Project Proposal

Modeling the Gaia Hypothesis: Daisyworld

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Abstract

The Gaia Hypothesis postulates that the Earth acts as a self-organizing collective unit. It argues that not only does the environment influence life on Earth, but that life also has the power to regulate environmental conditions. It is through this regulation that the conditions on Earth are kept within the tolerable range for life to continue.

A model which has been used to demonstrate evidence for the Gaia hypothesis is the Daisyworld model proposed by Watson and Lovelock (1983). This model involves simulating a planet which is inhabited entirely by black and white daisies. Since the daisies reflect different amounts of light they are able to modify the planetary albedo and thus regulate global as well as local temperature.

For this project, I propose to simulate Watson and Lovelock's Daisyworld model using the Netlogo simulation package. Netlogo has been selected because of the discrete nature of the Daisyworld model. Also, because of its simplicity NetLogo will enable a larger number of daisies to be simulated on Daisyworld.

A question to be answered while investigating the Daisyworld model is how varying the changes in luminosity of the sun affects the effectiveness of the daisies to regulate global temperature. For example, the sun has increased in intensity over the course of time and most Daisyworld models only consider a sun which increases in intensity. This project may want to explore a sun which decreases in intensity or perhaps fluctuates.

Parameters of interest to the model will include the albedo of the daisies as well as the barren earth. The ideal growing temperatures of the daisies can also be modified to produce different results. Metrics of the model will be average global temperature as well as number of daisies. Time permitting, the effects of pollution on Daisyworld will be modeled. This could be accomplished by making the daisies leave land uninhabitable after a certain period of time, or perhaps by including daisies which can influence the local temperature of daisies in their immediate area. The simulation of pollution on Daisyworld is particularly relevant with the effects of global warming and the greenhouse effect being debated.

Resources:

D. Bice. Modeling Daisyworld.
http://www.carleton.edu/departments/geol/DaveSTELLA/Daisyworld/daisyworld_mode.htm . Accessed on: 01/16/2006.

G. Booth.Lovelock's DaisyWorld & the Gaia Hypothesis.
http://gingerbooth.com/courseware/pages/demos.html\#daisy . Accessed on: 01/16/2006.

J. Lovelock. Gaia: A New Look at Life on Earth. Oxford University Press UK, 2000.

J. Lovelock, A. Watson. Biological homeostasis of the global environment: the parable of Daisyworld. *Tellus*, **35B**:284--289, 1983.