

Glaciological investigations in Johan Dahl Land 1980, South Greenland

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Glaciological investigations in Johan Dahl Land, southern West Greenland, were started in 1977 by GGU in connection with the proposal for a hydroelectric project in the Nordbosø basin (ACG/VBB, 1975). The Nordbogletscher with an area of 208 km² covers 68 per cent of the basin area and is the most important water source. The work of the GGU has therefore concentrated on the Nordbogletscher and the relation between its mass balance and climate, while the Greenland Technical Organization (GTO) is measuring runoff from the Nordbosø as well as making engineering studies. Results from GGU's fieldwork are published in annual reports, e.g. Olesen & Weidick (1978) and Clement (1980).

Mass balance of Nordbogletscher 1979–1980

During 1980, the field programme was extended to include measurements in the accumulation area so that the total mass balance of the Nordbogletscher can be determined for the first time. The results are summarized in fig. 22 and in Table 7.

The winter balance was measured at the end of May in snowpits and by depth soundings at points scattered over the whole glacier area. The total winter balance was calculated to be $+103 \times 10^6$ m³ of water, corresponding to a mean specific winter balance of +0.49 m of water equivalent. The established accumulation pattern appears to be rather uniform over the whole glacier and there is no strong variation with altitude. The summer balance was determined in the middle of September by measurements within a network of stakes drilled into the glacier. The total summer balance was -163×10^6 m³ of water and the specific summer balance shows a marked increase with elevation.

The net balance for 1979/1980 is -60×10^6 m³ which represents a large net mass loss. The corresponding elevation of the equilibrium line was close to 1550 m, i.e. an accumula-

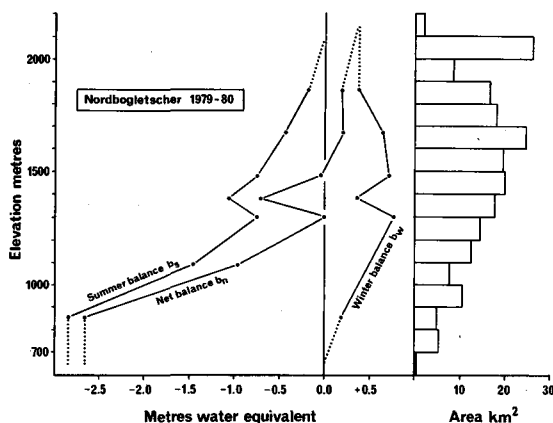


Fig. 22. Winter, summer and net balance in relation to the elevation and area distribution.

Table 7. Winter, summer and net balance in relation to the elevation and area distribution. Nordbogletscher, Johan Dahl Land, 1979-1980

Height m a.s.l.	Area, S km ²	Winter balance		Summer balance		Net balance	
		B_w 10 ⁶ m ³	b_w m	B_s 10 ⁶ m ³	b_s m	B_n 10 ⁶ m ³	b_n m
2200-2100	1.97	(0.73)	(0.37)	(0)	(0)	(0.73)	(0.37)
2100-2000	26.11	(9.66)	(0.37)	-(1.31)	-(0.05)	(8.36)	(0.32)
2000-1900	8.51	(3.15)	(0.37)	-(1.11)	-(0.13)	(2.04)	(0.24)
1900-1800	16.47	6.09	0.37	-3.29	-0.20	2.80	0.17
1800-1700	17.99	9.35	0.52	-5.94	-0.33	3.42	0.19
1700-1600	24.46	16.14	0.66	-11.50	-0.47	4.65	0.19
1600-1500	19.62	13.34	0.68	-12.56	-0.64	0.78	0.04
1500-1400	19.86	11.32	0.57	-16.48	-0.83	-5.16	-0.26
1400-1300	17.69	8.31	0.47	-16.98	-0.96	-8.67	-0.49
1300-1200	14.45	9.83	0.68	-13.15	-0.91	-3.32	-0.23
1200-1100	12.25	6.86	0.56	-15.31	-1.25	-8.45	-0.69
1100-1000	7.97	3.43	0.43	-13.31	-1.67	-9.88	-1.24
1000- 900	10.58	3.17	0.30	-22.75	-2.15	-19.57	-1.85
900- 800	4.84	0.87	0.18	-13.75	-2.84	-12.87	-2.66
800- 700	5.22	(0.37)	(0.07)	-(14.82)	-(2.84)	-(14.46)	-(2.77)
700- 600	0.32	(0.01)	(0.02)	-(0.91)	-(2.84)	-(0.90)	-(2.82)
2200- 600	208.30	102.63	0.49	-163.17	-0.78	-60.50	-0.29

tion area ratio of about 50 per cent. As this is the first time that the complete mass balance has been measured, it is not possible to compare 1979/1980 with previous years directly. However, from ablation measurements made on the glacier tongue in 1978 and 1979, it appears that the 1979/1980 mass balance is the most negative one since studies started in 1977.

Other investigations

Detailed ablation measurements were made on the tongue of Nordbogletscher on a daily-weekly basis as in previous years. At the same time, climatological elements were recorded at two weather stations; one at base camp beside the glacier and one at the same altitude on the glacier itself. Results show that the main control on ablation variations is due to temperature while sunshine duration shows surprisingly no effect.

A number of ice-dammed lakes were kept under observation. In particular, water-level variations and inflow were continuously recorded for a lake immediately beside the Nordbogletscher at 850 m elevation, which taps every year under the glacier. The results will permit estimation of the water quantities involved in the tapping.

Observations were also made on a number of glacier fronts. The glaciers in the area are growing. For example, Nordgletscher which lies 10 km east of Nordbogletscher has advanced 400 m since 1969.

In August 1980 a special survey programme using an airgun system was made on Nordbosø to measure water depth and thickness of bottom sediments.

Studies in Johan Dahl Land will be continued in the coming year.

References

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Modelling glacier hydrology in West Greenland

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There is great interest in the possibility of using runoff in West Greenland for the generation of hydroelectric power. However, there is still very little information about hydrological conditions in the country. For example, measurements of runoff and glacier mass balance were only started at a few sites in the late 1970s by the GTO and GGU, respectively. This means that the choice of any particular basin for possible exploitation must be made initially in the absence of direct field data. However, a solution to the problem is to develop a runoff model which can be applied to ungauged basins, i.e. a model which does not require field calibration. Such a model should give, as a minimum, estimates of the long-term mean runoff and the likely year-to-year variability. These estimates can be used to calculate hydropower potential and reservoir size at the feasibility or preliminary design stage of any proposed project. Naturally, if it is decided that a particular project is feasible, field measurements will then be started on-site for as many years as possible so that the final design of the project can be based upon a series of real data.

Present work

The current project started in May 1979. At present, the work is concerned with modelling specific values of precipitation, evaporation and glacier mass balance on a regional scale in West Greenland, so that specific runoff can be calculated from the water balance equation. In turn, total runoff can then be computed by multiplying the specific runoff by the appropriate basin area, e.g. as in Weidick & Olesen (1980). Climatological data obtained from coastal weather stations are used in the models in combination with parameters and assumptions which are either guesses or are taken from other areas.

Three models have been worked out so far:

- (1) A regional runoff model for West Greenland assuming that all glaciers have zero mean balance (Braithwaite, 1980a).