THERMAL REGIME OF A SMALL ALASKAN STREAM IN PERMAFROST TERRAIN

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Goldstream Creek near Fairbanks, Alaska is about 8 m wide, 0.25 m deep, and flows 0.3 to 1.3 $m^3\ s^{-1}$. From 1963 to 1973, hydrological and temperature observations were made to determine thermal effects of the stream on the relict permafrost that underlies much of the valley. Soil freezing beginning in October causes build-up of ground-water pressure, and the stream overflows repeatedly until about January, forming aufeis deposits 1 to 2 m thick, depending on depth of soil freezing, which is primarily controlled by the amount of snow cover. The data permitted calculations of the thermal diffusivity of unfrozen soil, using Fourier series, numerical step models and differential analyses; average values ranged from $4 \times 10^{-7}\ m^2\ s^{-1}$ in areas away from the stream to over 15×10^{-7} beneath the stream. Overflows facilitate heat loss from the ice by removing the insulating snow layer. However, they also add heat as the water percolates through fractures in the ice and releases latent heat as it freezes. The mechanism of adding heat is more effective than conduction which is the only mechanism for transporting heat to the upper surface. Although the surface temperature during summer is lower in the stream than in the surrounding ground (11°C compared with > 22°C) the summer heat pulse penetrates deeper under the stream; this is partly due to the topography of the stream channel. The net effect on the permafrost is to lower the relict permafrost table, from about 4 m away from the stream, to nearly 6 m beneath the stream.