Chapter 8 Homework Answers

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Contents

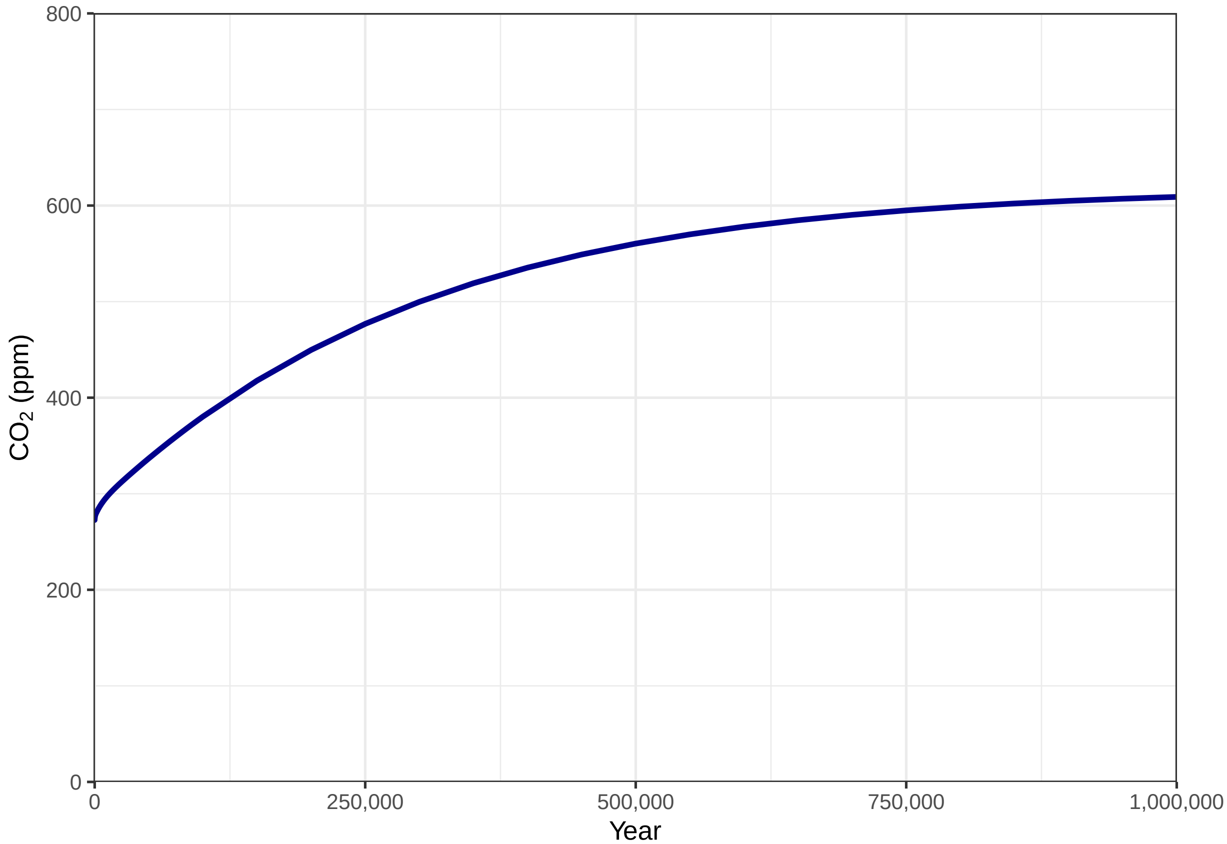
Exercise 8.1: Weathering

Weathering as a function of CO_2. In steady state, the rate of weathering must balance the rate of CO_2 degassing from the Earth, from volcanoes and deep sea vents. Run a simulation with a higher CO_2 degassing rate at the transition time.

a) Does an increase in CO_2 degassing drive atmospheric CO_2 up or down? How long does this take?

Answer to 8.1(a)

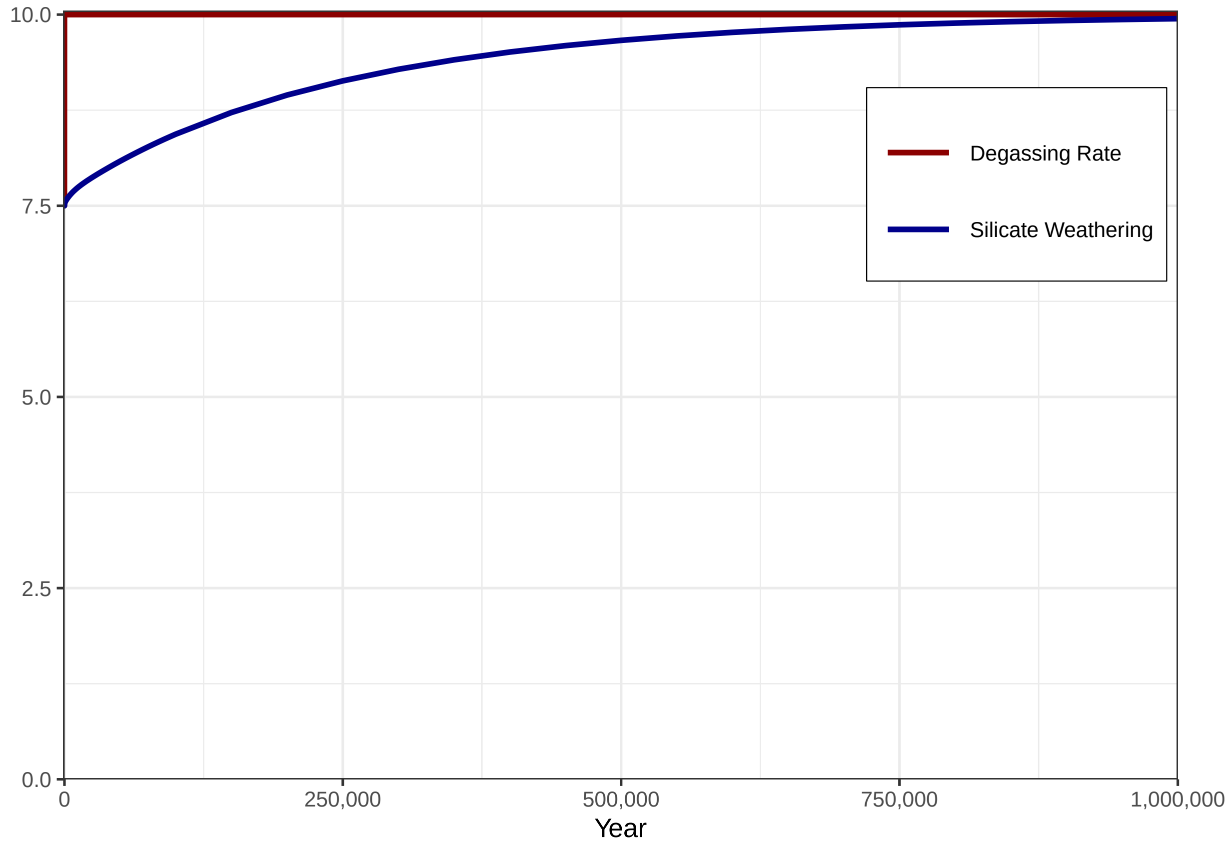
It takes about 1 million years for CO_2 to come to equilibrium after the volcanic degassing rate changes.



b) How can you see that the model balances weathering against CO_2 degassing?

Answer to 8.1(b)

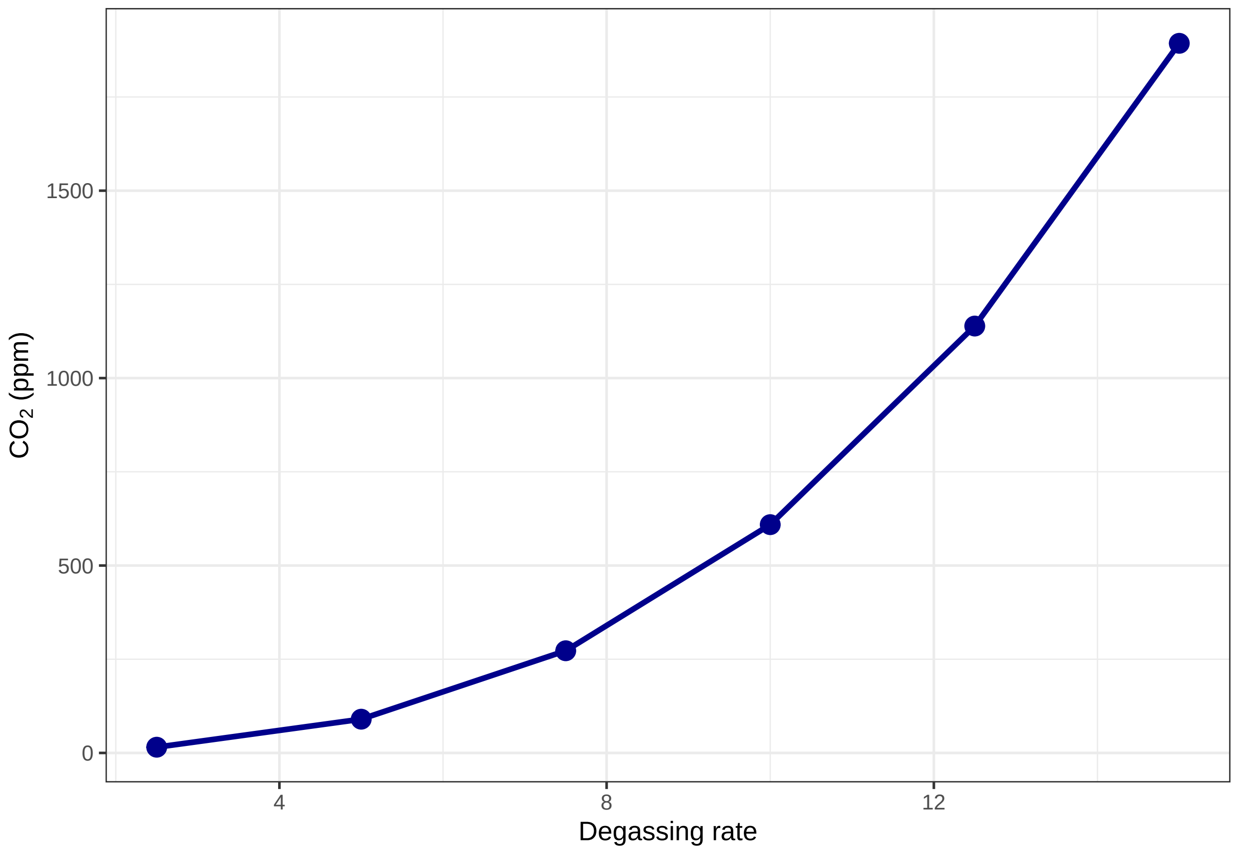
Look at the “Silicate Thermostat” graph: Watch how the weathering rate gradually rises until it meets the degassing rate.



c) Repeat this run with a range of degassing rates, and make a table of the equilibrium CO_2 concentration as a function of the CO_2 degassing rate. The CO_2 degassing rate is supposed to balance the CO_2 consumption rate by silicate weathering.

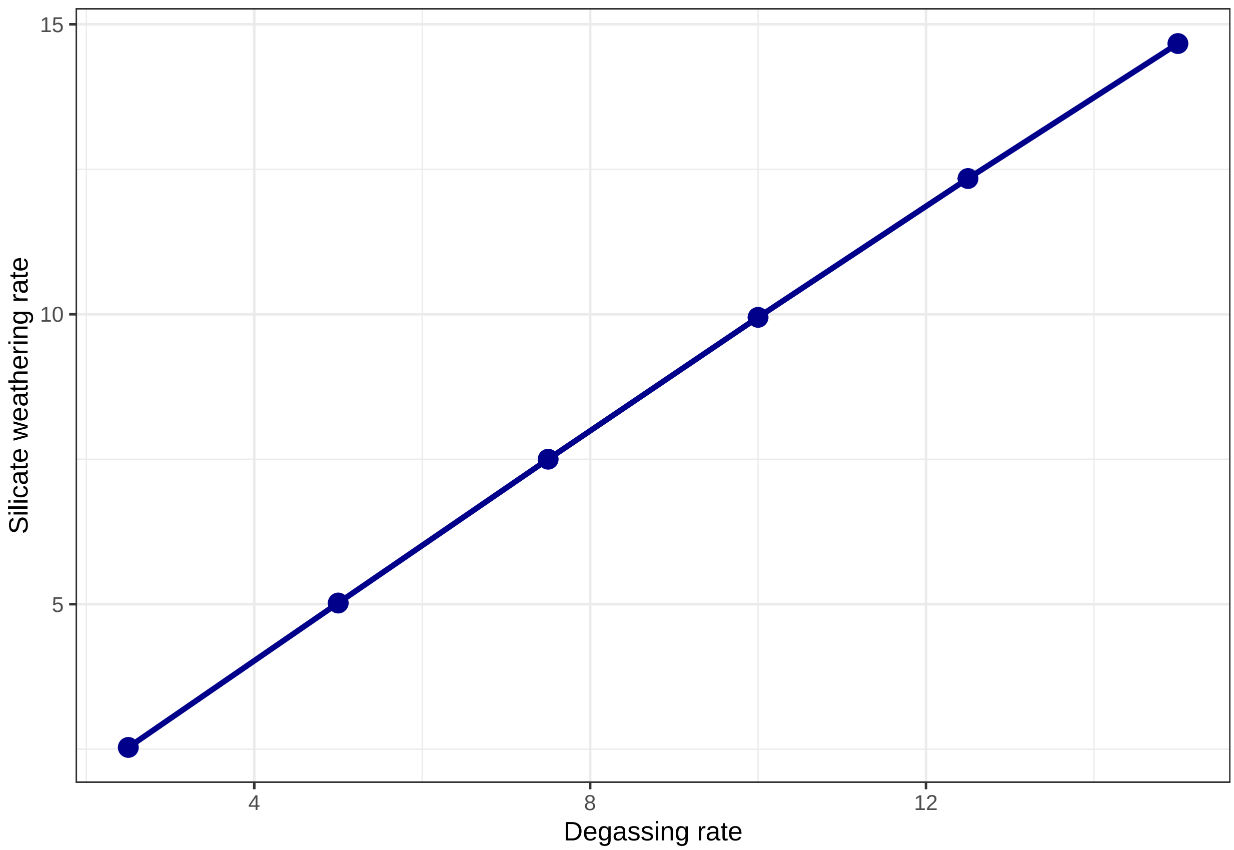
Answer to 8.1(c)

Degassing rate	CO2
2.5	15
5.0	90
7.5	273
10.0	609
12.5	1139
15.0	1893



d) Make a plot of weathering as a function of atmospheric pCO_2 using your model runs.

Answer to 8.1(d)



Exercise 8.2: Weathering as a Feedback

> Effect of solar intensity on steady state CO_2 concentration. The rate of weathering is a function of CO_2 and sunlight, a positive function of both variables. By this I mean that an increase in CO_2 will drive an increase in weathering, as will an increase in sunlight. The sun used to be less intense than it is now. Turn back the clock 500 million years to when the sun was cooler than today. What do you get for the steady-state CO_2, and how does this compare with what you get for today's solar intensity? Explain why.

Answer to 8.2

Using today's solar intensity, the CO_2 concentration is 272.6 parts per million.

Using the solar intensity from 500 million years ago, we find a CO_2 concentration of 2,372 parter per million, almost 10 times greater.

This is because, with less sunlight and the same CO_2 concentration we have today, the temperature would be much lower. The reduced temperature would slow down weathering and with less weathering the CO_2 would build up in the atmosphere and increase the temperature until the weathering matches the degassing rate.