The role of small-footprint LiDAR in multi-resource inventory and monitoring of Montreal Process C&I

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ABSTRACT

Governments, industry and private landholders are being increasingly required to accurately and transparently quantify and monitor a range of landscape and forest values to detect trends in commercial and ecosystem values, and to assess the performance of management and policy objectives at local to national scales. In developing cost-effective methods to assess and monitor an increasing number of parameters, there is a need not only to focus on individual components, but also on how a range of methods and technologies can be used within an overall monitoring framework.

This paper demonstrates the integrated use of airborne scanning lidar, large-scale photography (LSP), airborne hyperspectral sensors, airborne SAR and Landsat ETM+, and in particular, the role that lidar can play in local and regional scale reporting on a range of Montreal Process criteria and indicators of sustainable forest management. The project was undertaken over a 220,000 area located near Injune, central Queensland, Australia with the objective of bringing together methods developed from a number of studies and to demonstrate their use within an operational framework for on-going monitoring.

Small-footprint airborne scanning lidar, large-scale photography and high resolution hyperspectral data were captured on a systematic 4 km grid, and AIRSAR synthetic aperture radar (SAR) and Landsat ETM+ were used to undertake wall-to-wall mapping within a multiphase and multi-stage sampling and mapping framework. The large-scale photography was used to stratify field sampling and to capture information on land use, land cover, forest types, age class, disturbance and condition. The lidar was used to provide estimates of vegetation height, forest density, and biomass. The Hyperspectral instruments were used to identify forest species. SAR was used to map forest biomass, and Landsat ETM+ was used to map forest species, density and forest cover change. Detailed field surveys were also carried out to calibrate and validate the remotely sensed data.

This study has confirmed the advantages and cost-effectiveness of bringing together a range of technologies, and identified significant improvements that can be made to existing monitoring systems. The work demonstrates that airborne lidar is capable of operationally monitoring the structure and biomass of Australia’s diverse multi-aged forests and woodlands more accurately than existing mapping programs, and more cost-effectively than traditional field surveys alone. In some cases lidar is also capable of delivering information of greater accuracy and precision than field surveys. In addition, we have been able to demonstrate that the quality, efficiency and cost-effectiveness of many satellite-based mapping programs can be significantly improved using a multi-stage and multi-phase framework that includes airborne scanning lidar, and large-scale photography. Importantly, this study also demonstrates that an integrated, multi-sensor approach is required to meet our increasing information needs.