

## THE FAO GLOBAL FOREST RESOURCE ASSESSMENT REMOTE SENSING SURVEY

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### ABSTRACT

Global concern is growing over deforestation, loss of biodiversity and carbon stored in forests and the role of forests in climate change. Remote sensing analyses offer some of the best ways to undertake forest monitoring over very large areas.

FAO has been reporting on the world's forests at 5 to 10 year intervals since 1946. The Global Forest Resources Assessments (FRA) are based on data that countries provide to FAO in response to a standard questionnaire. FAO then compiles and analyses the information and presents the current status of the world's forest resources and their changes over time. FAO released the last assessment ([FRA 2005](#)) and is currently working with countries and partner organizations to compile the next report for 2010. As part of FRA 2010, FAO, its member countries and partner organizations will undertake a new global remote sensing survey of forests. The survey will substantially improve knowledge on land use change including deforestation, reforestation and natural expansion of forests. The assessment will sample the whole land surface of the Earth with about 9,000 Landsat image mosaics covering 10km by 10km at each of the intersections of the latitude and longitude degree lines.

The main outcomes will be information at the global and biome level on trends in:

- the rate of deforestation, afforestation and natural expansion of forests using Landsat data from 2005, 2000, 1990 and back to 1975 where possible;
- a global framework and agreed methodology for monitoring forest change;
- An information gateway providing easy access to remote sensing imagery;
- Enhanced capacity in many countries for monitoring, assessing and reporting on forests.

The paper will describe the FRA2010 Remote Sensing Survey and encourage involvement of others who can provide useful additional data or techniques for validation.

### INTRODUCTION

The world's forests provide vital economic, social and environmental benefits. They help reduce climate change by storing carbon, provide wood and non-wood forest products, generate livelihoods, supply clean water and provide habitat for half the species on the planet (Wilson, 1988).

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conservation issues. The breadth of the data collected has also increased with the FRA 2005 report being the most comprehensive in scope ever (FAO, 2006).

During the recent G-8 Summit, world leaders “encouraged actions for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) including the development of an international forest monitoring network building on existing initiatives” (G8 Summit 2008; FAO, 2008).

As part of the Global Forest Resources Assessment, FAO and its member countries and partners are undertaking a remote sensing survey which will form the basis for a long-term global forest monitoring system (FAO, 2008).

## **WE NEED RELIABLE GLOBAL INFORMATION ON FORESTS**

Deforestation continues at an alarming rate of about 13 million hectares annually worldwide (FAO, 2005). It is responsible for about 17 percent of human-produced greenhouse gas emissions (IPCC 2007). To tackle this issue we need better information on deforestation: where is it occurring, at what rate and why – for conversion to what other land uses?

Quantitative information on progress in maintaining and expanding forests is also vital, particularly for supporting systems of payment for the environmental benefits that forests provide.

FAO and its member countries and partners have responded by developing a new and ambitious global remote sensing survey to be undertaken between 2008 and 2011.

## **WHY USE REMOTE SENSING?**

Remote sensing can help us map the distribution of forests in a consistent way globally and importantly provide better estimates of trends and changes over time. FAO and countries make significant efforts to harmonise forest data but due to different national data collection systems some inconsistencies remain. Also countries are often improving their systems and changing methodologies so the new information may not be directly comparable to the old. Most countries do not have detailed national forest inventories that can answer the difficult questions of changing forest areas in a consistent way over time. Using satellites, it is possible to collect data that is more consistent globally and it can be done same way over different years to get trends.

Remote sensing does not replace the need for good field data which is still required. By combining remote sensing with field data collection, we can deliver more accurate and more efficient results than either method alone.

## **THE REMOTE SENSING SURVEY**

The primary aims of this global survey are to obtain information on the distribution of forests and on changes in forest area over time at regional, biome and global levels. It is intended to provide complementary information and build on and in some cases strengthen national systems but not replace them.

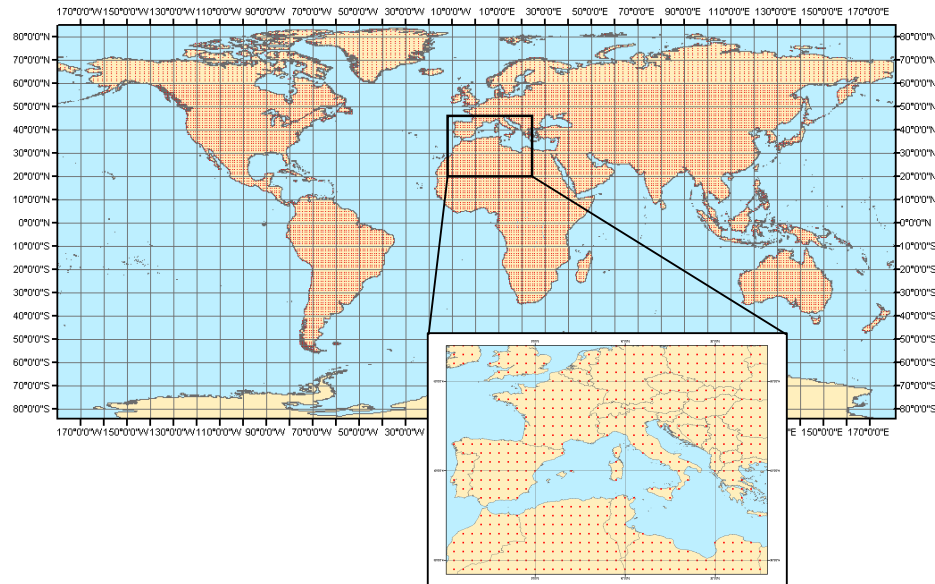
The FRA Remote Sensing Survey (FRA RSS) will bring together the best available comprehensive global satellite imagery and some of the worlds leading scientists to analyse satellite data and engage with country experts in over 150 countries to get the best results we can.

There will be two main outputs from the survey:

1. **A new and validated global tree cover map** using MODIS satellites at 250 metre resolution
2. **Improved estimates of forest area and change** using Landsat images at 30 metre resolution.

### **A scientific sampling design**

The survey will primarily be based on the use of available Landsat imagery(30 metre resolution), but will incorporate auxiliary information including other remote sensing images, local knowledge and results from existing and past field inventories. A systematic sampling design will be used based on each longitude and latitude intersects (Figure 1), with a reduced intensity above 60 degrees North due to the curvature of the Earth. The assessment will provide a comprehensive sample of the land surface of the Earth and will consist of about 13,500 samples, of which about 9,000 samples are outside deserts and areas with permanent ice. Each sample tile will cover a 10 by 10 kilometre box at every one degree latitude and longitude junction (approximately 100km apart). This grid of sample plots is the same basic layout but a lower intensity (wider spacing) than the national forest assessments supported by FAO and by many national forest inventory programmes.



**Figure 1: The systematic grid sampling scheme with Landsat images of 10km x 10km on the junctions of the latitude and longitude lines.**

Images from 1975, 1990, 2000 and 2005 will be processed for forest extent and change to get statistically reliable results that can be summarised at biome and global totals. This will enable us to tell us which forest types are changing the most.

### **BENEFITS FOR DECISION-MAKING**

Key outputs and benefits of the Survey will be:

- Improved knowledge on global forest and land use changes, especially patterns and processes of deforestation, afforestation and natural expansion of forests;
- Baseline information at the global, biome and regional level on trends in the rate of deforestation over past 15 or more years;

- Vital information that can assist decision-makers understand the forces driving deforestation and help develop appropriate policies and interventions to address them;
- A global framework and commonly agreed methodology for monitoring forest change, which can be expanded to generate statistically valid estimates at country level;
- Internet access to remote sensing imagery, and image processing software which can be used for other studies and monitoring purposes;
- Enhanced capacity in countries for monitoring, assessing and reporting on forests and land use changes.

FRA 2010 will provide a basis for reporting on progress towards sections of:

- the United Nations Convention on Biological Diversity's target of reversing biodiversity loss by 2010
- the Millennium Development Goals
- the Global Objectives of the UN Forum on Forests
- the International Tropical Timber Organization's Objective 2000
- land use and land use change for the UN Framework Convention on Climate Change and the Kyoto Protocol and the Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD).

The increased transparency of information will improve the general public's understanding of forest issues.

## TESTING SAR-RADAR TO SEE THROUGH CLOUDS

To help overcome the problems of gaps in optical satellite data through clouds or other losses the Survey will include a research component by Jena University that will investigate the use of radar data that can penetrate through clouds (Figure 2).

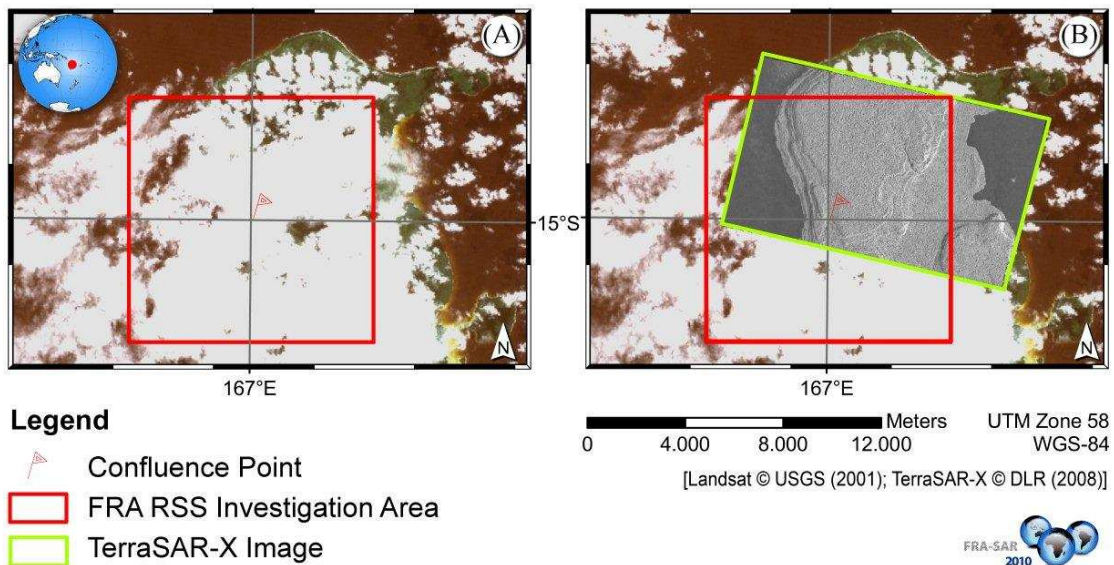


Figure 2: Example of (a) optical satellite imagery obscured by cloud that can be penetrated by radar (b).

### A framework to build on

The RSS system of data collection and analysis can also be used to help many countries establish their first environmental monitoring system. Or the Survey design it can be expanded

or linked to a more intensive national system for national reporting or help countries build a more comprehensive forest inventory such as the National Forest Monitoring and Assessment systems that FAO has over 20 assisted countries to set up. The framework can be expanded for reporting on land use and land use change for the Kyoto Protocol and the emerging initiative for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) under the UN Framework Convention on Climate Change.

## **REMOTE SENSING SURVEY TIMETABLE**

- 2008 - The Survey was launched and a Task Force of 22 countries established to Pilot test the methodology during late 2008 and early 2009
  - The United States Geological Survey is processing the Landsat data archive to build global compilations for 1990, 2000 and 2005 which will form the basis of the sampling imagery
- 2009 FAO and its partner organizations will make pre-processed satellite imagery available through an internet system and will develop training material
- 2009 15-20 Regional workshops and analysis work for countries to have input to analysis
- 2010 Analysis of global data and prepare report
- 2011 Global remote sensing survey final report

## **PARTNERSHIPS**

The Survey will work closely with governments and national institutions and with a wide range of other international and non-governmental organisations.

### **Quality control**

Data will be reviewed by hundreds of national and international experts in regional and global workshops. The process will be guided by an external advisory group and by FAO member countries through the FAO Committee on Forestry and FAO's six Regional Forestry Commissions. An external evaluation will be undertaken by an independent group of scientists. All of this will combine to make the Remote Sensing Survey the best global map of tree-cover and estimates of changes over time.

## **COUNTRY INVOLVEMENT**

Countries will be involved in the analysis to include the best national data and provide local knowledge of what forest and land use changes are occurring in their region and why. This will provide two-way benefits to both the countries with new remote sensing data and training and help ensure the results are validated and as accurate as possible.

Special computer software for viewing the imagery and labelling the changes will be made freely available by FAO. A series of 15 to 20 training workshops will be held around the world in regional centres to improve the technical capacity of many staff in analysing remote sensing imagery. The long term aim of this is to strengthen the abilities of countries to regularly monitor and report on their forests in future for the increasing reporting requirements of many international processes.

## **CONCLUSIONS**

The Global Forest Resource Assessment coordinated by FAO continues to evolve and improve. FRA 2005 was the most comprehensive global report compiled so far. Preparations are well

underway for FRA 2010 which will incorporate a new remote sensing survey which will be a global systematic sample of the world's forests. For more information on the RSS please look at: <http://www.fao.org/forestry/fra2010-remotesensing/en/>

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