令和4年度　環境科学院　修士論文内容の要旨

Tree species classification based on multi-source geospatial data and machine learning

(マルチソース地理空間データと機械学習に基づく樹種分類)

Hokkaido University, Graduate School of Environmental Science,

Division of Environment Science, Course in Global Environmental Management

Fu Jinjin

Acquiring reliable and accurate information on tree species is of great importance for effective forest management including protection of native species, timber harvesting, wildlife mapping and invasive species. In this study, the research area is a cool-temperate mixed forest, located in the Uryu Experimental Forest of Hokkaido University (N44° 21′ 21″, E142° 15′ 29″) in northern Hokkaido, Japan. In view of this, this study aimed at classifying and mapping tree species using Red-Green-Blue (RGB) images and multispectral images taken by an unmanned aerial vehicle (UAV) and machine learning such as Support Vector Machine (SVM), Random Forest (RF) and Classification And Regression Trees (CART) on Google Earth Engine (GEE) platform. For this purpose, the UAV data were acquired in May, July, October 2021 and April 2022. A combination of multi-seasonal UAV multispectral images was also applied to classify seven tree species, five from the broadleaved and two from the coniferous ones.

In this study, we calculated the Digital Surface Model (DSM) obtained by the UAV, and segmented the UAV images automatically using the Simple Non-Iterative Clustering (SNIC) algorithm combined with vegetation indices such as Normalized difference vegetation index (NDVI), Normalized difference red-edge index (NDRE), Green Chlorophyll Index (GCI) and Normalized difference Red-edge green index (NDEGE). And using the Gray-Level Co-occurrence Matrix (GLCM) to calculate cluster textural indices. Regarding the tree species classification, a comparison of classifiers was made based on the overall accuracy and kappa coefficient which were determined from the confusion matrix.

Results showed that the RF classifier produced the highest performance with an overall accuracy of 83.98% and a kappa coefficient of 0.80, respectively. All classifiers produced low values of accuracy for classifying Betula ermanii species. The combinations of DEM and vegetation indices of UAV multispectral multi-seasonal images improved the tree species classification by 8.7%. Overall, applying cost-effective UAV multispectral images acquired at different seasons improves the tree species classification in a cool-temperate forest and fusion of multispectral bands with vegetation indexes can improve machine learning-based classification accuracy if the vegetation indexes are properly selected. This study suggests to use the RF classifier in a mixed cool-temperate nature forest for classify tree species to extract tree species level information, and could support better decision making and planning for sustainable forest management.