Team Members

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Background

The Animas River comes down from Colorado. In 2015, Gold King Mine workers spilled polluted water into the river. Beside the water looking cloudy and orange, it including arsenic, lead, barium and mercury, among others. These chemicals can cause health defects, birth defects, and shorter life spans for any animal, plant or human that consumes or has extended exposed to these elements.

Executive Summary

Not at this time, in April it is due.

Statement of Problem

The problem is that chemicals went into the Animas River in Colorado, travelled down the watershed, into New Mexico, and Utah, at the minimum. We do not know the long term or short term effects that this spill may have on humans and animals. We want to use computational models to help study the spill.

Description of Method

We want to use NetLogo 5.3.1 plus GIS (geographic information system) data to look at the spread of the spill.

Validating the Model

We will run the model several times to validate the model.

Results

We want to learn as much as we can about how this will affect people now and in the future. Some people live along the river, and the watershed feeds the water system that people drink in Farmington, NM.

Overview

Subcategory A

Subcategory B

Subcategory C

Subcategory Additionals (D, E, etc.)

We have started coding, which we have never done before in NetLogo.We have also looked at Tutorials from YouTube to learn how to code. We have also looked at many scientific papers to know more about this important subject.

Acknowledgements

We would like to thank Ms. Gabrel for helping us find tutorials, coding, going to the Farmington Citizen's Water Committee meeting and helping us find contacts in the community.

We would like to thank Evan O'Keefe, GIS Supervisor at San Juan County, for sharing Excel sheets, etc. related to GIS and other data, including from the EPA.

We would like to also thank Mr. Henegar, from Mesa View Middle School, who has agreed to help us with coding when we are confused.

Finally, we would like to thank Mr. Jimmy E. Johnson, Jr., who has also volunteered to help with GIS + NetLogo 5.3.1

Screenshots

Code

References

See attached.

Hands-On Activity

It's All Downstream

In this activity, students will create a model of a watershed that includes Ch then simulate the introduction of pollutants somewhere in the watershed ar can travel downstream and affect many different water resources.

Estimated time to complete: 40 minutes

Materials:

Per each group of students:

- Approximately eight feet of aluminum foil; four feet to cover a la help them model landforms. Have extra foil on hand in case it is
- Medium-sized hardcover book
- Cooking oil with food coloring
- 2 cups of water
- Large cookie sheet (or other similar-sized flat and rigid material)
- Map of Virginia with watersheds clearly delineated
- Modeling clay

CREDITS AND REFERENCES

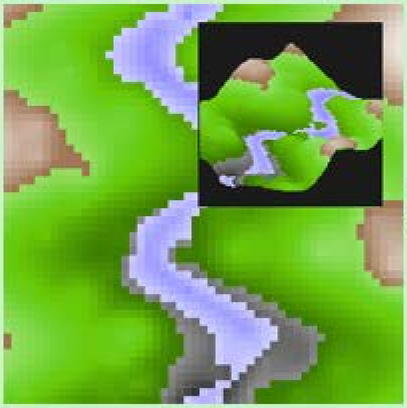
Thanks to Boyce J Baker, who by seeking assistance on a model of his own, got me thinking about the fun of modeling a watershed.

NetLogo User Community Models

(back to the NetLogo User Community Models)

watershed

by James Steiner (Submitted: 03/05/2004)



Download watershed

If clicking does not initiate a download, try right clicking or control cli

(You can also run this model in your browser, but we don't

WHAT IS IT?

A terrain generator demo and watershed simulator, with a nifty 3
thrown in as a bonus.

HOW IT WORKS

The patch "elev" is the hard surface of the terrain. Level is the n
current surface level. If the patch is dry, level is the same as ele
then level is greater than elev by the depth of the water.

To simulate the flow of water, each "wet" patch compares it's ow
level of it's neighbors. If any neighbor has a lower level, the pat
neighbors with the very lowest level, figures the difference betw
and shares half of that difference with the low neighbor. In other
from the patch to it's lowest neighbor to make both patches leve
high patch could pour into the low patch, if needed.

To clear the 3-d display, click the clear-3d button.

The animate button continuously refreshes the 3-d display, useful when adjusting the tilt and spin sliders.

The auto-spin switch causes the animate button to continuously changes the spin slider, as well.

OTHER CONTROLS:

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The label? siwtch turns on the labeling of the patches with their current water depth.
If altitude? is on, the label shows the actual level, rather than the water depth.

The false-color? switch causes the model to use a different coloring scheme, that exposes the elevations differently.

The altitude? switch alters the way the water is colored.
Altitude? on colors by the surface level of the water.
Altitude? off colors by water depth.

THINGS TO NOTICE

Notice how water flows downhill! I'm a fricken genius!

THINGS TO TRY

What conditions will cause the river to overflow it's banks? How do you think this compares to real-world flood conditions?
Import some real terrain data, perhaps from a geographic information system.
Does the model-generated flow match the real-world flows on that terrain?

EXTENDING THE MODEL

Add additional terrain generators: cistern, septic field, mountain.

Generate a terrain that has one straight river and one curvy river. Is the flow rate different?
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Add the effect of erosion from the passage of water.
Allow for different types of ground (soil, sand, rock, clay) that erodes differently.
Further, allow for each elevation to be a different type of rock so as erosion occors, different layers are exposed, affecting the rate of erosion.
Further, make it so each patch has strata.
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HOW TO USE IT

GENERATE TERRAIN:

To get started, click one of the terrain generator buttons. The model comes with river valley and volcano (atoll) generators.

ADD WATER

To add water to the river, click the river? switch on.
Water flows from the head of the river.
The head is defined as the point of lowest elevation on the top row. That may not be at the center of the row.

Click on Drain? to contantly remove water from the bottom row.

To make the volcano "erupt" click the erupt? switch on.
Water flows from the center of the volcano. I know, it's silly.

To add water to the entire surface of the terrain (to turn the volcano into an atoll, for example) click the rain, rain-hard, or quick-fill buttons. Rain-hard is 100 X the normal rain-rate. Rain and rain-hard add to the already present water, if any. Quick-fill sets the water depth to be even with the mean elevation of the entire terrain.

To create a flash-flood, click the flood button. The top row gets flooded.

The dry-all button removes all the water from the terrain.

MAKE IT FLOW:

Click the Flow button. The water on the terrain will seek it's own level. Rivers flow, lakes form, dams fill, lava flows, islands emerge from the sea!

3-D Visualization
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To see the terrain in 3-D, click the "setup-3d" button.

After that, if you make changes in the terrain, or to see the effects of water flow, click the "render-3d" button to update the display.

To clear the 3-d display, click the clear-3d button.

The animate button continuously refreshes the 3-d display, useful when adjusting the tilt and spin sliders.

The auto-spin switch causes the animate button to continuously changes the spin
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Add the ability to track, measure, whatever the direction and velocity of the water flow. Perhaps a turtle on each patch can show the direction that the water flowed, and remember how much water it was. Or perhaps the sliding mean of the directions and amounts.

Then put boats or flotsom in the water, moving with the currents!
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The model treats the ground as completely waterproof. However, in the real world, different ground types absorb water differently. Rock, none. Sand, lots! Sandlots! Get it? Anyway, water flows *below* the surface, *through* layers. Expand the model to allow water to flow through permeable surface layers.
Ok, now this is crazy: extend the model to support multiple strata with different permiabilities, including voids, and all water to flow through, around, and between the layers. This would allow for undergound springs, water-tables, and predicting otherwise unexpected run-off behaviors due to water-permeable subsurface layers.
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Enhance the 3-D visualizer. It is fairly primitive, and could use the following enhancements:

Z-order clipping: Hide nodes that should be behind other nodes.
Perspective: The current view is an orthagonal projection. Add a perspective projection.
Additional rotations: How about x-axis rotation?
3D detail adjustment: For models with low resolution, the option to add additional nodes between the "real" nodes, so that the 3-d view is smoother. For models with high resolution, the option to reduce the number of 3d nodes to improve performance of the 3-d view

NETLOGO FEATURES

Patch Scheduling:
Because the patches execute code in a particular order, a bias is introduced that tended to make water flow much faster in some directions that in others. To reduce the effect of this bias, which is due to water flowing to adjacent patches in the same order they are executed, the model updates patches randomly. Each time through the "flow" loop, only 1 in 5 patches are updated.

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