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Formation and Survival of Water Drainage Channels in Temperate and Polar Glaciers

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The study of glacial drainage systems is essential for understanding of glacier dynamics, inner ablation, outflow hydrograph, and other hydrological processes in the glacier. It is also helpful to water resource use planning in glacial regions and forecasting of the outflow hydrograph during ice-dammed lake outbursts. In this work we studied the behavior of a single channel in cold and temperate ice to clarify the channel evolution, as well as formation and survival criteria.

A numerical model of a channel of cylindrical geometry was developed. It calculates the rate and direction of phase change on the channel walls and the ice creep rate.

We defined two main scenarios corresponding respectively to the channels at the initial stages of formation and to the fully developed channels (Figure 1). The first scenario revealed some critical parameters (channel radius, ice thickness, ice temperature etc.) on which possibility of the channel developing depends, and the most favorable conditions for the channel growth. Using the second scenario we found out that already developed channels tend to become equilibrium in size. Longterm (several years) modeling showed that ice thickness is more critical than ice temperature for a channel to survive till the next melting season.

Keywords: drainage; channel; melting; water; ice; temperature.

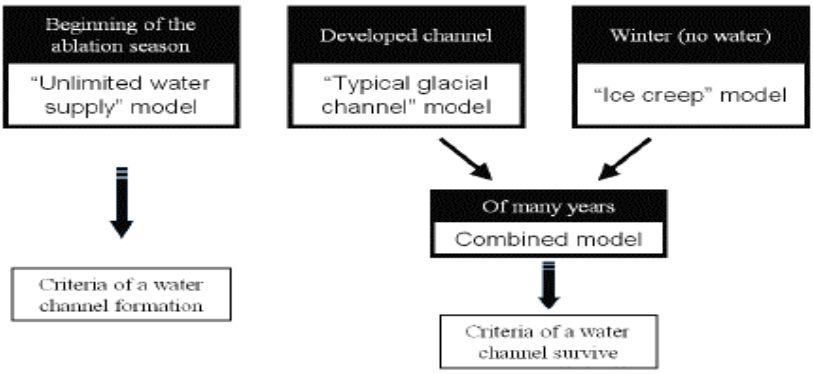

Figure 1. Types of the models (scenarios)