Irkutsk Regional Information System for Environmental Protection

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IRIS assesses the current status and dynamics of the Irkutsk region's forestry environment, influenced by man-made changes and anthropogenic impact.
IRIS benefits and contributes to on-going European–Russian cooperation projects.

IRIS

Coordination: Friedrich Schiller University Jena, Germany
Funding: European Commission, 6th Framework Programme (SSA)
Live time: July 2006 - July 2008

- Establishing links in the system "Economy and Environment" -

European Commission
Sixth Framework
Programme (FP6)

-Irkutsk Science Center, Department of Regional and Social Problems, Irkutsk
-International Institute for Applied Systems Analysis, Laxenburg, Austria
-Nansen International Environmental and Remote Sensing Centre, Saint Petersburg
-Research Centre for Earth Operative Monitoring - Russian Space Agency, Moscow
-Friedrich-Schiller-University Jena (Coordinator)

Establishing links in the system “Economy and Environment”

Within the concept of IRIS, the partners have undertaken an attempt

- to estimate quantitatively the contribution of the Lumber Industry Complex into the economy of Irkutsk Province;
- to determine how essential is the factor of environmental degradation while estimating and forecasting the Gross Regional Product (GRP);
- to identify human-induced regional as well as global environmental impacts that are both economic and socially responsible;
- by using and efficiently sharing multi-scale up-to-date as well as long-term satellite-based EO data.

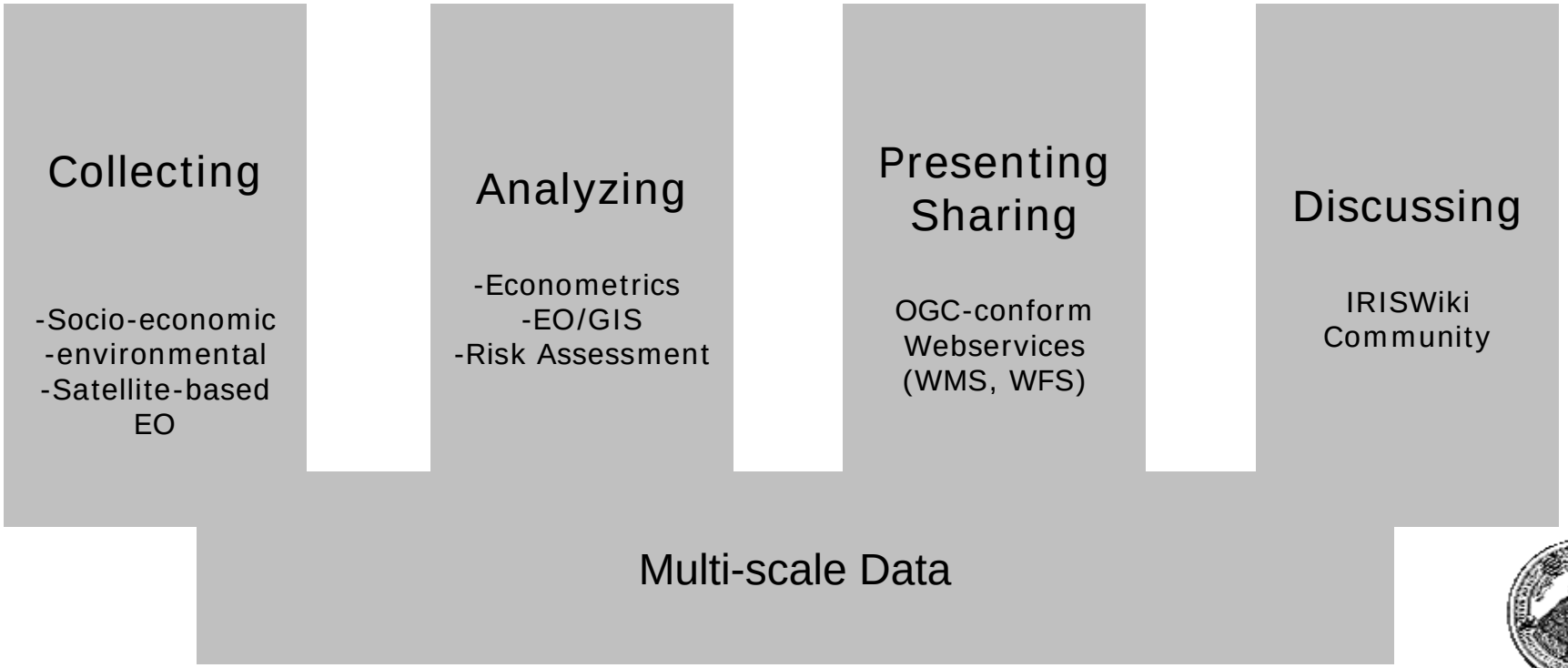
IRIS profits from recent technological developments, like

- universal connectivity (Internet),
- new advanced EO sensors (ASAR, ALOS-PALSAR),
- comprehensive analysis environments (GIS, SDI, Stats),
- standards for data, metadata and web services (like OGC), or
- communication platforms for computer-supported cooperative work (Wikis).

Establishing links in the system “Economy and Environment”

Where do we go from here?

- need to assess the current status and dynamics of the Region’s environments
- need for public (governance) access to data products and simulation tools
- need for more structure and documentation of what is available
- need to continue dataset generation to build up time series



Lumber Industry Complex (LIC) and public welfare

Forest resources in Irkutsk Province:

-High value forests (66.8 million hectares or 9.9% of Russian forested areas)

Human impacts:

-wood processing and pulp and paper industries
  -about 20% of the industrial production
  -leading role of the forest complexes in industries' structure
  -Lumber industries' enterprises are the major ones in many administrative districts
-clear cutting and cultivation
-common forest fire events
-atmospheric pollution by large industrial zones (LICs)
-contamination by untreated waste water effluents
-increasing canopy temperatures

Status:

-intensive large area changes of forests
-high and very high levels of pollution of the natural environments
-low levels of added values and low labour productivity while LIC is operating

Needs:

-an adequate measurement of the region's economy functioning by taking into account a certain number of factors considering environmental impacts and describing public welfare

Econometrics framework

GRP has been chosen as the major indicator, characterizing the efficiency of the economy functioning.

To measure the GRP, econometric models have been applied.

Such models usually consist of two parts, estimation equations and defined equations as that the GRP is composed of consumption, investment and export off import.

The statistical method to get the estimation equation is regression analysis.

Here, the GRP is the independent variable and several factors are the dependent variables in forming the regression equation.

The Role of the Lumber Industry Complex (LIC) in the Generation of the Gross Regional Product (GRP)

$$GRP = u_c C + u_p P + \lambda_1 S + \lambda_2 F(K(t),R(t),t) + \lambda_2 \mu(t) * P'(t) + \lambda_3 [r*(H-K) + + X_e(t) + X_0(T)]$$

where,

C is the purchasing power in the LIC (salaries, dividends, allowances and other payments in all enterprises in the province, savings);
P : the harm made to the environment while LIC operates;
H : major LIC's funds (fixed capital);
S : total number of the forest cuttings (obtaining of the major resource for the LIC);
F(K(t),R(t),t) : production of goods made from the forest resource;
P'(t): allowable pollution level, established by the State, the excess of this level results in fines and penalties;
r : rate of return used in the capitals market (LIBOR rate);
K : volumes of the retiring assets in the LIC;
$X_e(t)$ **:** round woods export;
$X_0(t)$: LIC products export;
$\lambda_1, \lambda_2, \lambda_3$**–:** shadow coefficients of the influence of the indicators presented on the GRP (national income in terms of the benefit should reflect the well being, and should be definitely corrected for the values of the resources depletion, increase of the pollution and increase of the national non-resource wealth, all these is evaluated as the shadows prices);
μ – the dependency ratio of the pollution from the permissions granted.

Mathematical model describing the role of the Lumber Industry Complex (LIC) in the generation of the Gross Regional Product (GRP) of Irkutsk Province with consideration to environmental impacts.

(Dumov, Lipnyagova, Dayneko)

The Role of the Lumber Industry Complex in the Generation of the Gross Regional Product (GRP)

The factors' values used for the econometric calculations

Year	GRP	C	P	S	F(K(t),R(t),t)	P'(t)	H
1995	90 214	32 087	436	425 446	66 444	-	270 834
1996	85 495	31 572	1586	374 920	54 686	1571	253 646
1997	76 701	40 012	869	401 362	37285	864	251 523
1998	115 327	55 761	1824	343 232	42 145	1807	271 755
1999	249 851	88 600	2216	408 272	48 610	2207	286 436
2000	397 129	118 870	3527	499 588	55 922	3523	203 925
2001	407 938	144 745	7007	547 683	60 560	6995	215 025
2002	447 562	183 595	2258	620 205	81 362	1919	244 822
2003	524 306	234 896	2103	1 120 556	109 315	-	260 220
2004	545 817	278 773	2191	1 351 018	121 948	1802	307 179
2005	417 035	355 920	2219	1 403 096	137 261	1834	312 294
	Thousand dollars						

Source: The State Report on the State and the Protection of the Environment in Irkutsk Province in 2004. - Irkutsk: Oblmashinform, 2005. - p. 296.
http: // faostat.fao.org/-the statistical information on the LIC's products. (export, import)

Datasets on pollution sources and other stress factors in the Region

Dataset on pollution sources:

Atmosphere
Surface waters
Soils (e.g. Parameters: Territory;
Enterprise;
Land's damage;
Grounds complained for the reporting year, ha;
Place of Location; Amount (excess);
Polluting substances (pesticides);
Decrease of the pollution's level in comparison to 1996;
Disturbed, abandoned, remediated lands, ha)

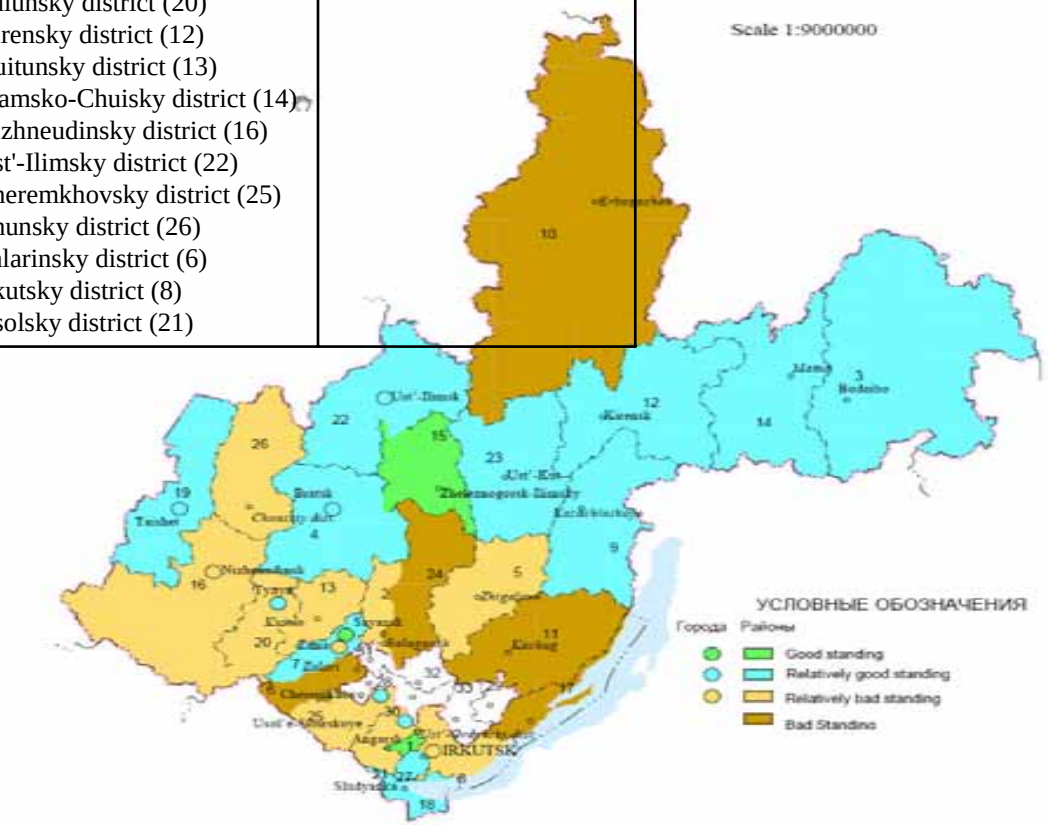
Dataset on other stress factors in the region (selection):

Medico-geographical situation
Anthropogenic factors of the ecological situation formation
Diseases
Birth and death rates
Infantile Death rates
Indicators of diseases
Indicators of migration
Sanitary-epidemiologic conditions
Maps of Complex Impact

Source of Data:
Territorial Agency of the Federal Service of the State Statistics in Irkutsk Province
The Irkutsk Science Center (Department of Regional Economic and Social Problems)

Groups of the municipal entities by the level of poverty based on the complex index of the territory's development.

Good standing municipalities and districts (group I)	Relatively good standing municipalities and districts (group II)	Relatively bad standing municipalities and districts (group III)	Bad standing municipalities and districts (group IV)
Angarsk[1)] **Bratsk** **Shelekhov** [1)] **Sayansk**	**Irkutsk** **Taishet** **Tulun** **Usolye-Sibirskoye** **Ust'-Ilimsk** **Ust'-Kut** (23)[1)] **Cheremkhovo** Ziminsky district (7) Kazachinsko-Lensky district (9) Nizhneilimsky district (15) Sludyansky district (18) Taishetsky district (19)	**Bodaibo** (4)[1)] **Zima** **Nigneudinsk** Bratsky district (3) Balagansky district (2) Zhigalovsky district (5) Tulunsky district (20) Kirensky district (12) Kuitunsky district (13) Mamsko-Chuisky district (14) Nizhneudinsky district (16) Ust'-Ilimsky district (22) Cheremkhovsky district (25) Chunsky district (26) Zalarinsky district (6) Irkutsky district (8) Usolsky district (21)	Katangsky district (10) Olkhonsky district (17) Ust'-Udinsky district (24) Kachugsky district (11)



Econometrics framework - Conclusions

• The solvent demand results in the growth of the province's regional product and is the most significant factor of the growth of the society's wealth.

• The pollutions paid for (enterprises are obliged to pay for the environmental contaminations, which exceed the limited by the state values, as penalties) are the factor positively influencing the well-being of the society.

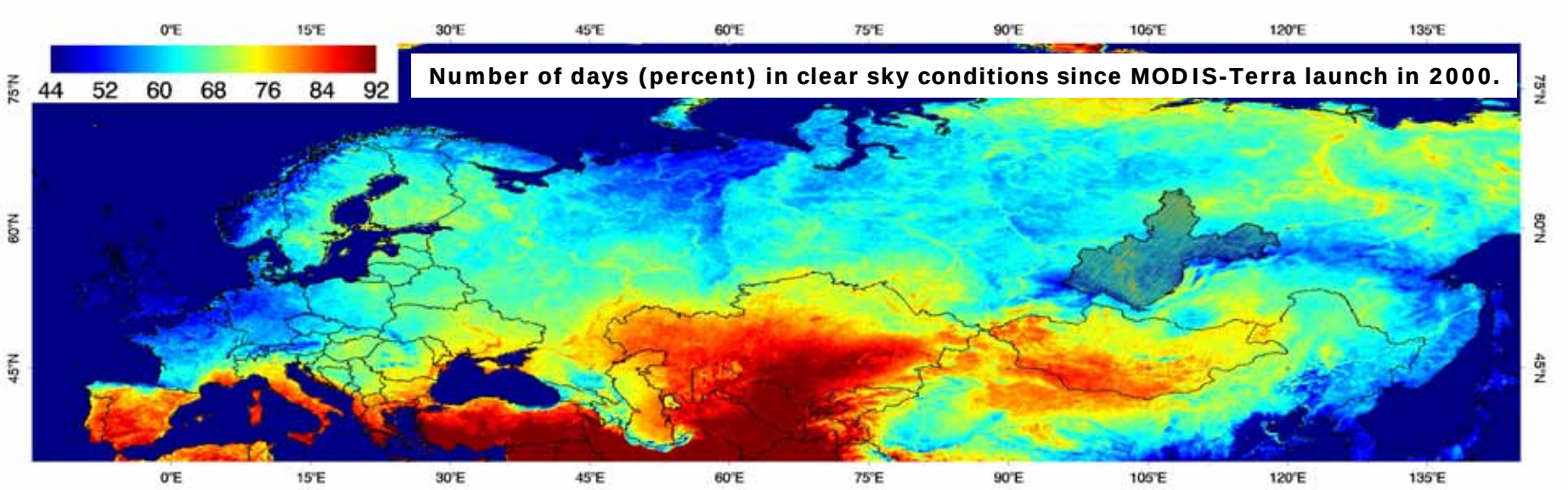
• The process of the deforestation is organized inefficiently: there is a high share of unaccounted cuttings, a smaller output of the wood products per square meter in comparison to the developed countries, a resource oriented export, a smaller margin profit from the functioning of the production.

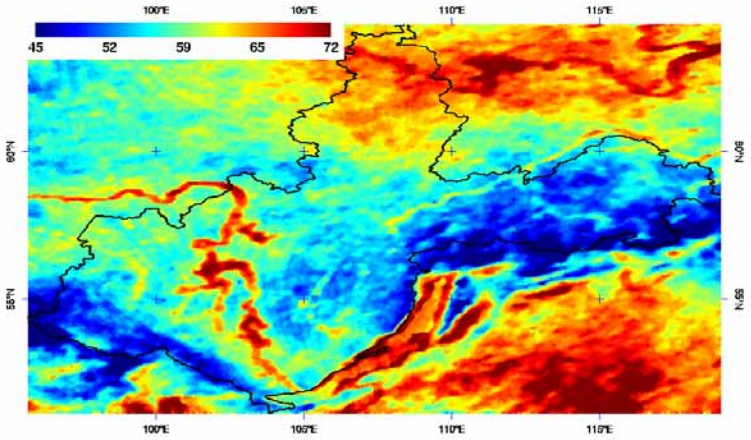
• the increase of the quantity of the permissions to pollute results in the fall of the well-being of the society: the growth of the unpaid pollutions, the growth of the uncompensated harm to the environment.

EO and GIS Framework

- Data availability is not an issue but analysis of existing data sets is the challenge
- scale-specific image processing is needed for a better understanding of the concepts of “objects” and “pixels”
- Geodatainfrastructures are the backbones in hosting, archiving, exchanging data as well as for their integrated analysis (SIB-ESS-C Catalog Service)

CLEAR_SKY_DAYS maps help to understand the Terra/Aqua-MODIS potential, how many validate measurements are contained in the higher level MODIS products such as NDVI or Net Primary Productivity. It also **helps to setup monitoring strategies, where optical EO platforms are considered the primary data source for area-wide, daily and monthly data.** In higher latitudes the data might be interpreted as percent of cloud-free days at 10:30 a.m. UTC !

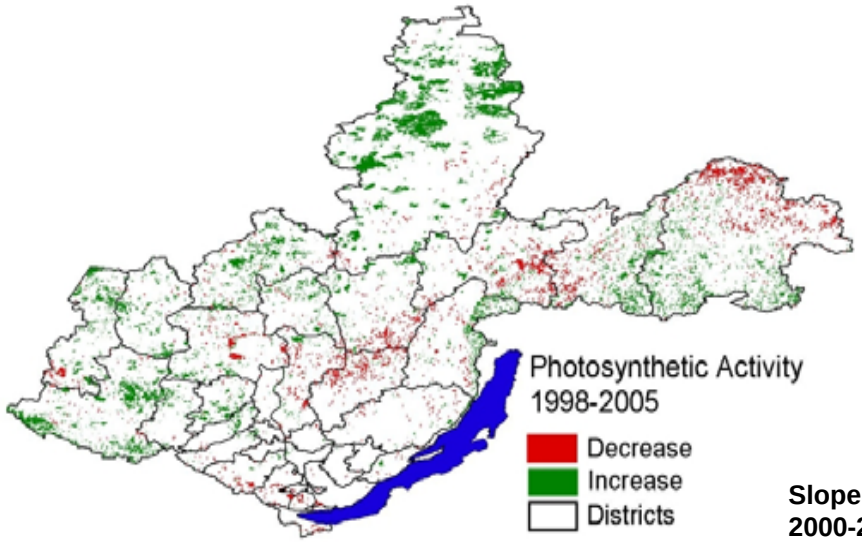




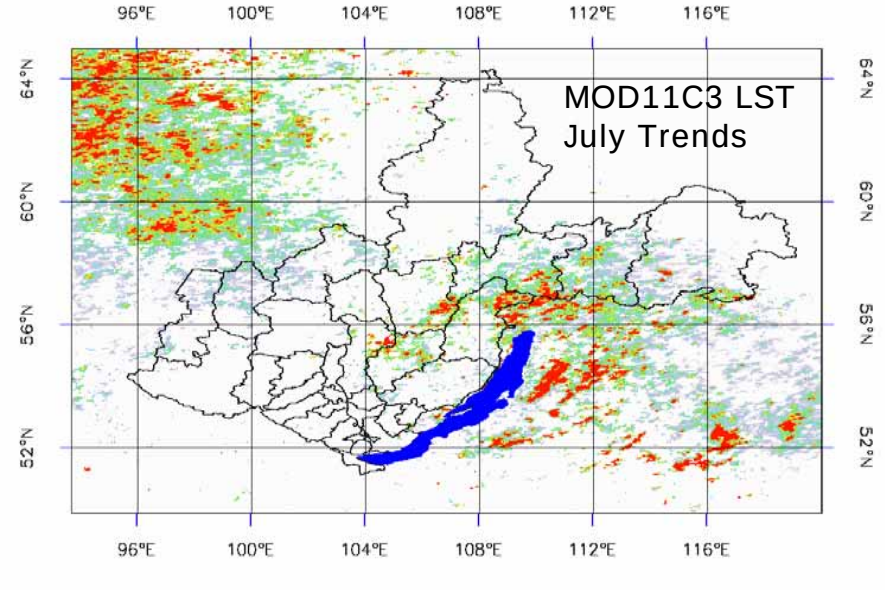
	2000	2001	2002	2003	2004	2005	2006	2007	2008
Jan*		46	54	56	59	66	44	64	56
Feb		48	52	51	55	82	48	54	62
Mar	49	54	39	66	51	59	59	68	
Apr	49	52	63	50	58	53	56	64	
May	59	57	71	65	49	66	53	54	
Jun	69	35	67	73	64	47	67	65	
Jul	65	56	71	58	67	77	72	73	
Aug	38	73	66	61	69	68	56	67	
Sep	55	46	49	48	43	56	56	54	
Oct	38	48	46	33	34	34	37	36	
Nov	59	42	56	54	52	50	50	45	
Dec*	71	62	68	36	53	71	52	49	

Trend Analyses – Linear Regression

MODIS LST and Spot VGT NDVI



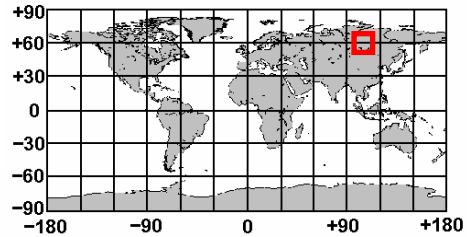
Data: Courtesy of Ch. Huettig.

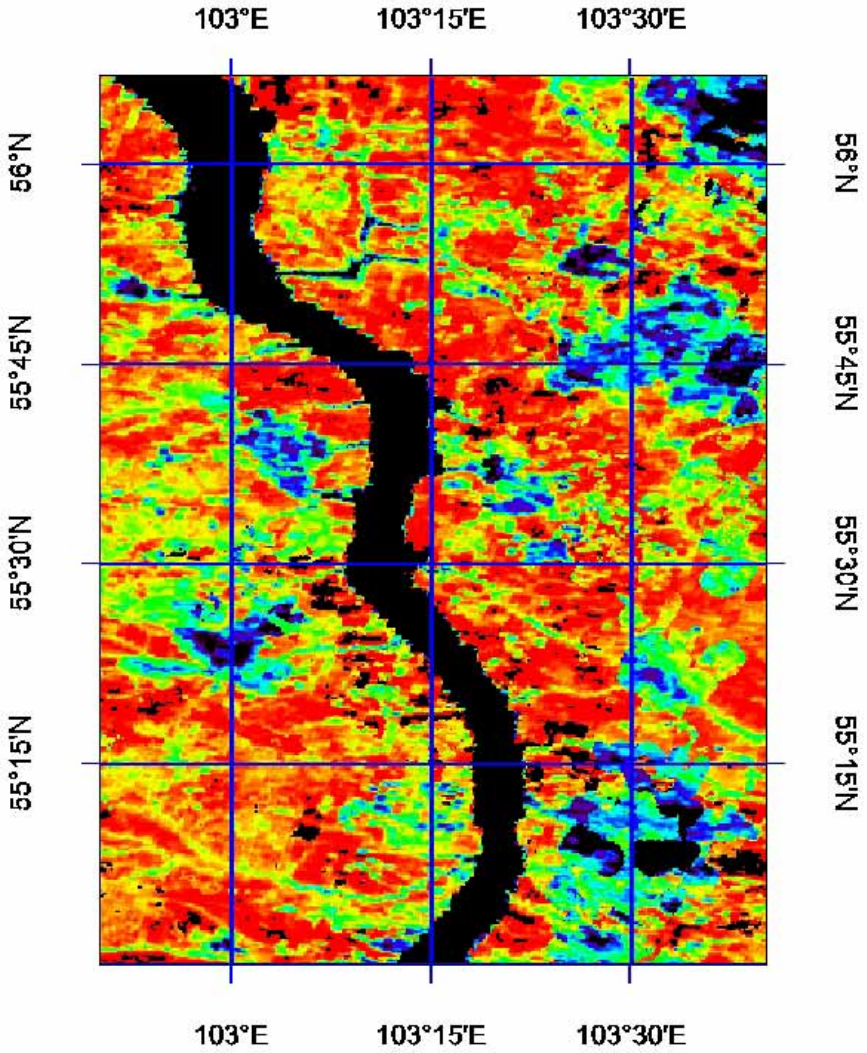


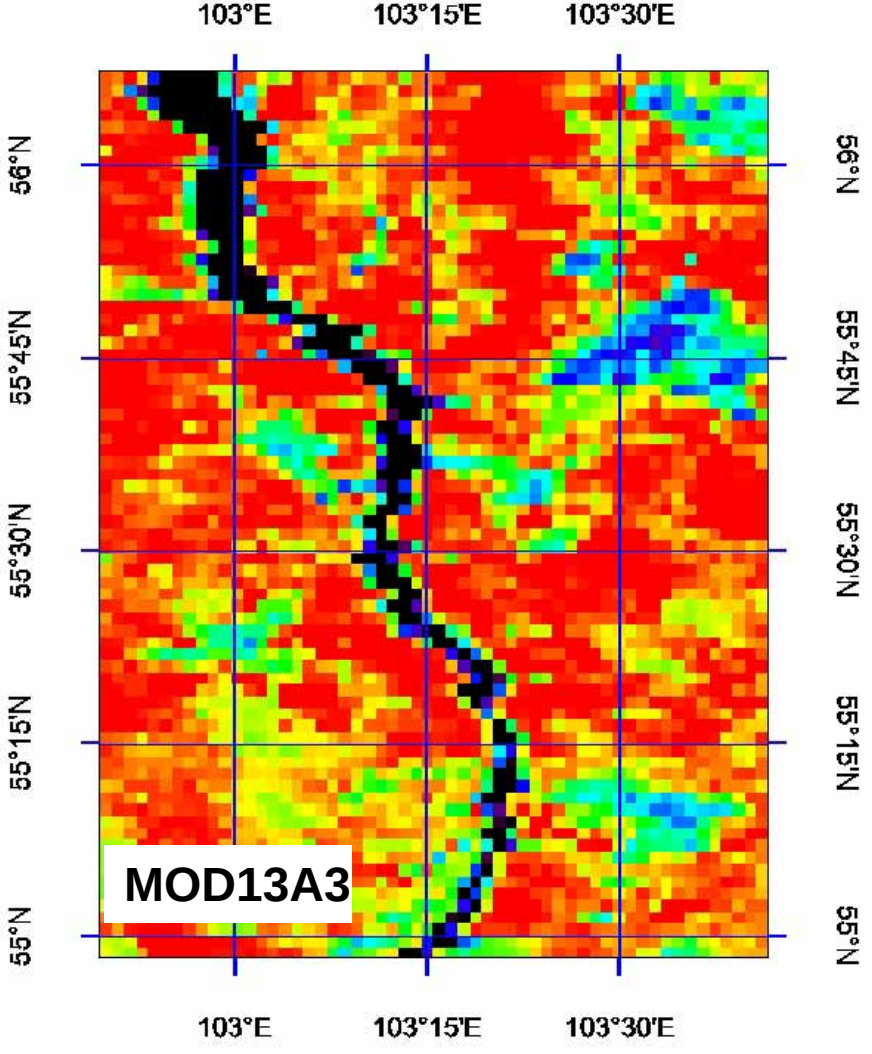
Slope of positive and negative trends for seasonal and monthly LST data for 2000-2007 , Irkutsk Province. The trends are analyzed on a confidence level of 95% using standard t-test. Values represent changes in Kelvin.

	Min		Max		Mean	
time\trend	positive	negative	positive	negative	positive	negative
spring	0.53	-1.45	0.68	-0.18	0.60	-0.67
summer	0.14	-1.67	1.59	-0.12	0.55	-0.74
fall	0.14	-0.50	1.37	-0.15	0.70	-0.30
June	0.13	-2.74	1.28	-0.16	0.54	-0.75
July	0.20	NaN	2.54	NaN	0.94	NaN
August	0.16	-1.43	1.89	-0.16	0.95	-0.64

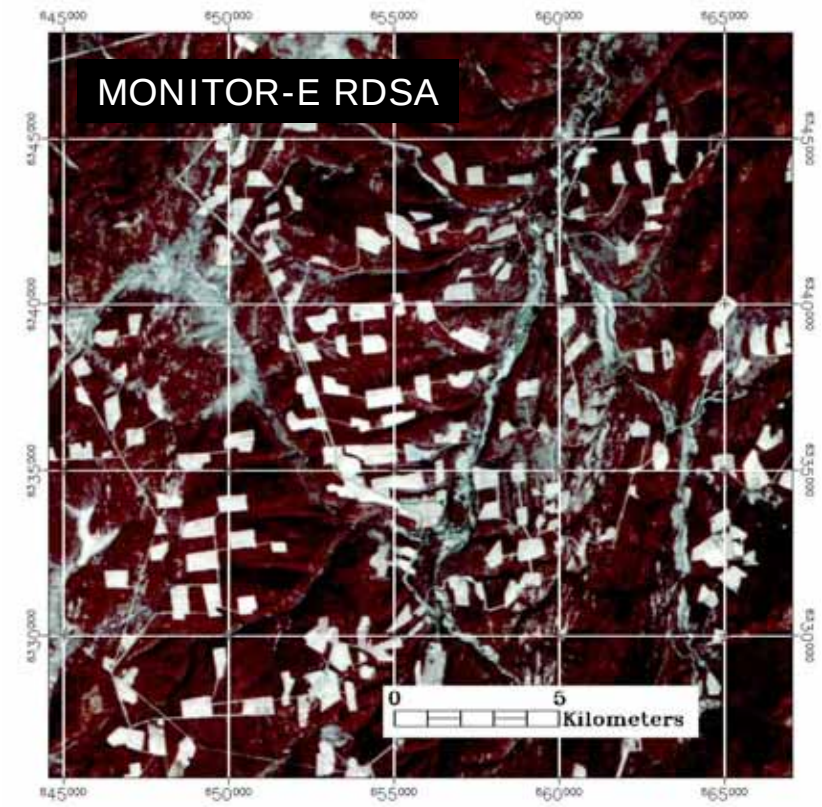
GLOBCOVER vs. MOD13A3

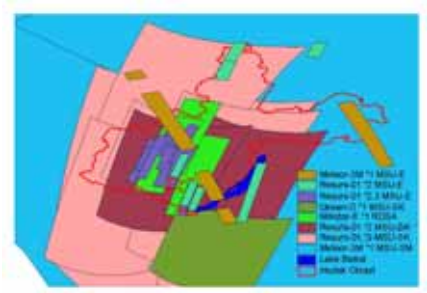




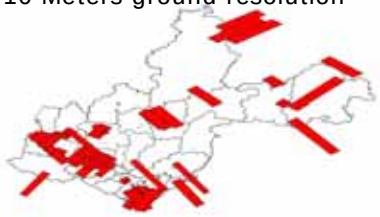


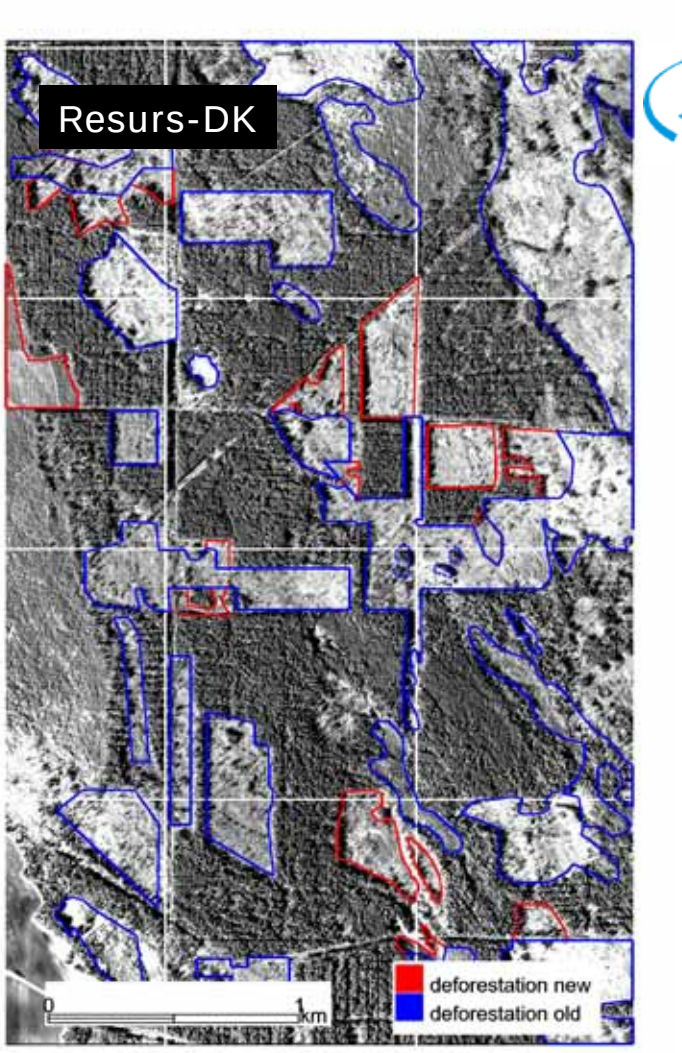
Use of up-to-date high-res optical EO data: Monitor-E-RDSA, Resurs-DK and object-oriented image processing techniques



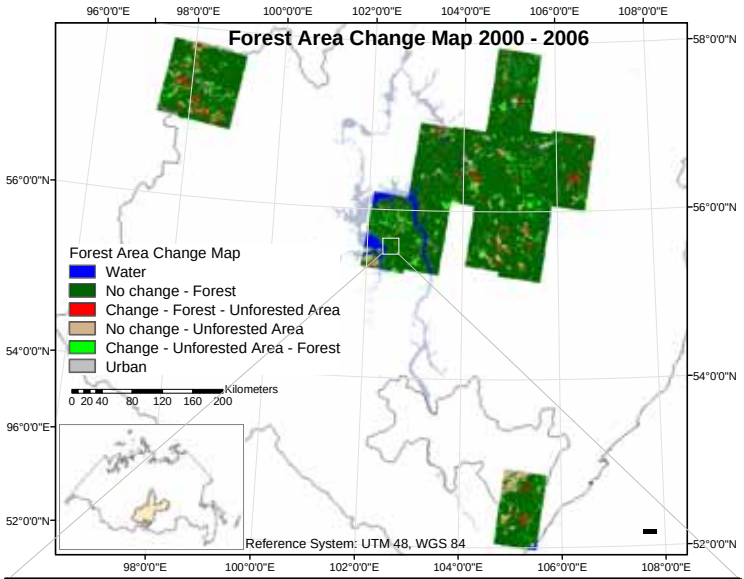


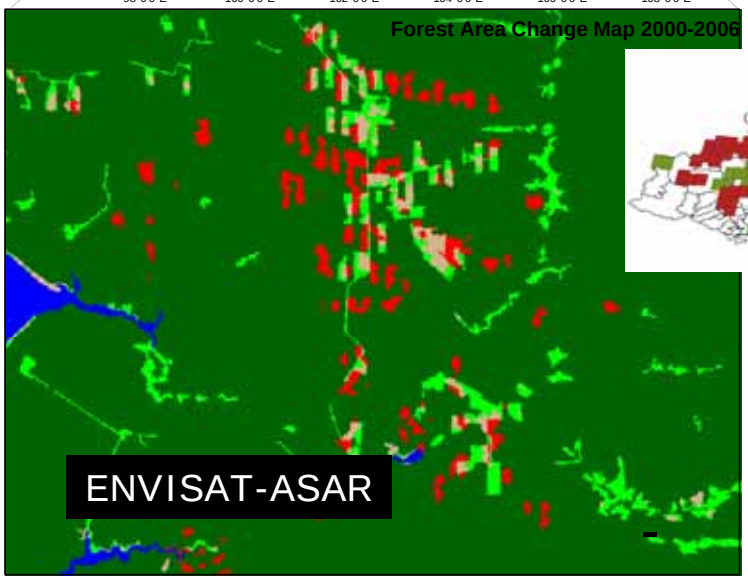
RDK coverage 2007/08
10 Meters ground resolution





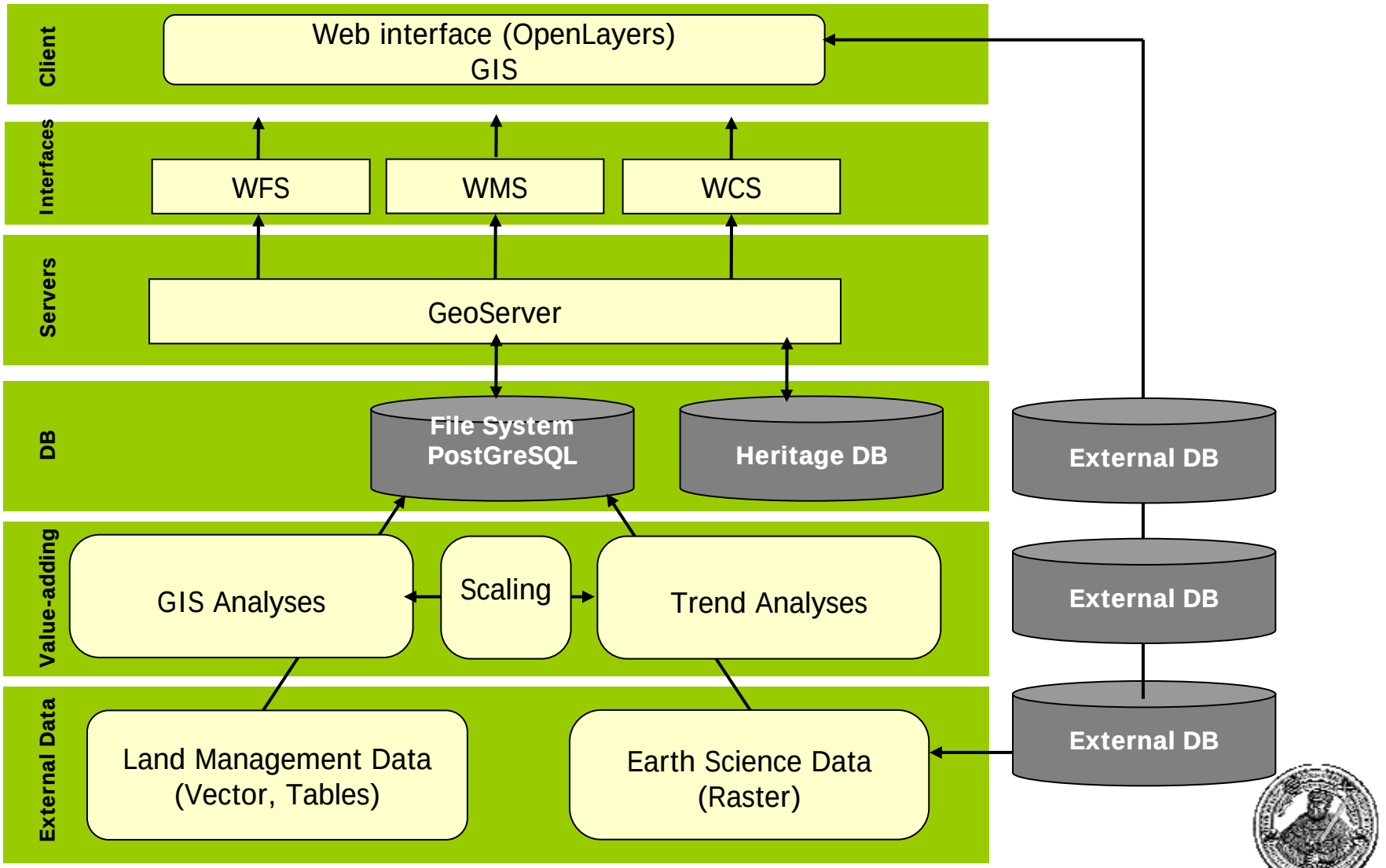
Use of up-to-date SAR data: ENVISAT-ASAR, ALOS-PALSAR and object-oriented image processing techniques





Courtesy of C.Thiel, GSE FM

WebGIS Technologies and Contribution to Standards



WebGIS Technologies and Contribution to Standards

The IRIS Web Service is implemented as 3-tier architecture with

(1) database server or simple file server,
(2) application server and
(3) internet browser

to make IRIS results (metadata and vector layers) available for Internet browsers.

Geoserver act as OpenGIS-compliant web services layer on top of existing data sources (even simple file directories). Geoserver supports open protocols from the OGC to produce KML/KMZ, GML, Shapefiles and more.

var wmsUrl = "http://argon.geogr.uni-jena.de:80/wms?SERVICE=WMS"; (OpenLayers)

Computer supported cooperative work - IRISWiki

The Communication Platform, that is online serves as the basis for computer supported cooperative work.

'The more people who use the platform, the more valuable it becomes.'

Due to the strong emphasis on multilinguality in the Wikimedia projects, internationalization has received significant attention by developers.

www.iris.uni-jena.de/

Conclusions

IRIS is designed to meet the needs of long-term monitoring and will establish therefore a basis for future cooperation in the field of environmental risk assessment and environmental protection.

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.

The prototype will allow to provide an assessment of state of the regional forests, to identify areas of rapid changes, which require operative monitoring, and to estimate environmental risk in different aspects.

Practical use by regional governance and nature-protection service for the management of risks associated with man-made changes and anthropogenic forcing affecting the forestry environments.

Fires across Lake Baikal Region, 17th May 2008, MODIS Rapid Response System