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Alpine vegetation monitoring using digital photography in the Kisokomagatake, central Japan

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The arctic and alpine floras are regarded as highly sensitive to the impacts of climate change. The climate changes will become increasingly pronounced over the next one hundred year. Therefore, we should accelerate our effort to assess and monitor trends in conditions of alpine vegetation to obtain early-warning signals of environmental change. However, most alpine regions are poorly monitored in Japan due to the harsh climate and difficult access.

We started the vegetation investigation at Mt. Koma and Mt. Sannosawa in central Japan. We also developed an automated green vegetation cover extraction methods using digital photography to simplify and accurately quantify the investigation. This study reported vegetation changes between 2008 and 2011.

We set 4 permanent quadrats of 1 m^2 at 14 sites on 6 regions and divided the each quadrat into 100 small grids (0.1 m^2). All vascular plant species were recorded each grids. Percentage of green vegetation cover was calculated using digital photography of each quadrats as follows. The classification of green vegetation and background was achieved by determining a threshold in one-dimensional colour space, which is based on transform values (G/(R + G + B)) from RGB image. Soil surface temperature (at depth of 0.5-1 cm) was automatically recorded with data loggers at 1-h intervals to determine the timing of snowmelt.

Species richness per quadrats slightly increased during three years. Total number of emerged species in 100 small grids significantly increased. Vegetation cover also significantly increased in some quadrats. These results seem to be primarily caused by the recent warming in the region. Unusually high summer temperatures, which were 1.5 degrees higher than usual, have recorded in 2010. Vegetation cover of shrub species, such as *Pinus pumila*, increased in some quadrats. Because species richness tended to decrease at the quadrats that shrub species were dominant, species composition would be changed if these trends continue.

The results of this study suggest that changes in the vegetation cover will precede detectable changes in number of species and composition. The vegetation cover can be obtained by digital photography, which is more effective, objective, and accurate than human conducted methods.

It should be considered that short-term studies are not enough to resolve the uncertainty of whether recorded signals are consistent trends towards serious changes in numbers of species and composition. We will continue the monitoring to reveal longer term vegetation changes.

Keywords: vegetation monitoring, alpine plant, species richness, plant cover, digital photography