

DOCUMENT CONTROL SHEET

	ORIGINATOR'S REF. NLR TP 96118 U		SECURITY CLASS. Unclassified												
ORIGINATOR National Aerospace Laboratory NLR, Amsterdam, The Netherlands															
TITLE Remote sensing based vegetation mapping projects - The Netherlands working group ROBO's perspective															
PRESENTED AT the Workshop on Remote Sensing Support for the Global Forest Resource Assessment (FRA 2000), 12-14 March 1996, USDA Forest Service Headquarters, Washington DC, USA															
AUTHORS W.J. Looyen		DATE 960216	pp ref 13												
DESCRIPTORS <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Airborne reader</td> <td style="width: 50%;">Land use</td> </tr> <tr> <td>Data acquisition</td> <td>Mapping</td> </tr> <tr> <td>Environmental monitoring</td> <td>Remote sensing</td> </tr> <tr> <td>Forest management</td> <td>Satellite imagery</td> </tr> <tr> <td>Image processing</td> <td>Tropical regions</td> </tr> <tr> <td>International cooperation</td> <td></td> </tr> </table>				Airborne reader	Land use	Data acquisition	Mapping	Environmental monitoring	Remote sensing	Forest management	Satellite imagery	Image processing	Tropical regions	International cooperation	
Airborne reader	Land use														
Data acquisition	Mapping														
Environmental monitoring	Remote sensing														
Forest management	Satellite imagery														
Image processing	Tropical regions														
International cooperation															
ABSTRACT This document describes the activities that are being carried out by the ROBO-members. The description of these activities serves as input for discussions on remote sensing support for the Global Forest Resource Assessment (FRA 2000) at the workshop, which will be held from 12-14 March 1996 in Washington DC, USA.															

NLR TECHNICAL PUBLICATION

TP 96118 U

REMOTE SENSING BASED VEGETATION MAPPING PROJECTS -
THE NETHERLANDS WORKING GROUP ROBO'S PERSPECTIVE

by

W.J. Looyen

Discussion paper for the Workshop on Remote Sensing Support for the Global Forest Resource Assessment (FRA 2000), 12-14 March 1996, USDA Forest Service Headquarters, Washington DC, USA.

Division : Space

Prepared : WJL/

Approved : GvdB/

WJL 23/2
GvdB

Completed : 960216

Order number : 571.501

Typ. : MM



Summary

This document describes the activities that are being carried out by the ROBO-members. The description of these activities serves as input for discussions on remote sensing support for the Global Forest Resource Assessment (FRA 2000) at the workshop, which will be held from 12-14 March 1996 in Washington D.C., USA.



Contents

Introduction	5
ROBO Objectives	6
Areas covered	6
Current status	7
Data used	8
Display of classes	9
Data interpretation	10
Sharing of results and data	10
ROBO composition	11



Introduction

Rapid changes in the state and extent of the Earth's natural resources, including forests, give rise to a growing environmental concern. The need to manage these resources in a more sustainable way is widely acknowledged. In order to establish improved management good and up to date information on (changes in) the state and extent of land surface areas is indispensable. At present, the availability of this type of information on, amongst others, forests, and notably on tropical rain forests, is limited. Remote sensing can support management as it has the unique capability to collect information over extensive areas at a repetitive basis.

The Working Group ROBO (Remote Sensing Research Forestry) focuses on research and operationalisation of the application of remote sensing in forested areas. ROBO was established in 1991 in order to co-ordinate and strengthen research and development activities in the framework of the Netherlands Remote Sensing Programme (NRSP-II) and "The Tropenbos Foundation".

ROBO's main interest in the application of remote sensing, in accordance with the objectives of the NRSP-II and The Tropenbos Foundation, is the development of methods to support sustainable use of tropical rain forest areas. These methods should facilitate:

- (a) Inventory of forests and derived vegetation types.
- (b) Monitoring of forest regeneration, deforestation, afforestation and settlement.
- (c) The study of forest dynamics and ecology.

Cloud cover and atmospheric conditions put severe constraints on the usefulness of satellite remote sensing systems using visible and infrared sensors. Therefore special emphasis is given to radar systems, which are unimpeded by the presence of clouds and can acquire data day and night in a repetitive and predictable way.

Developments in radar remote sensing technology offer new and unique possibilities, such as the use of the P-band, polarimetry, interferometry and high spatial resolution. Possibilities which still have to be studied systematically and in much more detail. In the development of monitoring applications, the high temporal resolution of satellite radar, the high spatial resolution of optical satellite systems, and their different information content, can be exploited.

ROBO Objectives

Specific objectives of the Working Group ROBO include:

- **Assessment of capabilities of radar satellite monitoring systems, optical satellite systems and advanced airborne radar surveys.** Ongoing studies include the use of the satellite systems: ERS-1/2, JERS-1, Landsat, SPOT, NOAA-AVHRR, Radarsat and SIR-C/X-SAR and the use of the airborne radar systems AIRSAR (NASA), DOSAR (Dornier, Germany) and PHARUS (FEL-TNO, The Netherlands).
- **Radar backscatter modelling and validation.** The Horsterwold and Speulderbos forest sites in the Netherlands have been selected for development and validation of backscatter models and basic insights. These well-studied sites serve as a reference for comparison and extrapolation to the far more complicated structure of tropical rain forests.
- **Execution of airborne radar campaigns.** Tropical rain forest sites in Colombia, Guyana, Kalimantan and Sumatra have been selected. Here ample logistic support and knowledge on site characteristics is available from The Tropenbos Foundation and counterpart organisations.
- **Application of image processing techniques and geographical information systems.** The utility of (automated) segmentation, speckle, texture and relief image processing techniques and a priori knowledge in support of land and forest cover type classification and cover type change assessment is studied.
- **Definition and development of operational monitoring systems.** Generally applicable tools, such as image processing techniques and backscatter models, and locally applicable tools, such as land cover change models, are integrated to develop operational monitoring systems to support natural resources management, management of settlement areas, verification of sustainable management in timber concessions or surveillance of natural reserves.

Areas covered

Past

Research on forest in temperate regions commenced in 1982 at the Horsterwold- and Speulderbos-site in the Netherlands.

Present

Based on the experiences gained, new activities in tropical areas started in 1990 at the Tropenbos sites in Colombia (Araracuara and Guaviare) and Guyana (Mabura Hill).



In 1994 the initiative was taken to add two Indonesian sites: the Tropenbos site in East-Kalimantan and the University of Gadjja Mada site in Central-Sumatra.

Future

In 1996 new proposals are submitted for funding which include work in the above areas and areas in Cameroon and the Guyana shield (Surinam and Venezuela). The RESPAS proposal is concerned with areas in Ecuador.

Current status

The work started in 1990 at the Tropenbos sites in Colombia and Guyana and the work started in Indonesia in 1994 will end in 1996 with two dissertations on the use of radar data in tropical forests. However, follow-up proposals have been submitted to the ESA, EU and BCRS for funding. The first proposal focusses on the test-sites in Indonesia (Sumatra and Kalimantan) with the objective of building a forest monitoring system using ERS-SAR data and airborne DOSAR data and AIRSAR data. DOSAR data acquisition is planned in July/August 1996. AIRSAR data acquisition is planned in October/November 1996. The second proposal focusses on expanding the results of the work performed in Colombia and Guyana to other parts, i.e. the Guyana shield, with particular emphasis on the Apura-site in Surinam and logging activities in Surinam and mining activities in Venezuela, and Cameroon (the Campo Reserve site and the Lac Lobeke site). A positive decision is hopefully to be expected at the end of March 1996.

In conjunction with the Ministry of Forestry and BPPT in Indonesia and NRI of the UK, a proposal has been submitted for funding to demonstrate the possibilities and opportunities of local PC-based ERS-SAR reception. The Tropenbos-site in East-Kalimantan will be one of the test-sites, together with a site in Sumatra. A positive decision on funding is hopefully to be expected at the end of March 1996.

RESPAS-development is about to start in Ecuador, although a positive decision still has to be made by the Dutch Ministry for Development Cooperation.



Data used

For all the sites data from a variety of sensors are used. However, emphasis is put on the use of satellite and airborne radar data.

Satellite data: mainly ERS-SAR data. To a limited extent RADARSAT data (to be expected in 1996) and SIR-C/X-SAR data (if available), complemented by NOAA-AVHRR data, Landsat-TM data and IRS-1C data are used.

Airborne data: mainly AIRSAR data, CCRS data and DOSAR data (to be expected in 1996 over Indonesian test-sites).

At each of the sites different data are used:

Guyana-site:	Satellite:	- ERS-1/2 SAR data - RADARSAT data (expected in 1996)
	Airborne:	- AIRSAR C-,L- and P-band fully polarimetric data - CCRS X- and C-band quad polarimetric data
	Contact:	- Joost van der Sanden / Dirk Hoekman
Colombia-sites:	Satellite:	- ERS-1/2 SAR data - SIR-C data (if available)
	Airborne:	- AIRSAR C-,L- and P-band fully polarimetric data - CCRS X- and C-band quad polarimetric data
	Contact:	- Wietske Bijker / Joost Duivenvoorden
Indonesia-sites:	Satellite:	- ERS-1/2 SAR data
	Airborne:	- AIRSAR C-,L- and P-band fully polarimetric data (expected in 1996) - DOSAR data (expected in 1996)
	Contact:	- Dirk Hoekman / Aart van den Berg
Cameroon-sites:	Satellite:	- ERS-1/2/ SAR data - SIR-C data (if available) - RADARSAT data (expected in 1996)
	Contact:	- Joost van der Sanden / Dirk Hoekman
Surinam-site:	Satellite:	- ERS-1/2 SAR data - SIR-C data (if available)
	Contact:	- Joost van der Sanden / Wim Looyen



Venezuela-site:	Satellite:	- ERS-1/2 SAR data - SIR-C data (if available)
	Contact:	- Joost van der Sanden / Wim Looyen
Ecuador-sites:	Satellite:	- NOAA-AVHRR data - Landsat-TM data - IRS-1C data (if available) - ERS-1/2 SAR data - RADARSAT data (expected in 1996)
	Contact:	- Wim Looyen

Display of classes

Each of the sites is characterised by various classes.

Guyana-site: rain forest
- mixed forest
- dry evergreen forest
- xeric mixed forest
- wallaba forest
swamp forest
- low swamp forest
- mora forest
selectively logged forest

Colombia-site: forest/non-forest
grasslands
forest
secondary forest
deforestation patterns

As starting point for RESPAS-development in 1993 a study has been executed with emphasis on establishing a basis for user requirements. A list of forest information requirements has been drafted based on the results of the above study, the results of the FAO/ECE KOTKA II meeting and the IUFRO International Guidelines for monitoring:



- forest/non-forest
- selectively logged areas (location and extent)
- change detection: forest to selectively logged areas
- slash&burn logged areas (location and extent)
- change detection: forest to slash&burn logged areas
- clear cut areas (location and extent)
- change detection: forest to clear cut areas
- fragmented areas (location and extent)
- actual forest type
- forest condition/health
- % vegetative cover
- fire distribution
- land use
- topography
- accessibility
- biomass
- timber volume
- human impact (e.g. settlements)

Data interpretation

All data interpretations were carried out through digital image processing. In Guyana, Colombia and Indonesia ground-truth data have been collected which assisted the interpretation.

RESPAS intends to conform the "working standards" in Ecuador and gradually building up capacity. Experiences obtained in Asia indicate that visual interpretation is still the most reliable source of interpretation. Digital enhancement of data is required, combining local knowledge with digital analysis techniques is preferred.

Sharing of results and data

The ERS-1/2 SAR data can be obtained through the commercial network of ESA. Airborne DOSAR data can be requested at ESA. Airborne AIRSAR data can be requested at NASA/JPL. RADARSAT data can be obtained through RADARSAT's commercial network. Landsat-TM data and IRS-1C data can be obtained through EOSAT's commercial network.

Ground-truth data for the Colombia-sites will be made available during 1996 on CD-ROM, if



funding is guaranteed by BCRS and conditions for use of the CD-ROM are negotiated.

Results of the work have been and will be published at international conferences, in international journals and in the mentioned dissertations in 1996.

ROBO composition

Dirk H. Hoekman (Chairman)

Wageningen Agricultural University, Department of Water Resources

Nieuwe Kanaal 11, 6709 PA Wageningen, The Netherlands

Tel: +31-8370-82894

Fax: +31-8370-84885

E-mail: Dirk.Hoekman@USERS.WHH.WAU.NL

Joost van der Sanden (Secretary)

Wageningen Agricultural University, Department of Water Resources

Nieuwe Kanaal 11, 6709 PA Wageningen, The Netherlands

Tel: +31-8370-82765

Fax: +31-8370-84885

E-mail: sanden@rcl.wau.nl

Joost Duivenvoorden

Hugo de Vries Laboratorium

Kruislaan 318, 1098 SM Amsterdam, The Netherlands

Tel: +31-20-5257844

E-mail: jfdui@sara.nl

Prof. Alfred de Gier

ITC

P.O. Box 6, 7500 AA Enschede, The Netherlands

Tel: +31-53-874444

Fax: +31-53-874400

E-mail: degier@itc.nl



Wietske Bijker
ITC
P.O. Box 6, 7500 AA Enschede, The Netherlands
Tel: +31-53-874444
Fax: +31-53-874400
E-mail: bijker@itc.nl

Wim Looyen
National Aerospace Laboratory NLR
P.O. Box 153, 8300 AD Emmeloord, The Netherlands
Tel: +31-527-248247
Fax: +31-527-248210
E-mail: looyen@nlr.nl

Aart van den Berg
DLO-Institute for Forestry and Nature Research (IBN-DLO)
P.O. Box 23, 6700 AA Wageningen, The Netherlands
Tel: +31-317-477978
Fax: +31-317-424988
E-mail: avandenberg@ibn.dlo.nl

Steven de Jong
Rijksuniversiteit Utrecht, Department of Physical Geography
P.O. Box 80115, 3508 TC Utrecht, The Netherlands
Tel: +31-30-2534050
Fax: +31-30-2540604
E-mail: s.dejong@frw.ruu.nl

Hans Vellema
Tropenbos Foundation
P.O. Box 232, 6700 AE Wageningen, The Netherlands
Tel: +31-317-426262
Fax: +31-317-423024



Ingrid Janssen
Netherlands Remote Sensing Board BCRS
P.O. Box 5023, 2600 GA Delft, The Netherlands
Tel: +31-15-2691111
Fax: +31-15-2618962
E-mail: i.m.h.janssen@mdi.rws.minvenw.nl

More detailed information on the ROBO can be found on Internet at
<http://neonet.nlr.nl/projects/neonet/bcrs/robo/robo.html>.