# Relation Between Global Temperatures and Sea Levels

## REGRESSION ANALYSIS OF HOW OUR CLIMATE IS CHANGING

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# Introduction

It is no secret that our climate is rapidly changing. Natural disasters are occurring more often, animal species are going extinct at a rapid rate, and the ice sheets at the poles are shrinking.

To take a low level look at how the Earth has changed in the last century, this program and analysis will attempt to answer the question "How has a rising global temperature related to rising sea levels?

The model used in this analysis is "statsmodels" OLS Linear regression

# Data

Two datasets are used for this analysis, one containing Global Average temperatures from 1880 to 2016 and one containing Global Average Sea Levels from 1880 to 2013.

## Datasets
- Global Average Temp
  - Source and details: https://data.world/gpsdd/c82de6b0-12c3-457e-9198-c48aee253d57
  - CSV html: https://query.data.world/s/2rwx5ges7kbt3ouhzi2pe4dv2dxuit
  - Variables
    - cartodb_id (index, unused)
    - the_geom (unused)
    - the_geom_webmercator (unused)
    - uid – categorical indicating whether reading is annual-mean or five year mean
    - date – date of reading
    - value - change in global surface temperature relative to 1951-1980 average temperatures
    - value_type - categorical indicating whether reading is annual-mean or five year mean (identical to uid, unused)
- Global Sea Levels
  - Source and Details: https://datahub.io/core/sea-level-rise#data
  - CSV html: https://datahub.io/core/sea-level-rise/r/csiro_recons_gmsl_yr_2015.csv
  - Variables
    - Time – Year of GMSL calculation (%Y-%m-%d format)
    - GMSL - Reconstructed Global Mean Sea Level in mm
    - GMSL uncertainty - Uncertainty due to reconstruction

# Plots and Analysis

## GLOBAL TEMP
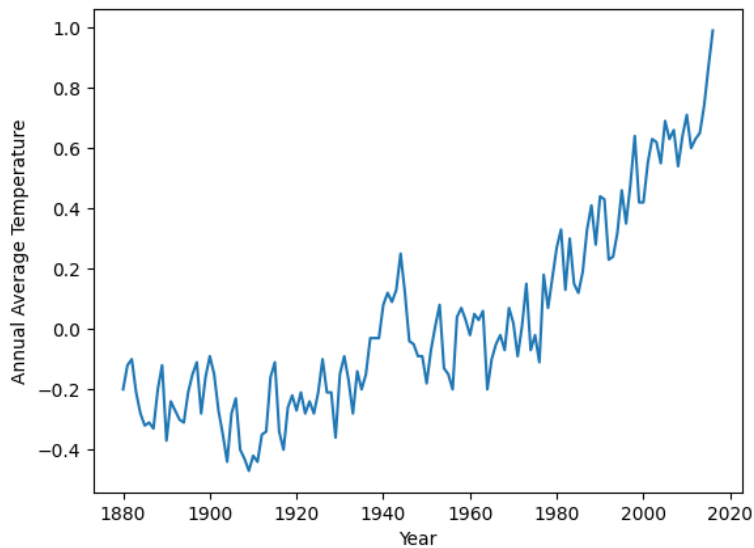


We can see here that overall the global temperature has been on the rise, especially since the 1960s. There are some pockets of a series of especially warm or cold years, but the trend is up. The following plow shows an OLS regression line displaying the steady overall increase in temperature.
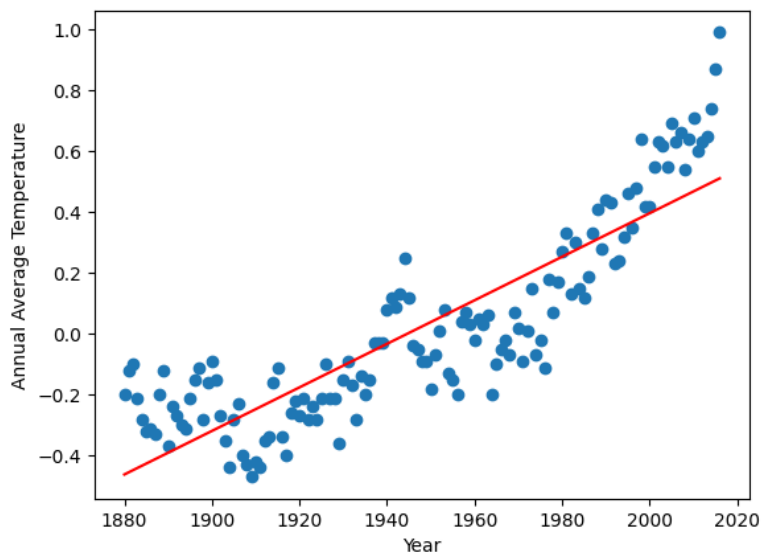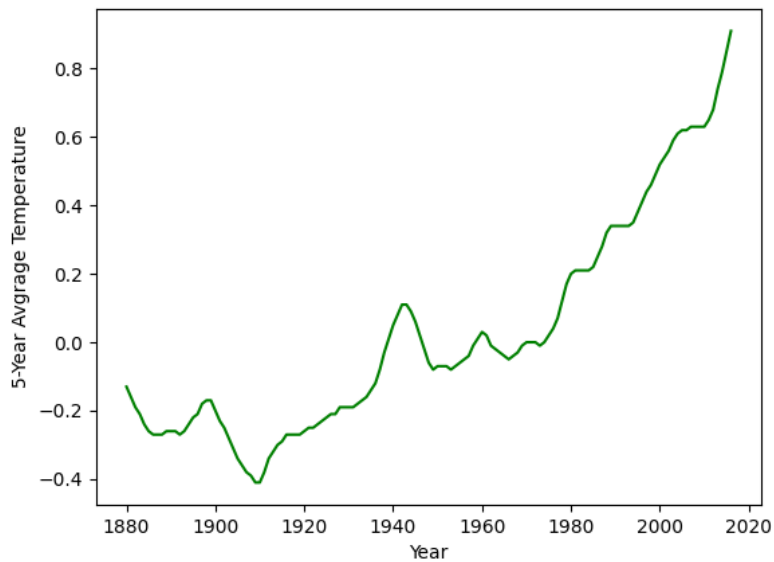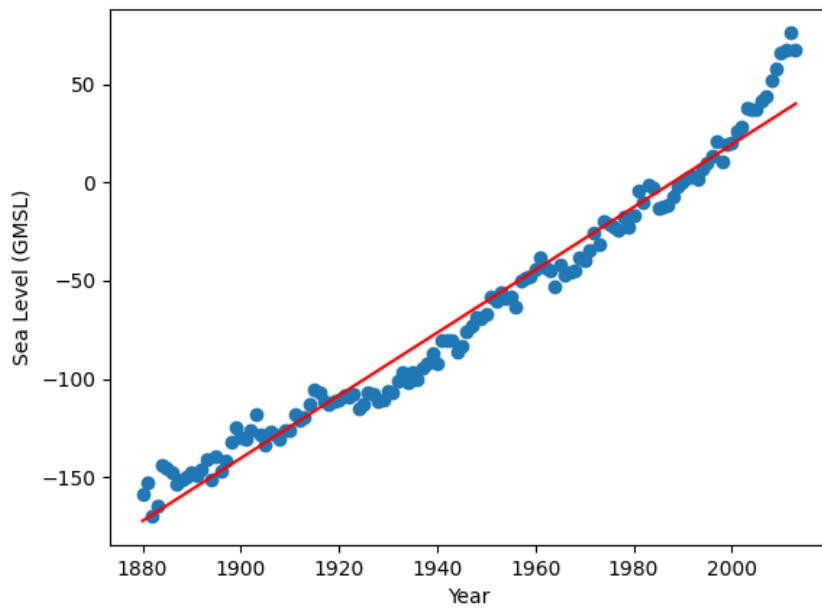
The five year average temperature has a bit more smooth growth. We can still see an interesting spike around 1940 and rapid growth starting around 1970.
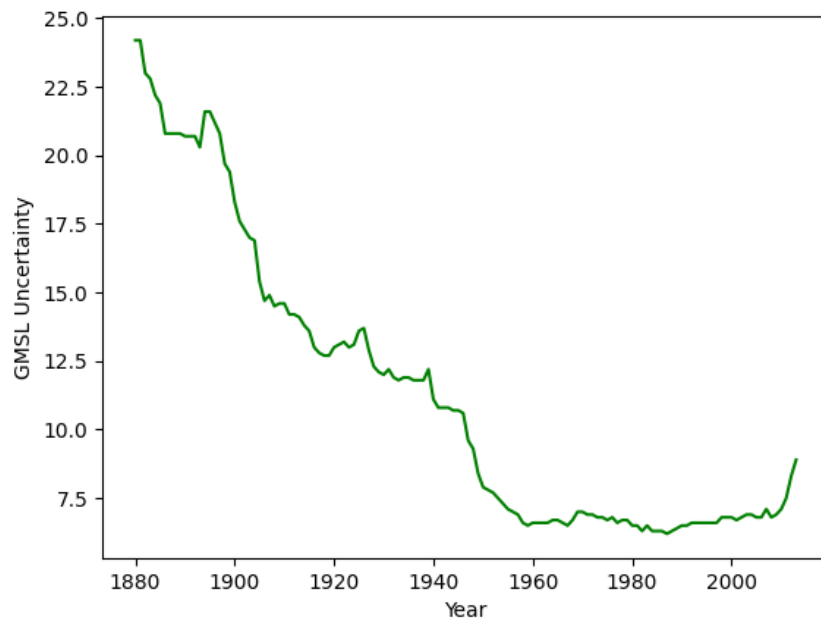
## SEA LEVELS
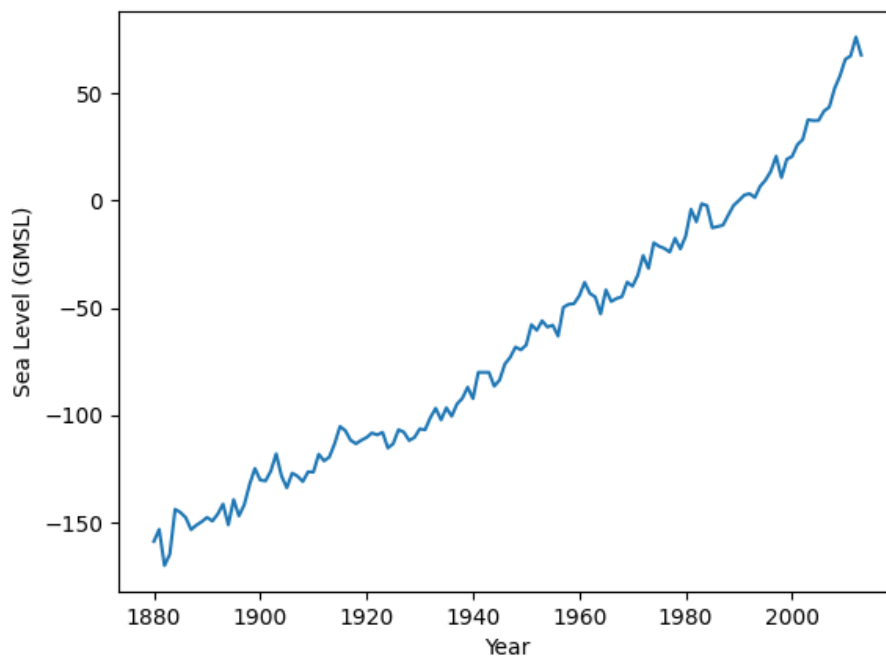


Sea levels have also certainly been rising, a bit steadier than the Global Temperatures
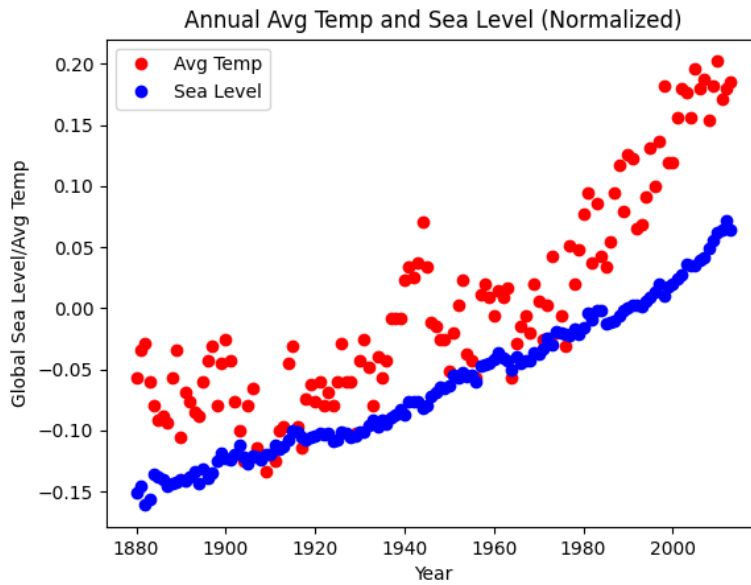
The regression line fits this data quite closely, and is a better overall fit than for the Global Temperature as well



We can see that uncertainty about the Sea Level has also been dropping, though hits in minimum in the late 1980s and has a spike towards most recent years.

# TEMPERATURE VS SEA LEVEL



Normalizing and combining the data and plotting both against year, we can see that they both trend up with each other, but Sea Level has slower but steadier growth.
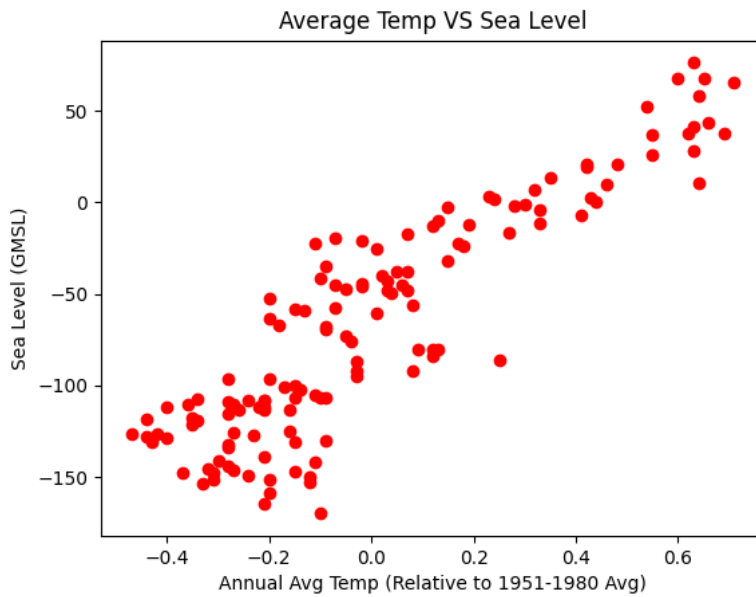


Plotting Temp vs Sea Level, we see that they do trend up consistently with each other, and have fairly tight grouping.

Running a regression we see that the correlation between the two is statistically significant (p-value less than .05)

OLS Regression Results

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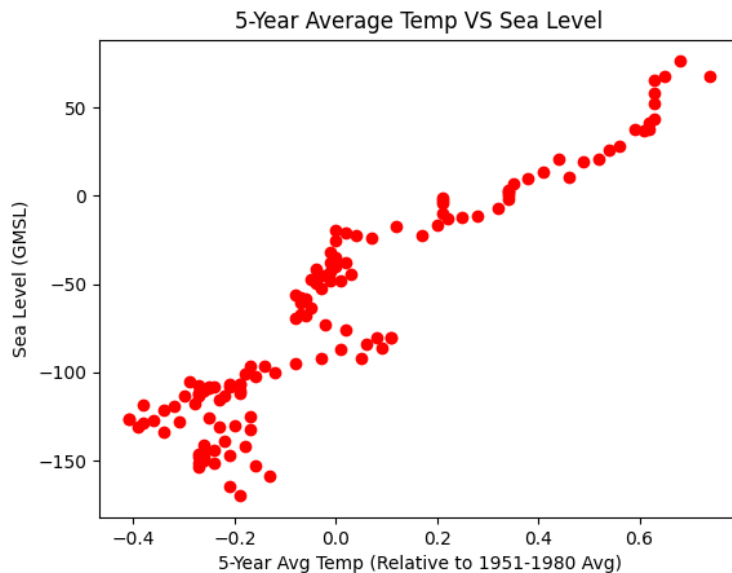| Dep. Variable: | Sea Level | R-squared (uncentered): | 0.364 |
|---|---|---|---|
| Model: | OLS | Adj. R-squared (uncentered): | 0.359 |
| Method: | Least Squares | F-statistic: | 76.00 |
| Date: | Thu, 30 Dec 2021 | Prob (F-statistic): | 9.99e-15 |
| Time: | 16:02:13 | Log-Likelihood: | -764.44 |
| No. Observations: | 134 | AIC: | 1531. |
| Df Residuals: | 133 | BIC: | 1534. |
| Df Model: | 1 | | |
| Covariance Type: | nonrobust | | |

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| | coef | std err | t | P>|t| | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| Annual Avg Temp | 181.0237 | 20.764 | 8.718 | 0.000 | 139.952 | 222.095 |



5-Year Average Temp VS Sea Level

Comparing the 5-year Average Temp to Sea Level, we can see that the grouping is even tighter.

Looking at the regression results comparing these two, Global Temperature is again statistically significant, but we also see an improved R-Squared value. We can conclude that sea levels better correlate with the average 5-year temperatures than the annual average.

OLS Regression Results

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Dep. Variable:          Sea Level   R-squared (uncentered):           0.391

Model:                        OLS   Adj. R-squared (uncentered):      0.387

Method:             Least Squares   F-statistic:                      85.55

Date:            Thu, 30 Dec 2021   Prob (F-statistic):            4.94e-16

Time:                    16:04:46   Log-Likelihood:                 -761.45

No. Observations:             134   AIC:                              1525.

Df Residuals:                 133   BIC:                              1528.

Df Model:                       1

Covariance Type:        nonrobust

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                  coef   std err      t     P>|t|    [0.025    0.975]

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5-Year Avg Temp  194.5517  21.034   9.249   0.000   152.947   236.156
```

# Conclusion

We can see that both Global Temperatures and Sea Levels are rising, and both seem to correlate with each other. The 5 year average temperature seems to correlate a little closer with sea level.

If Global Temperatures rise, we can surely agree that Sea Levels will be likely to as well. This would be bad news for all humans, especially those that live coastally. This should come as a warning of things to come, and an alarm for governments of the world to act as soon as they can to try to reverse or stop the effects that lead to Global Warming.