technique - which is the two-dimensional analogon of the plate condenser - was used as sensor for measuring the dielectric constant of thin snow layers. A sensor consisting of a combination of two flat condensers has also been developed. The geometry (spacing and width of the two coplanar conducting stripes) has been designed to allow the measurement of the vertical gradient in the dielectricl properties of a snow cover (Foglar 1983). The sensor is operated at 27 MHz. Neglecting the effects of snow texture and liquid water distribution, the dielectric constant of snow is a linear function of density and a quadratic function of the volumetric water content (Denoth and others 1984): snow wetness can, therefore, be calculated from the measured dielectric constant and the snow density.

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HEAT BALANCE OF A MARITIME GLACIER IN GONGGA MOUTAINS, AND A DISCUSSION OF IMBALANCE

Abstract

by

Han Yuan-jie

Lanzhou Institute of Glaciology and Cryopedology, Academia Sinica, Lanzhou, Gansu,
People's Republic of China

The author observed and analysed all terms of glacier heat budget at four altitudes and on three kinds of surface, in three glaciers of the Gangga Mountains during the ablation season (April to August 1983), and recognised that the Gongba Glacier was a quasi-maritime glacier. The radiation term Q_b was primary heating. It reached 400-800 cal/cm^2.day (mean value about >80%). The sensible heat transfer term Q_s was not so high as in other maritime glaciers, such as Ivory Glacier and McCall Glacier. Maximum values of Q_s reached 40% (moraine), 30% (moraine mixed with ice), and 9% (ice). Ablation term Q_a was the same as other maritime glaciers: 94.5% (ice) and 50% (moraine mixed with ice). The feature was near to the middle Ronbuk Glacier, in the Himalayas. Its imbalance was large and near to that of the McCall Glacier.

In this study, by means of heat budget estimation on the three sorts of glacier surface, we found that there were two feedback processes relating respectively to horizontal turbulence and ablation permeation. Horizontal turbulence on the moraine induced heat energy diffusion or dispersion and therefore protected the glacier from ablation. The process was a negative feedback. Ablation permeation on the ice surface brought surface heat energy to the deep ice levels, simultaneous to heat the porous and crack ice environment and further to split it. This was another positive feedback.

Thus two feedbacks caused two kinds of heat budget imbalance. On the moraine surface of the Small Gongba Glacier, the imbalance reached -65 to -158 cal/cm^2.day (14% - 29%). On the moraine mixed with ice surface of Big Gongba Glacier, it reached -70 to -161 cal/cm^2.day (8% - 18%). But for the Hailogou Glacier, on a similar surface, it was between 0 and 36 cal/cm^2.day (6.8%).

To measure horizontal turbulence and permeation directly is very difficult. We estimated the quantity of heat brought by horizontal eddy exchange, for the nonuniform (moraine) surface, indirectly by means of differential of Q_c (conduction) ie ΔQ_c. We also calculated the quantity of heat brought by permeation indirectly; from the vertical gradient of Q_c, ie dQ_c/dz, for the uniform surface (ice, or moraine mixed with ice).

With dimension analysis, we found the heat balance equation for the nonuniform moraine surface had this form:

$$dT/dt = Q_b + Q_c + Q_a + Q_{sz} + Q_{sl} + Q_{lz} + Q_{ll} \tag{1}$$

where dT/dt = moraine temperature varing, Q_b = net radiation flux, Q_c = conduction heating, Q_a = ablation, Q_{sz} = vertical sensible heating, Q_{sl} = horizontal sensible exchange, Q_{lz} = vertical latent heating, Q_{ll} = horizontal latent exchange.

On the ice and moraine-mixed-with-ice-surfaces equation (1) becomes:

$$0 = Q_b + Q_c + Q_a + Q_s + Q_{lz} \tag{2}$$

When Q_a is measured by ablational run-off, the ablation permeation is always to be ignored. But it has a very important role in the heating of deep ice levels, and in particular on deep snow levels. Hence equation (2) must be used with care in describing the moraine surface heat budget of glaciers, as it may induce a large imbalance. Vice versa, we can use the imbalance to predict the morainize and ablational intensify.

Finally, with a view of thermodynamic theory, the entropy of glacier system is proportional to T^3 of the system; there the glacier is a dispersional structure. According to Prigogine's theory the glacier varies from balance to imbalance and of course a heat balance equation showing imbalance is reasonable. However the imbalance is except of artificial error, that is our stand.