

冬期の降雨等に伴う雪崩災害の危険度評価技術に関する研究

Danger Rating Method for Snow Avalanches Caused by Rain and Other High-Moisture Weather Conditions during Winter

近年、冬期における気温の上昇や降雨の増加が報告されています。このような気候変動に伴い、積雪寒冷地では雪の乾湿などの性質が変化し、湿雪雪崩による災害の多発が懸念されています。しかし、湿雪雪崩の発生条件については不明な点が多いことから、雪崩・地すべり研究センター(新潟県妙高市)と連携して、冬期の降雨等に伴う雪崩災害の危険度評価技術に関する研究に取り組んでいます。

In recent years, there have been increasing numbers of reports on elevated air temperatures and rain in winter. Snow characteristics, including water content, have changed with recent climate changes, and concerns have arisen over the increasing frequency of wet-snow avalanche disasters. The occurrence conditions of wet snow avalanches, however, have not been clarified. The Snow and Ice Research Team of the CERl, in cooperation with the Snow Avalanche and Landslide Research Center (Myoko City, Niigata Prefecture), has been engaging in research on a danger rating method for snow avalanche disasters caused by high-moisture weather conditions including rain in winter.



湿雪雪崩の発生事例
Sites of wet-snow avalanches

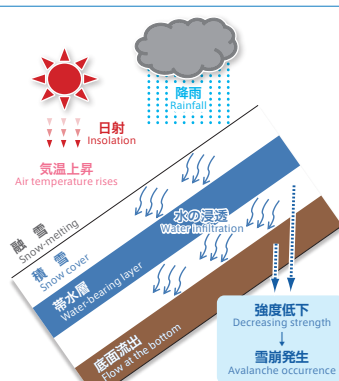
湿雪雪崩発生時の気象条件に関する調査

Survey on Weather Conditions That Lead to Wet-snow Avalanches

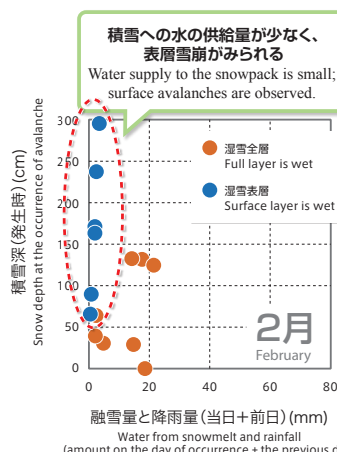
湿雪雪崩の発生に関わる気象条件を明らかにするために、気温上昇や日射、降雨等に注目した過去の雪崩事例の解析を行いました。

これまでの事例解析より、厳冬期(2月)と融雪期(3月)で湿雪雪崩の発生条件が異なることなどが明らかになりました。

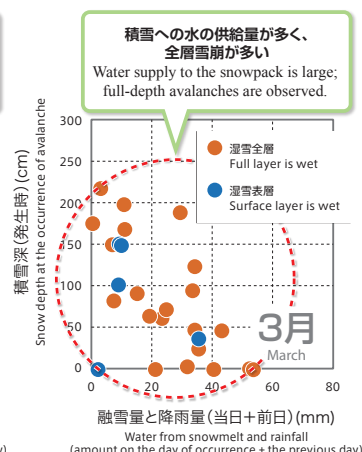
To clarify the weather conditions that lead to wet-snow avalanches, analyses and field observations on avalanches that have involved warm temperatures, considerable insolation and rainfall have been conducted. Analyses of the past cases have revealed that the occurrence conditions for wet snow avalanches in the severe cold period (February) differ from those in snow-melting period (March).



▲湿雪雪崩の発生過程の概念
Concept of the occurrence process of wet-snow avalanches



▲湿雪雪崩発生時の積雪深及び融雪量と降雨量の合計値
Snow depth and the total water from snow melt and rainfall at the occurrence of wet snow avalanche



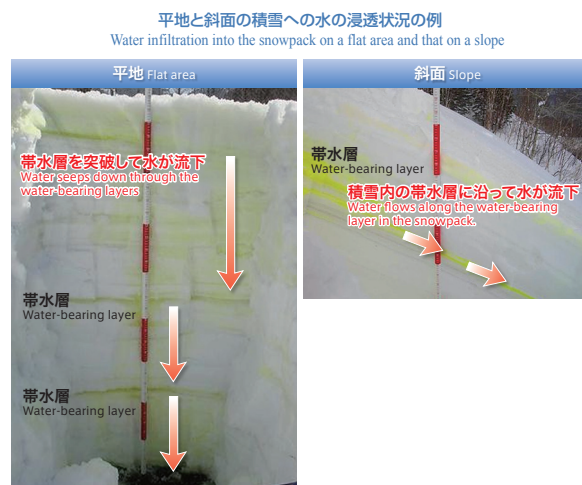
湿雪雪崩発生時の積雪条件に関する調査

Survey on Snow Cover Conditions of Wet-snow Avalanches

湿雪雪崩の発生に関わる積雪条件を明らかにするために、積雪中の帯水層の形成過程や含水率を変化させた場合の積雪の破壊強度特性に関する現地調査と実験を行います。

これまでの調査から、平地と斜面における雪質と水の浸透状況の違いや、含水率と積雪硬度の変化状況などが分かりました。

To clarify the snow cover conditions that promote wet-snow avalanches, field surveys and experiments were done on the formation of water bearing layers in snow cover and the failure strength characteristics of snow cover at different moisture contents. Surveys have clarified the difference in snow grain type and pattern of water infiltration on the flat areas vs. on slopes, and the changes in water content and hardness of the snowpack.



平地と斜面の積雪への水の浸透状況の例

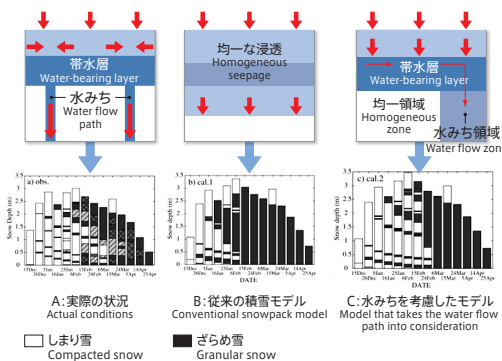
Water infiltration into the snowpack on a flat area and that on a slope

雪崩危険度評価技術の検討

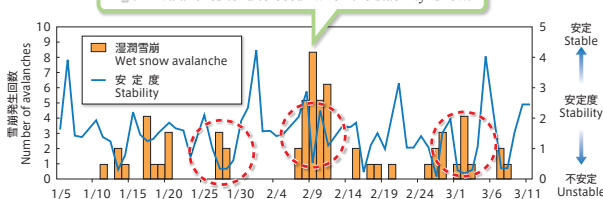
Examination of technology for a danger rating method for snow avalanches

気象条件や積雪条件の調査を基に、積雪推定モデルの改良を行いました。

積雪内の水の浸透における水みちを考慮した積雪モデルをベースに、透水係数、帯水層の含水率、水みち流出量などの設定値を観測データと比較して検討し、特に斜面における積雪構造の再現性を向上させました。これにより、斜面積雪内の水の浸透状況を考慮した湿雪雪崩発生時の危険度評価が可能であることを示しました。



安定度が低いときに、雪崩が起こる傾向あり
Avalanches tend to occur when the stability is low.



▲積雪モデルを用いた積雪安定度の計算(2002-2003年、新潟県糸魚川市柵口)
Calculation for snowpack stability by using the snowpack model (2002 - 2003, Maseguchi, Itoigawa City, Niigata Prefecture)

The snowpack estimation model was improved based on surveys of weather and snowpack conditions. The model was improved based on a snowpack model, that takes into consideration the water flow path in the infiltration of water in the snowpack. The set values of the model, including the coefficient of permeability, the moisture content of the water bearing layer and the flow rate of the water flow path, were compared with the observed data. The reproducibility of the structure of a snowpack on the slope was particularly improved. It was demonstrated that it is possible to rate the danger of wet snow avalanches by using the improved model, in which the infiltration conditions of water within the snowpack on the slope are considered.