

# 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

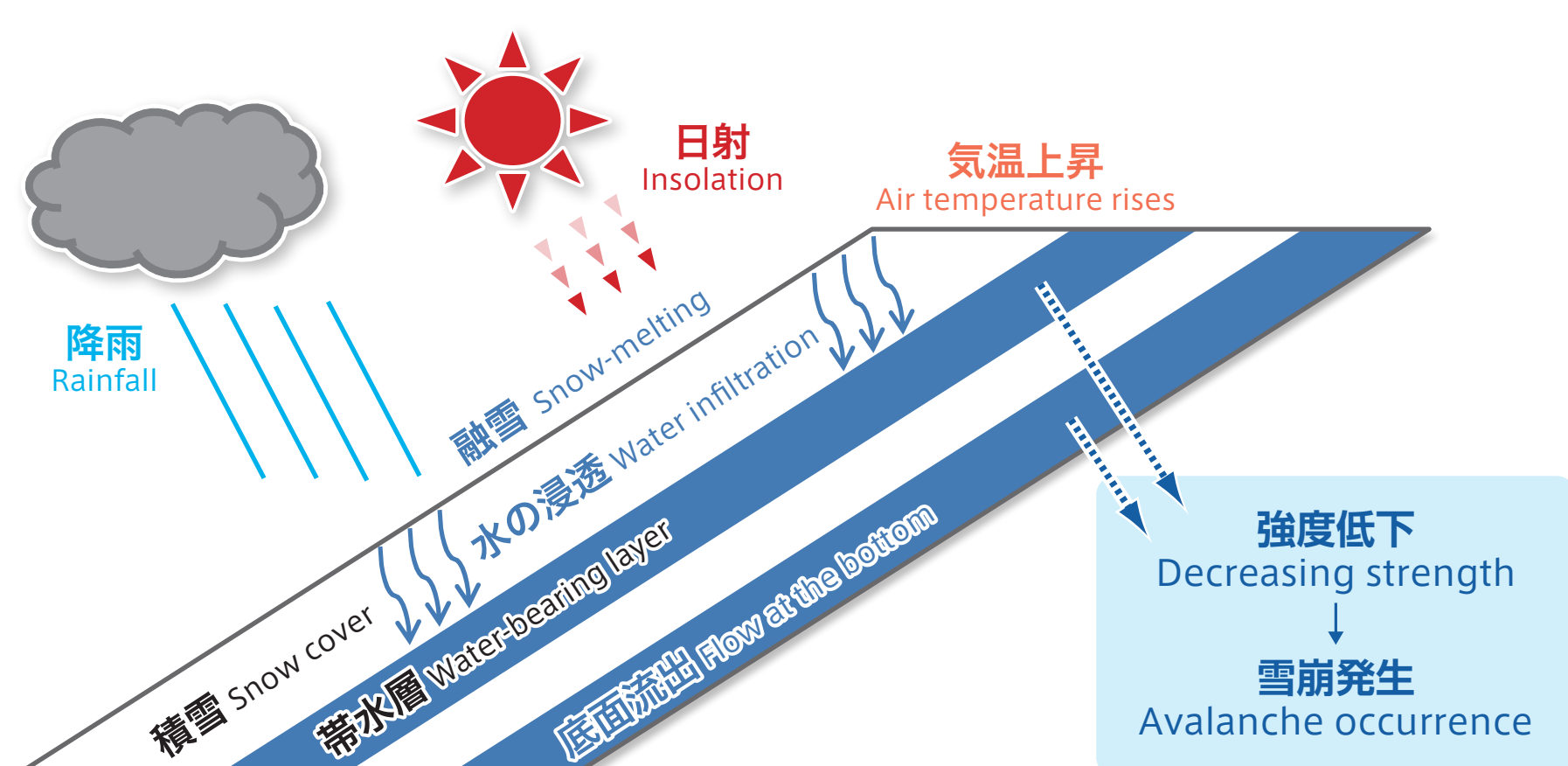
In recent years, there have been increasing numbers of reports on elevated air temperatures and rain in winter. Snow characteristics, including water content, in cold, snowy regions have changed with recent climate changes, and concerns have arisen over the increasing frequency of wet-snow avalanche 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。



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

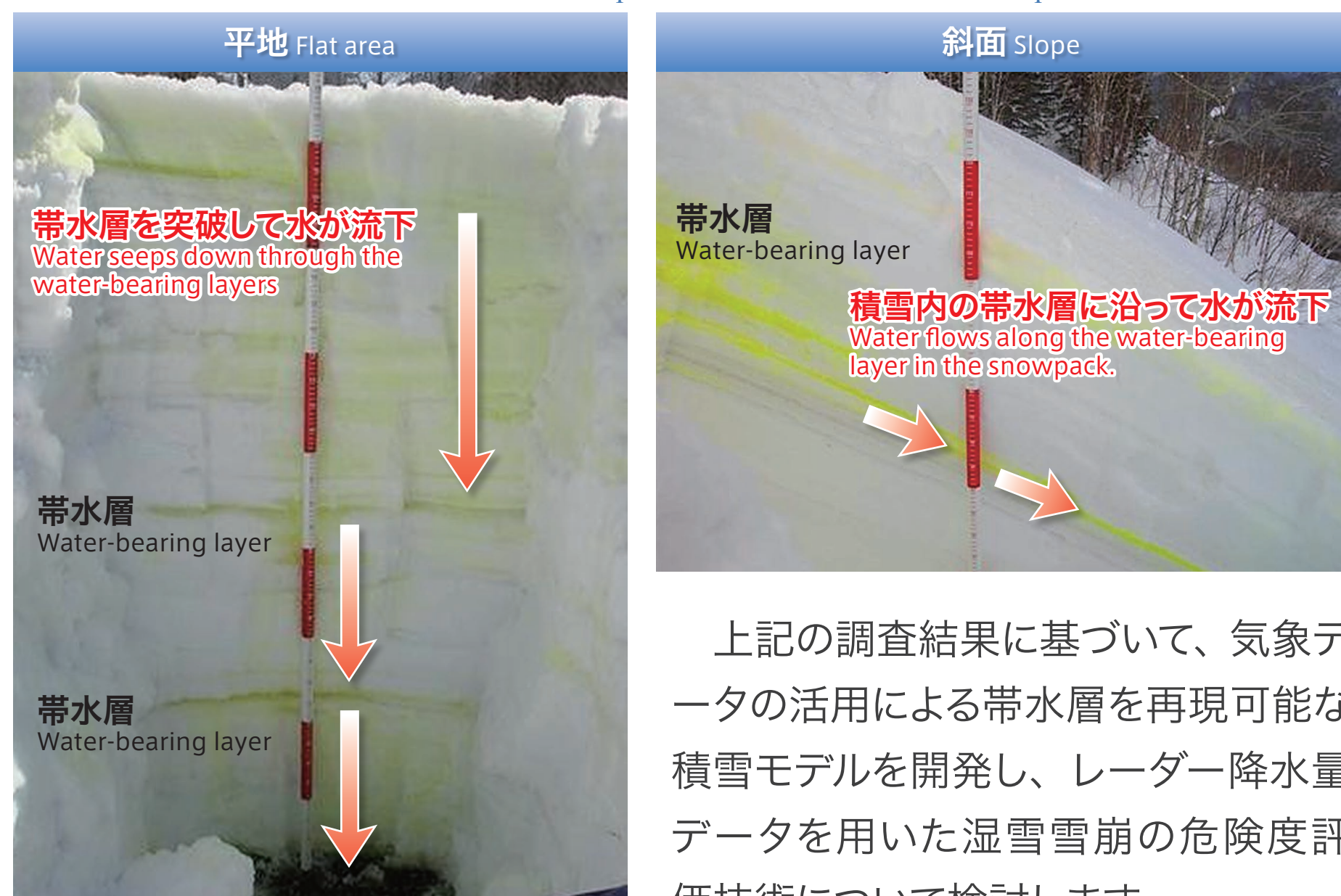
## 湿雪雪崩発生積雪条件に関する調査

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。

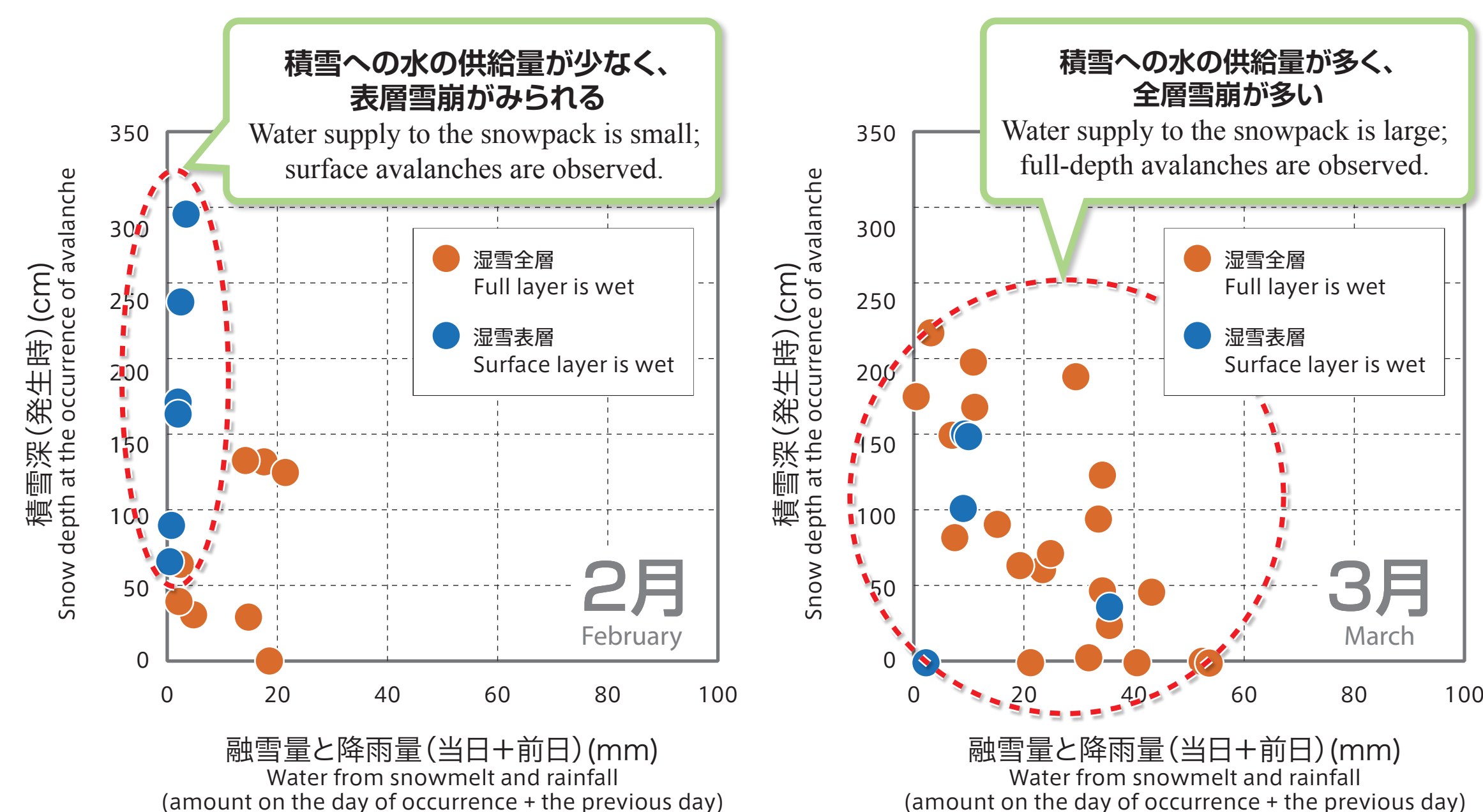
これまでの調査から、平地と斜面における雪質と水の浸透状況の違いや、含水率と積雪硬度の変化状況などが分かりました。

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



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。

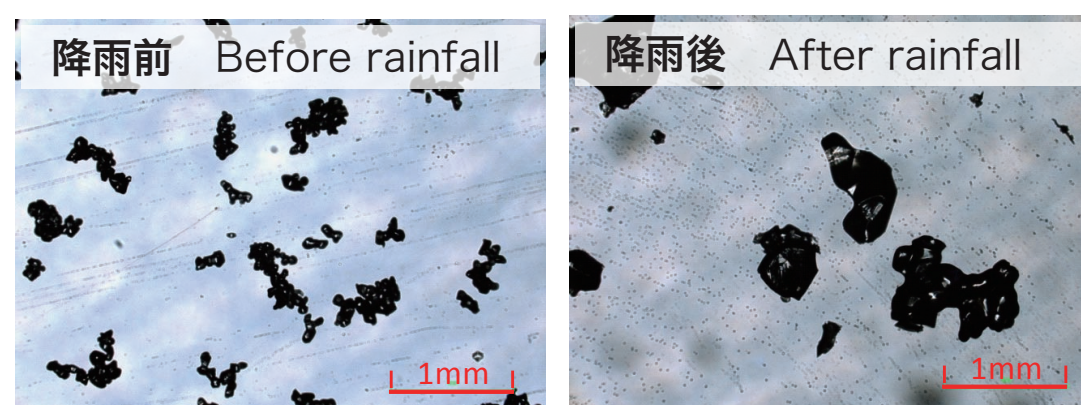
To clarify the weather conditions that lead to wet-snow avalanches, analyses and field observations on avalanches that have involved warm temperatures, considerable insolation and rainfall have been conducted. Analyses of the past cases have revealed that the occurrence conditions for wet snow avalanches 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

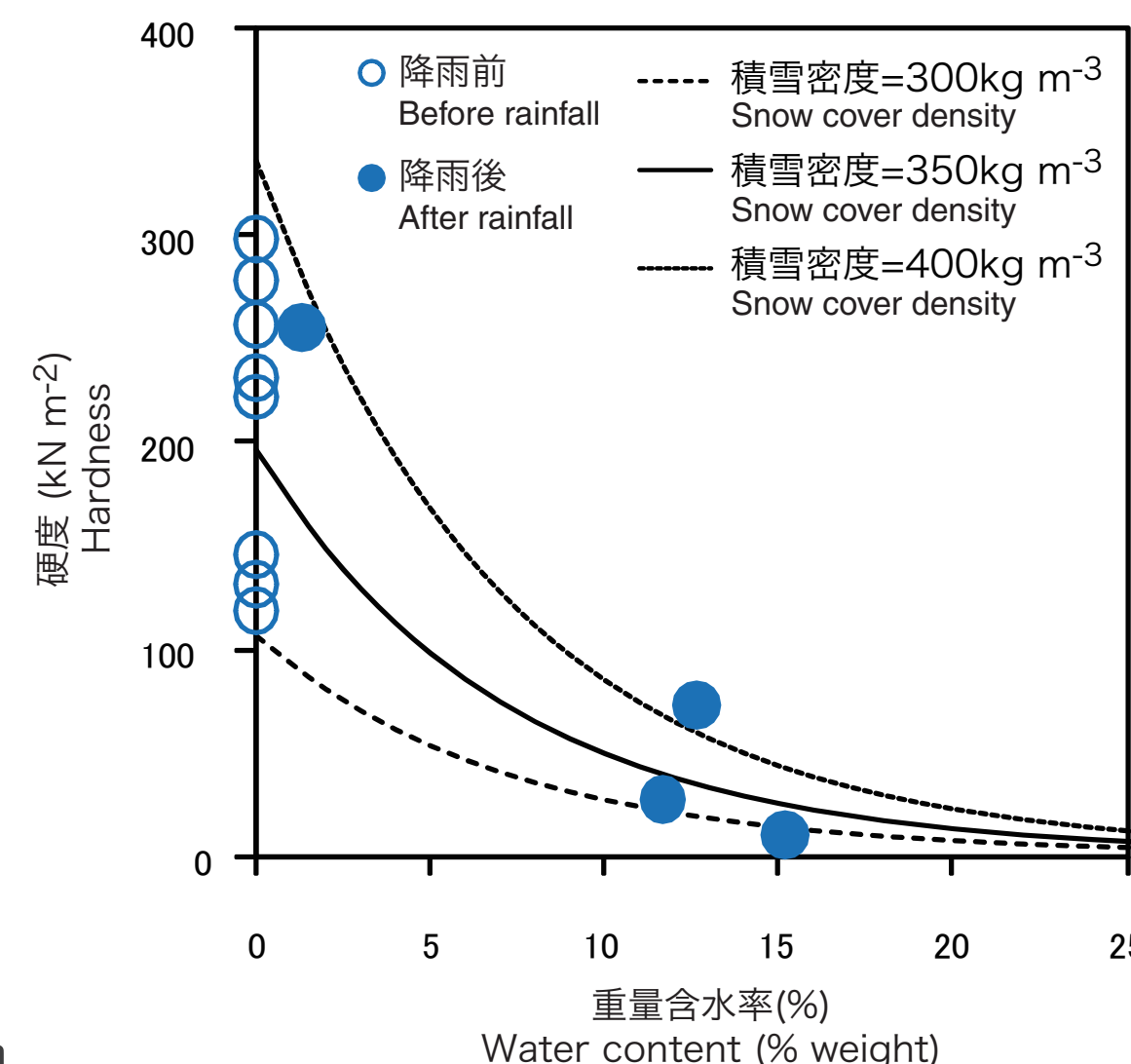
To clarify the snow cover conditions that promote wet-snow avalanches, field surveys and experiments were done on the formation of water bearing layers in snow cover and the failure strength characteristics of snow cover at different moisture contents.

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.



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

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 a danger rating method that uses radar rainfall data.



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