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A short-term experiment on sub-debris melt on highly maritime Franz Josef Glacier, Southern Alps, New Zealand

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Melt rates of glacier ice underneath a debris cover are dependent on the energy transfer through the debris cover. The effective heat conduction through the debris material wich is the major source of melt energy might be influenced by a number of processes, like air or water advection in the pore space of the debris material. In order to examine the potential contribution of individual parameters on ice melt we placed an ablation stake into a hand-drilled hole below 24 cm of supraglacial debris cover on the lower part of Franz Josef Glacier. Three thermistors were installed at the stake at depths of 6 cm, 12 cm and 18 cm below the debris surface, ensuring equal vertical distances between debris surface, individual thermistors and the debris-ice interface. The results show the expected and distinct diurnal temperature variation and a decreasing amplitude with depth.

Melt rates were calculated assuming that conductive heat flux is the only energy source. Although heavy precipitation occurred on one day during the experiment, the observed melt agreed well with calculated values for dry conditions. This suggests that even in this highly maritime environment, additional energy provided by percolating rain is of minor importance for sub-debris melt. As a consequence, ablation beneath debris is mainly controlled by sensible heat flux and shortwave radiation. Both factors are closely related to air temperature. This is probably one reason why air temperature is a strong predictor of melt under debris and the degree day approach usually works well also for debris covered glacier parts. These findings will be of importance in the future with larger proportions of the glacier tongue expected to become successively covered by debris