

Name: \_\_\_\_\_

Name(s) of people you worked with on this assignment: \_\_\_\_\_

How long did you work on this assignment? \_\_\_\_\_

*Please sign the honor pledge below:*

*I pledge on my honor that I have neither given nor received unauthorized aid on this assignment:*

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- This assignment is due at the beginning of class on Friday, April 19, 2019
  - Please print out these pages and either handwrite or type solutions to the answers on additional sheets of paper.
  - Please staple all sheets together when you turn them in
  - Please refer to the Homework Guide handed out with the syllabus (and available on Brightspace) for tips for a successful homework experience
  - Regarding the honor code for this assignment
    - You are welcome to work with other people, but each person is responsible for completing the entire assignment and writing down all work and answers in their own words. Please write down all names of your collaborators in the space above. Honor Code violations include parceling out questions so that each person only thinks about one or some but not all, or giving/receiving answers without serious and constructive discussion.
    - You are welcome to use any book or online resource to help with completing this assignment. For example, you are welcome to look up definitions on Wikipedia, but you must rewrite terms in your own words and cannot simply copy text from a reference.
    - Please do not simply look for solutions online. You may not use any answer keys or solved problems found online.

Score: \_\_\_\_\_ / 15 + Neatness \_\_\_\_\_ / 5 = \_\_\_\_\_ / 20

### **Glacier flow model**

1. Read the article by Roe and Baker (2014), “Glacier response to climate perturbations an accurate linear geometric model.”
2. Write a sentence (or two or three) to explain the following equations.
  - a) 1a and 1b
  - b) 2, including the sub-equations 3a, 3b, and 3c
3. Why doesn't the one-stage model work very well? Why do the authors prefer the three-stage model.
4. Write a sentence (or two or three) to explain the following equations.
  - a) 14a, 14b, and 14c
5. In a few sentences, describe the difference between the three-stage model developed in this paper, and the one stage model the authors had developed previously.

### **MATLAB code**

Download the three files: “glac\_init\_baker” “FlowlineGlacierModel.m” and “ThreeStageModel\_HW10” from Brightspace.

To begin, run the model “FlowlineGlacierModel.m” to understand the model and the output. This model runs the one-stage flowline model. The code plots and animation that shows the glacier flowline moving and tracks the glacier length over time. Note, the model has random temperature and precipitation data entered, so it will be different each time you run it.

Next, run the model “ThreeStageModel\_HW10.m” to understand the model and the output. This code does not create an animation, but plots the glacier length anomalies for the length of the model (2,000 years), and highlights the last 500 years of the model so you can see more detail. Note, I said glacier length “anomalies.” This code doesn't plot glacier length over time, but plots the difference from the mean length over time. A zero length anomaly means the glacier was at its mean length that time. -500 m means it was 500 meters shorter than average. +750 m means it was 750 meters longer.

6.
  - a) Run the model with the “default” parameters and record the mean, max, min, and standard deviation of the glacier length anomalies.
  - b) Double or halve one parameter in section 1 of the model and run it again. Record the mean, max, min, and standard deviation of the glacier length anomalies. You're welcome to explore different parameters until you find one that seems interesting to you.
  - c) Describe how this run was different from the default parameters.

7. In section 7 of the model, I want you to create a for-loop that will run the model in steps 1 – 3 for 100 times, and each time it will record the mean, max, min, and standard deviation of the glacier length anomalies. After the model has run 100 times, calculate the mean, max, min, and standard deviation for each of these four parameters in the 100 model runs.

*Hints:* Do not have your loop plot 100 plots. You can leave the plot part out of your loop. All you really need to do is set up a loop for 100 runs and copy and paste the model. You'll have to edit it a bit (it won't like the double %% inside the loop) and then set up some matrices to record the data you want. That's it!

a) Run this 100-loop run for the "default" parameters and write down the mean, max, min, and standard deviation for the mean, max, min, and standard deviation of the glacier length anomalies. Yes, this means you'll tell us 16 different values.

b) Take the same parameter that you altered in question 6.b) and change it the same way you did above. Then run the model 100 times with this alteration and write down the mean, max, min, and standard deviation for the mean, max, min, and standard deviation of the glacier length anomalies.

c) Describe how changing this parameter looks different when you compare the data from 100 different model runs in a and b.

→ Print out your full code with this

8. Cynics might argue that this is "just a model" and doesn't mean anything. What can you learn from a model? What can a glacier model like this be used for?