Approach to hierarchical forest cover type classification with object-oriented method

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Abstract: In order to comprehend detailed forest resources, the use of high spatial resolution data is expected. However, the efficeint forest cover type classification method of high spatial resolution data is not cleared yet. So, this study discussed the potential of the forest cover type classification such as classification of coniferous forest, broadleaved forest, and mixed forest, and tree speices classification, from high spatial resolution IKONOS data (1-m resolution) using image analysis software, eCognition which has adopted the object-oriented hierarchical classification method. The study site is the Kirishima area over Miyazaki Prefecture and Kagoshima Prefecture, Japan. This site contains natural coniferous forest, natural broadleaved forest and artificial plantation forest and so on. The consistency about IKONOS data classified for every forest cover type using eCognition and stand description data was assessed using the Kappa coefficient. Moreover, medium spatial resolution LANDSAT/TM date (30-m resolution) was analyzed by the same process, we compared with results of IKONOS.

1. Introduction

The international approach turned to establishment of continuous forest management now is advanced. In order to comprehend forest resource and environmental conditions, each country takes in the technology of remote sensing, and use of high spatial resolution data is expected. However, the use of high-resolution data has a limit in the process of pixel-oriented classification mainly adopted to medium spatial resolution data (Blaschke and Strobl, 2002; Hofmann, 2001; Limp, 2002; De Jong et al., 2000). Then, as the new image classification approach, the method of object-oriented classification which thought as important the spatial-relations of the pixels which compose an image attracts attention. Since it has the classificatory function which gave the hierarchical structure that image analysis software, eCognition (Definiens Imaging, Germany) which has adopted this classification method in this object-oriented classified a forest and the classified object into a coniferous forest and a broadleaved forest further after classifying into a forest and a non-forest first, it can be said that it is suitable for the detailed classification of a forest area (Ursula et al., 2004). However, the availability of the object-oriented classification is not cleared in many cases.

The objectives of this study were to discuss the potential of object-oriented classification the forest cover type, such as classification of a coniferous forest, a broadleaved forest, a mixed forest, and tree speices classification, from high spatial IKONOS sensor data (1-m resolution) using the advanced image analysis software, eCognition. Moreover, medium spatial resolution LANDSAT/TM sensor date (30-m resolution) which used with the monitoring activities until now was analyzed by the same process, we compared it with high spatial resolution sensor data.

2. Study Site and Data

The study site is the Kirishima area over Miyazaki Prefecture and Kagoshima Prefecture, Japan. This site contains *Abies firma* (Momi) and *Tsuga sieboldii* (Tsuga) natural forest, *Pinus densiflora* (Akamatsu) natural forest and *Japanese cedar* (Sugi) and *Japanese cypress* (Hinoki) artificial plantation and natural broadleaved forest and so on.

The satellite data is the IKONOS image observed on 25 October, 2001, and the LANDSAT/TM image observed on 4 January, 2001. A Digital Map 50-m grid, published by Geographical Survey Institute of Japan, was used for the digital elevation model (DEM). A Digital Map 25000 (map image), produced by Geographical Survey Institute, was used for geometric registration. The stand discription data in 1999, produced by forest district, was used as data for classification accuracy assement.

3. Method

Almost all analyses were executed on eCognition Version 4.0. First, the ratio of color and shape was configured as 0.9:0.1, 0.5:0.5, and the value of each scale parameter was also configured as 300, 500, and 700. In order to classify each forest cover type, the objects which made it generate from IKONOS data by this segmentation of eCognition were referred to the attribute data of the stand description, elements, such as an effective spectral radiance value and various statistics values, and the threshold value of those were clarified. The classification processing of each IKONOS data was performed using these results. Thus, the consistency about IKONOS data classified for every forest cover types and stand description data was assessed using the Kappa coefficient. And, the potential of each classification was examined from these results about items, such as tree species, classification of an artificial plantation and a natural stand, a rate of a mixture, and so on. Moreover, medium spatial resolution LANDSAT/TM sensor date (30-m resolution) which used with the monitoring activities until now was analyzed by the same process, we compared with high spatial resolution sensor data.

The standard of forest cover type classification used this study was shown in Fig1.

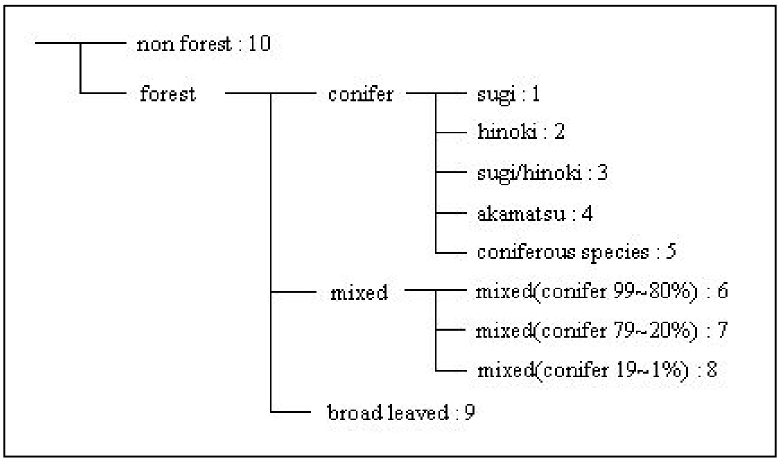

Fig. 1. Hierarchcal forest type (the following numbers use for each forest type)

4. Results and Discussion

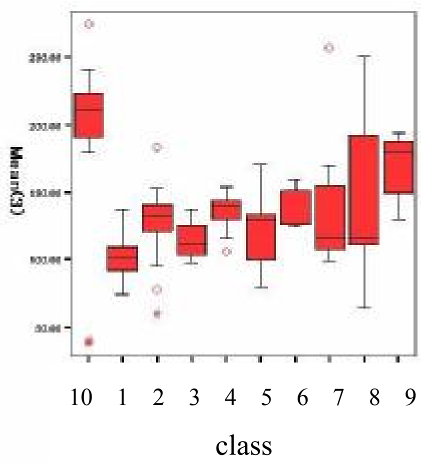

Fig. 2. Mean value (Band3) of each class

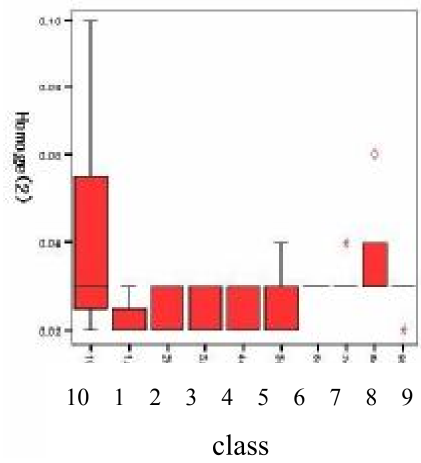

Fig. 3. Homogeneity value (Band2) of each class

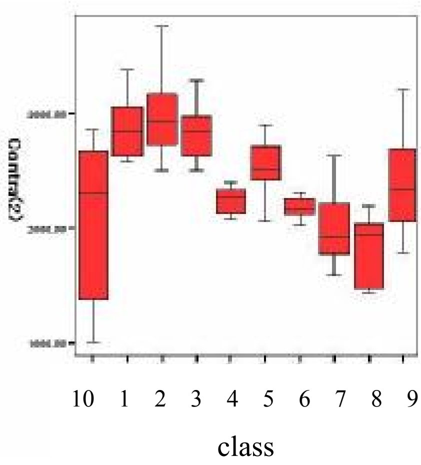

Fig. 4. Contrast value (Band2) of each class

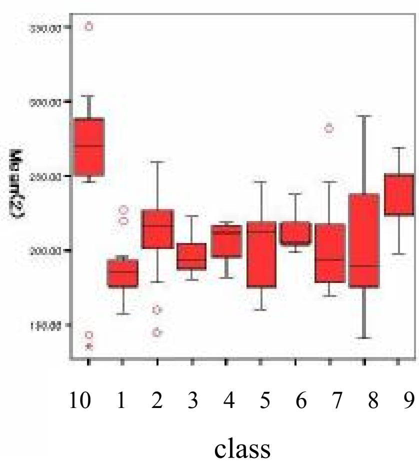

Fig. 5. Mean value (Band2) of each class

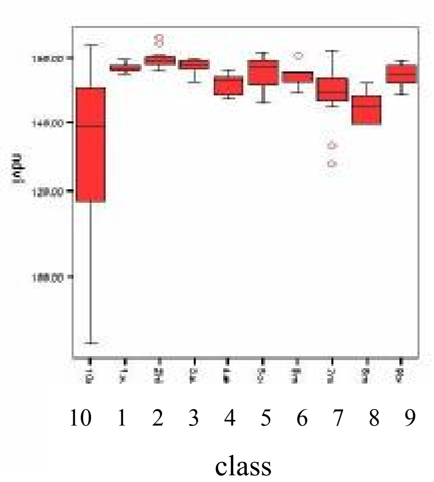

Fig. 6. NDVI value of each class

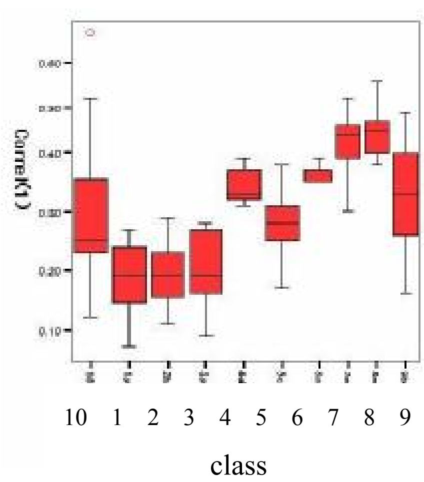

Fig. 7. Correlation value (Band1) of each class

Figure 2 shows that the efficient feature is mean (band3) of spectral radiance value for classification of forest and non forest. Figure 3 shows that the efficient feature is GLCM Homogeneity value for classification of coniferous forest and broadleaved forest. Figure 4, 5, 6, 7 show that the efficient features are GLCM contrast value (Band2), mean value (Band2), GLCM correlation value (Band1) for classification of coniferous forest. These features were used in detailed classification. Classification accuracy improves with the combination of not only one feature but also many features.

The lower resolution data is not fit for a detailed class classification. The satellite of the resolution corresponding to the purpose of the use is used, and it can be said that it is required to set up scale prameter corresponding to the purpose of use.

As a future task, how to take a sample object, and the discuss about the difference of the classification accuracy by the difference in a season, improvement in the classification accuracy by the further combination of feature, etc. are mentioned.

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