DAISY WORLD

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2019

1 Abstract

Here, We try to modeL, Daisy World.This model explores the "Gaia hypothesis", which considers the Earth as a single, self-regulating system including both living and non-living parts. In particular, this model explores how living organisms both alter and are altered by climate, which is non-living. The example organisms are daisies and the climatic factor considered is temperature.

2 Introduction

Daisyworld is a world filled with two different types of daisies: black daisies and white daisies. They differ in albedo, which is how much energy they absorb as heat from sunlight. White daisies have a high surface albedo and thus reflect light and heat, thus cooling the area around them. Black daisies have a low surface albedo and thus absorb light and heat, thus heating the area around them. However, there is only a certain temperature range in which daisies can reproduce; if the temperature around a daisy is outside of this range, the daisy will produce no offspring and eventually die of old age.

When the climate is too cold it is necessary for the black daisies to propagate in order to raise the temperature, and vice versa – when the climate is too warm, it is necessary for more white daisies to be produced in order to cool the temperature. For a wide range of parameter settings, the temperature and the population of daisies will eventually stabilize. However, it is possible for Daisyworld to get either too hot or too cold, in which case the daisies are not able to bring the temperature back under control and all of the daisies will eventually die.

White daisies, black daisies, and open ground (empty patches) each have an albedo or percentage of energy they absorb as heat from sunlight. Sunlight energy can be changed with the SOLAR-LUMINOSITY slider (a value of 1.0 simulates the average solar luminosity of our sun).

Each time step, every patch will calculate the temperature at that spot based on the energy absorbed by the daisy at that patch and the diffusion of 50

Run the simulation. What happens to the daisies? Do the populations ever remain stable? Are there ever population booms and busts? If so, what causes

them? (Hint: how do the daisies affects the climate? How does the climate then affect the daisies?)

What happens if boom and bust cycles just keep getting bigger and bigger? The swings can't keep getting bigger forever.

Does the planet ever become completely filled with life, or completely devoid of life?

Try running the simulation without the daisies. What happens to the planet's temperature? How is it different from what happens with the daisies?

Can the Daisyworld system be said to exhibit "hysteresis"? Hysteresis is a property of systems that do not instantly follow the forces applied to them, but react slowly, or do not return completely to their original state. The state of such systems depend on their immediate history.

Black and white daisies represent two extreme types of daisies that could exist in this world. Implement a third species of daisy. You will need to choose what your daisy does and how it is different from black and white daisies. How does your new daisy affect the results of this model?

Sunlight is only one aspect that controls the growth of daisies and other forms of life. Change the model so different parts of the world have different levels of soil quality. How will this affect the outcome?

Many people feel that the Gaia hypothesis can be disturbed by human causes. Implement pollution in the model. Does this cause the daisies to die off quicker or more often?

Can you think of any other ways in which living organisms both alter and are altered by their environment?

3 Methods

We model Daisy world for Black and White albedo with climatic factor and later extend that to other more species of daisies.

4 Results

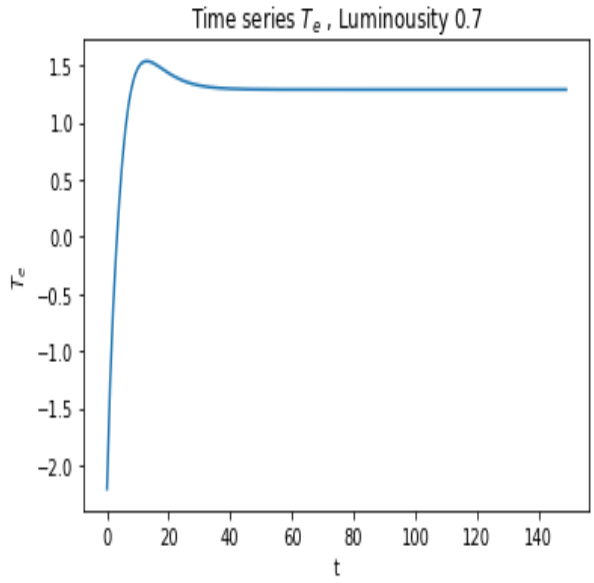
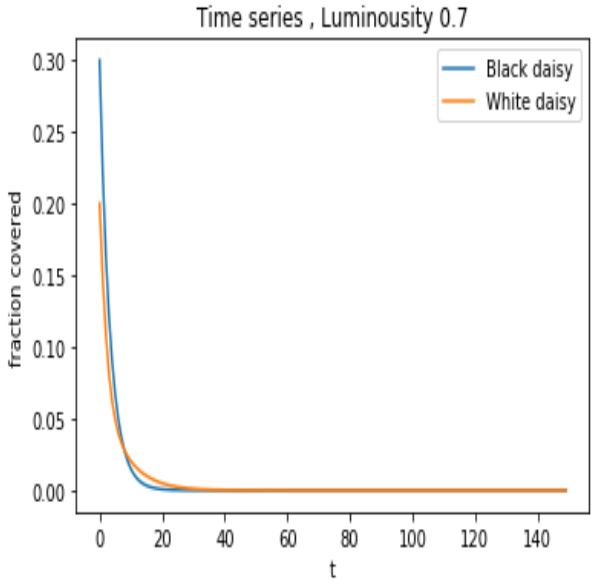
- 

Figure 1:

- 

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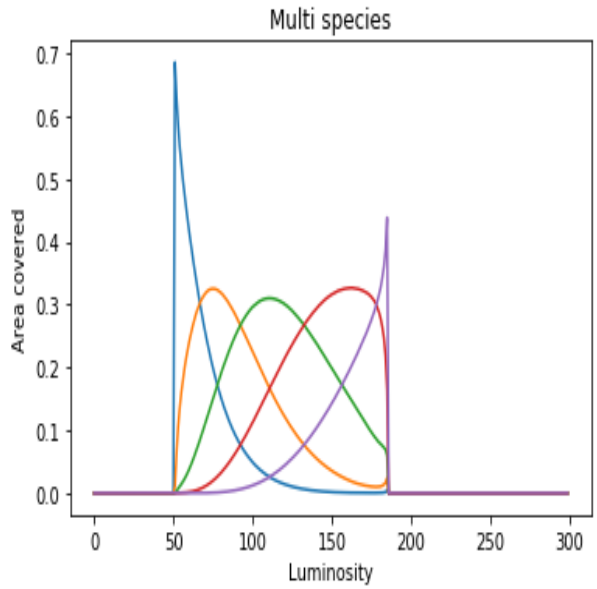
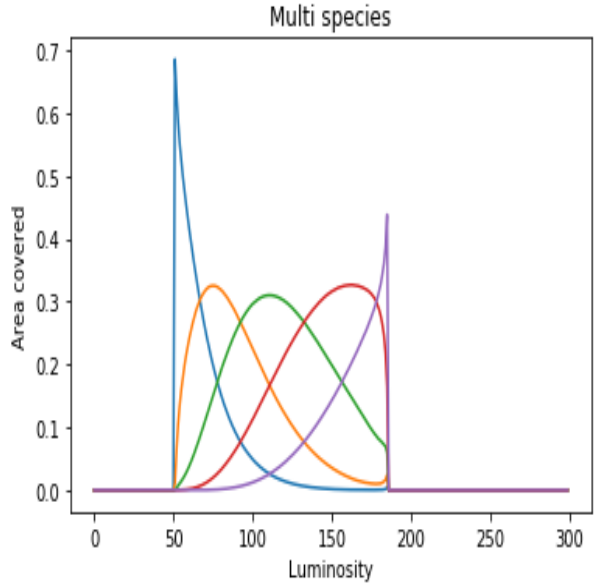


- Figure 4:



- Figure 4:

5 References

1.Novak, M. and Wilensky, U. (2006). NetLogo Daisyworld model. http://ccl.northwestern.edu/netlogo/models Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL. 2.Wilensky, U. (1999). NetLogo. http://ccl.northwestern.edu/netlogo/.

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