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CLASSIFICATION OF MULTITEMPORAL ALOS PALSAR DATA

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ABSTRACT: The aim of this study is to demonstrate the validation of the original and ancillary derived polarization components of multitemporal polarimetric synthetic aperture radar (POLSAR) data for land cover mapping using supervised and unsupervised methods. For this purpose, the original and ancillary derived polarization components of the ALOS PALSAR data are used and the results are compared. As the methods for the land cover discrimination, the statistical maximum likelihood decision rule and isodata clustering are selected. Overall, the research indicated that the original and ancillary derived ALOS PALSAR polarization components can be successfully used for separation of different land cover types.

1. INTRODUCTION

In order to conduct thorough analyses using any RS data sets, one should use a sophisticated interpretation method or apply a well-known and reliable mapping technique. In recent years, polarimetric synthetic aperture radar (POLSAR) data sets have been successfully used for different environmental and socio-economic studies. Unlike the traditional single frequency and single polarisation SAR, the POLSAR has a number of advantages, because some objects which are not seen in one polarization can be seen in another polarization, thus improving the interpretation and analysis of the images.

In general, one of the principle aims of RS image analyses is to extract reliable thematic information and creation of a high quality thematic map. Thematic information can be extracted in different ways, including manual, automatic and knowledge-based approaches (Amarsaikhan and Sato, 2003). However, in most cases, users of spatial information like to apply sophisticated and easy to use automatic method for a land cover mapping. One of such methods known to RS community could be a statistical maximum likelihood classification (MLC). Another such a method could be an isodata clustering method [5,6].

In the present study, we wanted to demonstrate the classification of the original and ancillary derived polarization components of multitemporal polarimetric ALOS PALSAR data for urban land cover mapping using supervised and unsupervised methods. As a test site, central and western parts of Ulaanbaatar, the capital city of Mongolia have been selected. As data sources, polarimetric ALOS PALSAR L-band data sets acquired on 25 May and 25 August 2006 have been used.

2. STUDY AREA AND DATA SOURCES

As a test site, central and western parts of Ulaanbaatar city have been selected. The area is situated in between forest-steppe and steppe zones and is characterized by such classes as building area (1), ger area (2), forest (3), grassland (4), soil (5) and water (6).

The used fully polarimetric ALOS PALSAR data sets were acquired on May 25 and 25 August 2006 and were resampled to a pixel resolution of 18m. The images used in the present study are shown in Figure 1**.**

a) b)

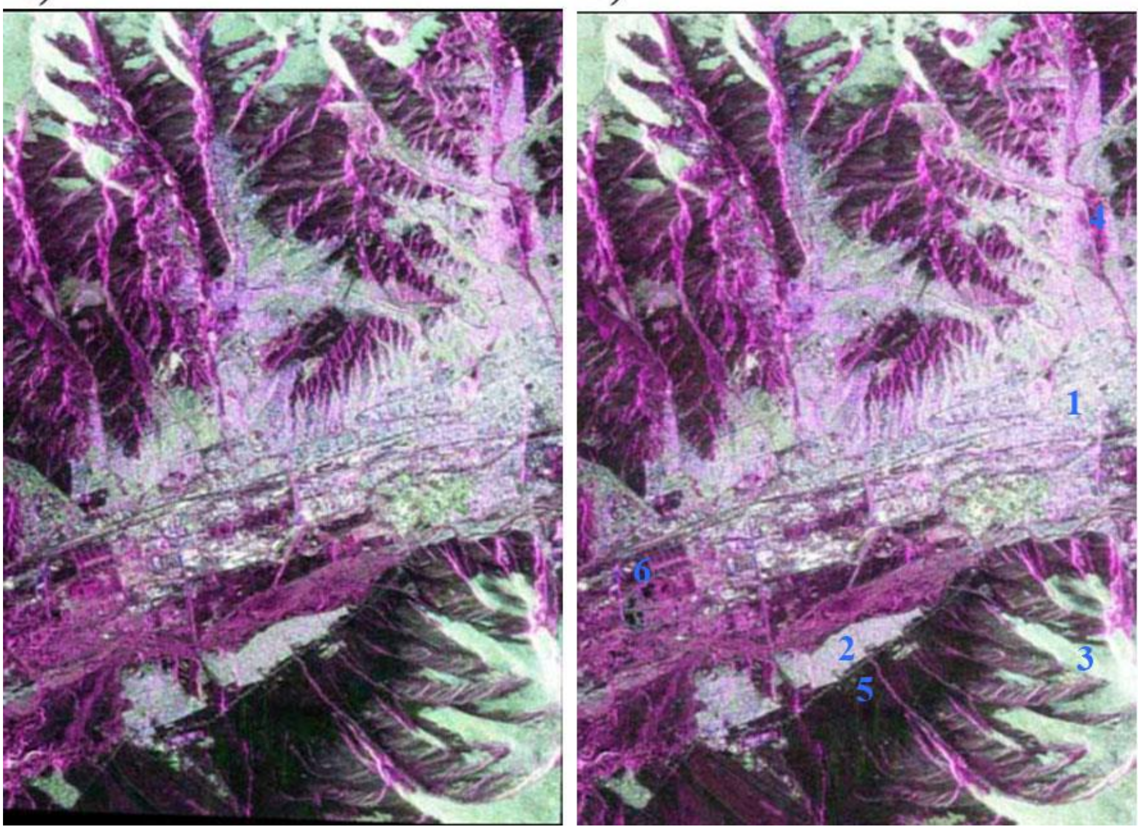

Figure 1. The polarimetric ALOS PALSAR images of Ulaanbaatar city.
a) ALOS PALSAR image of May 25 2006, b) ALOS PALSAR image of 25 August 2006, (Red=HH, Green=HV, Blue=VV).

3. DERIVATION OF THE POLARIZATION FEATURES

For the extraction of different features from the ALOS PALSAR images, the below techniques have been applied.

3.1. Derivation of the texture features

To derive texture features, occurrence and co-occurrence measures were applied to the polarimetric intensity images of the multitemporal ALOS PALSAR data sets. The occurrence measures use the number of occurrences of each grey level within the processing window for the texture calculations, while the co-occurrence measures use a grey-tone spatial dependence matrix to calculate texture values. By applying these measures, initially 38 features have been obtained, but after thorough checking of each individual feature only 12 features were selected. Detailed descriptions of the occurrence and co-occurrence measures as well as the texture filters are given in [4].

3.2. Principal components (PC) images

To reduce the dimensionality of the dataset, the principal component analysis (PCA) has been performed to the original and extracted POLSAR features. For the PCA, 18 features, including the original polarization components of the multitemporal ALOS PALSAR images, and 12 texture features were used. The PCA has shown that the first 3PCs contained 98.4% (PC1=97.2%, PC2=0.91%, PC3=0.29%) of the total variance. Therefore, the first 3PCs have been selected for further analysis and the remaining PCs were rejected.

4. LAND COVER CLASSIFICATION

In general, before applying a classification decision rule, the speckle noise of the SAR images should be reduced. The reduction of the speckle increases the spatial homogeneity of the classes which in turn improves the classification accuracy. In the present study, to reduce the speckle of the selected features a 5x5 size gammamap filter has been applied [4].

Initially, from the features, 2-3 areas of interest (AOI) representing the selected six classes have been selected using a polygon-based approach. Then, training samples were selected on the basis of these AOIs. The separability of the training signatures was firstly checked on the feature space images and then evaluated using transformed divergence [8]. Then, the samples which demonstrated the greatest separability were chosen to form the final signatures. For the classification, the following feature combinations have been used:

1. The original ALOS PALSAR polarization components of May image,
2. The original ALOS PALSAR polarization components of August image,
3. 12 features,
4. The first 3PCs.

Table 1. The overall classification accuracies of the classified features.

Feature combinations	Overall accuracy of MLC (%)	Overall accuracy of Isodata (%)
ALOS PALSAR polarization components of May image	78.56	74.28
ALOS PALSAR polarization components of August image	79.12	72.47

12 features	79.09	74.16
The first 3PCs	76.84	70.91

For each of these feature combinations, supervised and unsupervised classifications have been applied. As a supervised classification the statistical MLC, whereas as an unsupervised classification the isodata clustering method have been used. For the accuracy assessment of the final classification results, the overall performance has been used. This approach creates a confusion matrix in which the reference pixels are compared with the classes in the classified image and as a result, an accuracy report is generated indicating the percentages of the correspondence (ERDAS, 1999).

As ground truth information, for each class 3-4 regions containing the purest pixels have been selected. In all cases, the performance of the MLC was better than the performance of the isodata method. The overall classification accuracies of the selected classes in the selected features are shown in table 1. As seen from table 1, the performances of the classifications using the original and ancillary products differ in each case.

5. CONCLUSIONS

The overall idea of the study was to demonstrate the validation of the original and ancillary derived polarization components of multitemporal POLSAR data for land cover mapping using standard classification methods. For this aim, the original and ancillary derived polarization components of the polarimetric L-band ALOS PALSAR data were used and as methods for the classification, the statistical maximum likelihood decision rule and isodata clustering were selected.

As seen from the results of the classifications, both original and ancillary derived ALOS PALSAR polarization components can be successfully used for separation of different land cover types.

REFERENCES

1. Amarsaikhan, D., Ganzorig, M. and Nieuwenhuis, W., 1994. A modification of the priori probabilities in the maximum likelihood classification. In: Proceedings of the 15th Asian Conference on RS, Bangalore, India, pp.I-7-1-I-7-4.

2. Amarsaikhan, D. and M.Sato., 2003. The role of high resolution satellite image for urban area mapping in Mongolia. In: “Reviewed Papers” part of CD-ROM Proceedings of the CUPUM’03 Conference, Sendai, May 2003.

3. Amarsaikhan, D. and Sato, M., 2004. Validation of the Pi-SAR data for land cover mapping. Journal of the Remote Sensing Society of Japan, No.2, Vol.24, 133-139.

4. Amarsaikhan, D., 2006. Classification of Multitemporal InSAR Data for Land Cover Mapping in Selenga River Basin, Mongolia. In: Proceedings of 2nd International Conference on Land cover /Land use study using RS and GIS, pp.65-68.

5. ERDAS. 1999. Field guide. Fifth Edition, ERDAS, Inc. Atlanta, Georgia.

6. Manual of Remote Sensing. 1999. 3d edition, Volume 3, American Society of Photogrammetry.

7. Richards, J.A. 1999. Remote Sensing Digital Image Analysis-An Introduction, 2nd edition (Berlin: Springer-Verlag).