THE RECORD OF ATMOSPHERIC CO_2

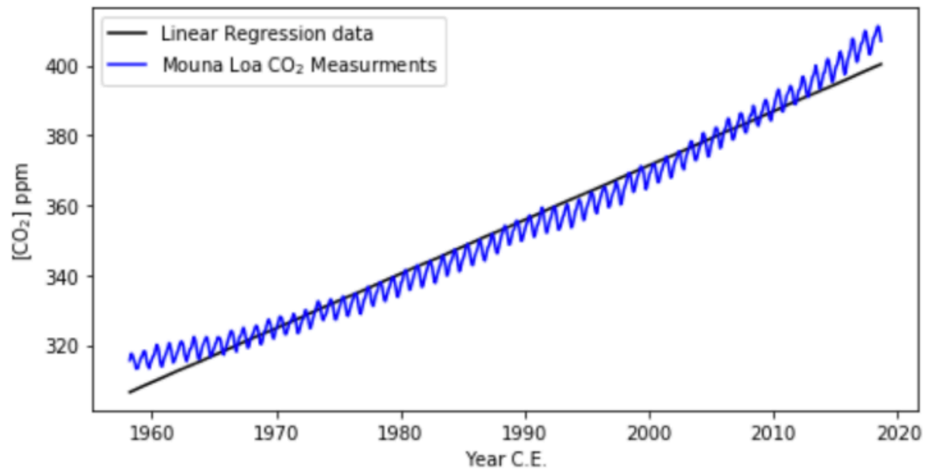
MEASUREMENTS OF THE ATMOSPHERE

Fit a linear model to the data (8 points)

- Use `np.polyfit()` to determine the best-fit linear (i.e. degree 1) model to the CO_2 data
- Use `np.polyval()` to find the model CO_2 concentration (y values) for the dates (x values).
- Plot the data and the best-fit line.
- Calculate and plot the residual.

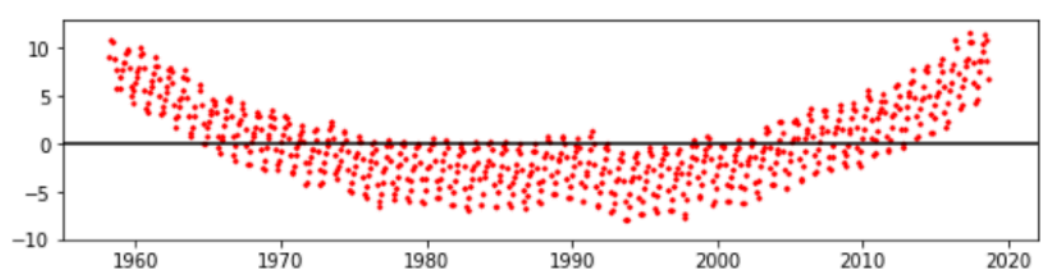
In [24]:
```
m_b = np.polyfit(data['Date'],data['CO2_ppm'],1)
new_y = np.polyval(m_b, data['Date'])
```

In [28]:
```
plt.figure(figsize=(8,4))

#linear regression line
plt.plot(data['Date'],new_y,color='black',label='Linear Regression data')
#actual data
plt.plot(data['Date'],data['CO2_ppm'],color='blue',label='Mouna Loa CO$_2$ Measurments')

#graphy stuff
plt.xlabel('Year C.E.')
plt.ylabel('[CO$_2$] ppm')
plt.legend()
plt.show()
```



In [30]:
```
#Calculating the residual
##residual = (actual y) - (calculated y)
residual = data['CO2_ppm'] - new_y
```

In [52]:
```
#Plotting the residual
plt.figure(figsize=(8,4))
plt.subplot(2,1,1)
plt.scatter(data['Date'],residual,color='red',s=3,marker='D',)
plt.xlim(1955,2022)
plt.ylim(-10,13)
plt.hlines(0,xmin=1950,xmax=2030)
plt.tight_layout()
plt.show()
```

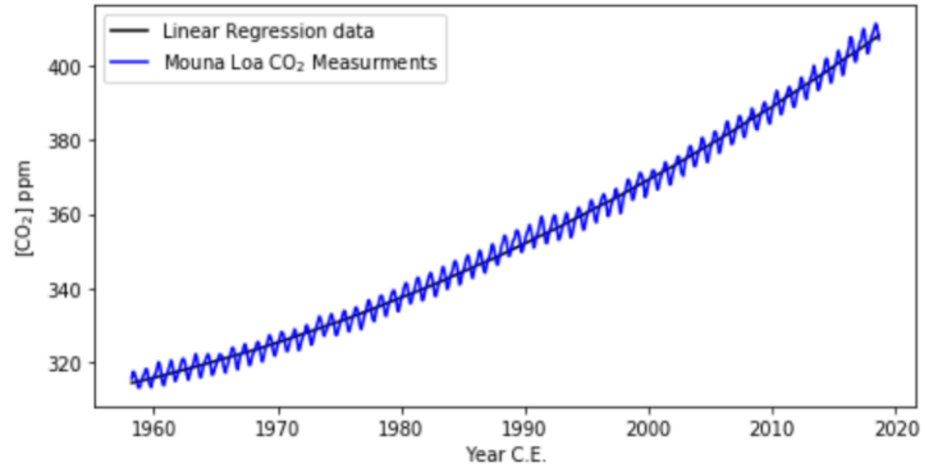


Fit a quadratic model to the data (8 points)

- Use `np.polyfit()` to determine the best-fit quadratic (i.e. degree 2) model to the CO_2 data
- Use `np.polyval()` to find the model CO_2 concentration (y values) for the dates (x values).
- Plot the data and the best-fit line.
- Calculate and plot the residual.

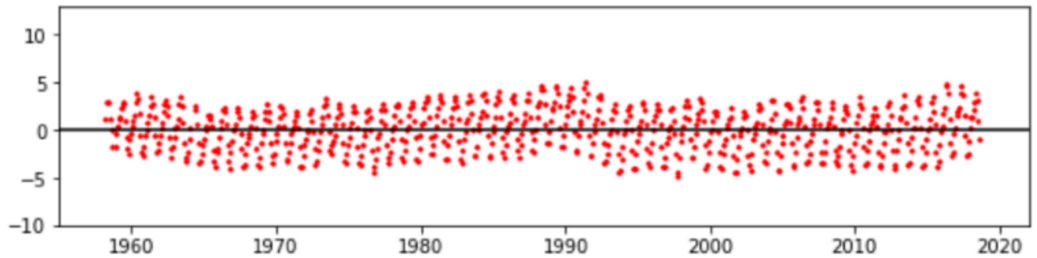
In [89]:
```
m_b_quad = np.polyfit(data['Date'],data['CO2_ppm'],2)
new_y_quad = np.polyval(m_b_quad, data['Date'])
```

In [90]:
```
plt.figure(figsize=(8,4))

#linear regression line
plt.plot(data['Date'],new_y_quad,color='black',label='Linear Regression data')
#actual data
plt.plot(data['Date'],data['CO2_ppm'],color='blue',label='Mouna Loa CO$_2$ Measurments')

#graphy stuff
plt.xlabel('Year C.E.')
plt.ylabel('[CO$_2$] ppm')
plt.legend()
plt.show()
```

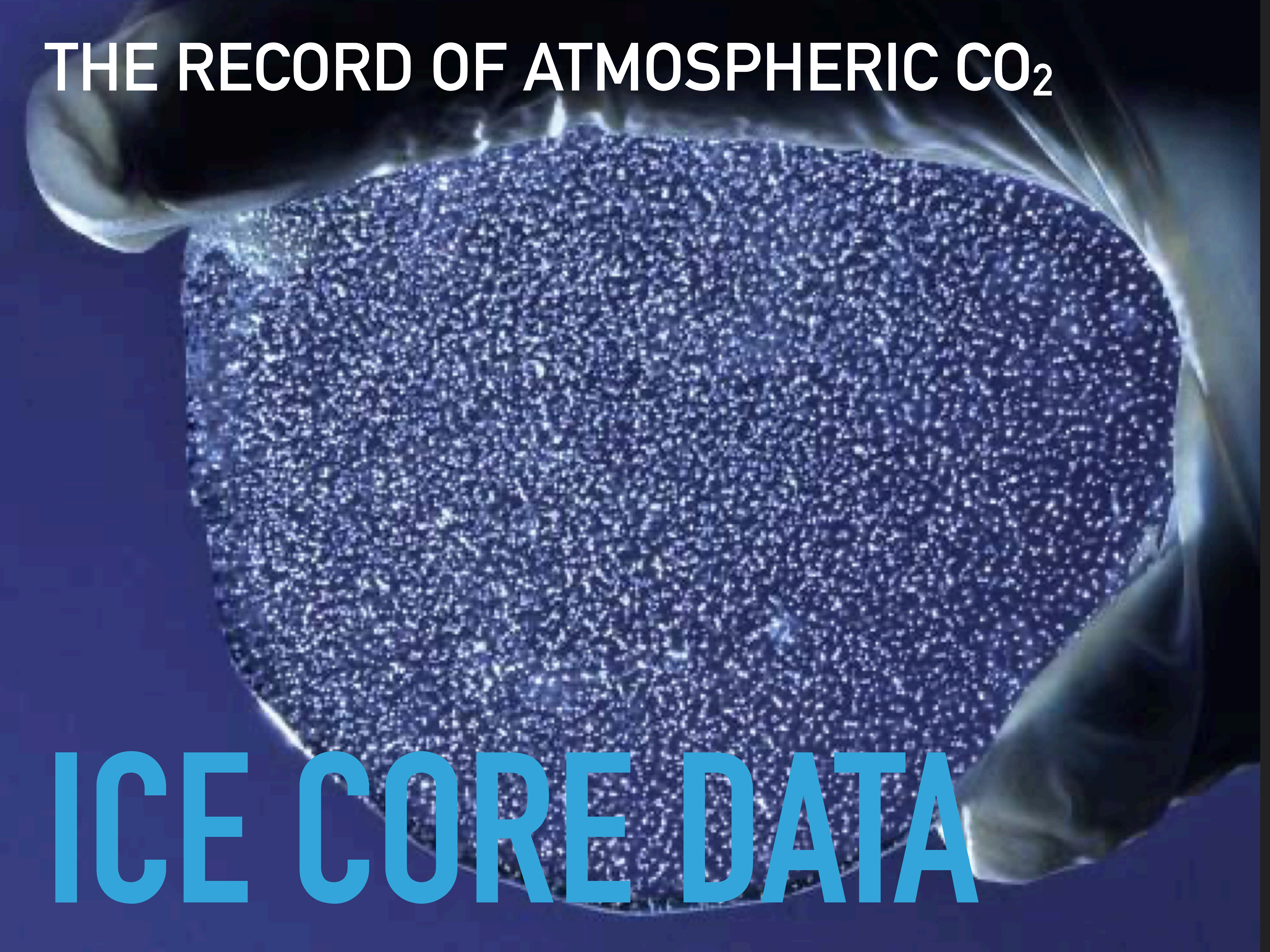


In [91]:
```
#Calculating the residual
##residual = (actual y) - (calculated y)
quad_residual = data['CO2_ppm'] - new_y_quad
```

In [92]:
```
#Plotting the residual
plt.figure(figsize=(8,4))
plt.subplot(2,1,1)
plt.scatter(data['Date'],quad_residual,color='red',s=3,marker='D',)
plt.xlim(1955,2022)
plt.ylim(-10,13)
plt.hlines(0,xmin=1950,xmax=2030)
plt.tight_layout()
plt.show()
```



THE RECORD OF ATMOSPHERIC CO_2



ICE CORE DATA

MAINE

ICE CORE DATA WRANGLING

- Part of our goals this week is to start to get you more self-sufficient in terms of dealing with data. Data aren't always pretty in terms of their format.
- Let's have look at importing some ice core data.

INITIAL COMPUTATION TASKS FOR TODAY

- Make a new Jupyter notebook (try to do it offline in Anaconda).
- Get in a group of 2 or 3 so that you can run ideas by each other.
- Import the Mauna Loa CO_2 data.
- Import the Antarctic ice composite CO_2 data.
- Plot the two records up together. Note that the timescale of the Mauna Loa data will need to be adjusted to match the Antarctic composite data (or vice versa)

HOW DOES THE MODERN DAY RATE OF CO2 CHANGE COMPARE TO THAT IN THE ICE CORE RECORD

- What is the rate of change in the Mauna Loa record? i.e. delve into your take home assignment and extract the the slope of a linear fit (perhaps refit for last 20 years?)

- Discuss with a small group: how should we go about estimating the rate of change from the ice core record? What different approaches could be taken?