SIO 115 Homework 6 (due Friday 21st February) Glacier mass budget

You will be graded on your writing style as well as the content of your answer. The marks for each answer are in parentheses. For questions that ask you to draw sketches, you may hand-draw this and add it as an image/figure to the PDF you submit. When submitting homework, please stick to the naming convention ***SIO115_Hw06_Lastname_Firstname.pdf****. Please email your answers to parndt@ucsd.edu with subject line* ***SIO115 Homework 6 Lastname Firstname*** *by the appropriate deadline. Please be careful with units and significant figures.*

1. Term paper. By now you should have a topic picked out for your term paper. Please write a concise, clear paragraph (less than 200 words) explaining what your topic is about, and provide three real, peer-reviewed references that you have looked at on this topic. [10]

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2. *Mass budget definitions.* (a) What are the processes by which mass is added to a land-terminating glacier, and what is the overarching word used for mass gain? [2]

(b) What are the processes by which mass is removed from a land-terminating glacier, and what is the overarching word used for mass loss? [2]

(c) What are the two extra mass loss terms for a tidewater glacier? [2]

(d) What is the *mass budget* (or *mass balance*) of a glacier? [2]

(e) What is the *equilibrium line* of a glacier, and can its position move? [2]

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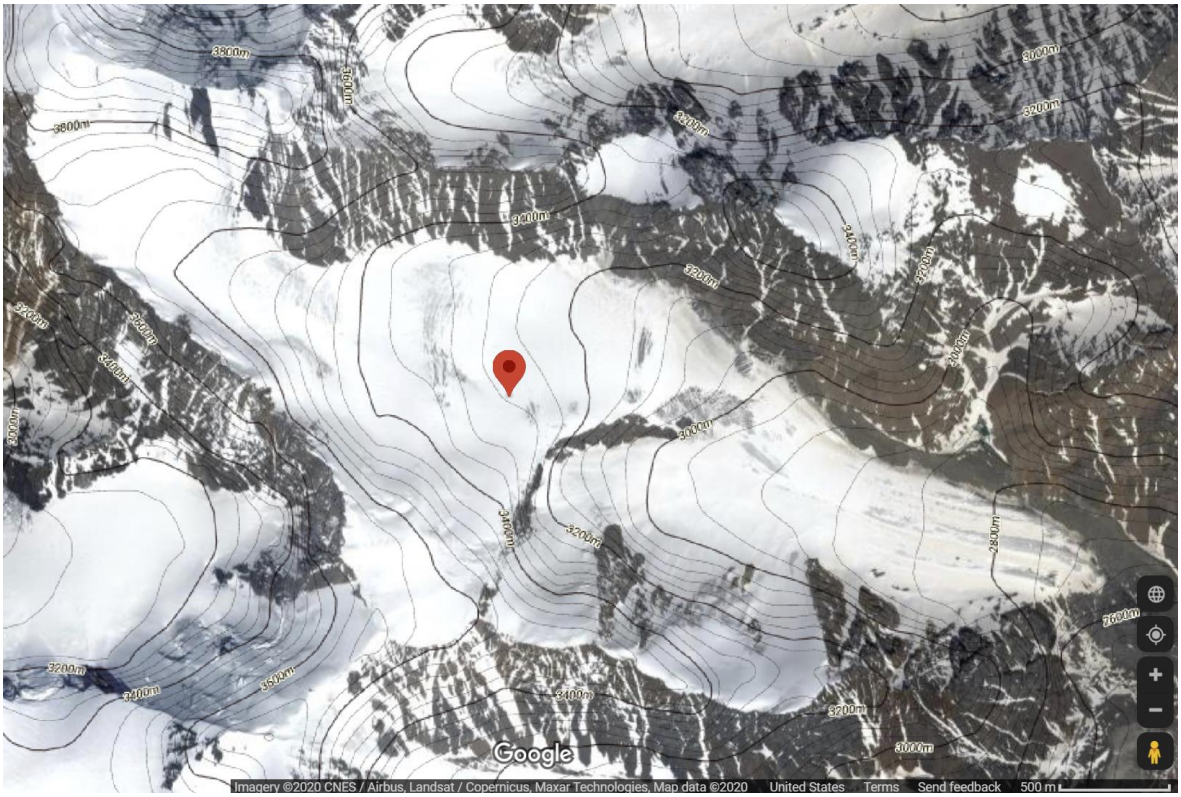
3. *Net mass balance.* To estimate net mass balance, glaciologists deploy a network of stakes and measure stake height at the start of the balance year (i.e. the end of summer/beginning of winter). At the end of the winter, they re-measure the stake height, and also measure the density of the accumulated snowpack, to estimate the mass gained; this is repeated at the end of the summer to calculate the mass lost. They do this at different points along the glacier, as evenly spaced in altitude (H) as possible.
Net mass balance (b_n) equals the winter balance (b_w) plus the summer balance (b_s): $b_n = b_w + b_s$.

The following mass balance data were data collected at stakes deployed on Leviy Aktru Glacier, Russia (50°05'N, 87°44'E) in 1993.

H (m)	b_w (mm)	b_s (mm)	H (m)	b_w (mm)	b_s (mm)
3950	860	330	3250	1020	-360
3850	720	330	3150	1060	-770
3750	550	330	3050	890	-950
3650	690	290	2950	780	-1670
3550	960	90	2850	560	-2080d
3450	1050	120	2750	290	-2860
3350	980	-50	2650	250	-3150



(a) Calculate the <u>total net mass balance</u> for Leviy Aktru Glacier from these data. State your assumptions. [3]

(b) Plot the summer balance, the winter balance and the net mass balance against altitude (NB: altitude goes on the <u>y-axis</u>). [3]

(c) In general, how does mass balance change with altitude regardless of season? [1]

(d) Why are all the values at all altitudes positive for the winter season? [2]

(e) Why are some summer season values positive while the other summer season values are negative? [2]

(f) At what altitude does the accumulation zone end and the ablation zone start? What is the name given to this altitude? [2]

(g) The mass balance *gradient* (*G*) is the change in mass balance with altitude measured across the equilibrium line: $G = (B_{n1} - B_{n2})/(H_1 - H_2)$
where:
B_{n1} is the first net mass balance measurement above the equilibrium line;
B_{n2} is the first net mass balance measurement below the equilibrium line;
H_1 is the altitude of the first net mass balance measurement above the equilibrium line; and
H_2 is the altitude of the first net mass balance measurement below the equilibrium line.

(i) What is the value of mass balance at the equilibrium line? [1]
(ii) Calculate the mass balance gradient using the measurements from the table. Your answer should be in mm/m. [1]