

Lab Activities
Climate Models

Consider the discretized zero-dimensional climate model

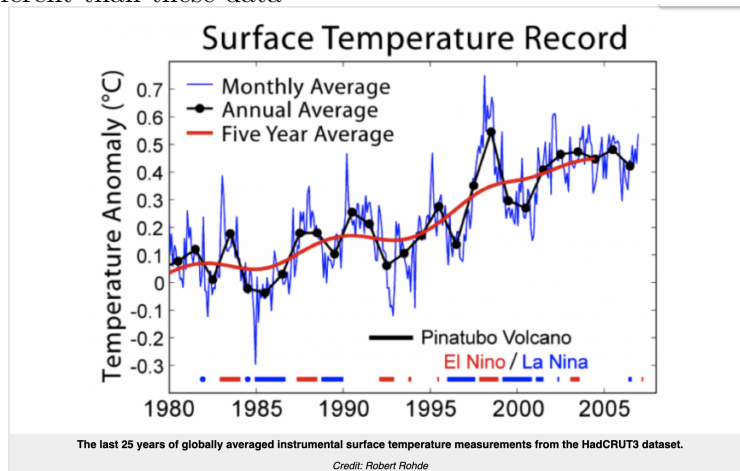
$$T(t_{j+1}) = T(t_j) + \frac{dt}{C_p} S(1 - \alpha) - \frac{dt}{C_p} 4\epsilon\sigma T(t_j)^4 \quad (1)$$

1. (a) Use the following information to estimate the global mean surface temperature $T(t_j)$ at times $t_1, \dots, \dots t_{1000}$ where $t_0 = 0$ and $t_j = j * dt$:

$$S = 1372 \text{ Wm}^2, \alpha = 0.3, \epsilon = 0.61, \sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{K}^{-4}, \\ C_p = 1.05 \times 10^{23} \text{ JK}^{-1}, dt = 1 \times 10^{21}, T(t_0) = 0.$$

Plot $T(t_j)$ vs t_j for $j = 0, \dots, 1000$. Discuss what you observe on the Slack channel “activities”. In particular, could you have guessed the graph would have this form by just looking at equation (??)?

- (b) Given the values of $T(t_j)$ you found in ??, now plot estimates of the global mean surface temperature anomaly. The temperature anomaly is found by first calculating $mean(T) = T_{mean}$ and then plot $T_{anom}(t_j) = T(t_j) - T_{mean}$. Once plotted, discuss how your graph looks different than these data



- (c) Vary values of the parameters in ?? and see if you can get a graph of $T_{anom}(t_j)$ that looks like the above data. If you can get a similar looking graph, please post your parameter values and graph on the Slack channel “activities”.