GMES RUSSIA ANNUAL REPORT SUMMARY

The contribution of the Russian expertise to European-Russian cooperation within GMES tasks and the assessment of the technical/scientific aspects of the Earth observation and environmental monitoring capabilities in Russia are basic objectives of the GMES-RUSSIA project.
Below the most important results of this technical /scientific assessment are presented.

1. The administrative structure of the monitoring of environment in RUSSIA is presented and the list of principal ministries and their departments responsible for the development, production and exploitation of the environmental monitoring networks is detailed. Fig. 1 gives the overview of the mentioned ministries.

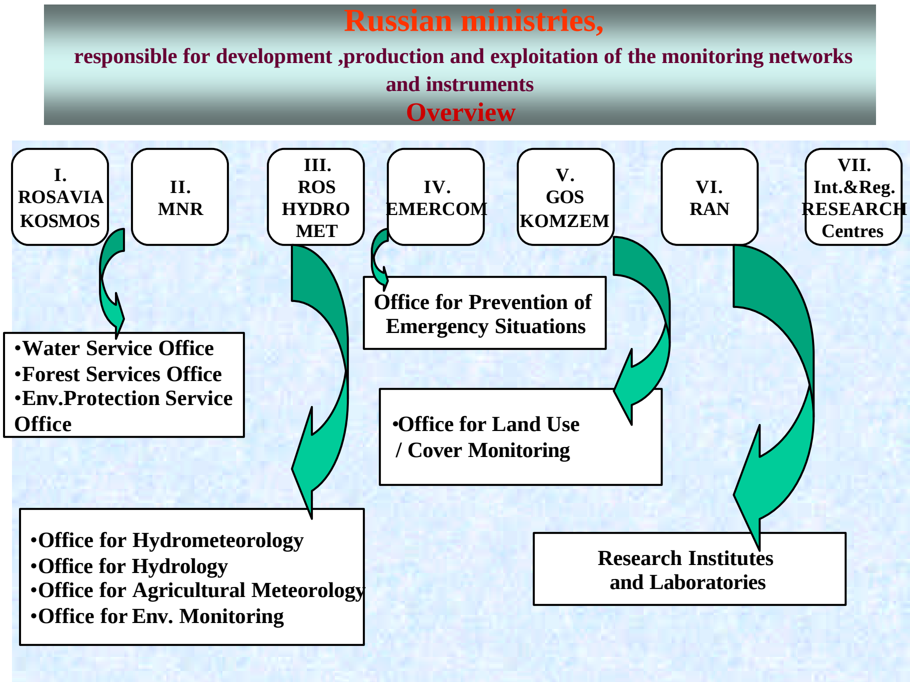


Fig.1 Overview of Russian Ministries

The particular attention here was paid to space monitoring and to **ROSAVIAKOSMOS** ministry. The space monitoring as well as other space activities in Russia is being done under guidance and control of **ROSAVIAKOSMOS** ministry. The operative environment monitoring from space is coordinated by Office of Space Systems for Earth Remote Sensing of **ROSAVIAKOSMOS** and is carried out by Research Centre for Earth Operative Monitoring **(NTs OMZ**). The space instruments for the monitoring of environment that are under operation now and those expected in the nearest future are developed in accordance to the official ***document "The Concept of Development of the Space Systems for monitoring of Environment".*** Here the main goals and objectives are grouped and categorized:
- Weather forecast and climate exploration
- Ecological monitoring
- Monitoring of emergency and risk situations
- Monitoring for sustainable development of natural resources
- Monitoring for Earth sciences and Atmospheric research

Naturally every group has different tasks and these tasks put different requirements to the parameters of the space instruments and sensors:
- Spatial resolution
- Radiometric accuracy
- Spectral content
- Timeliness/currency

As a result of thorough analysis of the monitoring tasks and objectives **ROSAVIAKOSMOS** specialists have developed the launch program of remote sensing satellites for the monitoring of environment. This program is presented in Fig.2

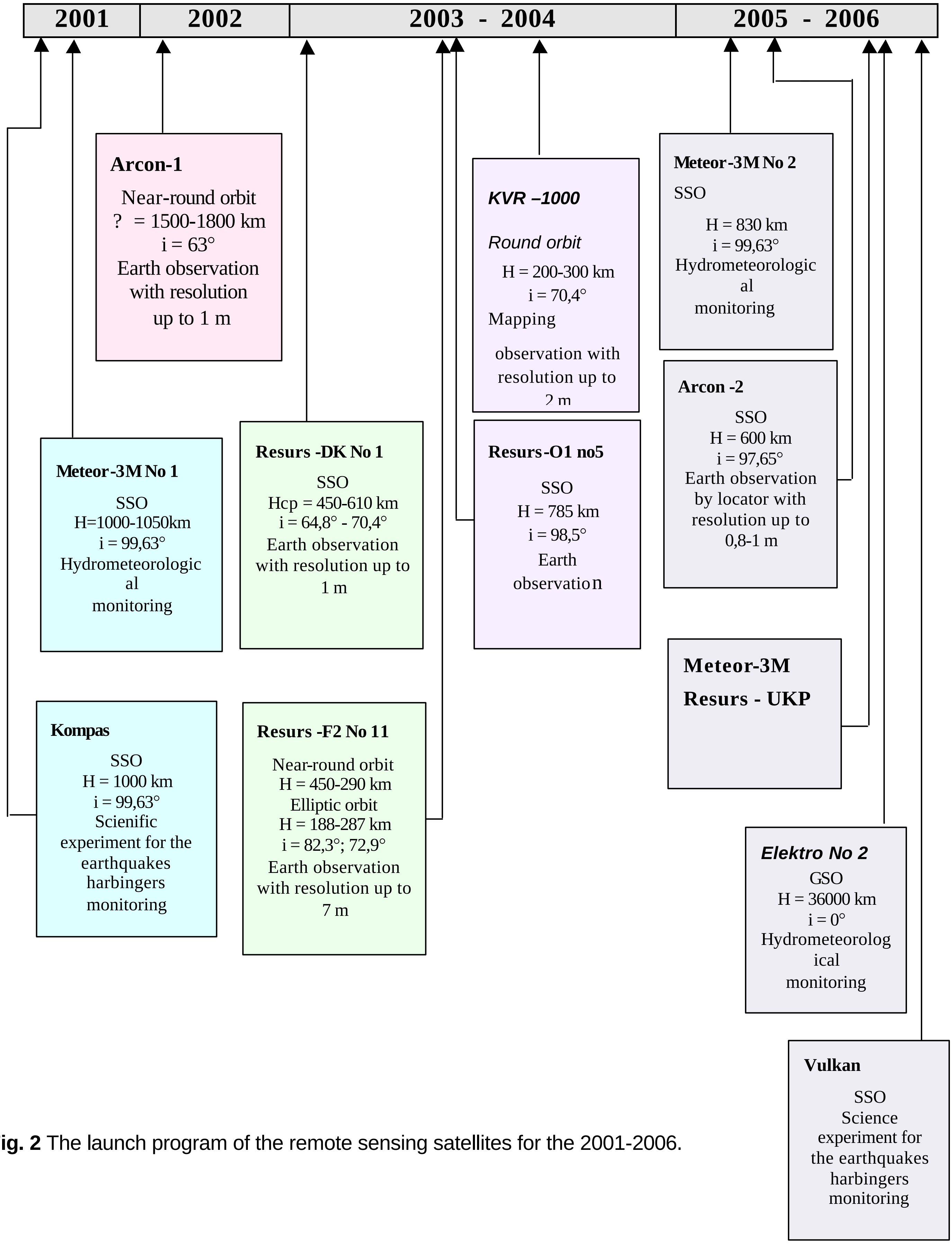


Fig. 2 The launch program of the remote sensing satellites for the 2001-2006.

The user requirements to space remote sensing data and instruments are summarised in Tabl.1

No	GMES Thematic Priorities	Resolution			Spectral Range	Data Updating Period	Time of Data Delivery
		Spatial	Spectral	Radiometric			
A 1	Land cover change observations (earth surface albedo, vegetation index)	0.5-1 km (VIS), 1-2 km (IR), 5-10 km (MCW)	0.01-0.05 µm (VIS, IR)	0.1-0.5% (VIS), 0.1-0.2K (IR), 1-2 dB (MCW)	VIS, IR, MCW	3-6 hours	0.5-1 hours
A 2	Snow and ice cover state monitoring	10-100 m (VIS, IR)	0.01-0.04 µm (VIS, IR)	0.1-1% (VIS), 0.1-0.2K (IR), 1-2 ?? (MCW)	VIS, IR, MCW	1-6 hours	3-6 hours
E 1	Atmospheric emission sources monitoring (smoke, thermal emissions)	1-10 m (VIS), 5-20 m (IR)	2-10 nm (VIS, ULV), 10-20 nm (IR)	0.1-0.5% (VIS), 0.5-1K (IR)	(0.5-0.6, 0.6-0.7, 0.8-0.9, 1.5-1.8, 2.1-2.4 3.0-5.0, 8.0-10.0, 10.5-12.5) µm	6-12 hours	1-3 hours
B 1	Soil pollution monitoring (dumps, oil spills, etc.)	1-10 m	2-10 nm (VIS, ULV), 10-20 nm (IR)	0.1-1%	0.4-1.1 µm 0.4-2.4 µm	6-12 hours	1-3 hours
B 2	Monitoring of vegetation cover stress	5-100 m	2-10 nm (VIS, ULV), 10-20 nm (IR)	0.1-1%	0.4-1.1 µm 0.4-2.4 µm	5-10 days	1-3 days
B 3	Ecological disaster zones: extent assessing and characterizing	5-100 m (VIS, IR, MCW)	2-10 nm (VIS), 10-4-nm (IR)	0.5% (VIS) ? (IR) 0.3-1 dB (MCW)	VIS, IR, MCW	3-6 hours	2-3 hours
B 4	Emergency assessment: fires, destructions, chemical and biological	1-100 m (VIS, IR, MCW)	5-20 nm (VIS, IR)	0.1-1% (VIS), 0.1-1K (IR),	VIS, IR, MCW	1-6 hours (over areas of emergenc	0.5-1 hours

	contamination, floods			0.1-1 dB (MCW)		y)	
B 5	Forest fire risk monitoring; forest fire detection	10-100 m (VIS, IR)	10-20 nm	1-5% (VIS), 0.1-0.5K (IR)	VIS, IR	6-24 hours	1-3 hours
C 1	Monitoring of crops during vegetative season; area determination of crops affected by pests, diseases, and adverse wintering conditions	10-20 m (VIS, IR, MCW)	10-20 nm (VIS, IR)	1-5% (VIS), 0.1-0.5K (IR), 0.5-1 dB (MCW)	VIS, IR, MCW	10-20 days	5-7 days
C 2	Forest state monitoring; acquiring initial data needed for forest management	5-20 m (VIS), 5-100 (IR)	10-20 nm (VIS, IR)	1-5% (VIS), 0.1-0.5K (IR)	VIS, IR	1-6 months	10-20 days
A 3	Soil and land condition monitoring	5-100 m (VIS, IR, MCW)	10-20 nm (VIS, IR)	1-5% (VIS), 0.1-0.5K (IR), 0.5-1 dB (MCW)	VIS, IR, MCW	7-10 days	1-3 days

Thematic Priorities for "GMES RUSSIA Project":
A — Land cover change, B — Environmental stress,
C — Global vegetation monitoring, E — Global atmospheric monitoring

Table 1 The user requirements to space remote sensing data and instruments

2. The following types of the environmental monitoring are analysed in the report:

- Atmospheric monitoring
- Environmental stress monitoring
- Forest Fund monitoring
- Sea Ice monitoring

For these particular thematic priorities the generic issues of technical/scientific assessment such as "users and user requirements to data and information", data quality control"," data policy", data archives and databanks" are given.

The atmospheric monitoring under ROSHYDROMET ministry is analysed in details. The infrastructure of atmospheric monitoring in Russia presents Fig. 3

The description of the peculiarities of the atmospheric monitoring in Russia is introduced along with emphasis that the latter is a part of global network of **the WMO.** Since the **WMO** regulations with regard to national networks dictate conformity with international standards, the Russian systems of observations meet all these requirements. The obtained information is used by the entire world community. The disadvantage of state monitoring network is in its ineffectiveness in operative monitoring *of air composition*. Therefore in a series of institutes of the Russian Academy of Sciences their own measuring networks have been developed. Each this station works in accordance with its own program without centralized guidance. Sometimes the Institutes transmit the data to the Geophysical Committee at the Presidium of Russian Academy of Science and provide the free access to information through the Internet. The difficult economical situation in Russia during last decades affects drastically the functioning of the atmospheric monitoring networks. Some stations work constantly, several stations work in regular intervals and some stations work irregularly.

The main conclusion that could be drawn is that advanced atmospheric monitoring system exists and is under operation in Russia. This system basically meets end user requirements to data and information and is a part of global international monitoring network under guidance **WMO.**

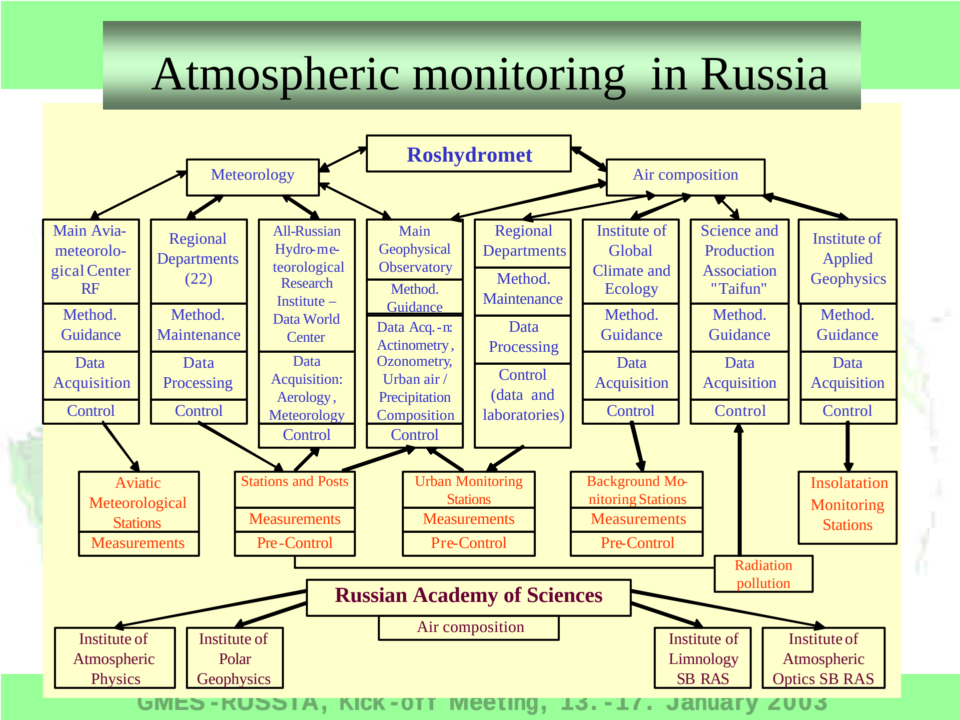
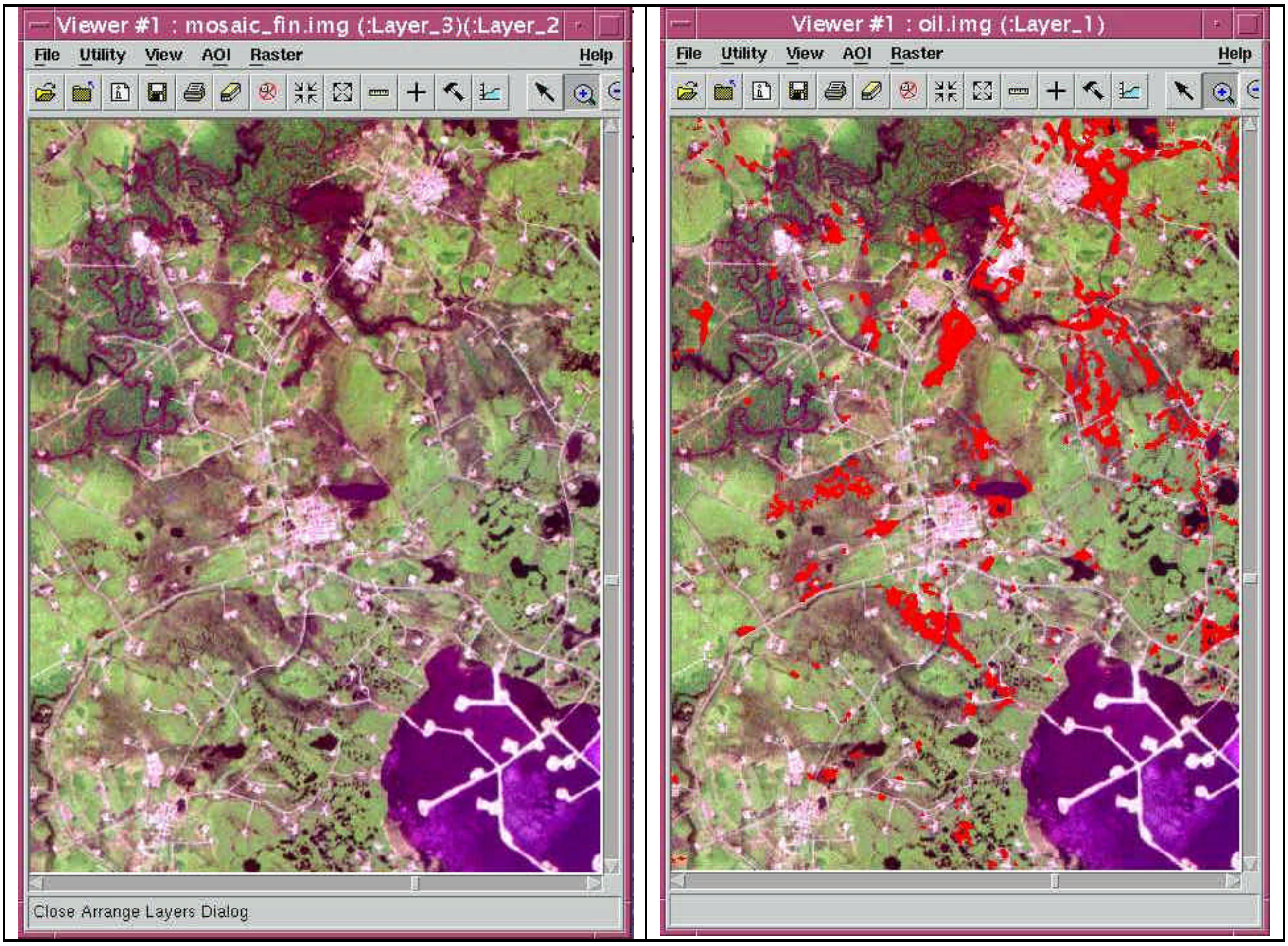


Fig.3 Infrastructure of the atmospheric monitoring in Russia

<u>Environmental stress mentoring</u> is presented on the regional level with regard to Khanty-Mansyisk Autonomous Region in Western Siberia.

Three particular tasks are addressed here: soil degradation monitoring, oil pollution monitoring and atmosphere pollution through gas fire monitoring. User's temporal and “content“ requirements to monitoring are formulated. The detail list of main chemical components to be measured for soil monitoring is presented along with the list of items being provided by extractive companies to local authorities regardless their activities. The experiments on oil pollution detection and atmosphere pollution through gas fires on a base of remote sensing imagery processing are given with good graphic illustrations (See Fig.4)The on-going research projects in this field in Russia are also described and recommendations on using the particular space instruments and sensors (active and passive) for these tasks are introduced.



a) the LANDSAT image of territory near Samotlor lake b) the result of image decoding.

Fig. 4 Results on oil pollution detection with the use of remote sensing imagery

Forest fund monitoring addresses several important issues. The administrative structure of forest management in Russia is given in explicit manner. The constituents of the whole problem of forest monitoring are enumerated. The exhaustive analysis and discussion of the capabilities of the current space sensors and instruments for forestry monitoring and those appearing in the nearest future is given (See tabl. 2) The panorama of the on-going domestic and international projects for forestry monitoring is introduced and described. The special emphasis and focus is given to the problem of forest fire monitoring. Here the main research groups, Institutes and organizations are listed along with Users for whom the work on forest fire detection and smoothing is being done. The organizational structure of Aviation Forest Protection Service („AVIALESOKHRANA") as a principle User of forest fire information is presented. The special attention is given to the analysis of the data policy issues. This analysis is done in accordance to data policy characteristics, accepted and elaborated within DPAG project The latter are : ownership, privacy, confidentiality, standards and metadata, pricing policy, licensing and distribution.

Satellite	Bands (mkm)	Resolution (meter)	Width (Km)	Time resolution (Day)	Assess
NOAA/AVHRR	0.58 -0.68 0.725- 1.1 1.58 -1.65 3.55 -3.93 10.5 -11.5 11.5 -12.5	1100 m	2048	4-6 times/day	Free
EOSAM/PM (Terra/Aqua) /MODIS	Chanells 1,2 0.62 – 0.876 Chanells 3-7 0.45 – 2.155 Chanells 8-36 0.405 – 14.3 mkm.	250 500 1000	2048	2-4 times/day	Free
LANDSAT/ TM, ETM+	0,52-0,90 PAN 0,45-0,52; 0,52-0,61; 0,63-0,69; 0,75-0,90; 1,55-1,75; 2,09-2,35; 10,4-12,5	30 m VIS 60 m IR	183x172	16 days	Commerce
SPOT 5	0,50-0,59; 0,61-0,68; 0,78-0,89; 1,58-1,758	PAN - 5 m MS – 10 m Super PAN – 2.5 m	60	26 days	Commerce
SPOT 4	0,50-0,59; 0,61-0,68; 0,78-0,89; 1,58-1,758	PAN - 10 m MS - 20 m	60	26 days	Commerce
EOS AM (Terra) /ASTER	0,56; 0,66; 0,81 1,65; 2,17; 2,21; 2,26; 2,33; 2,40 8,30; 8,65; 9,10; 10,6; 11,3	15 m 30 m 90 m	60	16 days	Commerce/free
BIRD					
IRS-1D	0,50-0,75 PAN 0,52-0,59; 0,62-0,68; 0,77-0,86 1,55-1,75	6 m 24 m 71 m	70 142 810	24 days	
OrbView -2 , OrbView-3	0,40-0,42; 0,43-0,45; 0,48-0,50; 0,50-0,52; 0,55-0,57; 0,66-0,68; 0,75-0,79	PAN – 1m MS – 4 m			Commerce
IKONOS	0,45-090 PAN	1 m 4	11 km	2.9 days for getting	Commerce

	0,45-052; 052-0,61; 0,64-0,72 0,77-0,88			ithe images with spatial resolution 1 m; and 1.5 days for 1.5 m resolution	
QuickBird	0,45-0,90 PAN 0,45-0,52; 0,52-0,59; 0,63-0,69; 0,76-0,89	0,5-1,25 2,5-3,3	16.5 km	1 – 3,5 days	Commerce

Table 3 The Capabilities of remote sensing systems for forest monitoring

This analysis comprises not only the remotely sensed data but data in a more wide extent, including ground data, meteorological data vegetation, land use maps and other.

The whole situation in Russia with satellite information for operational monitoring of forest can be considered as rather satisfactory. However, the questions on fire forecast, independence of weather conditions, early fire detection when the fires are small are still not solved so far. There exists an idea of broadening satellite data. It means the simultaneous utilisation of all-weather survey and forest fire controlling satellite systems. These systems must have supplementary radar sensors, that can also detect big forest fires, and theirs burned scars.

It should be stated that recently new developments in the field of portable satellites for forest fire observation («BIRD» of DLR, Germany) have been created. A steady operation of satellites "BIRD" with increased spatial resolution in IR spectral bands and practically with non-restricted temperature threshold is of great interest for Russia.

In monitoring of big fires the problem of fire propagation is still open. There are no good models of forest fires propagation that went through practical testing. This is the result of the fact that it is very difficult in Russia to make experiments with applying a wide range of ground data and foreign satellite systems. There is no good feedback to do the work on validation of satellite and ground information. Annual ground data about registered forest fires taken from Federal and regional subdivisions are very often falsified. The practical collaboration with Airbases in feedback regime shows that real area characteristics of fires may differ from reported several times.

Sea Ice monitoring .The compact description of the administrative and organisational structure of the sea ice monitoring in the Northern Sea Route (**NSR**) is given. The experience gained in the process of operation of **AIIA (Automated Ice Information System for Arctic)** enabled to formulate user requirements to sea ice information. These requirements summarised in the Table 4.

	Strategic	Operative	Tactical
Users	NSRA, MOH	MOH, captains	Captains
Coverage	Global (the whole NSR)	Regional	Local
Spatial resolution	~ 10 km	< 1 - 2 km	< 100 m
Time delay	10 days	2 - 3 days	2 - 3 hours
Scale of ice chart	1:7 000 000 1:5 000 000 1:2 000 000	1:7 000 000 1:5 000 000 1:2 000 000	1:500 000 1:200 000

Table 4 Summary of requirements to sea ice information for ice navigation

It is pointed out the extrem importance of the SAR data for sea ice monitoring. In Russia, there is a pressing demand for cloud and daylight independent, high resolution SAR data, to support sea ice monitoring, and other environmental studies. The European Commission financed the Project for the implementation of the ERS data acquisition and processing station at Research Centre for Earth Operative Monitoring (NtsOMZ), Moscow, which lasted for 6 months from June to December 2001. During this period the ERS SAR ground station was installed at NTs OMZ quarters in Moscow. After the Project is finished, the system became operational and the antenna coverage reaches mid-Novaya Zemlya in the North, river Ob in the east, northern Caspian Sea in the south and France in the west (Fig. 5).

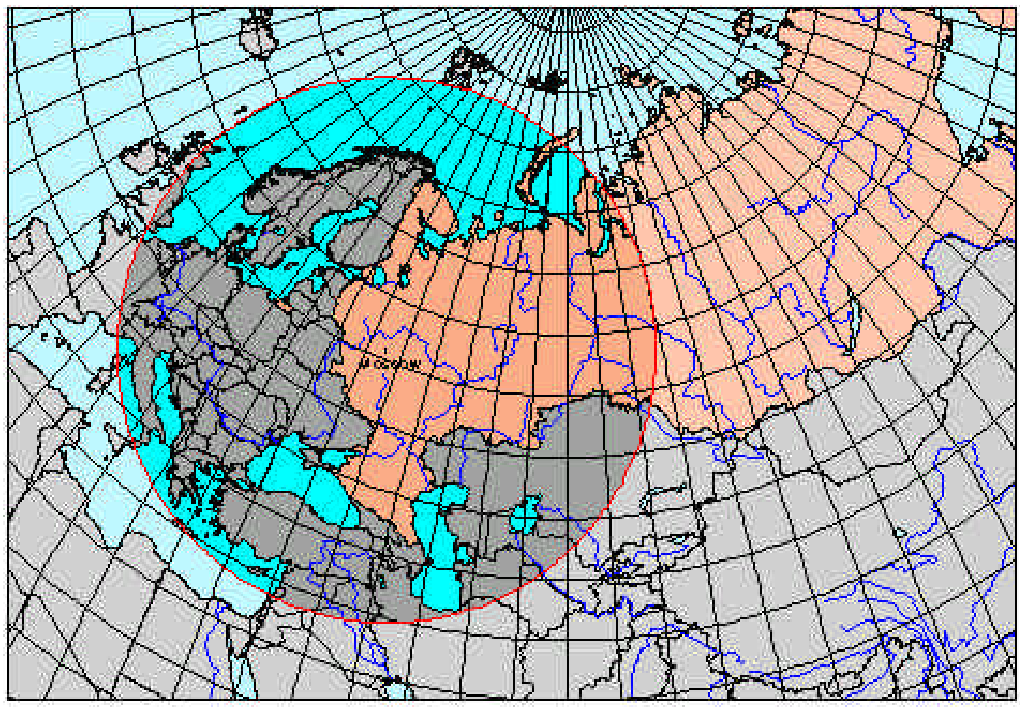


Fig.5 Moscow ERS ground station antenna coverage

The proposal for ERS station deployment in Siberia was elaborated. In 2002 the scientific pilot project"Monitoring sea ice conditions in the NSR" has been fulfilled. During the project implementation series of ERS-2 SAR images have been acquired by Moscow receiving station, processed and transmitted to MOH of Murmansk Shipping Company.

It is foreseen that SAR images can be received directly by customers working at sea provided that the images are processed onboard the satellite, and derived products can be transmitted to the vessels and platforms in near-real time. The benefits of using SAR data onboard ships are not only related to safety but also can improve efficiency and time saving which has considerable economic importance. It is the requirement from several captains that future ice information should be included into electronic charts and be displayed together with bathimetric data and other relevant information on one terminal on the bridge.

The focus of the development of sea ice monitoring service should include implementation of SAR data as an addition to satellite data in visible and IR bands. The Main EO data will be SAR from ENVISAT and RADARSAT, supported by scatterometer products and other EO-data. Based on SAR data from ENVISAT/RADARSAT a number of products can be provided such as high-resolution maps of ice extent, concentration, age, freezing rate, deformation/ridging, drift, leads, and polynyas as well as processes in the marginal ice zone related to wind, waves, eddies, freezing and melting. The scheme of data flow in the operational system of sea ice monitoring with inclusion of SAR data is presented in Fig. 9.3. The maps can be provided for the whole Arctic Ocean, on regional and local scale at time intervals from daily to weekly coverage. The scatterometer products from Quickscat allow monitoring of the multiyear ice boundary. When CRYOSAT data becomes available in 2004-2005, Arctic ice thickness data will be incorporated as a new element in ice monitoring. The microwave satellite products will be integrated with existing marine and climate observing and modelling systems.

3. The significant step forward in the designing the effective communication tools within GMES activities is described in Chapter X of the report. The proposed concept of interactive database with sophisticated but user's friendly search mechanisms will allow to bridge the gap existing in the communication and information exchange between Russia and Europe. Thus the GMES RUSSIA WEB site with server located in Novosibirsk is not only world wide accessible infromaiton source for Russian and Europeans but excellent communication mechanism. The **GMES-Russia Database** and server should provide information about both GMES activities and the goals of the GMES-Russia Project. Russian WEB site portal should be localized in Russia to be understood by Russians. The role of the WEB site is to promote EU and GMES activities between Russian organizations and help them in understanding of the role of GMES as a whole. Each organization and or single researcher could provide information about their activity, data and information products they have and the complete addressing information as well. The first version of the GMES-Russia Database server was established in Novosibirsk, Russia, and can be reached under the URL address:

http://www.giscenter.ru/GMES

Fig.6 shows how the home page looks like

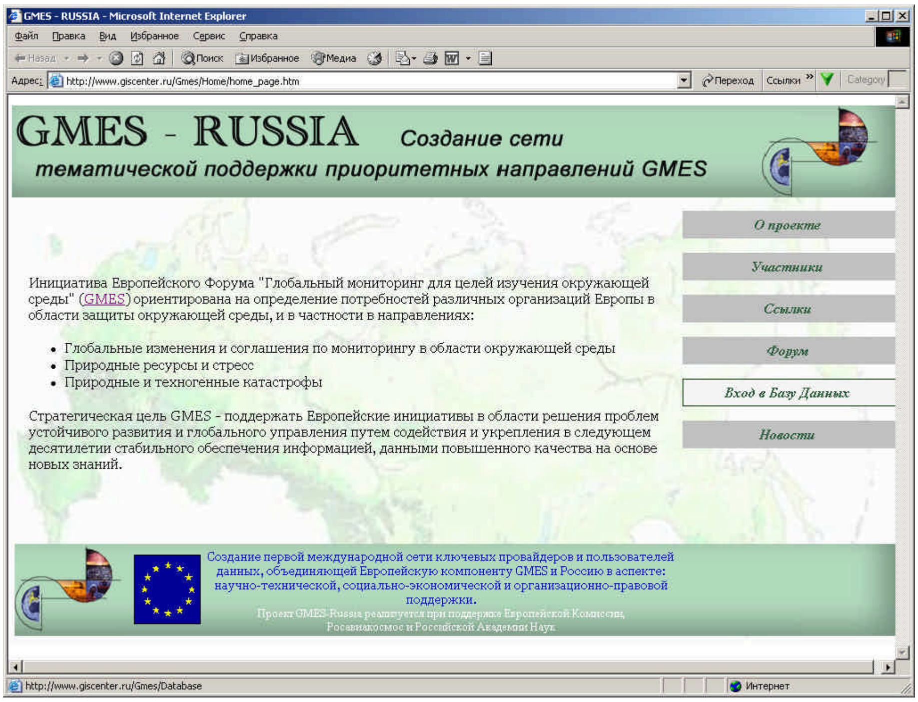


Fig.6 GMES RUSSIA Home page(Russian)