Investigation on the water stress in alpine vegetation using Hyperspectral Sensors

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Fig. 1. Expansion of *Sasa kurilensis* into alpine meadow in DNP (photo by G. Kudo)

The effect of global warming may be seen even on the top of the Mt. Daisetsuzan National Park (DNP) in Japan's northernmost island of Hokkaido where communities of alpine plants having been greatly suffered from the expansion of alien species. During period of last 30 years, several herbaceous species in alpine meadow were largely replaced by dwarf bamboo (*Sasa kuriliensis*) in the central part of DNP (see Fig. 1). Alpine of the Mt. Daisetsu is in protected zone of the Daisetsuzan national park and has no direct human influence. So far, this happening might indicate the negative effects of global scale climate changes in high mountainous area. Seriousness of that phenomenon is that it is completely changing the local vegetation. Due to the global

warming, increased temperature causes rapid melting of the snow coverage at DNP and soil is quickly losing its moisture.

In this study, alpine meadow vegetation in DNP was photographed with aid of the hyper-spectral sensors mounted on the airplane. Simultaneously, ground observations were also made. Hyper spectral sensors are having 60 bands with wavelength from 400 to 1000 nm, and resolution of 10 nm. Ground observations were made using the Field Spec devices for spectral measurement, GPS for mapping. Plant species, coverage, and soil moisture were investigated.

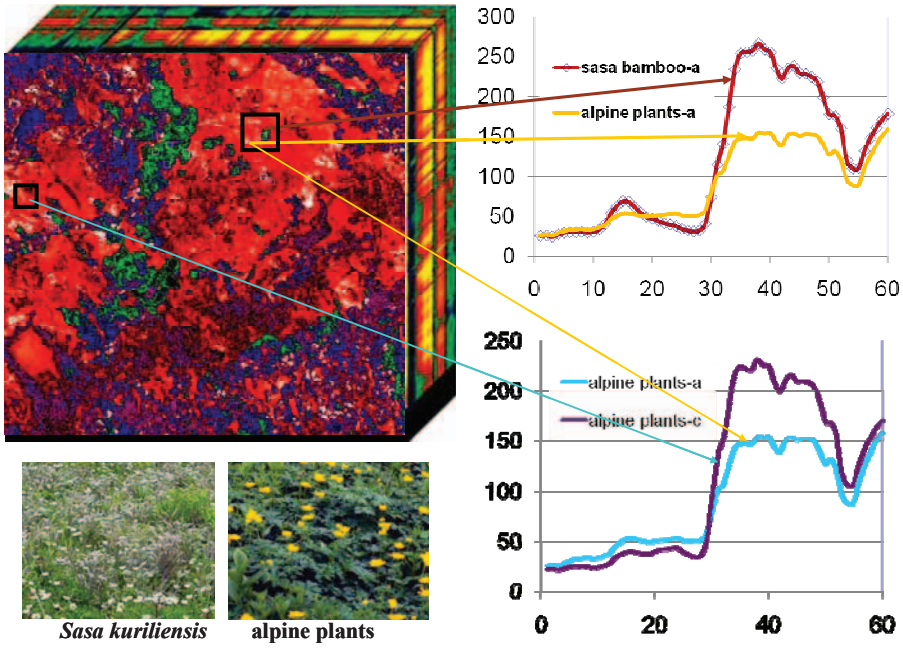

Fig. 2. Hyperspectral sensor reflectance of alpine plants and *Sasa kurilensis*

Obtained data were analyzed separately for alpine plants, *S. kurilensis* and alpine dwarf pine (*Pinus pumila*); selection of optimal hyperspectral bands was based on the model of mutual entropy methods; MNF (minimum noise factor), PCA (principal component analysis) and Alpine Plants Water Stress Indices (APWST) were calculated.

Our results show that the *S. kurilensis* expansion into alpine vegetation has two different routes, one is continuous spreading from existed focuses in sub-alpine biotopes and another is mosaic dispersal. Estimated speed of the *S. kurilensis* expansion was 10 to 15 meters in 30 years period. The zones of the *S. kurilensis* expansion are characterized by soil dryness and water stress syndrome was observed in aboriginal plant species. Moreover, laboratory experiments show that when water stress occurs in alpine plants the ability to absorb a visible red light spectrum is declined, as well as ability to reflect near-infrared light.