LAND COVER CLASSIFICATION AND ANALYSIS USING RADAR AND LANDSAT DATA IN NORTH CENTRAL ETHIOPIA

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ABSTRACT

Radar and Landsat data were used to classify land cover in north central Ethiopia. Both images were registered and resampled to 12.5 m spatial resolution. Maximum Likelihood Classifier (MLC) and C4.5 algorithm were applied. The original radar data produced low overall classification accuracy (66%). To improve this classification accuracy, de-speckling and texture measures were used for image enhancements. The de-speckling methods used in this study are Median, Lee-Sigma and Gamma-MAP. Lee-sigma, Gamma-MAP and Median de-speckling improved the overall accuracy by 15, 18 and 20% respectively. The maximum overall accuracy achieved in this study by de-speckling method is 86.4% using Median at 27*27. Urban producer accuracy improved by 58% by using Median de-speckling. All de-speckling techniques improved urban user accuracy to more than 90%. In most de-speckling cases, MLC outperformed C4.5 classifier in the overall classification accuracy.
The highest overall accuracies achieved by texture are 88.8 and 90.5% when MLC and C4.5 algorithms at window size 51*51 were used respectively. This shows 22% improvement compared to the original radar data. Urban and forest producer accuracy improved by 58 and 26% respectively at window size 43*43. The overall classification accuracy of Landsat data was 93.7%. Combining Landsat and derived radar data measures improved land cover accuracy by about 5%. This study showed the importance of texture and de-speckling techniques to improve a land cover classification in radar data. Therefore, radar data can be used as an alternative to optical data in the tropics and Ethiopia for land cover classification.

METHODOLOGY

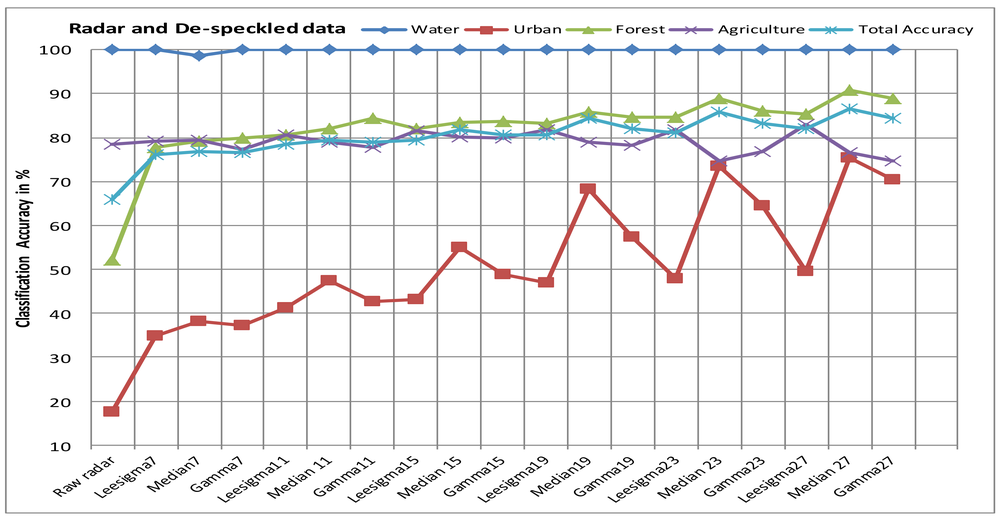
This study examines land cover classification and analysis using radar and Landsat data. De-speckling and texture measures using different window sizes were applied to the original radar data. The de-speckling techniques used in this study are Median, Lee-Sigma and Gamma-MAP. ERDAS IMAGINE was used for image registration, enhancement, classification, and accuracy assessments. Maximum likelihood classifier and C4.5 decision tree techniques were used to classify both Landsat and radar data. WEKA, open source software, was used to apply a decision tree for the classification. Digital Numbers (DN) of raster images used for C4.5 classification were converted from Pixels to ASCII for decision tree classification. Image to image registration and resampling were used for both Landsat and radar data to Universal Transvers Mercator (UTM). The resampled cell size of all the images is 12.5 m spatial resolution.

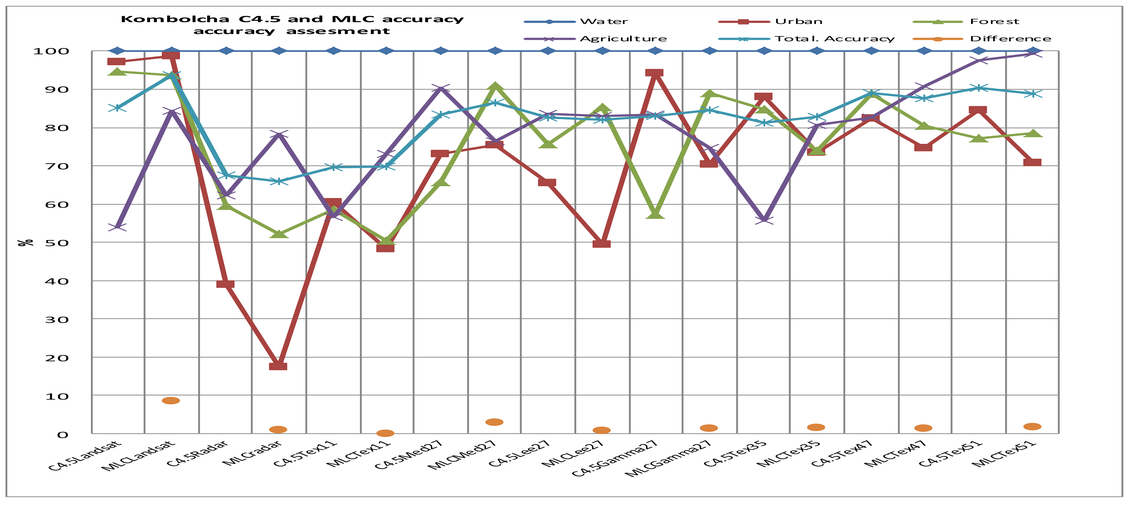
STUDY AREA AND DATA SOURCES

The study area is located in north-central Ethiopia. This research site includes Kombolcha, and Hayk cities in Amhara state. Kombolcha has an estimated total population of 68,766 (CSA, 2005) and it has a latitude and longitude of 11° 4'N and 39 ° 44'E. This city is located 363 km north of Addis Ababa. The data sources are Thematic Mapper (TM) Landsat data from USGS and PALSAR from Advanced Land observation satellite (ALOS). The spatial resolutions of Landsat and radar data are 30 and 12.5 m respectively. PALSAR radar data used in this study area has HH and HV bands. All Landsat data bands except band 6 were included in this research study.

CLASSIFICATION RESULTS

Maximum Likelihood classifier (MLC) and C4.5 Algorithms were used to classify land cover. These classifiers were applied to the original radar and Landsat data. De-speckling and texture measures techniques were applied to the radar data, and these algorithms were used to classify land cover units.





CONCLUSION

The best classification accuracy achieved using de-speckling techniques was when median was applied at window size 27. At this window size, all de-speckling methods used in this study produced more than 81% overall classification accuracy. For urban and forest producer accuracy, median de-speckling techniques gave the best classification accuracy. Agriculture producer accuracy is highest when Lee-sigma speckle suppression was applied. However, Gamma-Map gave the highest agriculture user accuracy. Overall, increasing window size beyond 27 decreased the overall and individual land cover accuracy in de-speckling filtering. Texture also produced very good land cover classification accuracy 88.8 and 90.5% when MLC and C4.5 classification algorithm were applied respectively. Texture measures produced good accuracy at larger window size as compared to de-speckling. Using a window size above 43 increased the confusion between urban and forest pixels. Data fusing has produced small overall land cover classification accuracy improvements compared to Landsat data alone. This study showed that classification results were dependent on the type of classification algorithm and image enhancement methods applied. Overall, radar data can be reliable source of data for land cover/use classification.