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く、雪崩対策の現場では、事前の避難や通行規制を的確かつ効率的に実施できる危険度評価技術が必要となっています。

寒地土木研究所の雪氷チームでは、つくば中央研究所の雪崩・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。

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

In recent years, there have been increasing numbers of reports on elevated air temperatures and rain in winter. Snow characteristics, including water content, in cold, snowy regions 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. For engineers who work to devise mitigation measures for snow avalanche disasters, a danger rating method that enables accurate and efficient evacuation and/or traffic control ahead of avalanche occurrence has become a pressing need. The Snow Engineering Team of the Civil Engineering Research Institute for Cold Region, in cooperation with the Snow Avalanche and Landslide Research Center of the Tsukuba Central Research Institute (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.

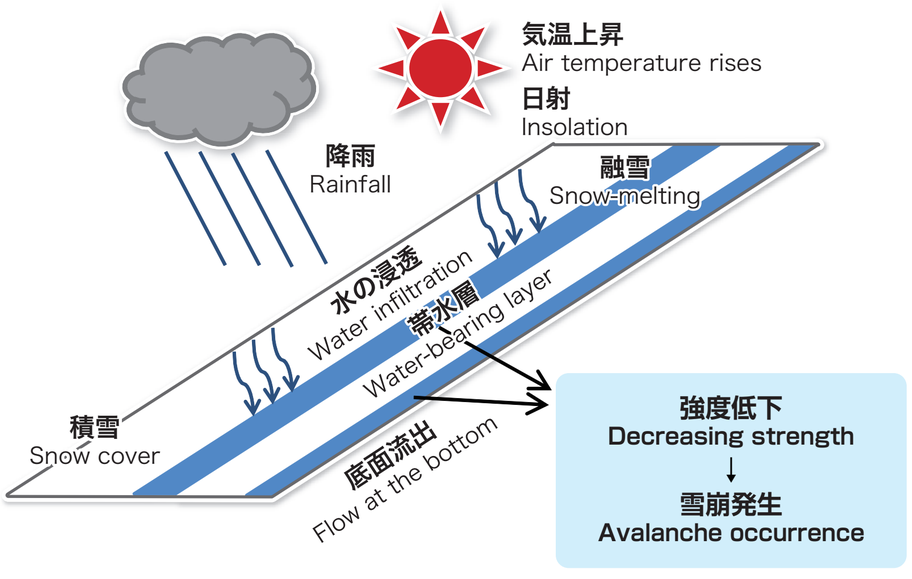
湿雪雪崩発生の気象条件に関する調査

Survey on Weather Conditions That Lead to Wet-snow Avalanches

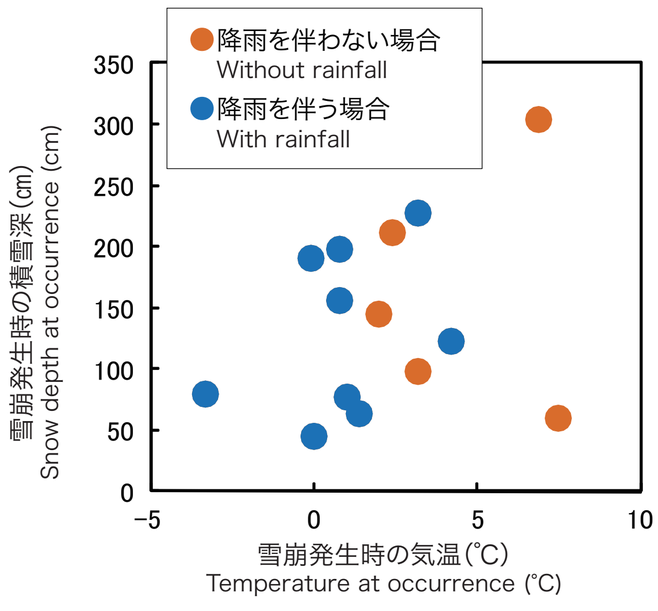
湿雪雪崩の発生に関わる気象条件を明らかにするために、気温上昇や日射、降雨等に着目した過去の雪崩事例の解析や現地観測を行います。

これまでの事例解析では、降雨を伴う湿雪雪崩は、気温の低い状況や積算気温が小さい場合でも発生する可能性があることなどが明らかになりました。

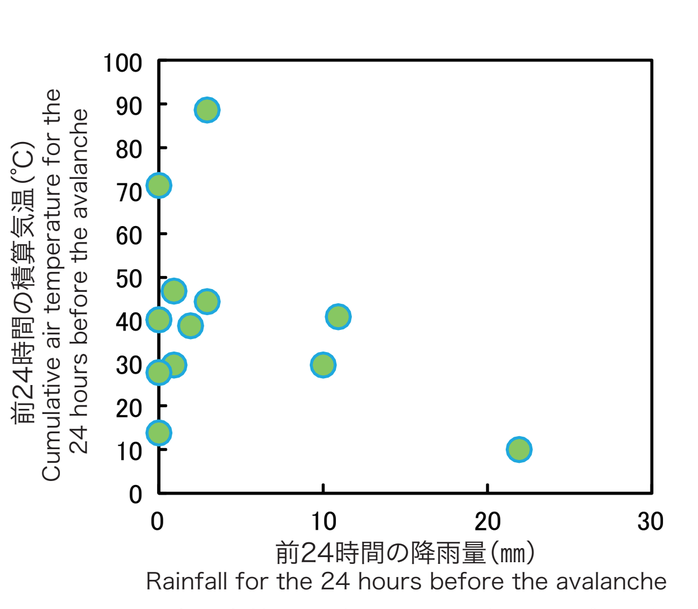
To clarify the weather conditions that lead to wet-snow avalanches, analyses and field observations on avalanches that have involved warm temperatures, considerable insolation and rainfall have been conducted.
Our analyses clarified that wet-snow avalanches can be triggered by rainfall even at low air temperatures or when the cumulative air temperature is small.



▲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と気温の関係
Snow depth and air temperature at the occurrence of the wet-snow avalanche



▲雪崩発生前の24時間における降雨量と0℃以上の積算気温の関係
Rainfall and cumulative air temperature (> 0°C) for the 24 hours before the avalanche

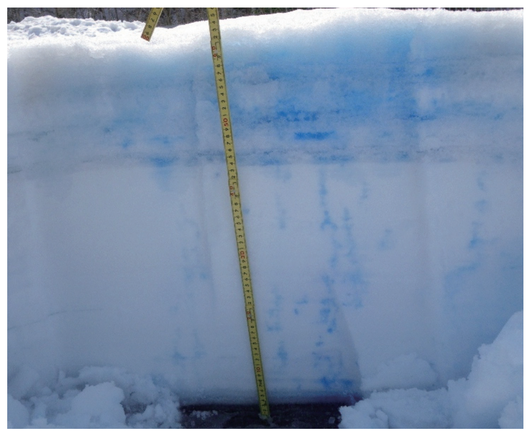
湿雪雪崩発生の積雪条件に関する調査

Survey on Snow Cover Conditions of Wet-snow Avalanches

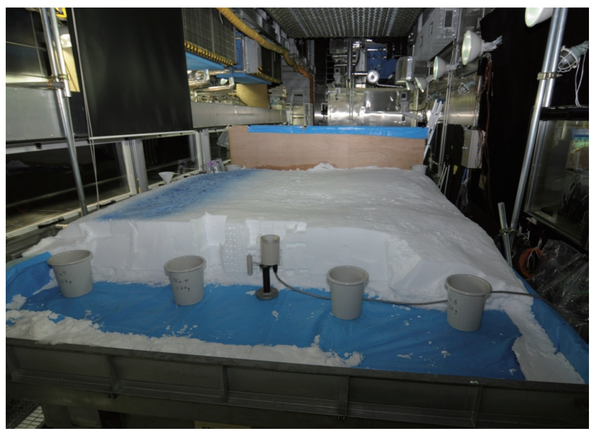
湿雪雪崩の発生に関わる積雪条件を明らかにするために、積雪中の帯水層の形成過程や含水率を変化させた場合の積雪の破壊強度特性に関する現地調査と実験を行います。

これまでの調査から、雪質による降雨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。

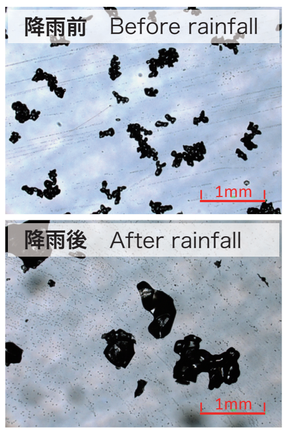
To clarify the snow cover conditions that promote wet-snow avalanches, field surveys and experiments were done on the formation of water bearing layers in snow cover and the failure strength characteristics of snow cover at different moisture contents.
The surveys clarified the relationship between the snow quality and rainfall infiltration, and between the snow cover hardness and the moisture content.



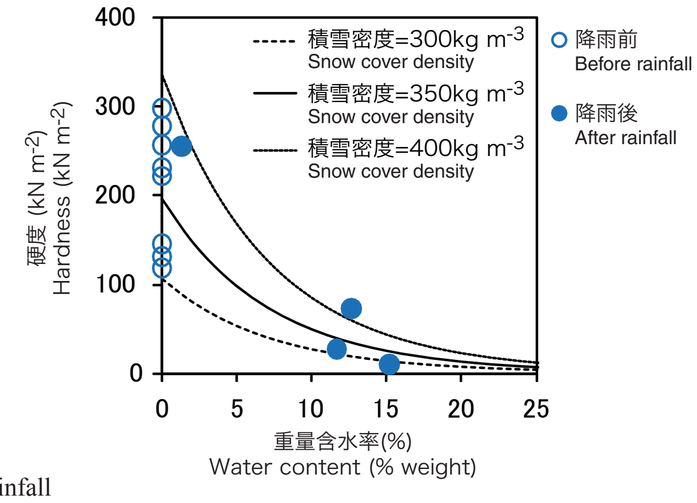
▲積雪への降雨の浸透状況の例
Example showing rain infiltration into the snow cover



▲低温室での実験状況
Experiment in a low-temperature laboratory



▲降雨前と後の雪粒子の状況
Snow particles before and after rainfall



▲積雪硬度と含水率の関係
Snow hardness and water content

上記の調査結果に基づいて、気象データの活用による帯水層を再現可能な積雪モデルを開発し、レーダー降水量データを用いた湿雪雪崩の危険度評価技術について検討します。

Based on our survey results, we will use meteorological data to develop a snow cover model for simulating water bearing layers and we will continue our examination toward developing danger rating method that uses radar rainfall data.