

Chapter 2

Introduction to Systems
/Daisyworld

What is a System?

- Definition: A system is a group of different components that interact with each other
- Example: The **climate system** includes the atmosphere, oceans, polar caps, clouds, vegetation...and lots of other things

How do we study systems?

- Identify the **components**
- Determine the nature of the **interactions** between components

Systems Notation



= system component

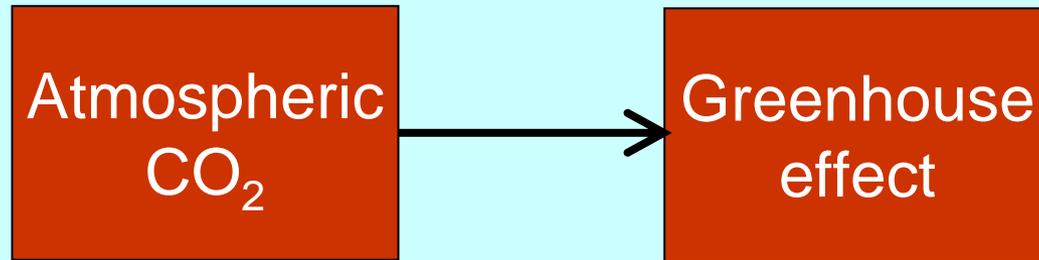


= positive coupling



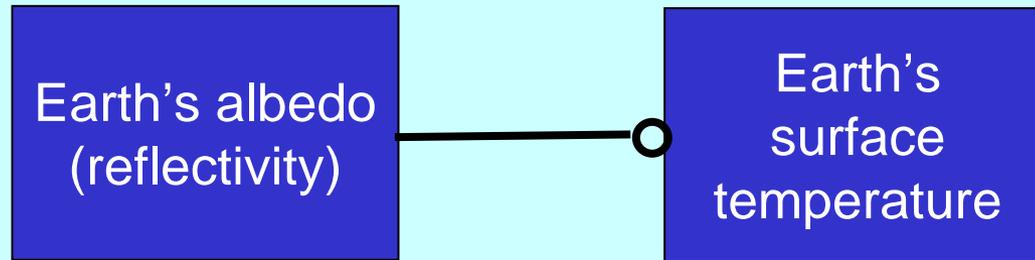
= negative coupling

Positive Coupling



- An *increase* in atmospheric CO₂ causes a corresponding *increase* in the greenhouse effect, and thus in Earth's surface temperature
- Conversely, a *decrease* in atmospheric CO₂ causes a *decrease* in the greenhouse effect

Negative Coupling



- An *increase* in Earth's albedo causes a corresponding *decrease* in the Earth's surface temperature by reflecting more sunlight back to space
- Or, a *decrease* in albedo causes an *increase* in surface temperature

The interesting thing to do is to put couplings together in **feedback loops**, which we will do shortly.

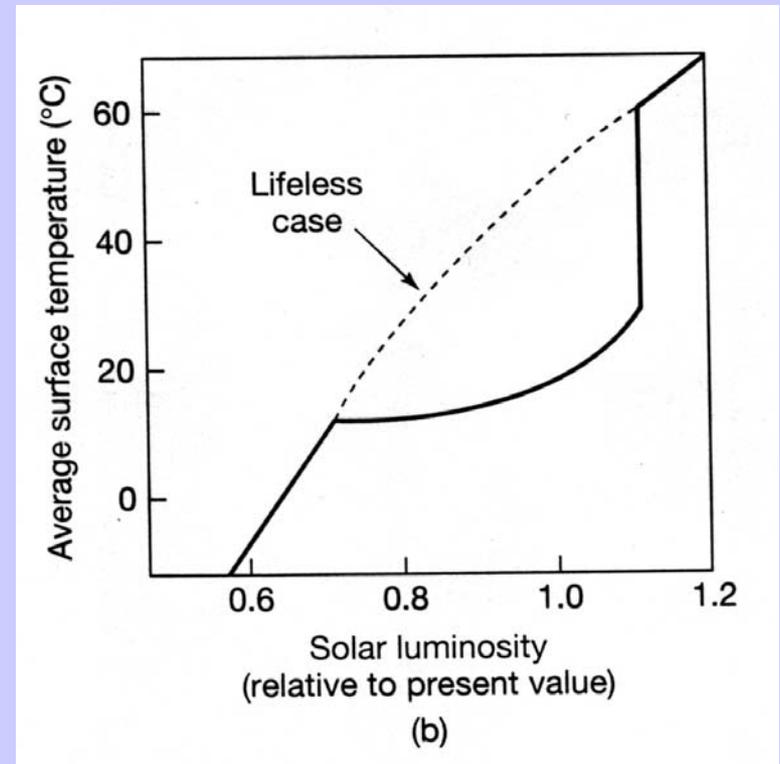
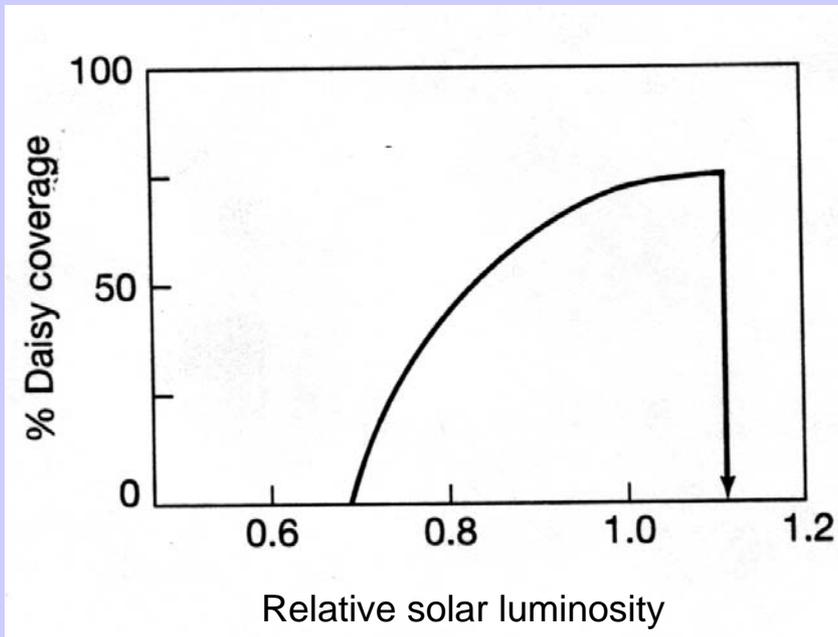
First, though, let's define a highly simplified climate system to examine how feedback systems might work.

A simplified climate system: DAISY WORLD

- ✓ Average Temperature = 30 °C
- ✓ No clouds, no ocean
- ✓ Soil = light gray (*absorbs some light*)
- ✓ Life = white daisies (*reflects all light*)
- ✓ Sun = like Earth's
- ✓ Daisy growth = changes with temperature



White Daisy Response to Increasing Solar Luminosity



The Earth System, Ch. 2

- The rest of Chapter 2 will be done on the blackboard...