



# Using Rainforest Research

## Seeing through the clouds and trees: Using Radar Systems to map rainforest health (Remote Sensing Series - I)

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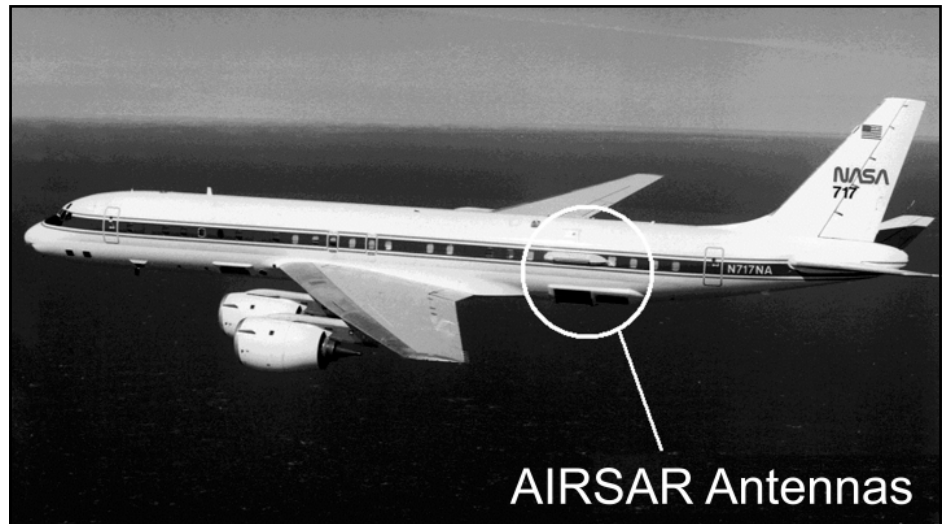
Collecting information for mapping tropical rainforests is often impeded by the cloudy, and frequently smokey conditions common in these areas. This restricts the use of traditional aerial photography and satellite based imaging systems for monitoring these environments. There is a solution to this problem. Rainforest CRC researchers are collaborating with NASA and local management agencies to develop effective new mapping techniques.

The new mapping approach relies on using a specific type of radar (radio-detection and ranging) system to produce images of the forest and the surface of the earth. Synthetic Aperture Radars (SAR) can produce images containing information about topography, vegetation height and density. Like flash cameras, they send a non-harmful pulse of energy from the sensor to the ground, after which they measure the strength of the return signal.

The return radar signal is used to estimate the distance of the ground from the sensor and the characteristics of the surface from which it has reflected. This signal can pass through cloud and smoke, enabling it to be used to map tropical forest environments. Different types of SAR images provide information on canopy characteristics, volume or density of wood, biomass and characteristics of the forest floor.

Rainforest CRC researchers are now determining the type of information on forest structure and condition which can be mapped from imaging radar, and designing procedures capable of using these data for monitoring rainforests in the Wet Tropics and elsewhere in the world.

A great advantage of radar imaging systems is that they measure the interaction of different types of energy with the surface of the earth. Just as we see separate colours like blue, green and red, imaging radar systems measure the response in different types of energy, as well as



**AIRSAR Antennas**

NASA JPL DC-8 aircraft flies the route from Port Douglas to Cooktown collecting SAR image data as ground teams below compile vegetation and ground survey data  
(Source: NASA JPL)

### **Why use SAR's for rainforest analysis ?**

Remote sensing instruments can collect data over relatively large areas in a relatively short time period. This enables field data from intensively sampled sites to be compared with image data sets and used to estimate the biological and physical properties of these areas. They can also provide data for remote or otherwise inaccessible areas.

their polarization (orientation of electric and magnetic wave of the energy). One type of radar C-band (old military code for the names of these systems) only interacts with the canopy of the forest and provides information on surface roughness. Another type of energy, L-band, is able to be transmitted through the canopy of forests and interacts with trunks and forest floor features.

Providing science for the conservation and management of Australia's World Heritage tropical rainforests.



**COOPERATIVE RESEARCH CENTRE  
FOR TROPICAL RAINFOREST  
ECOLOGY AND MANAGEMENT**





The Rainforest CRC is a research partnership involving the Commonwealth and Queensland State governments, the Wet Tropics Management Authority, the tourism industry, Aboriginal groups, CSIRO, James Cook University, Griffith University and The University of Queensland

Hence, the radar image can be used to provide a variety of information about the rainforests. Combined, the different radar types provide information about tree height, canopy density, vegetation structure and density.

A Global Rainforest Mapping Mission being undertaken by Japan's National Space Agency, NASA and the European Joint Research Centre for Remote Sensing is also using imaging radars. The focus of this work however, is mapping the extent of rainforests, whereas the focus of the Rainforest CRC project is to map the structure and condition to help determine and monitor the health of the forest.

#### Collecting the Data

On August 31, 2000 NASA's Airborne SAR instrument was flown along a ten kilometre wide strip from Port Douglas to Cooktown. At the same time research staff from the University of Queensland and CSIRO Land & Water collected ground survey and vegetation data in rainforests and mangroves to calibrate the image data set. Vegetation structural information included tree height, canopy depth, trunk diameter at breast height (dbh), tree location and as far as possible species. The purpose of the flight was to investigate the relationship between the radar images and rainforest structure and condition. A previous NASA AirSAR mission in 1996 collected images over the same area which, together with field data and the 2000 images, will be used to examine changes in the rainforest over time.



The ground team setting up calibration equipment prior to the AirSAR flight

Prior to and following the AirSAR flight, very high spatial resolution images were collected using multispectral systems operated by the University of Queensland, and a hyperspectral instrument operated by CSIRO's Earth Observation Centre. These datasets will provide essential calibration data for the radar and will also be examined using information collected during the Space Shuttle's historic global radar topography mapping mission in February 2000 to produce an accurate digital elevation model for the Earth.

#### Where to from here?

The AirSAR image data are currently being processed at the Jet Propulsion Laboratory, NASA. Once these data are returned, the area will be mapped into rainforest, mangroves, pasture and crops. Detailed analyses will then be applied to relate field measured structural properties of vegetation to the radar image to produce maps of

vegetation biomass and density, and the changes which have occurred since the 1996 image.

These data will also be incorporated with other satellite and airborne datasets and the methods developed will be tested and refined before being delivered as operational monitoring tools. The combined data set will enable the structure and condition of the rainforest to be characterized and a methodology for mapping these various parameters can then be developed for general use in Australia's Wet Tropics and elsewhere in the world.

#### For more information:

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#### Related Web Sites:

NASA imaging radar homepage:  
<http://southport.jpl.nasa.gov/>  
NASA AirSAR homepage with  
data from the 2000 mission:  
<http://airsar.jpl.nasa.gov/>  
Access Remote Sensing data for  
Australia - Australian Centre for  
Remote Sensing:  
[http://www.auslig.gov.au/acres/  
index.htm](http://www.auslig.gov.au/acres/index.htm)

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