It BURNS!!!!!!

New Mexico
Supercomputing Challenge
Final Report
April 2, 2014

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Table of Contents:

Executive Summary

Introduction

Description

Results

Conclusion

Recommendations

Acknowledgements

References

Appendix

Executive Summary:

Our problem is to model the effects of acid rain on trees. Our code shows the acid rain falling, being absorbed by earth/water, and eventually killing trees. Several sliders and buttons allow one to interact with the model and change things.

INTRODUCTION:

The problem that we are modeling and researching is the effect of acid rain on an envorinment along with the bacteria and other life forms in the surrounding water supply. The environment that we decided to model was a forest. Since a forest is rich in natural elements such as trees, rivers/streams, and bacteria/organisms, and the fact that a large amount of our research explained that trees and other natural elements that are affected by acid rain more than human populated areas. The reason we chose this topic was because it isn't a topic that most would go for. Our entire group found this topic interesting due to how it is created and how heavily it affects the entire world.

DESCRIPTION:

Our model only models one environment, but with slight adjustments and proper statistical inputs to code, the model could show any environment and even a community. With enough time to do research and work through the possible errors in the code, it would possible to use a certain country with a variety of environments. To get a bigger scope, the code could be adjusted to continents or even the entire Earth!

The EPA website was the reliable source that we used throughout the researching process. It was very helpful because they had an entire section for different questions that could be asked about acid rain. We began researching after we chose a project topic and it was after we started researching that we realized that our project didn't have a plausible solution other than to possibly raise awareness of the causes of acid rain.

The method we used to get the research, do the coding, and write the necessary papers was to do it as a team. There was a main programmer, but we tossed ideas around and made suggestions that could be incorporated into the code. There was one main researcher and we wrote our proposals, interims, and final reports together. This way everyone"s ideas were incorporated and in case someone forgot to add something that the other knew it could be added.

RESULTS: Our project has one result, Deterioration Rate. In our model we have a plot that models the amount of deterioration as each tick goes by. We have the trees on the black line that goes across the interface to represent the trees in the soil. Underneath it we have the water which is modeled to be in front of our trees and soil. As the acid rain falls it hits trees on the waterline as well as the water itself.

What the water represents is the spread of the pollution to the trees that may not have been hit by the rays themselves and the ones that were hit by the rays. This shows the absorbtion of the pollutants through the trees roots. As ticks go by the acid rain slowly deteriorates the trees causing them to change colors. They continually change color until they've contracted so mush pollution that they just die after they hit black.

CONCLUSIONS:

Overall our project and model were successful. Even though things didn't turn out the way we pictured them in the beginning, they still worked out just the same. Our research was extremely useful and conclusive.

RECOMMENDATIONS: Next time there is many things we could do to improve our project next time. We could widen our model's scope to a more universal setting. Maybe adding more environments or a, region with many different environments. Also maybe model the effects of acid rain on an entire biome for more results and possible products.

ACKNOWLEDGEMENTS: We would like to thank our teacher, Ms. Melody Hagaman, for all her help throughout this time period.

REFERENCES: Environmental Protection Agency. Acid Rain. Date accessed: 1/3/14. http://www.epa.gov/acidrain/

APPENDIX:

```
globals [
  sky-top      ;; y coordinate of top row of sky
  water-top    ;; y coordinate of top row of water
 deterioration ;; overall deterioration or corrosion from acid
]

breed [rainfalls rainfall]     ;; packets of rainfall
breed [evaporates evaporate]       ;; packets of evaporating acid-water mix
breed [acids acid]   ;; packets of acid pollution
breed [trees tree];; packets of clouds
trees-own [tree-id]

;;
;; Setup Procedures
;;

to setup
  clear-all
  set-default-shape rainfalls "ray"
  set-default-shape evaporates "ray"
  set-default-shape trees "tree"
  set-default-shape acids "dot"
    setup-world
```

```
  reset-ticks
  plot deterioration
end

to setup-world
  set sky-top max-pycor - 5
  set water-top 0
  ask patches [  ;; set colors for the different sections of the world
    if pycor > sky-top [  ;; space
      set pcolor scale-color white pycor 22 15
    ]
    if pycor <= sky-top and pycor > water-top [ ;; sky
      set pcolor scale-color blue pycor -20 20
    ]
    if pycor < water-top
      [ set pcolor blue ] ;; water
      if pycor = water-top ;; water surface
      [update-earth]

  ]
end

to update-earth ;; patch procedure
  set pcolor scale-color blue water-top 0 1
end

;;
;; Runtime Procedures
;;

to go
  run-rainfall   ;; step rainfall
  ;; if the earth slider has moved update the color of the "earth surface" patches
  ask patches with [pycor = water-top]
  [update-earth]
  run-acid  ;; step heat
  run-evaporate    ;; step IR
  tick
  plot deterioration
  ask trees
  [ if count rainfalls-here > 0
    [ set color color - 1 ]
    if count acids-here > 0
    [
      set color color - 1
    ]
    if color < 1
    [
```

```
    die
   ]
  ]
end


to add-tree          ;; we want the trees to be on the earth surface
   create-trees 3 + random 20 [
     set size 5
     set color green ]
   ask trees
   [setxy random-ycor 0]

end

to remove-tree ;; erase trees and create new ones, minus one
  if any? trees [
    let doomed-id one-of remove-duplicates [tree-id] of trees
    ask trees with [tree-id = doomed-id]
    [die]

  ]
end


to run-rainfall  ask rainfalls [
    if not can-move? 0.3 [ die ]  ;; kill them off at the edge
    fd 0.3                    ;; otherwise keep moving
  ]
  create-rainfall  ;; start new sun rays from top
  encounter-earth   ;; check for absorption
end

to create-rainfall
  ;; don't necessarily create a rainfall ray each tick
  ;; as concentration gets higher make more
  if 10 * acid-concentration > random 50 [
    create-rainfalls 1 [
      set heading 160
      set color yellow
      ;; rays only come from a small area
      ;; near the top of the world
      setxy (random 10) + min-pxcor max-pycor
    ]
  ]
end
```

```
to encounter-earth
  ask rainfalls with [ycor <= water-top] [

    ;; either the water absorbs the acid
    if 100 * water  > random 100
      [ rt random 45 - random 45 ;; absorb into the water
        set color red - 2 + random 4
        set breed acids ]
  ]
end

to run-acid    ;; advances the acid turtles
  ;; the temperature is related to the number of acid turtles
  set deterioration 0.99 * deterioration + 0.01 * (12 + 0.1 * count acids)
  ask acids
  [
    let dist 0.5 * random-float 1
    ifelse can-move? dist
      [ fd dist ]
      [ set heading 180 - heading ] ;; if we're hitting the edge of the world, turn around
    if ycor >= water-top [  ;; if heading back into sky
      ifelse deterioration > 20 + random 40
            ;; acid only evaporates back at a small area
            ;; this makes the model look nice but it also contributes
            ;; to the rate at which acid can re-cycle back into the water cycle
            and xcor > 0 and xcor < max-pxcor - 8
        [ set breed evaporates              ;; let some evaporate
          set heading 20
          set color green ]
        [ set heading 100 + random 160 ] ;; return them to earth
    ]
  ]
end

to run-evaporate
  ask evaporates [
    if not can-move? 0.3 [ die ]
    fd 0.3
    if ycor <= water-top [   ;; convert to acid if we hit the earth's surface again
      set breed acids
      rt random 45
      lt random 45
      set color red - 2 + random 4
    ]
    if any? acids-here
      [ set heading 180 - heading ]
  ]
```

end