Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)


ACG35-P04 会場:コンベンションホール 時間:5 月 22 日 18:15-19:30

# 空中写真判読による中部山岳における越年性雪渓の分布特性
# Perennial snow patch distribution in Japanese Alps Region by aerial photograph interpretation

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Variations in glaciers are visible indicators of climate change, especially in mountain region. In Japan, snow patch can be an alternate indicator since glaciers, long years, were not recognized in the Japanese Alps. One characteristic of the Japanese Alps is their extensive distribution of perennial snow patch. A snow patch inventory for this mountain is urgently required, not only for monitoring snow patch variations but also to evaluate water reservoir in the region. Limited number of studies has attempted to complete snow patch atlas in Japan. As a step in this direction, the authors have produced a snow patch inventory of 1976/77. This study addresses the results of snow patch mapping. The status of snow patch distribution may indicate snowfall character in winter and also future possibilities of snow patch change.

The work of compiling a perennial snow patch inventory for the Japanese Alps initially involved preparing a detailed map using aerial photographs. First, vertical aerial photographs at scales of about 1:16 000 were interpreted for the entire study area using a stereoscope. The photographs were taken by the Geographical Survey of Japan in fall seasons of 1966 and 1967. In addition, aerial photographs taken by the Forest Agency of Japan in 2009/2010 and 1968/1969 were applied. Then the compilation of these perennial snow patch maps may identify snow patch variations during the past 43 years. The planimetric outline of each perennial snow patch of fall was carefully delimited and drawn on 1:25 000 scale topographical maps. Interpretation of stereopairs of aerial photographs was employed to determine the exact three-dimensional position of snow patch with reference to the surrounding topography. Moreover, stereo interpretation was used to discriminate snow patch from other associated assemblages around a snow patch could be misconstrued to be snow patch forms. Debris flow, landslide portion, and gully erosion can be clearly clarified, while an orthoimagery cannot discriminate them from small-sized snow patch. Once satellite images were applied for the compilation of inventories, the spatial resolution of the imagery limited the accuracy of mapping. However, when stereopair of aerial photographs are used, mapping resolution depend not on the scale of the aerial photographs but on the scale of the base map. This study used 1: 25 000 scale topographical maps. 1 mm at this scale corresponds 25 m of actual distance on the ground; hence this is regard as the limit of resolution for the snow patch map produced by this study.

Snow patch maps from around the study area illustrate successful aerial photograph interpretation in the Northern Japanese Alps and Mt. Norikura. Even very tiny snow masses, smaller than 0.005 ha, were identified. Then manual delineation from aerial photograph interpretation is reliable method of producing complete, accurate perennial snow patch maps. The inventory of 1976/77 thus compiled reveals 226 perennial snow patches with a total surface area of 244.41 ha (2.44 $km^2$). Major distribution concentrated in Mts. Tsurugi and Tateyama, whereas highest mountains, the Yari-hotaka Mountains, the southern part of the Northern Japanese Alps have quite limited number of snow patches. In addition, almost of all snow patches distribute the eastern flank of the mountains, in contrast, rare snow patches at the western flank of the mountains. The biggest snow patch appeared at Tsurugi-sawa valley with the area of 14.94 ha and length of 1410 m. Basically Mt. Tsurugi has 62 perennial snow patches with the total surface area of 90.69 ha. Distribution changes of these perennial snow patches during the past 34 years are not so remarkable. However minor change in the size and distribution are significant.

キーワード: 雪渓, 中部山岳, 空中写真
Keywords: Snow patch, Japanese Alps Region, aerial photograph