

# Simulation of Global Warming in the Continental United States Using Agent-Based Modeling

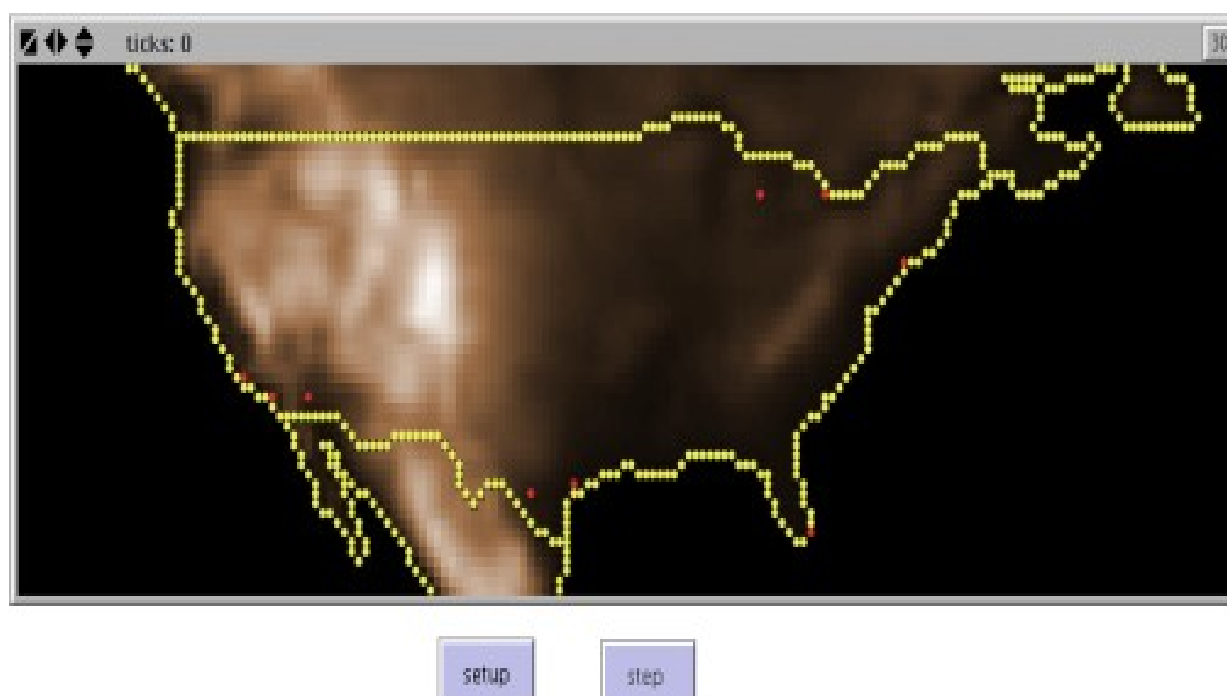
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## Abstract

It is a commonly accepted fact that as the population increases, the carbon footprint of the United States increases, further accelerating the effects of global warming. However, not many studies have been constructed correlating the effects that global warming will have on population. The purpose of this experiment is to combine that effects that population will have on greenhouse gas output and then the effect that the resulting temperature and sea-level changes will have on the population. The goal of the experiment is to show the detrimental effects that global warming will have in the United States if nothing is done to limit the greenhouse gas output. The results of this experiment would be useful to environmental scientists all over the world, not just in the United States, since similar population changes should be happening globally.

## Background

Most of the common formulas used in this project come from these Stella models and from an online University of Michigan class based on global change. There are various versions of global warming models available on the internet, but none of them concentrate on the effects of people on global warming and climate change on the population. The basic elevation map was taken from a previous project by Josh Unterman on the Continental Divide, and a temperature map was based off of it. Agent-based modeling is a popular way to represent human behaviors through simple heuristics and basic societal rules. David Batten, in his paper "Are some human ecosystems self-defeating?" discusses the potential downfalls and problems of such modeling and proposes that the agents should be able to communicate with one another in addition to their environment. Each agent needs to have a set of values, which in this case is the temperature and elevation of the patch that they are currently inhabiting and of the ones around them. Romulus-Catalin Damaceanu performed his research on studying wealth distribution using NetLogo, which used similar parameters and private variables as will be used in my simulation of the global warming and population effects.



For Patches (Land):  
Each patch has its own temperature and elevation variable, that changes with greenhouse gas output.  
For Agents (Population):  
According to demographic information, each agent has a salary.  
Constant Variables:  
Temperature limits and birth rate.  
Changing Variables:  
Death rate changes according to temperature and sea-level.

## Variables



Currently I am working on completing the temperature map of the United States using linear interpolation and averages with the average yearly temperatures of the major U.S. Cities. I expected to be further along originally, but I should be able to finish this by the first couple of weeks of the second quarter.

## Progress

## Results

The main purpose of this experiment is to show a possible bleak future scenario of what will happen when nothing is done about global warming. The expected results are unknown, but will most likely show that over time, the population will first increase due to favorable conditions. However, as the population increases, more greenhouse gases are produced and thus the climate changes and heats up. As infectious diseases start to spread and sea-levels start to rise, the population will decrease, now decreasing the amount of greenhouse gases in the atmosphere. The climate will now cool down, and the death rate will once again decrease, enabling the birth of more agents. There should be a slow oscillating relationship between the population and greenhouse gases in the atmosphere. However, the majority of the population will move north, away from the coastal areas to escape high temperatures and flooded cities.