PhD Dissertation
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ABSTRACT

Developing reliable land use maps from satellite optical sensors for tropical areas like Ethiopia is a challenge due to frequent cloud cover. A possible alternative would be to use radar data, which is not affected by weather conditions. However, speckle is commonly observed in radar data and requires application of filtering techniques to make the data more useful. The radar data used in this study were fine beam dual polarization (FBD) and fully polarized (PLR) PALSAR data. In addition, Landsat Thematic Mapper (TM) was also used for land use classification comparison and change detection purposes. Speckle filtering, variance texture, and data fusing techniques were evaluated. The de-speckling techniques applied were Median, Lee-Sigma, and Gamma-MAP. Four classification approaches, of Maximum Likelihood (MLC), C4.5, Multilayer Perceptron (MLP), and a Stacking method, were also assessed.

This study showed that speckle filtering techniques improved land use classification accuracy between 18%, and 30% depending on study site. The highest classification accuracy improvements achieved by texture was 22%. Combining Landsat data with un-filtered radar data also produced a 3% improvement. The land cover change analysis showed that forest cover increased by more than 6% within 14 years. MLP classifier achieved the best overall classification accuracy followed by MLC and then C4.5. The Stacking method also improved the overall classification, indicating that it is a promising technique. Validation results indicated the importance of radar data as an alternative source of information for land use classification in the tropics. However, the performance of the classification algorithms and radar filtering varies from one study area to another. Therefore, the study recommends an application of different combinations of techniques in different research sites. Ethiopia, with its inadequately studied physical features, can greatly benefit from greater use of radar-based data analysis in its environmental studies. Further research is important to assess the applicability of radar data for forest fire detection and crop classification in tropics. Besides this, additional researches on post classification filtering, image enhancement, polarization, and data mining techniques may be useful to further improve the reliability of radar data for land use classification and analysis.