WALL-TO-WALL MAPPING OF FOREST EXTENT AND CHANGE IN TASMANIA USING ALOS PALSAR DATA.

Anthea L. Mitchell[1], Tony Milne[1], Ian Tapley[1], Kim Lowell[2], Peter Caccetta[3], Eric Lehmann[3], and Zheng-Shu Zhou[3].

[1]Cooperative Research Centre for Spatial Information (CRC-SI), School of Biological, Earth and Environmental Sciences, The University of New South Wales, Kensington, Sydney, NSW 2052, Australia; [2]CRC-SI, Department of Geomatics, University of Melbourne, Carlton, Victoria 3052, Australia; and [3]CSIRO Mathematical and Information Sciences, Floreat, Western Australia 6014, Australia.

1. INTRODUCTION

Consistent estimation of carbon stocks at national level requires the integration of wall-to-wall, time-series satellite and *in situ* data of forest area, type and change. In 2008, the Group on Earth Observations (GEO) initiated the Forest Carbon Tracking (FCT) task to address concerns over the lack of standardised methods for the processing and generation of forest information products for use in carbon assessment [1]. Previous forest and land cover mapping has relied upon coarse to moderate resolution optical data. The extent of time-series of optical data, e.g., the Landsat series, has lead to the establishment of historical baselines from the early 1970s and facilitated the estimation of annual rates of deforestation [2]. With limited opportunities for ongoing data collection however, Synthetic Aperture Radar (SAR) presents a viable means of acquiring complementary, wide-area, repeat coverage, and in particular over tropical areas where cloud cover is prevalent [3]. In this paper, we address the fundamental requirement of a baseline mosaic for subsequent derivation of forest maps and time-series change. A consistent approach to the generation of wall-to-wall, time-series mosaics using ALOS PALSAR data acquired over 2007 to 2009 for Tasmania is presented.

2. DATA PROCESSING STRATEGIES

All data were processed using ENVI SARscape (ITT VIS) software. Our approach to mosaicking involves a sequence of steps comprising data selection, multi-looking, ortho-rectification using a DEM, radiometric calibration, speckle filtering, image overlay and resampling. The initial data selection is important in maintaining consistency in the final mosaic. For the generation of wide-area, annual mosaics, data should be acquired optimally at the same time of year and when local conditions are favourable for discrimination of forest and other land cover. Data acquired by multiple sensors should proceed simultaneously or as near to,

and using complementary imaging modes. Climate records should also be consulted to assess the impact of rainfall on imagery.

Fine Beam Dual (FBD) ALOS PALSAR data were acquired in Single Look Complex (SLC) format and imported into the SARscape environment. Data was first multi-looked to reduce image speckle and produce square pixels. Ortho-rectification proceeded using a 25 m DEM of Tasmania state, which corrected for terrain and illumination effects resulting from the non-nadir viewing geometry of SAR. Radiometric calibration was applied to allow for direct comparison of images acquired on different dates, and with other SAR data, including JERS-1. Standard radar equations using a sensor specific calibration factor were used to convert to sigma Nought (σ^o). Adaptive filtering was applied to the calibrated data to further minimise speckle and noise. Individual images were then subset to remove the area of overlap on either side, and subsequently overlain from east to west to generate a state-wide mosaic. Mosaics were then resampled to 25 m spatial resolution to match the Landsat time-series.

The process resulted in the generation of three annual, ortho-rectified, terrain and illumination corrected, radiometrically calibrated, wall-to-wall SAR mosaics using ALOS PALSAR data acquired in 2007, 2008 and 2009. Through application of a consistent approach to ortho-rectification and radiometric calibration, and having achieved a co-registration accuracy of less than 25 m (i.e., 1 pixel), the mosaics are well suited for precise forest cover mapping and change detection. Further processing will ensure co-registration with historic JERS-1 data for analysis of forest area change.

Following generation of the SAR mosaics, and as a first priority, maps of forest/non-forest and their trends (referred to as Horizon 1a forest products) will be generated. Using a segmentation and rule based classification approach, maps of land use type (Horizon 1b), including agriculture, plantations, native forest and grassland, will be generated. Subsequent forest information products to be derived from high resolution SAR data may include maps of forest type and degradation and sparse woody perennial cover (Horizon 2 products). These data will provide direct input to ecosystem process and carbon models for direct estimation of forest carbon stocks and identification of 'hotspot' areas where deforestation is occurring at alarming rates.

The methodologies developed for the acquisition, processing, mosaicking and generation of forest information products using SAR data (and subsequently through fusion of optical and SAR data) will be included in high-level technical documentation and ultimately provided to GEO member countries as a guide to operational time-series forest observations from satellite data for forest monitoring and carbon assessment.

3. REFERENCES

[1] Group on Earth Observations (GEO), "GEO Forest Carbon Tracking: Satellite Data Product Specifications", draft v3, December 1, 2009.

[2] R. DeFries, F. Achard, S. Brown, M. Herold, D. Murdiyarso, B. Schlamadinger, C de Souza Jr., "Earth observations for estimating greenhouse gas emissions from deforestation in developing countries", *Environmental Science and Policy*, 10, pp. 385-394, 2007.

[3] F. Achard, R. DeFries, H. Eva, M. Hansen, P. Mayaux and H-J. Stibig, "Pan-tropical monitoring of deforestation", *Environmental Research Letters*, 2, 11 pp., 2007.