AN ASSESSMENT OF ALOS L-BAND POLARIMETRY FOR LAND-USE MONITORING IN MALAWI

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1. INTRODUCTION AND MOTIVATION

This paper addresses the potential use of the experimental quadpol PLR21.5 mode of ALOS-PALSAR for improved land-use mapping and forest biomass estimation for several test sites located in Malawi. This application links with a much wider program of carbon asset determination for the region. The potential for developing carbon finance projects from the avoided deforestation and conservation of forests in Malawi has been assessed using baseline figures from Mkuwazi Forest Reserve, and the Thazima region of Nyika National Park as examples [1]. The approach used is likely to be suitable for forest conservation projects in National Parks and Forest Reserves throughout Malawi that maintain natural forest cover. Data were collected in collaboration with the communities of Mkuwazi Forest Reserve and the Thazima Region of Nyika National Park, the Department of National Parks and Wildlife (DNPW), Department of Forestry (DF), and Forest Research Institute of Malawi (FRIM), and staff and students from Chancellor College, Malawi and The University of Edinburgh, UK. Satellite imagery, existing literature and land use maps, community consultations, and site visits were used to estimate the areas covered by different land use and land cover classes, estimate past trends in the rates of deforestation and identify the threats present in each of the project areas. Existing carbon stocks were then quantified for the Thazima Region of Nyika National Park and Mkuwazi Forest Reserve in the Nkhata Bay district of Malawi. Reference Carbon stocks were calculated using standard carbon inventory methods for each identified land use and land cover classes, including aboveground and below-ground woody biomass and deadwood.

The key agents and drivers of deforestation within Mkuwazi Forest Reserve and Nyika National Park, were identified by local communities, DNPW and DF staff. For both project areas key agents included local and distant communities and commercial interests in the forest reserve area. Weak enforcement, population pressure and government policies were identified important drivers of the quantity of deforestation, while key determinants of the areas most at risk of deforestation included proximity to settlements, paths and roads and existing and planned developments and markets. Both Nyika National Park and Mkuwazi Forest Reserve are under encroachment pressure from surrounding areas where suitable land for agriculture and charcoal production is becoming scarce. In both areas initial gazettement resulted in the displacement of communities, which has the potential to cause conflict with any future changes in government.

Estimation of the past trends in rates of deforestation across the whole of Malawi range from 0.9% to 2.8% [1]. Primary forest land, including areas protected areas are under greatest threat. Predicting future trends in deforestation is a complex and multi-faceted problem because of the diverse nature of the causes and drivers of deforestation. Projection of the losses in primary forest experienced between 1990 and 2005 suggest that all primary forest in Malawi will be degraded or deforested by 2040. The current threats to carbon stocks within Mkuwazi Forest Reserve and Nyika National Park are likely to increase in the future because of the growing demand for woodfuel and charcoal, increasing threats from businesses and infrastructure development, population growth, and development of tobacco and timber markets. For this reason we are investigating the use of satellite radar technology for monitoring land-use change and, if possible, the estimation of forest biomass and biomass change in the region.

2. METHODOLOGY

We have checked data availability from AUIG and plan to acquire ALOS-PALSAR PLR21.5 data for the test sites in Malawi from the JAXA archive in cycles 10 and 11 (March-June 2007) and use them to develop a range of secondary products based on two main approaches, the first the use of decomposition theory [2] to both improve land-use classification [3,4] and to provide separability of surface and volume scattering for biomass estimation, as shown in [5]. In a second phase we employ repeat-pass interferometry to investigate the possibility of tree height estimation, as originally applied by us to airborne data in [6] and later investigated for ALOS PALSAR [7]. Previous studies of POLInSAR with ALOS-PALSAR have shown large degrees of temporal decorrelation over the 46-day repeat time of ALOS, [5] but in Malawi the climate conditions (during cycles 10 and11) were more conducive to long term stability. For this reason we will investigate POLInSAR height retrieval as a secondary objective, with a primary objective remaining the use of single pass quad polarimetric data for improved land use and biomass studies.

3. CONCLUSIONS

The PLR mode of ALOS-PALSAR is experimental and not designed to provide global coverage or systematic multi-temporal acquisitions. However, the issue of whether to use quad or dual polarized modes for future radar satellites is of great topical interest and in this study we use the PLR mode of ALOS to investigate this issue for a well calibrated and important African test site. Our test sites in Malawi will provide a useful test of the utility of quadpolarized L-band data, over single and dual polarized data sets, for improved land-use classification and biomass estimation. Our conclusions will comprise three stages. In the first, an assessment of the potential of polarimetry for improved land-use classification. In the second an assessment of the potential for single-pass biomass estimation using L-band quadpolarimetry and finally an assessment of the potential for POLInSAR height retrieval using 46-day repeat data.

4. REFERENCES

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