Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

ACC32-P11 Room:Convention Hall Time:May 24 13:30-14:30

Snowpack estimations in the starting zone of large-scale snow avalanches using the SNOWPACK model

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The Makunosawa valley in Myoko is ideally suited to study how meteorological elements influence avalanche activity, because snow avalanches have often occurred there. Since 2000, five large-scale snow avalanches with a running distance exceeded 2000 m have been observed and some characteristics on avalanches in this valley have been obtained from the 12 winter seasons up to 2011. However the characteristics of snowpack in the starting zone of the large-scale avalanches have not been obtained, because it is too difficult to approach there and snow pit observation have not been carried out in the starting zone. We simulated the snow profile and stability index of the snowpack in the starting zone using the SNOWPACK model. Meteorological data (air temperature, relative humidity, precipitation, global radiation, atmospheric radiation and wind speed) was used as input data for the simulation. Air temperature was corrected for the starting zone altitude (1700 m a.s.l.) considering a lapse rate of 6.5 x 10^{-3} ^{o}C m^{-1}. The slope angle (40 degrees) and the direction were inputted as same as those in the starting zone. In the results, similar characteristics were found in the snowpack before the three dry-snow avalanches occurred in February. That is to say, faceted grains were formed near the snow surface due to large temperature gradient during nighttime and much snow was deposited on the faceted snow layer in succession. The avalanches were considered to have been released because of the faceted snow layer with small shear strength and rapid loading from snowfall. On the other hand, the faceted snow layer was not found before one avalanche occurred in January and the sliding surface of the avalanche was presumed to be new snow. The only wet-snow avalanche was considered to be released because the decrease in the shear strength due to infiltration of meltwater and increase in the liquid-water content in the boundary of two layers with different grain sizes.

Keywords: SNOWPACK model, snow avalanche