NSS2001

Science and Society

Week 6 Modelling Activity

We will be using the software, Netlogo, to conduct simulation on urban heat island effect that you have been introduced to in week 5. Netlogo is an agent-based simulation software in which agents that are free to move around are known as turtles.

Introduction

1. Instruction to download Netlogo.
   Visit the website https://ccl.northwestern.edu/netlogo/ to download Netlogo to your computer. Alternatively, you can also use Netlogo Web which allows you to run the software directly on the browser.

2. Download the file 'NSS2001_UHI.nlogo' from canvas to your computer. Open the file with the Netlogo software or open it with Netlogo Web.

3. Navigating around the model:

   When you open up the file 'NSS2001_UHI.nlogo', you will see the following interface. There are three main tabs at the top.
   Interface tab: Where simulations are run
   Info tab: For comments on the model's assumption and uses
   Code tab: Where the code for the model is written.
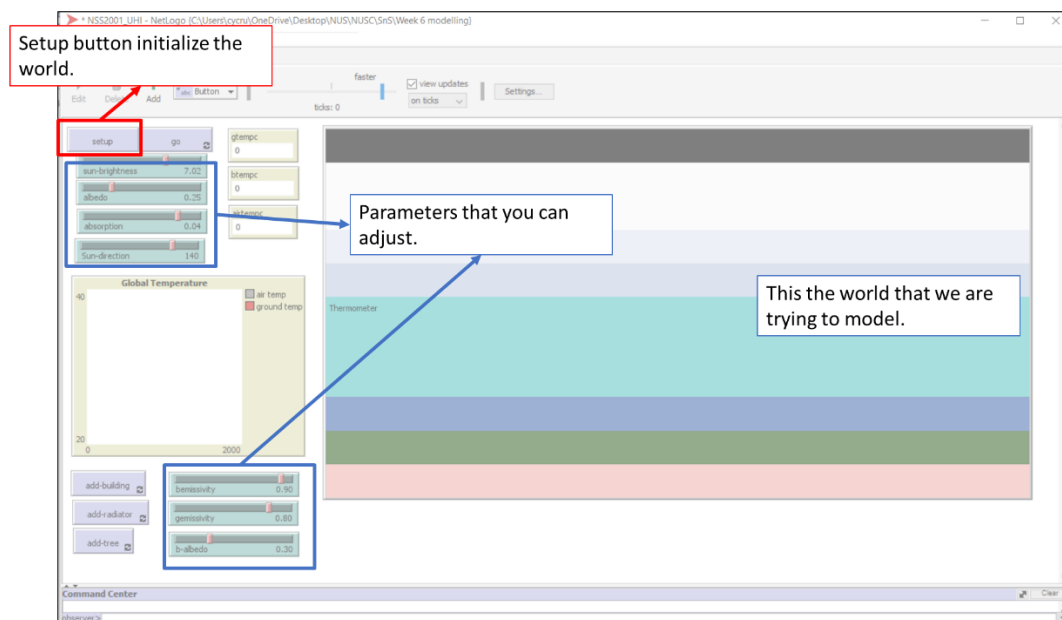
Controlling the model:
There are two main buttons: setup and go, which is crucial for executing the simulation.
Setup Button: By clicking on the 'setup' button, you will initialize the simulation and setup the world that you are trying to model.
Go Button: By clicking on the 'go' button, the simulation will run.

Parameters: Parameters are values that control the behaviour of the turtle agents in the simulation. Here are some notes about each parameter:

sun-brightness: Controls the amount/intensity of sunlight.

albedo: Controls the albedo of the ground.

*absorption:* Controls the absorption of sunlight when it encounters the atmosphere.

*sun-*direction: Controls the angle in which the sun rays enter the world.

bemissivity: Controls rate of heat escape from building in the form of infra-red radiation.

gemissivity: Controls rate of heat escape from the ground in the form of infra-red radiation.

b-albedo: Controls the albedo of the building.

4.   Adding additional environment features into the model.
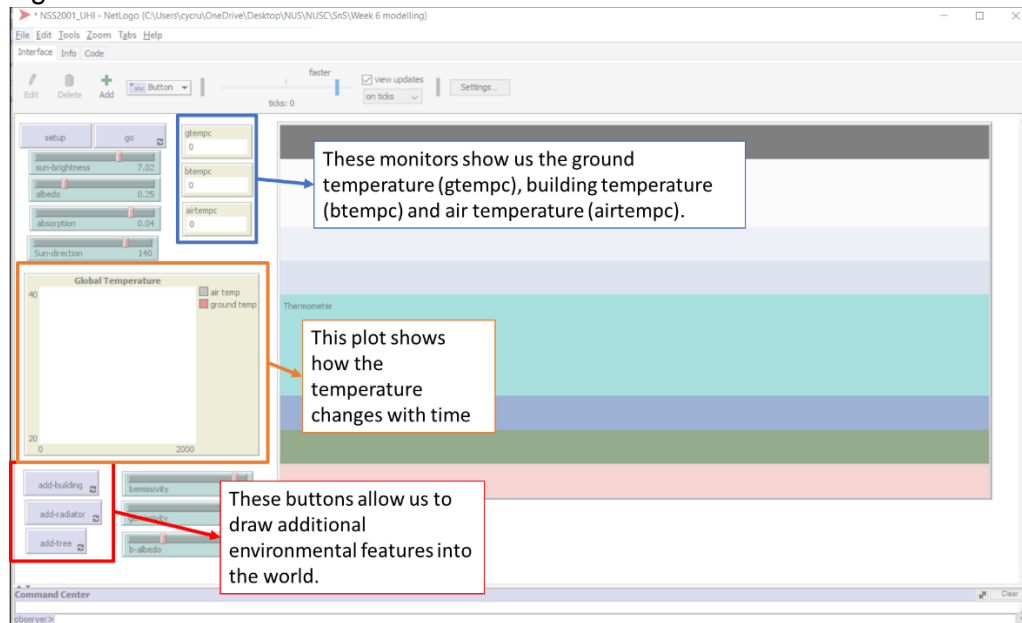
We are going to add some environmental features to the model to find out how temperature varies with addition of such features.

The various environmental features can be added with the buttons add-building, add-radiator and add-trees.

Clicking the 'go' button will run the simulation and temperature of the air, ground and building will be monitored with the monitors. You can also show a plot of the variation of the temperature with time when the simulation is running.

To help you understand and visualise how the energy flow in the system, you can play the simulation at a very slow speed by decreasing the ticks slider.

In the next few parts of this activity, you are going to run several simulations to get yourself familiar with the software.

[Take **screenshots** of the simulation to record the journey of your simulation for each part. For measurements, you can use any software for calculation.]

Note that when you want to run a new simulation, you should click the 'setup' button again to reset the world. Addition of environmental features should be done after clicking the 'setup' button.

Part I: How does temperature changes when the ground albedo changes.

(a)   Try running the simulations with no environmental features. How does the air temperature and ground temperature vary with time? Can you tell the average temperature from graph? [Hint: you can right click on the graph and download the data in csv format.]

(b)   Adjust the value of the albedo, run the simulation for different values of albedo. What happen to the air temperature and ground temperature when albedo increases?

Part II: Adding building into the world

(a)   Now, click the 'add-building' button. You can now draw building on any part of the world. Try running the simulation again. What happen to the air and ground temperature? Compare the average temperature with the value obtained in part (I), do you observe any difference? Discuss.

(b)   Add more buildings to the world, observe what happen to the temperature. Discuss.

Part III: Adding trees to the world

Reset the world again. Now, all some trees to the world using the 'add-tree' button. What happen to the air temperature? Compare the average temperature with the value obtained in part (I), do you observe any difference? Discuss.

[NOTE: You should ensure the 'add-building' button is unchecked before adding trees.]

Part IV: Adding radiators to the world

The 'add-radiator' button allows you to add features that represent source of anthropogenic heat. Try adding some radiators to the world using the 'add-radiator' button. What happen to the air temperature? Compare the average temperature with the value obtained in part (I), do you observe any difference? Discuss.

[NOTE: Again, we want to ensure that the 'add-building' and 'add-tree' button are unchecked.]

Part V

(a)   Try combining various features to mimic an environment. Observe and record the temperature.

(b)   Do you think this is a useful model? Can you identify some of the limitations of this model? (You can refer to 'properties of a useful model' from week 6 lesson 1.)