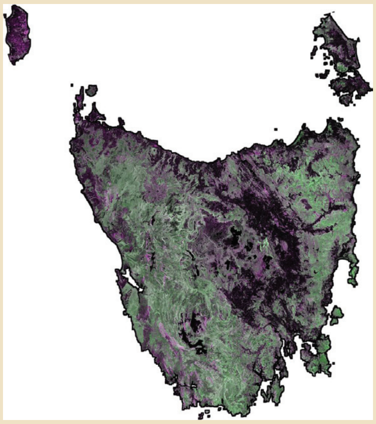
SAR, Optical Image Analysis Assesses Forest Change

Geospatial imagery provides specific information about geographic areas of interest and is used to make informed, accurate decisions in a variety of applications. One popular application is environmental conservation and resource management. Many local, national and global environmental and conservation programs have begun to take advantage of increasingly available geospatial imagery to address problems ranging from monitoring the effects of pollution to identifying optimal locations for planting trees.

In the last few decades, leaders from countries around the world started working together to tackle global environmental issues. One of the main goals is reducing greenhouse gases—and ultimately global warming. One way they're attempting to reduce emissions of greenhouse gases is from restricting deforestation and forest degradation.

To address the challenge of measuring and monitoring ecosystems and land use changes, the Group on Earth Observation (GEO) Forest Carbon Tracking Task (FCT) was established. Now, with close to 80 governments and 56 leading international organizations in its partnership, GEO FCT (*www.geo-fct.org*) aims to demonstrate the feasibility of coordinated Earth observation to monitor forests and collect information to serve as input to future national forest and carbon monitoring systems.

Dr. Anthea Mitchell, visiting research fellow in the Cooperative Research Centre for Spatial Information at Australia's University of New South Wales, is one of several individuals around the world tasked by GEO FCT with creating standardized methods for processing data and imagery and generating forest information products for use in carbon assessment. Ultimately, Mitchell is working to develop image analysis routines that can be used worldwide to measure, monitor and report forest change.



An image of Tasmania from Japan's Advanced Land Observing Satellite (ALOS) PALSAR sensor was orthorectified, radiometrically calibrated and mosaicked using SARscape.

A SAR Solution

One of Mitchell's primary methods for monitoring forest change is using important data from optical and Synthetic Aperture Radar (SAR) imagery. The differences between these types of imagery make them complement each other. SAR sensors emit their own illumination source in the form of microwaves, which allow them to record data at all times of day and all weather conditions. SAR technology uses different wavelengths than optical sensors, allowing it to record data through atmospheric interference like clouds and storms. These wavelengths, combined with the fact that SAR is a side-looking sensor compared with optical sensors that mainly look straight down, mean that terrain and cultural targets respond uniquely to radar.

Because SAR scans Earth differently than optical sensors, the technology gives Mitchell a unique layer of contextual information about specific geographic areas of interest. According to Mitchell, SAR is unique in that it provides information about 3-D structure and moisture content of items on Earth's surface and is useful for discriminating and mapping different forest types and biomass.

To effectively use the SAR data Mitchell is given as part of GEO FCT, she needed a solution that could effectively process and analyze SAR data and easily work with optical imagery. After evaluating her options, she ultimately chose SARscape Modules for ENVI from ITT Visual Information Solutions (*www.ittvis.com*). SARscape has unique capabilities to read, process, analyze and output information from SAR data and imagery. SARscape converts data from hard-to-interpret numbers to meaningful, contextual information. And, because SARscape is integrated with ENVI image processing and analysis software, users can take advantage of multiple types of imagery and exploit the critical information they contain.

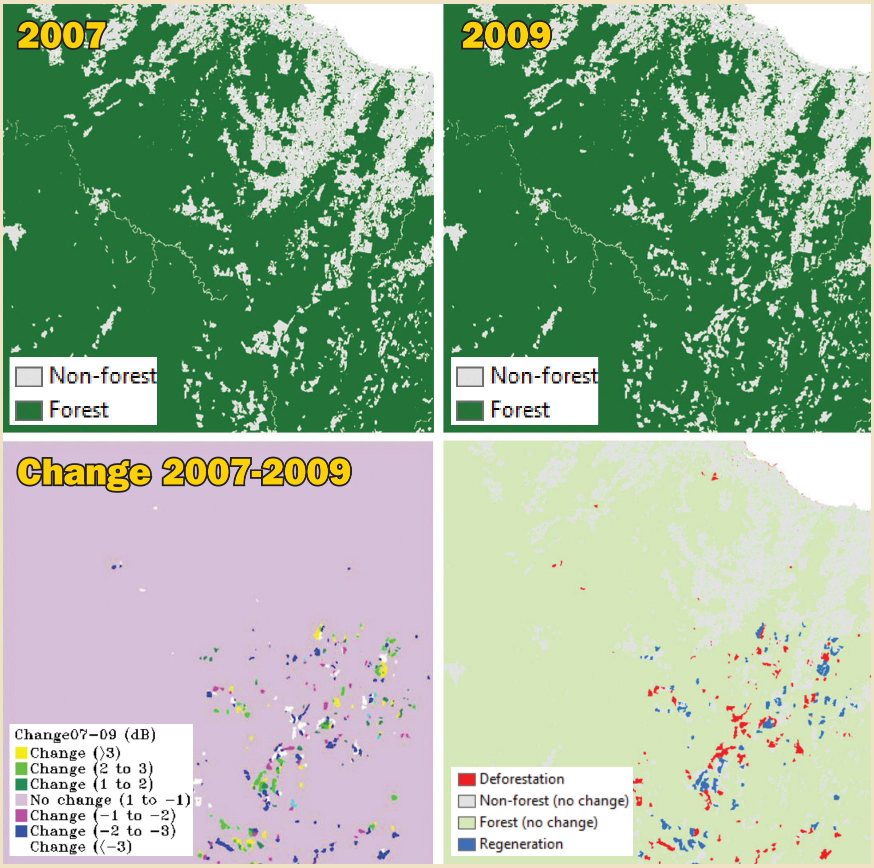
To extract valuable information within SAR data, the data first must be read and processed. Because Mitchell is given SAR data from a variety of sources, it's critical that she has one software package that can accurately read the data in the correct format. SARscape streamlines the process of importing and reading SAR data from a variety of sensors.

After reading the SAR data, Mitchell uses SARscape to perform a variety of automated processing tasks to prepare the data for visualization and analysis. These tasks include multilooking, coregistration, despeckling, geocoding and radiometric calibration, as well as mosaicking. Because radar images typically have a lot of noise, Mitchell thoroughly filters them to minimize the noise. The coregistration process automatically superimposes images acquired over the same area on different dates. The data also are geometrically and radiometrically corrected, which is required to be able to analyze and compare images acquired at different times or by different sensors.

Once processed, the SAR data are analyzed with ENVI. Because SARscape is integrated with ENVI, Mitchell can perform advanced image analyses without leaving the software. She uses ENVI's change detection tool to detect and measure changes between the images. The automated workflow for detecting change in ENVI identifies the type and extent of changes that have taken place in an area over time. Using change detection, Mitchell looks for increases and decreases in brightness, which often signify forest areas that have been cleared or have regenerated. Because a brightness increase might also be a result of an increase in soil or canopy moisture, optical imagery is brought in to confirm the results.

SAR Success

Mitchell has had a lot of success achieving the GEO FCT objectives. She has been able to generate annual forest and nonforest extent and land cover maps and change maps that show deforestation and regeneration changes over time by processing and analyzing SAR and optical imagery in SARscape and ENVI. She has created standardized methods for processing and analyzing SAR data from different sensors and used the data to create forest information products for carbon assessment. In short, SAR data have provided Mitchell with critical information that she wouldn't be able to gather solely using optical imagery.



To evaluate forest extent and land cover/land use change using ALOS PALSAR data, ENVI's change detection tool can detect brightness (backscatter) variations between dates that can be related to on-ground change. A decrease in brightness may indicate clearing of forest for plantation, while an increase may indicate regeneration of forest or a change in soil/canopy moisture.