

# HAWC Rates and Pressure Analysis for the years 2015 - 2023

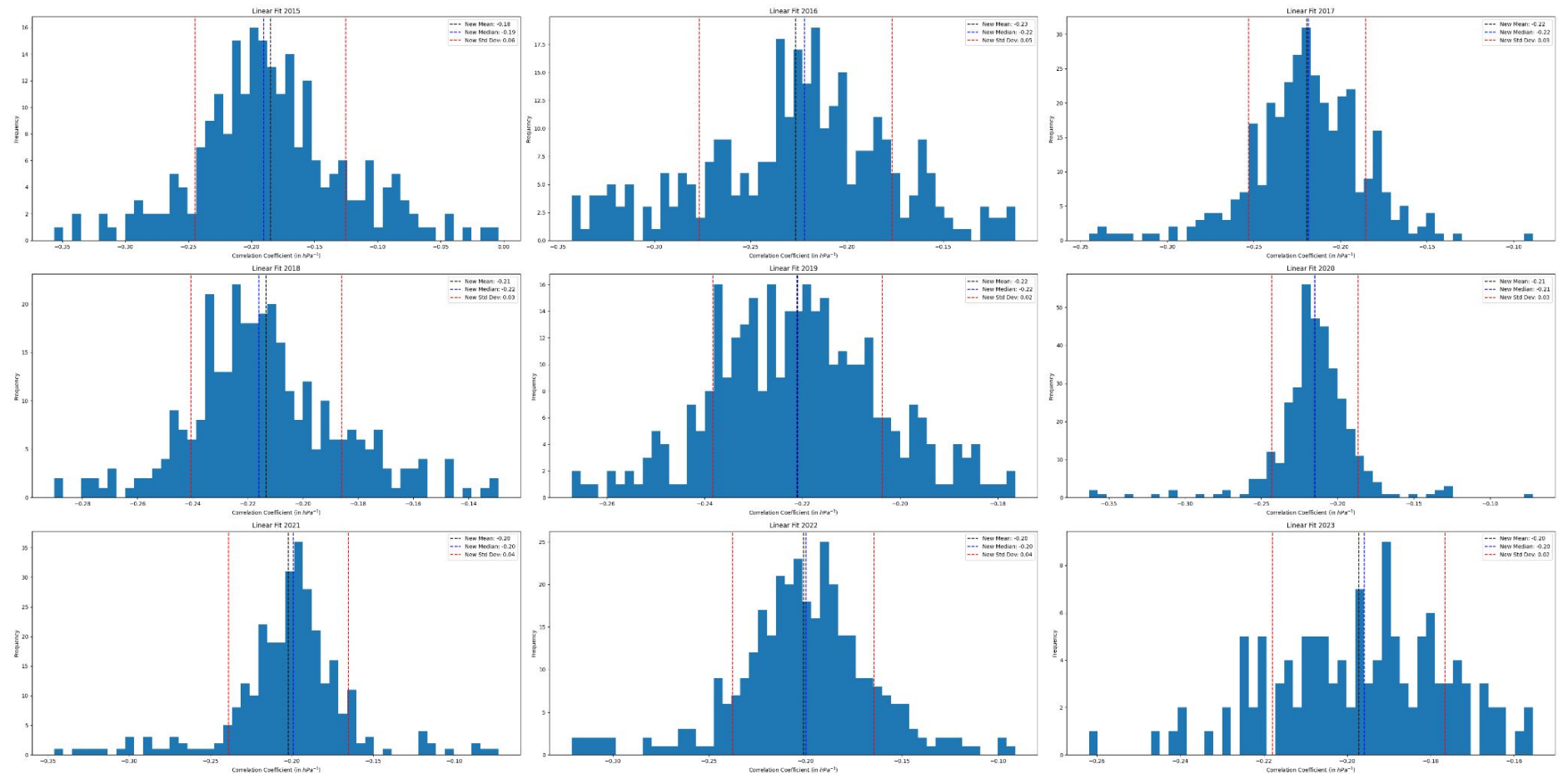
Riya Kore

- I started with binning the Rates and Pressure data for each year with each bin having the values in 8 mins range. (I chose 8 mins because the Rates data is taken every 4 mins while the Pressure data is taken every 1 min)
- I performed a linear regression to calculate the linear and exponential correlation coefficient.
  - The linear correlation coefficient is the slope calculated when I perform a linear regression on the average rates per time interval vs. the average pressure per time interval (Here, the time interval is 8 mins).
  - Similarly, the exponential correlation coefficient is the slope when I perform a linear regression on the log on average rates per time interval vs the average pressure per time interval.
- After this process, I cleaned the data by only taking into account the correlation coefficients in a year that are one standard deviation away from the mean.

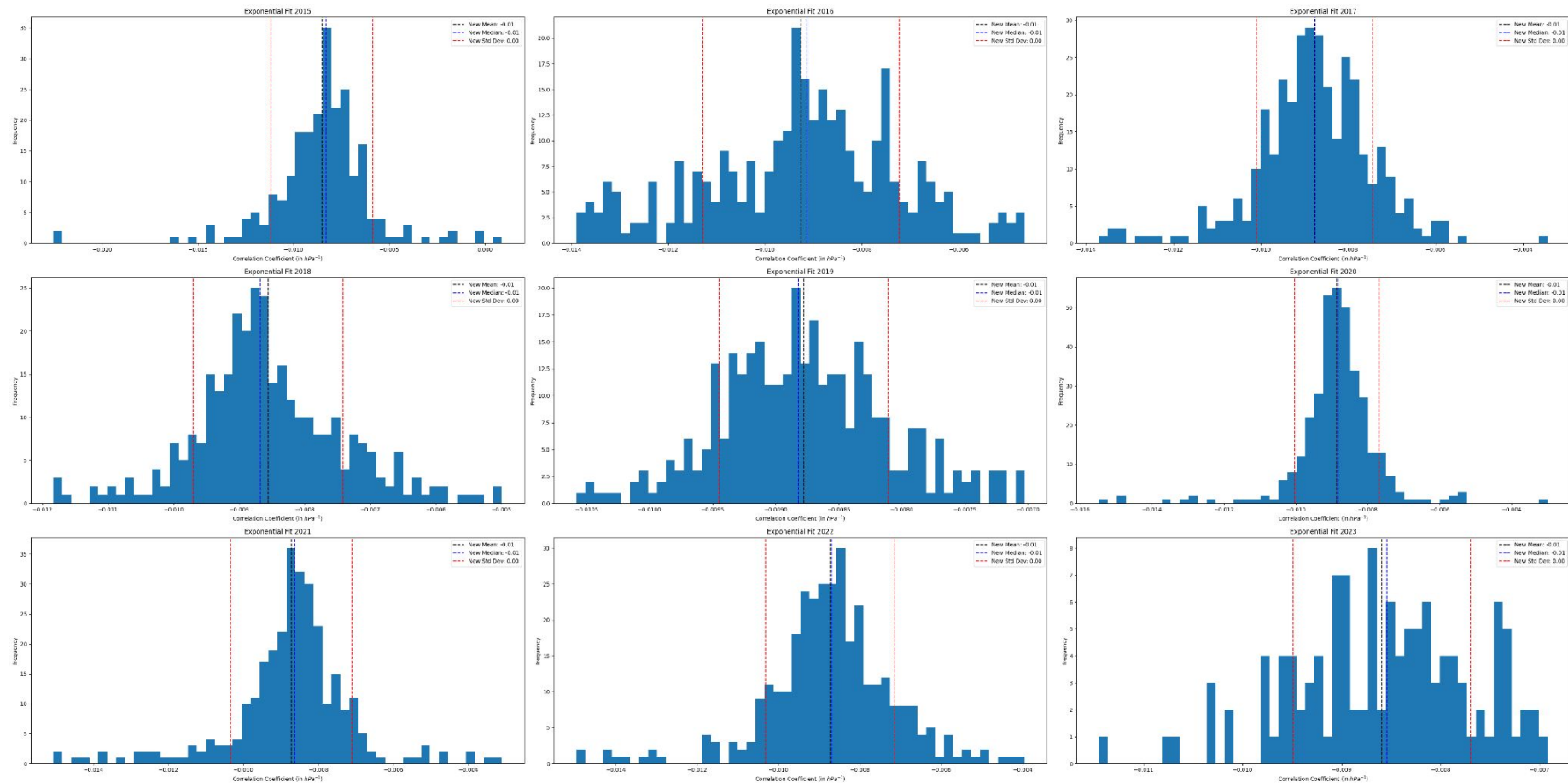
- For the linear fit, I used  $f(x) = -bx + c$ , here “f(x)” is rate, “x” is pressure, and “b” is the required linear correlation coefficient.
- For the exponential fit, I used  $f(x) = ae^{-bx}$ , here “f(x)” is the rate, “x” is the pressure, and “b” is the required exponential correlation coefficient.

**Here are the plots I got after the cleaning...**

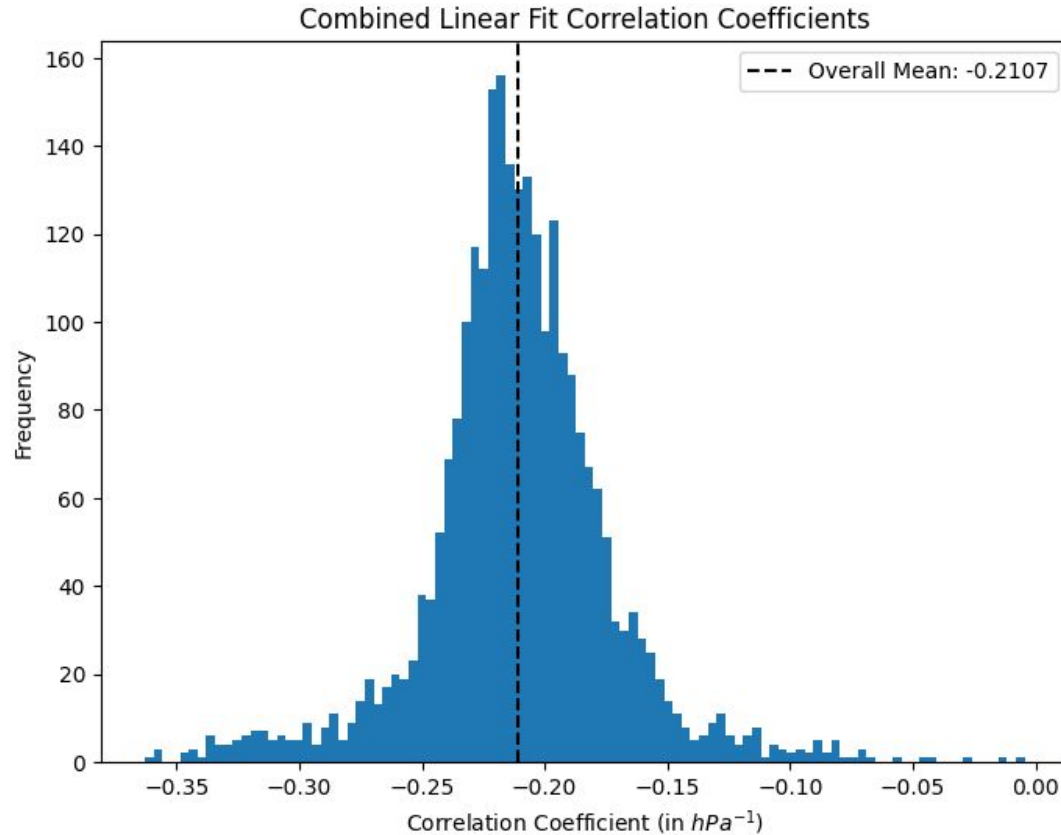
# Linear Correlation Coefficient Distribution:



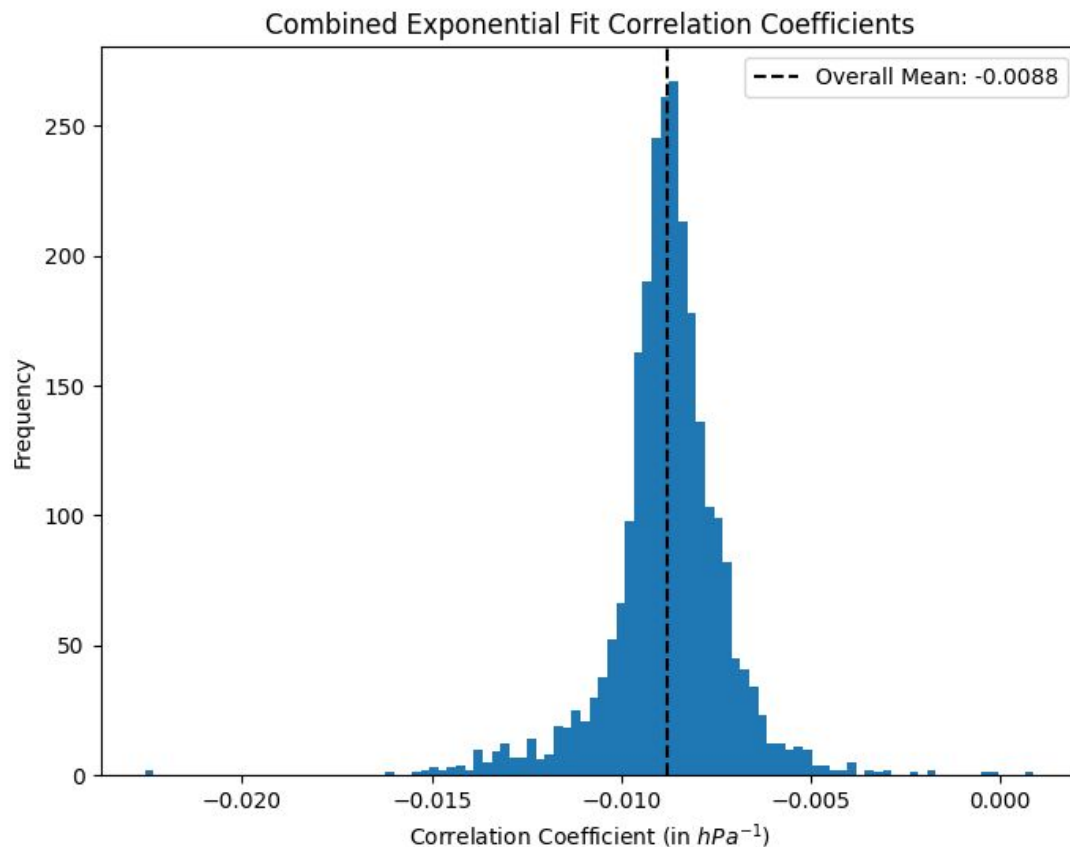
# Exponential Correlation Coefficient Distribution:



I combined all the data from all the years for the linear correlation coefficient and plotted the values one standard deviation away from the mean



I did the same thing for the exponential correlation coefficient and this is the plot I got with the mean value being  $-0.0088 \text{ hPa}^{-1}$



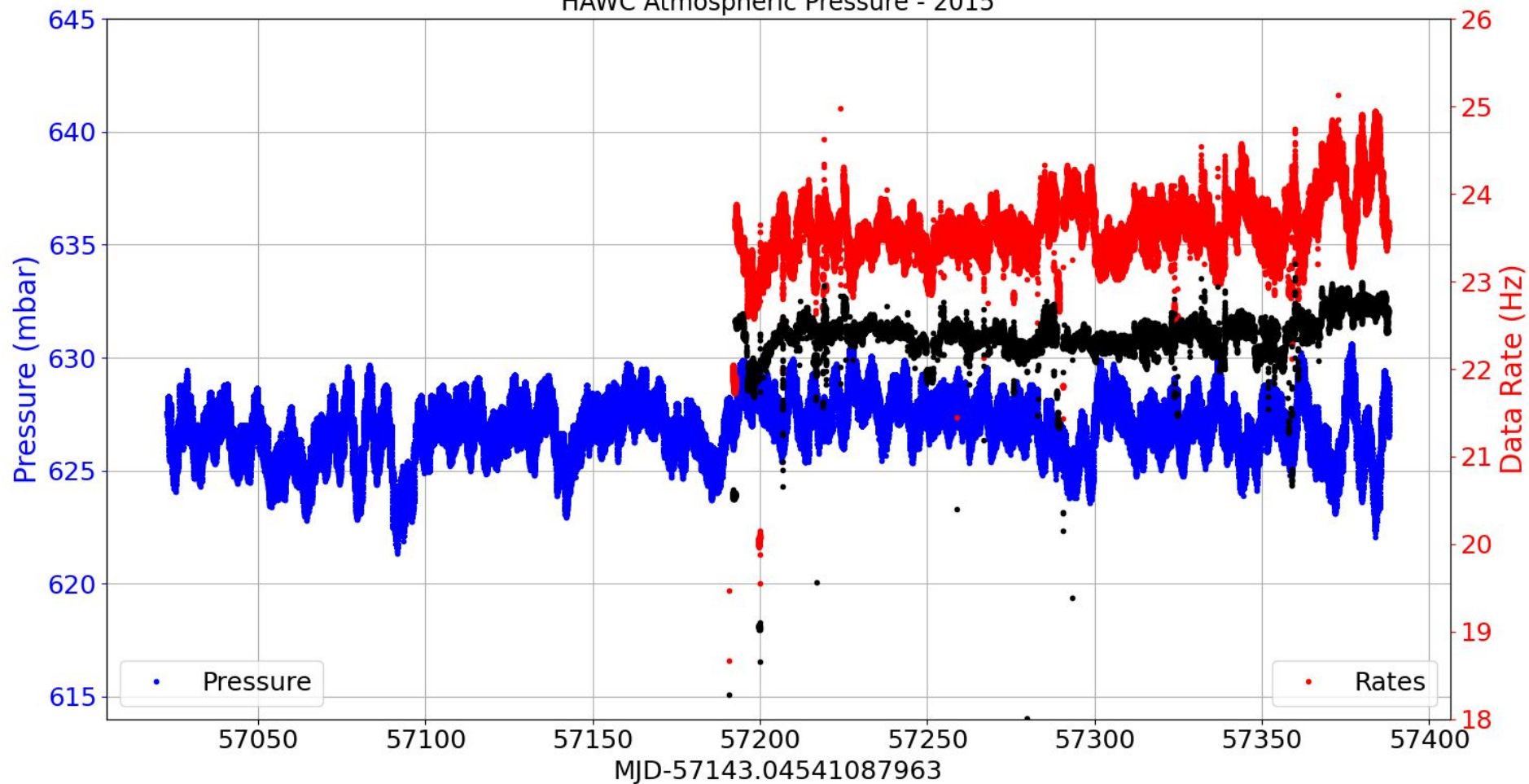
Then, I applied a correction to the rates to scale them with a factor that involves the exponential correlation coefficient and the pressure. Here is the equation is used:

$$r_{CORR} = r * e^{-\beta(p-p_o)}$$

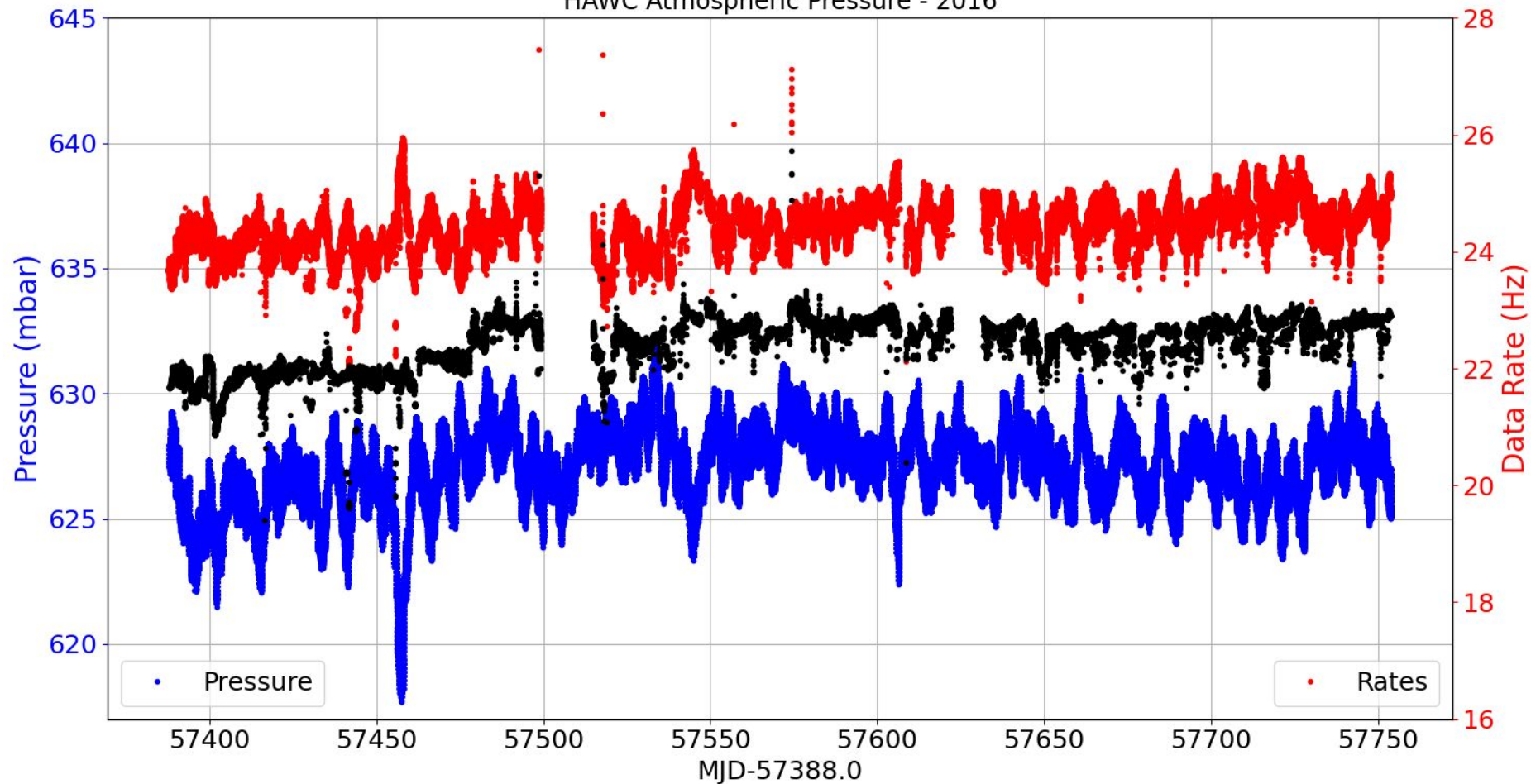
I calculated the corrected rates by binning the Rates and Pressure data in the same way as when I was calculating the correlation coefficient. This gave me a flattened rate value for every entry in the Rates data. I plotted the Pressure, Rates and Corrected Rates for each year with time being on the x axis. Here are the plots:



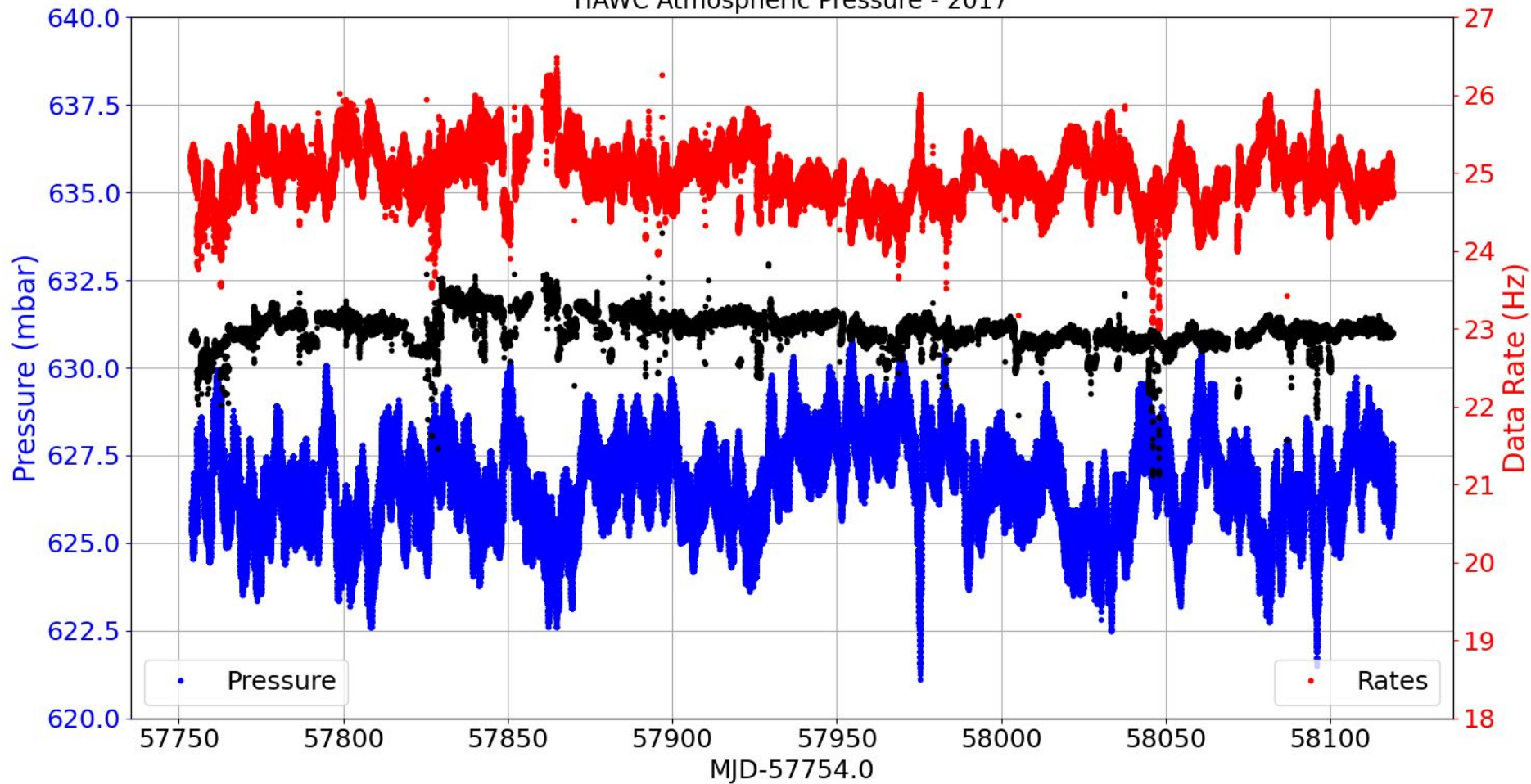
HAWC Atmospheric Pressure - 2015



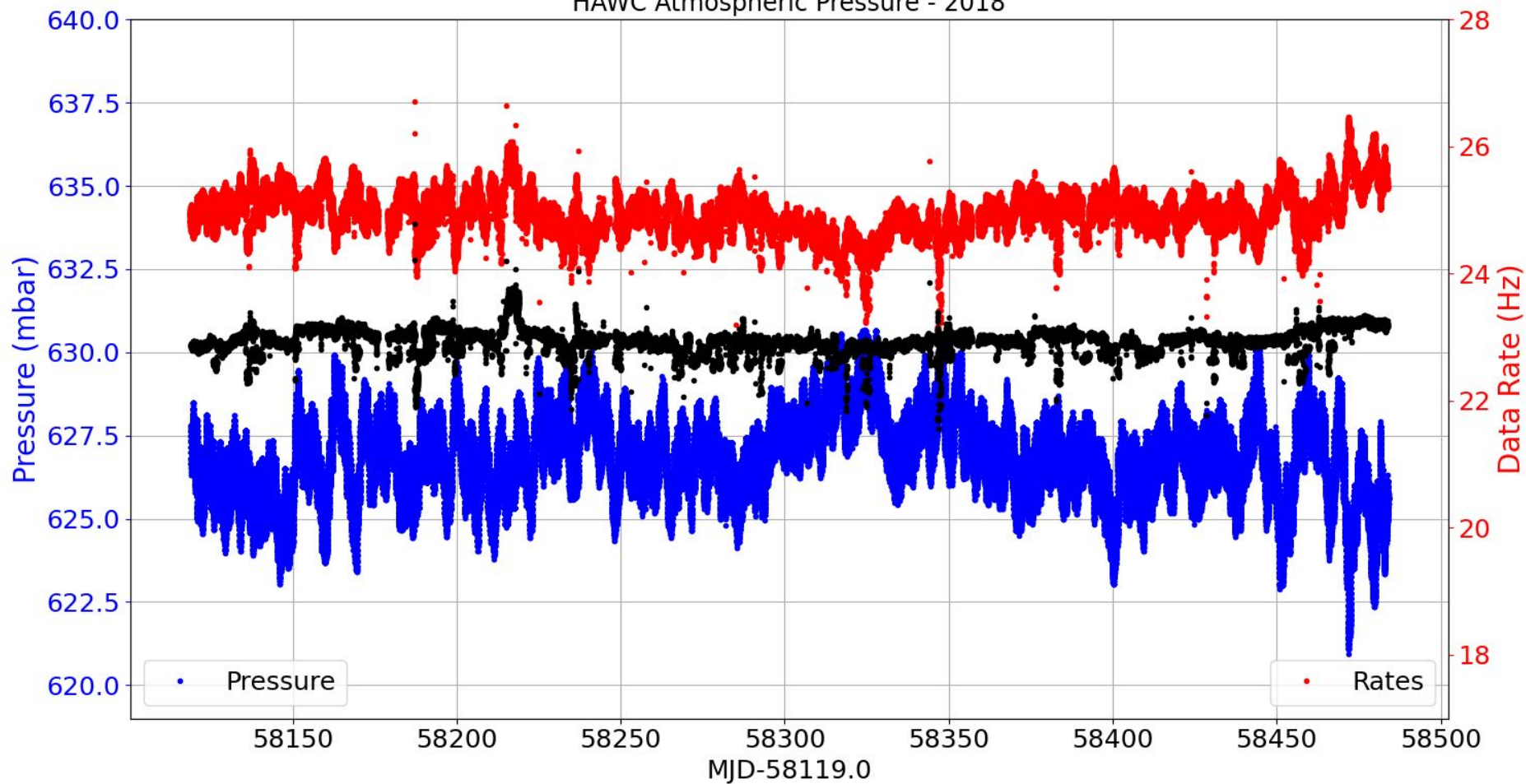
HAWC Atmospheric Pressure - 2016



HAWC Atmospheric Pressure - 2017

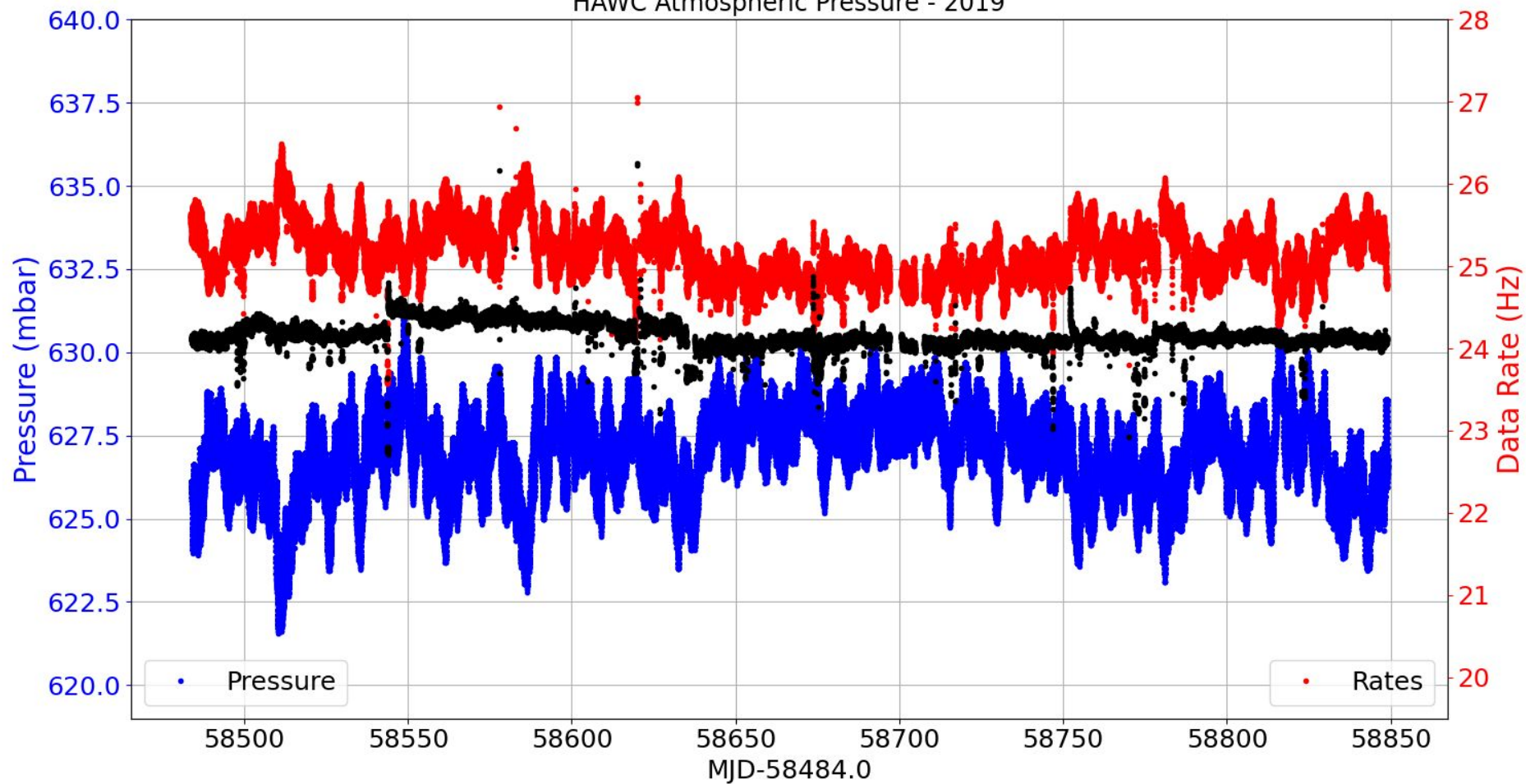


HAWC Atmospheric Pressure - 2018

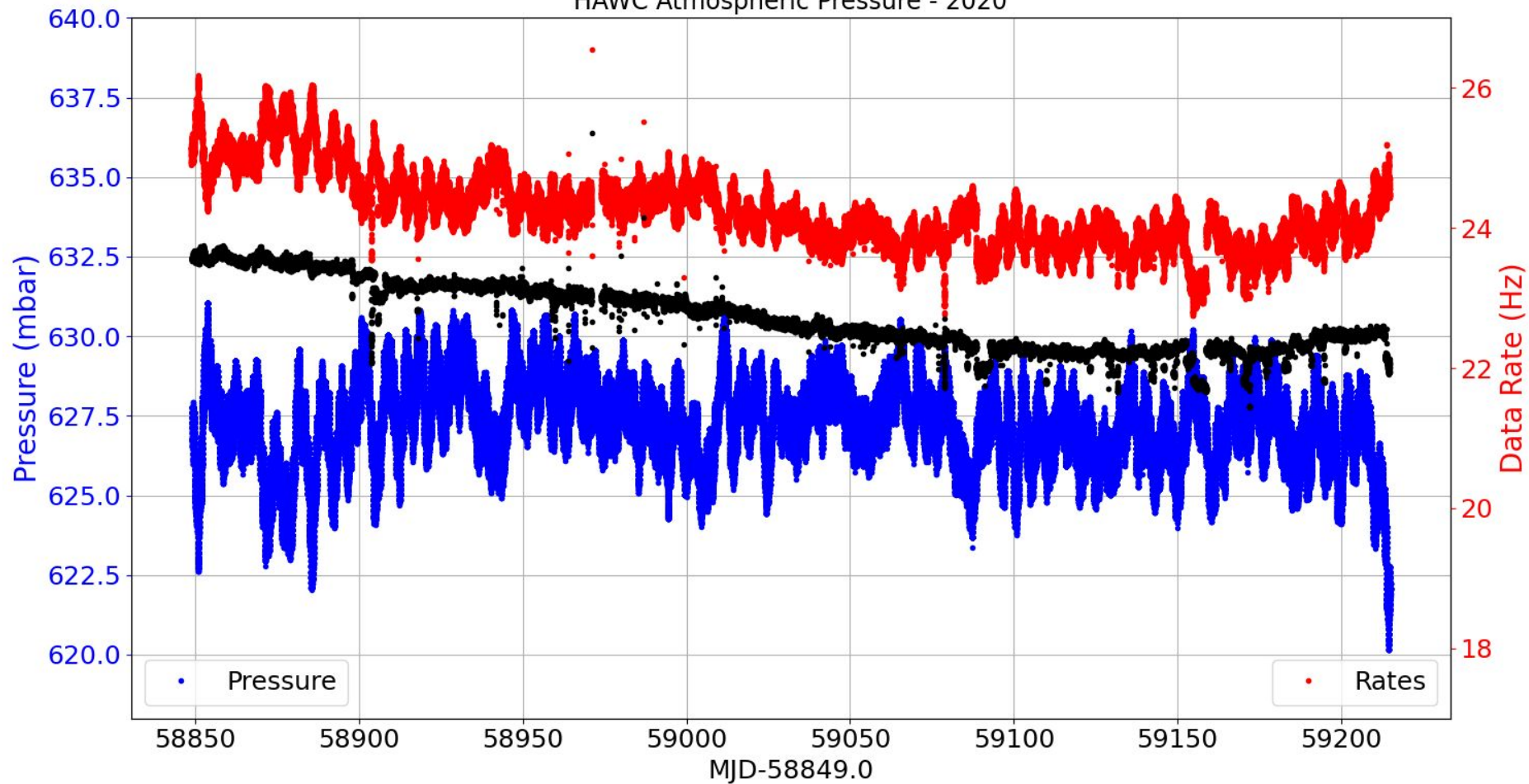




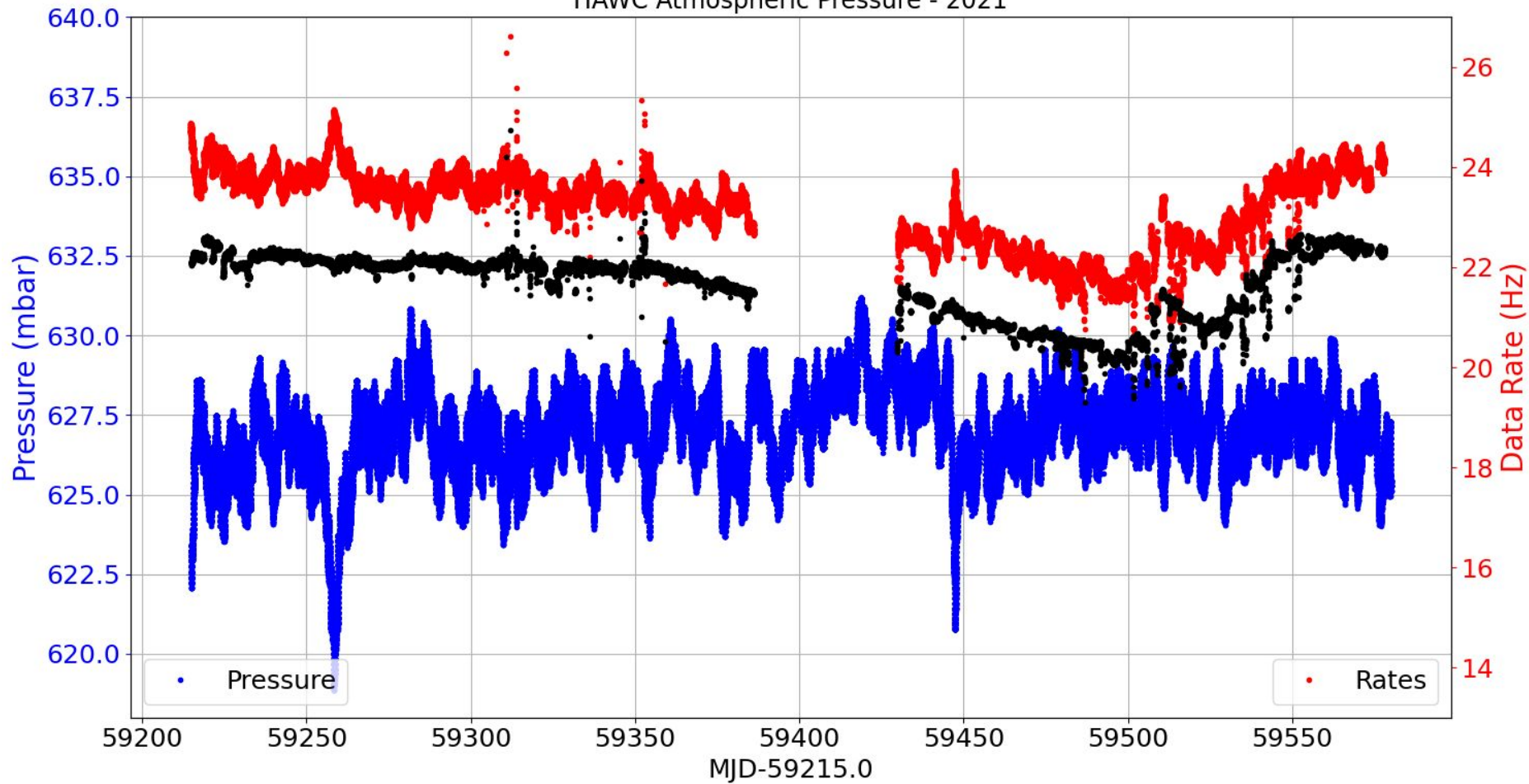
HAWC Atmospheric Pressure - 2019



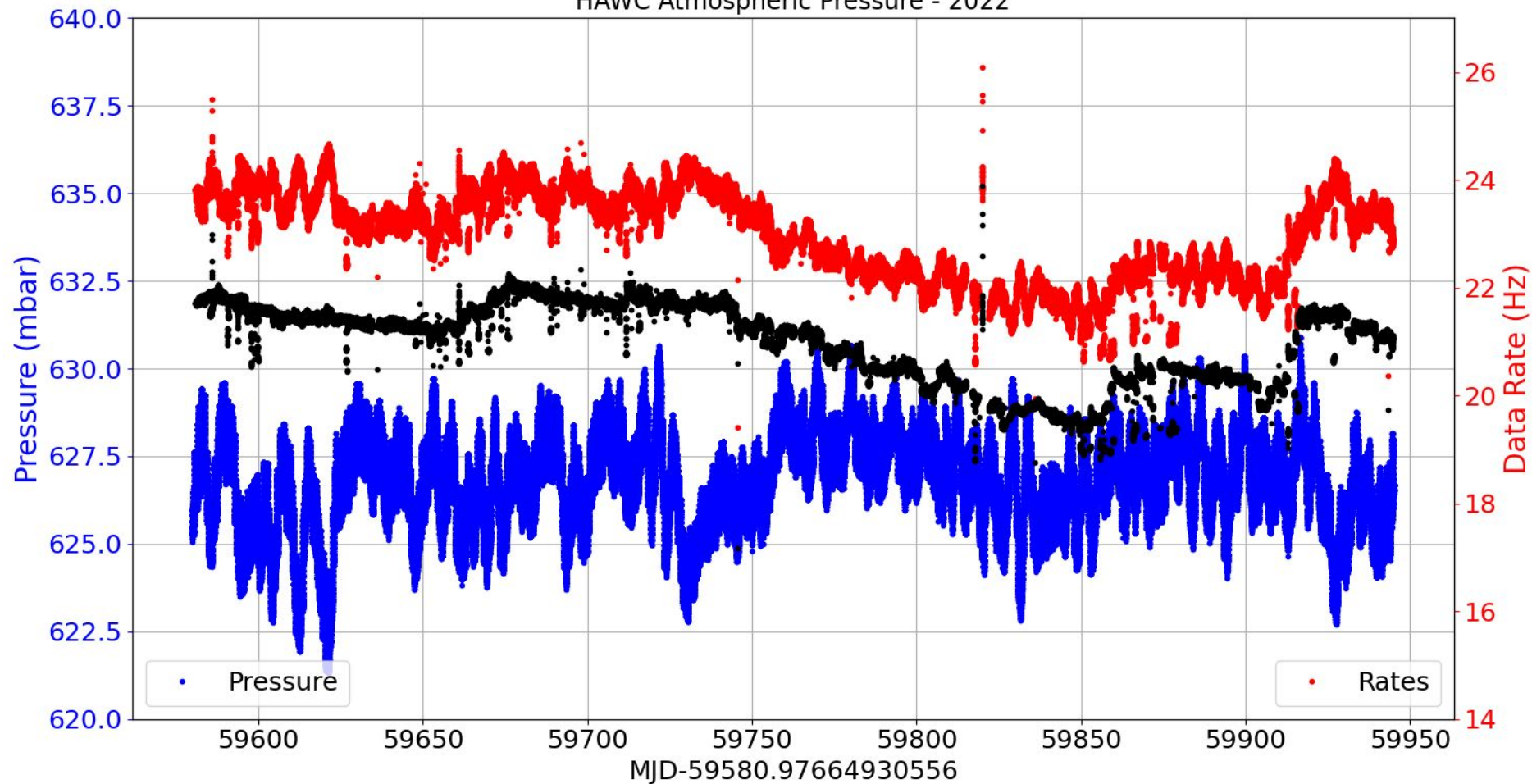
HAWC Atmospheric Pressure - 2020



HAWC Atmospheric Pressure - 2021

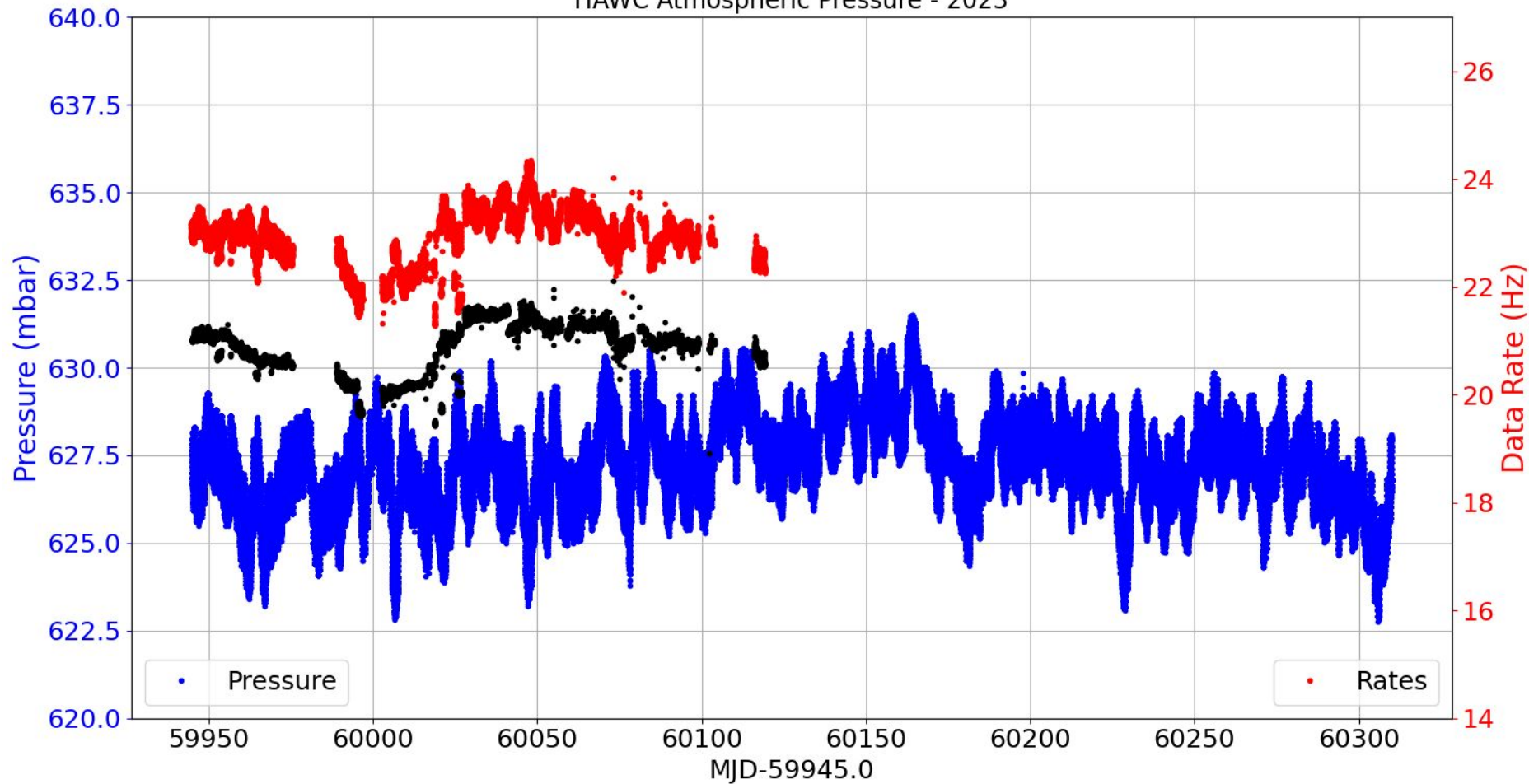


HAWC Atmospheric Pressure - 2022



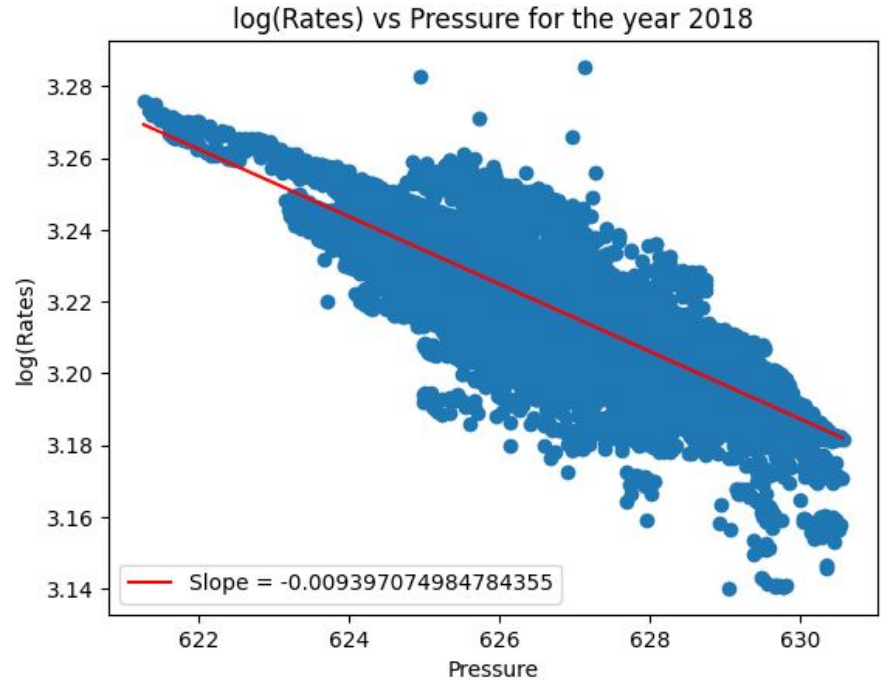
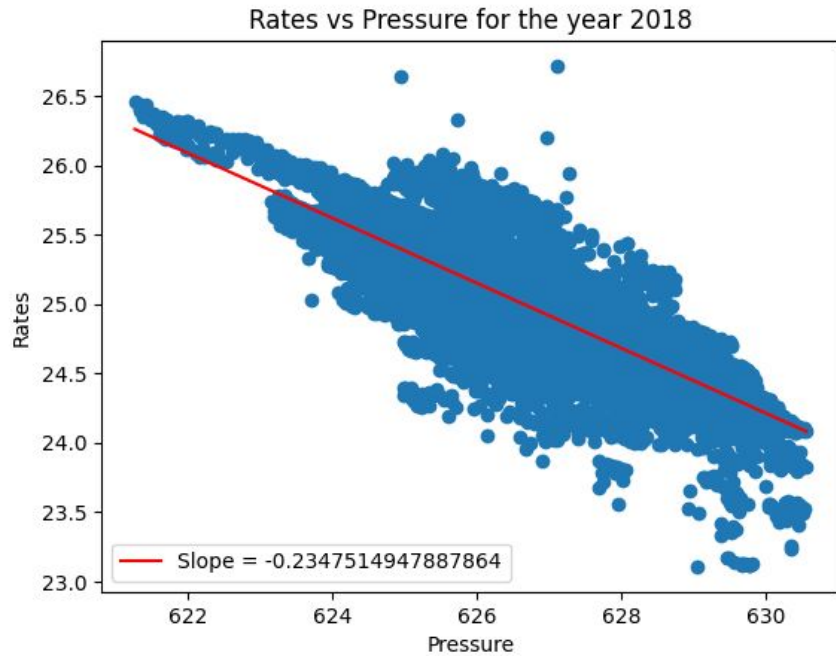


HAWC Atmospheric Pressure - 2023



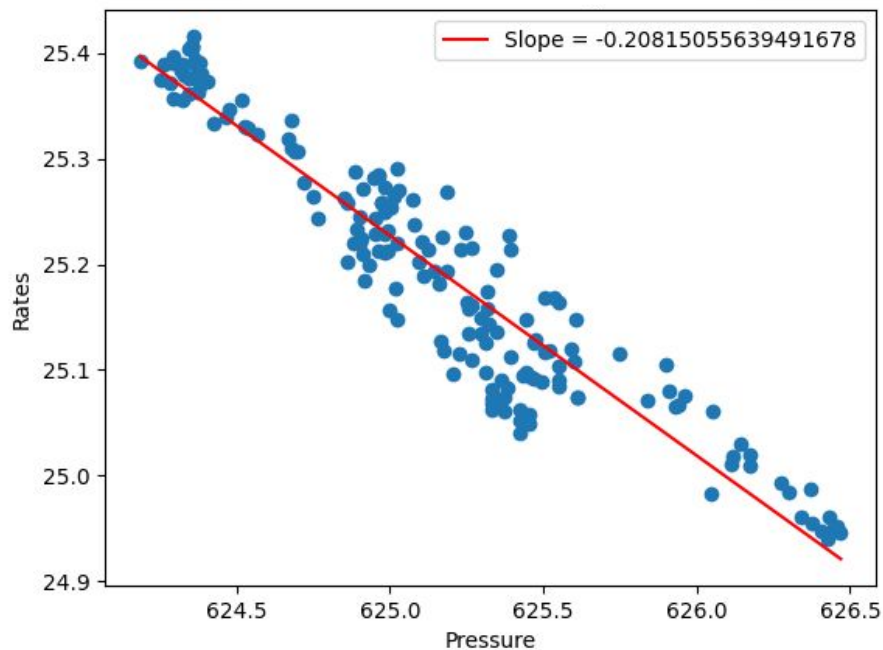
# Backup Slides

What exactly is the correlation coefficient? It is the slope of the line of best fit which passes through the points of the rates vs pressure plot.



If we plot the rates vs pressure along with the line of best fit for one day of the year, this is what it looks like:

Rates vs Pressure for a day in 2018



$\log(\text{Rates})$  vs Pressure for a day in 2018

