Project no. INCO-CT2006-015110

IRIS

Irkutsk Regional Information System for Environmental Protection
Integrating and strengthening the European Research Area

Instrument Specific Support Action

Thematic Priority Environmental Protection

Deliverable D.1.1 Quarterly report (Year I, Quarter I)

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Organisation name of lead contractor for this deliverable: Friedrich-Schiller-University Jena

Revision [draft, 1, 2, …]

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	PU
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Section 1 – Project objectives and major achievements during the reporting period

Project objectives

The Irkutsk Regional Information System for Environmental Protection – 'IRIS' assesses the current status and dynamics of the Irkutsk Region's forestry environment, influenced by man-made changes and anthropogenic impact arising from pollution sources and other negative anthropogenic drivers located in the region and in adjacent areas. It will investigate the responsiveness and vulnerability of forestry environment within the Region under different scenarios of industrial development and nature-preserving measures.

The output of the project is the adaptation of the existing GIS layers, completion and transfer into operative testing and exploitation a simplified version of the Regional Information System that serve as a prototype for other regions of Northern Eurasia. The project also includes the preparation of the detailed prospective studies and explorations aiming at the development of the efficient simulation and management tool for practical use by regional governance and nature-protection service(s). The tool will help to manage the risks associated with man-made changes and anthropogenic stress affecting the forest ecosystem of the region under investigation, as well as other regions of Northern Eurasia.

The major goal of IRIS is to efficiently share Earth Observation data and domain-specific (ecologic and economic) information within earth science community and regional governance to identify environmental impacts that are both economic and socially responsible. Thus, for integrated environmental management methodical designs are necessary which refer to the complexity of the natural resource to be managed and the difficulty to predict the factors or driving forces influencing them.

Following the principle of interoperability IRIS is planned to become part of a distributed network of similar systems where not only data is being distributed and shared, but also applications are being offered and used throughout the network. IRIS is thus using standards published by the World Wide Web Consortium (W3C®), the Open Geospatial Consortium (OGC™) or the International Organization for Standardization (ISO). On the long-term, decision makers and earth science communities will highly profit with applications, where domain-specific knowledge and information has been rigorously categorized.

Major achievements during the reporting period

IRIS builds on former Framework Programme 4 and 5 projects, extends their networks to Russia and adopts some of their findings to the specific needs of the involved governmental agency. This implements for the first time that the scientific results from former EC-funded scientific co-operations are being collected and transformed to tools for regional management by the administration. Thus, the first reporting period dealt with questions like:

What is currently available from finished and on-going projects, from consortium's heritage?
The information and methodological basis of the project intends to be developed in the form of a regional information system. The GIS being already developed by some Russian and international groups includes a number of levels highly relevant to the objectives of this study. The project supplements this GIS by other layers, adapt the system and transfer it into operative testing and exploitation. A wide dissemination of a system is planned by preparation of both CD and Internet oriented version.

What is currently available from recent technological developments?
It is a methodical challenge to derive sound parameter sets from Earth Observation data and to implement spatial tools in large regions and, at least across administrative boundaries. In this context IRIS will profit from recent technological developments, like (1) universal connectivity (internet, web), (2) comprehensive analysis environments (GIS, spatial databases), (3) standards for data, metadata and services (like OGC), or (4) communication platforms for computer-supported cooperative work.

Where did we go from here during the reporting period? There is a
- need for more structure and documentation of what is available,
- need for strategies to make data and information synergistically available (GIS-compatible),
- need to use data services to build up both, spatial high-resolution information and time series,
- need for the involvement of IRIS users in the development process.

Subsequently and according to the workplan, additional information/data are collected and investigated for the domains (1) remote sensing information, (2) information on man-made changes and stress sources and (3) the development of GIS as well as strategies for efficient communication among IRIS developers and IRIS users.

With an adequate infrastructure, Earth Observation data can serve as the base for analysing landscape structure and related socio-economic and environmental processes at multiple scales. IRIS generates and compounds domain-specific knowledge from both sides, the information providers and the information users. Besides investigating long-term regional environmental problems, Earth Observation data sets are of major relevance for providing on-demand information such as for large and partly inaccessible regions like the Irkutsk Region.

The use of satellite-based EO data and derived information for environmental applications is commonly hindered by mismatches between information user and information provider. The underlying cause is that remote sensing sensors are the front-end stage and complex data manipulation is needed in the process flow in order to meet the user's requirements for the final thematic content. The initial satellite vision system focuses on a specific spectral and spatial domain at a particular point in time. The transformation of such records into reliable information is controlled by the capabilities of image processing and expertise about the ground. Data of different EO sensors in different spectral, spatial and temporal dimensions need to be made compatible and synergistically available to be in line with user's demands. Altogether this limits the use of EO data but nevertheless EO platforms are the primary data source for up-to-date information, whereas derived landscape units are regarded as primary units for further landscape quantification and modelling. Thus, IRIS concepts set high value on advanced database integration of multi-resolution EO data/products. For concept and knowledge building, the involvement of the IRIS user community is the most challenging objective and remains an ongoing process.

Section 2 – Workpackage progress of the period

The quarterly report refers to year 1, months 1-3 (see table 1). Active Workpackages (WP) for this period are WP 2000 and WP 3000. WP 4000 is in discussion. WP 1000 is reported in Section 3.

Table 1: Reported Workpackages.

Work Package	**Year 1**				**Year 2**			
	I	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
WP 1000								
WP 2000								
WP 3000								
WP 4000								
WP 5000								
WP 6000								
Months	from 1 till 3	from 4 till 6	from 7 till 9	from 10 till 12	from 13 till 15	from 16 till 18	from 19 till 21	from 22 till 24

WP 2000 follows the break-down structure as defined in the IRIS work programme. The first nine months of IRIS are being used to firstly collect additional in-situ and remote sensing data and metadata for Irkutsk region. Tasks concern the collection of satellite remote sensing data (archived and newly obtained) for forest monitoring (WP 2100), collection of in-situ data (WP 2200), thematic processing of the collected remote sensing data and their adjustment for inclusion in regional GIS (WP 2300).

In parallel with WP 2000, implementation of **WP 3000** was also performed. During the first three months of IRIS the current man-made changes and pollution sources in the Irkutsk region are assessed (WP 3100). The hypotheses on major potential pollution sources will be also formed and carefully checked (WP 3200). Output of WP 3000 is an input for WP 4000 (start month 10).

The results of previous two workpackages will serve as an input for **WP 4000** focused on update of existing GIS for Irkutsk region. Currently, the GIS being developed for the Irkutsk region by IIASA together with a number of Russian institutions includes a number of layers (landscape, soil, vegetation, forests), which could be effectively used for the goals of the regional information system on environmental protection and anthropogenically-driven risk assessment. However, in order to serve as a basis of IRIS, the GIS requires to be supplemented and adapted to friendly user interface. This prototype of the IRIS-GIS will allow to provide an assessment of state and functioning of the regional forests, to identify areas of rapid changes, which require operative monitoring, and to estimate environmental risk in different aspects. From another side, an expert system for assessing the impacts of negative anthropogenic drivers on forests (WP 4100/3) will serve as a basis for preparing of programs of new advance studies and research initiatives.

WP 2000

Objectives

- To collect additional available remote sensing data for the region under study to update existing GIS (e.g. historical and Russian acquisitions).
- To collect additional available in-situ data for the region under study to update existing GIS.

Progress towards objectives

(1) Test site selection: Bratsk, Zima, Usolye-Sibirskoye (see figure 1).

(2) Up-to-date information on forest characteristics and changes from other projects such as GSE FM were investigated and will be substantially used (service area 2006, see figure 2).

(3) Remote sensing data search was carried out for Russian acquisitions. Archives from Planeta and the Research Centre for Earth Operative Monitoring, Russian Space Agency, Moscow (see figure 3). The focus was set on Monitor-E data.

Internal reports on:

(4) Use of GoogleEarth imagery for the generation of high resolution ground-truth data
Objective: Digitizing small-scale features (clear cuts, housing, industrial facilities etc.) from high-resolution Quickbird imagery within Google Earth-Pro software (see figure 1).

(5) Workflow for an integration of GoogleEarth high-res imagery
Objective: For validation purposes: acquisition of information (e.g. digitalization of clearcuts) from GoogleEarth's-Quickbird coverage at no cost.

(6) Preliminary Investigation on Satellite-based Atmospheric Data and Information Services
Objective: Pre-scanning of the Irkutsk Region for aerosol distribution using online data and information services (TOMS, OMI, MODIS Online Visualization and Analysis Systems and Goddard Chemistry Aerosol Radiation and Transport Model Products).

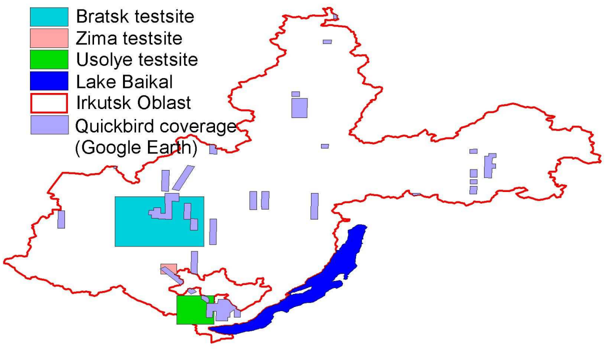

Figure 1: Selected test sites.

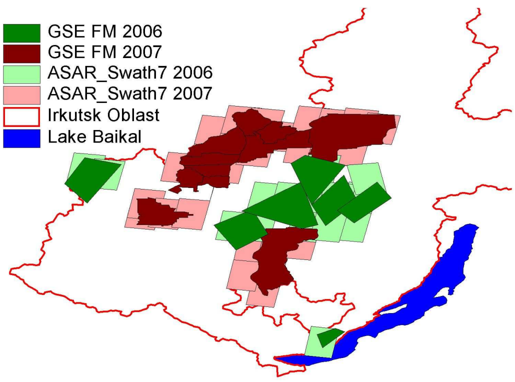

Figure 2: Forest service areas from linked projects.

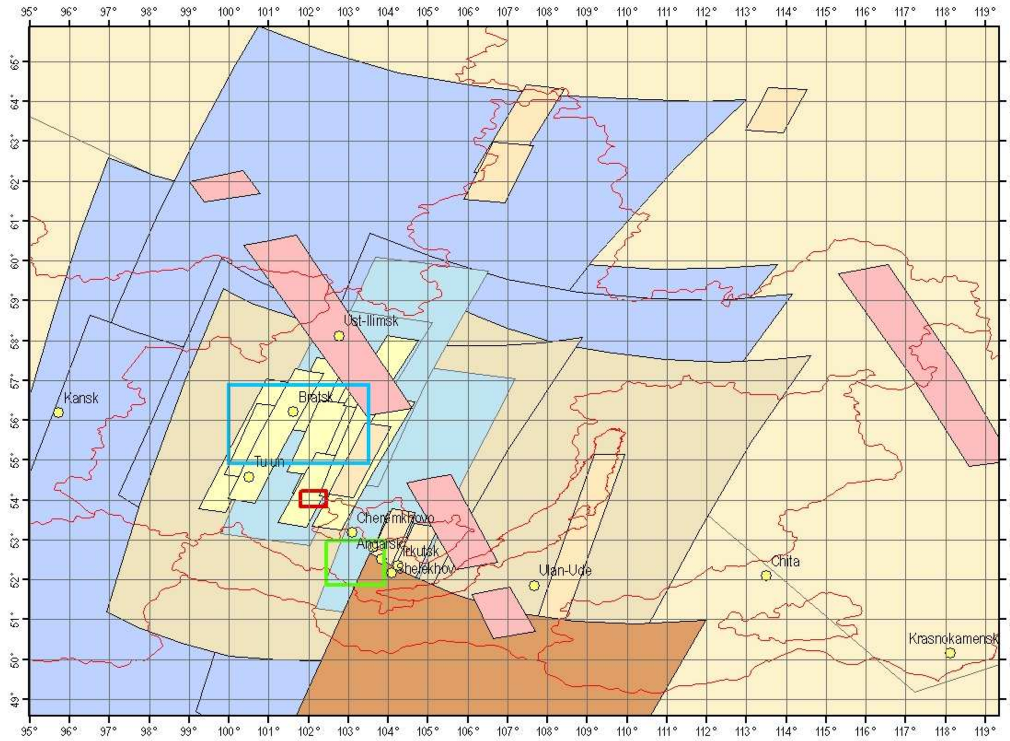

Figure 3: Recent acquisitions from Russian satellite systems for the Irkutsk Region.

Table 2: Specifications of Russian satellite systems.

satellite	device	swath width	ground resolution
Resurs-01 *2,3	MSU-E	45 km	45 m
	MSU-SK	600 km	175 m
Okean-O *1	MSU-SK	620 km	150 m
Meteor-3M *1	MSU-E	80 km	35 m
	MSU-SM	2250 km	225 m
Monitor-E *1	RDSA	150 km	20 m

Example: Monitor-E

The Monitor-E remote Earth-probing satellite is the first Russian satellite in a family of small spacecrafts, which are designed to serve as an EO constellation for environmental monitoring in regional scale. Monitor-E, launched on August 26, 2005, operates on sun-synchronous circular orbit with the orbit inclination 97.5° at an altitude of about 550 km. The instruments payload of this satellite includes two imagers, a panchromatic imager (spectral band 0.58 – 0.8 µm, spatial resolution in nadir 8 m over a 93.8-km wide swath) and a multichannel imager (spectral bands 0.54 – 0.59; 0.63 – 0.68; 0.79 – 0.9 µm, spatial resolution in nadir 20 m over a 160-km wide swath). In the early phases of its orbital life Monitor E ran into some problems, when Khrunichev Space Center lost all contact and control of the Monitor-E satellite.

WP 3000

Objectives

- To assess the current and historical man-made changes and negative impacts arising from pollution sources and other anthropogenic drivers located in the Irkutsk region and in adjacent areas.

- To gather information on actual and potential sources of pollution in the region under study and in the proximity of its border

Progress towards objectives

(1) IIASA GIS-compatible database with 36 feature datasets from 1:1 Mio. to 100m scale/resolution including forest inventory data, fire scars or eco regions

(2) Irkutsk Science Center: 42 datasets on biodiversity(flora & fauna) including information on reforestation or forest-land percentage (see figure 4)

(3) Irkutsk Science Center: 6 datasets on the medico-geographical situation such as 'recreational possibilities of forest plants'.

(4) Irkutsk Science Center: 38 datasets on anthropogenic factors of the ecological situation formation like:

- density of the industrial load on the natural environment or
- concentration of the carbonic/nitrogen/sulphurous oxides at the underlying surface in April/December

Problem: This information only exists as printed/scanned maps. Reference and map notations are in Russian. To supplement the IRIS-GIS by this new and relevant layers, the maps need to be made GIS-compatible and synergistically available.

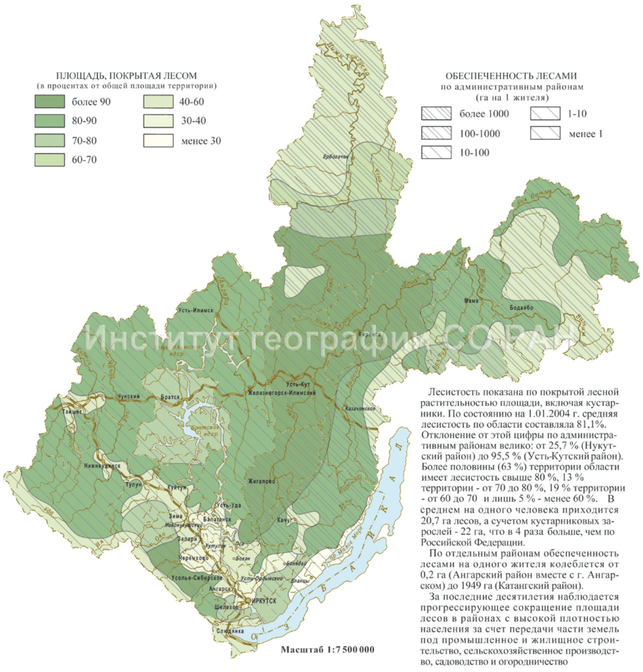

Figure 4: Forest-Land percentage as printed and scanned but not GIS-compatible map.

WP 4000

Objectives

- To assemble available open data sources for IRIS GIS
- To develop easy-to-use IRIS GIS interface for use by policy makers, scientists and the public

Progress towards objectives (content-related)

Requirements analysis

Requirements analysis will be an important part of the GIS system design process, whereby GIS engineers identify the needs or requirements of the users/clients. Once user requirements have been identified, the system designer is then in a position to design a solution. We will employ a combination of prototyping and use cases to establish the exact requirements of the users, so that a system that meets the needs is produced. Summarized, requirements analysis is the task of communicating with users to determine what their requirements concerning the IRIS-GIS are. Thus, the involvement of the IRIS user community is the most challenging objective and remains an ongoing.

GIS engineering

For GIS (software) engineering, we intend to use the Unified Modeling Language (UML) as the industry standard modeling language. UML is a non-proprietary modeling language that includes a standardized graphical notation used to create an abstract model of a system, referred to as a UML model. UML uses diagrams as a partial graphical representation of a system's model. In UML 2.0 there are diagrams referring to concepts of systems (1) structure, (2) behavior and (3) interaction. We will try to develop use case diagrams, written descriptions of system behavior regarding user requirements.

Contributions to standards

One of essential components of IRIS will be an Open Source GIS system. Open Source technology is a growing field that encourages the free sharing of software, codes and services. The goal of the Open Geospatial Consortium (OGC) is to promote standard open software interfaces called OpenGIS. These interfaces will enable geoprocessing so that different geospatial systems can communicate with each other. The use of common languages such as XML or GML enable easy integration between systems. OpenGIS supports the easy retrieval of geospatial information in a distributed environment, regardless of physical location of the data. These distributed datasets can then be combined and rendered for display.

First implementations towards the IRIS Online-GIS (planned for 2006)

We discuss to implement the Debian GNU/Linux operating system as Ubuntu Server Edition (most recent version 6.10) which provides server applications such as a LAMP **Web Server Platform**. The acronym LAMP (Linux, Apache, MySQL, PHP) refers to a set of free software programs commonly used together to run dynamic Web sites or servers. The LAMP option that comes along with the Ubuntu Server Edition saves the trouble of installing and integrating each of the four separate LAMP components, which will be helpful for later installations

The **Spatial Data Base** can implemented as 3-tier architecture with database server, application server and internet browser. In our case, PostgreSQL, the highly scalable, SQL compliant, open source object-relational database management system with the PostGIS extension and the Mapserver. PostGIS follows the Simple Features for SQL specification from the Open Geospatial Consortium. MapServer is an Open Source development environment for building spatially-enabled internet applications. MapServer was created by the University of Minnesota.

The **Communication Platform**, that will come along with the prototype GIS serves as the basis for computer supported cooperative work. – 'The more people who use the platform, the more valuable it becomes.' - We are implementing MediaWiki, a free and open source software that is used to organize and facilitate collaborative work. Due to the strong emphasis on multilinguality in the Wikimedia projects, internationalization has received significant attention by developers. The user interface has been fully or partially translated into more than 70 languages (http://www.mediawiki.org).

Section 3 – Consortium management and coordination

Consortium management tasks

Administrative coordination included the task of preliminary payment. Partner No. 5, the Irkutsk Science Center did not provide bank details yet.

Comments regarding contributions

As defined in the work plan, each partner has well defined responsibilities within the project. First deliverables have to be submitted after 6 months. To monitor the progress of the workpackages and to check it regularly against the work plan, the coordinator is using modern communication technology for the communication between the different partners. Teleconferences at regular intervals (two-week) using voice-over-IP technologies are held with Russian partners in Irkutsk, Moscow and St. Petersburg.

Co-ordination activities in the period

In order to disseminate the results of the study carried out in the framework of the project, the following actions are foreseen:

(1) strengthen communication between partners by weekly teleconferences,

(2) to maintain a Wiki-like website devoted to IRIS

Our project Wiki (called IrisWiki) can help partners to quickly find and view information and applications relevant to their roles and responsibilities (English and Russian language). With a Wiki, partners can make more information available to partners on a "pull" basis. IrisWiki will serve as a powerful tool for communication within the project, for developer issues and even more important, for the collection of stakeholder requirements. The IrisWiki will represent the project in the web, will document the GIS-development and will specifications and discussions of standards in an ongoing process.

Project Meetings

Kick-off meeting July 7-8 2006, organized by FSU and the ORESP team of the ISC

Session 1: Regional Activities

- The Irkutsk Science Center
- The Department of Regional Economic and Social Problems
- The Irkutsk Province (a.o. Economic development, Timber Industry Complex, Formation of Oil and Gas-Chemical Cluster)
- Consortiums Heritage

Session 2: IRIS Introduction

- Strategic Objectives
- Relevance to the objectives of SSA
- Contributions to standards

Session 3: IRIS Description of work, Deliverables, Workpackages

Participants:

Dumova, Irina	ISC Department of Regional Economic and Social Problems
Lipnjagova, Rushana	ISC Department of Regional Economic and Social Problems
Berezhaya, Nadezhda	ISC Siberian Institute of plant Physiology and Biochemistry
Belogolova, Galina	ISC Institute of Geochemistry

Bashalkhanov, Innokentii	ISC Institute of Geography
Bessolitsyna, Ekaterina	ISC Institute of Geography
Baturin, Vladimir	ISC Institute of Dynamic Systems
Vashchuk, Leonid	(formerly State Forest Agency of Irkutsk)
Emelyanovshould, Kirill	NTSOMZ
Permitina, Larisa	NTSOMZ
Bobylev, Leonid	NIERSC
Shvidenko, Anatoly	IIASA
Schmullius, Christiane C.	FSU
Frotscher, Karsten	FSU

Section 4 – Other issues

IRIS - Internal Reports

(1) Kick-off meeting July 7-8 2006, Irkutsk Science Center - 'Minutes of the meeting'

(2) Use of GoogleEarth imagery for the generation of high resolution ground-truth data
Objective: Digitizing small-scale features (clear cuts, housing, industrial facilities etc.) from high-resolution Quickbird imagery within Google Earth-Pro software (see figure 1).

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IRIS - Presentations on Conferences

Frotscher, K. & C.C. Schmullius (2006): Projects and Initiatives addressing Environmental Impact Studies in Northern Mongolia and the Lake Baikal Region. 2nd International Conference on Land cover/Land use study using Remote Sensing and Geographic Information System, Ulaanbaatar, Mongolia, 8-9 June 2006.

Abstract
Fast-growing economies and worldwide growing consumer demands have a considerable impact on natural resources and thus on the way Earth Science community addresses the acquisition, storage and analyses of spatial data. Reliable and up-to-date information on land surface characteristics and changes are therefore required by decision makers in order to fulfil several international and national treaties and for its own policy. Satellite-based Earth Observation (EO) serve thereby as an independent and unbiased framework to analyse landscape structure and related environmental processes as well as impacts at multiple scales. Advanced image processing techniques such as for Synthetic Aperture Radar (SAR) or time series, embedded in a hierarchical system of an object-oriented GIS framework help to handle the complex character of the problem. One of the essential components of information distribution is the

development of spatial data infrastructures by using open standards as recommended by the Open Geospatial Consortium (OGC^{TM}).

Frotscher, K. & C. Thiel (2006): Forest Monitoring in the Framework of a Regional Information System for Environmental Protection. ENVIROMIS Conference, Tomsk, Russia, 1-8 July 2006.

Abstract

The Irkutsk Regional Information System for Environmental Protection (IRIS) will assess the current status and dynamics of the Irkutsk Region's forestry environment, influenced by man-made changes and anthropogenic impact arising from pollution sources and other negative anthropogenic drivers located in the region and in adjacent areas. It will investigate the responsiveness and vulnerability of forestry environment within the Region under different scenarios of industrial development and nature-preserving measures. The output of the project is the adaptation of the existing GIS layers, completion and transfer into operative testing and exploitation a simplified version of the Regional Information System that serve as a prototype for other regions of Northern Eurasia. One of essential components of IRIS will be an Open Source GIS. The use of common languages such as XML or GML enable easy integration between systems. OpenGIS supports the easy retrieval of geospatial information in a distributed environment, regardless of physical location of the data.

The GSE Forest Monitoring service provides another powerful tool for effective forest monitoring and inventory at regional scale. Reliable and up-to-date information on forest characteristics and changes therein are required by the State Forest Service of Irkutsk General Survey of Natural Resources (FS of GSNR) in order to fulfil several international and national treaties, for its own forest policy as well as to perform the task of delivering data to the federal level. Forest area maps will be generated using high-resolution, cross-polarized Envisat ASAR precision images acquired at large incidence angles (swath 7). Main processing steps include image preprocessing, image segmentation, computation of object statistics, image classification and accuracy assessment. Change detection analysis will be performed by comparing the derived forest area map with existing land cover maps. For quality control and product verification archived Landsat TM5 and Landsat ETM 7 as well as ground reference data will be used. The approach includes a documentation of the applied methodology as well as the assessment of product quality and accuracy. The acceptability threshold of the thematic mapping accuracy is 90% for forest areas and 85% for forest area changes, respectively.