How Does Global Warming Affect New Mexico and its Indigenous Communities?

New Mexico
Super Computing Challenge
Final Report
April 4, 2007
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Executive Summary

Through out the years the Native American Pueblo people of New Mexico have been living their natural lifestyles on the desert land. They learned to cope with their surrounding environment to survive. As years passed, the climate has been changing due to the increase of the modern society, such as the growth rate in population the lead to industries to provide jobs and the needs for people. Industries then lead to pollution, which give off green house gases such as carbon dioxide.

Some of the focus points that we are concentrating on are the agriculture productivity change due to the precipitation trends and snowfall over the annual seasons. Some of the areas of focus also include the increase in health risks such as allergens in the atmosphere's climate change due to global warming have The idea of this project is to design a computer model using a mathematical equation, which views the routes and changes in which the climate has been making and the impacts it has on the communities in New Mexico.

To solve an issue that will lead to a solution, steps are to be taken. By putting together known data from the past and current changes that the pueblo have faced in their daily routine, by living off the land, on the reservations. Using a mathematical equation, we will be able to visualize the rainfall, snowfall, wind speed, and the quantity and quality of the different climate changes. We will also look at how pollution affects mother earth and the changes that lead to drought, and economic issues.

Currently, working on the project research has been done in various geological setting in how global warming works. Were able to get an idea how we can collect data and change the functions of the climate into a mathematical equation and model.

Only slight research has been done in a broad area of global warming, we learned how to combine it and create awareness in local communities to protect the environment.

Introduction

To demonstrate the trends climate change has on the environment within the state of New Mexico, computer coding programs such as Mathematica is used to simulate the environmental changes such as, precipitation, snowfall, rising temperature levels on the ground and in water, agriculture crop productivity growth, By doing this project, we hope to not only work on one mathematical equation, but with many. With more that one mathematical model, we hope to identify how the climate works, and how we can present and relate it into the future. The question that is expected of this project is, how can Native Americans that make up less than 1% of the worlds population create a positive impact to the global warming issue?

Agent specifications

To create the environment, there is one canvas, representing the state of New Mexico. A Buffer is created to quarantine the trends of Carbon Dioxide emissions New Mexico is responsible for.

Ground, atmospheric, and water temperature levels

Organisms: Fish and Robins

Vegetation: Crop Productivity increase and decrease (Chile, Corn, and wheat)

Allergens: Pollen Increase

Health Rick Factors: Increase of respiratory diseases

The agent that represents the Temperature levels will be set at a changing variable and not remain constant. The Temperatures will be set based on the percentage rate it has increased and decreased over the passing years and seasons such as, spring, winter, summer, and fall.

The water temperature level will also correspond to the temperature levels, as the temperature increases by 10%, and then the levels of the water temperatures will increase by 4 degrees Fahrenheit. The statistics based upon the temperatures fish in streams and rivers are vulnerable to. In the Mathematica model, a chain reaction will be demonstrated by the model that when the temperature increases on the earth's surface, then the river temperatures increase therefore, making the water too hot for fish to withstand the high temperatures of the water. The agent of the temperature will be constantly changing due to the changing seasons over time, and the amount of Carbon Dioxide emitted in the atmosphere.

Buffer action:

The state of New Mexico will be covered in a buffer that will be placed over the state. The buffer will represent itself as a visual aid to demonstrate the trends of precipitation and agriculture due to the rapid change. The buffer's action will not only demonstrate the visual blooms of the vegetation blooms in the state, it will show the starting point of the cloud over the state of New Mexico as a transparent shade. The transparent shade will have a quantity set number based upon the percentage and amount the state of New Mexico is emitting.

Vegetation circles:

The productivity rate will be an agent based variable that will assist the growth rate f the major crops produced within the state.   Reduced Wheat yields will be set at a standard number of a decrease from 10-30%, chili decreasing about 7-9%, and corn decreasing to about 4% in the agricultural fields. The decrease and increase of the productivity rate will be tied in to the statistical measurements of the precipitation and snow pack levels to determine the growth rates on the earth's soil.

The Environment

The simulation environment is set up in patches arranged on a grid which also consists of an x and y grid.

The Mathematica environment is a large quad of New Mexico that consists of grid lines which provide boundary lines to the atmospheric rates of CO_2 emitted into the atmosphere, and the amount of precipitation in the

The User Interface

Before beginning the model/program, the different types of variables can be set by the user.

• The Number of Carbon Dioxide: The percentage rates of the temperature increase and decrease will substitute the changing variable within the equation to create a linear graph of CO2 gradually increasing over the changing seasons.

• The Number of Animals: The variables of x and y, represent the quantity of robins and rabbits available and living in the New Mexico habitats. With the rising earth temperature, the temperature will set of an alert of low precipitation due to the high temperature levels. The vegetation will be triggered unable to stand a lack of water for nutrients and will eventually dry out. This will lead the agent to decrease in population in New Mexico because of the lack of food.

• The Number of Vegetation: The vegetation variable are number assigned to a specific variable component and will be attached to it when it the climate and precipitation rates change, whether it would decrease or increase. When the precipitation percentage rate increases, then the vegetation growth will increase by 8%. By every 2.5 inches of rain, the vegetation rate will increase by 4% and will double as the rainfall increase, or the opposite if the amount of rainfall decreases by -2.5 inches, then the productivity rate of crops in chili, corn, and wheat will decrease by 4%.

• The Number of allergens:

Linked to the bloom of moist air in the atmosphere that trigger a bloom of flowers, therefore, producing more pollen and increases the health risks of individuals having respiratory problems.

• The Number of Precipitation: The precipitation agent is a variable the changes constantly. With the set standards of an annual calendar and a chart of the four seasons, the precipitation rate will follow its inclination or declination determining the statistics in each season.

-In summer there is a 10% decrease in rain

-In spring there is a 6% increase in rain

-In fall there is a 15% increase in rain

-In winter there is 30% increase in rain.

• The Temperature Level:

The temperature is the agent that is most crucial to changing. When the amount of Carbon Dioxide in the earth's atmosphere around the state of New Mexico increases and is triggered by the buffer, the earth's surface temperature will increase which will lead to the chain reaction setting off the decrease or increase of fish, allergens, health risks, crop productivity or can be the exact opposite, which can lead to the decrease in the amount of fish living in rivers, birds flying (food source for pueblo Indians), vegetation growth, and the amount of rainfall every year.

Running the Simulation

When running the computational model Mathematica,the computer code will analyze the given variable agents specified such as temperature change and the increase and decrease quantities of the environmental change. When we substitute the agents in the computational code, the model will demonstrate the affects and chain links of the global warming impacts on the state of New Mexico and its indigenous communities. By using Mathematica, the computer program will demonstrate the future affects global warming will have. In terms of the changing seasons, the model will show the future affects towards nature and the human society.

When changing the temperature variable, the water temperature will increase, leading to the rapid decrease of fish in the rivers. Also when changing the precipitation agent, the percentage of rainfall will determine the percentage productivity of major crops grown in agricultural fields.

Assumptions

• Assumption 1- The state of New Mexico emitts approxiamately 40% of Carbon Dioxide in to the earth's atmosphere, based upon the buffer (zone) set over the state.

• Assumption 2 - .Average house hold (3-5 people) water consumption ranges are:

1.5 gallons per flush (daily approxiamately 10 times).

5 gallons used for washing dishes.

2.5 gallons per/min taking showers (approxiamately 10 mins per shower).

• Assumption 3 - . Temperature increase based on annual seasons when Greenhouse gas emissions are

raised by 8%:

1. Winter/Summer: Increase by 5 Degrees Farenheit.

2. Spring: Increase by 3 Degrees Farenheit.

3. Fall: Increase by 4 Degrees Farenheit.

• Assumption 4 – Precipitation and snow pack changes:

1. Summer: Decrease by 10%, when temperature increases by 5 Degrees.

2. Fall: Increase by 6%, when temperatures decrease by 4 Degrees.

3. Spring: Increase by 15%, when temperatures decrease by 3 degrees.

4. Winter: Increase by 30%, when temperatures decrease by 5 degrees.

• Assumption 5- . Agricultural Productivity rates/trends due to climate change:

1.Reduced Wheat yields will decrease from 10-30%, When temperatures increase by 8 degrees farenheit.

2.Chili decreasing about 7-9% when temperatures increase by 8 degrees farenheit.

3.Corn decreasing to about 4% in the agricultural fields, when temperatures increase by 8 degrees.

-The increase of wheat, chili, and corn will be proportional to the temperature increase change.When the temperature decreases the crop growth will increase.

• Assumption 6- . Water temperature: Fish such as trout in rivers and streams withstand water levels to about 50 degrees farenheit.

1.1.When the temperatures increase by 4-10%, the water temperature levels will increase by 4-8 degrees farenheit.

2.Fish such as trout in the river and streams can stand water temperatures ranging from 50 to 55 degrees farenheit. When the temperatures increase by 10-15 degrees farenheit on the earth's surface, the water levels increase by 10 degrees, which makes the water levels too high for the fish to adapt and survive, therefore decreasing the amount of fish by 15%.

3.When temperatures decrease, the water levels lower gradually not rapidly which allow fish to live in their aquatic environments.

• Assumption 7- . Due to climate change, the seasonal patterns change making seasons longer or shorter. The amount of rabbits and robins living within the environment will change depending on how each animal has adapted to their habitats.

• Assumption 8 -. When the precipitation rate increases by 15%, the amount of carbon dioxide present in the ozone (approxiamately 45%), will moisten the air and rainfall will wet the ground resulting a vegetational bloom by 35%.

1. With a vegetational bloom of 35%, more pollen producing plants grow to about 10% in quantity.

2. Pollen and allergens increase by 5%

3. Respiratory health concerns increase by 10%.

Results

Table 1: Buffer over New Mexico:

40 % CO2 Emissions

10-15 degrees farenheit increase on earth's surface.

3-6 degrees farenheit increase in water temperature.

15% Vegetation/shrub growth: 5% pollen/allergen increase.

5% Respiratory health affects increase.

5% decrease/increase of food sources such as fish, robins, and rabbits.

10-15% Growth rate of major crops in New Mexico, such as chile, corn, and wheat.

Table 2: CO2 emitted X Percent % increase/decrease of temperature: 40% Carbon Dioxide

10% Temperature levels on earth's surface and in water

6% crop growth

4.5% Allergen/pollen bloom

3% Respiratory health risks

Conclusion

Through experimental observations and changing variables, the higher rate of CO2 emitted into the earth's atmosphere, the quiker the trends and percentage rates decreasing in crop growth, animal survial, vegetation growth. With high levels of rainfall/snowfall contaminated by harmful minerals, this will result a rapid vegetaion and shrub bloom, which will increase a higher percentage rate of pollens/allergens, which

will then increase the amount of respiratory problems in individuals. The water level temperature increase

will also result in the decrease of fish living in streams and water. These are food sources for communities

for survival. Each variables are connected in a link and chained together, when one agent is triggered

another variable is affected. The starting cause focused on climate change, is the amount of carbon dioxide

emitted into the earth's atmosphere.

References

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How has Global Warming affected the Indigenous tribes of New Mexico. We would especially like to thank the Super Computing Challenge Program, which has created a wider perspective toward the issues the world is facing in today's society.
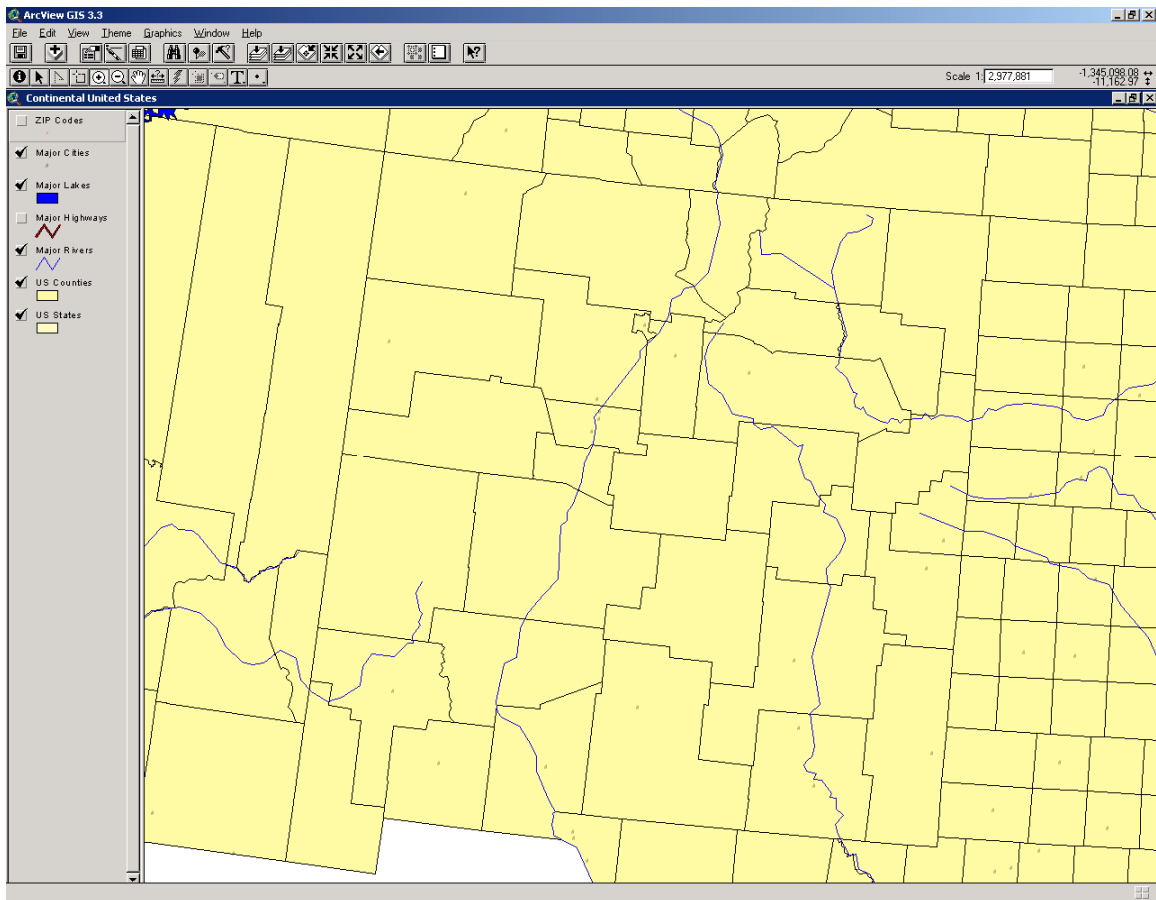
Appendix A

Charts and Graphs

Native species		Percent Increase/Decrease			Contour measurements			Water Quantity Range	
98%		3%			25ft	26	122	120 cu m/s	
95%		5%			65ft	68	131	130 cu m/s	
95%		5%			38ft	34	140	120 cu m/s	
98%		3%			42ft	41	168	120 cu m/s	
95%		5%			40ft	38	145	120 cu m/s	
							143		

Water Quantity Range

Quantity

200
150
100
50
0

Data Points

1 2 3 4 5 6 S1

□ Series1

Contour Measurements

80
70
60
50
40
30

Measurements

◆ Series1
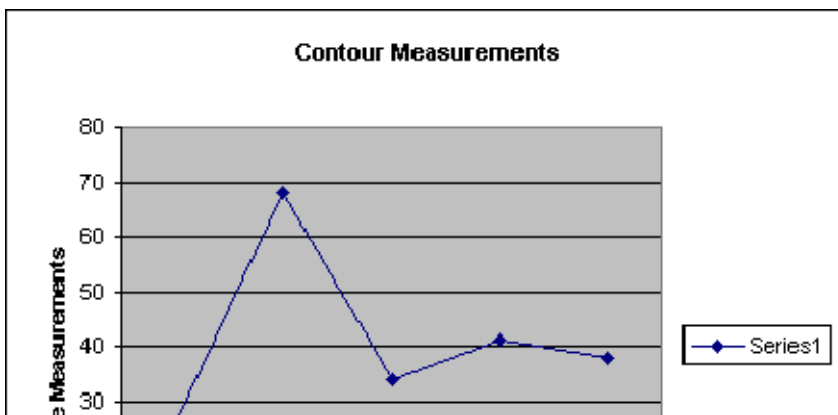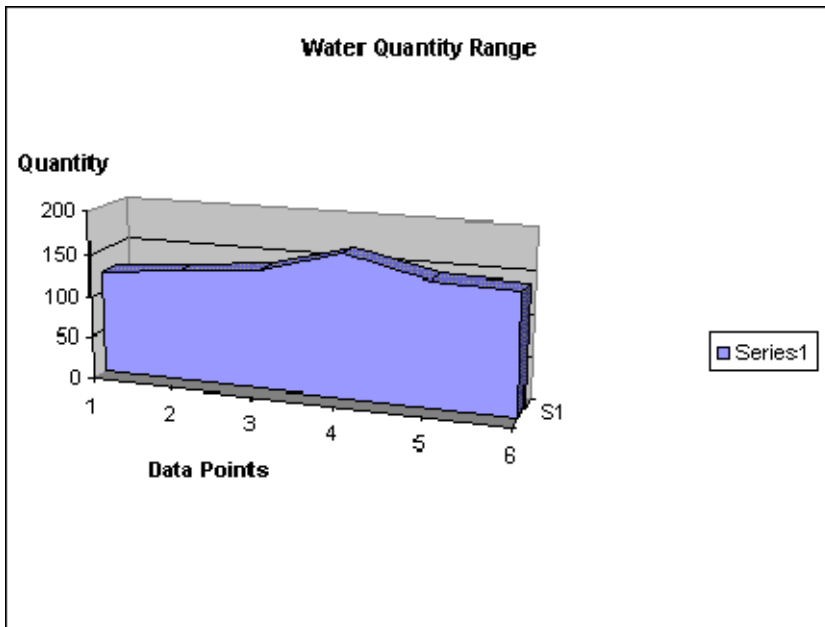
Appendix B: Maps

New Mexico: River contours
- Buffer boundary over New Mexico (40%) CO2 emissions

Chart : Water usage X Percent % taken from each territory

40% CO2

55% Temperature Increase (Water and ground levels)

5%   Precipitation Rates