ZAPÁS Assessment and Monitoring of Forest Resources in the Framework of the EU - Russia Space Dialogue

ANNUAL REPORT **SEPTEMBER 2012**

ZAPÁS

Assessment and Monitoring of Forest Resources in the Framework of EU-Russia Space Dialogue

Progress Report I

by

Christian Hüttich, Christiane Schmullius, Christian Thiel, Carsten Pathe, Mikhail Urbazaev, Mikhail Korets, Sergey Bartalev, Kirill Emelyanov, Anatoly Shvidenko, Dmitry Schepaschenko

ZAPÁS is funded by the European Commission, Space, Cross-cutting Activities, International Cooperation, Grant no. SPA.2010.3.2-01 EU-Russia Cooperation in GMES (SICA)

Content

1 Publishable summary

1.1 Summary description of project context and objectives

Abstract

ZAPÁS (Rus.: Запас) – was chosen as project acronym since this Russian word is used in forest terminology for growing stock volume or forest stock, which is one of the envisaged products of this project. Addressing the important issue of assessing forest resources in the boreal zone, particularly in Siberia, the ZAPÁS project is aiming to actively support the EU-Russian Space Dialogue. ZAPÁS delivers innovative procedures and new products for forest resource assessment and monitoring using jointly ESA and ROSCOSMOS satellite data. In accordance with the FP7 call SPA.2010.3.2-01 EU-Russia Cooperation in GMES (SICA), ZAPÁS focuses on the synergistic exploration of Earth Observation (EO) data provided by ESA and ROSCOSMOS and on the exchange of methodological know-how in processing Earth Observation data.

The geographical focus of research and development within the ZAPÁS project is Central Siberia, which contains two administrative districts of Russia, namely Krasnoyarsk Kray and Irkutsk Oblast. The project team aims at developing Earth observation products at two geographical scales. Improved regional scale land cover and biomass maps will be derived for Central Siberia to (a) improve existing coarse scale land cover databases, (b) link them with biomass information from medium resolution Radar imagery, and (c) use these up-to-date land-cover and forest resource geo-information as input for a full carbon accounting (Nilsson et al., 2000). The results of the terrestrial ecosystem full carbon accounting are addressed to the Federal Forest Agency as federal instance. The high resolution products comprise biomass and change maps for selected local sites. These products are addressed to support the UN FAO Forest Resources Assessment as well as the requirements of the local forest inventories. The team consists of a balanced distribution of leading experts from Europe and Russia. The Russian partners come from two geographically different, federal regions: the city of Moscow and the Krasnoyarsk Kray. An external review board, the ZAPÀS Advisory Board (ZAB) has been installed to involve representatives of the Russian space agency as well as the Federal Forest Agency and connect ZAPÁS to the United Nations Forest Resource Assessment 2010 (FRA 2010) and further international programs.

Forest Monitoring in the Framework of the EU-Russia Space Dialogue

Russia, the European Union's largest neighbor, is considered by the European Parliament as a key player in its efforts to protect the global climate and environment. The strengthening of genuine strategic partnerships founded on common interests and shared values is strongly supported. The ZAPÁS project represents such a strategic partnership between well acknowledged Russian and European scientists in the field of Earth Observation with the support, direct involvement and contribution of the Russian and European Space Agencies.

A further important international agreement is the Kyoto Protocol of the UN Framework Convention on Climate Change, providing mechanisms to reduce greenhouse gases and tackle global warming. The intensification of collaboration between the EU and Russia on environmental issues is a welcome step forward in bringing ecological sustainability and social responsibility more to the forefront in economic dealings. This makes the harmonization of European and Russian environmental policies and legislation particularly important. The collaborative development of advanced methods and the exchange of Earth Observation data fully compliant to the cooperation policy established between the EU and Russia.

The ZAPÁS network is involved in international programs such as GEO FCT (Group on Earth Observation – Forest Carbon Tracking), GOFC-GOLD (Global Observation of Forest Cover and Land Dynamics) and NEESPI (Northern Eurasian Environmental Science Partnership Initiative) through which support to international conventions related to the global environmental issues, such as UNCBD, UNFCCC and its Kyoto Protocol, is ensured.

Multi-scale Assessment and Validation of Central Siberian Forest Maps

Looking at the large-sale distribution of the Siberian Taiga, the systematic monitoring of forest dynamics is still challenging. Satellite earth observation is the only alternative for a frequent monitoring of biomass-decreasing processes such as clear cutting, selective logging, fire, insect infestation, but also afforestation and forest succession processes (White et al., 2005; Yatabe et al., 1995; Kasischke et al., 1992).

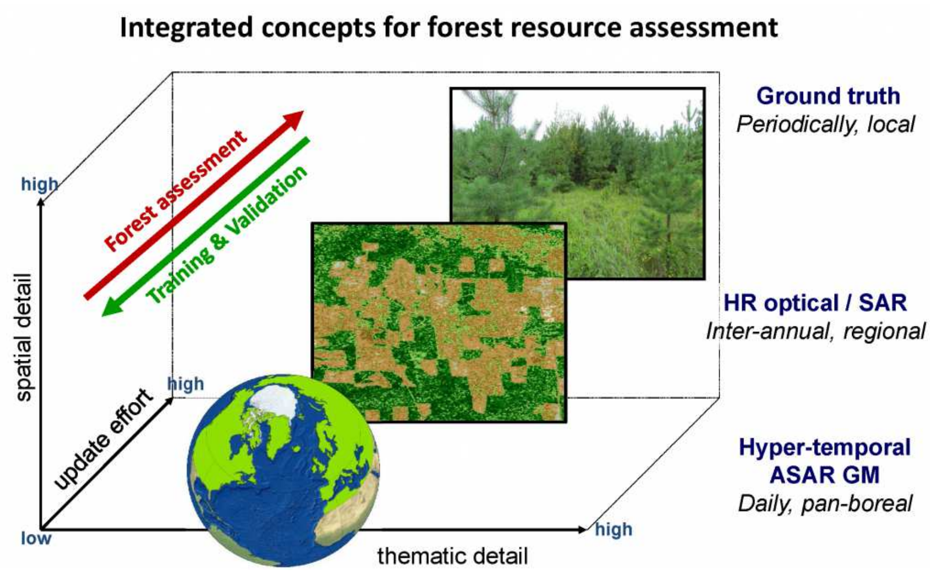


Fig 1: Integrated concept for forest resource assessment and forest geo-information cross validation to be implemented by the ZAPÁS project. The graph exemplarily indicates the range of data specifications in terms of spatial and thematic detail in relation to the effort of frequent update.

ZAPÁS investigates and cross-validates methodologies using both Russian and European Earth observation data to foster the development of a worldwide observation system. The methodologies include state-of-the-art optical and radar retrieval algorithms and their improvement as well as investigation of innovative synergistic approaches (Thiel et al. 2009). Products include biomass maps and biomass change for the years 2007-2010 on a local scale, a biomass and improved land cover map on the regional scale, and a 1 km scale land cover map as input to a carbon accounting model. These products serve the inventory community (e.g. FAO Forest Resource Assessment) as well as the Kyoto Protocol implementation bodies. In specified regions land cover change dynamics, specifically forest regrowth and land abandonment, will be investigated.

One of the key perspective goals of the ZAPÁS initiative is to overcome still existing uncertainties in Carbon Accounting. Since the synergistic biomass – land cover product will be one new parameter of the full ecosystem carbon accounting (conducted at IIASA) some general future improvements will be considered for carbon accounting, such as *in-situ* and multi-scale Earth observation synergies and combining regional land cover mapping and biomass products.

1.2 Work performed during the first year of the project

Synergistic ESA-ROSCOSMOS Satellite data base and reference database

An overview of the sensor specifications is given in Table 1. Optical and SAR imagery was acquired in WP 2 basically from ESA and ROSCOSMOS archives (including the ESA Third Party missions of NASA and JAXA) are used in a synergistic manner by (1) enhancing the data acquisition by involving the national space agency contacts and

Table 1: Joint ESA-ROSCOSMOS satellite data base used in the ZAPÁS project.

Sensor	Sensor characteristics	Purpose
ALOS PALSAR	imaging microwave radar: Fine beam modes (FBS/FBD): 7 - 44-m, ScanSAR Mode: 100-m, L-band, polarization modes: VV, HH, VV/HH, HV/HH, or VH/VV	local scale mapping of biomass, forest cover and disturbances (fire, clear cuts)
ENVISAT ASAR	imaging microwave radar: Image, Wave and Alternating Polarization modes: app. 30-m, Wide Swath mode: app. 150-m, Global Monitoring mode: app. 1000-m, C-band, polarization modes: VV, HH, VV/HH, HV/HH, VH/VV	regional scale biomass mapping for Central Siberia
RESURS DK-1	imaging multispectral radiometer: spectral resolution: pan: 0.58 - 0.8 µm, green: 0.5 - 0.6 µm, red: 0.6 - 0.7 µm, NIR: 0.7 - 0.8 µm; spatial resolution: panc. 1-m, multispectral 2-3-m	local scale forest cover and change mapping (fire, clear cuts)
MONITOR-E	Panchromatic camera (PSA): spectral resolution: pan: 0.51 - 0.85 µm, 8-m spatial resolution	ground truth reference data for forest land dynamics (cover change due to logging and fire)
Meteor-M KMSS	Multi-spectral camera: 3 spectral bands, 535 – 575 nm, 630 – 680 nm and 760 – 900 nm; spatial resolution - 60 m.	regional scale land cover mapping for Central Siberia
ENVISAT MERIS	imaging multispectral radiometer: spectral resolution: VIS-NIR: 15 bands selectable across range: 390 nm to 1040 nm, spatial resolution: 300-m	regional scale land cover mapping for Central Siberia
TERRA MODIS	imaging multispectral radiometer: spectral resolution: VIS-SWIR: 7 bands selectable across range: 620 nm to 2155 nm, spatial resolution: 250 - 500-m	regional scale land cover mapping for Central Siberia

(2) combining optical and SAR high VHR imagery with time series for local and regional scale biomass, forest cover, and forest disturbance mapping. Optical MERIS and MODIS time series data are used for the generation of an improved Central Siberian land cover database (WP3). Hyper-temporal ASAR imagery is used for regional scale biomass mapping by applying the BIOMASAR algorithm (Santoro et al., 2010) (WP4). A reference database was generated in WP 2 by defining high-priority areas in the Siberian Forestries of Krasnoyarsk Kray and Irkutsk Oblast. These areas also define the local mapping test sites (WP2). By involving recently updated forest inventory data (e.g. growing stock volume, species composition on forest stand level) the SAR data is being used for high resolution biomass mapping. Additionally, optical high resolution imagery is used for forest cover and disturbance mapping and validation purposes (WP 8).

1.3 Expected final results and their potential impact

The ZAPÁS project represents and fosters the future collaboration between Russian and European scientists in the field of Earth Observation of forest resources by actively involving ESA and ROSCOSMOS.

The overall goal of the ZAPÁS initiative is to overcome still existing uncertainties in carbon accounting of the boreal zone, particularly for Russia, based on (1) in-situ and multi-scale Earth observation synergies and (2) combining regional land cover mapping and biomass products. As described in this paper, *in-situ* and local site forest resource assessment is being realized in the first phase of the project. Future activities will focus on the integration of these results for generating a synergy map on regional scale including land cover and biomass classes as a novel parameter set for full ecosystem carbon accounting. The key methodological objectives of ZAPÁS are briefly summarized:

- **Joint exploitation of new (optical and radar) EO data:** Earth Observation data synergies are a one of the key challenges towards the implementation of multi-source earth observation data in trans-boundary forest monitoring systems. There is little practical knowledge about the synergistic use of ESA and ROSCOSMOS data (including ESA third party missions). ZAPÁS presents the potential based on first ALOS-PALSAR and RESURS-DK1 data acquisitions of the Krasnoyarsk and Irkutsk test sites.
- **Analysis of up- and down-scaling effects of integrated data sets and products:** Land cover and biomass are becoming more and more available for the Boreal ecosystems. However, the comparability and possibility of combining these products is still lacking. Within the project, related spatial scaling and thematic integration effects (constraints, potential, and limitations) are systematically assessed.
- **Realization of cross-validation approaches:** Local and regional biomass maps are being developed by a number of projects and programs. Validation of biomass maps is limited by the availability of inventory and in-situ data in general or strong temporal mismatches of the data takes. The project presents first results of using up-to-date inventory data surveyed by local Forest Agencies to be used for validating EO-based biomass maps at local and regional scales.

ZAPÁS is unique with respect to the team composition, its Earth observation operational expertise, interdisciplinarity, and envisioned improved synergistic products. The bi-lingual web portal will provide access to findings, data and products to the general forest, GMES, GEOSS and Earth observation community. ZAPÁS aims to support the design of an ESA-ROSCOSMOS approach to support a worldwide forest observation system.

1.4 Project web-site

The results being achieved during the project are presented and disseminated through the bilingual ZAPÁS web portal. Acting as the main communication platform of the EU and Russian scientific and stakeholder community on forest resource assessment the ZAPAS web portal is delivering recent reports and scientific outcomes. The above mentioned geo-information products on forest biomass distribution and dynamics are being disseminated through the ZAPÁS web portal available at http://zapas.uni-jena.de.

1.5 Project partners and general contacts for the ZAPÁS project

The consortium consists of a balanced distribution of leading experts from Europe andRussia in the field of Earth observation for forestry applications, involving Russian stakeholders, i.e. the Sukachev Forest Institute of the Russian Academy of Sciences, who themselves apply remote sensing techniques. The Russian partners come from two geographically different federal regions: the city of Moscow and the Krasnoyarsk Kray. An overview of involved organizations is given in Table 2.

Table 2: ZAPAS expert consortium.

Institution	Abbrev.	Persons involved	Country
Friedrich-Schiller-University Jena	FSU	C. Schmullius, C. Hüttich, C. Thiel, C. Pathe	Germany
International Institute for Advanced System Analyses	IIASA	A. Shvidenko, D. Schepaschenko	Austria
Space Research Institute of the Russian Academy of Sciences	IKI-RAS	S. Bartalev, V. Egorov, V. Zharko, T. Khovratovich, T. Moskalenko	Russian Federation
V. N. Sukachev Institute of Forest, Siberian Branch of the Russian Academy of Sciences	SIF-RAS	M. Korets	Russian Federation
Joint Stock Company "Russian Space Systems"	NTsOMZ	K. Emelyanov	Russian Federation

An external and informal review board - the **ZAPÀS Advisory Board** (ZAB) - has been installed to involve representatives of the Russian Space Agency as well as the Federal Forest Agency. Further, the ZAB communication connect ZAPÁS to the

United Nations Forest Resource Assessment 2010 (FRA 2010) and link international scientific programs, such as the Global Observations of Forest Cover and Land Dynamics and (GOFC-GOLD). The ZAPÁS Advisory Board Members are:

Chris Steenmans	European Environment Agency (EEA) Copenhagen, Denmark
Tony Janetos	Chair of GOFC-GOLD Joint Global Change Research Institute Maryland, United States
Henri Laur	European Space Agency (ESA) Earth Observation Missions Management Office Frascati, Italy
Nina Novikova	Scientific Centre for Earth Operational Monitoring Roscosmos, Moscow, Russia

2 Project objectives, work progress and achievements, and project management

2.1 Project objectives for the period

The first year period aims at the generation of a common environmental database comprising the **Data Acquisition and pre-processing** (WP2). More specifically, this task includes the Data Acquisition of earth observation data (WP2.1) as well as the earth observation data pre-processing (WP2.2) and the data acquisition of in-situ data (WP2.2). The database is being built in the first year at least for the first 5 local test sites and for the full coverage of the Central Siberian mapping region.
Parallel to the database generation the regional scale **Central Siberia Land Cover Mapping** (WP3) starts for the generation of the first land cover prototype map. The regional scale **Central Siberia Biomass Mapping** (WP4) starts in the last quarter of the first period. At the local scale WP8 **Local Sites: Biomass and Change Mapping** comprises the generation of the following map products for the first set of fife local test sites. The sub-tasks include the work packages Biomass Mapping (WP 8.1), Forest Cover Change Mapping (WP 8.2), and Abandoned land and Forest Regrowth Mapping (WP 8.3). In association with the finalization of the first set of local scale maps the **Validation** (WP 9) starts within the last quarter of the reporting period. Project dissemination activities will be ongoing from the start of the project, in particular by setting up the **ZAPAS Web-portal** (WP10).

2.2. Work progress and achievements during the period

2.2.1. Project management in the reporting period

2.2.1.1. Consortium management tasks and achievements

During the reporting period FSU was responsible for management activities conducted in WP 1 “Management /Administration”. The responsibilities of FSU regarding the management and administration of the project include to:

- implement of a project-specific database for reporting and controlling;
- monitor the project time tables, milestones, and deliverables;
- perform an efficient intra- and extra-consortium communication and cooperation;
- maintain a constructive dialog with the EC project officers;
- lead the communication with the ZAPÁS Advisory Board (ZAB).

2.2.1.2 Summary of progress made

A common database for documentation, reporting, and data exchange was generated and is maintained by FSU. All data are accessible to the project consortium via an FTP server hosted by FSU. All work packages for the first phase started in time. The schedule is in time so far. Deliverables were uploaded to ECAS and controlled by FSU. All specific issues and problems were communicated between the consortium and the EC project officer.
A ZAPÁS Inauguration event was organized in April 2012 in close cooperation with NTsOMZ in Moscow. The ZAB was also invited. Chris Steenmans (EEA) joined the event as one of the ZAB representatives and followed the state of the art presentations of the consortium. SIF-RAS represented the project at the current preparatory meeting of the EU-Russia Space Dialogue on 15 May 2012. The project was appreciated as a key part of the dialogue.

2.2.1.3. Problems occurred and applied solutions

Within WP 10 “Development of Web-Portal and Product Dissemination” a transfer of 10 PM was realized to FSU due to a changed personnel situation at IKI-RAS. The WP 10 tasks were divided by FSU and IKI. The leadership of WP 10 will be at IKI-RAS. The responsibilities of IKI-RAS and FSU concerning the maintenance of WP 10 as stated in the DoW (WP descriptions) are:

- FSU: Web-portal for dissemination of the generated within the project products to the wide community of potential users, distribution of publications through the web-portal.
- IKI-RAS: Web-map service and graphic user interface along with basic tools to derive spatial-temporal statistics on land cover classes area, forest changes IKI-RAS: Tools-set for the interactive forest change detection analysis.
- All Partners: Publication of results at several Symposia and in Journal papers.

Within WP 4 “Regional Forest Biomass Mapping for Central Siberia with Radar Satellite Data (300m / 500 m resolution)” the initial goal to map the greater study area of Krasnoyarsk Kray and Irkutsk Oblast cannot be achieved. Reasons are massive data gaps due to the reduced limits of ASAR Wide Swath scenes in the current ESA Cat-1 proposal. Since a minimum of 70 observations is required for the application of the BIOMASAR algorithm for biomass estimation the project consortium decided to reduce the mapping region for the regional scale biomass mapping to the southern part of Krasnoyarsk Kray and Irkutsk Oblast. This core study region covers all local test sites and ensures that all further validation tasks in the following phases can be realized. A 1 km Biomass map for the whole Central Siberian study site will be obtained by integrating the current BIOMASAR-II GSV map in the task of WP 4.

2.2.1.4. Changes in the consortium

No changes in the consortium occurred.

2.2.1.5. List of project meetings, dates, venues and participants

Table 3: ZAPÁS project meetings in the first reporting period.

Kind of Meeting	Location	Date	Participants
ZAPÁS Kick-off Meeting	Krasnoyarsk	17/08/2011	Consortium
GEO VIII Plenary Session	Istanbul	16/11/2011	FSU
Fall Meeting of the American Geophysical Union	San Francisco	06/12/2011	FSU
Project workshop	Moscow	21/03/2012	Consortium
Project Inauguration Event	Moscow	22/03/2012	Consortium
JAXA Kyoto & Carbon Initiative Workshop	Tokyo	28/032012	FSU
Preparatory Meeting for the EU-Russia Space Dialogue	Moscow	15/05/2012	IKI-RAS NTsOMZ
IEEE International Geoscience and Remote Sensing Symposium - Remote Sensing for a dynamic Earth	Munich	27/07/2012	FSU
“Environment and Global Climate Change” Workshop within the joint German-Russian Sib-Lab Project	Krasnoyarsk	22/08/2012	FSU SIF-RAS
ForestSAT 2012	Corvallis	14/09/2012	FSU

2.2.1.6. Project planning and status

Although a delay in the acquisition of EO data and the above-mentioned data gaps were identified no considerable deviations occurred with regard to the GANTT.

2.2.1.7. Impact of deviations from the planned milestones an deliverables

No deviations from the planned milestones occurred.

2.2.1.8. Changes to the legal status of beneficiaries

No changes in the legal status of beneficiaries occurred.

2.2.1.9. Use of the resources

The following table lists the person-months per participant in the first 12 months in WP1.

Table 4: Person-months per participant in the first 12 months in WP1.

FSU	IIASA	IKI-RAS	SIF-RAS	NTsOMZ
2	0	0	0	0

2.2.2 Work Package 2 - Satellite and In-situ Data Acquisition and Preprocessing

Lead partner:FSU Jena
Contributing partners: IKI-RAS, SIF-RAS

2.2.2.1. Overview of WP objectives

This WP provides the required database for the project's scientific goals and products under consideration of Earth Observation (EO) data. Data are provided by means of the ESA/ROSCOSMOS data agreement at a level appropriate for further data exploration. Specific tasks are sub-structured in order to:

- procure the required EO data for 2007-2009 (Task 2.1)
- provide preprocessed EO data appropriate for further data exploration (Task 2.1.1).
- provide the required in-situ data (Task 2.2).

2.2.2.2. Summary of progress made

Task 2.1: Data procurement accordant to ESA/ROSCOSMOS data agreement.-Task leader: FSU Jena

Task 2.1:1.: EO Data Preprocessing

SAR data overview

SAR data were acquired through a successfully submitted ESA Cat-1 proposal covering 300 ASAR wide swath and 200 PALSAR FBD/FBS datasets. Further PALSAR data were acquired through JAXA Kyoto & Carbon Panel membership of FSU. SAR data acquired and pre-processed at PM8 of the project comprise:

- PALSAR fine beam single (FBS) / fine beam double (FBD), 2006-2011
- PALSAR FBD Mosaic, 2007-2010
- ASAR wide swath (WS), 2006-2010

PALSAR FBS/FBD

PALSAR SAR acquisitions (2006-2011) in FBD mode and 25 m spatial resolution were ordered from ESA in the framework of the Cat-1 project and the Kyoto & Carbon Panel membership. Footprints of the PALSAR coverage per acquisition are visualized in Figure 2 for the local test sited of Central Siberia. SAR data preprocessing was performed comprising calibration, multilooking, orthorectification, and topographic normalization. SAR coherence estimation was conducted by means of: SLC data co-registration at sub-pixel level, slope adaptive common-band filtering in range, and common-band filtering in azimuth.

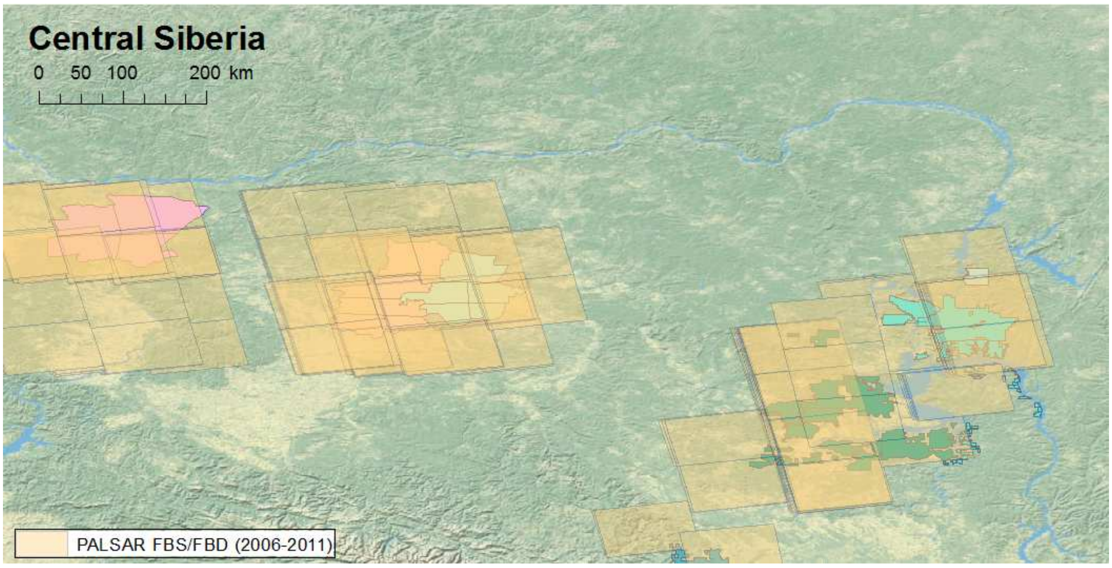


Fig. 2: PALSAR FBS/FBD scenes covering local test sites in Central Siberia

PALSAR FBD Mosaic

A global mosaic of PALSAR FBD SAR data is generated by JAXA in a spatial resolution of 25 m with HH and HV polarizations. The mosaic is freely available within the K&C project and was ordered from JAXA for the years 2007 to 2010. Above mentioned SAR preprocessing steps were conducted by JAXA/RESTEC. Single mosaic tiles data were downloaded and mosaicked by FSU. The data and highlighted local test sites of Krasnoyarsk Kray and Irkutsk Oblast are shown in Figure 3.

Fig. 3: Exemplary PALSAR FBD mosaic (backscatter in HH polarization 2010) providing full coverage of the Central Siberian test sites.

ASAR WS

Hyper-temporal ASAR WS acquisitions were made available through the EASA Cat-1 project and ESA's processing unit (G-Pod). SAR data preprocessing was performed within G-Pod comprising calibration, multilooking, orthorectification, and topographic normalization. 300 scenes were selected for the biomass modeling approach within the ZAPÁS project. This affects an acquisition frequency of over 70 observations for certain areas (Figure 3) which is a pre-condition for the application of the BIOMASAR biomass algorithm.

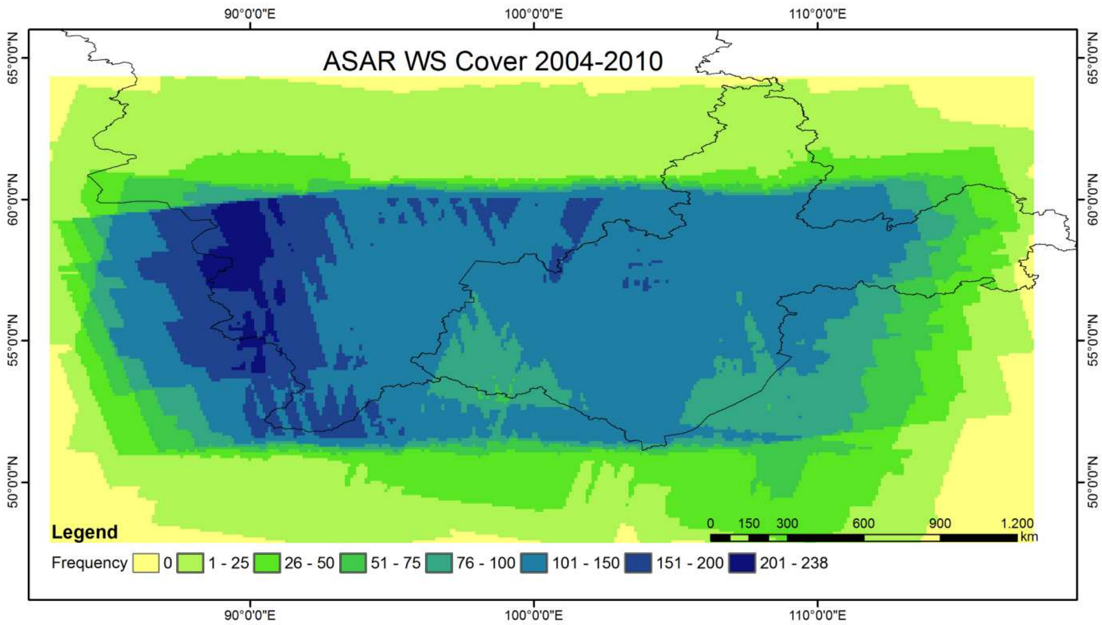


Fig. 3: ASAR wide swath scene coverage (2004-2010).

Optical Data Overview

Through the ESA GlobCover web-site (http://ionia1.esrin.esa.int/) six freely available bimonthly ENVISAT-MERIS data products over Russia (80 tiles, H: 51 - 59; V: 1 - 9 Latitude: 400N - 850N; Longitude: 750E - 1200E) have been downloaded for the time period of 2009. This dataset included images of earth's surface reflectance in 4 spectral bands, centered at 490, 560, 665 and 885 nm respectively in the geographical projection at a spatial resolution of 300 m. The provided snow and no-data mask for the MERIS bimonthly composites was used in order to exclude low quality measurements. As shown in Figure 4, three MERIS-based seasonal image composites and the corresponding annual composite of clear territory have been produced.

- May – June composite
- July –August composite
- September – October composite
- Annual composite

Available through the ROSCOSMOS program (http://www.federalspace.ru/) 53 METEOR-M KMSS scenes over Central Siberia region (Latitude: 400N - 700N; Longitude: 700E - 1200E) have been downloaded for the time period 2010-2012. This dataset has images of earth's surface reflectance in 3 spectral bands, 535 – 575 nm, 630 – 680 nm and 760 – 900 nm in the UTM projection at a spatial resolution of 60 m.

METEOR-M KMSS data set for years 2010-2012 is a time series of scenes that are distributed across the seasons presented in the table below.

Table 5: METEOR-M KMSS data for the years 2010 – 2012.

	Winter	Spring	Summer	Autumn	Sum
Number of scenes	9	17	16	11	53

The KMSS data pre-processing consists of following steps:

- detection of clouds, snow cover related pixels and other bright territory;
- buffering mask of bright pixels;
- manual correction of masks with the effect of parallax for the cloud.

The freely available through the NASA web-site (http://modis.gsfc.nasa.gov/) MOD09 Terra-MODIS daily standard data products over Russia (31 granules, H: 19 - 27; V: 01 - 04 Latitude: 400N - 800N; Longitude: 00E - 1800E) have been downloaded for the time period from 01 November 2009 until 31 October 2010. This dataset included images of earth’s surface reflectance in red (620 – 670 nm), NIR (841 – 876 nm) and SWIR (1628 – 1652 nm) spectral channels in the sinusoidal projection at a spatial resolution of 250 m.

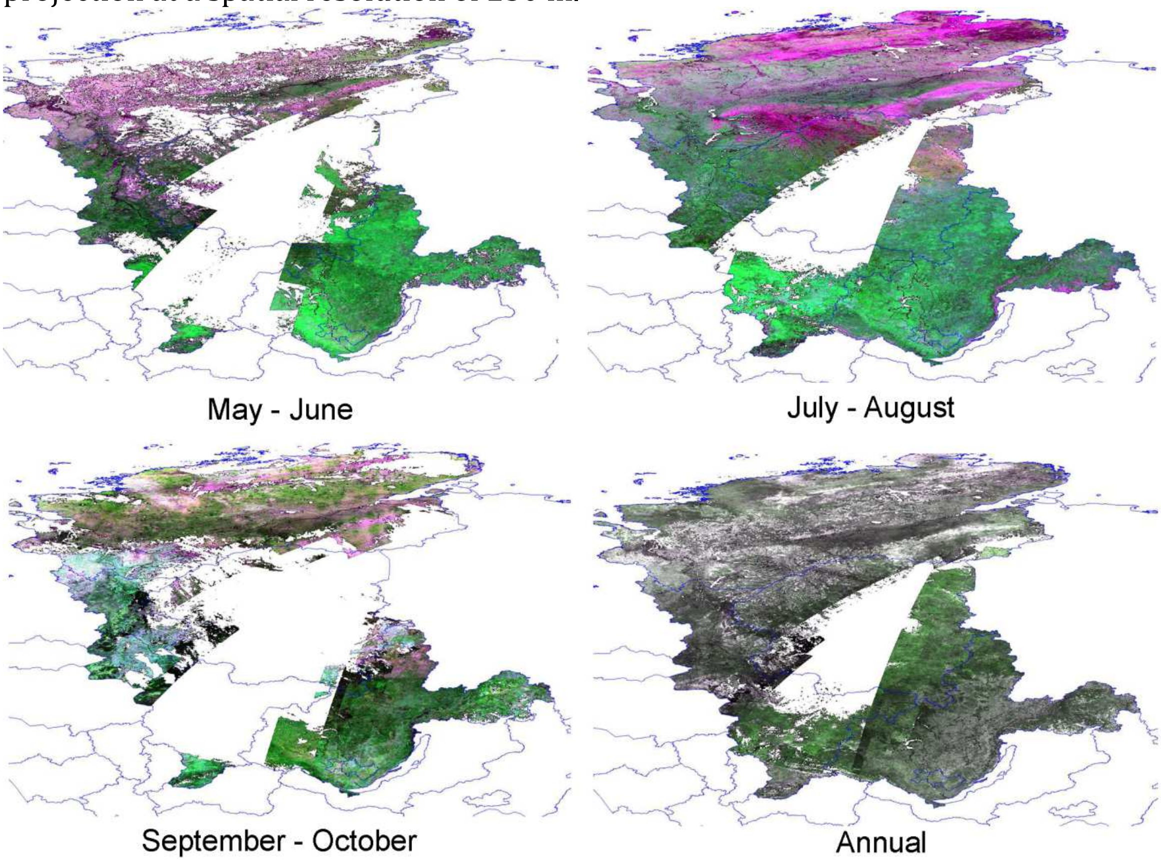


Fig. 4: Meris GlobCover Project Mosaics over Central Siberia.

The data pre-processing steps aimed at the removal of snow cover, clouds and cloud shadow effects, as well as instrumental radiometric noise. The daily standard MODIS data products, such as MOD09GA and MOD09GQ, were used as input for cloud-free image mosaics production. The MODIS data pre-processing consists of following steps:

- masking out pixels with satellite observation and sun elimination angles above certain critical thresholds;
- detection of clouds, cloud shadows and snow cover related pixels;
- detection of residually contaminated pixels through statistical filtering of time-series data.

Four MODIS-based seasonal image composites have been produced (Figure 5) by temporal averaging of uncontaminated pixels for spectral channels, as follows:

- Spring composite for time interval 15/04/2010 – 15/06/2010
- Summer composite for time interval 15/06/2010 – 15/08/2010
- Autumn composite for time interval 15/08/2010 – 15/10/2010
- Winter composite for time interval 15/11/2009 – 15/03/2010

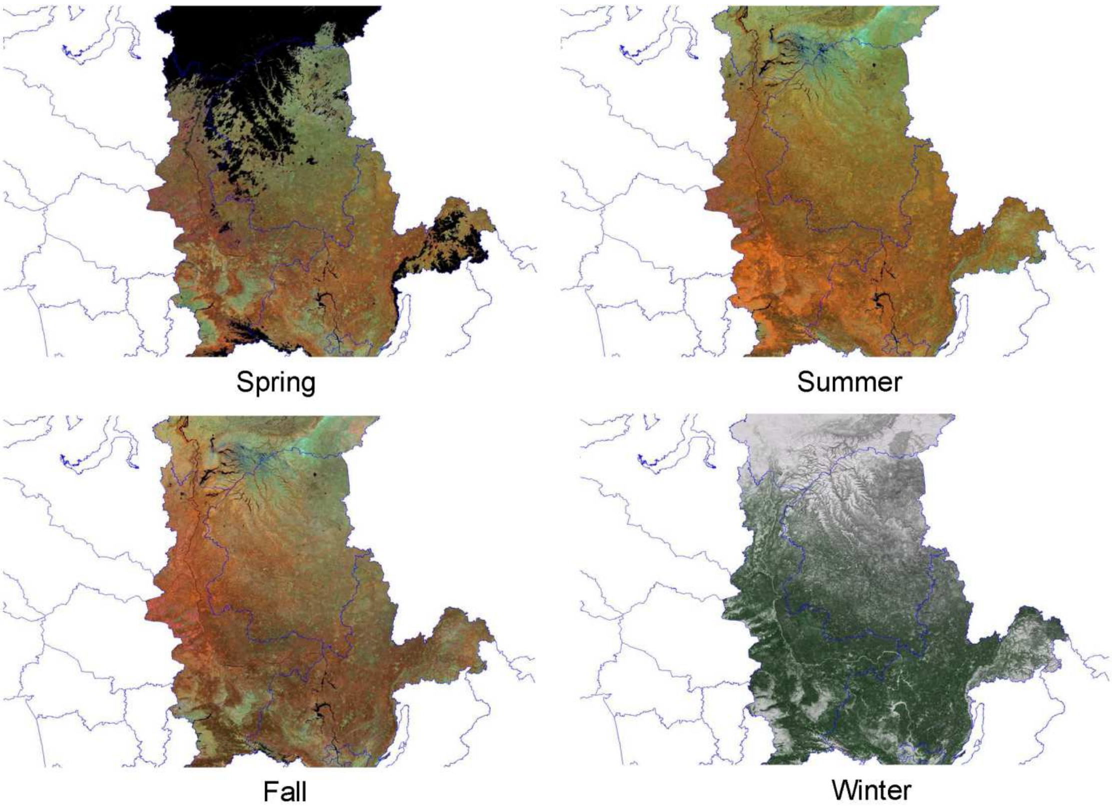


Fig. 5: MODIS Mosaic data as gap filler.

For the winter image composite production snow cover related pixels have been involved into temporal averaging of surface reflectance values. Three seasonal composites, such as spring, summer and winter ones, have been produced for three (red, NIR and SWIR) spectral channels, while winter mosaic generation did not involve SWIR channel due to its relatively high noise level. It is also important to mention that seasonal composites in VNIR and SWIR channels have been produced at different spatial resolution with 230m and 460m pixel sizes correspondently. All generated datasets, including Proba-V/MOD345, MOD1035 and VGT1035, have been reprojected to the Albers Conic Equal Area map projection.

The NTs OMZ's objectives within the project are to take part in the studies on using the Russian Earth remote sensing optical and IR data for forest and land cover monitoring. To achieve these objectives, the following tasks are being addressed:

- Retrieval and pre-processing of archived optical and IR data that have been acquired since 2006 over the test areas;
- Imagery planning, receiving and pre-processing of optical and IR data from the operational spacecraft.

By agreement with the ZAPAS project partners, there were specified the Central Siberia areas of particular interest. The satellite data was pre-processed over test areas of the Krasnoyarsk Kray and Irkutsk Oblast. The satellite data specifications are as follows:

1. MONITOR-E (imaging equipment - PSA) - 6 scenes over 2006. These satellite data was transferred SIF-RAS for intending of detection forest cover change. Below are given the characteristics of imaging equipment:
   Swath width: 96 km;
   Resolution on ground: 8 m;
   Radiometric resolution: 10 bits
   Spectral bands: 1 range (0,51-0,85 visible)
   Revisit time: 6 day
2. RESOURS-DK (imaging equipment - GEOTON) - 13 scenes from 2006 to 2011. The satellite data was transferred SIF-RAS for intending of forest cover change. The characteristics of imaging equipment:
   Swath width: 28.3-47.2 km (at nadir);
   Resolution on ground: 1 m;
   Radiometric resolution: 10 bits
   Spectral bands: 1 range (0,58-0,80 visible)
   Revisit time: 6 days

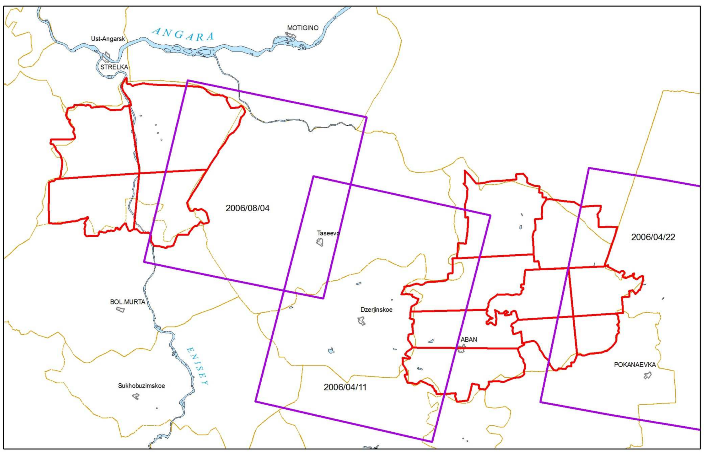


Fig.6: PSA/MONITOR-E data coverage of Krasnoyarskiy Kray scheme.

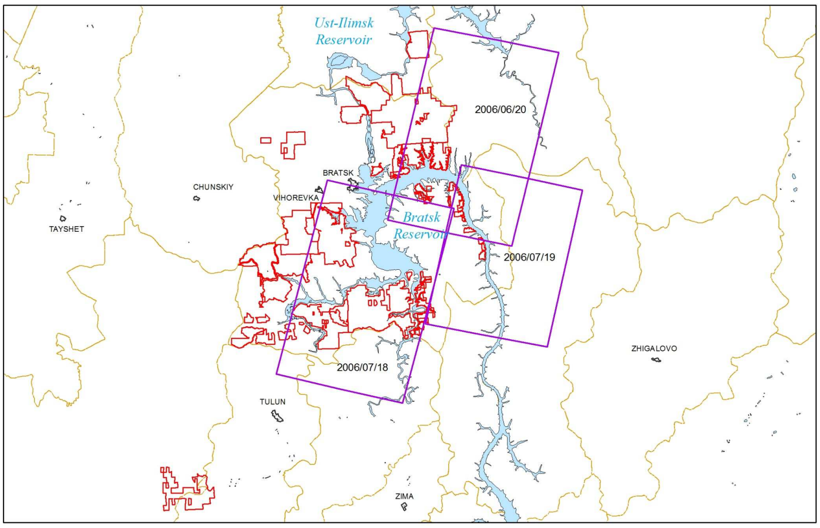


Fig.7 PSA/MONITOR-E data coverage of Irkutskaya Oblast scheme.

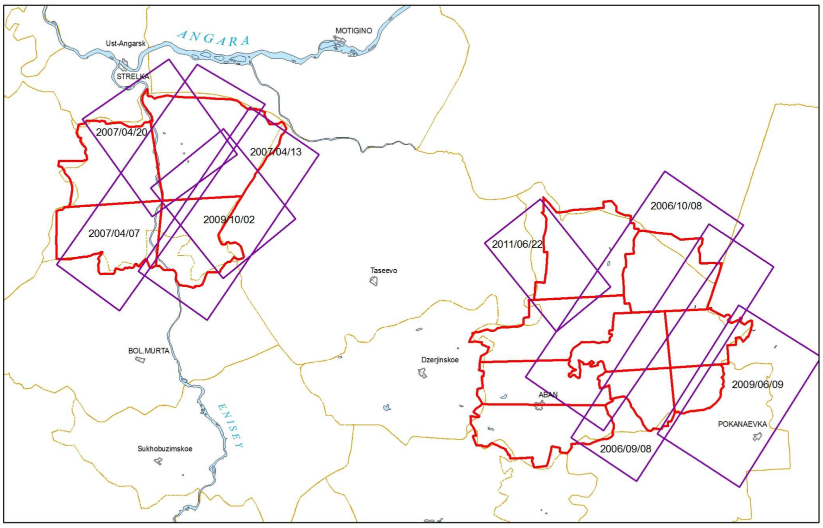


Fig.8: GEOTON/RESOURS-DK data coverage of Krasnoyarskiy Kray scheme.

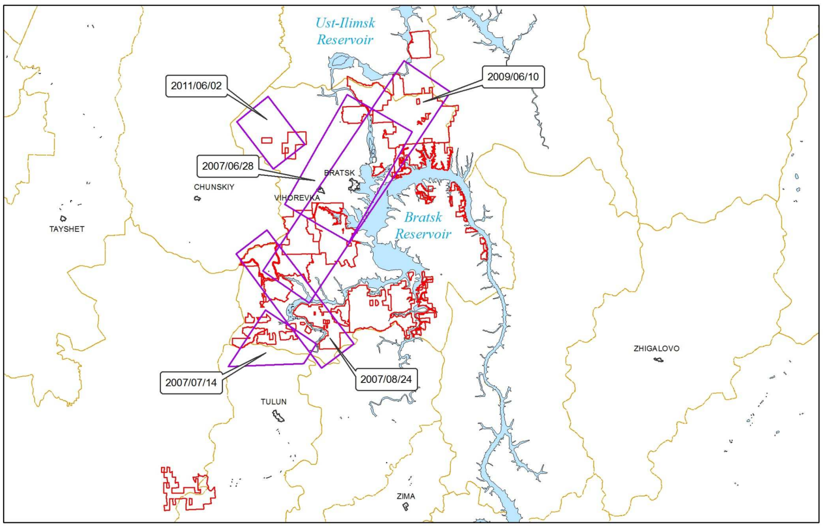


Fig.9: GEOTON/RESOURS-DK data coverage of Irkutskaya Oblast scheme.

3. METEOR-M №1 (imaging equipment - KMSS) - 52 scenes from 2010 to 2012. These EO data was transferred IKI-RAS for generation of large area land cover products. The characteristics of imaging equipment are:

    Swath width: 450 km for one device, 900 km for both devices
    Resolution on ground: 60 m
    Radiometric resolution: 10 bits
    Spectral bands: 3 ranges (0,54-0,58; 0,63-0,68 and near IR 0,76-0,9)
    Revisit time: 2-3 days

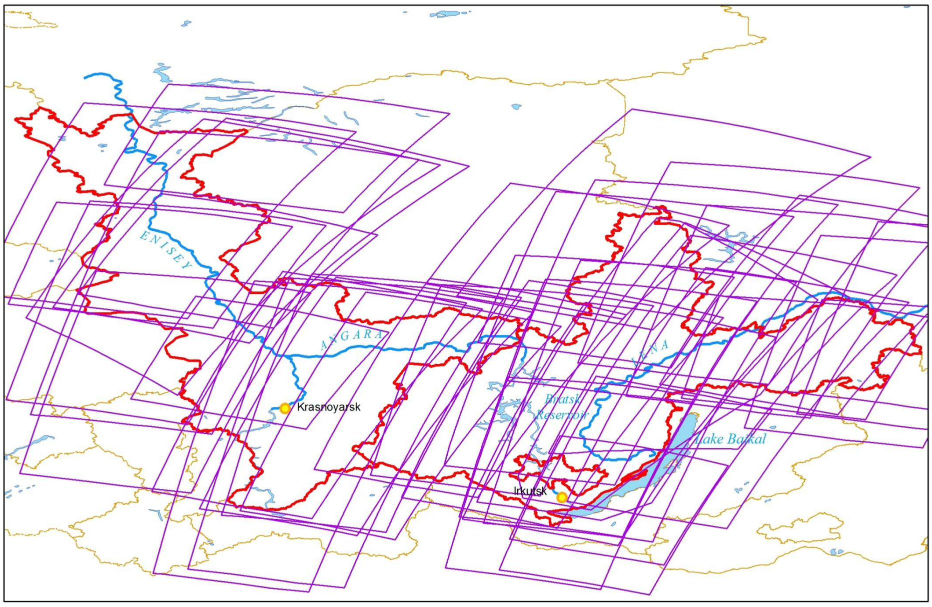


Fig.10: KMSS/METEOR-M №1 total coverage of Central Siberia Region scheme.

Data preprocessing involves radiometric and geometric correction of raw information (Level 2B processing). The cloudiness in an image should not exceed 50%. An image of full spatial resolution with Level 2B processing presented in the UTM map projection in IMG or GeoTIFF format.

In the following receiving and pre-processing EO data from Russian perspective Kanopus and Resours-P satellites is planned. Kanopus was launched in July 2012. The spacecraft is undergoing flight tests at the moment. and Resours-P (launch is scheduled at the end of 2012).

Task 2.2: Forest Inventory data acquisition – Task Leader: SIF-RAS

To build up and to update the forest inventory (FI) data for the test sites, forests have been inventoried in several localities in Krasnoyarsk and Irkuts Regions. The updated inventory GIS includes forest stand polygonal layers in ESRI shapefiles. The attributive database contains fields of land cover type, stand species composition, density, age, height, tree diameter, and growing wood stock. The forest stand polygon layers were rectified to a 1:200000 topographic base map and Landsat ETM+ (15m pixel size) mosaic and SPOT (5m pixel size) RGB mosaic.

The FI GIS database was assembled considering EO data for consistency, reliability, positional accuracy, and timeliness. Preliminary selected sites are shown in the Table 6. Test sites names are the same as those used in FI. Site locations (fig. 1) and processing priority (tab. 6) were assigned with an account of the most resent local forest inventory dates.

Forest inventory information was updated and vegetation cover changes were detected up to 2011 using recent optical RS imagery (LANDSAT TM, Resource-DK, Monitor-E, RAPIDEYE, QUICKBIRD, WORLDVIEW 1,2).

2.2.2.3. Highlights

Summary of progress made in FI data acquisition and processing is shown in Table 6.

Table 6 Technical status of forest inventory data.

Name of region	Test site name	Area, 1000 ha	Previous actualization dates	Final actualization date	Priority	Completion (%) or planed dates
Krasnoyarsk	Abanskoe	423	2008 - 2009	2012	1	100
Krasnoyarsk	Dolgomostovskoe	488	2009 - 2011	2012	2	100
Krasnoyarsk	Kazachinskoe	600	2006 - 2009	2011	3	100
Krasnoyarsk	Bolshemurtinskoe	480	1990 – 2007	2011	1	50
Irkutsk	Padunskoe	400	2010	2011	1	30
Irkutsk	Tulunskoe	60	2009	2011	2	Planed on Oct – Dec 2012
Irkutsk	Nijneilimskoe	30	2010	2011	3	Planed on Jan – Mar 2013
Irkutsk	Bratskoe	590	2011	2011	4	Planed on Apr – Jun 2013

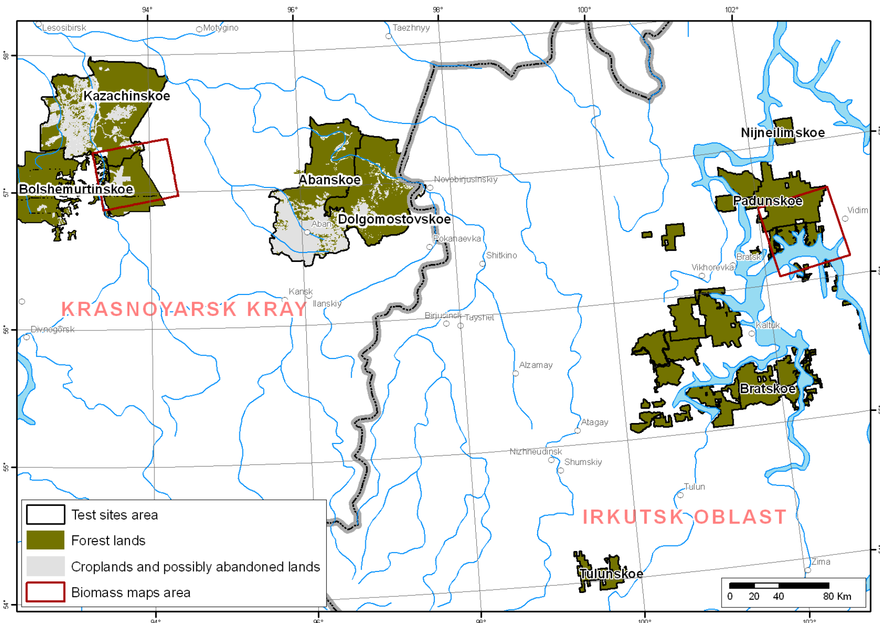


Fig. 11: Geographic distribution of the Central Siberian local test sited in Krasnoyarsk Kray and Irkutsk Oblast.

2.2.2.4. Deviations and impact on tasks and resources

Once SAR scenes were ordered and the wood biomass maps of the test areas were produced, an additional test site, a part of the Bolshaya Murta Forest Management Area, Krasnoyarsk Region, was chosen (Figure. 11, Table. 6). The FI data for this test site has some georeferencing errors and also has to be updated from 2007 to 2012.

Taking into account some negotiation problems with Irkutsk Forest Inventory the data processing was focused on Krasnoyarsk test sites first. These problems were solved and FI data for Irkutsk was started to process. The total amount of the processed FI data (acquired and updated) was consistent with the planned one.

These problems were not affecting much on used resources but it would have impact on the timetable of Work Package 9. The stage of validation and cross-comparison of products could be shifted on the next period.

2.2.2.5. Use of the resources

The following table lists the person-months per participant in the first 12 months in WP 2.

Table 7: lists the person-months per participant in the first 12 months in WP 2.

FSU	IIASA	IKI-RAS	SIF-RAS	NTsOMZ
3,25	**0**	**4**	**30**	**3**

2.2.3 Work Package 3 - Regional Land Cover Mapping for Central Siberia with Optical Satellite Data

Lead partner: IKI-RAS
Contributing partners: IIASA

2.2.3.1. Overview of WP objectives

The objective of WP 3 is land cover mapping of Central Siberia based on medium resolution satellite data and the available MODIS based Land Cover Map (produced at IKI-RAS) as well as ESA GLOBCOVER products. To achieve this, a multi-temporal classification approach developed at IKI-RAS is to be extended to enable the processing of various medium resolution input datasets.

2.2.3.2. Summary of progress made

Draft land cover maps for Central Siberia - Task leader: IKI-RAS

Classification technique

A method developed at IKI-RAS for land cover mapping over large areas is based on the supervised maximum likelihood classification using locally adaptive approach. The locally adaptive approach implies that the area to be classified is covered by the regular grid, and for every node of the grid unique local class signatures are derived, so that spatial variability of spectral characteristics of land cover classes is taken into account. The input for the classification process is a time series of spectral reflectance composite images, corresponding to different seasons of the year; various land cover classes are identified based on the unique dynamics of their biophysical characteristics, which is reflected in their multi-spectral and multi-temporal class signatures.

Data quality

According to the initial plan MERIS and METEOR-M1 KMSS data were supposed to be used to form input datasets for the classification process in order to obtain the land cover map of the Central Siberian study area. However, neither MERIS nor KMSS data provide full coverage of the study area with composite images of sufficient quality.

KMSS images cover 39.9% to 45% of the territory, depending on the season. Moreover, absence of atmosphere-related (blue) band in KMSS imagery significantly complicates the creation of good quality composite images, free form snow, cloud and cloud shadow contamination. The net coverage of MERIS images was found to be 31.7%, and due to the specifics of the MERIS bi-monthly composite processing chain, their quality for the territory of Siberia (especially for spring and autumn seasons) is poor as well.

Since both KMSS and MERIS data fail to provide full coverage with the images of sufficient quality, it was decided to use MODIS to ensure the necessary data consistency. However, experiments on local scale land cover mapping using MERIS and KMSS data were also conducted to determine if there is any advantage in using this data where it is available.

Input datasets

For the classification of MODIS data composite images for spring (15 April — 15 June), summer (15 June — 15 August), autumn (15 August — 15 October) and winter (1 November — 31 March) seasons of 2010 were formed using a preprocessing and production approach developed for MODIS data at IKI-RAS. The dataset included images of the earth's surface reflectance in red (620 – 670 nm), near infrared (841 – 876 nm) and medium infrared (1628 – 1652 nm) spectral channels at a spatial resolution of 250 m. The classification of this dataset was used to produce the current version of the land cover map for Central Siberia, as shown in Figure 12.

The MERIS based dataset consisted of 3 bi-monthly composite images (May-June, July-August and September-October 2009) produced as a part of GLOBCOVER project. The images provide information on surface reflectance in 4 spectral bands, centered at 490, 560, 665 and 885 nm respectively with a spatial resolution of 300 m.

KMSS imagery did not provide more than 3 cloud-free measurements over the study area during the period of one year. The generation of a separate composite image for each season was not feasible. Instead, a set of two KMSS scenes for May 14 and August 2, 2011 was used for the local scale classification experiment. The images had 3 spectral bands (535 – 575 nm, 630 – 680 nm and 760 – 900 nm) and a spatial resolution of 60 m. Examples of the KMSS based and MERIS based results compared to MODIS-derived map are shown in Figure 13.

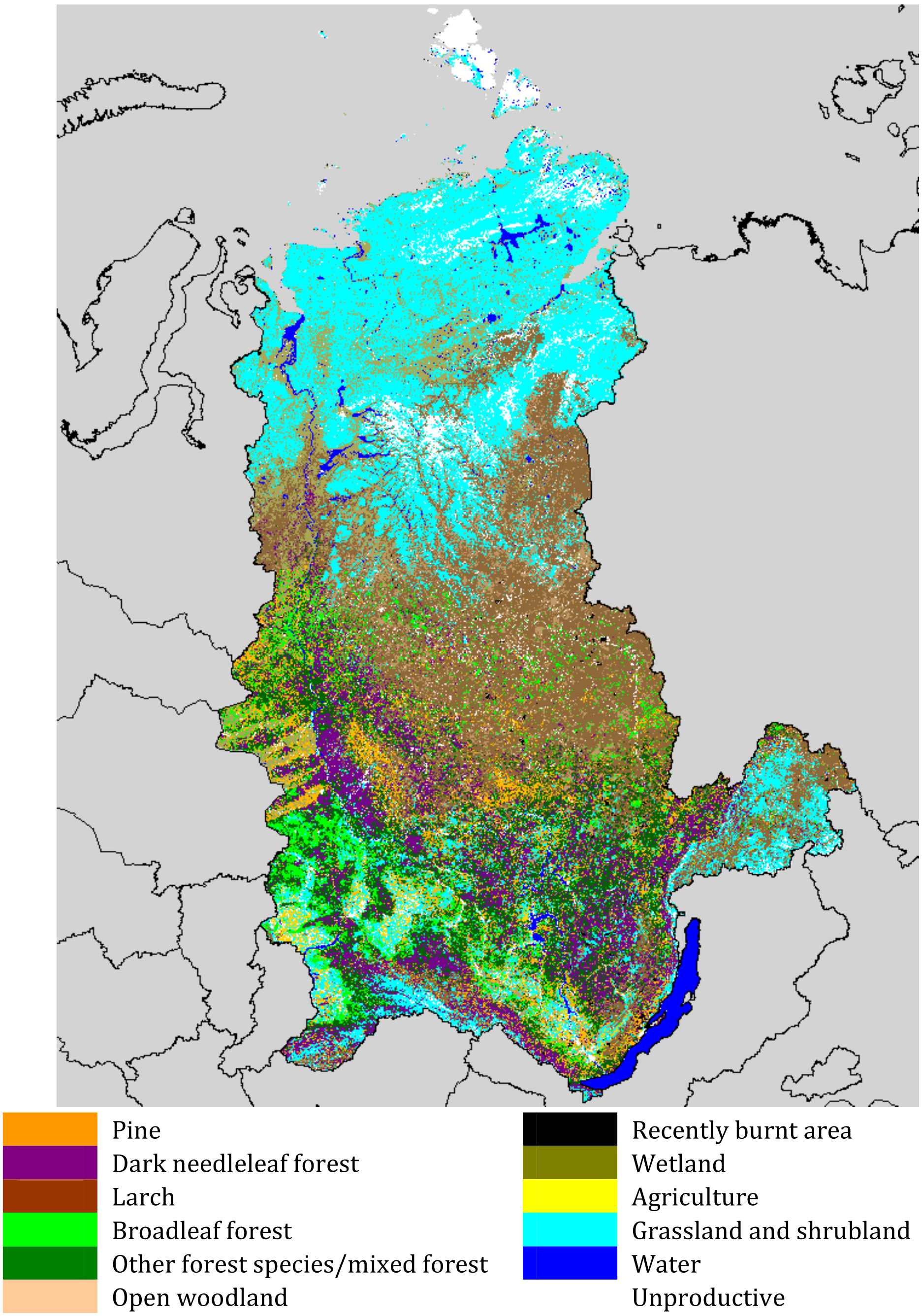


Fig. 12: Preliminary land cover map for Central Siberia.

Map reliability evaluation

To analyze the reliability of the produced map the probability of misclassification was evaluated for each image pixel. Then each pixel was assigned to one of the five reliability classes based on its probability value and the range of probability values of its land cover class.

Further work

Further work to achieve WP 3 project goals will mainly be focused on the efforts to divide "Dark needleleaf forest" and "Broadleaf forest" classes into separate forest species based on the analysis of weekly composite images time series. The possibility of this division is illustrated in Figure 14, where mean trajectories of different forest species in 2-dimentional phase space are shown, with axes representing surface reflectance in Red and NIR MODIS bands respectively.

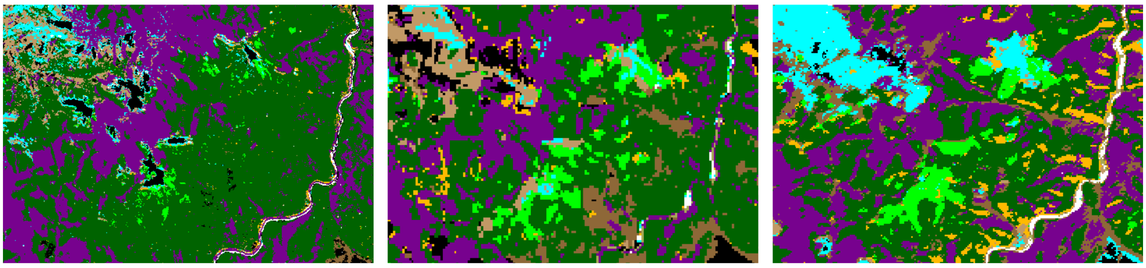


Fig. 13. Comparison of KMSS based (left), MERIS based (middle) and MODIS based (right) classification results.

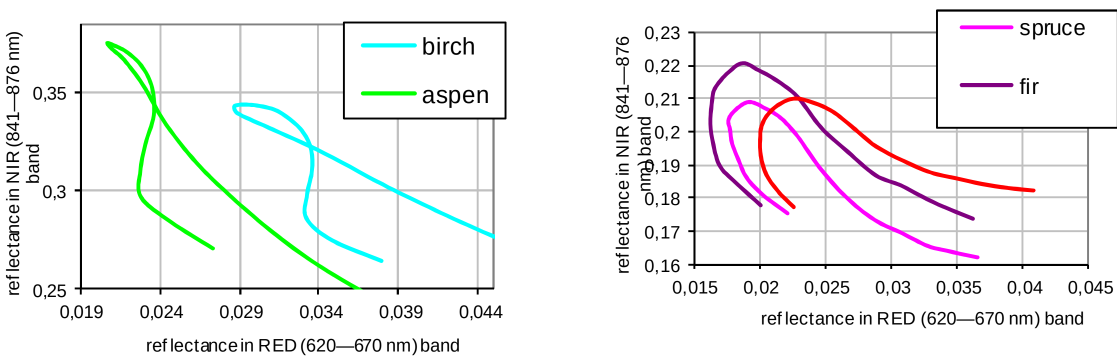


Fig. 14: Mean trajectories of different forest species in Red-NIR phase space.

2.2.3.3. Highlights

The preliminary MODIS based land cover map for Central Siberia including reliability flags was produced.

2.2.3.4. Deviations and impact on tasks and resources

Due to the poor coverage and questionable quality of KMSS and MERIS data it was decided to focus the work on using MODIS data instead. Based on the local scale classification experiments no apparent advantages in using KMSS or MERIS data (if available) were found.

2.2.3.5. Use of the resources

The following table lists the person-months per participant in the first 12 months in WP 3.

Table 8: Person-months per participant in the first 12 months in WP 3.

FSU	IIASA	IKI-RAS	SIF-RAS	NTsOMZ
0	1	10	0	0

2.2.4 Work Package 4 - Regional Forest Biomass Mapping for Central Siberia with Radar Satellite Data

Lead partner:FSU Jena
Contributing partners: IIASA

2.2.4.1. Overview of WP objectives

The goal of WP 4 is to provide a forest biomass map for Central Siberia based on ASAR WS data in 300 m and 500 m resolution for 2007-2011.

2.2.4.2. Summary of progress made

Draft forest biomass map for Central Siberia -Task leader: FSU Jena

A ESA Cat-1 proposal was successfully submitted to ESA. 300 ASAR WSM scenes (140 m spatial resolution) were ordered and pre-processed which covers the data contingent within the CAT-1 project. The ASAR data preparations for the application of the hyper-temporal biomass retrieval algorithm are on-going including time series generation.

Fig. 15: Processing regions for the application of the BIOMASAR algorithm over Eurasia using 1 km ENVISAR-ASAR Global Mode data.

The hyper-temporal retrieval approach has been successfully applied using ASAR global Mode data (1000 m spatial resolution). At this stage of the project a quality assessment for the Central Siberian mapping regions Asia Center North and Asia Center is conducted (Figure 15).

2.2.4.3. Highlights

The draft forest biomass map for Central Siberia could be achieved in 1 km spatial resolution. The map is currently in the final refinement and quality check phase.

2.2.4.4. Deviations and impact on tasks and resources

The initial goal to map the greater study area of Krasnoyarsk Kray and Irkutsk Oblast with 250 m spatial resolution cannot be achieved. Reasons are massive data gaps due to the reduced limits of ASAR Wide Swath scenes in the current ESA Cat-1 proposal. Since a minimum of 70 observations is required for the application of the BIOMASAR algorithm for biomass estimation the project consortium decided to reduce the mapping region for the regional scale biomass mapping on 250 m spatial resolution to the southern part of Krasnoyarsk Kray and Irkutsk Oblast. This core study region covers all local test sites and ensures that all further validation tasks in the following phases can be realized. A 1 km Biomass map for the whole Central Siberian study site will be obtained by integrating the current BIOMASAR-II GSV map in the task of WP 4. Besides the reduced areal coverage of the initial study region no massive impacts on the other work packages occur.

2.2.4.5. Use of the resources

The following table lists the person-months per participant in the first 12 months in WP 4.

Table 9: Person-months per participant in the first 12 months in WP 4.

FSU	IIASA	IKI-RAS	SIF-RAS	NTsOMZ
1,1	1,75	0	0	0

2.2.8 Work Package 8 - Local Sites: Biomass and Change Mapping

Lead partner: SIF-RAS
Contributing partners: FSU Jena

2.2.8.1. Overview of WP objectives

The objectives of WP 8 are to provide maps for local sites within Krasnoyarsk Kray and Irkutsk Oblast. Biomass maps refer to forest biomass maps based on PALSAR data (data availability through JAXA Kyoto&Carbon Panel membership of FSU), change maps refer to forest disturbance mapping as well as detection of potential new forest land (abandoned agricultural land). I particular, the following thematic goals are defined:

1) Adapt and apply forest biomass estimation approach based on PALSAR data. Provide recent forest biomass maps for at least 10 local sites (5 for Krasnoyarsk Kray plus 5 for Irkutsk Oblast). Local site refers to forest enterprise subdivisions or its smaller fragments with average area of 100000 ha each.
2) Provide forest disturbance maps (clear-cut & fire damage) for the same sites from above. Timeframe of change to be detected: 2000-recent.
3) Provide maps of recent abandoned land which corresponds to potential new forest land for 5 local sites within Krasnoyarsk Kray (same sites as selected above). Recent refers to the year 2005.

2.2.8.2. Summary of progress made

Recent fine scale forest biomass maps

Objective
One key objective of WP 8 is the generation of recent fine scale biomass maps for 10 local sites within Krasnoyarsk Kray and Irkutsk Oblast (5 for Krasnoyarsk Kray plus 5 for Irkutsk Oblast). Biomass maps refer to forest biomass maps based on PALSAR data (data availability through ESA Cat-1 project and JAXA Kyoto & Carbon Panel membership of FSU). The recent fine scale forest biomass mapping aims at the adaption and application of forest biomass estimation approaches based on PALSAR data. The 10 local sites Local site refer to forest enterprise subdivisions or its smaller fragments with a maximum area of 100000 ha each.

Local scale forest biomass map of Kazachinskoe and Bolshemurrtinskoe test sites
Three PALSAR SAR acquisitions in FBD mode and 25 m spatial resolution were used for the mapping process. SAR data preprocessing was performed comprising calibration, multilooking, orthorectification, and topographic normalization. SAR coherence estimation was conducted by means of: SLC data co-registration at sub-pixel level, slope adaptive common-band filtering in range, and common-band filtering in azimuth. Multitemporal backscatter imagery and coherence images (Figure 16) were used for the training of the linear regression model.

<u>Input data:</u>
- SAR coherence image (02jul08_17aug08_HV)
- Mean of SAR backscatter intensity ((02jul08_HV+17aug08_HV)/2)

<u>Classification method</u>
- Parameterization of linear regression model for SAR coherence image
- Parameterization of linear regression model for SAR backscatter intensity images
- Application of models on coherence and backscatter imagery
- Averaging model results of coherence and backscatter results to derive the final biomass map

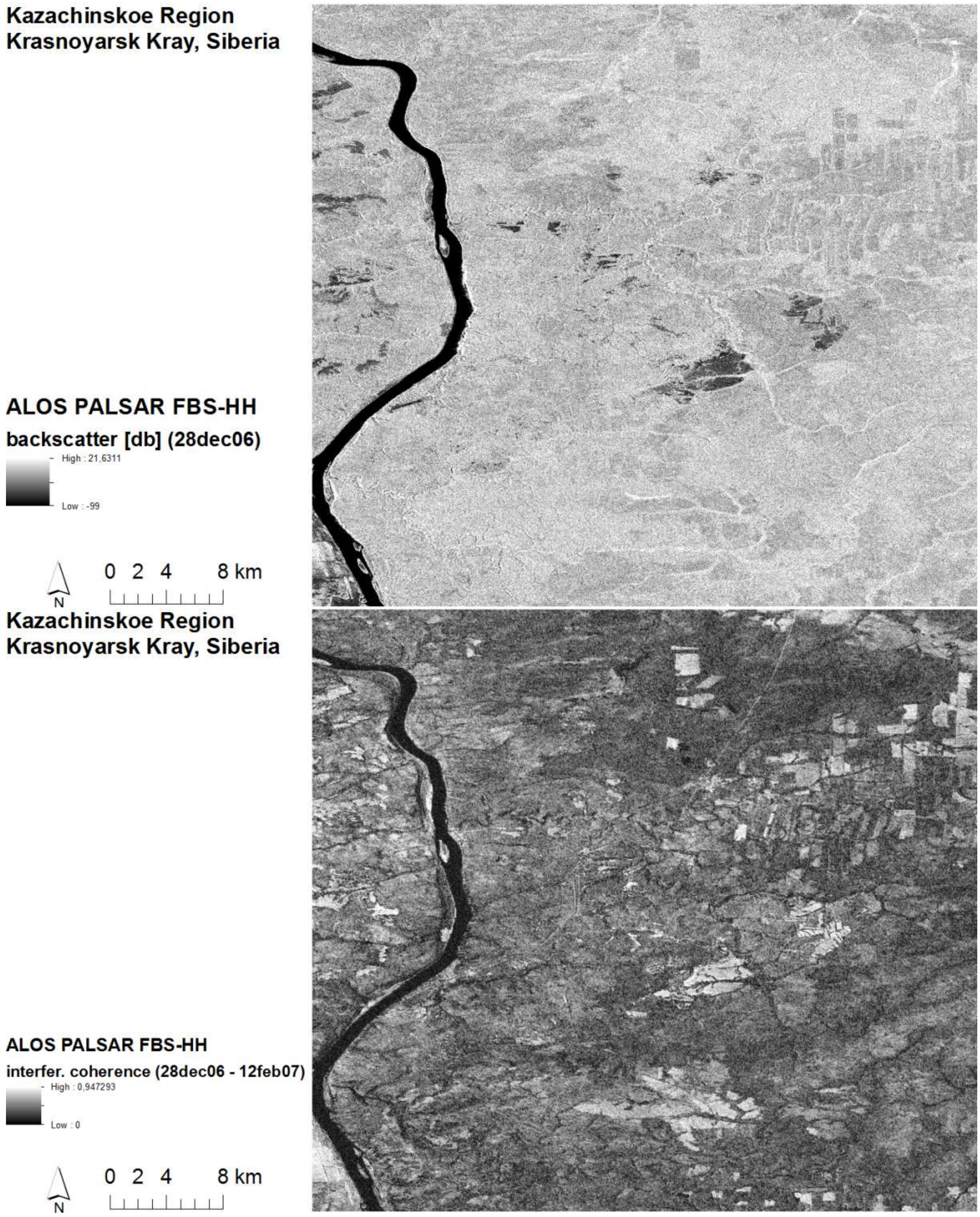


Fig. 16: Backsactter (upper image) and interferometric coherence (lower image) information build the input parameters for the biomass model training process.

Local scale test sites

The mapping of biomass in terms of growing stock volume (m^3/ha) was conducted for specific forest enterprise subdivisions. As shown in Figure 17 and 18, the first three resulting maps were derived for the test sites of the Krasnoyarsk Kray focus region:

- Kazachinskoe
- Bolshemurtinskoe West
- Bolshemurtinskoe East

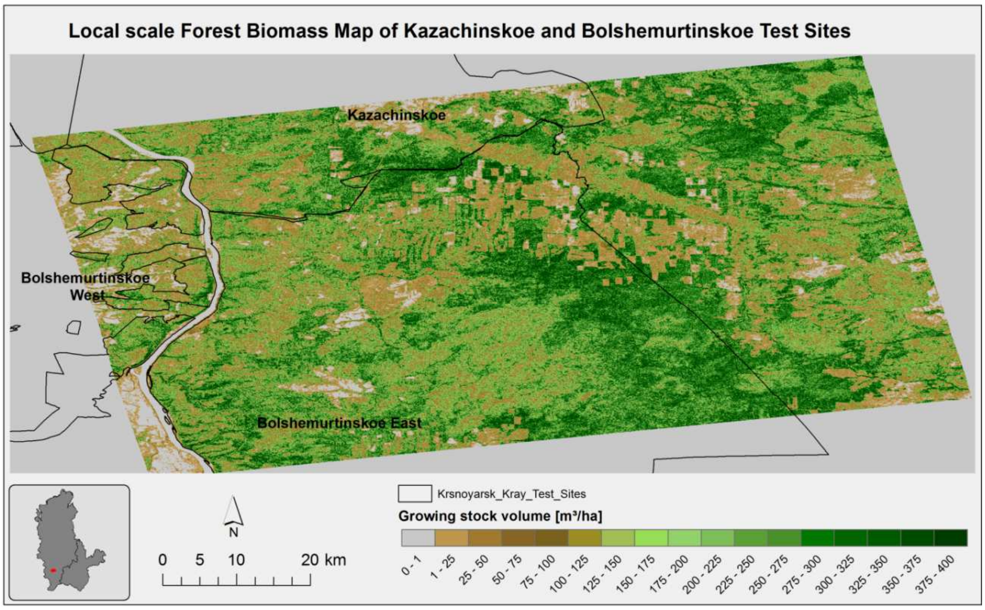


Fig. 17: Fine scale forest biomass maps for Central Siberian test sites in the Krasnoyarsk region. The map shows the distribution of three local test sites of Kazachinskoe and Bolshemurtinskoe (east and west).

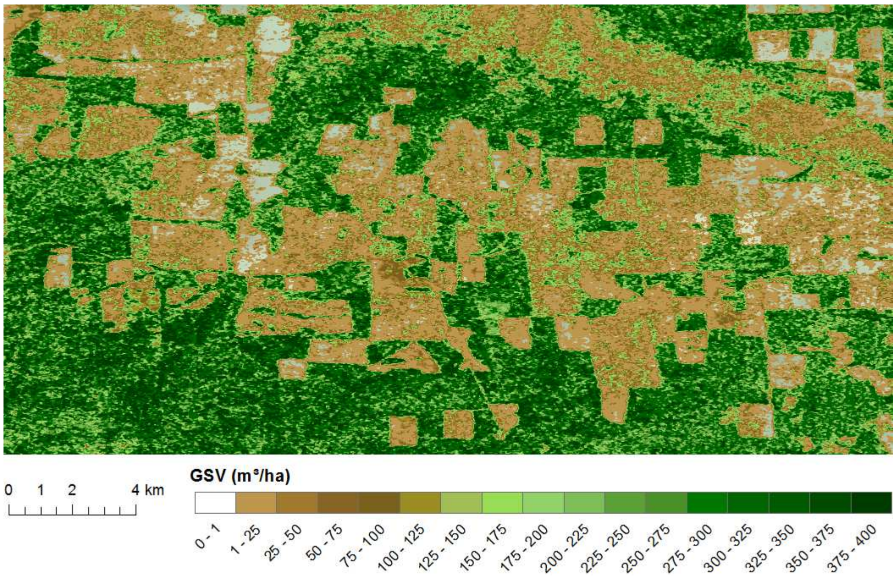


Fig. 18: Local scale forest biomass map of Bolshemurtinskoe test site showing high spatial details of growing stock volume distribution, such as high biomass forest stands, clear cuts, and re-growing forest on old clear cuts.

Fine scale forest disturbance maps

Objective

One key objective of WP 8.3 is the generation of recent fine scale forest disturbance maps for 10 local sites within Krasnoyarsk Kray and Irkutsk Oblast (5 for Krasnoyarsk Kray plus 5 for Irkutsk Oblast). Forest disturbance maps refer to forest biomass maps based on PALSAR data (data availability through ESA Cat-1 project and JAXA Kyoto & Carbon Panel membership of FSU). The recent fine scale forest disturbance mapping aims at the adaption and application of mapping techniques for forest disturbance monitoring based on PALSAR data. The 10 local sites Local site refer to forest enterprise subdivisions or its smaller fragments with a maximum area of 100000 ha each.

Local scale test sites

The mapping of biomass in terms of growing stock volume (m^3/ha) was conducted for specific forest enterprise subdivisions. As indicated in D.8.1 the first three resulting maps were derived for the test sites of the Krasnoyarsk Kray focus region:

- Kazachinskoe
- Bolshemurtinskoe West
- Bolshemurtinskoe East

Fine scale forest disturbance map of Kazachinskoe and Bolshemurtinskoe test sites

Three PALSAR SAR acquisitions in FBD mode and 25 m spatial resolution were used for the mapping process. SAR data preprocessing was performed comprising calibration, multilooking, orthorectification, and topographic normalisation. SAR coherence estimation was conducted by means of: SLC data co-registration at sub-pixel level, slope adaptive common-band filtering in range, and common-band filtering in azimuth. Based on the multitemporal imagery the coherence and backscatter images and the biomass map (D8.1) was used for the development of a segment-based and knowledge-based classification process (Figure 19 and 20).

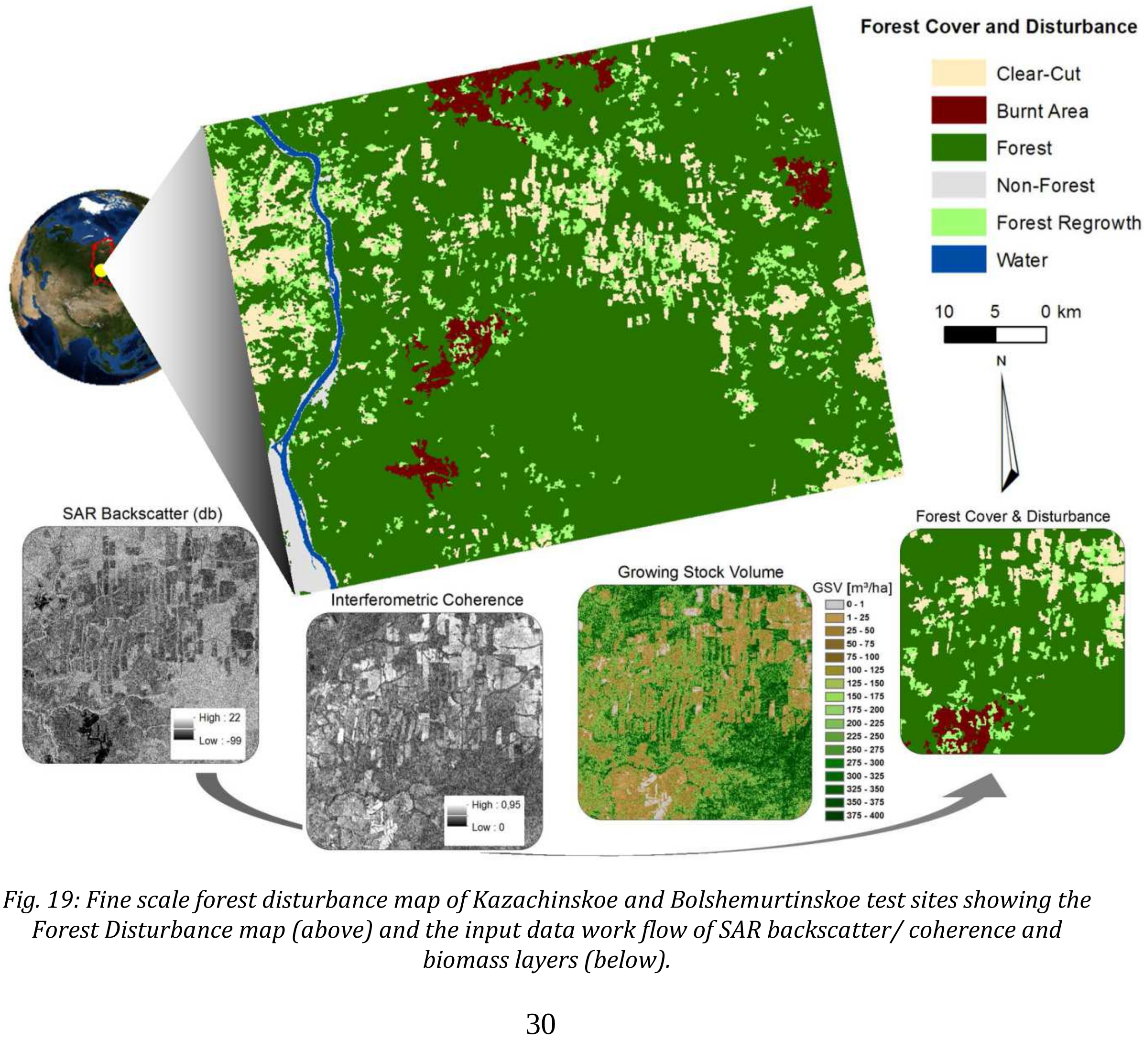


Fig. 19: Fine scale forest disturbance map of Kazachinskoe and Bolshemurtinskoe test sites showing the Forest Disturbance map (above) and the input data work flow of SAR backscatter/ coherence and biomass layers (below).

Input data:

- SAR coherence image (02jul08_17aug08_HV)
- Mean of SAR backscatter intensity ((02jul08_HV+17aug08_HV)/2)
- Ratio (02jul08_HV/17aug08_HV)
- Biomass map (D8.1)

Classification method

- Image segmentation (scale 5, shape 0.1, compactness 0.9)
- Classification non-forest (Threshold: backscatter < -15db und biomass < $50 m^3/ha$)
- Classification regrowth (Threshold: biomass < 100 m^3/ha)
- Classification forest (Threshold: biomass > 30 m^3/ha)
- Classification non-forest (Threshold: biomass < 3 m^3/ha)
- Classification water (all remaining segments)
- Classification clear-cuts and burnt areas by expert knowledge and further GIS analyses

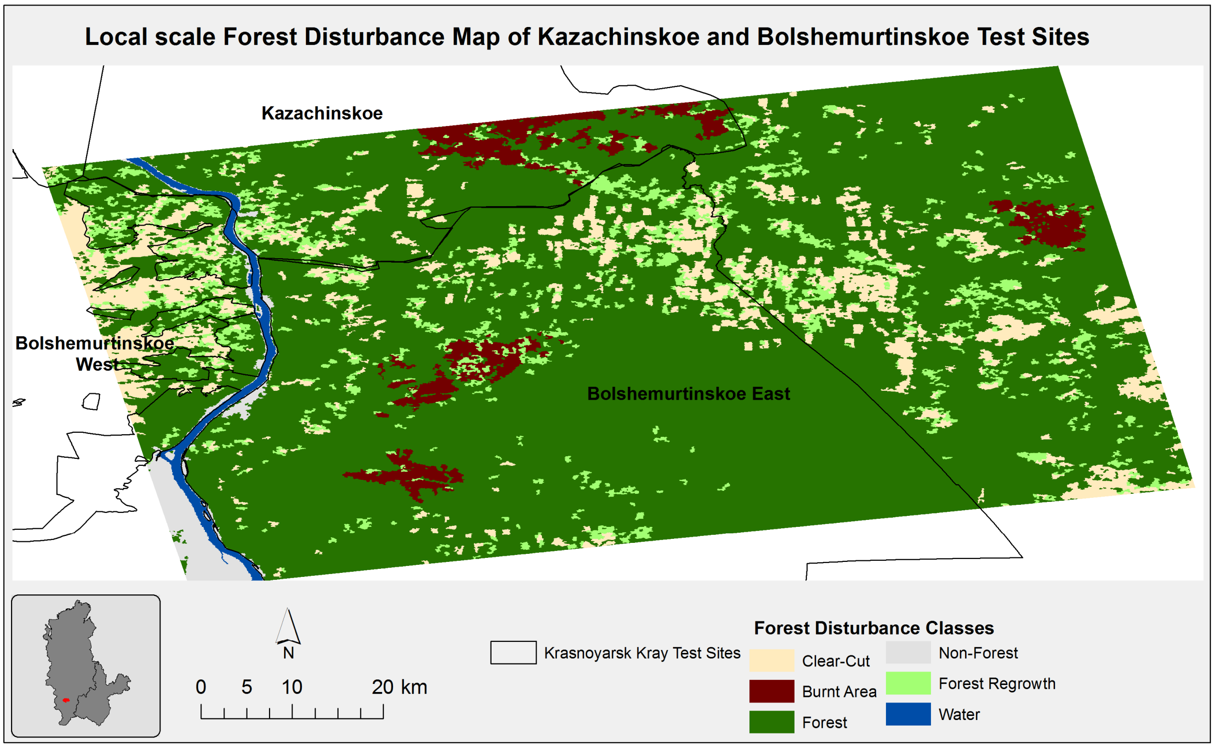


Fig. 20: Fine scale forest disturbance map for Central Siberian test sites in the Krasnoyarsk region. The map shows the distribution of three local test sites of Kazachinskoe and Bolshemurtinskoe (east and west).

Fine scale maps of recent abandoned land

Objective

One of the objectives of WP 8 is to derive maps of recent abandoned land which corresponds to potential new forest land for 5 local sites within Krasnoyarsk Kray. Abandoned land – with regards to PALSAR backscattering intensity and coherence – can perform like forest disturbances or arable land, as the arboreal vegetation in general is sparse and features very low biomass levels. Thus, for the distinction between abandoned land and arable land SAR time series are required. The dynamic of the backscatter due to diverse states of the arable land needs to be captured by the data. This will be achieved by using recently archived ASAR and PALSAR data. Abandoned lands can often be treated as potential new forested land due to forest regrowth processes.

Local scale test sites

The first resulting map aiming at the detection of abandoned lands and re-growing forests was derived for the Bolshemurtinsk test site, as indicated by the PALSAR coverage in Figure 21.

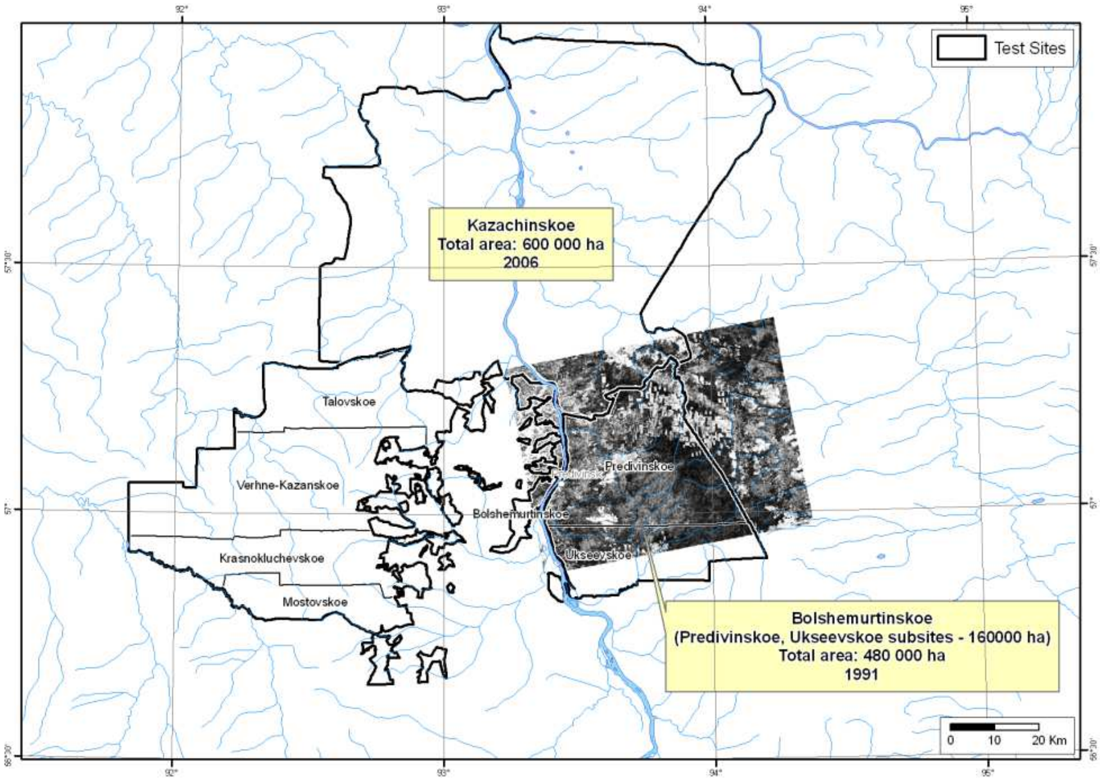


Fig. 21: Bolshemurtinskoe and Kazachinskoelocal test sites.

Abandoned land and Forest Regrowth Map

Three PALSAR SAR acquisitions in FBD mode and 25 m spatial resolution were used for the mapping process. SAR data preprocessing was performed comprising calibration, multilooking, orthorectification, and topographic normalization. SAR coherence estimation was conducted by means of: SLC data co-registration at sub-pixel level, slope adaptive common-band filtering in range, and common-band filtering in azimuth. Based on the multitemporal imagery the coherence and backscatter images and the biomass map (D8.1) was used for the development of a knowledge-based classification process.

Input data:

- SAR coherence image (02jul08_17aug08_HV)
- Mean of SAR backscatter intensity ((02jul08_HV+17aug08_HV)/2)
- Ratio (02jul08_HV/17aug08_HV)

- Biomass map (D8.1)

<u>Classification method</u>

- Image segmentation (scale 5, shape 0.1, compactness 0.9)
- Classification non-forest (Threshold: backscatter < -15db und biomass < 50m^3/ha)
- Classification regrowth (Threshold: biomass < 100 m^3/ha)

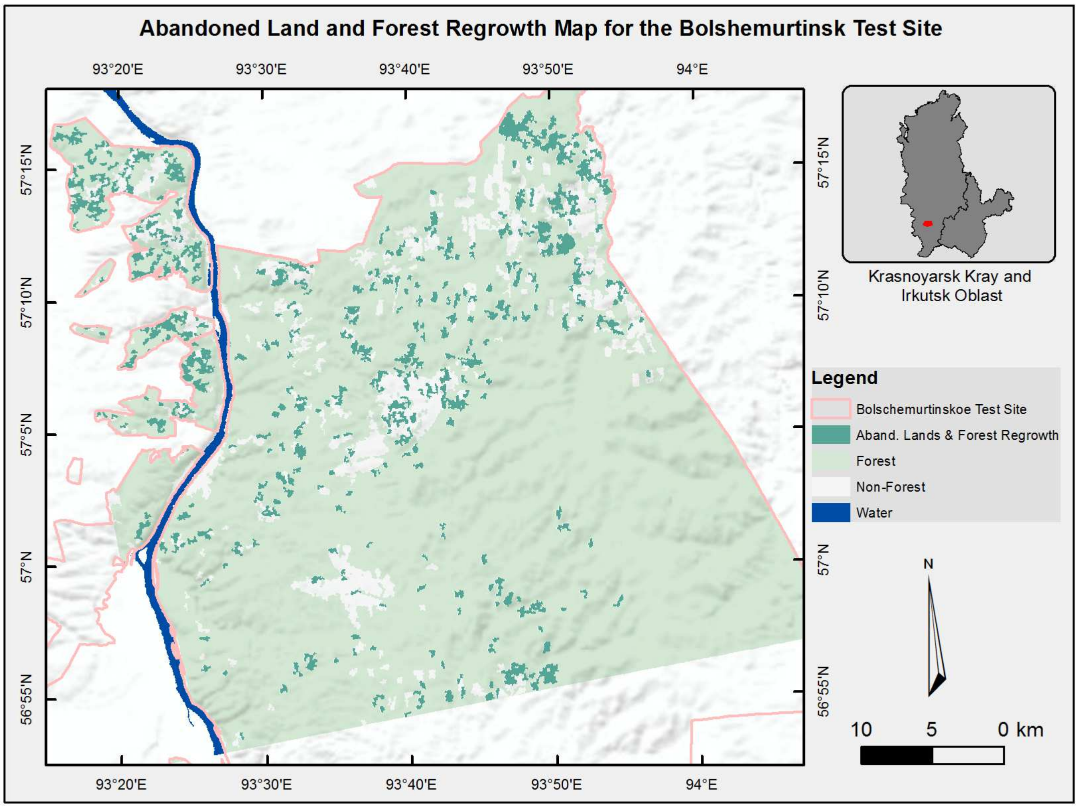


Fig. 22: Abandoned land and Forest Regrowth Map for the Bolshemurtinsk test site.

2.2.8.3. Highlights

A one-day field trip to the Bolshemurtinskoe local test sites was realized on 28 August together with FSU and SIF-RAS. The field trip organized by SIF-RAS was aiming to validate the first set of local map products, such as forest biomass and disturbance maps (Figure 23).

The following deliverables for the first year were successfully generated and disseminated among the project consortium:

- D8.1: recent fine scale forest biomass maps for 10 local sites (PM09: 3 sites)
- D8.3: Fine scale forest disturbance maps for 10 local sites (PM09: 3sites)
- D8.6: Fine scale maps of recent abandoned land for 5 local sites (PM09: 1 site)

Further, the mapping is in the process of being extended to the local Irkutsk test sites. The first set of biomass and forest disturbance maps could be finalized.

Fig. 23: field validation of local mapping activities showing forest regrowth on abandoned agricultural fields (upper left), recent forest clear cuts (upper right), on the fly validation of waypoints and satellite data (lower left), and land cover information collection in the field (lower right).

2.2.8.4. Deviations and impact on tasks and resources

No deviations occurred.

2.2.8.5. Use of the resources

The following table lists the person-months per participant in the first 12 months in WP 8.

Table 10: Person-months per participant in the first 12 months in WP 8.

FSU	IIASA	IKI-RAS	SIF-RAS	NTsOMZ
3	**0**	**0**	**15**	**0**

2.2.9 Work Package 9 - Validation and cross-comparison of products

Lead partner: SIF-RAS
Contributing partners: FSU Jena, IIASA, IKI-RAS, NTsOMZ

2.2.9.1. Overview of WP objectives

All products based on EO data foreseen for delivery will be validated to assess the quality and usability for further implementation into forestry related services. These are the forest biomass map for Central Siberia, the improved land cover map for Central Siberia, the updated IIASA GIS land cover layer, the results of carbon accounting for Central Siberia, the recent forest biomass maps, the forest disturbance maps, and the maps of recent abandoned land. Cross-comparison of maps generated within the project: Forest biomass map for Central Siberia against recent forest biomass maps and improved land cover map for Central Siberia against maps of recent abandoned land and forest disturbance.

2.2.9.2. Summary of progress made

A GIS-based approach was applied to inter-compare the forest inventory data and the recent optical RS data. With this approach, the initial set of elementary forest inventory units (EFIU) was subjected to several filtering procedures, during which the size, shape and spatial homogeneity of the sample polygons were analyzed. In attempt to reduce the georeferencing inaccuracy, the buffer zone was cut off from EFIU polygons. Statistical signatures (mean and standard deviation (SD) values) were calculated for each EFIU based on RS pixel values.

Special attention was paid to an analysis of spatial homogeneity of EFIUs. The high SD often indicates that a given EFIU dos not correspond to what is in the satellite image. Using EFIU clustering on the basis of SD values we detected the areas of recent changes, such as clear-cuts and fire-caused forest disturbances. On the other hand, the heterogeneous EFIUs were removed from the reference sample in order to form a statistically adequate set for further calibration and validation of the biomass maps.

The resulting EFIU sets included: (1) a set needing updating (D 2.4); (2) a high-accuracy set, in which EFIUs are sufficiently adequate for calibration and validation (D 8.1); and (3) forest disturbance layers (clear-cuts & fire-caused disturbances) for the test sites (D 8.2).

At this stage the FI data obtained for Abanskoe, Dolgomostovskoe, and Kazachinskoe local test sites were processed and updated. Table 11 summarizes the information on the forest disturbances detected after the above intercomparison. The EFIU set (2) was used to evaluate the average SAR-based pixel biomass per EFIU in order to compare it with FI values. The results of preliminary comparative analysis of SAR-based and FI-based growing woods stock are presented in Table 11.

2.2.9.3. Highlights

The first results of its inter-comparison FI data and SAR-based classification shows the mistakes of classification of permanent Grass-shrubs vegetation as regrowth and some other disturbs classes mixing also. So, now we are trying to make the adequate interpretation of all that. But one main point of all - we have to use combination of optical and SAR –based classification.

Table 11: Forest disturbances detected after cross comparison of forest inventory data (2009) with Landsat TM and Worldview 1/2 imagery (2011) for Aban and Dlogomostovsk test sites.

Disturbance type	Aban		Dolgomostovsk	
	Polygons	Area, ha	Polygons	Area, ha
Last cutting (< 2 years ago)	5	29	6	57
Clear-cut (2 - 10 years ago)	526	3692	181	1408
Fire (2 - 10 years ago)	99	2364	42	961
TOTAL	630	6085	229	2426

Table 12: Results of preliminary comparative analysis of SAR-based and FI-based growing woods stock.

Test site	EFIU set count	Mean Error, m3/ha (SAR-based – FI-based)	RMSE
Kazachinskoe, 2010	1073	-5.5	76
Bolshemurtinskoe, 1990	2735	16.5	90

2.2.9.4. Deviations and impact on tasks and resources

No deviations occurred.

2.2.9.5. Use of the resources

The following table lists the person-months per participant in the first 12 months in WP 9.

Table 13: Person-months per participant in the first 12 months in WP 9.

FSU	IIASA	IKI-RAS	SIF-RAS	NTsOMZ
0	**0**	**0**	**0**	**0,5**

2.2.10 Work Package 10 - Development of Web-Portal and Product Dissemination

Lead partner: IKI-RAS
Contributing partners: NTsOMZ, FSU Jena

2.2.10.1. Overview of WP objectives

The goal of the Web-Portal is to provide a platform for intra-project communication and data dissemination as well as external product provision. Moreover, the web portal will be used for data dissemination when products are finalised and the dissemination of scientific publications.

2.2.10.2. Summary of progress made

Web-Portal Prototype

A bi-lingual web portal was established and hosted by the FSU team. The ZAPÁS web portal is available under http://zapas.uni-jena.de. The web portal is the main tool for the dissemination of project information and background, documents (scientific publications, reports, and presentations) and the communication within the project team. All activities will be communicated and published in a web blog style. The data distribution service within the project is provided by the Siberian Earth System Science Cluster (SIB-ESS-C). The web portal is also hosted by FSU, available under http://www.sibessc.uni-jena.de and linked in the ZAPAS web portal.

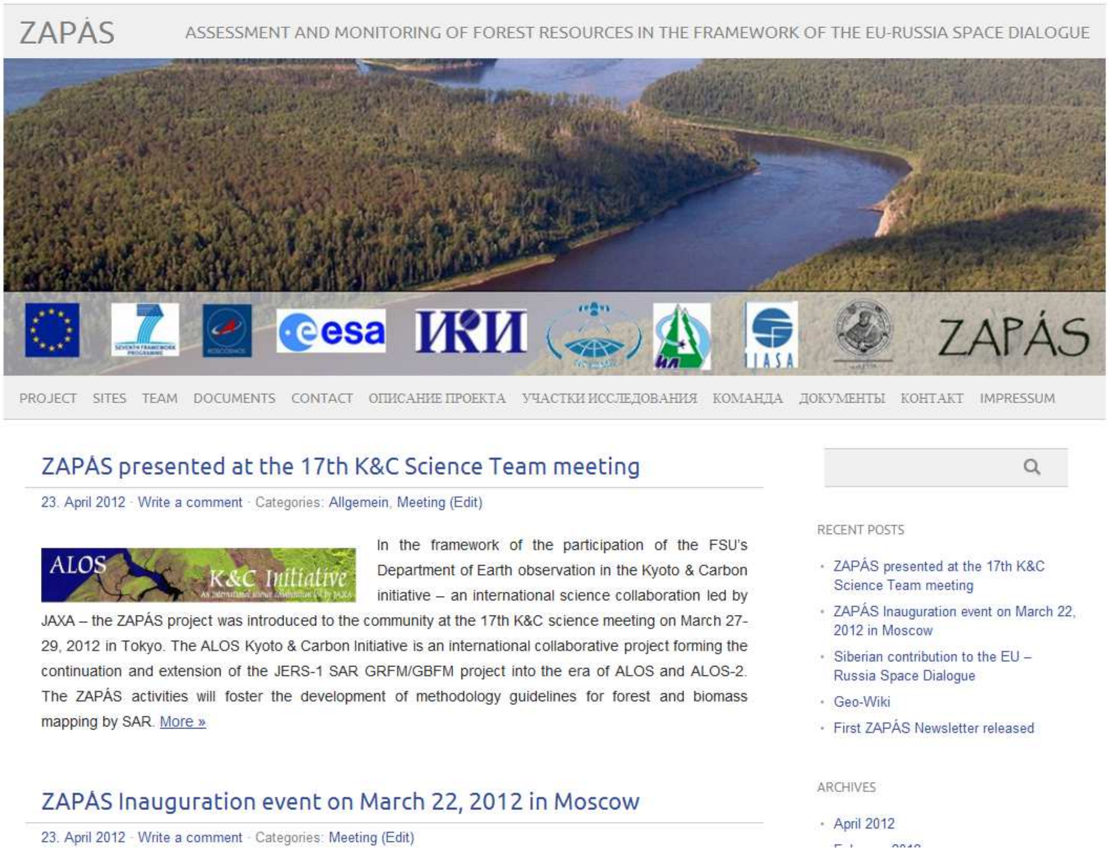


Fig. 24: The ZAPÁS Web Portal.

Designed as an informal web portal the content is structured in the following sub-sites:

- News blog (entering web site)
- Project (English and Russian language)
- Sites (English and Russian language)
- Team (English and Russian language)
- Documents (English and Russian language)
- Contact (English and Russian language)
- Link to the Siberian Earth System Science cluster (SIB-ESS-C)

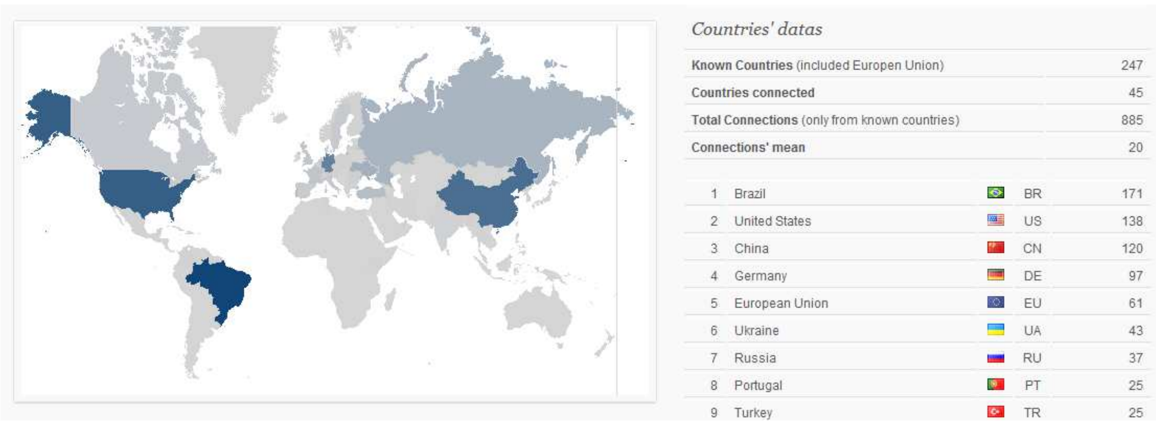
The news blog is editable for the project consortium and enables the timely publication and communication of project-related activities, results, and information linked to the ZAPÁS goals. Examples can be given with the report on the 17th Kyoto and Carbon Meeting (March 27-29, 2012, Tokyo) or the ZAPÁS inauguration event held in Moscow on March 22, 2012.

The other pages are of formal character aiming at (a) describing the background and objectives of the ZAPÁS project, (b) showing and describing the geographic location of the study areas. Local test site locations are depicted on a web-map viewer. The project consortium and contact information is presented on a single site describing participant names and institutions. As the web portal is aiming to fulfill key dissemination purposes documents and presentations of the project team are presented and frequently updated.

The ZAPAS web-portal also include a link to a map-service (http://zapas.smislab.ru), which provides access to the satellite data sets and thematic products developed within the project framework along with various tools for data analysis.

2.2.10.3. Highlights

In summary, the generation of the informational part of the web portal prototype is finished. Recent activities comprise the frequent update of the information portal and the generation of the link to the web map service delivering the achieved result on the local and regional biomass and forest (cover change) map products.



Countries' datas

Known Countries (included Europen Union)			247
Countries connected			45
Total Connections (only from known countries)			885
Connections' mean			20

1	Brazil	BR	171
2	United States	US	138
3	China	CN	120
4	Germany	DE	97
5	European Union	EU	61
6	Ukraine	UA	43
7	Russia	RU	37
8	Portugal	PT	25
9	Turkey	TR	25

Fig. 25: Map of web portal visits since January 2012 acquired from http://zapas.uni-jena.de indicating the interest in applying earth observation techniques in the forest sector for countries with major forest areas.

2.2.10.4. Deviations and impact on tasks and resources

A transfer of 10 PM was realized to FSU due to a changed personnel situation at IKI-RAS. The WP 10 tasks were divided by FSU and IKI. The leadership of WP 10 will be at IKI-RAS. The responsibilities of IKI-RAS and FSU concerning the maintenance of WP 10 as stated in the DoW (WP descriptions) are:

- FSU: Web-portal for dissemination of the generated within the project products to the wide community of potential users, distribution of publications through the web-portal.

- IKI-RAS: Web-map service and graphic user interface along with basic tools to derive spatial-temporal statistics on land cover classes area, forest changes IKI-RAS: Tools-set for the interactive forest change detection analysis.
- All Partners: Publication of results at several Symposia and in Journal papers.

2.2.10.5. Use of the resources

The following table lists the person-months per participant in the first 12 months in WP 10.

Table 14: Person-months per participant in the first 12 months in WP 10.

FSU	IIASA	IKI-RAS	SIF-RAS	NTsOMZ
3	0	5	0	0

3 Deliverables and Milestones

The first project year includes the realization of two milestones comprising the provision of the first set of inventory data (MS1) and the launch of the web portal (WP 10). MS 1 was reached in time. Inventory data received at SIF-RAS for all local test sites. For the first set of local maps the quality check and temporal update could be finalized. This process is on-going for the remaining test sites. MS 2 is to provide the web portal. The main web page is active and up to date. The map web service could also be finalized so that a prototype is available. First map products are implemented.

Table 14: ZAPÁS milestones in the first year.

MS No.	Milestone Name	WP Number	Lead beneficiary	Delivery (month)
MS1	Provision of first set of forest inventory data	WP 2	FSU	9
MS2	Launch of Web-portal	WP 10	IKI-RAS	12

After the first reporting period all required deliverables were submitted. The list of the finalized deliverables is shown below.

Table 15: ZAPÁS deliverable in the first year.

WP & Del. No.	Title	Lead beneficiary	Delivery date (from annex I)	Actual date
2.1	Preprocessing of EO optical and SAR data	FSU	31/03/2012	03/07/2012
2.2	Report on Preprocessing of EO optical data	IKI-RAS	31/08/2012	19/06/2012
2.4	forest inventory data	SIF-RAS	30/04/2012	20/06/2012
3.1	Draft land cover maps for Central Siberia	IKI-RAS	30/04/2012	18/06/2012

8.1	Recent fine scale forest biomass maps for 10 local sites. Delivery at PM09: 3 sites, PM32: 7 sites.	SIF-RAS	30/04/2012	16/08/2012
8.3	Fine scale forest disturbance maps for 10 local sites. Delivery at PM09: 3 sites, PM22: 3 sites, PM3	SIF-RAS	30/04/2012	16/08/2012
8.6	Fine scale maps of recent abandoned land for 5 local sites. Delivery at PM09: 1 site, PM22: 2 sites,	SIF-RAS	31/07/2012	28/06/2012
10.1	Web-Portal Prototype	IKI-RAS	31/01/2012	18/06/2012

4. Explanation of the use of the resources

The explanation of the use of the resources is listed in the appendix.

5. Financial statements

The financial statements are listed in the appendix.