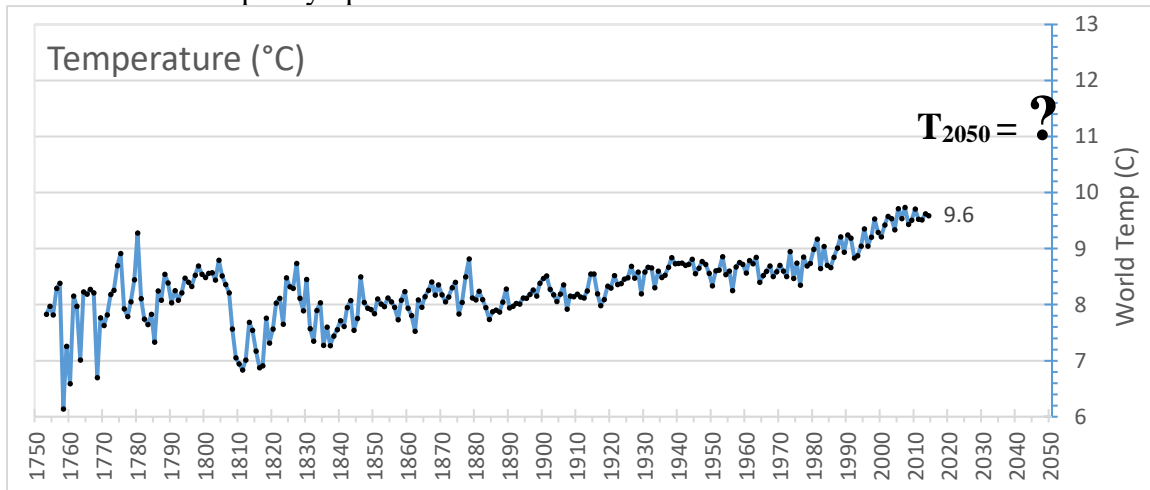


Developing Simple Climate Model

Objective: Your group is part of the Department of Climate Change of the USA. USA government requested for you to make assessment of the changing climate in the country. Your goal is to predict what temperature will be in USA in 2050 under different climate scenarios and advice on a better policy option.

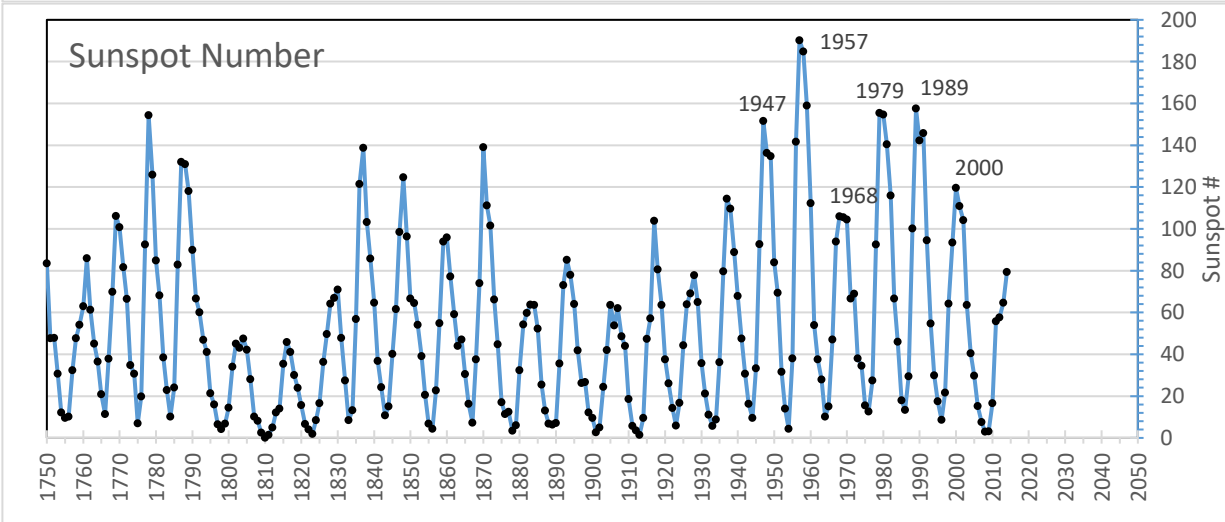
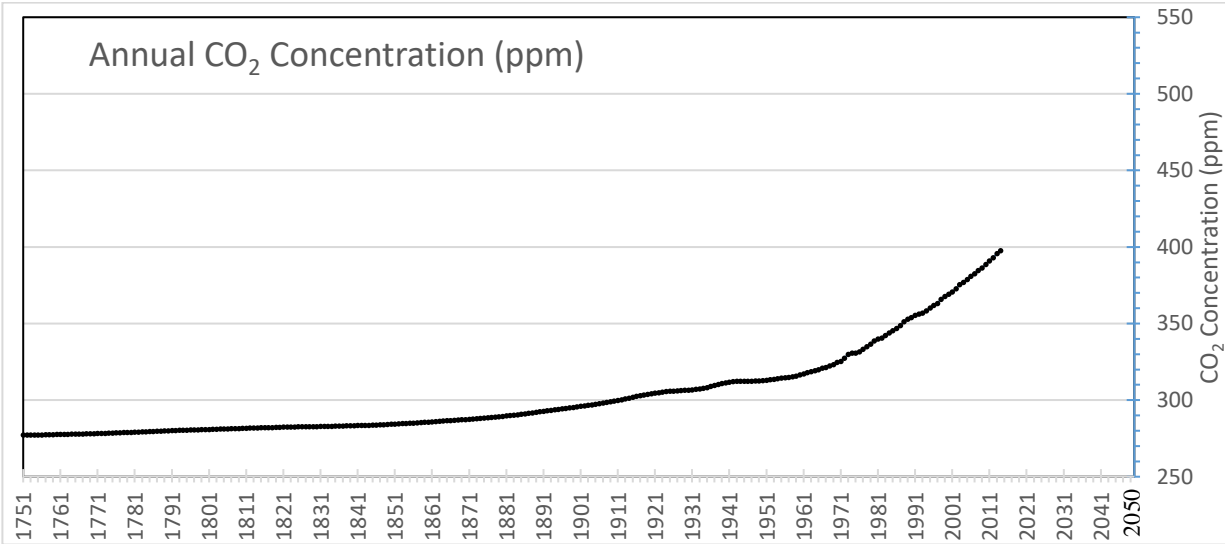


Part 1: Explore the Trend

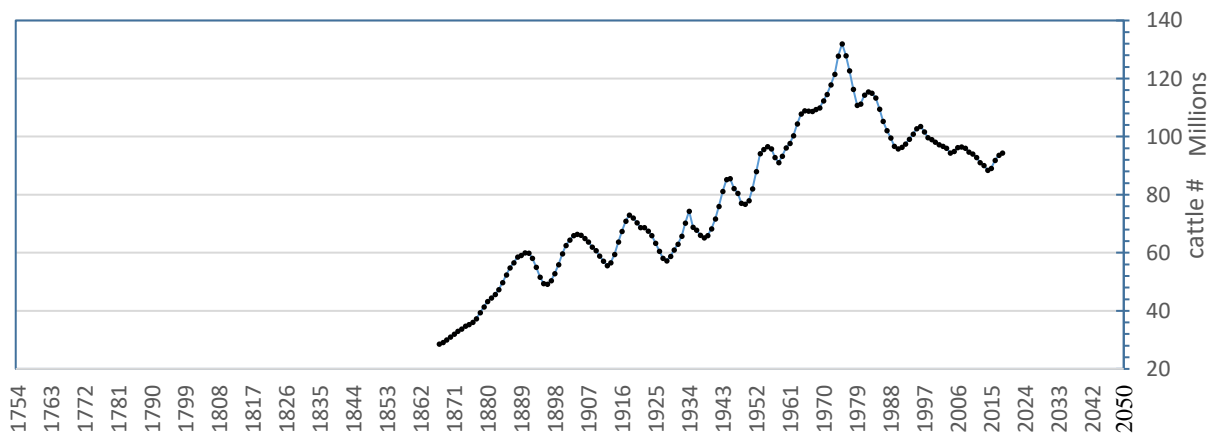
Prior to any modeling, it is important to explore and get familiar with your data. Thus, to predict the event that will happen in the future it is important to understand how certain parameter varied in the past and present.

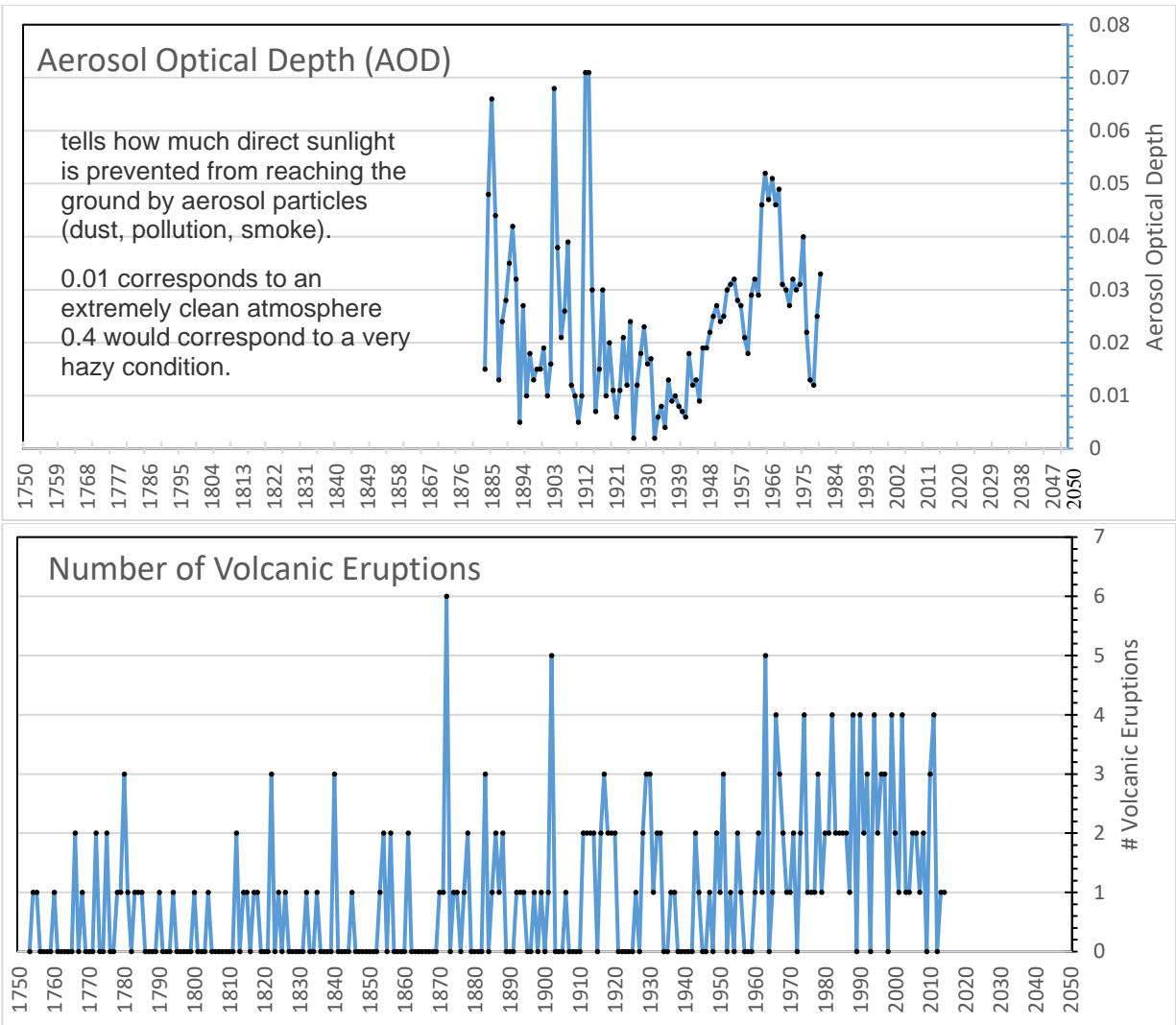
- 1) Explore the data given below that are available to your team (annual variability between 1750-2014)
- 2) Fill in the table below, briefly describing the trend in the data (is it increasing, decreasing, cyclic or staying the same over time), variability (is the trend constant over time or does it vary widely from year-to-year), and general notes on the pattern that you see.

Variable	General Trend	Variability	Notes
CO ₂ Concentration			
Sunspot Number			
Cattle in USA			
Aerosol Optical Depth			
Volcanic Eruptions			



Cattle in USA



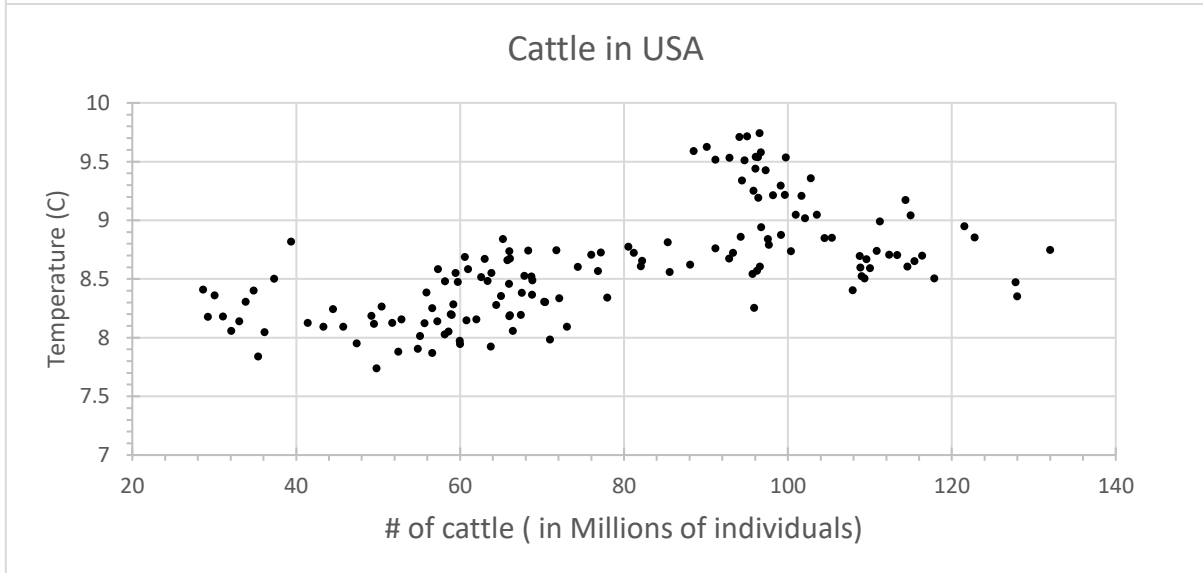
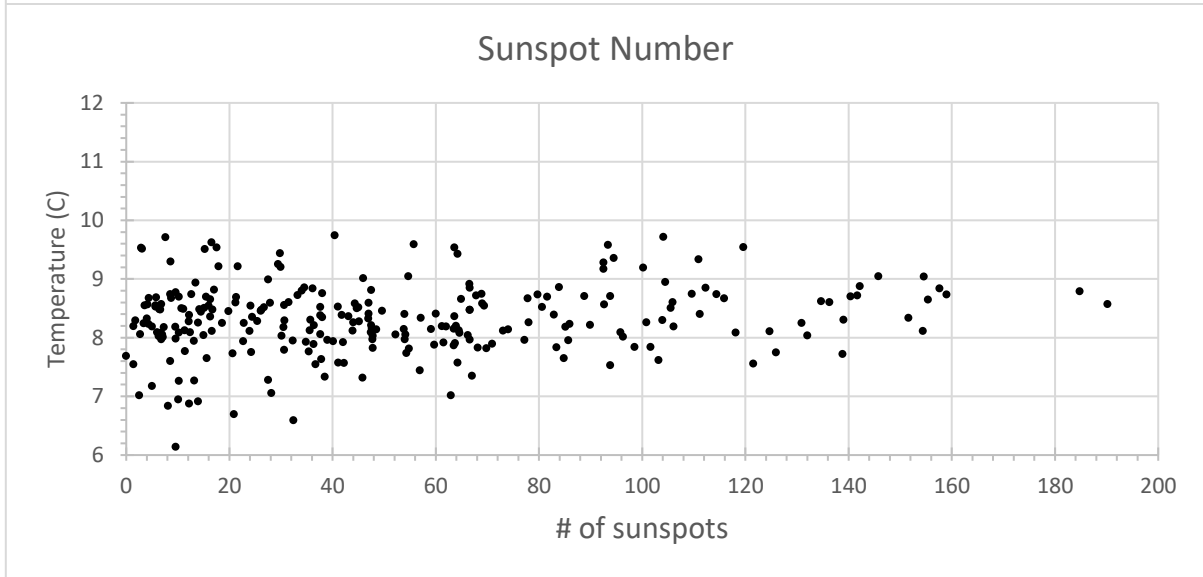
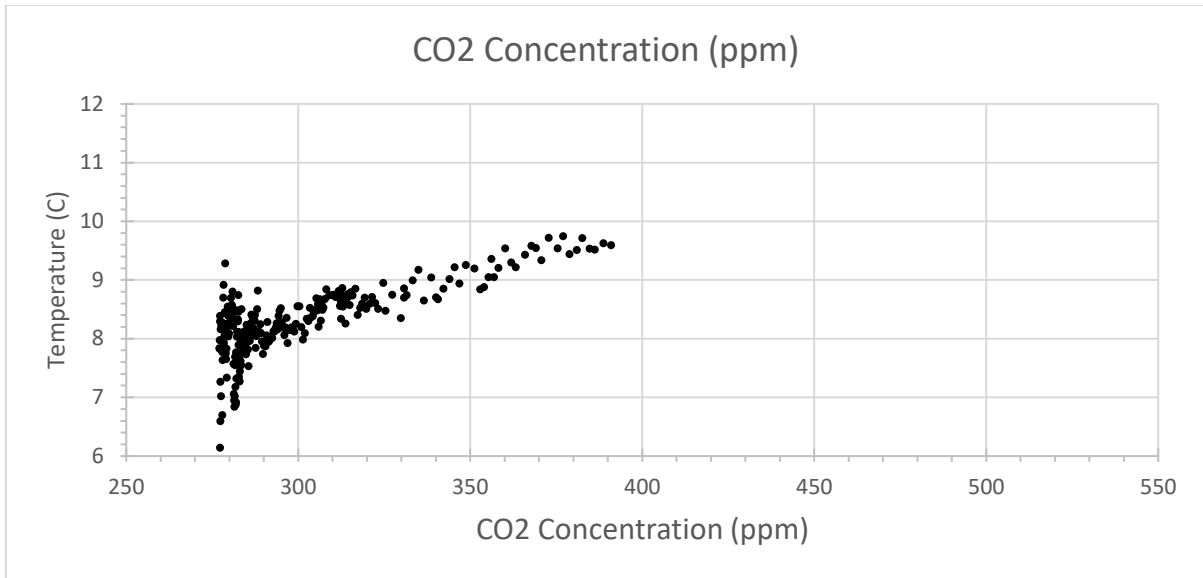


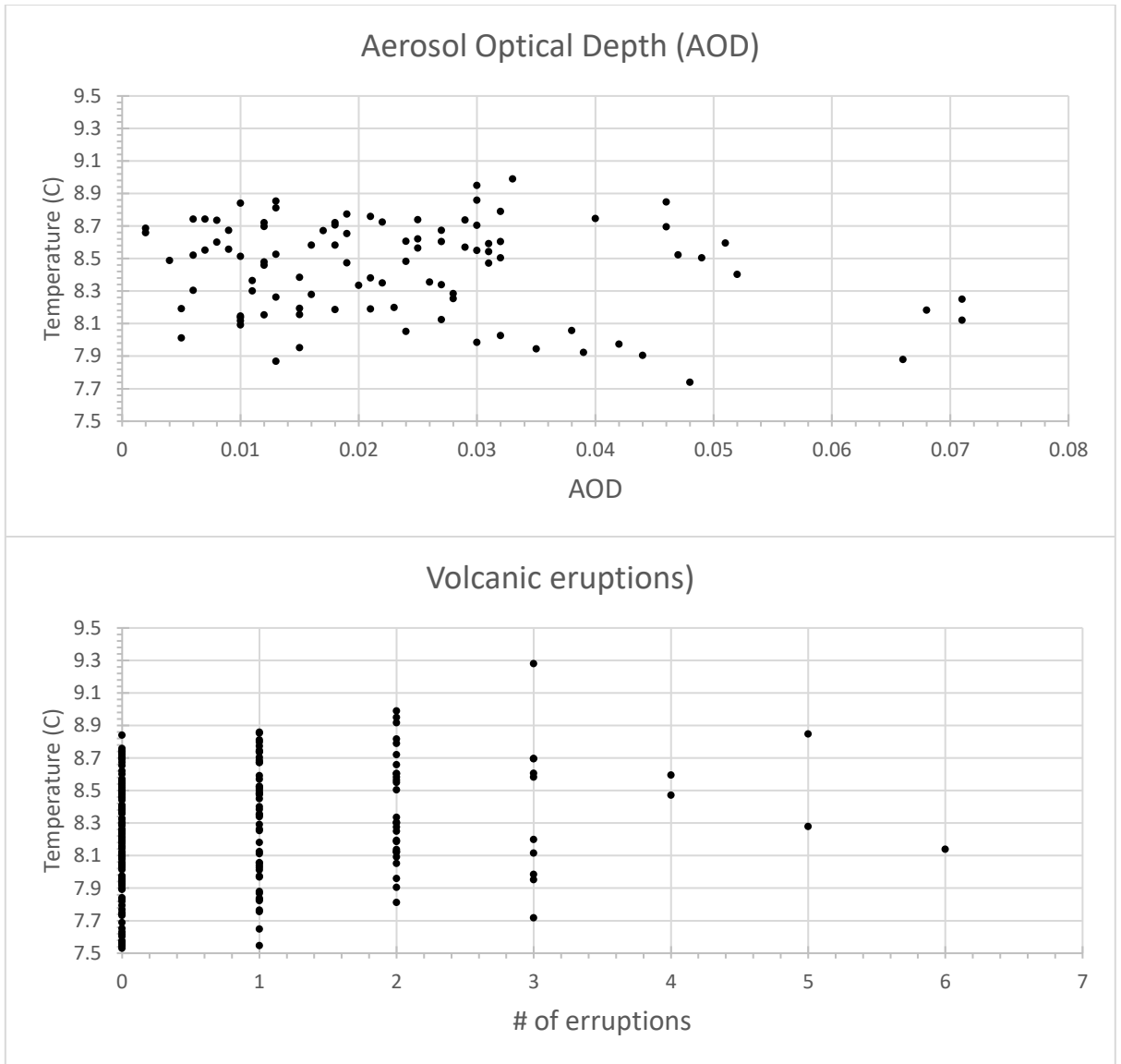
Part 2: Explore Correlation with Temperature

As you were asked to predict change in temperature, it is of interest to explore how each parameter varies with temperature.

- 1) Explore the relationship between a parameter and the temperature in the graphs below.
- 2) Fill in the table below to indicate the relationship between that variable and global temperature (are they positively related, negatively related, or unrelated) and the strength of any relationship (is it a strong relationship or just a weak one with a lot of variation).

Variable	Direction of Relationship	Strength of Relationship	Notes
CO ₂ Concentration			
Sunspot Number			
Cattle in USA			
Aerosol Optical Depth			
Volcanic Eruptions			





Part 3: Creating your own Climate Model

T = function (parameter 1, parameter 2, parameter 3...)

- a) We are modelling temperature as a function of some parameters. Now, your team needs to decide which parameter to use.
 - 1) Based on the relationship between global temperature and each variable, decide whether or not you think it would be important to include that variable in your model (Circle Yes or No) in the table below. Provide a short rationale why you decided to include and omit some of the parameters:

- b) For each of the variables you chose to include in your model:
 - 2) From Part 1, estimate what the value of the variable going to be in 2050. Record your estimates in the third column (“Estimated Value in 2050”)
 - 3) Using Part 2 graphs, determine what temperature is likely to be in 2050 based on 2050 values you determined above. Record your estimates in the fourth column (“Predicted Temp in 2050”).
 - 4) Finally, calculate an average of the predicted temperatures from each of the variables above to determine your final prediction.

Variable	Included in the model:	Estimated Value in 2050	Predicted Temp in 2050
CO ₂ Concentration	Y / N		
Sunspot Number	Y / N		
Cattle in USA	Y / N		
Aerosol Optical Depth	Y / N		
Volcanic Eruptions	Y / N		
Your prediction for average global air temperature in 2050: (Average)			

Your prediction for average global air temperature CHANGE since 2014 (Temperature in 2014 is labeled on the graph from Part 1): _____

Part 4: Different Policy Scenarios

US Government wants to reduce the warming, and they came up with 2 possible scenarios that can help to achieve their goal. Your team have been asked to explore, using your model how different scenarios will affect the temperature.

Scenario 1:

Adopt stricter CO₂ emissions standards by reducing the rate of increase of atmospheric CO₂ increase by 50%.
Estimated COST \$6.6 billion

Scenario 2:

Replace portion of meat protein with a plant-based, thus reducing the number of cattle to 60 million.
Estimated COST \$4.0 billion

What would happen to your predicted temperature for 2050 if nations adopted Scenario 1?
Explain how you determined your new estimate.

What would happen to your predicted temperature for 2050 if nations adopted Scenario 2?
Explain how you determined your new estimate.

US Government only has money to implement one of the policies. Advice US government on what type of policy should be implemented, give your rationale.

Synthesis & Wrap Up

In what ways do you think your model is accurate? In other words, how does your model accurately represent the real world?

Give two limitations of your model. In other words, how is your model not like the real world?

What other variables do you think would help your model? What other things could influence global temperatures that could be included?