
D3.9 Design Specifications and implementations of the FAO - EuroGEOSS Web-based geo-information services

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Creator	Erik Lindquist (FAO)
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ACRONYMS AND ABBREVIATIONS

Abbreviation	Name
ADC	Architecture and Data
AIP-2	Architecture Implementation Pilot, Phase 2
AOC	Advanced Operating Capacity
BPMN	Business Process Modelling Notation
CIF	Climate Investment Funds
CSR	Components and Services Registry
DOPA	Digital Observatory of Protected Areas
DoW	Description of Work
E2EDA ER	End to End Discovery and Access Engineering Report
GCI	GEOSS Common Infrastructure
GUI	Graphical User Interface
FAO	United Nations Food and Agriculture Organization
FAOC	Forest Advanced Operating Capacity
FIOC	Forest Initial Operating Capacity
IOC	Initial Operating Capacity
JRC	Joint Research Centre
OWS	OGC Web Services
SBA	Societal Benefit Area
SIR	Standards Registry System
SWG	Scenario Working Group
UIC	User Interface Committee
UNEP	United Nations Environment Programme.
WCMC	World Conservation Monitoring Centre
WCS	Web Coverage Service
WFS	Web Feature Service
WG / WP	Working Group / work package
WMS	Web Mapping Service
WPS	Web Processing Service
XPDL	XML Process Definition Language

1 INTRODUCTION

The goal of this task is to provide national level forestry statistics and metadata compiled from the United Nations Food and Agriculture Organization's Global Forest Resources Assessment (FRA) for use in national, regional or global analyses. Since 1948, the FAO publishes the FRA report every 5 to 10 years. It summarizes forestry statistics reported by all 233 countries around the world. The 32 FRA global data tables cover a wide range of forestry information from forest area and change to policy and legal framework issues; all linked to a specific country or territory. The FRA tabular attributes can thus be joined geographically with country political boundary spatial data layers. None of the FRA data tables are currently available via OGC Web Services WMS/WFS. Results of the integration of FRA data layers within the EuroGEOSS framework can provide several web-services not available in the original FAO's FRA dissemination tool such as be queried on-line at the national and multi-national level and integrated into assessments as background information, used for statistical comparisons, or increase the temporal span of assessments and to support the formulation of forest policies.

In 2010, the FRA included an independent remote sensing-based survey (RSS) of global forest land use. The RSS is a collaborative project between the FAO and the Joint Research Centre of the European Commission (JRC) and integrates the work of the JRC TREES, FOREST and MONDE research groups. The RSS is based on land cover and land-use classifications of a one-degree (e.g. one site located at each degree of latitude and longitude) systematic sample of Landsat satellite imagery from the years 1990, 2000 and 2005 (fig. 1). The RSS database contains nearly 7 million individual polygons of classified land cover, land use and change (fig. 2).



Figure 1 . The location of the 13 689 sample sites of the RSS systematic survey.

The scenario that will be developed within the context of this research will allow a user to query and produce summary statistics, with corresponding estimates of precision, of land cover, land use and change information for a user-defined area of interest. This information can be integrated into assessments as background information on forest area and change, extend the temporal span of the analysis and used for statistical comparisons against other existing data.

The data for this scenario will be maintained and hosted by the FAO and will in time be federated within the EuroGEOSS Discovery Broker and in turn contribute to the GEOSS Data Core. Within the context of this document, the FAO OGC services will be discussed with respect to the existing viewers that have been developed within WP3.



Figure 2. The satellite imagery (left), the land use classification (center) and the changes between time periods (right) for a RSS sample site in Australia. At each RSS sample site worldwide, land cover and land use are classified and changes between time periods are recorded.

1.1 FAO Systems Architecture

GeoNetwork –

FAO have initiated an instance of GeoNetwork to host the FAO FRA metadata records. FAO metadata have been created for each of the FRA forestry statistics datasets conforming to the ISO19139 standard (Figure 3). This catalogue has been federated within the EuroGEOSS Discovery Broker and it has also been successfully harvested by the EuroGEOSS Forest Metadata Catalogue.

The end-point for the FRA Metadata catalogue is accessible here:

<http://foreststats.org/geonetwork/srv/en/main.home>

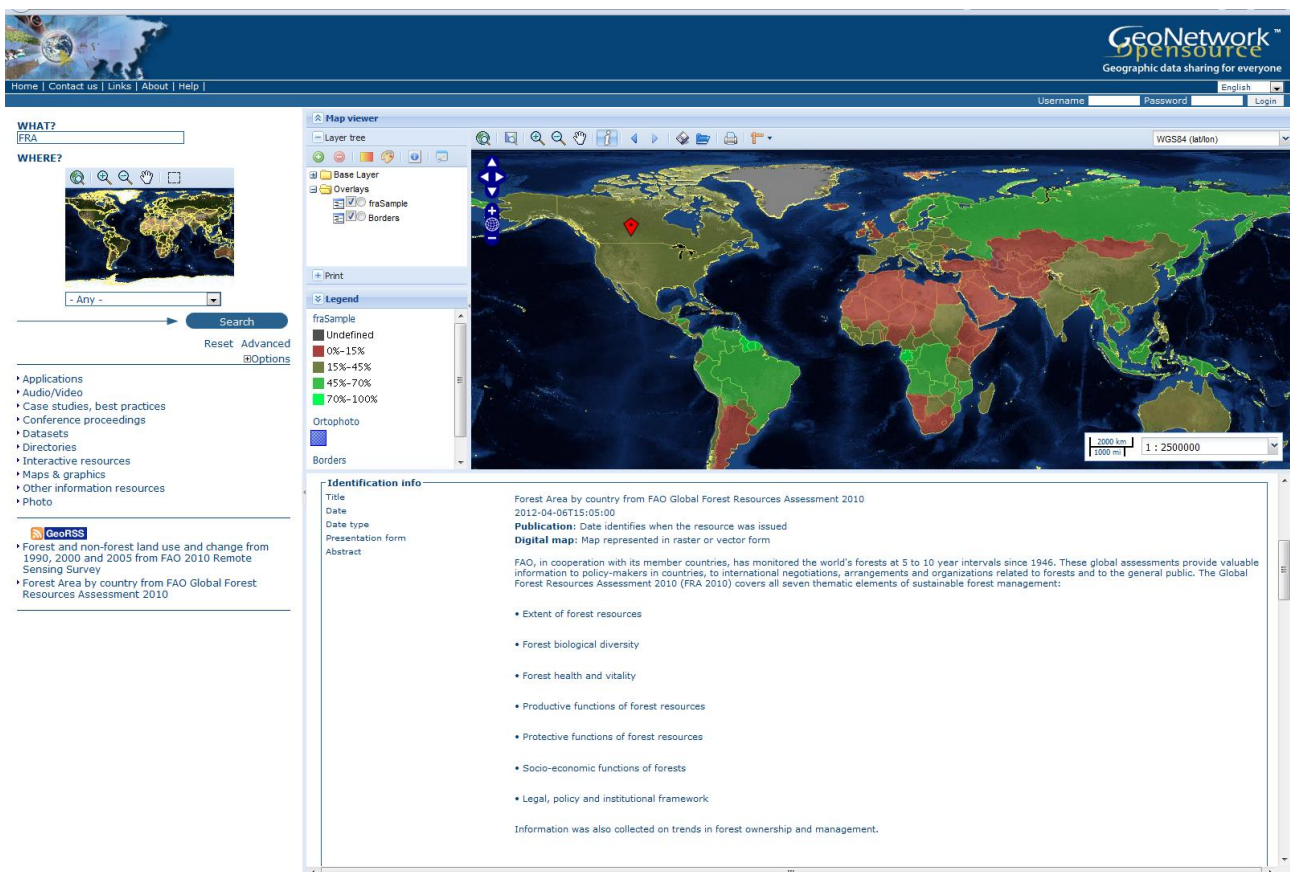


Figure 3 FAO FRA GeoNetwork Metadata catalogue

Geoserver –

FAO have also initiated an instance of GeoServer for the storage and publication of the geographic data corresponding to the metadata records contained in the Geonetwork. Geographic data are stored in a PostgreSQL/PostGIS database and the layers are now available as OGC WMS and WFS layers. Specific to this project, the FRA data will be accessible in a simple web-based viewer, the EuroGEOSS Forest Map Viewer and the services will be federated within the EuroGEOSS discovery broker. The variables that have been published include the extent of forest and other wooded land statistics per country. Appendix 1 includes a full list of variables that will be published within the FAO server.

The end-point of the WMS and WFS services are as follows:

<http://foreststats.org/geoserver/ows?service=wms&version=1.3.0&request=GetCapabilities>

<http://foreststats.org/geoserver/ows?service=wfs&version=1.1.0&request=GetCapabilities>

WPS –

The Web Processing Service technology that will be developed as part of the Advanced Operating Capacity will be based on PyWPS, a Python WPS environment. PyWPS is light weight, but it enables processes to access underlying geo-spatial and analytical software, such as GDAL/OGR, GRASS-GIS , R Statistics and indeed a plethora of UNIX/Linux programs. The scenario will be

Based on these technologies, the Forest WP will focus on the development of standard WPS services that will be used to analyse forest thematic data primarily from the JRC EFFIS and EFDAC services, but also in conjunction with other thematic data, such as drought and biodiversity information. Initially the WPS services will consist of standard spatial analytical tools, such as: R routines for analysing forest area and forest area change will be encapsulated within Python and accessible from PyWPS.

The integration of the FAO FRA and RSS data within the EuroGEOSS WP3 architecture is presented in Figure 4 and demonstrated within the WP3 FAOC viewer in figure 5. The WMS and WFS allow for the FRA and RSS data to be visualized from any GIS client, including the EuroGEOSS map client. With respect to the latter platform, the WMS services are registered within the system, and users can load the individual layers to the map canvas and view them with respect to other forest layers from the JRC's European Forest Data Centre (EFDAC) and the e-Forest platform.

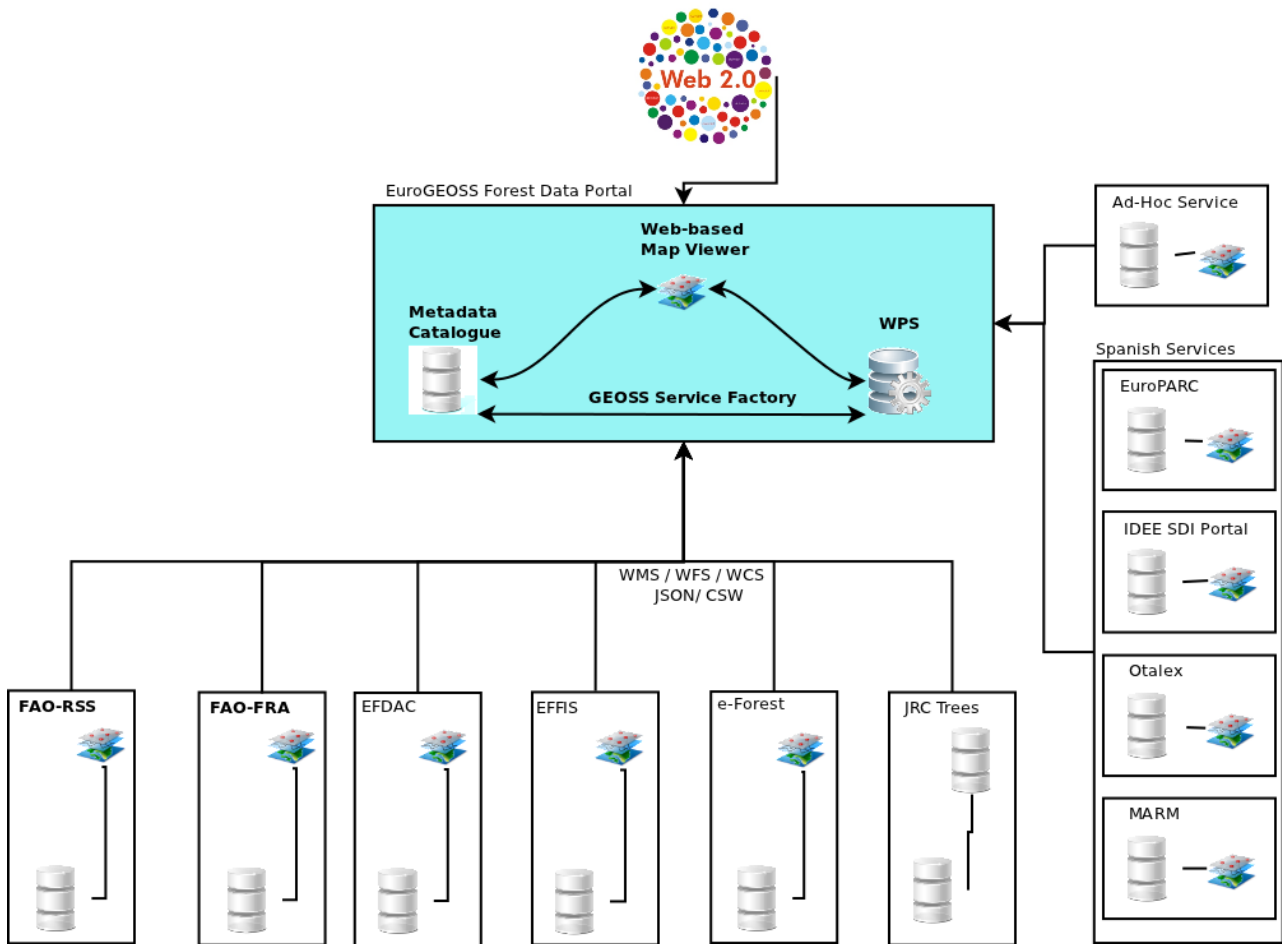


Figure 4 WP3 Architecture with FAO Services

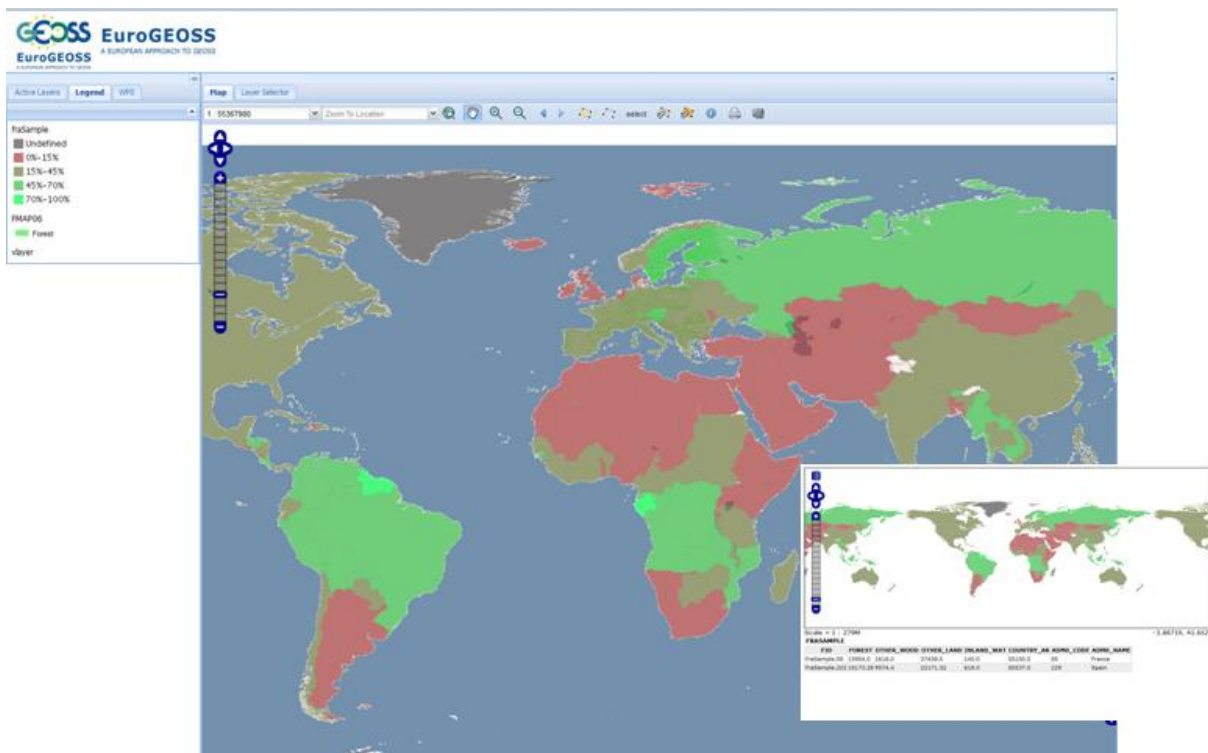


Figure 5 Integration of FAO data into WP3 viewer

Furthermore, with the RSS data published for Spain, it provides a unique means of testing the TREES-3 Validation Tool that has been developed within the EuroGEOSS project.

1.2 Actors

1. The Forestry Department of the Food and Agriculture Organization of the United Nations. The Global Forest Resources Assessment (FRA) is a report published by the FAO every five to ten years since 1948. The FRA report is a compilation of individual county reports of forestry and forestry-related statistics and is meant to indicate the state of the World's forests with respect to key forest attributes.

The 2010 Remote Sensing Survey (RSS) is a systematic sample of the World's forests based on satellite remote sensing data from 1990, 2000 and 2005. Land cover and land use are classified for a 10x10 kilometre site at each one degree intersection of latitude and longitude. Globally, there are over 7 million individual polygons for over 13 000 sample sites.

2. The Joint Research Centre of the European Commission and specifically the Forest Action and TREES Action from the Institute of Environment and Sustainability. These groups deal

specifically with the use of forest geo-information to monitor forests as well as for policy support to the EU.

3. End-users: Forestry experts, forest managers, forest and environmental researchers, educational users, individual users. Forestry policy makers
4. Users of TREES application: editing user (registered guest), administrator user, viewing user.

2 USE CASE SCENARIOS

The FRA use case scenario will be implemented through and integrated with the forest cover change WPS (EuroGEOSS, 2011). The implementation of the WPS in the FRA use case scenario will consist of two sub-scenarios:

- (i) Retrieve, query and summarise FRA tabular data;
- (ii) Retrieve, query and summarise FRA Remote Sensing Survey sample data.

For both sub-scenarios, the user searches (CSW/WMS/WFS) for forest data from the FRA dedicated Metadata catalogue. From there, they can select the preferred thematic layers. Next, the user selects the geographic area of interest for which the statistics should be retrieved. Likewise, the user could select the preferred thematic layers available in the Forestry Map Viewer or from the various other systems accessible by the broker.

The nature of the FRA tabular statistics precludes sub-national analysis thus, for (i) only countries or country grouping in their entirety can be selected for analysis. Information from the FRA Remote Sensing Survey in (ii), however, could be summarized for any suitably-sized geographic area (there should be a minimum size requirement). In case (ii), confidence intervals will be generated with all statistics.

In either sub-scenario, FRA data could be used to produce summary results by themselves in the form of graphs, tables or chloropleth map products (via WMS/WFS) (Figures 6-8) or augment any other results desired from the available forest thematic layers.

The FRA dedicated GeoNetwork metadata catalogue and associated Geoserver, will be integrated into the EuroGEOSS Forest Map Viewer as well as in the EuroGEOSS Discovery Broker. This will increase the visibility of the databases and allow them to be searched by users from different disciplines.

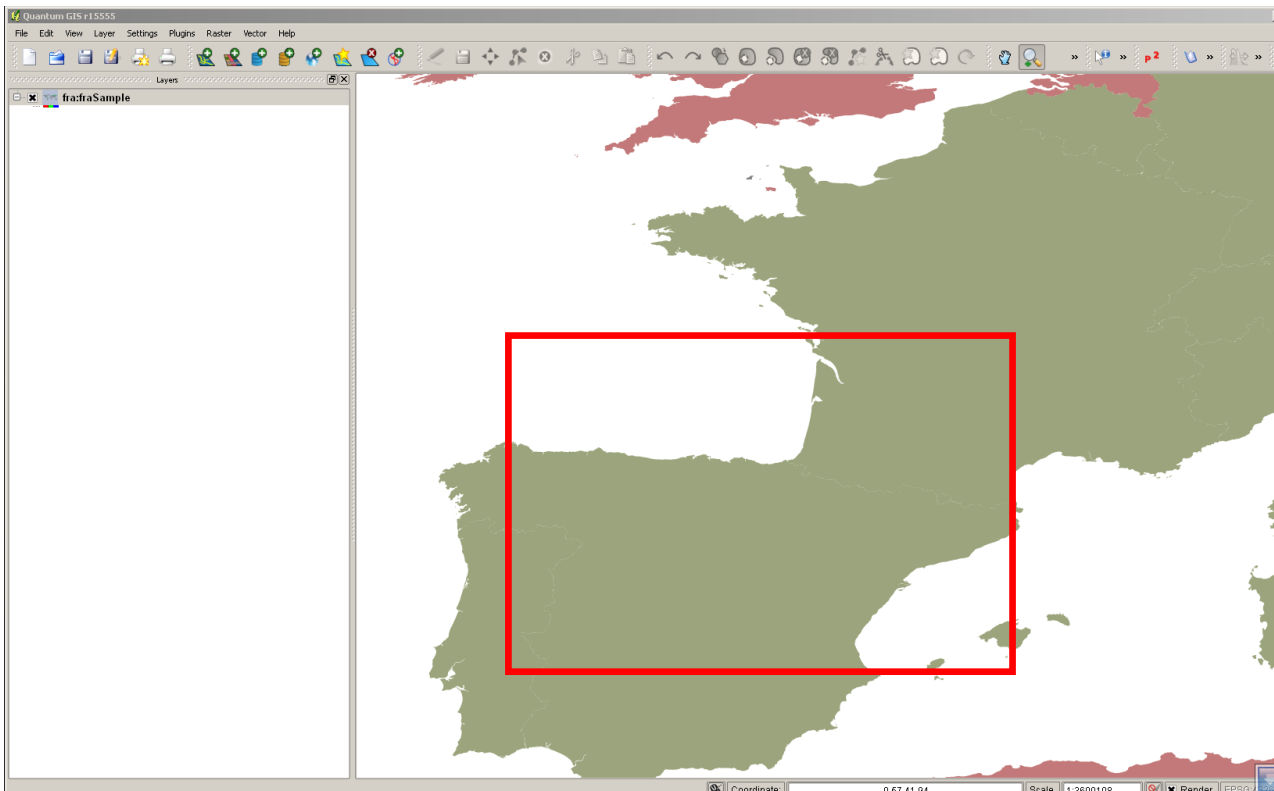


Figure 6 Example of a selection of Area of Interest

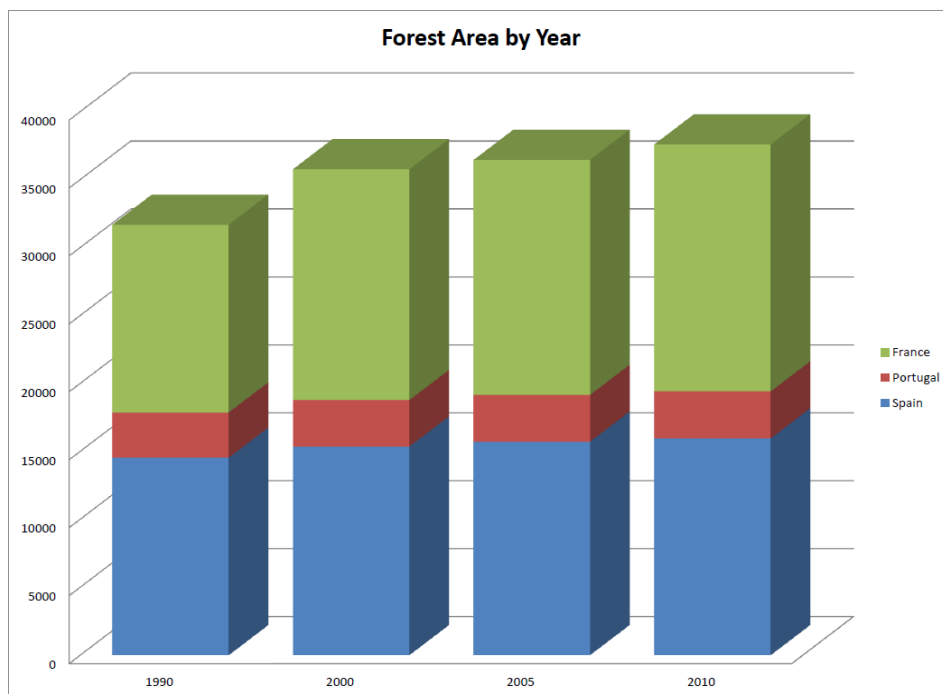


Figure 7 An example of forest area by year for the selected area of interest.

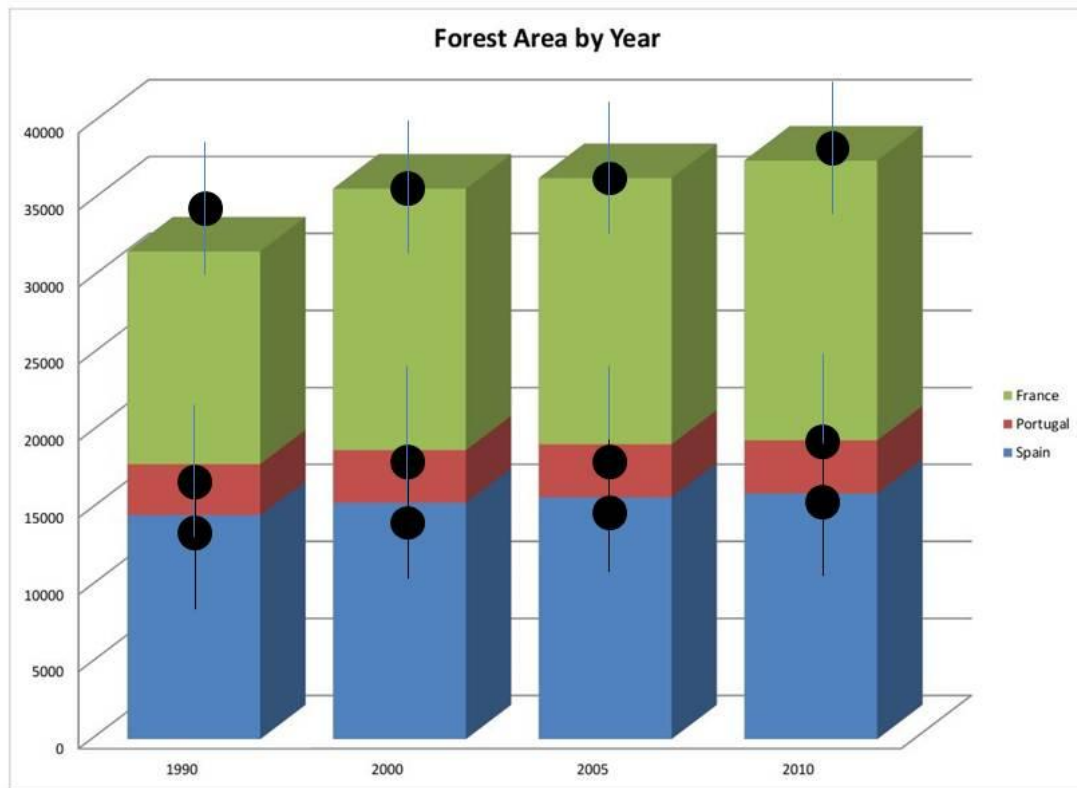


Figure 8. Same as figure 5 but with simulated results from the sample-based FRA Remote Sensing Survey (RSS) overlaid. RSS data allow estimates of statistical precision. The two estimates taken together form the basis for multi-scale assessments of regional forest

2.1 Scenario 1 – FRA Chloropleth Analysis

Brief Summary
<p>This WPS will focus on regional or national scale analysis of forestry statistics collected by the Global Forest Resources Assessment (FRA) of the FAO. Key forestry statistics such as forest area, forest type, forest uses and others are summarized at the national level but can be queried and combined at regional level or country groupings to produce results suitable for general assessment of forest characteristics. Allowing the FRA data to be analyzed in a web-based processing environment will facilitate the use of the FRA statistics by a wider range of users and enable rapid regional assessments.</p>
Actors
<p>Users:</p> <ol style="list-style-type: none"> 1. The Forestry Department of the Food and Agriculture Organization of the United Nations. The Global Forest Resources Assessment (FRA) is a report published by the FAO every five to ten years since 1948. The FRA report is a compilation of individual county reports of forestry and forestry-related statistics and is meant to indicate the state of the World's forests with respect to key forest attributes. <ul style="list-style-type: none"> The 2010 Remote Sensing Survey (RSS) is a systematic sample of the World's forests based on satellite remote sensing data from 1990, 2000 and 2005. Land cover and land use are classified for a 10x10 kilometre site at each one degree intersection of latitude and longitude. Globally, there are over 7 million individual polygons for over 13 000 sample sites. 2. The Joint Research Centre of the European Commission and specifically the Forest Action and TREES Action from the Institute of Environment and Sustainability. These groups deal specifically with the use of forest geo-information to monitor forests as well as for policy support to the EU. 3. End-users: Forestry experts, forest managers, forest and environmental researchers, educational users, individual users. Forestry policy makers 4. Users of TREES application: editing user (registered guest), administrator user, viewing user.
Scenario options

step	General scenario option description
1	The end-user through WMS services (CSW/WMS/WFS) searches, accesses and visualizes forest area and area change statistics for countries or country groupings. These are returned as a table, chart or chloropleth map.
2	The end-user through WMS services (CSW/WMS/WFS) searches, accesses and visualizes forest area and area change statistics for suitably-sized geographic areas. These are returned as a table or chart with desired statistical summaries and associated confidence intervals.
3	The end-user can access other appropriate datasets as available via the broker from other participating sites and institutions.
4	The query is sent and processing completed using WPS which summarizes the individual country statistics for the countries selected under the area of interest and returns the results in the desired format.
5	In the absence of any better information, the FRA statistics can serve as national or regional summaries or a baseline upon which to base more detailed analyses. Trends between FRA data and other data collected for similar geographic regions can also be compared.
Post-Conditions	
N/A	
Special Requirements	
N/A	
References	
www.fao.org/forestry/fra	

2.2 Scenario 2 – FRA RSS Multi-scale analysis

Brief Summary

This WPS will focus on the multi-scale analysis of forest resource data primarily using the FRA RSS tiles. The RSS sample sites enable forest area and forest area change statistics to be generated for 1990, 2000 and 2005, with associated confidence intervals, for any suitably large geographic region. RSS results can also be compared with data from the EuroGEOSS Forest Change WPS that is based on the forest maps published by EFDAC.

This scenario offers users and scientists a new and dynamic way of accessing, interacting and analyzing the FRA RSS data.

Actors

Users:

1The Forestry Department of the Food and Agriculture Organization of the United Nations. The Global Forest Resources Assessment (FRA) is a report published by the FAO every five to ten years since 1948. The FRA report is a compilation of individual county reports of forestry and forestry-related statistics and is meant to indicate the state of the World's forests with respect to key forest attributes.

The 2010 Remote Sensing Survey (RSS) is a systematic sample of the World's forests based on satellite remote sensing data from 1990, 2000 and 2005. Land cover and land use are classified for a 10x10 kilometre site at each one degree intersection of latitude and longitude. Globally, there are over 7 million individual polygons for over 13 000 sample sites.

2. The Joint Research Centre of the European Commission and specifically the Forest Action and TREES Action from the Institute of Environment and Sustainability. These groups deal specifically with the use of forest geo-information to monitor forests as well as for policy support to the EU.
3. End-users: Forestry experts, forest managers, forest and environmental researchers, educational users, individual users. Forestry policy makers
4. Users of TREES application: editing user (registered guest), administrator user, viewing user.

Scenario options	
<p>The forest change mapping scenario will be implemented through WPS. The implementation of WPS in Forest change mapping scenario will follow this line: the user searches (CSW/WMS/WFS) the forest data from different systems (EFDAC, E-forest, Spanish forest data) and selects the preferred forest thematic layers. Later the user searches (CSW/WMS/WFS) data from other thematic area available in the Forestry Map Viewer (EuroParc, biodiversity, droughts data) and selects the preferred layers. Within the common Map Viewer through the developed WPS the user overlays those in combination with the layers from other thematic areas or other data on forest in order to perform various analyses, for instance: calculation of forest loss and gain in protected areas over certain period.</p> <p>With respect to the analysis of spatial pattern according to the 3 classes (forest gain, forest loss and stable forests within the period 1990-2000) within protected areas, the pseudo-code for WPS will broadly consists of the steps describes below.</p>	
step	General scenario option description
1	Summaries by region, ecozone or other large geographic region are desired in order to obtain a depiction of forest area and area change.
2 3	The end-user selects the statistics of interest (forest area, proportion forest gain, proportion forest loss, net change in either proportion or real numbers) and desired confidence interval and then selects the output format for the results (either table or chart).
4	The end-user selects the statistics of interest (forest area, proportion forest gain, proportion forest loss, net change in either proportion or real numbers) and desired confidence interval and then selects the output format for the results (either table or chart).
5	The results are returned in the desired format with confidence intervals in the appropriate format. In some cases, the confidence interval can be greater than the mean value.
6	The query is sent and processing completed using WPS which summarizes the selected statistics for the area of interest and returns the results in the desired format.

Post-Conditions	
N/A	
Special Requirements	
N/A	
References	
www.fao.org/forestry/fra	

www.fao.org/forestry/fra

References

EuroGEOSS, 2011. *D.3.2b: Report on the Design Specifications for EuroGEOSS Forestry Components and Interfaces (FAOC)*, available at: <http://www.eurogeoss.eu/>.

GeoNetwork, 2011. <http://geonetwork4.fao.org/geonetwork/srv/en/fra.home>

Appendix 1 - List of FRA Data tables

1. Extent of forest and other wooded land (1 000 ha) by country, FRA categories and year (T01FO000)
2. Rubber plantations, mangroves and bamboo (1 000 ha) by country, FRA categories and year (T04bFO00)
3. Forest characteristics (1 000 ha) by country, FRA categories and year (T04FO000)
4. Holder of management rights of public forests (1 000 ha) by country, FRA categories and year (T02bFO00)
5. Forest ownership (1 000 ha) by country, FRA categories and year (T02FO000)
6. Special designation and management categories (1 000 ha) by country, FRA categories and year (T03bFO00)
7. Forest designation (1 000 ha) by country, FRA categories and year (T03FO000)
8. Forest establishment introduced species (ha/yr) by country, FRA categories and year (T05bFO00)
9. Forest establishment total (ha/yr) by country, FRA categories and year (T05FO000)
10. Growing stock (Million m³ over bark) by country, forest/Other wooded land, FRA categories and year (T06FO000)
11. Biomass stock (Million metric tonnes) by country, forest/Other wooded land, FRA categories and year (T07FO000)
12. Carbon stock (Million metric tonnes) by country, forest/Other wooded land, FRA categories and year (T08FO000)
13. Number of fires by country, FRA categories and year (T09bFO00)
14. Proportion of planned fires and wildfires in forest (%) by country, FRA categories and year (T09cFO00)
15. Area affected by fire (1 000 ha) by country, FRA categories and year (T09FO000)
16. Disturbances affecting forest health and vitality (1 000 ha) by country, FRA categories and year (T10FO000)
17. Employment (1 000 years FTE) by country, FRA categories and year (T13FO000)
18. Proportion of females within public forest institutions (%) by country, FRA categories and year (T15bFO00)
19. Human resources within public forest institutions (number) by country, FRA categories and year (T15FO000)

20. Proportion of graduation of female students in forest-related education (%) by country, FRA categories and year (T16bFO00)
21. Professionals working in publicly funded forest research centres (% female) by country, FRA categories and year (T16cFO00)
22. Professionals working in publicly funded forest research centres (number) by country, FRA categories and year (T16dFO00)
23. Graduation of students in forest-related education (number) by country, FRA categories and year (T16FO000)
24. Public expenditure in forest sector by funding source (1 000 USD) by country, expenditure, FRA categories and year (T17bFO00)
25. Forest revenues (1 000 local currency) by country and year (T17FO000)