

DAISYWORLD MSC 409, April, 2007

An imaginary world is populated only by white and black daisies. The white daisies love the heat of the sun, but, being white, they tend to reflect sunlight and cool down. The black daisies love coolness, but, being black, they tend to absorb more sunlight and heat up. This program simulates the struggle for space between the white and black daisies within a finite spatial domain as the solar flux to the planet increases with time and each daisy equilibrates to the new conditions – one time step behind.

The attached MATLAB code basically codes up the equations as presented in Hartmann's Global Physical Climatology book pp. 250-252. The code will run as written. Your tasks:

1. make some figures of daisy fraction and temperature versus solar luminosity. I wrote basic code for one figure, you write the rest. Use Matlab Help to learn plotting options.
2. Explain what is up with the figures just from looking at the code.
3. As time permits, and for more credit: experiment with the code. Change parameters, see what happens., explain..
4. For serious extra credit, add a third population of daisies with an albedo of your choosing. Now what happens ? Or, rather than having a constant value for the daisy death rate, code it to be a function of the daisy temperature (a "wilt" factor if you will) or of daisy area (ie., more daisies, more likelihood of disease or predators). Or, add an atmosphere that attenuates the solar luminosity as a function of daisy area (ie., more daisies, more pollen in the air, less sunlight reaches surface. White pollen more reflective than black pollen).

While this example may seem very artificial, it is often invoked as the "Gaia hypothesis", to mean that the earth's climate can also be influenced by biological factors. One example of this may be phytoplankton: these release dimethylsulfide, which then forms sulfate aerosols that can nucleate clouds. This may be operating in regions with high ocean productivity, such as the oceanic upwelling region near California, also site of large decks of stratus clouds.