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Development of continuum snow avalanche model

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Six decades of observational and experimental studies revealed that well-developed dry snow avalanches consist of three layers: dense-flow layer in the lower part of the flow (up to 1 to 3 m above the snow surface with density on the order of 300 kgm-3), the saltation layer (typical height and density are a few meters and about 30 kgm-3, respectively) above or ahead of the dense layer, and the suspension layer (density below 10 kgm-3, height up to several hundred meters and growing with distance) above and behind the saltation layer. Since the dense flow involves most of the mass of the avalanche and is very destructive, understanding its characteristics is of practical significance. Runout distances and velocities increase markedly with flow depth. The highest measured front velocities approached 80 ms-1, and internal velocities up to 100 ms-1 have been measured.

Although a number of snow avalanche models were proposed so far, the models used in hazard mapping practice are typically one to three-parameter models of the hydraulic type. Frictional parameters to express the speed and the runout distance have been improved. However, they are still not satisfactory to obtain the important information for the disaster prevention such like the avalanche thickness and the flow distribution over the natural terrain.

In order to overcome the weak point in the previous models, we have started to develop a continuum flow model, focused upon the dense flow motion. Since one dimensional calculations agreed fairly well with the experimental results, we are trying to extend the model two-dimensional at this stage. Our goal is to simulate the avalanche behavior over the natural topography and to utilize it for the hazard mapping.

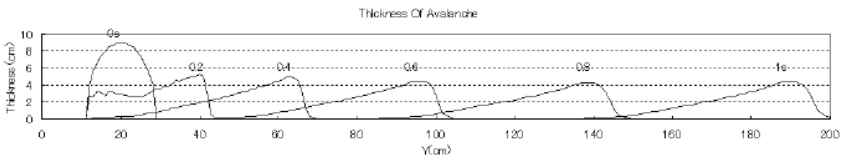

Figure1. Result of one-dimensional calculation