

PHOTOGRAMMETRIC INVESTIGATION OF BYRD GLACIER SURFACE LOWERING (Abstract only)

by

Henry H. Brecher

(Institute of Polar Studies, Ohio State University, Colorado, Ohio 43210, USA)

ABSTRACT

While carrying out photogrammetric measurements to provide surface velocities and elevations for use in studies of the equilibrium and dynamics of Byrd Glacier, I noted that comparison of elevations obtained by ground surveys in 1978-79 with US Geological Survey topographic maps made from 1960-62 aerial photography indicated a very large apparent lowering of the glacier surface in this short time-interval. The apparent lowering varied between 50 and 150 m along a 60 km section of the glacier for which data were available (Brecher 1980).

The ground measurements were estimated to be in error by no more than 3 m but the accuracy of elevations on the maps was unknown. Because these are reconnaissance maps, however, substantial errors would not be unexpected. It was therefore necessary to obtain more accurate glacier surface elevations for 1960-62 in order to determine whether the lowering is real. Photogrammetric strip triangulations of three individual strips of photography, two taken in November 1960 and the third in February 1963, which

cover the region of the greatest apparent lowering, have now been completed. The old strips were oriented to fixed points on the two "banks" of the glacier derived for this purpose from the 1978-79 photogrammetric work, thus bringing the measurements from the old and new photography into a common coordinate system.

The glacier surface elevations for 1960-62 are the same as those obtained from the 1978-79 ground survey and photogrammetry. While it is difficult to give measures of accuracy of the results since no independent data are available for comparison, internal evidence indicates that precision higher than the expected 10 m has been achieved in the measurements. It can thus be stated unambiguously that no detectable surface lowering has occurred on any of the parts of the glacier which have been investigated.

REFERENCE

Brecher H H 1980 Apparent surface lowering on Byrd Glacier between 1960 and 1978. *Antarctic Journal of the United States* 15(5): 64-65

THE EFFECT OF CREVASSING ON THE RADIATIVE ABSORPTANCE OF A GLACIER SURFACE (Abstract only)

by

Tad Pfeffer

(Department of Geological Sciences, University of Maine at Orono, Orono, Maine 04473, U.S.A.)

ABSTRACT

Surface melting has been observed on the lower, floating half of Byrd Glacier, Antarctica, during the height of the summer ablation season, in spite of regional air temperatures consistently below 0°C. The thickness of ice in this area is about 2 500 m, but surface crevasses penetrate to a depth of about 20 m, and bottom crevasses, being water-filled, may extend all the way up to sea-level. This leaves a zone of uncrevassed ice between which is of the order of 200 m in thickness, across which lateral shear stress due to drag against fjord walls will be concentrated. Variations in the mechanical properties of ice in this zone, specifically variations in hardness due to temperature changes, will obviously have a significant effect on the dynamics of the ice stream.

A model of the rough ice surface has been constructed, in which large crevasse furrows are represented by cylindrical V-grooves. These form the upper boundary of a solid conduction region which is semi-infinite below, and whose transient temperature distribution is calculated using the finite element method. The free surface boundary condition, that of sunlight warming the rough ice surface, is calculated by the construction and solution of coupled Fredholm integral equations of the second kind; these represent the energy absorbed at a point on the V-groove surface as being due to (1) energy directly incident from the sun, if the point is not in shadow, and (2) indirect radiation reflected from the opposite wall of the V-groove. This formulation takes into account all multiple reflections of radiation between the walls of the V-groove cavity. Additionally, the reflectivity of the ice surface is not given a constant

value, but is allowed to vary, increasing as the angle of incidence departs from the surface normal.

The purpose of the model is to compare temperature distributions with a rough surface to the same model with a smooth surface. Due to the many simplifications made with regard to surface heat transfer, it is imprudent to make assertions about actual temperature distributions based on the model results, but the difference between the rough and smooth model results will provide a lower bound on the actual enhancement effect of surface roughness, i.e. future, more comprehensive, modeling of energy exchange at an ice surface will be in error by at least the predicted amount if the surface is treated as if it were flat.

The major effects of the surface roughness are greater absorptive capacity and non-uniform distribution of the absorbed energy. The greater absorptive capacity of a V-groove cavity is well known from studies in radiation heat transfer. Non-uniform distribution is due to two mechanisms: (1) the cavity effect is most pronounced at the apex of the V-groove, and (2) when surface melting occurs, energy is transported in the form of latent heat of melting from wherever the melting occurs to below the apex of the V-groove where the melt water refreezes.

The possibility that lateral shear stress is concentrated in a zone only 200 m thick means that temperature perturbations due to surface roughness need only penetrate on the order of 200 m, or possibly even less, to have a significant effect on the mechanical properties of the ice, and in turn on the dynamics of the ice stream.