B: Remote sensing and GIS
Estimation of Forest Biomass using Remotely-sensed Data and k-Nearest Neighbor Algorithm
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This study purposed to estimate the forest biomass using k-Nearest Neighbor (kNN) algorithm. Multiple data sources were used for the analysis such as 5th forest type map, field survey data and Landsat TM data. Forest biomass accuracy was evaluated with the forest stratification, horizontal reference area (HRA) and modal filtering. Forests were divided into 3 types such as conifers, Hardwoods and Pinus koraiensis. The applied radii of HRA were 3 km, 4 km, 5 km and 10 km, respectively. The estimated forest biomass of conifers forest was 255 ton/ha when the value of k was 9, the radius of HRA was 4 km, and 5 by 5 modal was filtered. The estimated biomass of Hardwoods was 210 ton/ha when the value of k was 6, the radius of HRA was 4 km, radius and 3 by 3 modal was filtered. The estimated forest biomass of Pinus koraiensis was 276 ton/ha when the value of k was 3, the radius of HRA was 11 km. The estimated total carbon stock by kNN method was 234 ton/ha. The estimated total biomass by kNN method was about 20 ton/ha less than that of filed survey data. This study was carried out with the support of ‘Forest Science & Technology Projects (Project No. S120911L010110)’ provided by Korea Forest Service.

Additional keywords: forest biomass, k-nearest neighbor algorithm, Landsat TM

Vegetation Map using Object-oriented Image Classification with Ensemble Learning
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Vegetation map is the basic information for forest management. In the remote sensing, creation of the accurate vegetation map is an important subject. Recently, the research using the object-oriented image classification technique or hyper spectral data have increased in the image classification by remote sensing data. Therefore, classifying image with the feature of multi-dimension is an important subject. In particular, in a linear model such as the maximum likelihood method in a pixel base classification, the pattern or relation of multi-dimension data are not characterized. In the classification of multi-dimension data, data mining and ensemble learning is effective. Ensemble learning is the method of raising accuracy and flexibility by combining two or more results. In this study, the object-oriented image classification using Random Forest (RF) advocated by Breiman was employed. Moreover, Nearest Neighbor (NN) method and Classification and Regression Tree (CART) were used as the candidate for comparison of classification accuracy. Our study area is Sado Island in Niigata Prefecture, Japan. SPOT/HRG imagery (June, 2007) was used for vegetation mapping. Our classification target was broad-leaved deciduous forest, coniferous forest, Japanese red pine, and bamboo forest. As the result, the accuracy of the vegetation map using RF and NN was high. Especially RF method was the most accurate within three techniques of image classification. We propose the effective classification technique in vegetation map creation using multi-dimensional data.

Additional keywords: image classification, random forest, Nearest Neighbor, CART, remote sensing

Development of Method to Estimate Understory Vegetation Coverage using Two Digital Cameras
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In Japan, conifer plantations were established for timber production after intensive clear-cutting of natural forests, particularly from the 1950s through the 1970s. However, these plantations have become overstocked during the past decades mainly due to lack of adequate management resulting from high labor costs and low wood value in the country. Presently, from the increasing interest in public benefit such as soil and water conservation brought by forest, the unsoundness of these overstocked forests poses a social problem with rapid increase of the belated thinning forest. Although thinning would open the canopy and lead to increased species diversity and understory vegetation coverage in these overstocked forest, the evaluation of the effects obtained by thinning have required significant time and labor. In this study, we therefore presented a method to estimate understory vegetation coverage using two digital cameras for investigating recovery of understory vegetation after the thinning of conifer plantation. For evaluating the accuracy of the method presented in this study, we established the 27 plots of 5 m × 5 m in size within the three hinoki cypress forests. We then compared the understory vegetation coverage directly measured in the field (UVCo: %) and that estimated using the method presented in this study (UVCe: %). The UVCo was significantly correlated with UVCo and the root mean square error of regression line of UVCo against UVCe was approximately 8%. Thus, the method presented in this study would be a useful method for measuring the understory vegetation coverage easily.

A Comparison of Stem Density Estimation Techniques using Very High Resolution Imagery
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For sustainable forest management, we need precise forest information from periodic and systematic measurements. Remote sensing could be a powerful tool for getting forest information for sustainable forest management. Several techniques for retrieving forest information from very high resolution imagery (VHRI) now exist. In this study, we compared stem density estimation techniques using VHRI. We used QuickBird imagery as VHRI. The study site consisted of even-aged plantations of Japanese cedar (Cryptomeria japonica) and hinoki cypress (Chamaecyparis obtusa). Two techniques using regression analysis and two techniques using individual tree counting were compared. RMSE was between 377 and 409, regression analysis methods being used. RMSE was between 450 and 1242, individual tree counting methods being used. RMSE of individual tree counting methods were strongly influenced by window size. Additionally, one reason suggested for individual tree counting error is the