

Experiments with Tim Osborn's simple climate model

Sensitivity experiments

- (1) Try out different sine-wave (sinusoid) forcing time series. Vary the period, vary the scaling factor (which controls the amplitude), and vary the climate sensitivity parameter of the model itself. You should find that the effect of climate sensitivity on the temperature response is smaller for shorter periods than for longer periods. What does this imply about whether we can calculate the climate sensitivity by observing the temperature response to short-term fluctuations, such as individual volcanoes or the annual cycle?
- (2) Set all forcing factors to 0 except noise=1. Try varying the mixed layer depth from 20m to 200m, while comparing the temperature simulation with the noise (random) forcing time series. Does a shallower or a deeper mixed layer emphasise the long-term variations most?

Simulation experiments (trying to reproduce the observed global temperature record)

- (1) With the natural and anthropogenic forcing time series set to their “best-guess” values (i.e., all factors set to 1 except sinusoid=0 and noise=0), what value of the model's climate sensitivity gives a best fit between simulated and observed global temperature? Just assess the fit by a visual comparison – no need to do any statistical comparisons!
- (2) Can an equally good fit between simulation and observation also be achieved if the climate sensitivity is at the low or high end of the likely range (i.e., $s = 1.5$ or $s = 4.5$ K for $2\times[\text{CO}_2]$)? Find one combination of forcing factors that gives a good fit for $s = 1.5$ K for $2\times[\text{CO}_2]$ and one combination for $s = 4.5$ K for $2\times[\text{CO}_2]$.
- (3) Can the observed global warming be simulated by a combination of natural forcing factors (volcanic=1, solar=1) and internally-generated “noise” (i.e., set noise factor=1 and try different choices of noise by selecting various noise seeds, between 1 and 100, at random, to see which happen by chance to improve the fit), with no anthropogenic forcings (ghg=0, sulphate aerosols=0), and an IPCC “best-guess” climate sensitivity of 3 K for $2\times[\text{CO}_2]$?