Coding the Climate:

Modeling the temporal relationship between Greenhouse Gases and Sea Ice

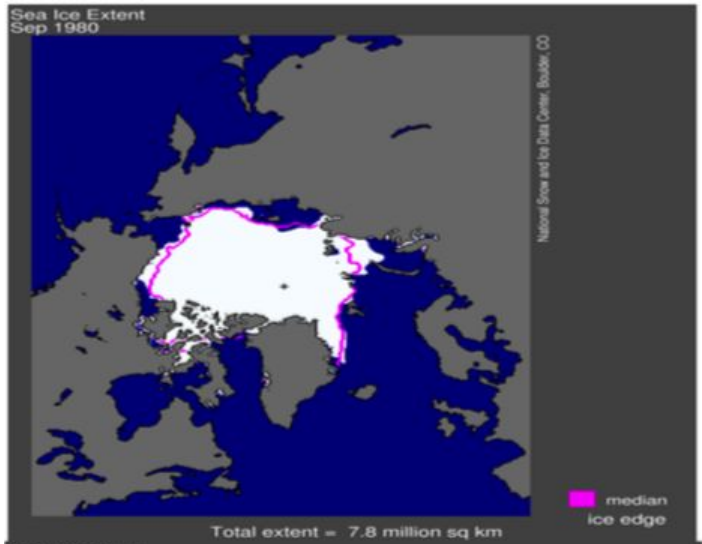
Rachel Hausmann

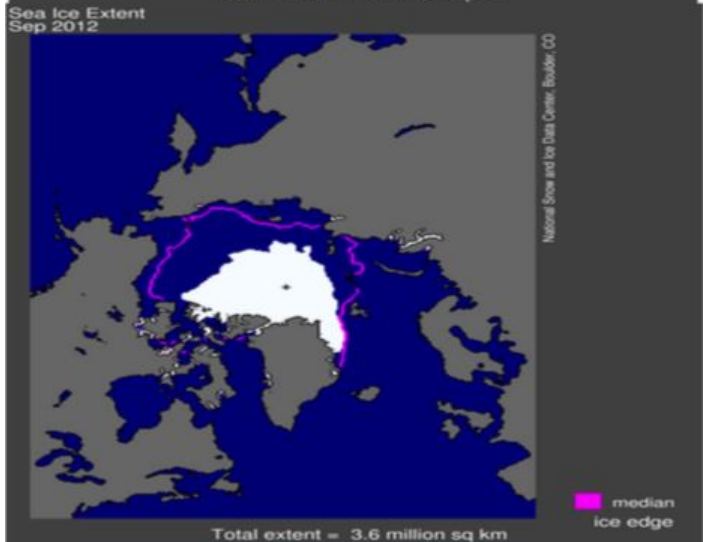
Introduction & Context

Climate change = melting sea ice = rising sea level

Objective: Test the feasibility of modeling sea ice extent and greenhouse gases

Goal: Select a regression model best suited for modeling a potential relationship between publicly available greenhouse gas data and the complete loss of our Arctic sea ice.



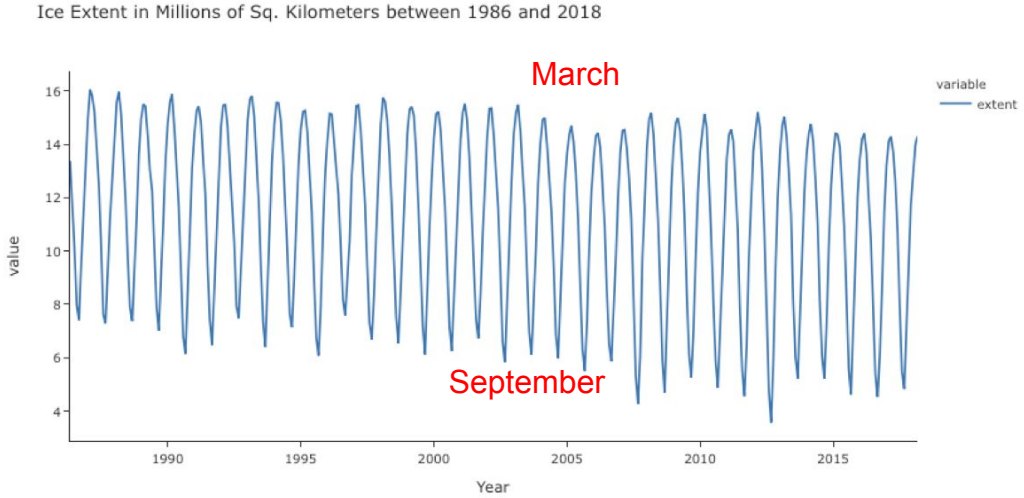


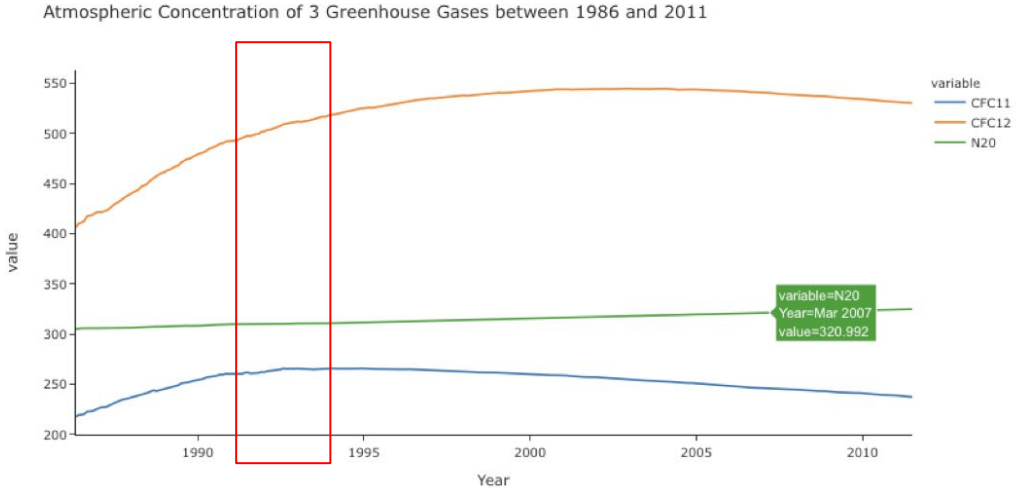
Methodology: Data

Monthly arctic sea ice extent between 1986 and 2018

Initial greenhouse gas dataset contained data that began decreasing in the 1990s.

Legislation passed by the U.S. Congress banned CFC11 and CFC12. Common in refrigerant and MVAC systems.



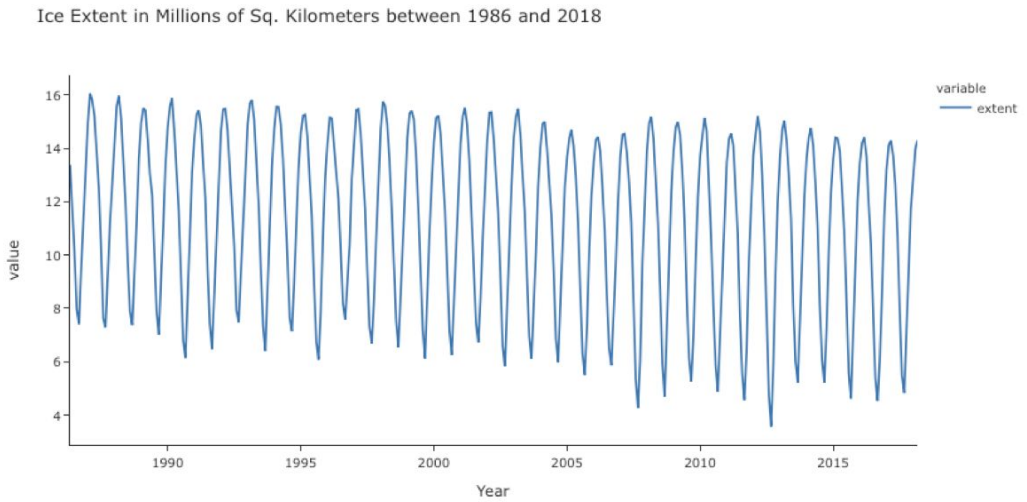


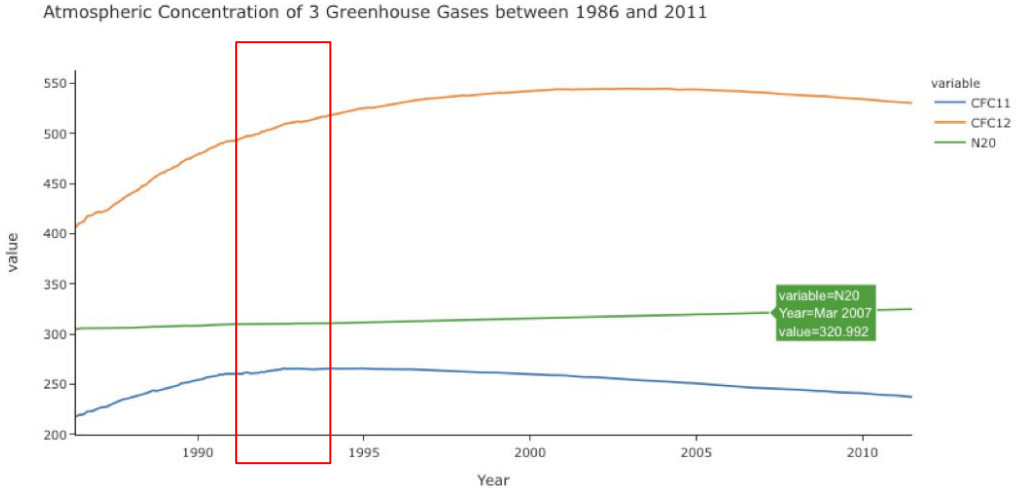
Methodology: Model

Initial dataset produced a severely underfit model- most likely due to the cyclical ice extent data and trend of CFC12 and CFC 11.

```
Validation R^2 score was: -0.23500426534302554
Feature coefficient results:

CFC11 : 0.06
CFC12 : -0.07
CFC113 : 0.04
CH4 : 0.00
N20 : 1.75
C02 : -0.66
El_Nino : 0.24
La_Nina : 0.52
```



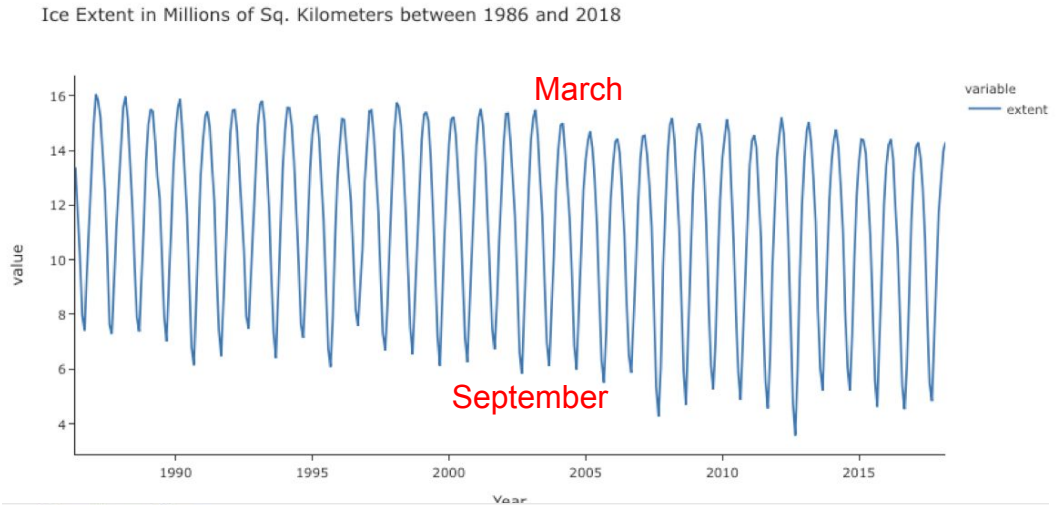


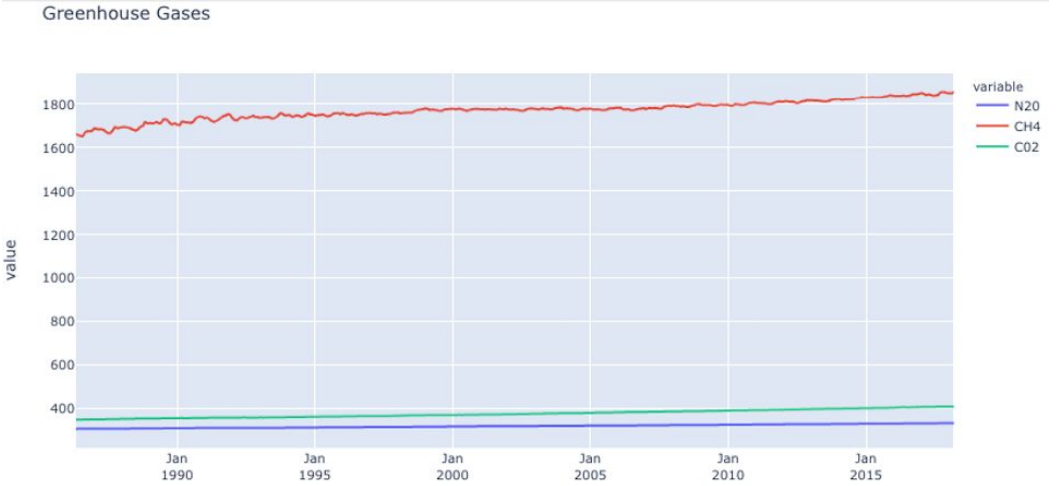
Methodology & Data Refined

Monthly arctic sea ice extent between 1986 and 2018

Goal Refined: Select a regression model best suited for modeling a relationship between sea ice extent, N20, CH4, and C02.

Final dataset includes Nitrous Oxide(N20), Methane (CH4), and Carbon Dioxide (C02). Three greenhouse gases increasing in atmospheric concentration present day.





Results

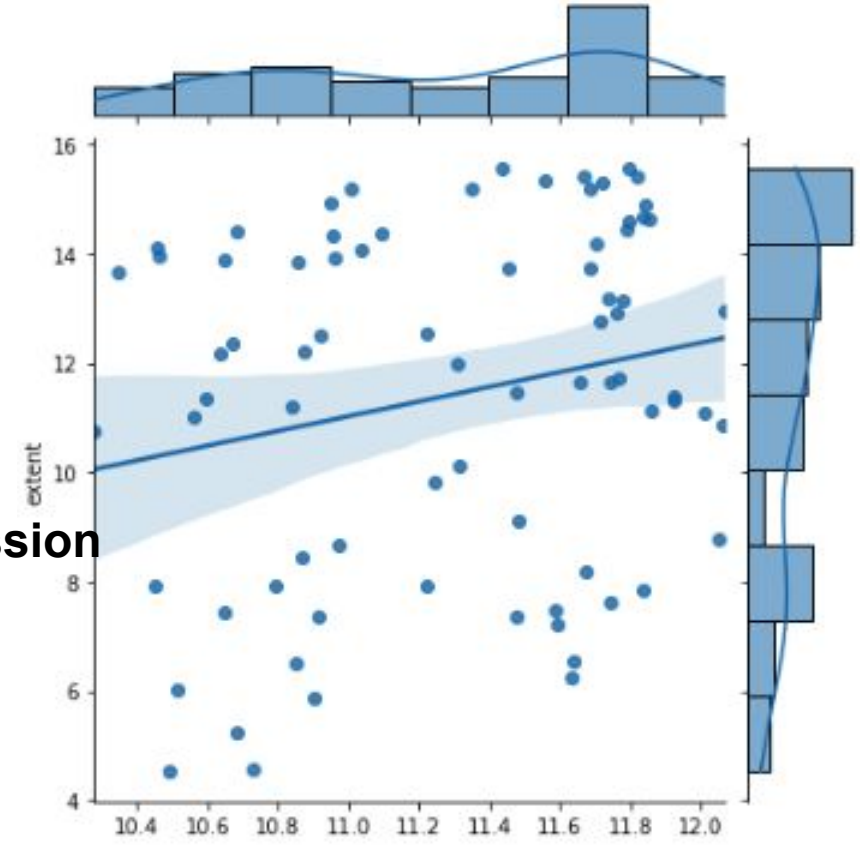
Feature Engineering:

- **Reduced features**
- **Aded polynomial terms to N20 and C02**

Current model is lacking is the ability to account for the cyclical and seasonal time series.

FINAL 2nd degree of polynomial regression
R^2 =
0.034.

Predicted vs Actuals.

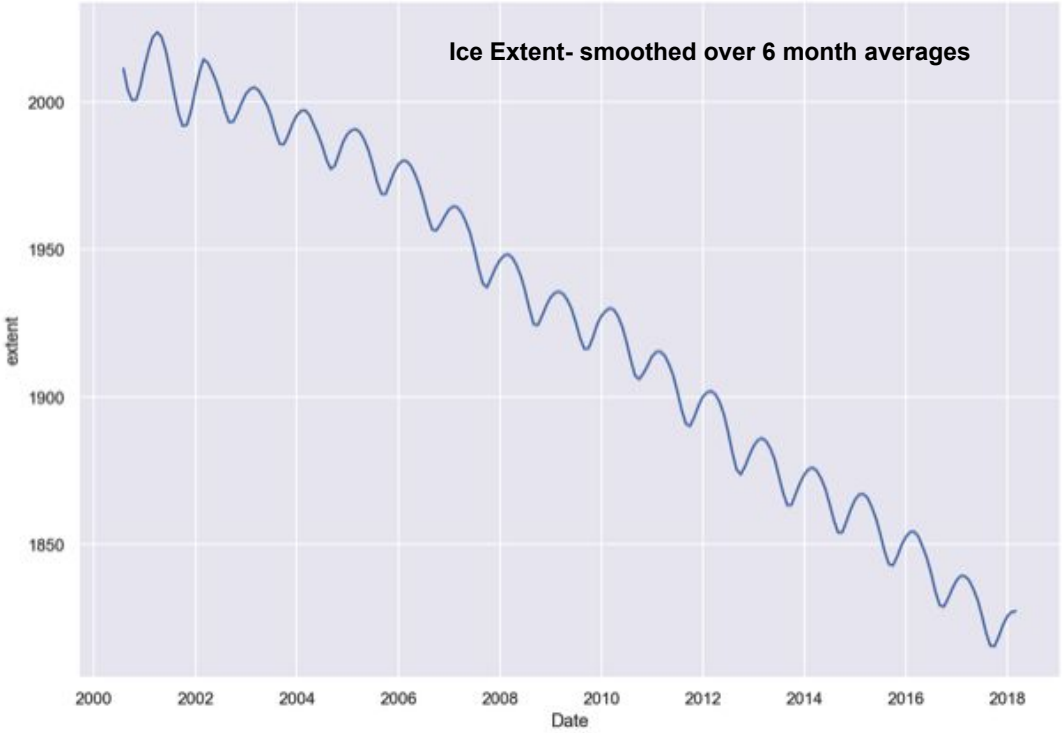


Line= regression model

Conclusion

Objective revisited: It is feasible with a model that will account for the seasonal ice extent.

Goal revisited: SARIMA model with polynomial degrees



Conclusion and direction of future work: Seasonal Autoregressive Integrated Moving Average Model (SARIMA)