Ejercicio 2.4: Detección y tratamiento de datos atípicos multivariante

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Lectura Fichero de datos y carga de librerías

```
library(dbscan)
```

```
Warning: package 'dbscan' was built under R version 4.5.2
```

```

Attaching package: 'dbscan'

The following object is masked from 'package:stats':

    as.dendrogram
```

```
library(class)
library(ggplot2)
library(patchwork)
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.1     v stringr   1.6.0
v lubridate 1.9.4     v tibble    3.3.0
v purrr     1.2.0     v tidyr     1.3.1
```

```
-- Conflicts --------------------------------------- tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becor
```

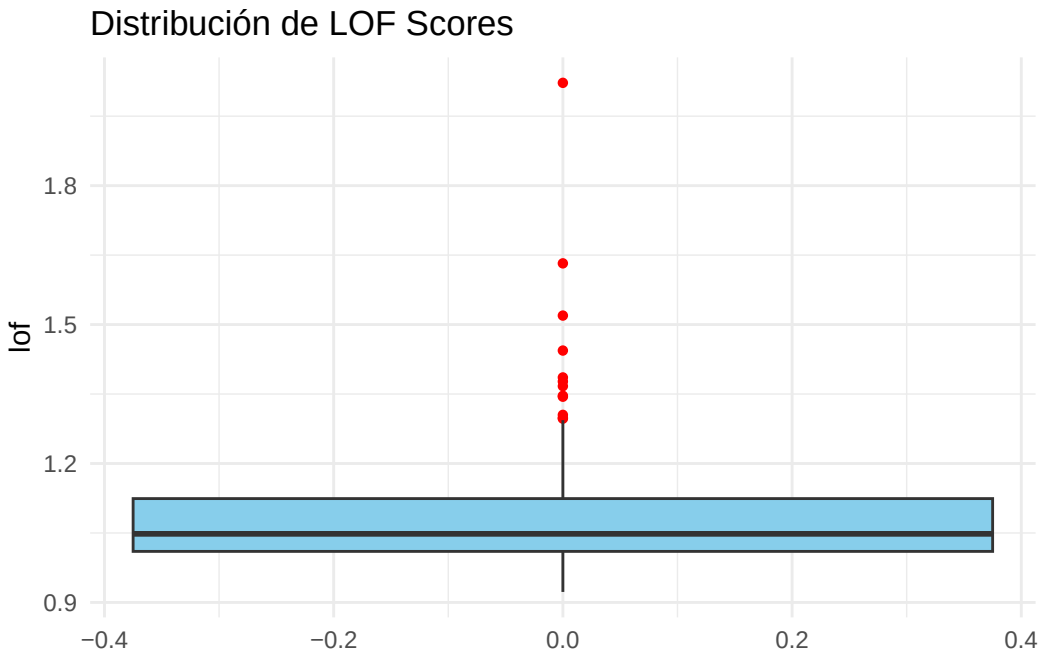
```
data <- read.csv("ozone.csv")  # import data
data$Month<-as.factor(data$Month)
data$Day_of_month<-as.factor(data$Day_of_month)
data$Day_of_week<-as.factor(data$Day_of_week)
```

Estudio Multivariante

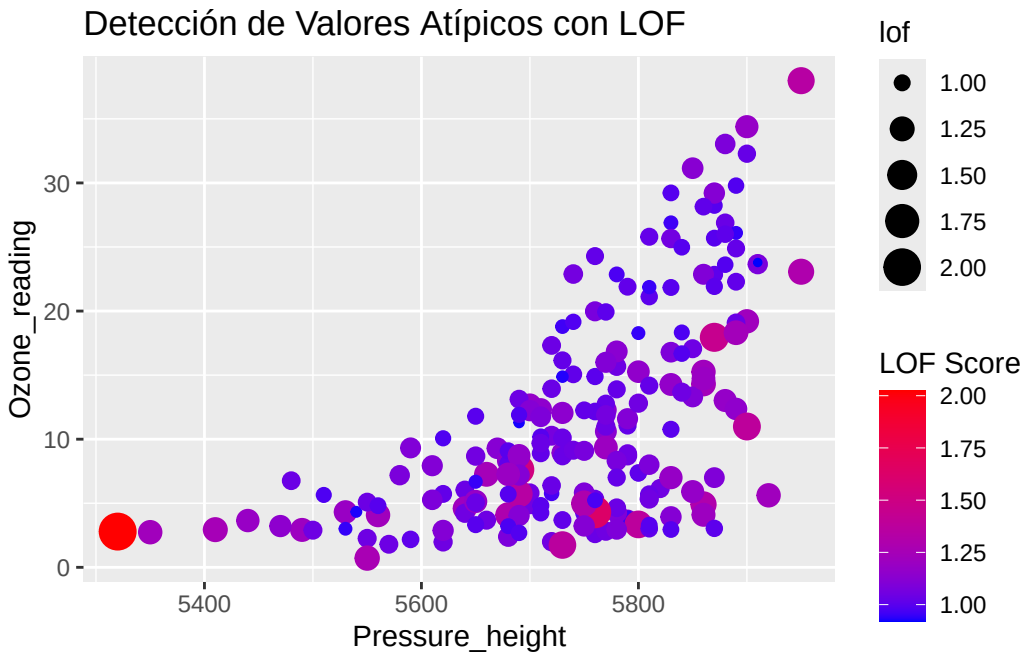
```
####Aplicamos LOF
k<-round(log(nrow(data)))
datos_lof<-scale(select(data,-Month,-Day_of_month,-Day_of_week,-Inversion_base_height))
lof<-lof(datos_lof,minPts = k)

data$lof<-lof

#Imprimimos los que son >1.5
data[which(data$lof>1.5),]
```

```
    Month Day_of_month Day_of_week Ozone_reading Pressure_height Wind_speed
37      3            3           3          2.79            5320         16
43      3           12           5          7.63            5690          0
188    12            8           3          4.31            5760          0
    Humidity Temperature_Sandburg Temperature_ElMonte Inversion_base_height
37        45                   25               27.68                    NA
43        60                   49               46.04                   613
188       32                   62               56.12                   826
    Pressure_gradient Inversion_temperature Visibility      lof
37                 39                 27.50        200 2.021929
43                -27                 59.72        300 1.519404
188               -16                 64.76        300 1.632160
```

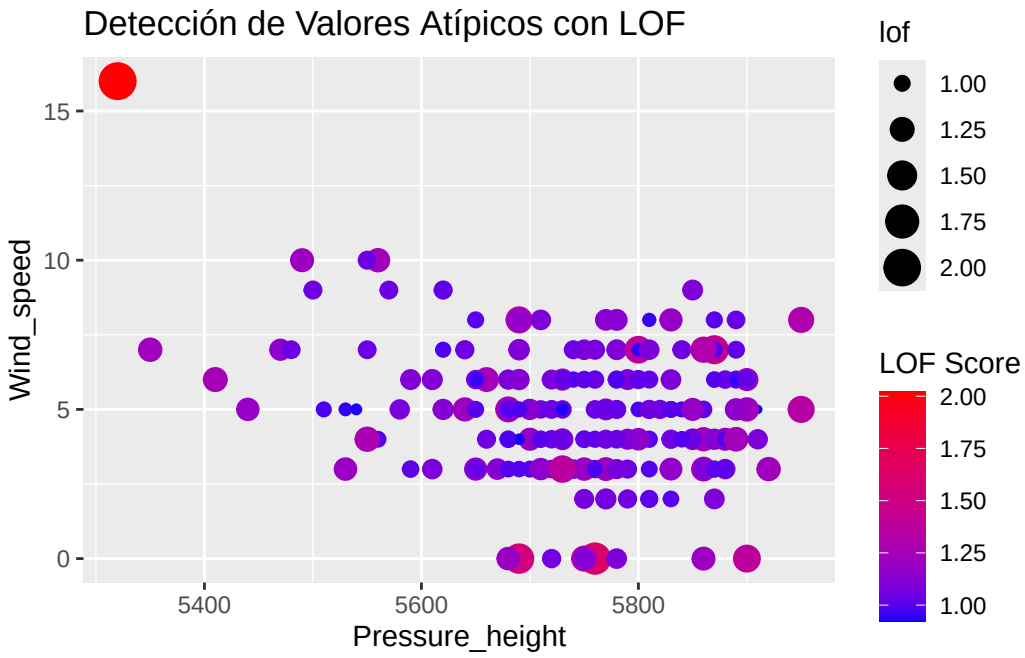
```
ggplot(data, aes(y = lof)) +
  geom_boxplot(fill = "skyblue", outlier.color = "red", outlier.shape = 16) +
  theme_minimal() +
  labs(title = "Distribución de LOF Scores")
```



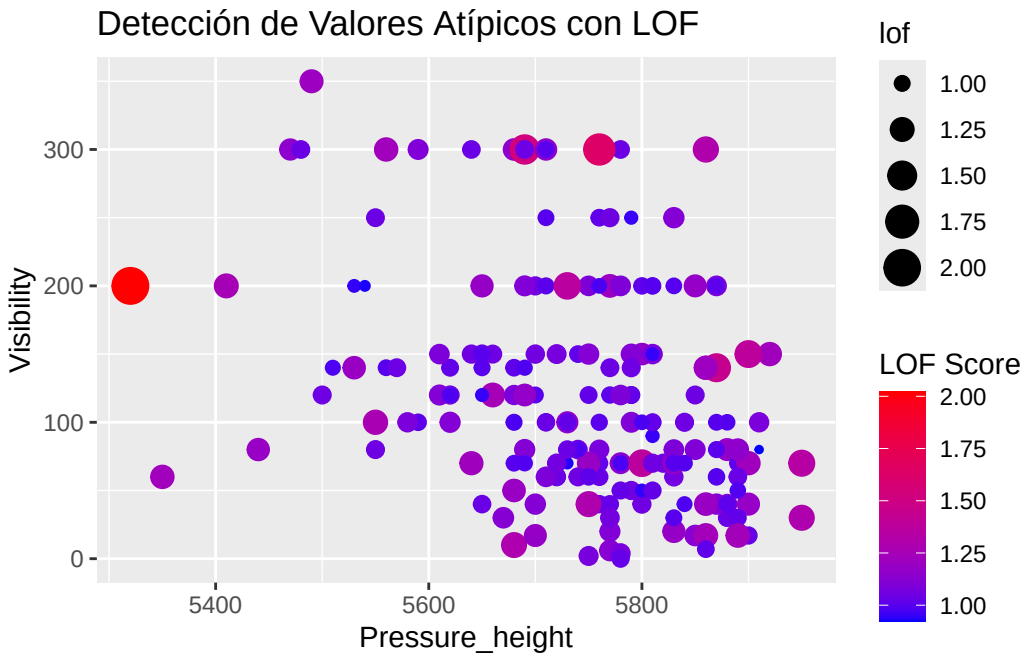

```
####Comprobamos las cuantitativas
ggplot(data, aes(x = Pressure_height, y = Ozone_reading, colour = lof)) +
  geom_point(aes(size = lof)) +
  scale_color_gradient(low = "blue", high = "red", name = "LOF Score") +
  labs(title = "Detección de Valores Atípicos con LOF")
```



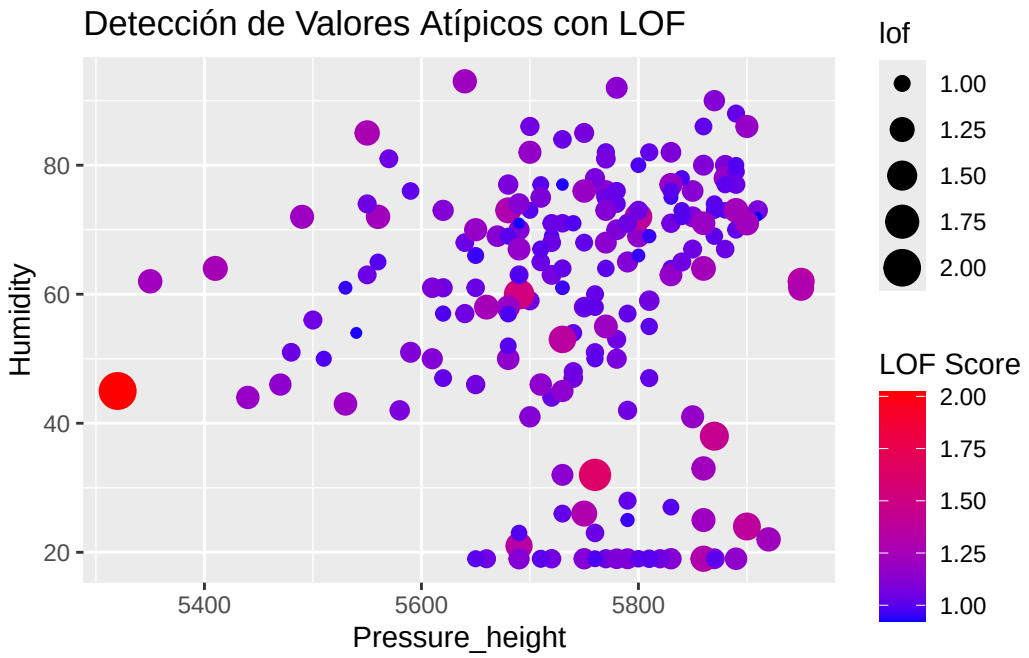
```r
ggplot(data, aes(x = Pressure_height, y = Wind_speed, colour = lof)) +
  geom_point(aes(size = lof)) +
  scale_color_gradient(low = "blue", high = "red", name = "LOF Score") +
  labs(title = "Detección de Valores Atípicos con LOF")
```



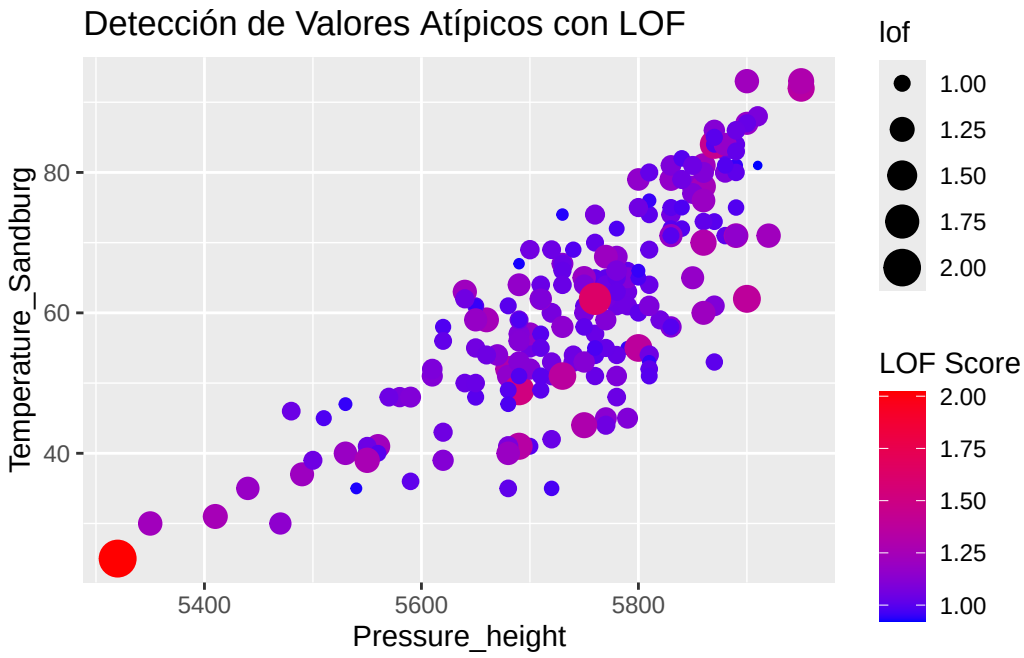

```r
ggplot(data, aes(x = Pressure_height, y = Visibility, colour = lof)) +
  geom_point(aes(size = lof)) +
  scale_color_gradient(low = "blue", high = "red", name = "LOF Score") +
  labs(title = "Detección de Valores Atípicos con LOF")
```



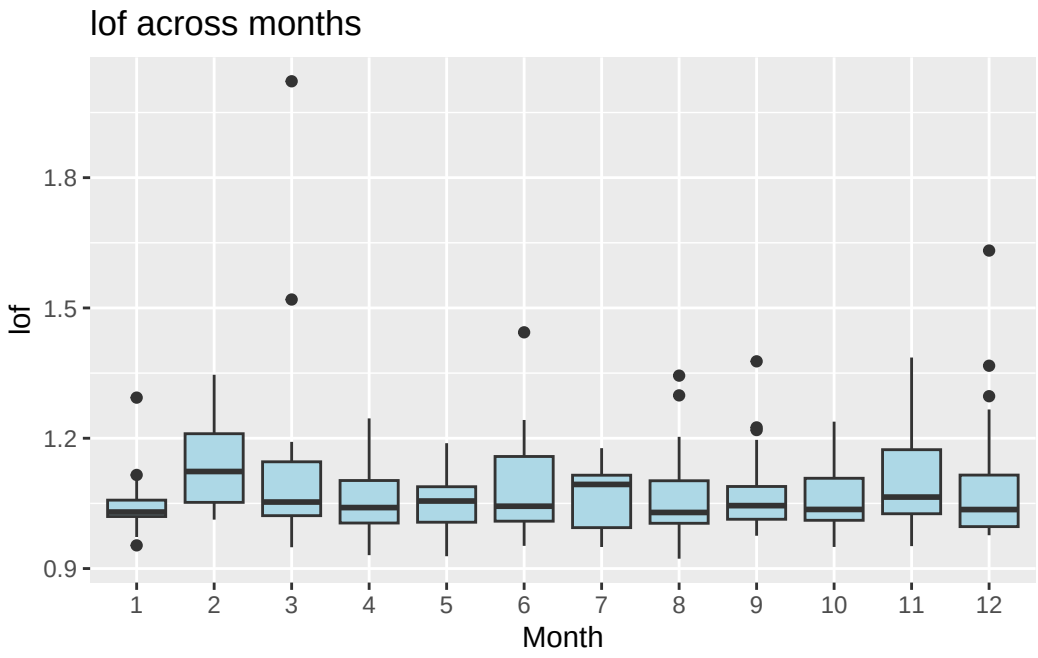

```
ggplot(data, aes(x = Pressure_height, y = Humidity, colour = lof)) +
  geom_point(aes(size = lof)) +
  scale_color_gradient(low = "blue", high = "red", name = "LOF Score") +
  labs(title = "Detección de Valores Atípicos con LOF")
```



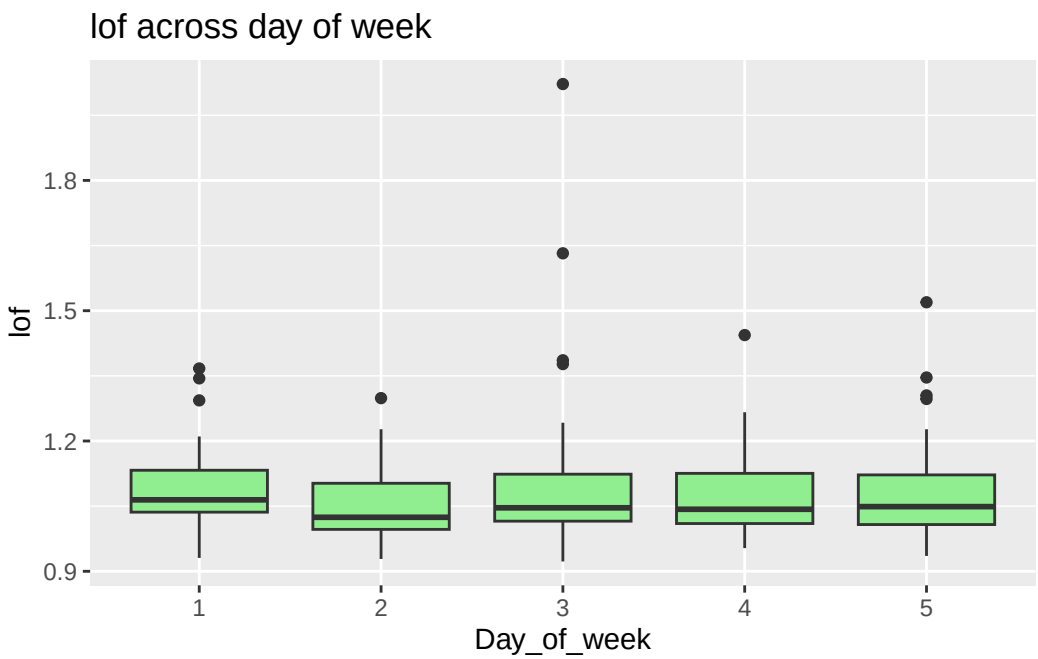
```r
ggplot(data, aes(x = Pressure_height, y = Temperature_Sandburg, colour = lof)) +
  geom_point(aes(size = lof)) +
  scale_color_gradient(low = "blue", high = "red", name = "LOF Score") +
  labs(title = "Detección de Valores Atípicos con LOF")
```



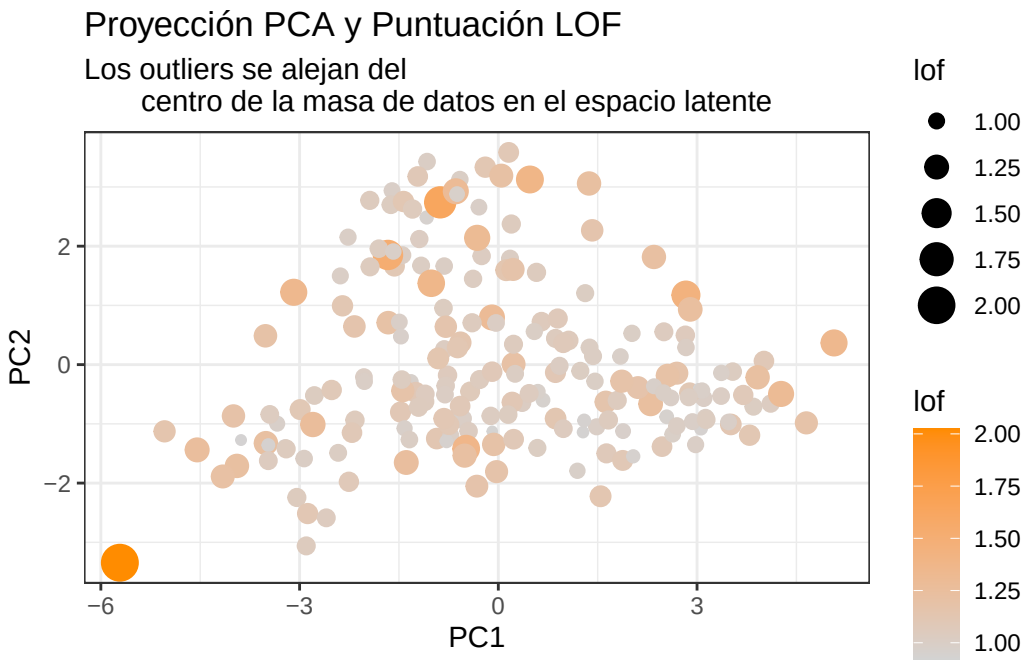

```r
####Comprobamos las cualitativas
ggplot(data, aes(x = as.factor(Month), y = lof)) +
  geom_boxplot(fill = "lightblue") +
  labs(title = "lof across months", x = "Month", y = "lof")
```




```
ggplot(data, aes(x = as.factor(Day_of_week), y = lof)) +
  geom_boxplot(fill = "lightgreen") +
  labs(title = "lof across day of week", x = "Day_of_week", y = "lof")
```



```r
# Ejecutamos un PCA rápido sobre las variables numéricas
pca_res <- prcomp(scale(select(data, -Month, -Day_of_month,
                               -Day_of_week, -Inversion_base_height, -lof)), center = TRUE)

# Creamos un dataframe para graficar
df_pca <- as.data.frame(pca_res$x)
df_pca$lof <- data$lof

ggplot(df_pca, aes(x = PC1, y = PC2, color = lof)) +
  geom_point(aes(size = lof)) +
  scale_color_gradient(low = "lightgrey", high = "darkorange") +
  labs(title = "Proyección PCA y Puntuación LOF",
       subtitle = "Los outliers se alejan del
       centro de la masa de datos en el espacio latente") +
  theme_bw()
```



Tras aplicar el algoritmo LOF vemos que hay 3 observaciones con LOF > 1.5 pero solo una que tiene un LOF $= 3.08$ y que sale de la distribución. Al representar las variables dos a dos coloreadas por el LOF, vemos como hay un punto que corresponde a varios de los Outliers que hemos detectado en el estudio uni y bivariante. Vemos que esa observación corresponde al extremos de Wind_Speed y que además también es un outlier de Pressure_height. Vemos que siempre está alejada de la nube de puntos y que en el PCA además también está completamente fuera.

En base a esto podría tener mucho sentido borrar la observación entera.