

SOME POTENTIALITIES FOR USING AEROSPACE INFORMATION IN THE FIELD OF NATIONAL SECURITY AND DEFENCE

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Abstract

The modern tendencies in using remote sensing techniques and systems for studying the Earth from space are formulated. The potentialities to use dual-destination space monitoring commercial satellites on the territory of the Republic of Bulgaria are outlined. General formulation of the tasks in the field of defence and security resolved through the space segment is given. A structure for a sovereign National Space Information Centre is suggested.

Introduction

This paper marks the start of a series of papers to be published in the journal *Aerospace Research in Bulgaria* dedicated to observing the Earth's surface by aircrafts and satellites for the purpose of resolving a wide scope of tasks in the field of crises management, national security and defence, agriculture, ecology and more. Many of the materials have been reported at various fora with the aim to urge the responsible bodies and institutions to take adequate decisions for undertaking and implementing a national monitoring system.

Based on the analysis of the current *status quo* of the country in the field, as well as on our long-lasting efforts to establish a National Aerospace Information Centre, we start a series of papers and suggestions related with national security, which is a modern and effective trend in the leading countries' defence and security in the end of the XX-th and the beginning of the XXI-st century.

The ready access to and moderate cost of a number of space technologies provide for their successful use nowadays by countries of the size of the Republic of Bulgaria (such as the Netherlands, Israel, Greece, Belgium etc.).

The analysis of world experience reveals that using space-based technologies provides to overcome a great part of the shortcomings and restrictions of traditional ground-based technologies related primarily with observation, communication, and navigation.

One basic type of space information systems, occupying a significant part of the field, are Remote Sensing Satellite Systems (RSSS), through which information about the Earth is acquired and interpreted.

The current great importance and wide application of RSSS providing the so-called **space monitoring** is determined by the following circumstances:

- global spatial scope of the observed territory (aquatoria);
- possibility to observe specific areas or objects in various spectral ranges at given intervals, day or night, or in complex meteorological conditions
- possibility to obtain images featuring high resolution and providing abundant information, and quite often – the required operativeness;
- well developed international market of space video- and photoimages.

The most active and dynamic component of the RSSS is the earth satellite furnished with appropriate dedicated equipment. It translates information about the monitored area to ground-based receiving centres either directly or through retranslating satellites.

Currently, the RSSS provide mainly three types of images: photoimages, electronic-optic images, and radiolocation images.

On the brink between the XX-th and the XXI-st century, a number of modern tendencies are observed related with the use of remote sensing techniques and systems for study of the Earth from space, such as:

- transfer of technologies;
- commercialization of high-resolution space images;
- integration of various-destination systems;
- introduction of GIS;
- facilitated online customer access to supplied data;
- mutual penetration and integration of military and civil space systems etc.

The tendencies outlined above suggest intensive penetration of space monitoring in both defence and security structures, as well as in communication, geodesy and cartography, transport, ecology, power engineering, agriculture, meteorology etc.

The experience from the so-called “space epoch wars”, starting with Desert Storm (1991) and ending with the military campaign in Iraq (2003) reveals that the MoD of the USA, irrespective of the military space system orbital formations it has maintained for dozens of years already, is among the greatest users of information supplied by civil RSSS (such as the *Landsat*, *Spot*, *Ikonos* etc.). The latter has been used successfully to plan the troops’ military activities and to spot aviation targets.

A tendency in space technologies on a world scale to reduce the gap in the information potentialities of RS earth satellites for civil and military purpose (Fig. 1) has been observed. Thus, for instance, the civil satellites *Ikonos*, *Quick Bird*, *Orb View*, *Resurs-DK* etc. feature image resolution of 1-4 m in the monochromatic and multispectral regime. The available ground-based receiving stations or terminals will provide to obtain on-line information about the observed objects. This will make it possible, at nowadays’ stage of space technologies development, using information from some civil RS Earth satellites, to also resolve military problems, including tactic ones, with a number of RSSSs featuring **dual destination**.

Among the companies constructing and launching in space commercial RS Earth satellites with particularly important military application are the American companies Space Imaging which constructed the satellite *Ikonos* and Digital Globe which constructed the satellite *Quick Bird*. The information from the mentioned “high-resolution” satellites triggered the establishment of a **coordinate data base** for each theatre of war, ensuring the successful hitting by controlled aircraft (rockets, aviation bombs etc.) of some specific targets using GPS-corrected orientation. Moreover, the information from these satellites provides to construct 3D models of the locality, which makes it possible to model the troops’ military actions. Conditions are also provided to form the so-called **geo-spatial information**, representing a set of various maps, aviation and space images, and intelligence data.

The classification of RS Earth satellites is shown in Fig. 1.

Accounting for the great information potentialities of the satellites *Quick Bird-2* and *Ikonos-2* featuring maximum resolution of 0,6 m and 0,8 m accordingly, in 2003, the National Ocean and Atmosphere Administration (NOAA), USA, provided a license to the companies Space Imaging and Digital Globe for the construction of satellites featuring resolution of up to 0,25 m. Buying and use of such fine-detail images by any state is of crucial importance for defence, security, economy, ecology, as well as for the successful conducting of a number of humanitarian and rescue operations.

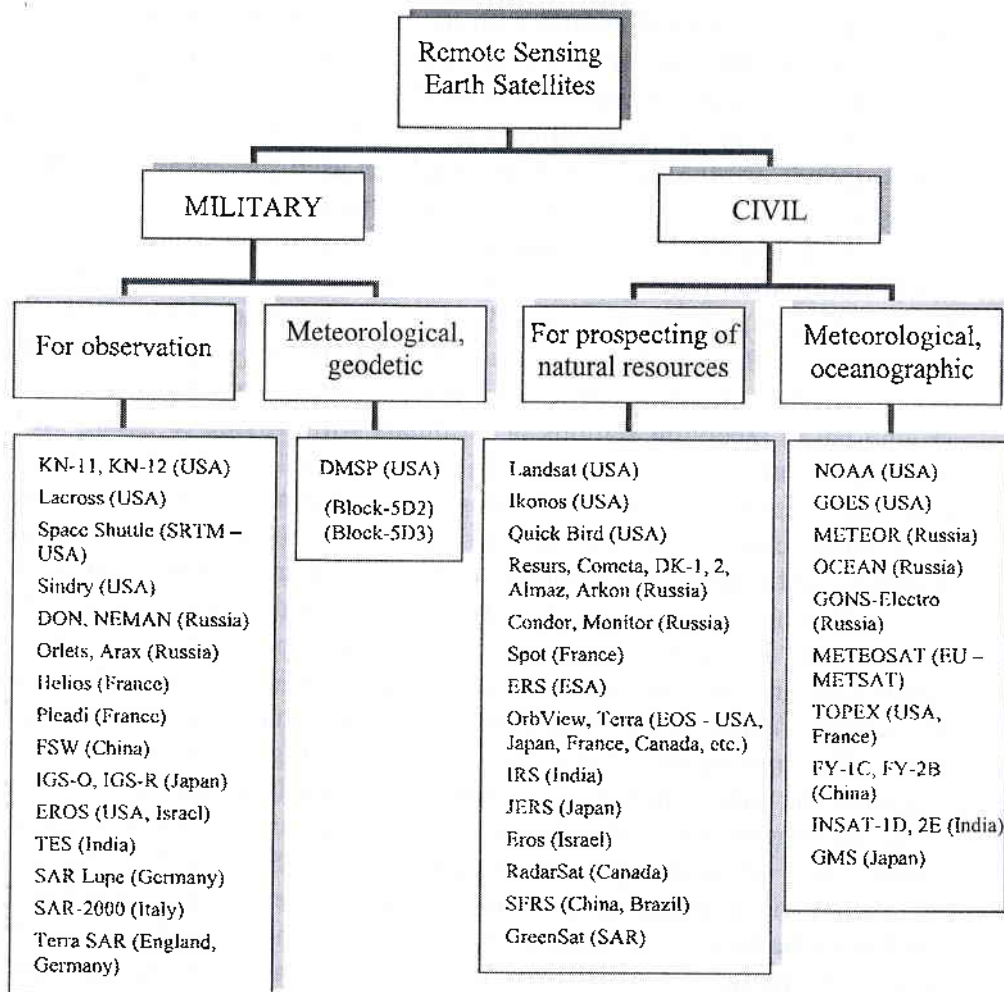


Fig. 1 Classification of RS Earth satellites

Experts believe that, by 2006, about 70% of the space image market will account for products featuring resolution of 1 m or better. Thus, in the beginning of the XXI-st century, the division of the major space states' programmes in the field of RSSS and in other fields into civil and military is only provisional, whereby the gap between the two types is decreasing continuously.

Accounting for the above-mentioned tendencies and for space's leading role in the struggle for information superiority, a number of countries having no potential of their own to launch and maintain Earth

satellites are establishing and using to the benefit of their national security the so-called “space segment”. It is based on the information obtained from various RSSs, global satellite navigation systems, and satellite communication systems which, upon being received at the ground-based stations, subject to dedicated processing and analysis, is submitted to the appropriate customers.

The material basis for space monitoring may be a mobile satellite image receiving station receiving information from satellites with electronic-optic and radiolocation sensors. An example of such station is the Dutch mobile receiving station RAPIDS, which was demonstrated in September, 2000, in Sofia and which features satisfactory characteristics and relatively low price.

Thus, with such a station available, the information from various RS Earth satellites will be fed to the appropriate users nearly on-line, in various climatic conditions, and various times of the day, which requires the use of dedicated software and modern GIS technologies during its processing at the ground-based component.

The establishment of the space segment will make it possible to obtain global, precise, and operative information for the region which is possible only through space monitoring.

The practical implementation of this approach will make it possible to resolve important defence-related problems of the country. The State and army early warning system will be elevated to a new, modern level, providing for monitoring of possible critical situations within and outside the country. Such information will assist greatly adequate decision-taking on the part of the State and military government. If the space information for the region is of sufficient size, trustworthy, and fed nearly on-line, this will speed up the “information-decision-action” cognitive cycle. The latter will be accomplished sooner than the traditional circumstance-related-information acquisition cycle, which will make it possible to outrun the opponent in applying active force and technique.

Digital cartography and GIS construction will be elevated to a new, modern level, too. Digital modelling and various types of simulation will be applied successfully in solving a wide range of defence tasks.

The nearly on-line use of fine-detail images will also enhance the solving of a number of tasks related with state security. Among them, the most topical ones currently are prevention of terrorist acts using transport technique, monitoring and identification of various objects, early detection of fires and floods, identification of earthquakes.

The considered topic's increased importance to defence, security, infrastructure, power engineering, ecology, agriculture, and other areas, coupled with the fact that now no single institution or organization has in its disposition enough funds to buy dedicated monitoring and professionals training equipment call for establishment of a sovereign National Space Information Centre to receive information from satellites for remote sensing, navigation, communication, and meteorology. The major nowadays users of the space monitoring system's information are the Ministry of Defence (MoD), the Ministry of Interior (MoI), the State Civil Protection Agency (SCPA), the Ministry of Agriculture and Forests (MoAF), the Ministry of Transport and Communications (MoTC), the Ministry of Environment and Water (MoEW), the Ministry of Power Engineering and Energy Resources (MoPWER), the Ministry of Regional Development and Town Planning (MoRDTP), the Bulgarian Academy of Sciences (BAS), the Bulgarian Red Cross (BRC) etc.

The structure and the human resource of the proposed sovereign National Space Information Centre will depend on the class of the dedicated equipment to be bought and its configuration, on the pertaining hardware and software, as well as on the commitment of the institutions and organizations intending to use the received space information. Accounting for the progress of space technologies, especially during the recent 10 years, the Centre might comprise a ground-based station receiving and processing information from RS Earth satellites, image formation station, communication-information unit with communication terminals for the satellite communication and meteorological systems, analysis and operative coordination department, and service section. The Centre's staff may amount to 25-30 people.

The accomplishment of this approach will provide information superiority to the State and military government under the conditions of various crises or potential military conflicts.

In peace times, the global space monitoring of the area circumstances will update the information provision of important economic or ecological spheres. The efficiency of a number of humanitarian and rescue operations performed by land or sea will be improved.

Modern information medium is built on space monitoring information. The space sector supplementing traditional information structure increases substantially the information field, velocity, precision, and quality of information processes.

The global space monitoring of the circumstances in the region fosters the role enhancement of the preventive factor in national security and the successful management of crises of various nature.

Based on the performed analysis, as well as on the obvious tendencies for implementing space technologies in this field, since 1997 until nowadays, we have continuously proposed to the military and political government of the Bulgarian Army to review the idea for a National Aerospace Information Centre.

Hereunder, the reader will find enclosed the last proposal to the MoD, slightly abridged:

Offer for Establishment of a Space Coordination Centre at the Council of Ministers of the Republic of Bulgaria

Accounting for the increasing role of space in armed struggle, information struggle including, as well as of space information commercialization process which started since the middle of the 90-ies of the XX-th century, in 1997, some leading scientists from the Space Research Institute, BAS, and the *G. S. Rakovski* Military Academy elaborated and forwarded to the Head of the General Staff of the Bulgarian Army a proposal for establishment of a Military-Space Coordination Centre (MSCC) at the BA. The basic idea of the proposal was to establish and operate **a space segment of the BA**, where the required space information for the region and the country will be received from **satellites of various destination** to be then processed, analyzed, and coordinated with the appropriate users for the purposes of a wide range of tasks in military affairs and in other spheres, inclusive of providing for humanitarian and rescue operations. Moreover, accounting for the experience of the MoD and the BA in using navigation, communication, and meteorological satellites, as well as in the field of satellite geodesy and cartography, it was suggested that the space segment be coordinated with the appropriate users and **images** of the country and the region from remote sensing Earth satellites (RSES). The experience of a number of European and other countries from the end of the XX-th century shows that the information supplied by these satellites for certain consideration is characterized by its ready access, global nature, image resolution of the order of a couple of meters, and where a receiving satellite station is available, operativeness. Images with the mentioned characteristics may provide the State and military government with **information superiority in the conditions of various crises or possible military conflicts**.

As a result of a series of organized events of various nature, in April 1998, a Memorandum was elaborated suggesting to establish an MSCC at the BA as a relatively sovereign subsystem of the National Space Information Centre. It was pointed out that the establishment of the MSCC at the BA should comply with the stages of the National Space Programme.

During 1998-2004, some individual activities were carried out on this topic, both at scientific fora, as well as political ones. Thus, for instance, in September 2000, in Sofia, demonstrations of a Dutch mobile station for receiving of satellite images (RAPIDS) were organized as well as a Bulgarian-Dutch seminar on the use and prospects for development of remote-sensing-of-the-Earth technologies. The conclusion was made that the RAPIDS system may serve as a material basis of the National Space Information Centre.

In 2001, in Sofia, on the invitation of the Standing Committee for Population Protection against Disasters, Accidents, and Catastrophes, and the State Civil Protection Agency, the potentialities of the Centre for Receiving and Analysis of Space Information at the Ministry of Emergency Situations of Russia were discussed, which is intended primarily for early detection of fires and floods, and for earthquake identification.

During the considered period (1998-2004), space information centres were established in Israel, Turkey, and Greece, the first two of them belonging to the system of military institutions. This confirmed the actuality and advisability of the offer from 1997 for establishment of a MSCC at the BA.

During the period from 1998 to 2003, the Interinstitutional Committee on Space Research at the Council of Ministers of the Republic of Bulgaria failed to establish a National Space Information Centre.

Meanwhile, the need of establishing such a centre increased greatly after the large-scale fires which flared up during the recent years in some mountainous and field regions of the Republic of Bulgaria. On behalf of the State Civil Protection Agency, in November 2003, the intention was expressed to establish a **Space Monitoring Centre** to receive satellite images at times of fires, floods, or earthquakes. It was suggested that this Space Monitoring Centre be subordinate to the Council of Ministers, so that the information might be used by all institutions.

The juxtaposing of the tasks assigned to the Space Monitoring Centre with those of the MSCC at the BA proposed in 1997 reveals that the tasks related with remote sensing of disasters and accidents constitute only one component and function of the MSCC at the BA, namely the one related with assessment of regional ecosystems. Moreover, at this stage, the

struggle to mitigate disasters, accidents, and catastrophes is **one of the BA's missions**, whereas experts in satellite image processing may be found in BAS and the Military-Topographic Office of the BA. The experts from the latter were educated at the Remote Sensing Development Centre of the French Space Agency.

Judging from the distance of time, i.e. more than six years after the submission of the proposal for establishment of a MSCC at the BA, the conclusion may be made that this proposal is still in line with the world tendency from the end of the XX-th century for establishment of **unified satellite information systems** for remote sensing, navigation, communication, and meteoropvision.

The implementation of **space-based technologies** in the BA will make it possible to overcome a great part of the shortcomings and restrictions of traditional ground-based technologies related mostly with observation, communication, and navigation.

Space-based technologies will provide for organization of a **modern early warning system** in the country, which will be in line with the new missions and tasks of the BA, including those outside the territory of the Republic of Bulgaria.

Accounting for the foregoing, as well as for the possibilities to sell space information to some countries of the region, it may be expected that the funds invested to buy a ground-based station for receiving of satellite images and other dedicated equipment (estimated price of about one million US dollars) will be restored to the State.

Accounting for the increased importance of the considered problems to defence, security, infrastructure, ecology, agriculture, and other fields, as well as for the fact that, at this stage, no institution or organization has in its disposition the required funds to buy the appropriate satellite equipment and to pay for adequate expert training necessitates to establish a **Space Coordination Centre (SCC)** for the information obtained from satellites for remote sensing, navigation, communication, and meteoropvision for the needs of users from various institution and organizations (MoD, MoI, SCPA, MoAF, MoTC, MoEW, BRC etc.).

It is expedient to establish and operate a SCC as a sovereign unit at the Council of Ministers of the Republic of Bulgaria.

The formation of a SCC may provide for **monitoring of possible critical situations in the country and the region** and assist taking appropriate decisions.

The structure and staff of the SCC will depend on the level of the bought dedicated equipment and its configuration, the respective hardware

and software, as well as the participation rate of the institutions and organizations as users of the received space information. Accounting for the progress in space technologies during the elapsed period, the SCC may comprise a ground-based station for receiving and processing of the information acquired by RS Earth satellites, an image-formation station, a communication-information unit with terminals for connection with the satellite communication and meteorological systems, an analysis and operative coordination department, and a service sector. The expedient establishment of an SCC, compatible with those of the neighbouring countries and allies, will turn into a preventive factor for national security; will elevate to a modern level the early warning system of the State and the army and will update the information provision of important spheres in economy, ecology, and the humanitarian field.

Based on the foregoing,

WE SUGGEST:

1. To initiate the establishment of a Space Coordination Centre as a sovereign unit at the Council of Ministers of the Republic of Bulgaria.
2. During the formation of the Space Coordination Centre, to avail of the experience, potential and infrastructure of the MoD, the BA, and the BAS, while inscribing the Centre onto the list of the country's management systems at times of crises.
3. To provide funding for the Space Coordination Centre in the budget for 200_, to be allocated specifically for this purpose by a Resolution of the Council of Ministers, with proportional participation of the leading institutions and organizations in the use of space information.
4. To supply the key elements of the organizational structure of the Space Coordination Centre in 200_, in advance of staff education, buying of dedicated systems, hardware and software, providing for receiving, processing, analysis, and coordination of space information among users.

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**НЯКОИ ВЪЗМОЖНОСТИ ЗА ИЗПОЛЗВАНЕТО
НА АЕРОКОСМИЧЕСКАТА ИНФОРМАЦИЯ
В ОБЛАСТТА НА НАЦИОНАЛНАТА СИГУРНОСТ И
ОТБРАНАТА**

Петър Гецов, Павел Пенев

Резюме

Формулирани са съвременните тенденции, свързани с използването на дистанционните методи и системи за изследване на Земята от Космоса. Посочено е мястото на комерсиалните спътници за дистанционно сондиране с двойно предназначение с възможности за космически мониторинг в условията на Р. България. В обобщен вид са дефинирани задачите в областта на отбраната и сигурността, решавани с помощта на космическия сегмент.

Предлага се структура на надведомствен Национален център за космическа информация.