Quantitative Reasoning in Environmental Science
Homework 5

Problem 1

Give an order-of-magnitude estimate of the total volume of domestic trash collected each year in the US (in cubic meters). If we pile this trash 10 meters high, how large an area do we need to dump it for 100 years? Compare this area with the area of the St. Louis city (66 square miles).  

*Hint:* Estimate the volume of trash per one household per day.

Problem 2

Give an order-of-magnitude estimate of the maximum flow rate of water in your kitchen sink. Give the answer in cubic meters per second. How long will it take to fill up an Olympic-size swimming pool (2500 cubic meters) at this rate?  

*Hint:* Estimate the time it takes to fill up a pan.

Problem 3

What is the residence time of water in all of Earth’s oceans?  

*Hint:* Use the global precipitation rate.

Problem 4

The volume of the Clear Lake (California) is $1.4 \times 10^9$ cubic meters. The residence time is about four and a half years. Calculate the flow-through rate. If the concentration of a pollutant in the lake is 0.1 ppm, how many tons of this pollutant are dumped into the lake annually (assuming steady-state)?

Problem 5

Give an order-of-magnitude estimate of the ventilation time of a room (for example, your own room).  

*Hint:* Estimate the air flow through the vents or windows and use an approximate “rule” that the clean-up time of a reservoir is of the order of magnitude of the residence time.