

Sub-task Number: US-09-03b (originally Agriculture Task AG-06-04)

Sub-task Title: Forest Mapping and Change Monitoring

Overarching Task: Cross-Cutting Products and Services

Area: USER ENGAGEMENT

Related Community of Practice: Forest

Relevant Committee: UIC

Related Targets: (to be included in 2009)

Sub-task Definition (as given in the 2009-2011 Work Plan):

Integrate international efforts on assessment and monitoring of forests and forest changes using a combination of ground and satellite information and internationally agreed standards. Make relevant synergies with CL-09-03b (Forest Carbon Tracking) and DI-09-03b (Implementation of a Fire Warning System at Global Level), and EC-09-01a (Ecosystem Classification and Mapping).

Leads (GEO Member or PO, Entity carrying out the work, Contact: e-mail):

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Motivation/Background

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 animal and plant species on the planet. However, consistent global data on forest extent and change does not exist at sufficient detail or has not been validated by countries. The primary aims of the new global survey are to use satellite data to obtain more consistent maps of the distribution of the world's forests and estimates of changes in forest area over time by using the same data and techniques globally. This will produce better estimates of the current status and trends in forest area at regional, biome and global levels.

Outputs (e.g. products and services which result from the activities of the Task/sub-task; outlined in the form of deliverables with timelines)

Planned:

The work has 2 main product outputs:

1. Generating a new validated, global tree cover map using time-series imagery from MODIS satellite at 250m resolution. Draft products from 2000 with annual updates expected in mid 2010 and final in 2011.
2. Gathering and analyzing a systematic sample of the best existing global image archive (Landsat images at 30m resolution) from 2005, 2000, 1990 and where possible going back to 1975) to develop improved estimates of forest area and forest area change over time by 2011.

In addition there are a number of other benefits that should be seen as outputs from the project:

- Identification of key actors and agreement on approaches for a global remote sensing survey.
- An agreed methodology for the Global Forest Resource Assessment Remote Sensing Survey.
- A sampling framework and dataset of time-series satellite imagery, land cover and land-use data that can be used for a range of other environmental and land management monitoring systems and purposes.
- Support to build national capacity for analysis of satellite imagery for forest monitoring through a series of regional workshops around the world between 2009 and 2011.

Produced (current status):

1. Several meetings have been held to bring together key actors and to decide on objectives and approaches on international assessments and monitoring of forests and forest changes. An Expert Consultation on Global Forest Resources Assessment was held in Finland 12-16 June 2006. This Consultation provided preliminary input for the user needs assessment for forest area and forest changes at global and regional scales as well as guidance for future global forest assessments. (<http://www.fao.org/forestry/fra-kotka5/en/>).

A preliminary Task Group Meeting was held in October 2006 and resulted in a revised description of the workplan. At the same time a UNEP/FAO Technical Meeting (sponsored by NASA) was held on the methodology and implementation aspects of the planned FRA 2010 Remote Sensing Survey with the attendance of all the Lead Organizations for this Task.

2. A working paper has been prepared Options and recommendations for a global remote sensing survey of forests (Ridder, FAO 2006) available at: <ftp://ftp.fao.org/docrep/fao/010/ai074e/ai074e00.pdf>

Activities (operations or work processes through which resources are mobilized to produce specific outputs; outlined in the form of milestones including timelines)

Planned:

1. Remote sensing data acquisition for annual MODIS data from 2000 to 2005 wall-to-wall globally and processing into Variable Cover Fraction (VCF) tree cover products.
2. Collect Landsat data from 2005, 2000, 1990 and where possible 1975 for the systematic sampling design with 20 x 20km samples selected at the junction of every latitude and longitude line around the world (more than 13,000 sites). These will be processed into draft land cover products by JRC and FAO and will then be validated by leading experts in over 150 countries.
3. Set up and maintain a website for access to download remote sensing imagery during the Pilot Study 2008.
4. Set up and maintain an advanced data portal for access to download remote sensing imagery and ancillary data as well as an uploading facility for validated results from countries during 2009.
5. Develop and distribute image viewing, interpretation and labelling software during 2008, test with countries 2009.
6. Test the survey methodology with at least 15 countries during a Pilot study in 2009.
7. Identify participating national RS agencies and regional implementation agencies in 2009 and 2010.
8. National and Regional interpretation and validation of draft land-cover sample data 2009 and 2010.
9. Hold between 10 to 20 regional validation workshops around the world during late 2009 and 2010.
10. Link with other organisations and projects and coordinate to develop partnerships and joint approaches/synergies including GLCN, GOF-C-GOLD, GEO, UN-REDD, and UNEP-WCMC.
11. Data processing and analysis of data at regional, biome and global levels during 2010 and 2011.
12. Produce a final report and undertake communication of the results by the end of 2011.

FRA-SAR radar component

Recognising the difficulties and gaps in many optical satellite image datasets especially due to cloud cover in the humid-tropics a research component of the project is being done by the University of Jena to develop methods to use TerraSAR-X and ALOS radar data to enhance national and international forest mapping assessments. The component tasks include:

1. Identification of high-cloud areas within the FRA sample framework.
2. Selection of acquisition and analysis of TerraSAR-X radar data for 350 identified areas.
3. Develop methods for processing and image analysis, to map the six forest classes required by FAO based on TerraSAR-X data.
4. Develop methods for radar multi-frequency composite analysis for enhanced forest structure mapping.

5. Develop training materials for courses for the national and regional experts to assist them using TerraSAR-X analysis for application of forest mapping in areas of persistent cloud cover.

Progress (current status):

1. A contract has been prepared with South Dakota State University (SDSU) for the preparation of the MODIS imagery, VCF analysis and Landsat imagery extraction from USGS and pre-processing.
2. The extraction, evaluation and pre-processing of the 13 500 samples of Landsat data for 1990, 2000 and 2005 has been completed by SDSU
3. The Pilot Study website has been completed: <http://globalmonitoring.sdstate.edu/projects/fao/index.html>;
4. A draft data portal which will enable authorised access to the imagery and auxiliary information on-line has been developed by FAO and tested for downloading and uploading of validated results by countries.
5. Draft (beta) computer software has been developed for image viewing, analysing and labelling of imagery during 2008. This was used in the Pilot Study workshop held in March 2009 with planned revised version to be developed and planned for release for countries involved in the survey in late 2009.
6. A workshop was held for 22 countries involved in the Pilot Study of the FRA 2010 Remote Sensing Survey (RSS) between 30 March and 3 April in Rome. Presentations by FAO and partners involved in the work including researchers from the EC Joint Research Centre and South Dakota State University are available through the FRA RSS meetings page: <http://www.fao.org/forestry/55919/en/>
7. Country focal points have been nominated by 22 countries with more to be invited during 2009.
8. Planning is well underway for a workshop for Central African countries from 28 Sept to 9 October in Kinshasa, DR Congo.
9. A series of workshops is being planned for 2009 and 2010 by JRC and FAO.
10. Relationships have been built with related organisations and projects through presentations on the FRA RSS:
 - 2nd GEOSS Asia-Pacific Symposium: The role of Earth observations in tackling climate change. <http://www.prime-intl.co.jp/geoss/announcement.html>
 - GOFc-GOLD 3rd Land cover symposium, Jena, Germany Oct 2008. <http://www.gofc-gold.uni-jena.de/sites/Jena08.php>
 - GEO Forest Monitoring symposium – Brazil Nov 2008 - <http://www.dpi.inpe.br/geoforest/>
 - REDD-Capacity Development Workshop on: “Land area change assessment: The experience of existing operational systems” Brazil Feb 2009. http://www.inpe.br/noticias/noticia.php?Cod_Noticia=1737
 - 33rd International Symposium on Remote Sensing of Environment (ISRSE) – 4 papers were presented on FRA related work; One by FAO, two from JRC and one from Jena on SAR at the Stresa conference, May 2009. <http://www.fao.org/forestry/55919/en/>
 - GEO Forest Monitoring workshop – Thailand June 2009. <http://conference.gistda.or.th/2ndgeoforest/> ; http://conference.gistda.or.th/2ndgeoforest/index.php?option=com_content&view=article&id=60&Itemid=72
11. Data processing is underway for preparing draft land cover samples at JRC and FAO.
12. A special study on forest degradation including fragmentation has been initiated by FAO and a technical workshop planned at FAO in Rome September 2009.

Progress on FRA-SAR radar component

1. High cloud cover areas have been identified and a process developed for prioritising and selecting sample locations for testing with TerraSAR-X imagery. <http://www.frasar2010.uni-jena.de/sites/studyarea.html>
2. Initial purchases and testing of methods for the use of TerraSAR-X imagery has begun in mid 2009.

Resources (indication of resources – e.g. financial, human – contributed by GEO Members or Participating Organizations to produce outputs)

The majority of the funding has been secured – firstly with thanks to in-kind contributions from the EU Joint Research Centre and the South Dakota State University (funded by the EC and NASA respectively) for initial meetings and technical input. NASA and the Governments of Finland and Australia contributed funds for initial start-up phase of the project in 2007 and 2008. The European Commission is funding the major work of the project with a grant of Euro 3.6 million for the project to be operational from 2009 to 2011. France has seconded a junior professional APO and has contributed additional funds for purchasing imagery for Africa. The FRA-SAR project is funded by German DLR and BMBF. More information on this component is available from <http://www.frasar2010.uni-jena.de/index.html>

Capacity Building Component

1) Does this Task have a capacity-building component? If so, please provide a short description of this component including a description of end users.

A series of capacity building workshops are planned for 2009 and 2010 as part of the project to be run by both FAO and the JRC. The JRC workshops will include land cover validation with regional experts at the JRC in Italy and capacity building workshops in developing countries.

Planning is well underway for a workshop to be held for Central African countries from 28 Sept to 9 October in Kinshasa, DR Congo. Approximately 15-20 participants are expected to attend. A training handbook, describing the methodology used for processing radar data will be prepared for forest experts and used in training courses to allow for the use of SAR-data in locations with persistent cloud cover.

2) Have any additional CB needs for this Task been identified? Please provide a short description.

There is a large need for better access to satellite image data and processed products free of charge or at low costs for developing countries to improve their ability to improve their information and management of forests.

The building of capacity to view, analyse, process, and store the satellite imagery is also an urgent need in many countries.

User Engagement Component

(please briefly describe to what extent end users are engaged in this Task and influence the nature of the outputs produced)

There has been active engagement of a wide range of stakeholders including national governments as the primary end-users of the results from this work. Consultations described above in 2006 at Kotka and 2007 and 2008 with NASA and key remote sensing specialists and agencies have helped shape the current task design. National government experts are actively engaged with 22 countries (representing over 80% of the world's forest area) involved in the Pilot Study during 2009. More than 150 countries will be involved in the full scale implementation of this task during 2009 – 2011.

Two workshops have been held by the Joint research Centre of the EC with European countries in a European Pilot Study in February and June 2009. The TREES group of the European Commission Joint Research Centre is also a key partner and has been developing forest and land cover maps for many years and is working with national experts on validating the results for the FRA RSS in humid tropical areas:

<http://gem.jrc.ec.europa.eu/index.php/pages/GlobalForestResourceMonitoring/4>

GEO groups have been widely consulted and well informed of the task through attendance and presentations at several GEO meetings outlined above. FAO is actively involved as a Co-Lead in the related GEO Forest Carbon Tracking Task (CL-09-03).

Science and Technology (S&T) Component

The project teams at FAO and in the various FRA partner organisations (JRC, SDSU and Jena University) are all developing new techniques for forest monitoring using remote sensing data at a high scientific level. Researchers at these organisations have been at the leading edge of research in their respective fields and published many peer-reviewed journal articles (e.g. see <http://gem.jrc.ec.europa.eu/index.php/publications>).

Close cooperation has been pursued with the scientific community (e.g. through GOF-C-GOLD) has been established for purposes of evaluating the methods and validation. FRA sites have the potential to be used as validation sites for other GEO tasks and we are close co-operation with the Forest Carbon Tracking Task (CL-09-03).

Four papers were presented on FRA related work by project partners (FAO, Jena University and 2 papers by JRC) at the International Society of Remote Sensing of Environment (ISRSE) – 4 papers were presented on FRA related work by FAO, two from JRC and one from Jena on SAR at the Stresa conference, May 2009.

<http://www.fao.org/forestry/55919/en/>

One of the major barriers to wider uptake of remote sensing techniques for analysis of forest cover and change detection is the high costs and difficulty of access to data, especially for developing countries.

The Task Group has identified at least one other technical constraint for reporting here: NASA has done an excellent service in providing Landsat imagery available free of charge. The new geo-rectification process has been run for 1990, 2000 and 2005 to improve the co-registration of imagery overcoming a constraint identified in earlier reports. However, NASA has not developed similar methods for processing the 1975 data which would be highly desirable for this study to extend the times series back 30 years. In many cases this would take countries back to times before there were large scale forest disturbances from industries processes or agricultural expansion and thus would be a valuable reference point for deforestation and degradation analyses.

Members and POs' Contributions to Outputs and Activities above:

FAO

FAO is leading the efforts of this task in collaboration with JRC, SDSU and Jena University (below). FAO is developing techniques for processing and classifying the satellite imagery and developing software for viewing and labelling Land-cover and Land-use classes. FAO is developing a portal to host the data and enable easier access for countries to download the data for validation and upload the results. FAO will also support countries with a series of capacity building workshops around the world during 2009 – 2011. There are 3 full-time staff working on the project with a number of consultants for additional specialist tasks.

<http://www.fao.org/forestry/fra;>

<http://www.fao.org/forestry/fra2010-remotesensing/en/>

European Commission Joint Research Centre (JRC)

The JRC Global Forest Monitoring activity (TREES-3) is funded by the European Commission and runs from 2007- 2013. The main goal is to improve present knowledge of the extent of and change in tropical and boreal forest cover. The main objective in connection to the GEO FRA task is to reduce uncertainties in global estimates of forest cover change and related biosphere-atmosphere processes. TREES-3 will make intensive use of most recent satellite remote sensing technology and builds on many years research of the previous JRC TREES projects.

<http://gem.jrc.ec.europa.eu/index.php/pages/GlobalForestResourceMonitoring/4>

<http://ies.jrc.ec.europa.eu/index.php?page=action-42003>

The JRC European forest group are also supporting the FRA implementation in Europe through cutting edge work using high resolution(30 metre Landsat based) wall-to-wall forest cover maps of Europe for 1990 and 2000 and developing a new map for 2006 and then analysing changes over time using object based classification.

<http://ies.jrc.ec.europa.eu/the-institute/units/land-management-and-natural-hazards-unit/action-22003.html>

South Dakota State University (SDSU)

The Geographic Information Science Center of Excellence (GIScCE) is a joint collaboration between South Dakota State University (SDSU) and the United States Geological Survey's National Center for Earth Resources Observation and Sciences (EROS). The purpose of the GIScCE is to enable South Dakota State University faculty and students, and EROS scientists to carry out collaborative research, seek professional development, and implement educational programs in the applications of geographic information science. The GIScCE is working with the FRA project to provide scientific advice and technical data processing on MODIS imagery to produce the VCF tree cover maps and extracting the Landsat imagery from USGS and pre-processing for FRA analysis. <http://globalmonitoring.sdstate.edu/>

Friedrich-Schiller-University Jena

The FRA-SAR 2010 component will use analysis of state of the art Synthetic Aperture Radar (SAR) satellite data to help overcome the data gaps and FRA partners at Jena University in Germany will undertake research on application of these techniques with support from the German Government (DLR/BMBF). For more information on the FRA-SAR work and the location of the study areas please go to the FRA-SAR website: <http://www.frasar2010.uni-jena.de/>

GOFC-GOLD

Lead by the land cover project office, GOFC-GOLD supports the global remote sensing survey through scientific and technical expertise, contributing research and implementation projects from its members, and regional partners and expertise within its regional networks (i.e. for capacity development). The FRA RSS will be a component in the ongoing global land cover validation exercises that help with the independent international validation of the RSS and make best use of the FRA RSS results for to achieve a more robust global accuracy assessment of global land cover mapping and monitoring products. <http://www.gofc-gold.uni-jena.de/index.php>

Germany

DLR DFD-L: Contributions to the FRA-SAR component and ESA GMES FOREST MONITORING Project.

Japan

FFPRI: Collecting forest cover type maps which were produced in Japan. These dataset will take part in global and regional forest mapping from satellite and other data as reference data

GSI: To generate map based on the new specifications in cooperation with the task contributors.

JAMSTEC: In situ measurement of above-ground forest biomass in boreal regions and development of estimation algorithm by satellite remote sensing.

JAXA: To contribute the outcomes derived from the ALOS Kyoto and Carbon initiatives.

Netherlands

WUR: Development and documentation of algorithms, methodologies and products (land classification and change mapping) for humid tropical regions; capacity building.

SarVision: Development and demonstration of operational methodologies; production of maps for selected test-sites (reference data sets).

Spain

Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA): Participating organization in the ESA Project, Forest Monitoring. Development of methodologies to use MERIS-ENVISAT images to chart forestry maps.

UK

CTCD, Sheffield: R&D and development of demonstrator for REDD - related monitoring using ALOS-PALSAR and other EO data.

CEOS

USGS: Compile mid-resolution LSI data sets over Southern South America, Southeast Asia, and part of Africa.

EC

EuroGEOSS will contribute GEOSS components for forest mapping and monitoring.

Participation

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