Polar Ice Caps

Past, Present, and Future

New Mexico
Supercomputing Challenge
Final Report
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Team #73

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Abstract

Climate change has quickly become a growing problem in recent years. This sudden change in the earth's climate is believed to be caused by emissions of CO2 gas, a common byproduct of fossil fuels, which are used to meet most of the energy demand of the world right now. The warming of the planet is causing the melting of the arctic sea ice, and this could cause major problems for the planet. Namely the rising sea levels that threaten to flood large areas of land, and loss of habitat. Our goal is to make a program that would attempt to model the change of polar ice levels over a period of time, and subsequently rising sea levels. This program would take into account ice and CO2, and attempt to find a direct correlation between them. We made a couple of models in the Python programing language, one to show polar ice levels if the current trend continues, and another that takes input for CO2 in PPM and outputs the size of the arctic sea ice for that amount of CO2 using the direct correlation that we will find between them. The raw data from the first program would then be placed in a graph, showing polar ice in relation to several factors that include temperature, CO2 levels in PPM, and sea level. The hypothesis that we created is that if international goals for combating climate change are met, the polar ice will return to preindustrial levels within one hundred years. We also hypothesize, that if the goals are not met but emissions of greenhouse gasses end within seventy-five years, the polar ice caps will take at least three hundred years to fully recover from the damage inflicted by humankind's emissions of greenhouse gasses. If this is correct, it means that emissions must be ended soon, or the effects will

take a much longer time to mitigate. The longer it takes for us to reverse this the harder it will become to go back.

Introduction

Global warming is the increase in the average temperature of Earth's surface air and oceans. Global warming is an event that is currently a problem as there has been a definite increase in the temperature of the Earth's surface and oceans since the mid-20th century. The primary cause that has been found for this is an increase in the level of greenhouse gas levels. Greenhouse gasses are naturally in our atmosphere and they act as a blanket for our planet by keeping the heat in and not allowing it to escape. This makes earth livable and we need it to survive but if there is too much in our atmosphere it will make the earth become too warm and people and many other living things will no longer be able to survive. Carbon dioxide (CO2) is a greenhouse gas that is one of the biggest contributors to global warming. This is because CO2 is the main gas that is created whenever we drive cars or burn coal for energy. We are concerned about the rising levels of CO2, which is why we focused on this for our project.

The increase in the temperature will do many things to our planet but one of the main things that will happen is the polar arctic sea ice will melt. In our project we have predicted the arctic sea ice size from the present until 2050. To accomplish this we wrote a program in Python that will output the future levels of the size of the arctic sea ice. The way we have done this is by taking the past data and making a line of fit for it. Then we projected the line further into future years.

We also wrote a program in Python that will ask for a CO2 amount in parts per million (PPM) and will give a predicted amount of the size of the ice with that amount of CO2 in PPM. Another thing that we did is we made a program in Scratch that is a visual representation of the second Python program. The Scratch program asks for a CO2 level in PPM and then shows an increase in the arctic sea ice's size or a decrease depending on the amount of CO2 input.

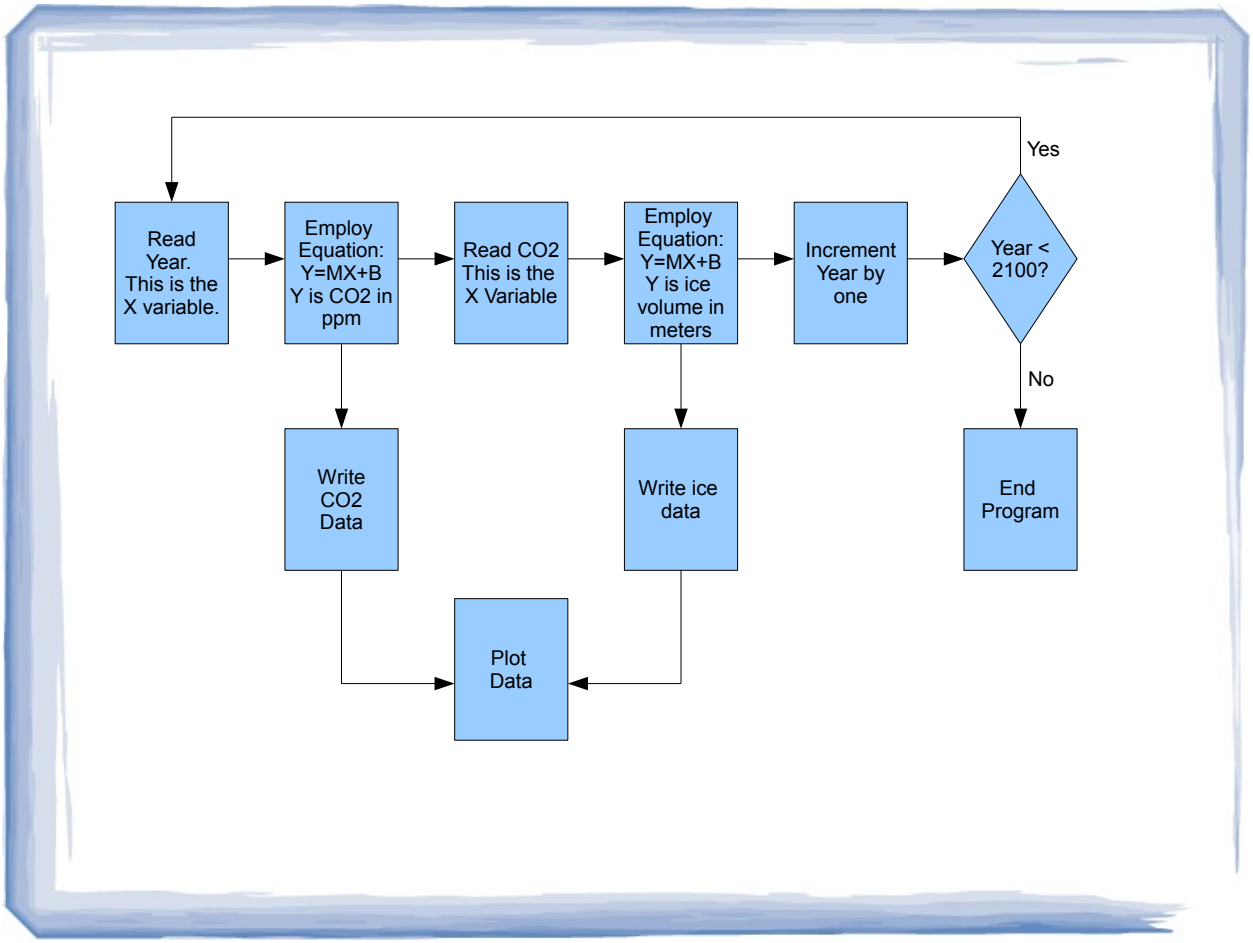
Program

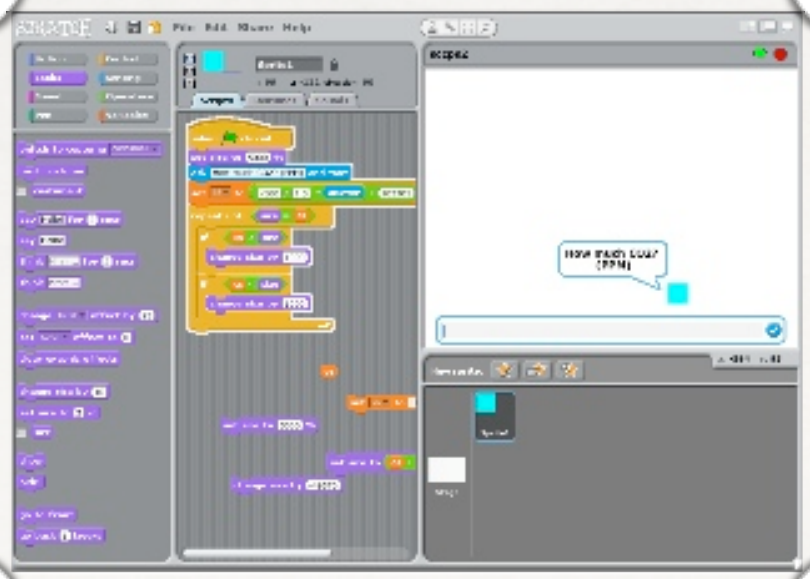
For the project our team chose to use the programming language "Python". Some of the variables that we assumed stayed constant were that the temperature was not rising for any other reasons, humidity, population increase on earth remained steady, and there was no other human intervention in ice shrinkage. In Python def is the way to begin a section of the program and the first sections of our program does just that, they define the variables used in our project. The program that we created basically runs an equation for each year which creates data points for Co2 levels and ice volume. Each section's steps are first defined and then at the bottom of the program they begin running. After producing the data our program actually compiles the statistics into a raw text file to be able to be transformed in to a graph or more presentable way of viewing the data.

Here is our Python program:

```
def nogoals():
    yr = 2000

    f = open("NoGoals.txt", "w")


    while yr < 2100:
        yr = yr + 1
        co2 = 1.5*(yr-2000)+370
        f.write(str(yr))
        f.write(" ")
        f.write(str(co2))
        f.write("\n")



    f.close()
def ice():
    yr = 2000

    f = open("ice.txt", "w")


    temp = 0
    while yr < 2100:
        yr = yr + 1
        vlme = (-500)*(yr-2000)+18000
        f.write(str(yr))
        f.write(" ")
        f.write(str(vlme))
        f.write("\n")
    f.close()
def ice2():
    userco2 = input("Enter Co2 in parts per million:")

    eq = 54054054
    ice2 = (userco2)*(eq)

    print (ice2)
nogoals()
ice()

ice2()
```

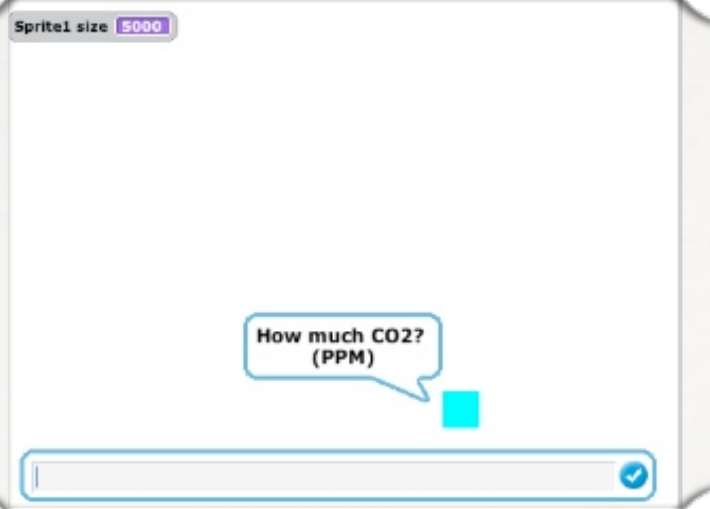
Here is a flow chart that explains how our program works:

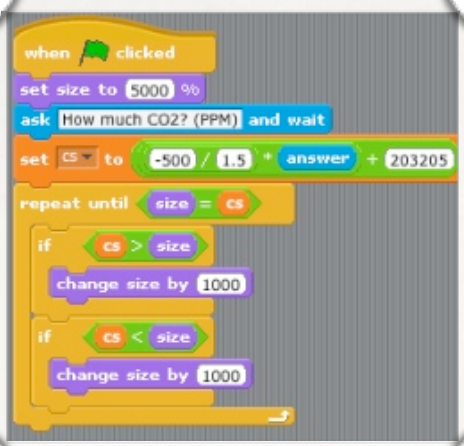




This shows the entire Scratch interface where we built our Scratch program

This shows our Scratch program while it is running. It is just asking how much CO2, once that is entered it will calculate size and that will be displayed.

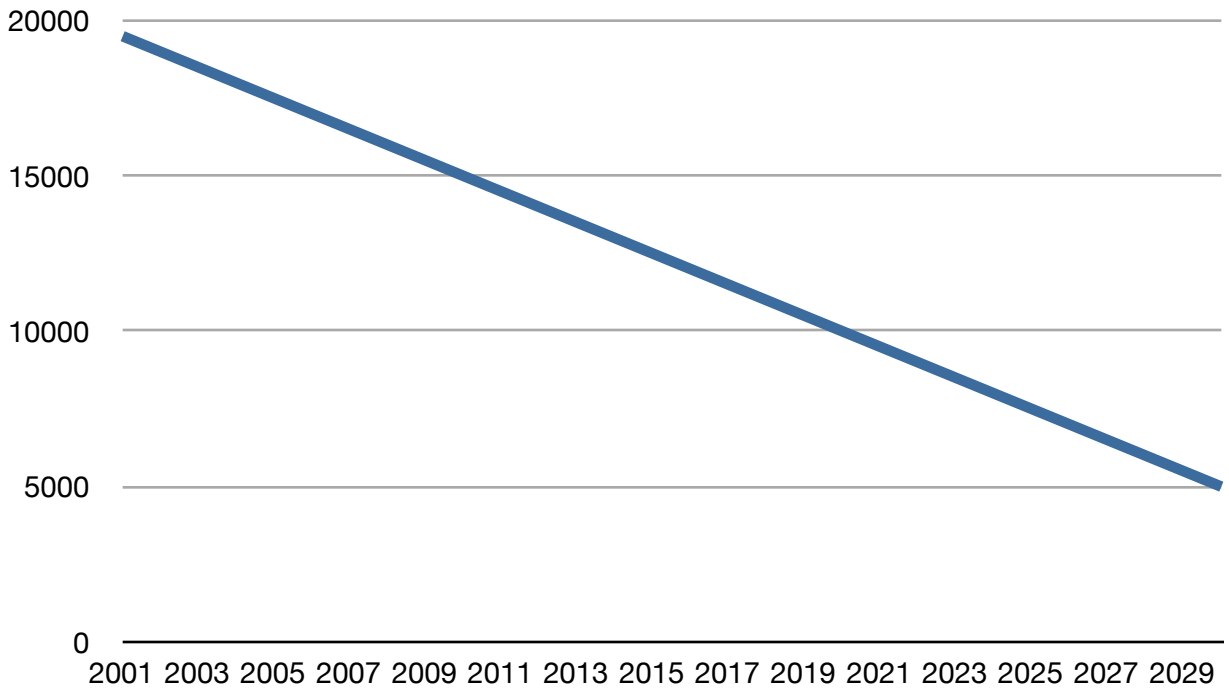




This shows our Scratch program. It is the part of the program that calculates the size of arctic sea ice given the CO2 amount.

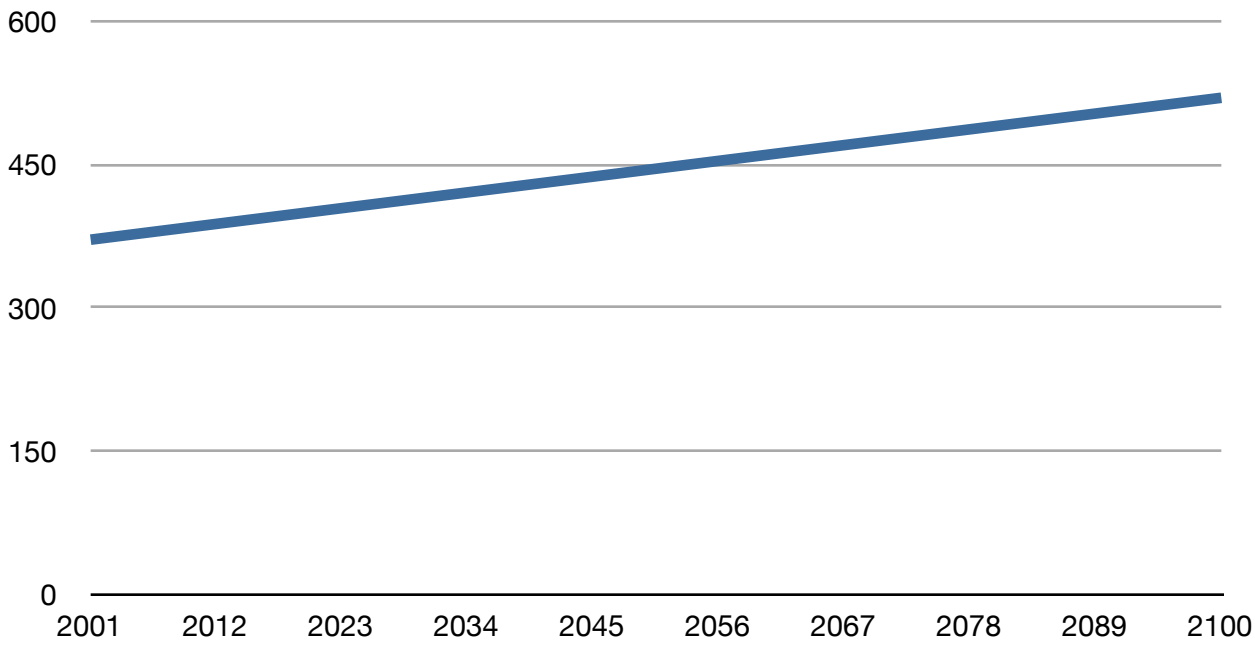
Results

Figure I



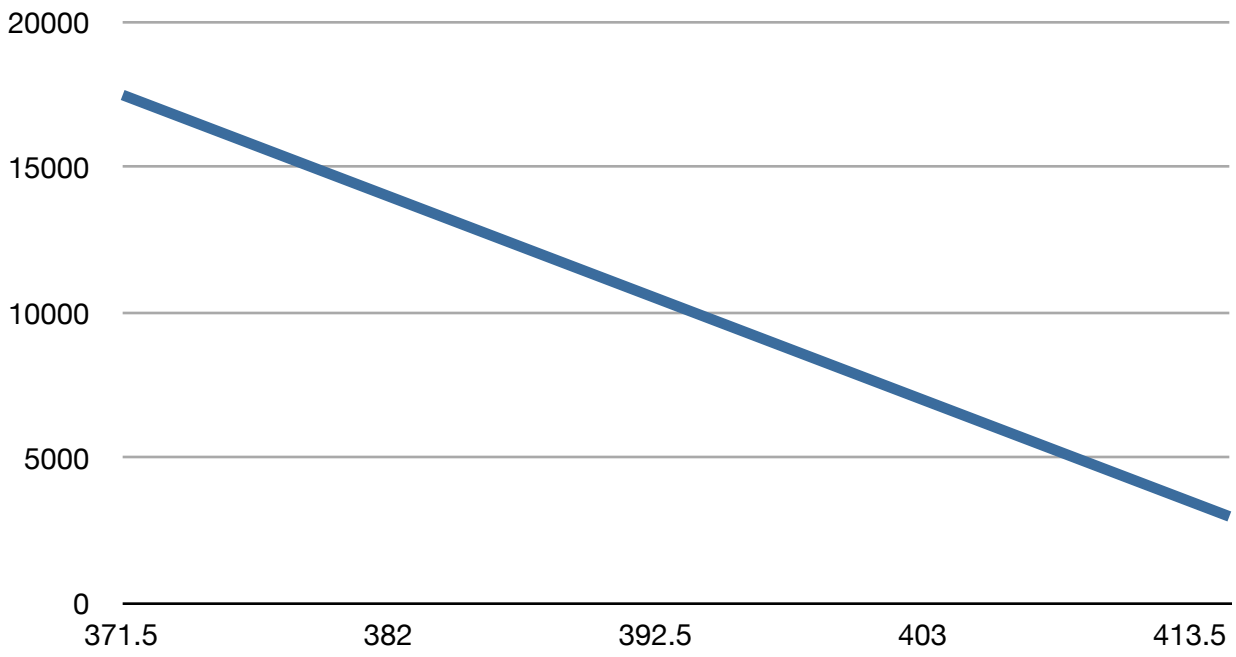
This graph shows the data that we collected in our program the y axis is KM cubed of arctic sea ice and the x axis is the year. This is a prediction based on past data and it's decreasing slope. As you can see it is a very dramatic decrease of the arctic sea ice. This shows how bad the situation is and how we need to do something to help stop it soon.

Figure II



This graph shows CO2 predictions that we put into the chart from our Python program. It is a prediction of future years that we based off of the past data's incline. The y axis is CO2 in PPM and the x axis is the year.

Figure III



This graph shows the correlation between ice and CO2. As CO2 levels rise the ice levels decrease. The y axis is ice in KM cubed and the x axis is CO2 in PPM. This is the graph that we used to make our second Python program and our Scratch program.

Conclusion

What we found doing this program is that as CO2 levels increase, ice levels decrease due to the greenhouse effect. The CO2 traps the heat in not allowing as much heat to escape our atmosphere. This is shown in the third graph. Using our program we found that at the current rate of decay of the ice it will be at about 3000 feet by the year 2030 which is about 10,000 cubic feet less than it is currently. This is obviously not good because it means loss of habitat for ice dwelling animals. It also means a rise in sea levels will occur which will cause loss of habitat for other land animals. Another negative effect of the melting of the ice is loss of drinking water and water used for watering crops because many people rely upon the natural, regular build up (in the winter) and melting (in the summer) for these things.

Applications

Using this approximate data, scientists can predict what the future will bring and can prepare for it. By lowering the use of fossil fuels, which when burned for energy create more CO2, we can lessen the ice shrinkage.

This can also be used by small coastal cities, by making them more prepared for ocean levels to rise and know when it's necessary to evacuate or take precautionary measures.

We also now know that CO2 emissions directly affect ice levels so to stop the shrinkage of the ice, renewable energy sources should be found.

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