Assignment 2: Coding Model for Monsoon Rainfall

By now you have read the paper "A statistically predictive model for future monsoon failure in India" by J. Schewe and A. Levermann. Here you will reproduce their model in R as a way to practice coding a simple simulation and histogram plots. You will partially recreate their Figure 1 and also perform a couple of extra simulations to better understand the drivers of the change in monsoon rainfall distributions. Later in this quarter you will use the functions you create here to learn about sensitivity analysis.

Exercises (10 pts)

1. (4 pts)
Adapt the matlab code provided by the authors to write an R code that simulates the same thing. Extra credit if you can remove the if statements related to (p > prmax) and (p < 1-pmax).

Enter the R command set.seed(5489) before running your code. This ensures we're all getting the same sequence of random numbers so we can directly compare answers. Note that you'll have to run this command anytime you run your code, not just once at the beginning of a session. What is rainfall in the 1st year of the simulation? How about in the 100th year?

2. (4 pts)
Write a function that takes a vector of 5 inputs corresponding to P_{strong}, P_{weak}, tau, pr_{max}, and p_{init}, respectively, and outputs the vector of yearly rainfalls.

Run your function for 4 different sets of parameters ($tau = 17$ for all of them):

Scenario	P_{strong}	P_{weak}	pr_{max}	p_{init}
1 (current climate)	9.0	0	0.8	0.75
2 (2150-2200 climate)	10.9	1.9	0.82	0.2
3 (high atmospheric sat.)	10.9	1.9	0.8	0.75
4 (Δ sea level pressure)	9.0	0	0.8	0.2

Note the first 2 correspond to the blue lines in figures 1a and b shown in the main paper, which correspond to current and 2150-2200 climate, respectively. The last 2 are intended to help understand the main differences, with the 3rd set only having changes in Pstrong and Pweak (driven by higher atmospheric saturation points), and the 4th set only having changes in *p_init* (driven by changes in sea level pressure during early season).

Make a 4-panel figure that shows the histogram for each run. Draw vertical lines (hint: look up the function *abline*) showing the quartiles of the distribution, and a thicker vertical line showing the mean rainfall for each distribution. You might find this link helpful: `http://www.statmethods.net/advgraphs/layout.html`

3. (2 pts)
Based on the plots, what do you observe about the relative contributions of atmospheric and sea pressure changes to the changes in monsoon rainfall in this model?