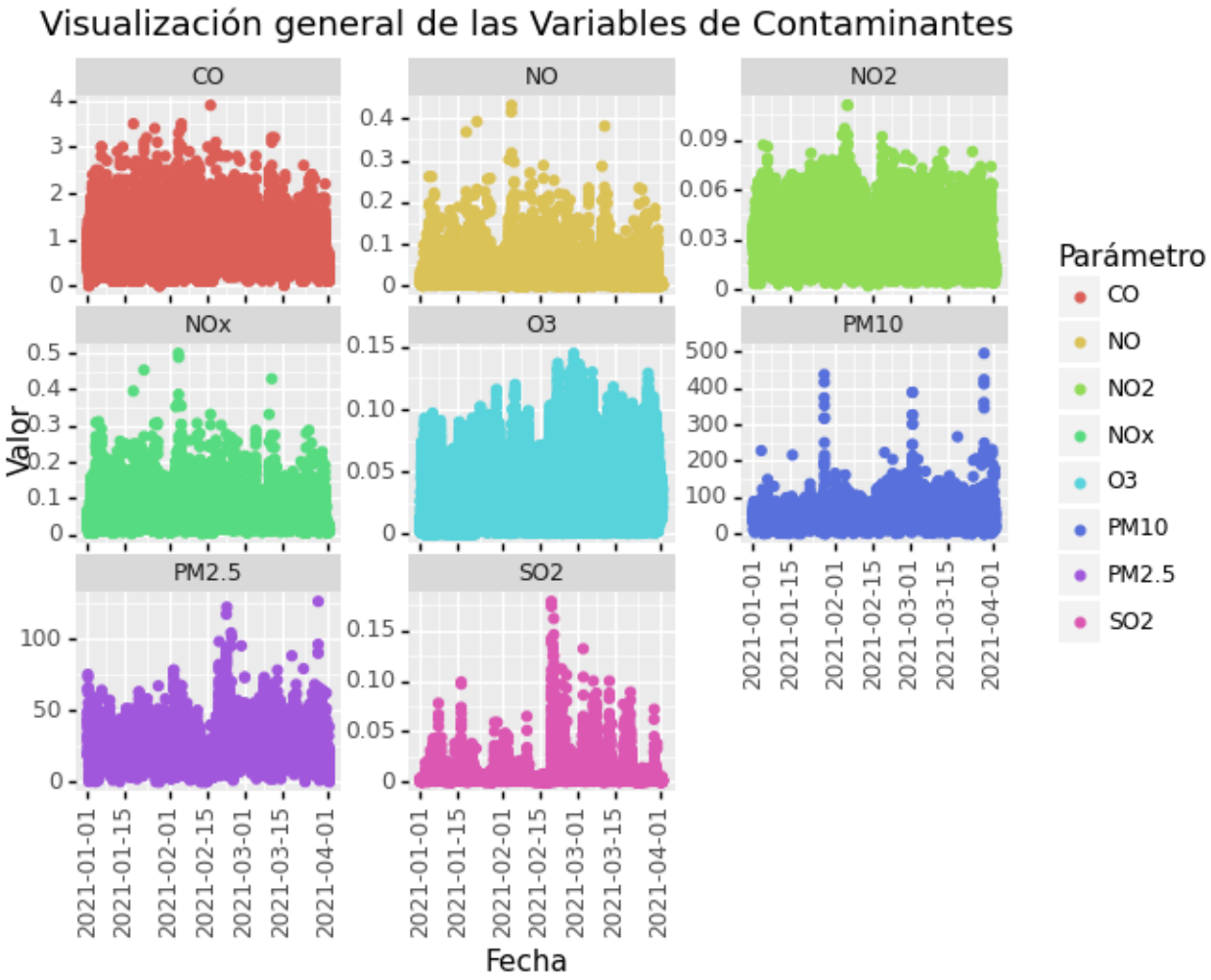
```
   Parámetro      Fecha  Valor Unidad   Estacion
1         CO 2021-01-01  0.600    ppm  Camarones
1         NO 2021-01-01  0.006    ppm  Camarones
1        NO2 2021-01-01  0.029    ppm  Camarones
1        NOx 2021-01-01  0.034    ppm  Camarones
1         O3 2021-01-01  0.011    ppm  Camarones
..       …        …    …    …        …
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:



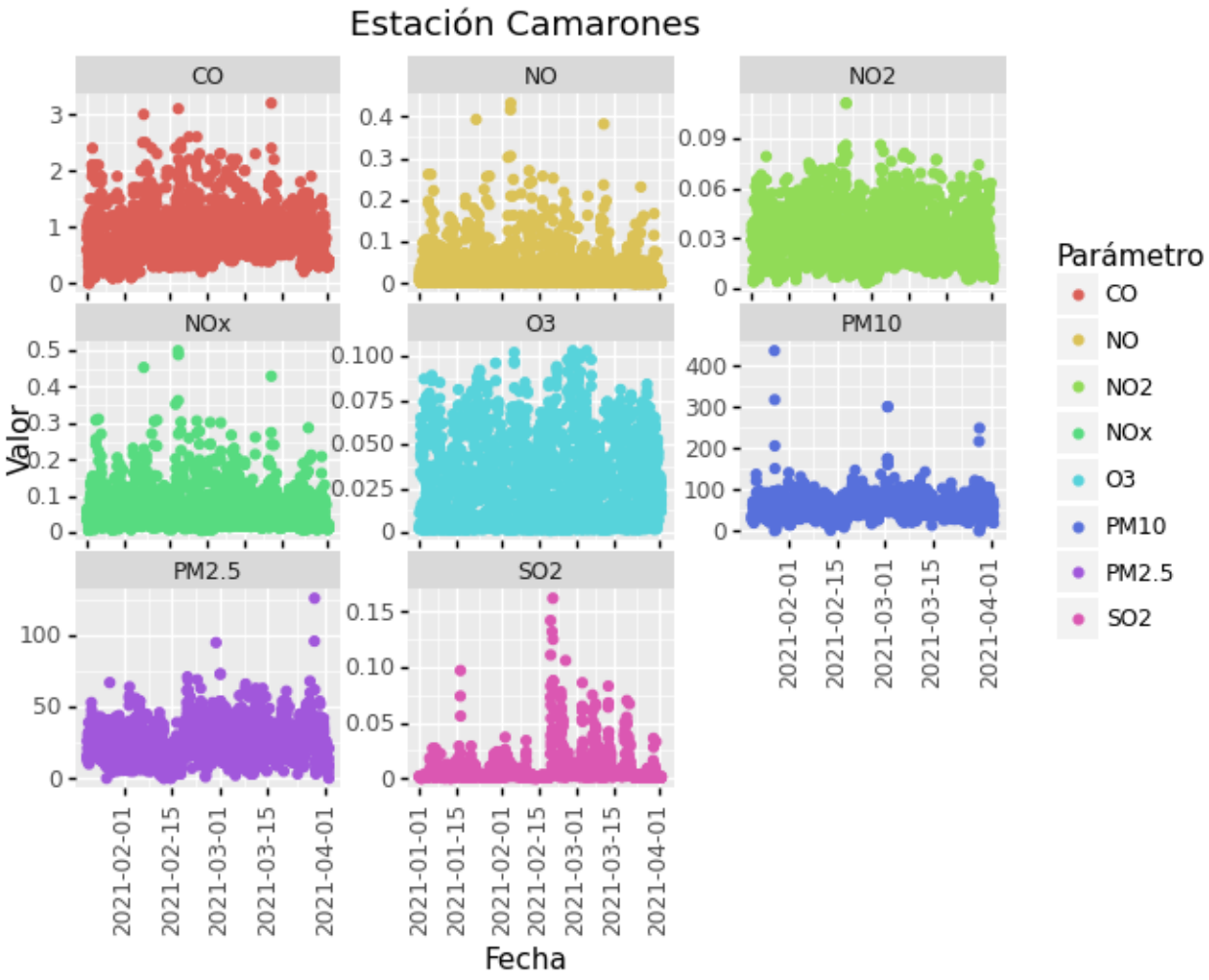

```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple`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




```
<ggplot: (8759791742085)>
```

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: (8759877268541)>
```

```
/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 31.8 s, sys: 7.06 s, total: 38.9 s
Wall time: 38.9 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 00:00:00   0.600    ppm     Camarones
1          NO 2021-01-01 00:00:00   0.006    ppm     Camarones
1         NO2 2021-01-01 00:00:00   0.029    ppm     Camarones
1         NOx 2021-01-01 00:00:00   0.034    ppm     Camarones
1          O3 2021-01-01 00:00:00   0.011    ppm     Camarones
..        …                   …     …    …           …
425       NOx 2021-04-01 23:00:00   0.014    ppm  Tlalnepantla
701        O3 2021-04-01 23:00:00   0.029    ppm  Tlalnepantla
681      PM10 2021-04-01 23:00:00  55.000  µg/m³  Tlalnepantla
679     PM2.5 2021-04-01 23:00:00  22.000  µg/m³  Tlalnepantla
696       SO2 2021-04-01 23:00:00   0.002    ppm  Tlalnepantla

[88034 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           0.6         0.006          0.029
1    2021-01-01 01:00:00           1.0         0.021          0.038
2    2021-01-01 02:00:00           0.8         0.013          0.035
3    2021-01-01 03:00:00           1.0         0.031          0.034
4    2021-01-01 04:00:00           0.6         0.005          0.029
```

```
…                   …            …           …            …
2166 2021-04-01 19:00:00           0.4         0.003          0.011
2167 2021-04-01 20:00:00           0.4         0.002          0.011
2168 2021-04-01 21:00:00           0.4         0.002          0.013
2169 2021-04-01 22:00:00           0.4         0.002          0.019
2170 2021-04-01 23:00:00           0.4         0.001          0.014

      Camarones_NOx  Camarones_O3  Camarones_PM10  Camarones_PM2.5  \
0             0.034         0.011             NaN              NaN
1             0.059         0.002             NaN              NaN
2             0.049         0.003             NaN              NaN
3             0.065         0.002             NaN              NaN
4             0.034         0.005             NaN              NaN
…               …             …               …                …
2166          0.013         0.016            69.0              7.0
2167          0.012         0.018            71.0              9.0
2168          0.015         0.016            37.0              9.0
2169          0.021         0.012            19.0              0.0
2170          0.015         0.021            61.0             21.0

      Camarones_SO2  FES Acatlán_CO  …  Miguel Hidalgo_O3  \
0             0.002             0.4  …              0.009
1             0.002             0.6  …              0.006
2             0.001             0.9  …              0.003
3             0.001             0.8  …              0.004
4             0.001             1.0  …              0.006
…               …               …  …                …
2166          0.001             0.3  …              0.023
2167          0.001             0.2  …              0.024
2168          0.001             0.2  …              0.023
2169          0.001             0.1  …              0.027
2170          0.001             0.2  …              0.033

      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
…                    …                …                …                 …
2166               0.000              0.3            0.009             0.017
2167               0.000              0.4            0.004             0.015
2168               0.000              0.3            0.002             0.014
2169               0.000              0.3            0.002             0.011
2170               0.001              0.3            0.001             0.014

      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
…                  …                …                  …
2166             0.025            0.017               52.0
2167             0.019            0.020               22.0
2168             0.017            0.021               21.0
2169             0.013            0.022               11.0
2170             0.014            0.029               55.0
```

```
      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
…                    …                 …
2166                24.0             0.003
2167                10.0             0.005
2168                14.0             0.002
2169                 7.0             0.001
2170                22.0             0.002

[2171 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	2050.0	0.771805	
Camarones_NO	Camarones_NO	2042.0	0.025181	
Camarones_NO2	Camarones_NO2	2042.0	0.031787	
Camarones_NOx	Camarones_NOx	2042.0	0.056961	
Camarones_O3	Camarones_O3	2042.0	0.025693	
Camarones_PM10	Camarones_PM10	1616.0	58.066213	
Camarones_PM2.5	Camarones_PM2.5	1604.0	25.158978	
Camarones_SO2	Camarones_SO2	2042.0	0.006598	
FES Acatlán_CO	FES Acatlán_CO	2020.0	0.634901	
FES Acatlán_NO	FES Acatlán_NO	1304.0	0.014301	
FES Acatlán_NO2	FES Acatlán_NO2	2015.0	0.025607	
FES Acatlán_NOx	FES Acatlán_NOx	2019.0	0.041234	
FES Acatlán_O3	FES Acatlán_O3	2015.0	0.033841	
FES Acatlán_PM10	FES Acatlán_PM10	1991.0	47.245605	
FES Acatlán_SO2	FES Acatlán_SO2	2015.0	0.006546	
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	2087.0	1.151749	
Merced_NO	Merced_NO	1381.0	0.021361	
Merced_NO2	Merced_NO2	2070.0	0.032723	
Merced_NOx	Merced_NOx	2070.0	0.056423	
Merced_O3	Merced_O3	2076.0	0.028389	
Merced_PM10	Merced_PM10	2142.0	54.485061	
Merced_PM2.5	Merced_PM2.5	2137.0	26.730463	
Merced_SO2	Merced_SO2	2094.0	0.006420	
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%      max  \
Camarones_CO             0.430131  0.000   0.500   0.700   1.0000    3.200
Camarones_NO             0.045487  0.000   0.002   0.006   0.0260    0.432
Camarones_NO2            0.015682  0.003   0.020   0.031   0.0420    0.111
Camarones_NOx            0.054418  0.004   0.022   0.039   0.0710    0.499
Camarones_O3             0.024107  0.001   0.004   0.018   0.0420    0.103
Camarones_PM10          26.906212  0.000  41.000  55.000  71.0000  437.000
Camarones_PM2.5         12.946419  0.000  16.000  24.000  33.0000  126.000
Camarones_SO2            0.013053  0.000   0.002   0.003   0.0050    0.162
FES Acatlán_CO           0.370808  0.100   0.400   0.500   0.8000    2.900
FES Acatlán_NO           0.024926  0.000   0.002   0.004   0.0130    0.215
FES Acatlán_NO2          0.014263  0.002   0.015   0.023   0.0330    0.092
FES Acatlán_NOx          0.035480  0.002   0.018   0.028   0.0520    0.260
FES Acatlán_O3           0.026037  0.003   0.013   0.027   0.0480    0.137
FES Acatlán_PM10        32.511497  0.000  27.000  41.000  61.0000  388.000
FES Acatlán_SO2          0.010034  0.000   0.002   0.004   0.0070    0.136
Gustavo A. Madero_NO2    0.014361  0.003   0.013   0.026   0.0360    0.081
Gustavo A. Madero_O3     0.029610  0.001   0.004   0.023   0.0510    0.128
Gustavo A. Madero_PM10  27.911189  0.000  34.500  50.000  67.0000  495.000
Gustavo A. Madero_PM2.5 13.182547  0.000  14.000  22.000  31.0000  117.000
La Presa_CO              0.513861  0.100   0.600   0.800   1.1000    3.500
La Presa_O3              0.025911  0.001   0.006   0.024   0.0455    0.118
La Presa_SO2             0.009749  0.000   0.001   0.002   0.0050    0.118
Merced_CO                0.413130  0.500   0.900   1.000   1.3000    3.900
Merced_NO                0.034552  0.000   0.003   0.008   0.0220    0.318
Merced_NO2               0.014052  0.005   0.022   0.032   0.0410    0.087
Merced_NOx               0.044741  0.006   0.027   0.042   0.0710    0.386
Merced_O3                0.029109  0.000   0.003   0.018   0.0460    0.140
Merced_PM10             23.727621  0.000  39.000  53.000  67.0000  411.000
Merced_PM2.5            12.805604  0.000  18.000  25.000  33.0000  122.000
Merced_SO2               0.010345  0.000   0.002   0.003   0.0060    0.146
Miguel Hidalgo_CO        0.343697  0.000   0.300   0.500   0.7000    2.600
Miguel Hidalgo_NO        0.038798  0.000   0.002   0.005   0.0220    0.368
Miguel Hidalgo_NO2       0.013166  0.004   0.019   0.028   0.0390    0.086
Miguel Hidalgo_NOx       0.046729  0.005   0.022   0.034   0.0620    0.395
Miguel Hidalgo_O3        0.028588  0.002   0.009   0.027   0.0500    0.145
Miguel Hidalgo_SO2       0.008925  0.000   0.001   0.002   0.0050    0.099
Tlalnepantla_CO          0.360615  0.100   0.500   0.600   0.9000    2.900
Tlalnepantla_NO          0.031055  0.000   0.003   0.007   0.0220    0.219
Tlalnepantla_NO2         0.014525  0.004   0.021   0.030   0.0390    0.097
Tlalnepantla_NOx         0.040767  0.005   0.026   0.039   0.0660    0.274
Tlalnepantla_O3          0.025335  0.000   0.007   0.020   0.0430    0.125
Tlalnepantla_PM10       27.959538  0.000  33.000  45.000  59.0000  423.000
Tlalnepantla_PM2.5      12.075484  0.000  14.000  21.000  29.0000   90.000
Tlalnepantla_SO2         0.014821  0.001   0.002   0.004   0.0080    0.179
Fecha                         NaN    NaN     NaN     NaN      NaN      NaN

                          NAs
Camarones_CO            121.0
Camarones_NO            129.0
Camarones_NO2           129.0
```

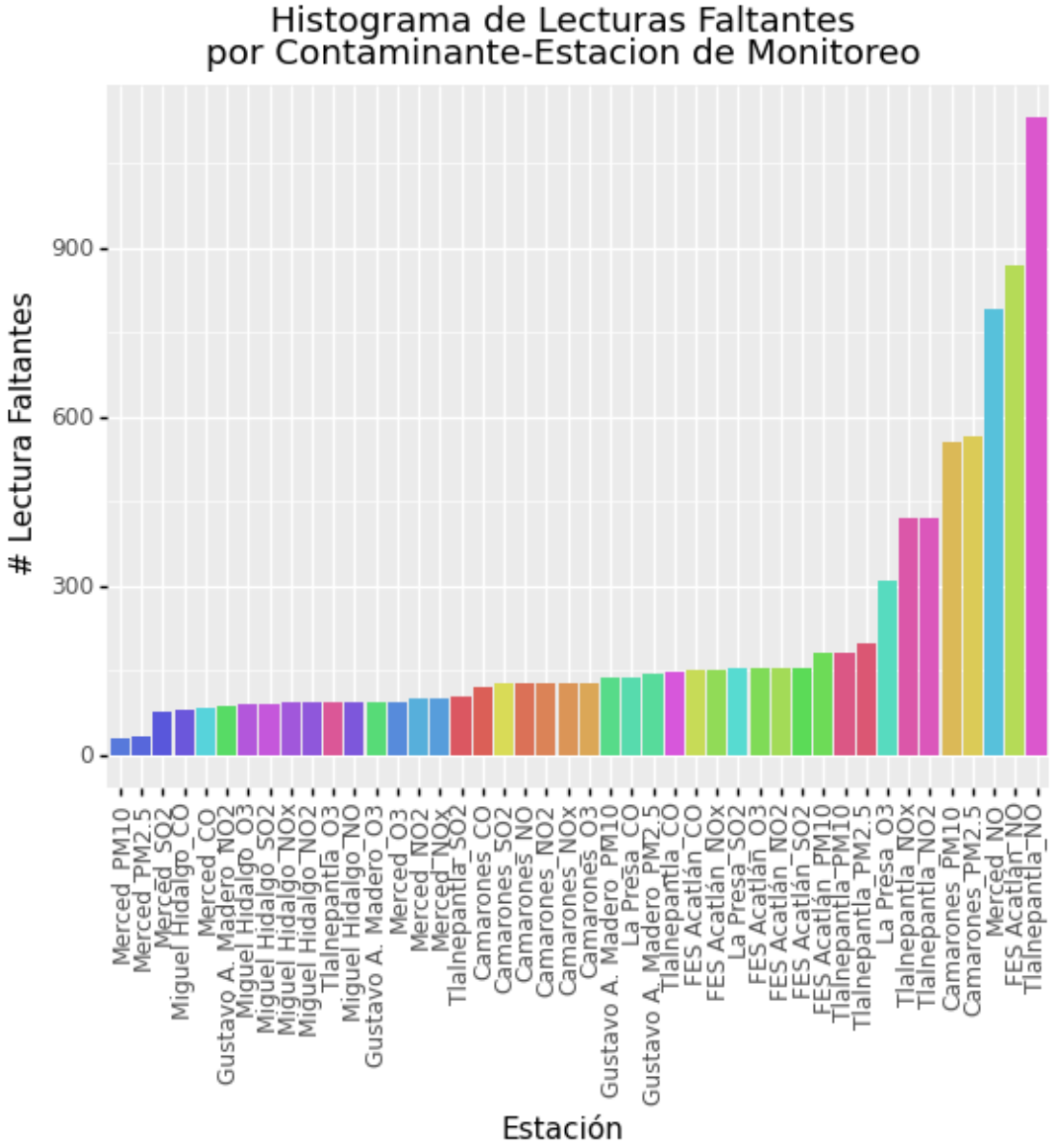
```
Camarones_NOx             129.0
Camarones_O3              129.0
Camarones_PM10            555.0
Camarones_PM2.5           567.0
Camarones_SO2             129.0
FES Acatlán_CO            151.0
FES Acatlán_NO            867.0
FES Acatlán_NO2           156.0
FES Acatlán_NOx           152.0
FES Acatlán_O3            156.0
FES Acatlán_PM10          180.0
FES Acatlán_SO2           156.0
Gustavo A. Madero_NO2      86.0
Gustavo A. Madero_O3       95.0
Gustavo A. Madero_PM10    136.0
Gustavo A. Madero_PM2.5   145.0
La Presa_CO               137.0
La Presa_O3               308.0
La Presa_SO2              154.0
Merced_CO                  84.0
Merced_NO                 790.0
Merced_NO2                101.0
Merced_NOx                101.0
Merced_O3                  95.0
Merced_PM10                29.0
Merced_PM2.5               34.0
Merced_SO2                 77.0
Miguel Hidalgo_CO          81.0
Miguel Hidalgo_NO          94.0
Miguel Hidalgo_NO2         93.0
Miguel Hidalgo_NOx         93.0
Miguel Hidalgo_O3          89.0
Miguel Hidalgo_SO2         90.0
Tlalnepantla_CO           148.0
Tlalnepantla_NO          1132.0
Tlalnepantla_NO2          420.0
Tlalnepantla_NOx          419.0
Tlalnepantla_O3            94.0
Tlalnepantla_PM10         182.0
Tlalnepantla_PM2.5        198.0
Tlalnepantla_SO2          105.0
Fecha                       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	121.0
1	Camarones_NO	Camarones_NO	129.0
2	Camarones_NO2	Camarones_NO2	129.0
3	Camarones_NOx	Camarones_NOx	129.0

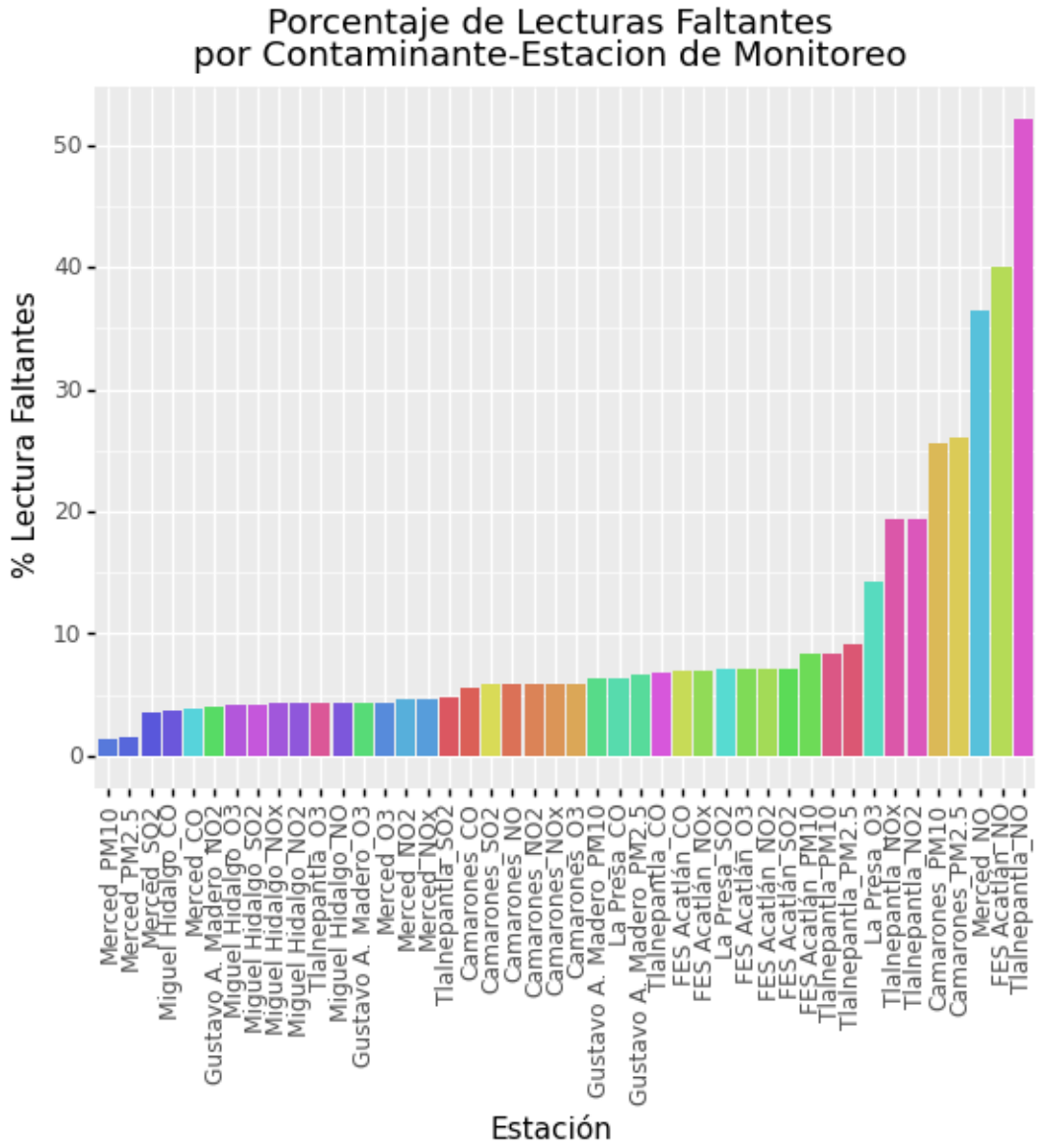
4	Camarones_O3	Camarones_O3	129.0
5	Camarones_PM10	Camarones_PM10	555.0
6	Camarones_PM2.5	Camarones_PM2.5	567.0
7	Camarones_SO2	Camarones_SO2	129.0
8	FES Acatlán_CO	FES Acatlán_CO	151.0
9	FES Acatlán_NO	FES Acatlán_NO	867.0
10	FES Acatlán_NO2	FES Acatlán_NO2	156.0
11	FES Acatlán_NOx	FES Acatlán_NOx	152.0
12	FES Acatlán_O3	FES Acatlán_O3	156.0
13	FES Acatlán_PM10	FES Acatlán_PM10	180.0
14	FES Acatlán_SO2	FES Acatlán_SO2	156.0
15	Gustavo A. Madero_NO2	Gustavo A. Madero_NO2	86.0
16	Gustavo A. Madero_O3	Gustavo A. Madero_O3	95.0
17	Gustavo A. Madero_PM10	Gustavo A. Madero_PM10	136.0
18	Gustavo A. Madero_PM2.5	Gustavo A. Madero_PM2.5	145.0
19	La Presa_CO	La Presa_CO	137.0
20	La Presa_O3	La Presa_O3	308.0
21	La Presa_SO2	La Presa_SO2	154.0
22	Merced_CO	Merced_CO	84.0
23	Merced_NO	Merced_NO	790.0
24	Merced_NO2	Merced_NO2	101.0
25	Merced_NOx	Merced_NOx	101.0
26	Merced_O3	Merced_O3	95.0
27	Merced_PM10	Merced_PM10	29.0
28	Merced_PM2.5	Merced_PM2.5	34.0
29	Merced_SO2	Merced_SO2	77.0
30	Miguel Hidalgo_CO	Miguel Hidalgo_CO	81.0
31	Miguel Hidalgo_NO	Miguel Hidalgo_NO	94.0
32	Miguel Hidalgo_NO2	Miguel Hidalgo_NO2	93.0
33	Miguel Hidalgo_NOx	Miguel Hidalgo_NOx	93.0
34	Miguel Hidalgo_O3	Miguel Hidalgo_O3	89.0
35	Miguel Hidalgo_SO2	Miguel Hidalgo_SO2	90.0
36	Tlalnepantla_CO	Tlalnepantla_CO	148.0
37	Tlalnepantla_NO	Tlalnepantla_NO	1132.0
38	Tlalnepantla_NO2	Tlalnepantla_NO2	420.0
39	Tlalnepantla_NOx	Tlalnepantla_NOx	419.0
40	Tlalnepantla_O3	Tlalnepantla_O3	94.0
41	Tlalnepantla_PM10	Tlalnepantla_PM10	182.0
42	Tlalnepantla_PM2.5	Tlalnepantla_PM2.5	198.0
43	Tlalnepantla_SO2	Tlalnepantla_SO2	105.0

```
/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.
```



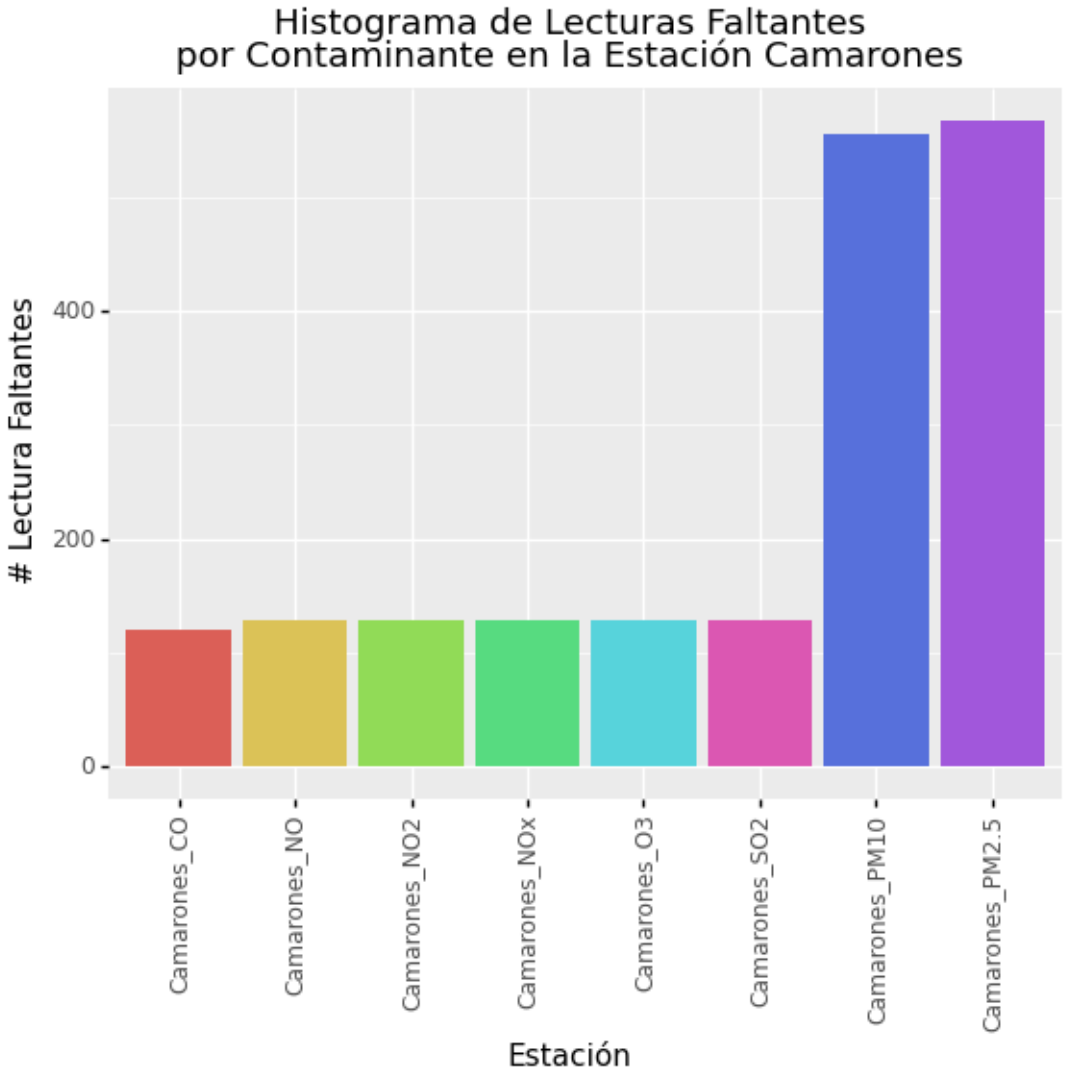

```
<ggplot: (8759875176429)>
```

```
/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.
```



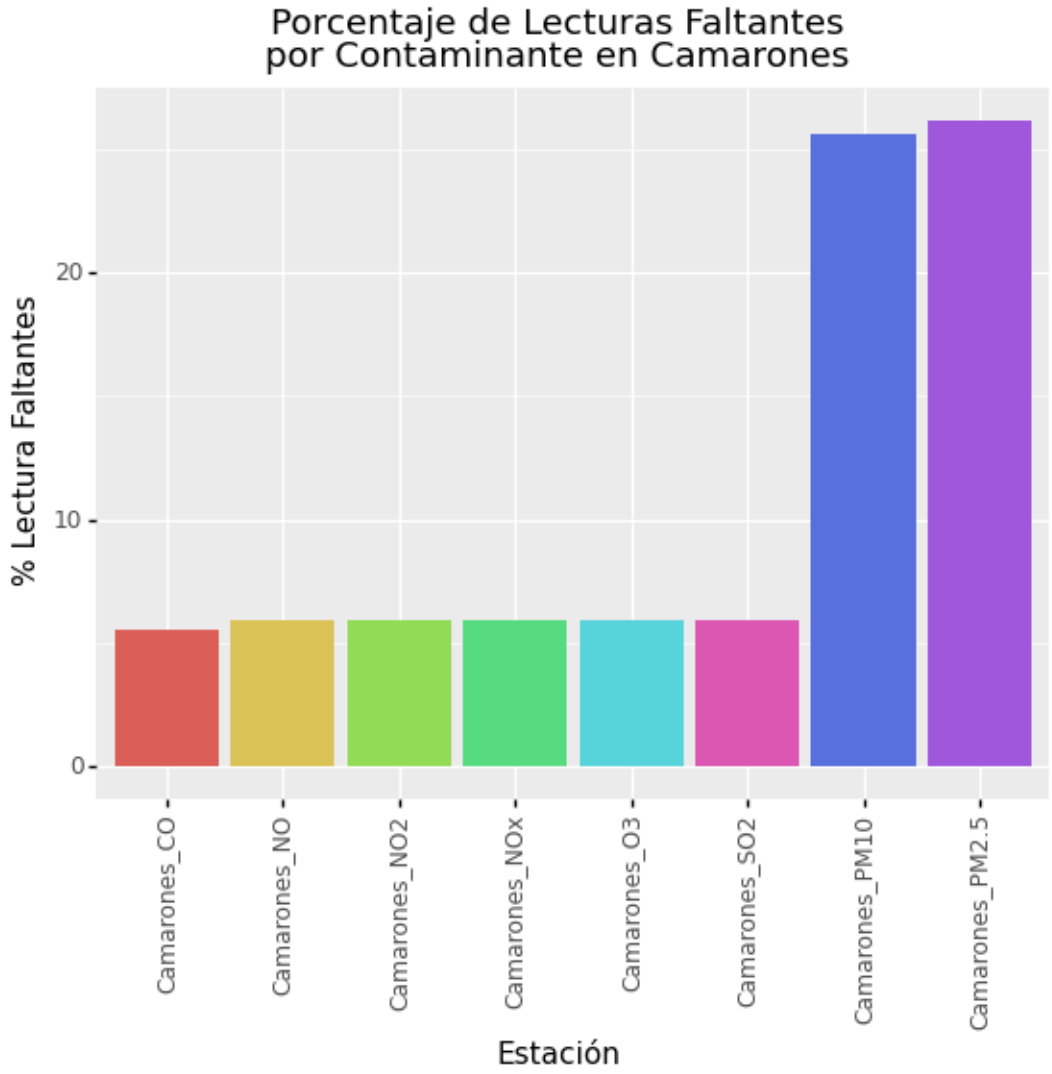

```
<ggplot: (8759685738189)>
```

```
/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: (8759791694833)>
```

```
/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: (8759792099749)>
```

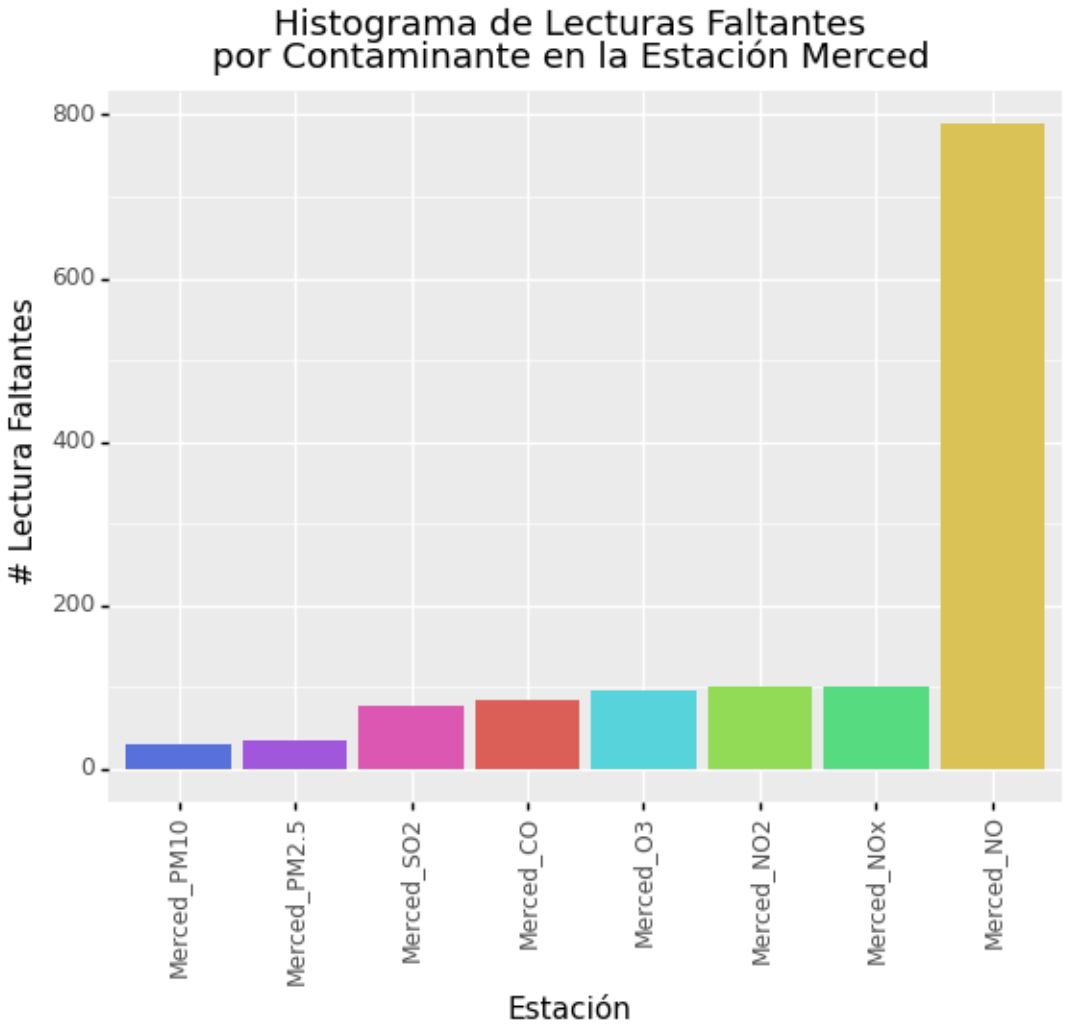
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple`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

		Estacion	NAs
0	Camarones_CO	Camarones_CO	121.0
1	Camarones_NO	Camarones_NO	129.0
2	Camarones_NO2	Camarones_NO2	129.0
3	Camarones_NOx	Camarones_NOx	129.0
4	Camarones_O3	Camarones_O3	129.0
5	Camarones_PM10	Camarones_PM10	555.0
6	Camarones_PM2.5	Camarones_PM2.5	567.0
7	Camarones_SO2	Camarones_SO2	129.0

```
/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.
```

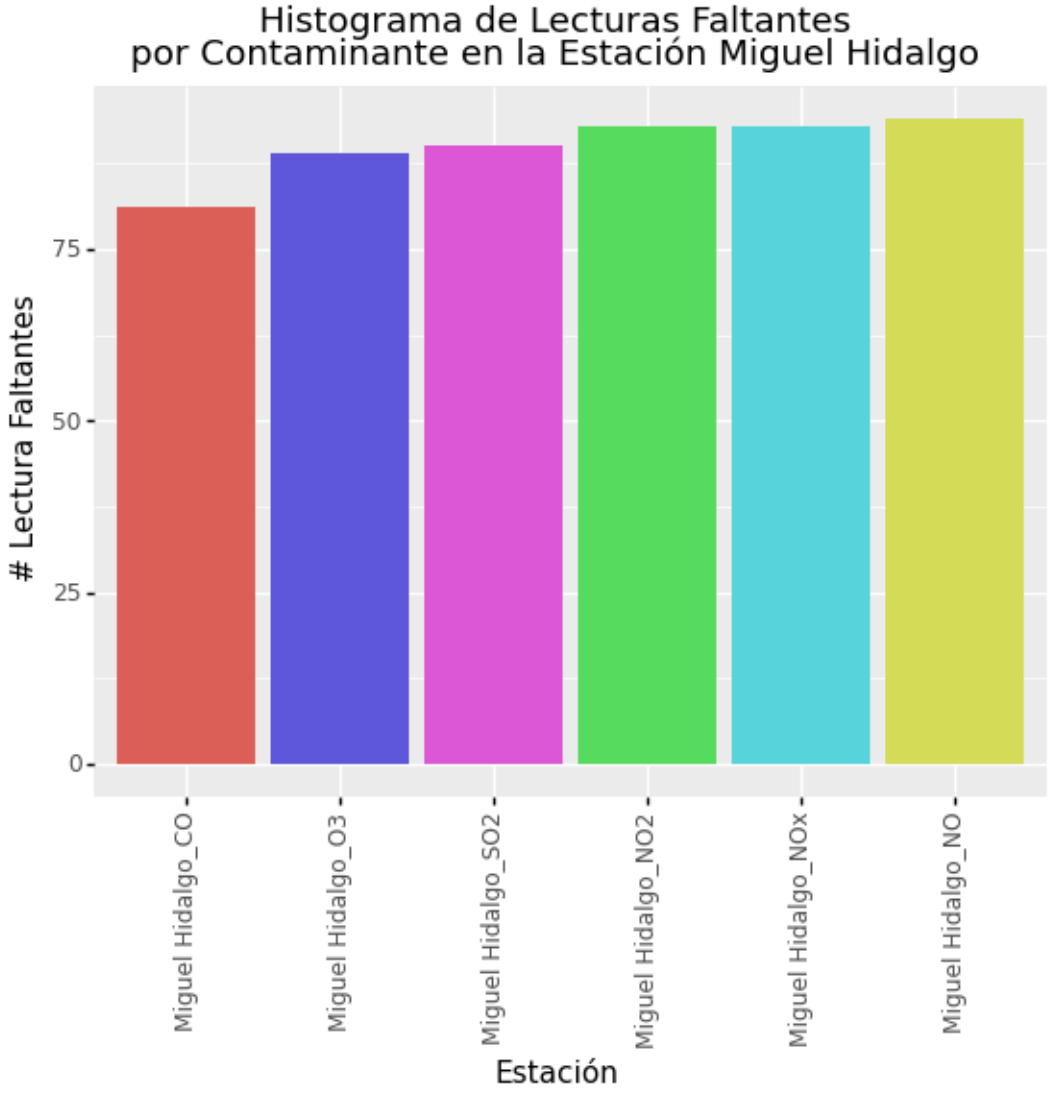
	Estacion	NAs
22	Merced_CO	84.0
23	Merced_NO	790.0
24	Merced_NO2	101.0
25	Merced_NOx	101.0
26	Merced_O3	95.0
27	Merced_PM10	29.0
28	Merced_PM2.5	34.0
29	Merced_SO2	77.0

```
/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: (8759792245861)>
```

```
/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: (8759791713777)>
```

```
/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

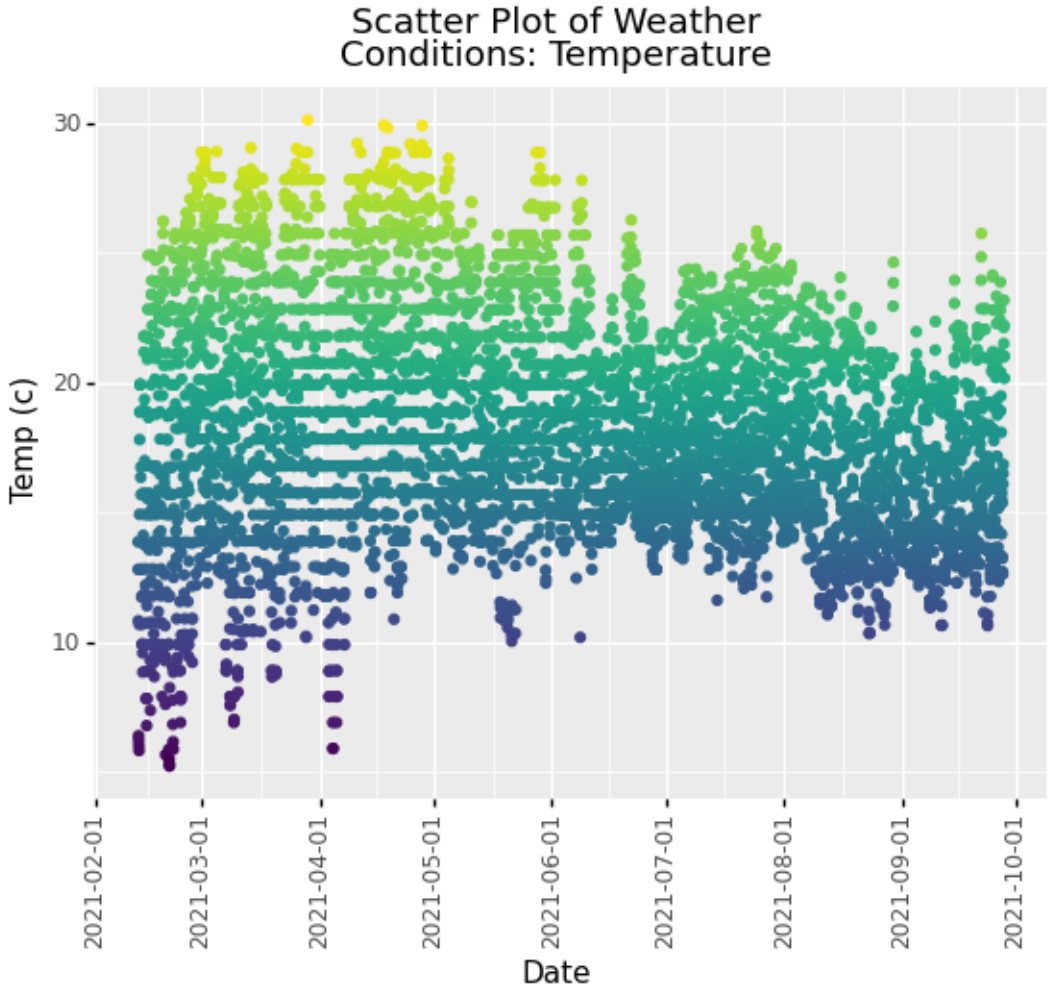
OpenWeatherMap Data

```
/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 1.06 s, sys: 118 ms, total: 1.17 s
Wall time: 1.17 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
```

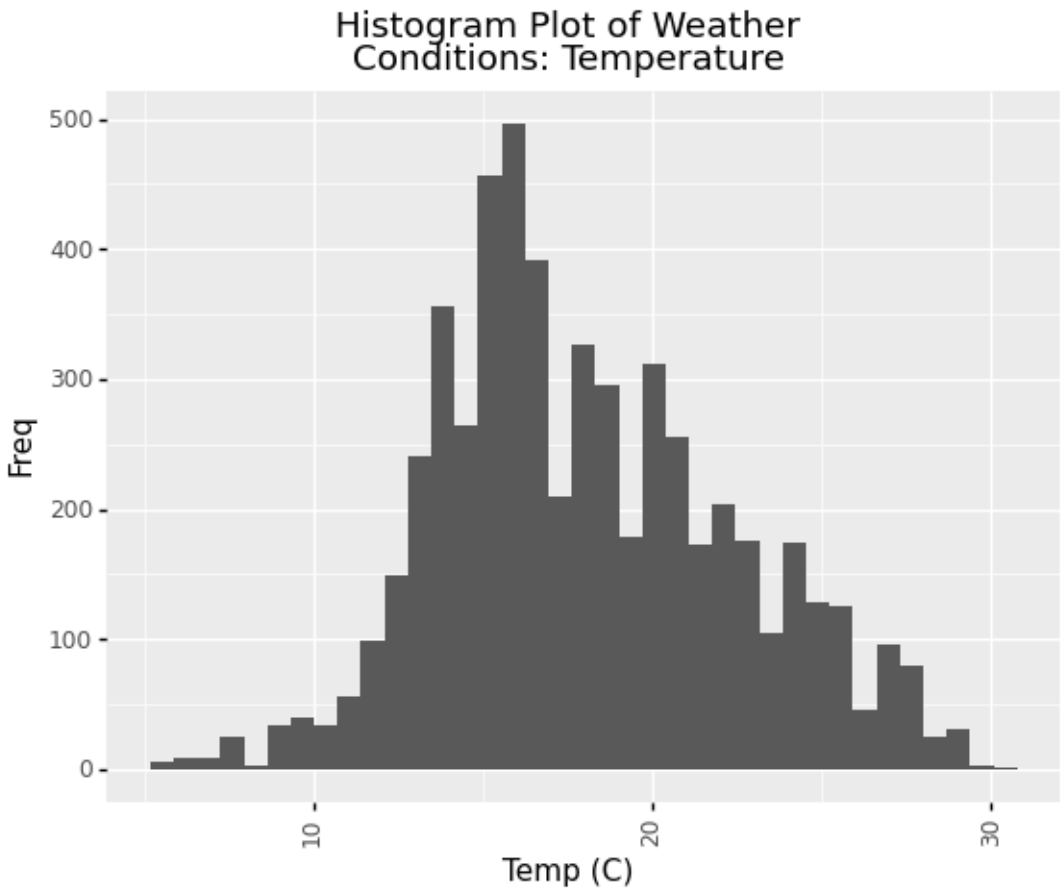
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple`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




```
<ggplot: (8759871460657)>
```

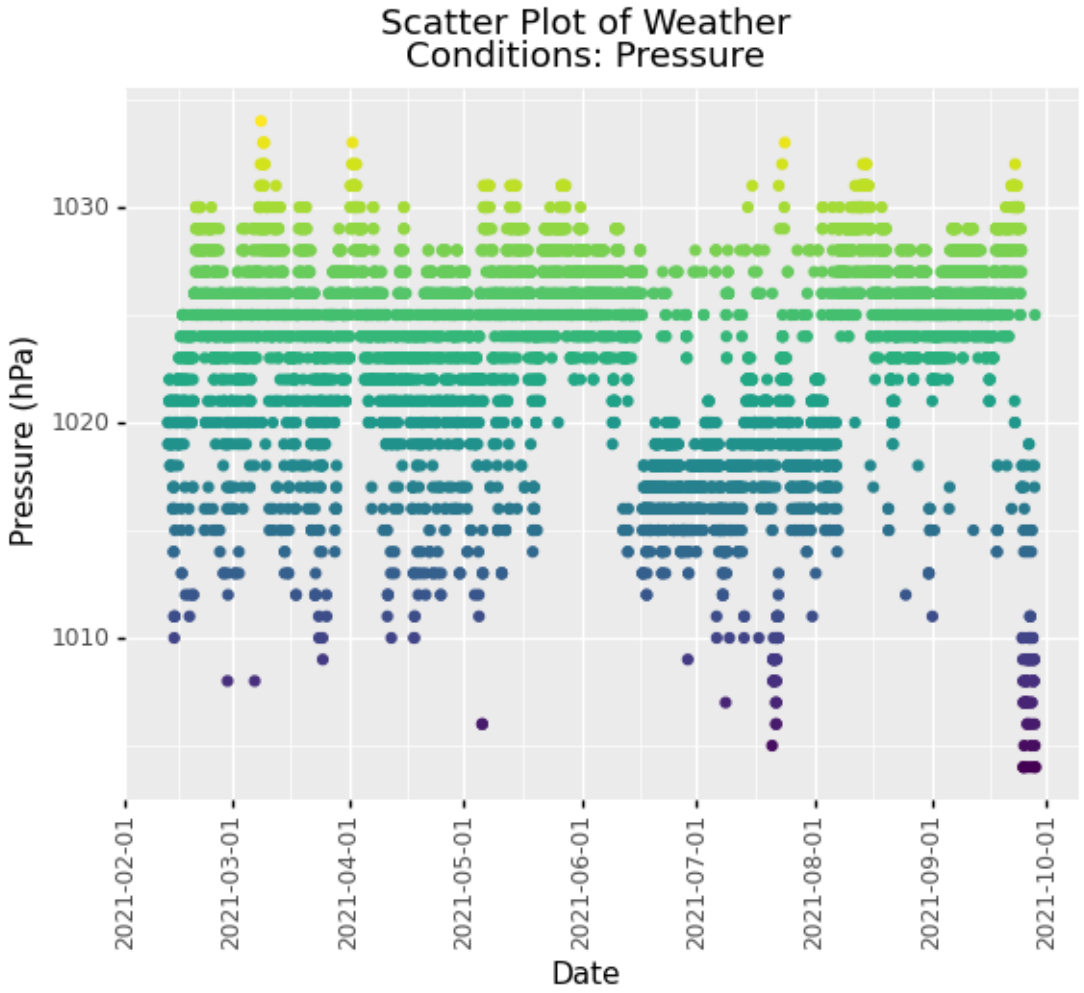
```
/home/jaa6766/.conda/envs/cuda/lib/python3.7/site-
packages/ipykernel/ipkernel.py:287: DeprecationWarning: `should_run_async` will
not call `transform_cell` automatically in the future. Please pass the result to
`transformed_cell` argument and any exception that happen during thetransform in
`preprocessing_exc_tuple`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



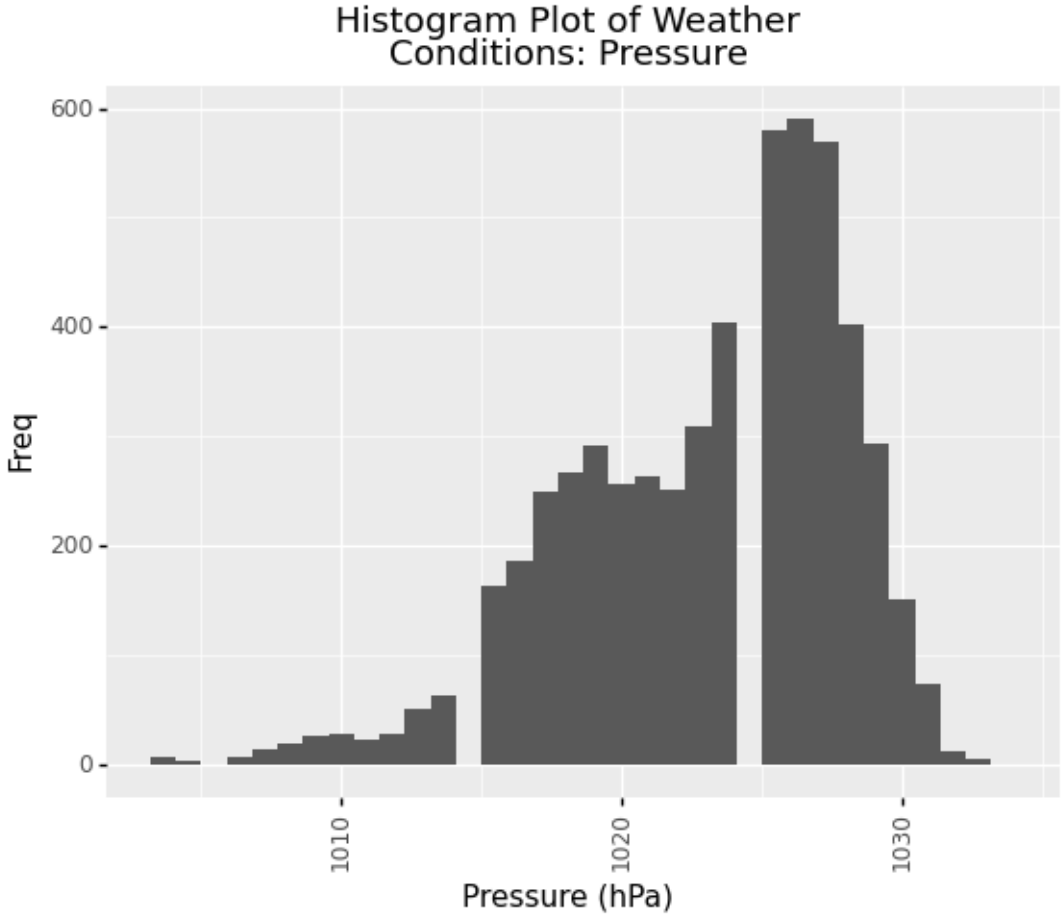

```
 <ggplot: (8759871700921)>
```

```
/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.
```



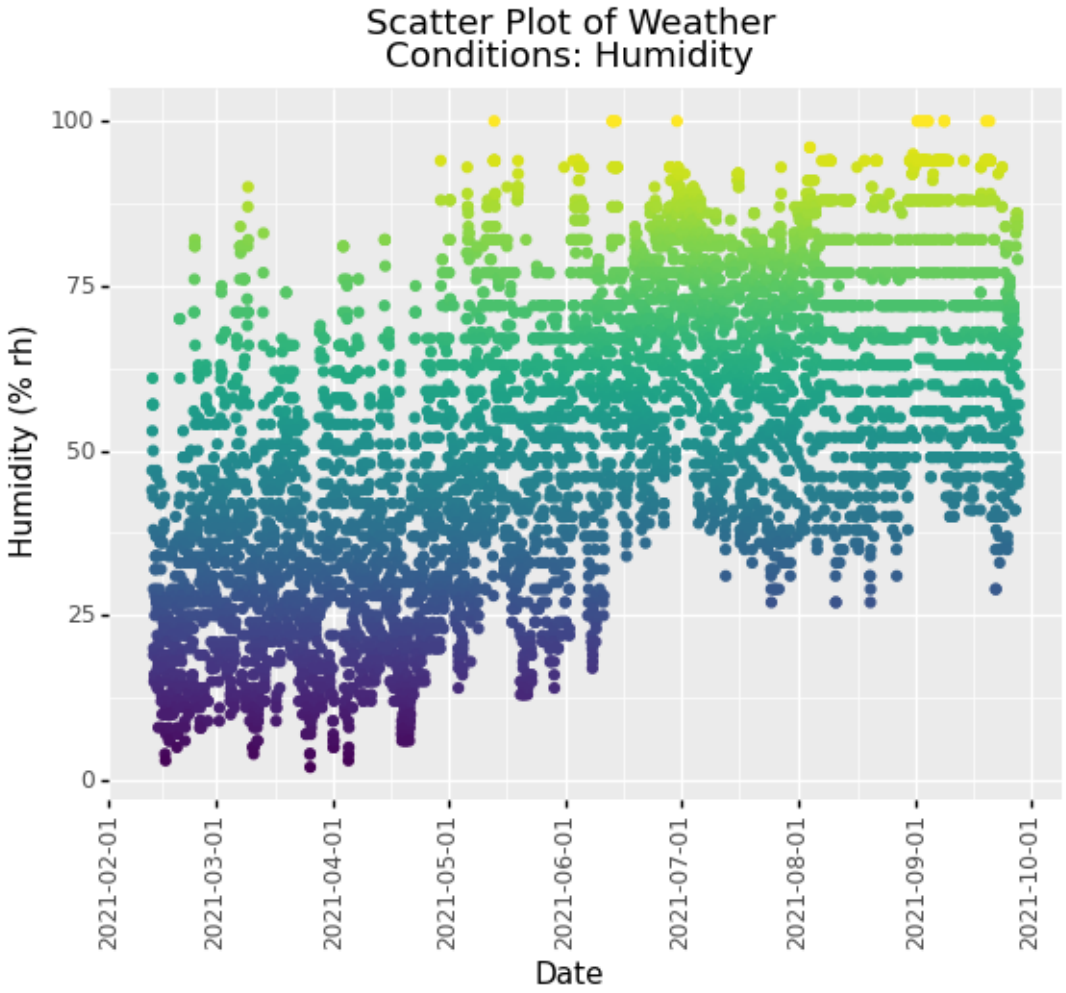

```
<ggplot: (8759871516885)>
```

```
/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'.
```



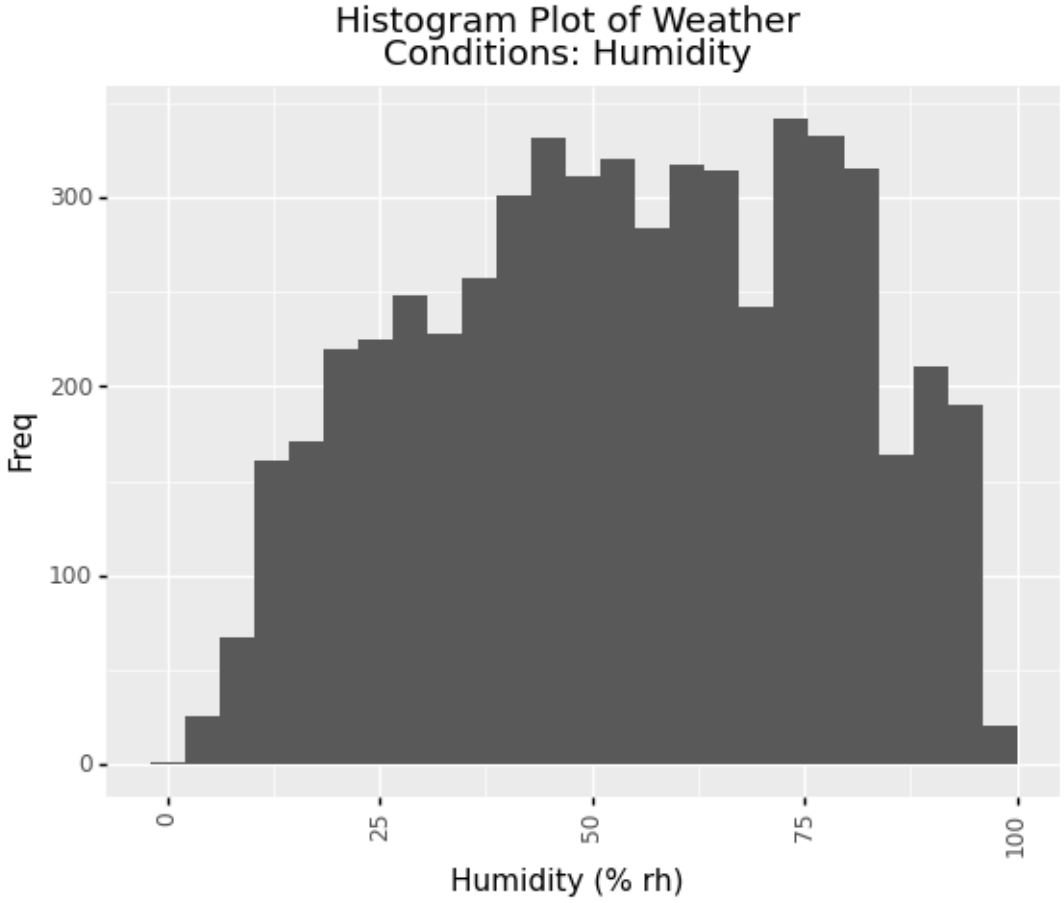

```
 <ggplot: (8759871192141)>
```

```
/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.
```



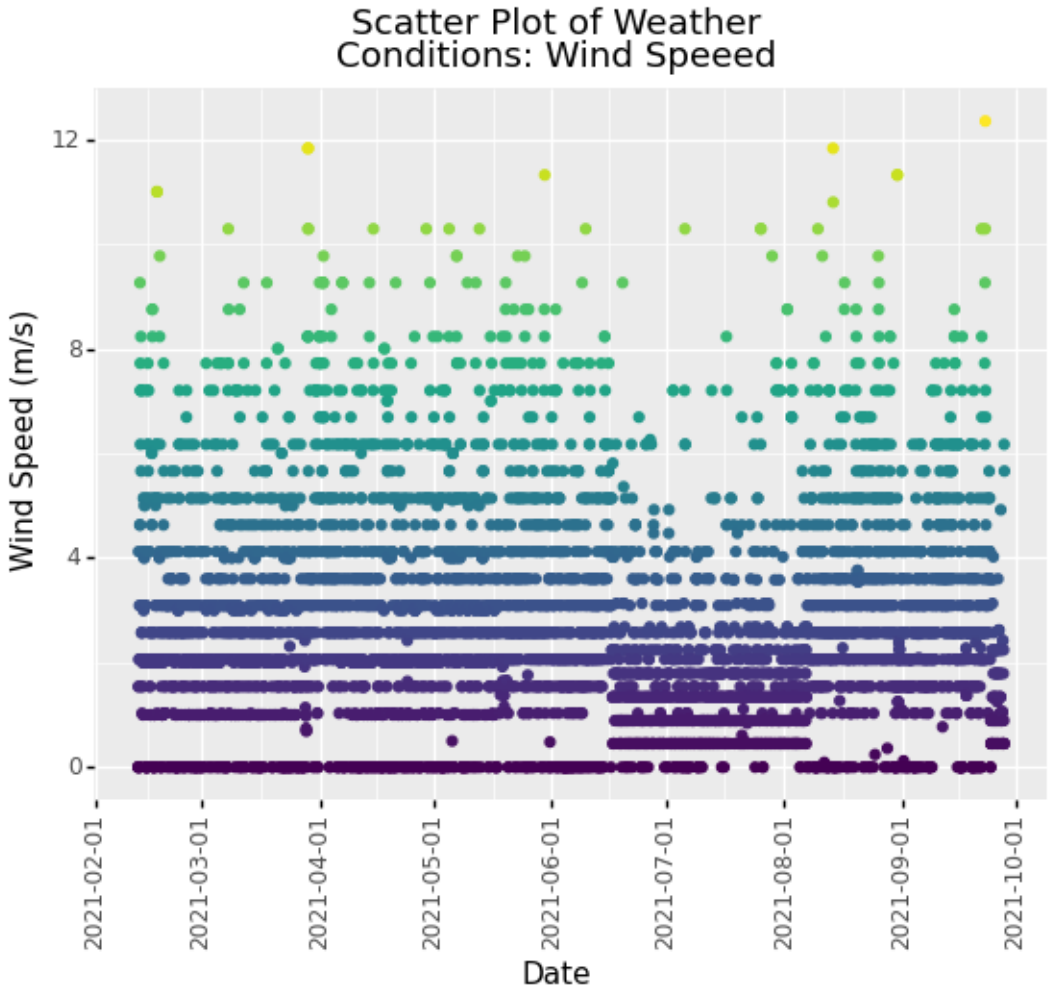

```
<ggplot: (8759872460273)>
```

```
/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'.
```



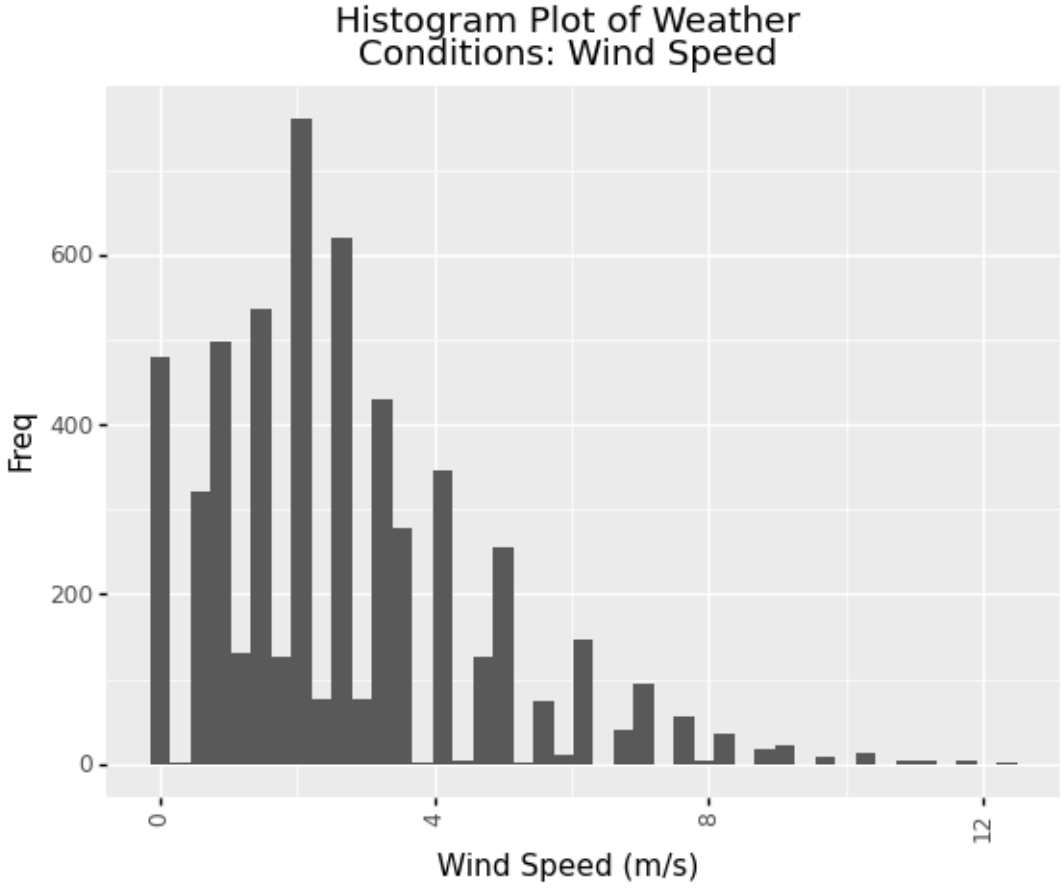

```
<ggplot: (8759872421517)>
```

```
/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.
```



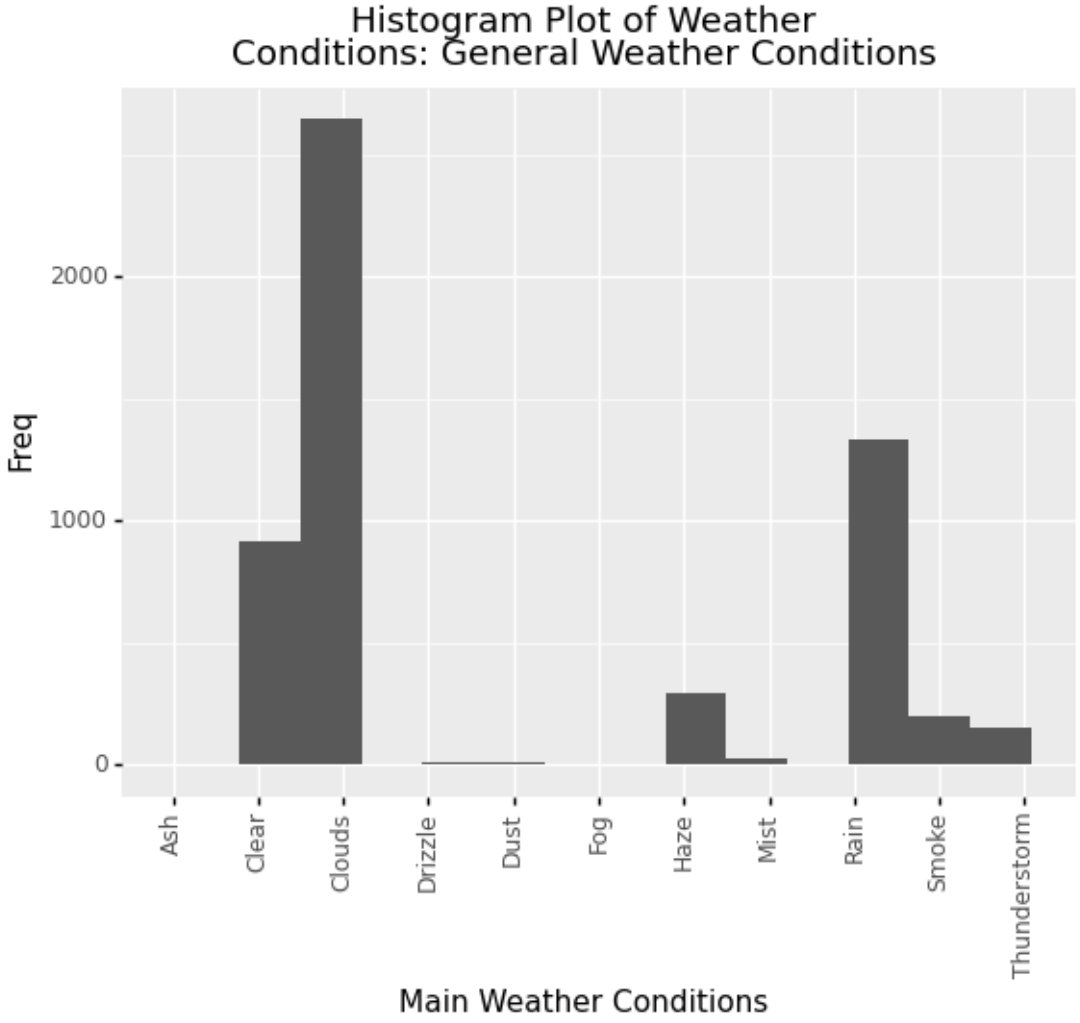

```
<ggplot: (8759871546769)>
```

```
/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: (8759871509709)>
```

```
/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: (8759872072773)>
```

1.7 References

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