

Annual (net) mass balance of a glacier

INSTRUCTION FOR WORKSHEETS 2 - 8

Worksheets 2-8 are used to draw the glacier mass balance charts and to determine the position of the equilibrium line altitude (ELA) in subsequent measurement years.

To perform the task you need:

- Data from work card no. 1 "Morphological section of the glacier surface"
- Measurement data for each subsequent accounting year in Tables 1 and 2 of this manual
- Worksheets from 2 to 8.

Instructions for implementation of the annual glacial mass balance on the example of the year 2004/2005:

1. Prepare Work Sheet 2 (2004/2005);
2. On the graph marked with A, draw a morphological cross-section of the glacier surface (use the data from the previous lesson);
3. On the graph marked with B, for each ablation stake, draw the bars corresponding to the amount of accumulation and ablation. Use the data included in Tables 1 and 2 of this manual. Note that for the 2004/2005 year we use 2004/2005 accumulation data and 2005 ablation data. The balance year starts in the autumn, so accumulation of snow lasts at the turn of the year.
4. Calculate the difference between accumulation and ablation, draw the corresponding bar at each ablation stake, then join the line segments at the ends of the annual balance posts. The intersection of this line with the line "0" of the graph defines the position of the ELA in the given year. The location of this point will be needed to solve the task on worksheet number 9.

Correlation between annual (net) mass balance and mean annual air temperature

INSTRUCTION FOR WORKSHEET 9

The task is to apply the morphological cross section of the ELA position in subsequent measurement years and to complete the figure by adding the average annual temperature data in the same years.

To perform the task you need:

- Worksheet 9
- Data on ELA position in subsequent accounting years - read from Worksheet 2 to 8.



- Mean annual temperature values for the relevant accounting years. Included in tab. 3. last column right.

Instruction:

1. On the graph labeled A, draw the morphological cross section of the glacier (from worksheet 1) and the ELA position for the subsequent balance years (worksheets 2-8).
2. On the graph marked with B, mark the mean annual air temperature (last column of table 3 in this manual).

Consider whether there is a link between ELA position changes and average annual air temperature?

Tab. 1 Accumulation [m w.e.]

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Ablation stake	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011
T1	0,55	0,59	0,46	0,63	0,38	0,38	0,44
T2	0,83	0,67	0,73	0,86	0,63	0,68	0,66
T3	1,14	1,12	0,81	0,84	0,41	0,62	0,82
T4	1,56	1,30	1,00	1,21	0,60	0,72	0,76
T5	1,14	1,17	0,78	1,00	0,61	0,81	0,70
T6	0,94	1,23	1,01	1,14	0,72	1,03	1,25
T7	1,14	1,38	1,14	1,52	0,87	1,39	1,28
T8	1,70	1,59	1,28	1,52	1,06	1,58	1,90
T9	1,71	1,88	1,54	1,64	1,09	1,65	1,70
T10	1,94	1,82	1,66	1,64	1,16	1,52	1,93
T11	1,06	1,55	1,05	1,51	0,80	1,56	1,31

Tab. 2. Ablation [m w.e.]

Hansbreen, Spitsbergen

Ablation stake	2005	2006	2007	2008	2009	2010	2011
T1	1,19	1,29	2,60	2,45	2,06	2,18	2,14
T2	1,73	2,00	1,56	1,85	2,02	1,78	2,05
T3	2,77	1,76	1,23	1,66	2,20	1,80	2,32
T4	1,02	1,40	1,42	1,11	1,99	1,50	1,90
T5	0,79	1,42	1,39	1,31	2,16	1,47	1,82
T6	1,44	1,12	1,08	1,06	1,41	1,05	1,14
T7	1,05	0,84	0,72	0,65	1,15	0,57	0,74
T8	0,98	0,75	0,55	0,88	1,04	0,45	1,38
T9	0,89	0,62	0,35	0,47	0,61	0,21	0,61
T10	0,73	0,85	0,11	0,64	0,81	0,18	0,47
T11	0,87	0,94	0,29	0,12	1,60	0,49	0,76

Tab. 3. Annual mean air temperature

Hansbreen, Spitsbergen

Table 18.16. Monthly and annual means as well as multiannual mean monthly air temperature [°C] in particular months and years and the multiannual means, maxima and minima

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual mean
2000	-7.1	-9.4	-12.3	-11.4	-3.5	1.9	4.8	4.1	2.5	1.9	-1.9	-8.2	-3.2
2001	-6.5	-7.1	-13.7	-11.3	-2.7	2.0	4.6	4.7	3.1	-3.4	-8.3	-7.5	-3.8
2002	-10.7	-11.3	-13.9	-4.4	-3.7	3.2	5.5	5.3	0.7	-2.1	-3.9	-6.9	-3.5
2003	-16.4	-9.1	-15.1	-7.5	-2.0	2.3	4.7	4.3	1.2	-2.7	-4.6	-15.3	-5.0
2004	-13.8	-14.5	-4.9	-2.7	-2.3	1.3	4.7	3.5	2.0	-2.1	-9.3	-5.0	-3.6
2005	-5.9	-5.1	-12.5	-7.9	-2.2	1.9	4.3	4.6	0.6	-3.4	-2.4	-2.6	-2.6
2006	-1.7	-7.5	-12.0	-0.3	-0.2	3.1	4.7	4.6	1.1	-2.9	-2.7	-4.1	-1.5
2007	-7.4	-7.5	-5.6	-8.6	-2.1	2.6	4.2	4.3	1.8	-0.9	-3.4	-5.6	-2.4
2008	-5.0	-7.0	-13.4	-9.3	-1.6	2.4	4.2	3.9	2.9	-3.8	-6.0	-6.0	-3.2
2009	-9.9	-9.1	-8.9	-11.7	-0.8	2.7	5.3	4.3	1.9	-2.3	-0.6	-3.5	-2.7
2010	-5.2	-7.9	-13.2	-6.5	-0.5	1.7	3.8	3.6	2.5	-2.0	-8.4	-9.5	-3.5
2011	-12.5	-9.4	-9.8	-3.7	-1.6	3.2	3.9	4.2	4.1	-0.9	-3.8	-4.6	-2.6
2012	-1.8	-3.6	-3.5	-7.9	-2.0	2.2	4.7	4.6	2.9	-0.5	-3.9	-4.8	-1.1

Marsz A.A., Styszynska A. 2013. Climate and Climate Change at Hornsund, Svalbard. Maritime University, Gdynia.