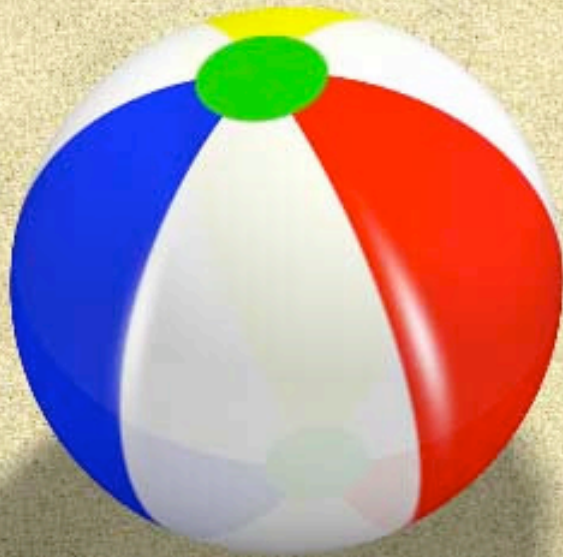


Biological Homeostasis

What's it all about?

Steve George



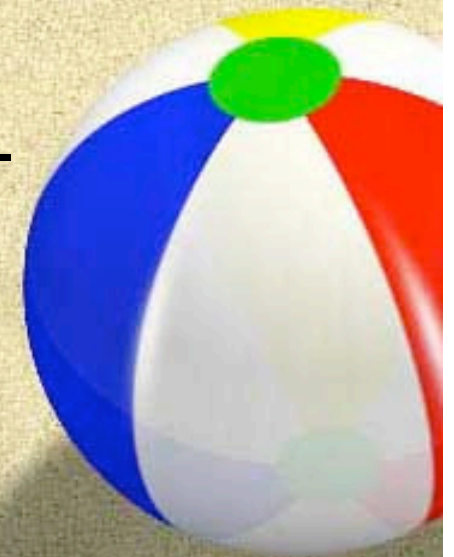
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First: Some Simple Modelling

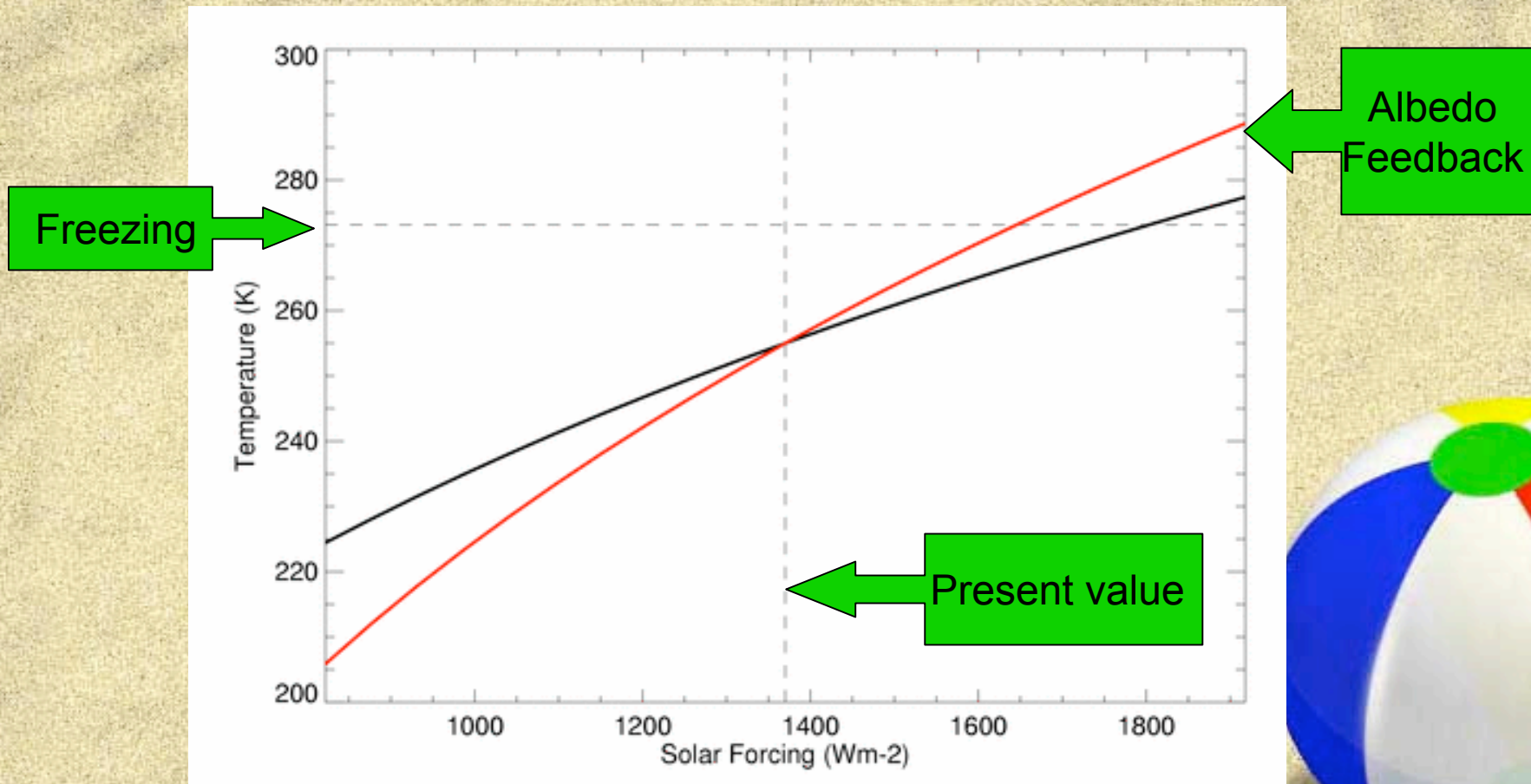
Energy Balance Model...

$$(1 - \alpha)S / 4 = \sigma T_e^4$$

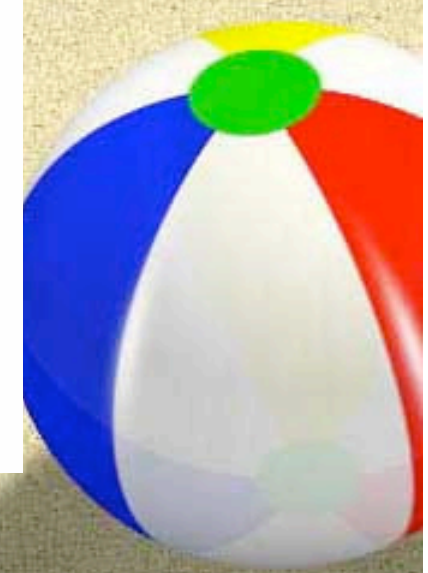
...albedo (α), solar constant (S), Stefan-Boltzmann constant (σ), effective temperature (T_e).



Balmy Temperatures...



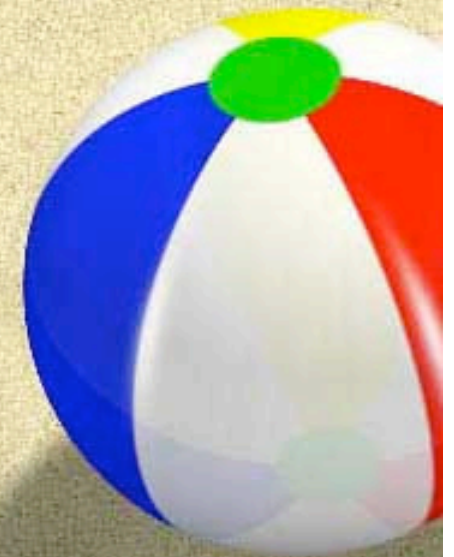
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Earth's Greenhouse Increment

- Actual surface temperature ~ 287K
- Increment of 33K due to greenhouse gases
- Equation adjusted to take into account infrared transmissivity (ϵ)

$$(1 - \alpha)S / 4 = \epsilon \tau \sigma T^4$$



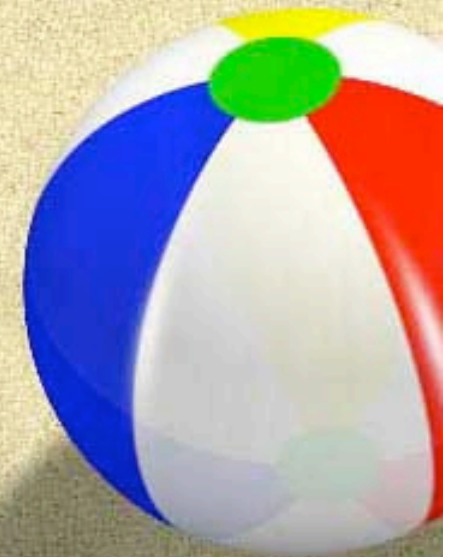
Daisy World: 1

- Simple, energy-balance world
- But, it has life!
- Daisy growth:

$$\frac{da}{dt} = a(x\beta - \lambda)$$

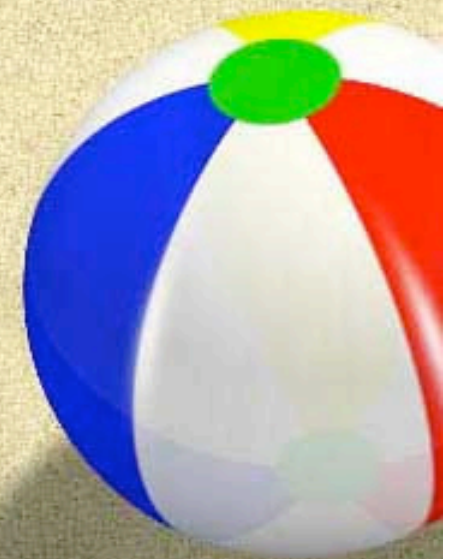
$$\beta = 1 - 0.003265(T_o - T)$$

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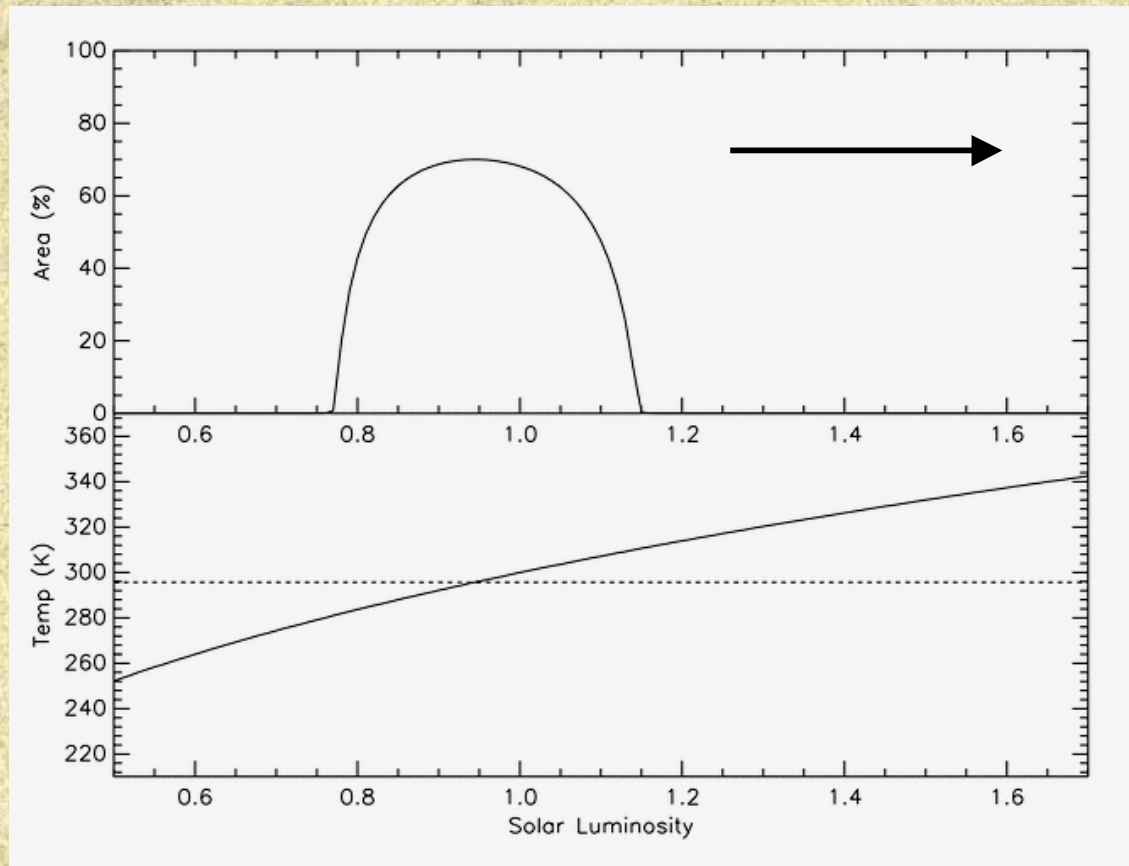


Daisy World: 2

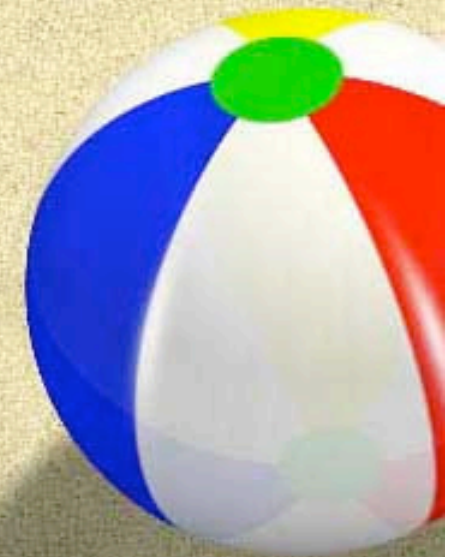
- Albedo: $\alpha_b < \alpha_g < \alpha_w$
- Local temps: $T_b > T_g > T_w$
- Planetary temp (T_e) a function of daisy areal coverage and local temps.



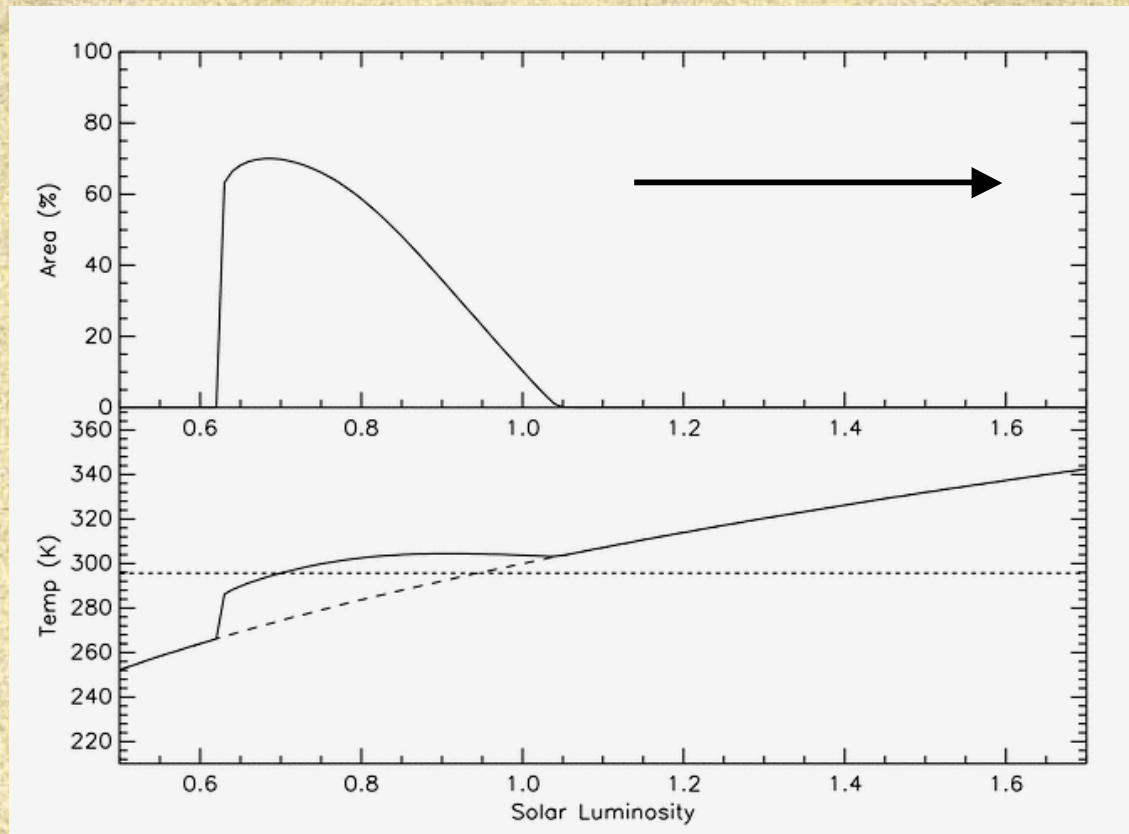
Neutral Daisy: Increasing Luminosity



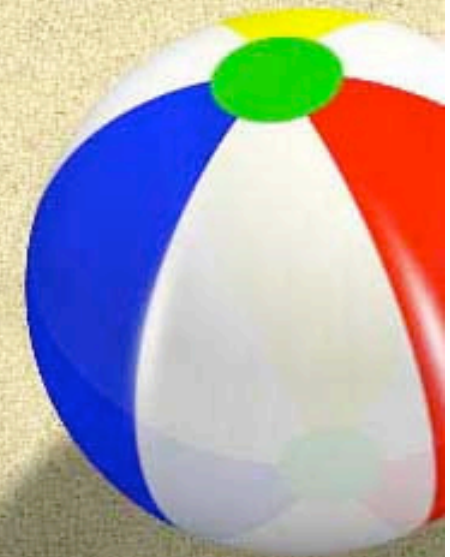
$$\alpha_n = 0.5$$



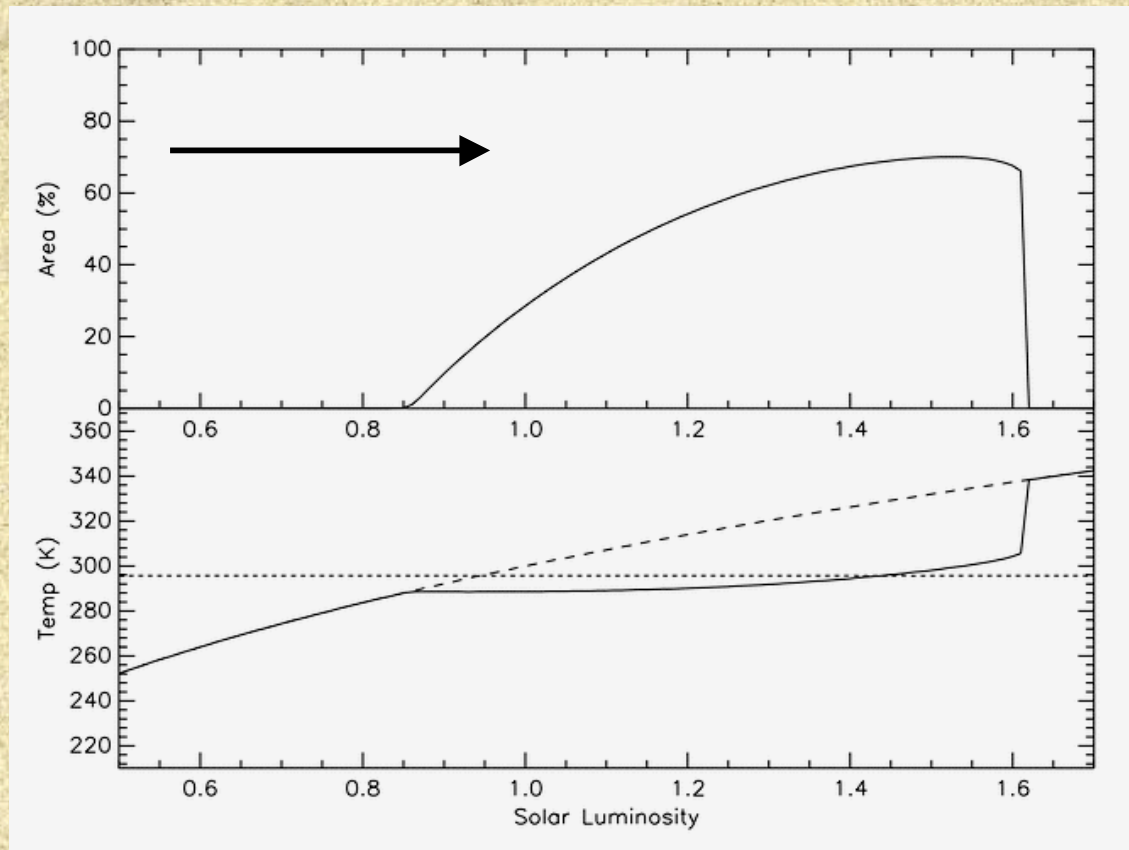
Black Daisy: Increasing Luminosity



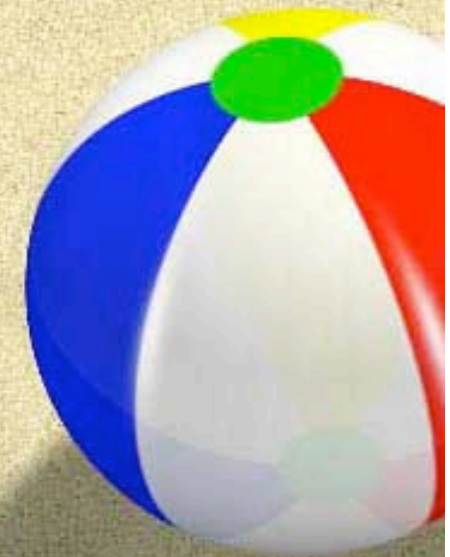
$$\alpha_b = 0.25$$



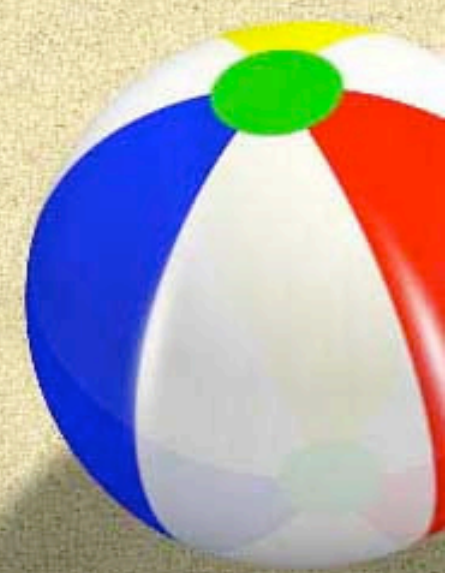
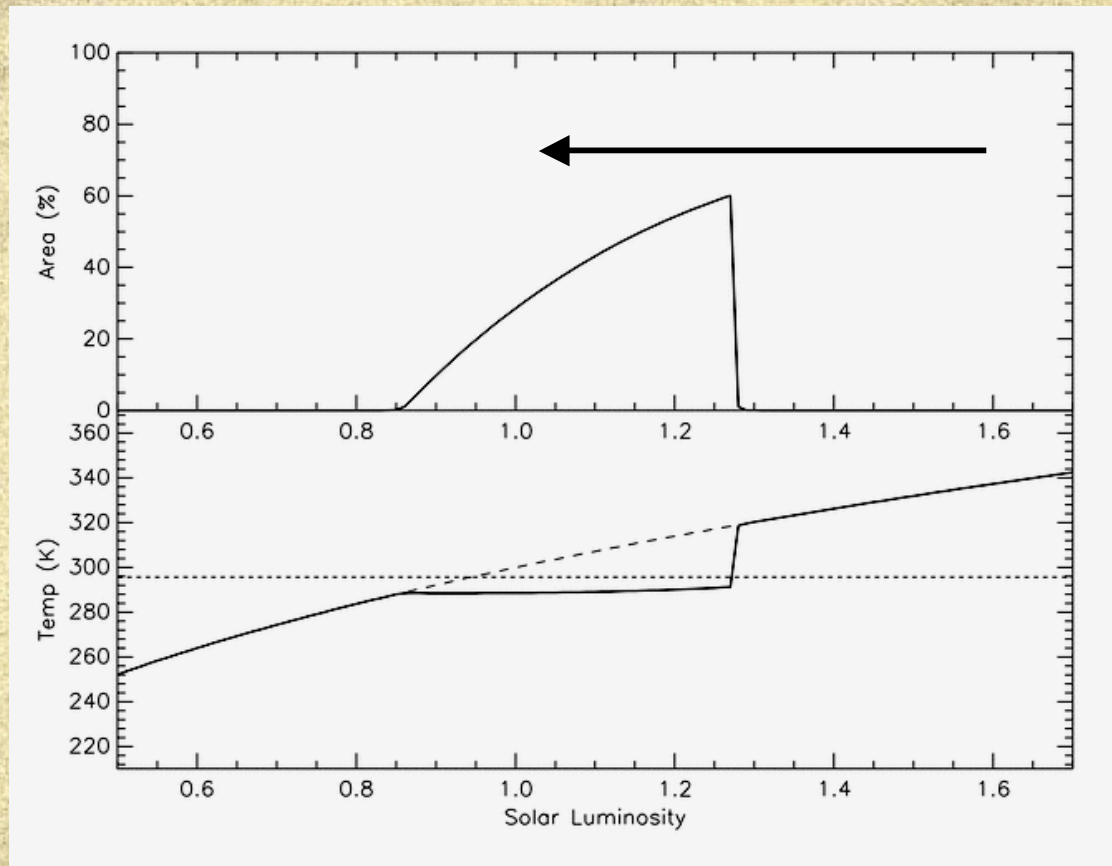
White Daisy: Increasing Luminosity



$$\alpha_w = 0.75$$

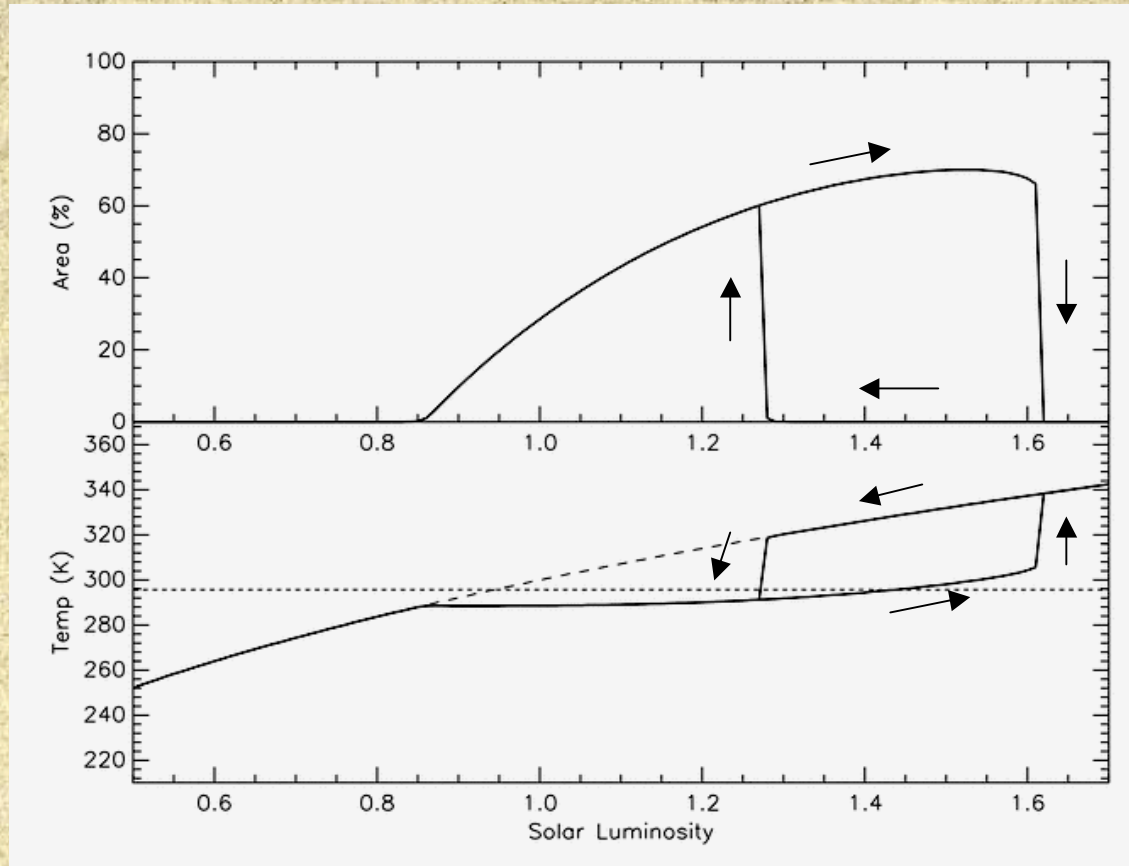


White Daisy: Decreasing Luminosity



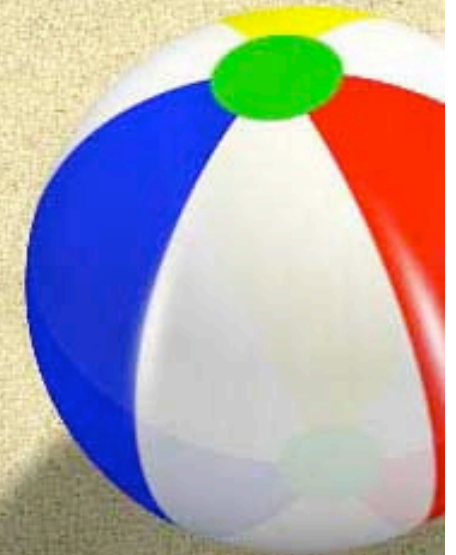
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White Daisy: Hysteresis!!!!!!!

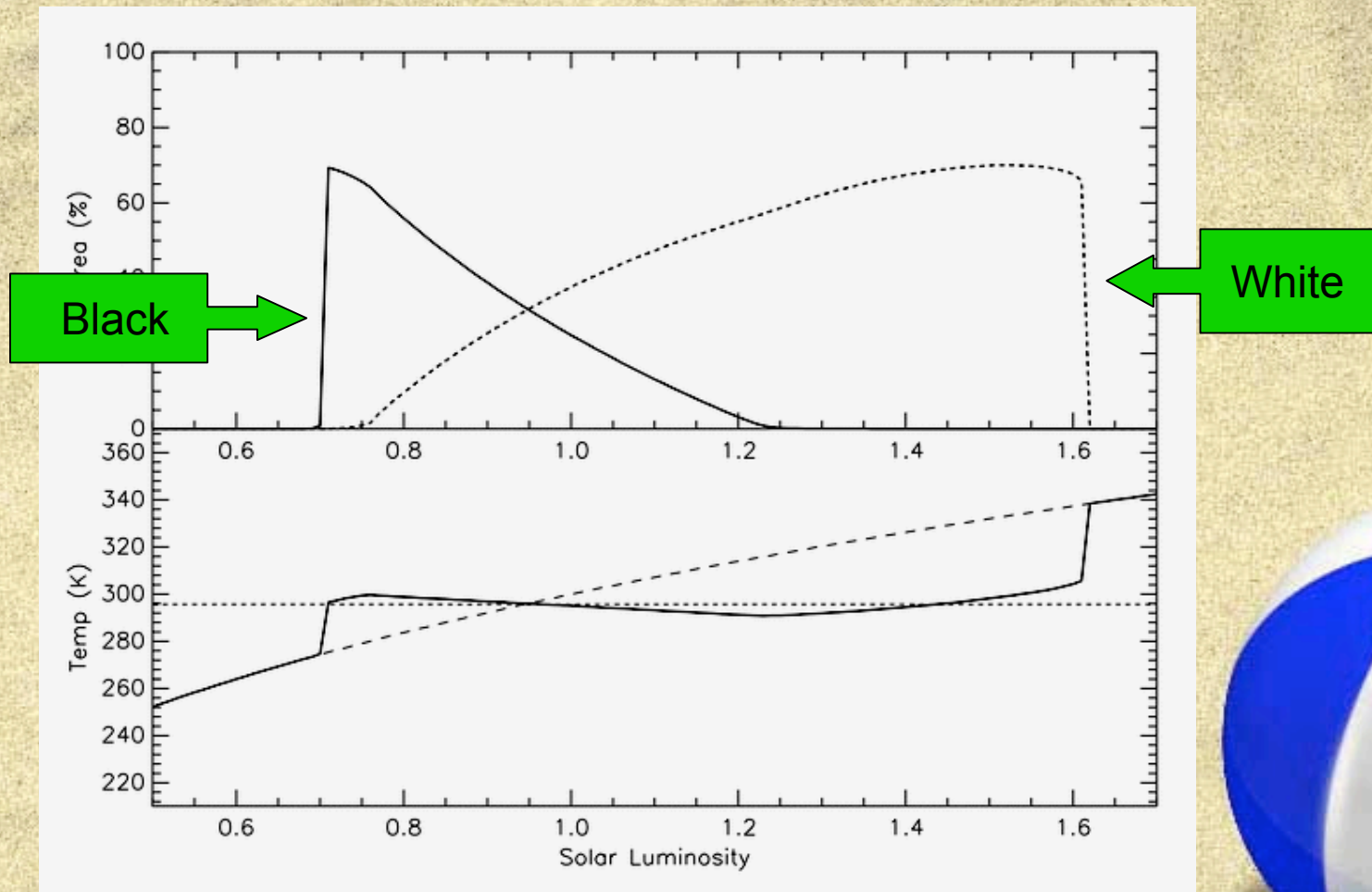


Climate Tipping Point?

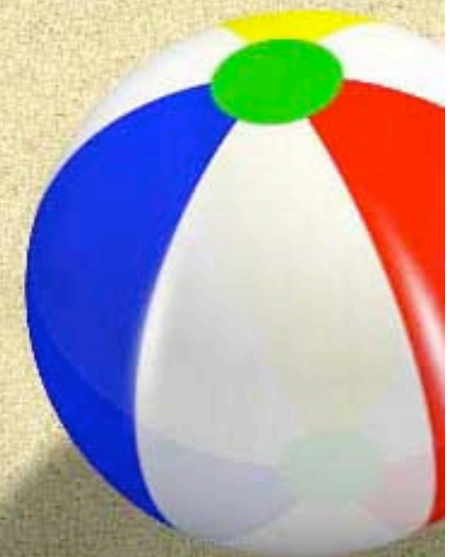
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Mixed Daisy: Competition



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Discussion!!

Is the theory of homeostatis
relevant to the Earth's climatic
system?

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