Earth observation from space:
satellites launched in 2006 and 2007 plans

In 2006, the world witnessed 17 attempts and 15 successful launches of remote sensing satellites for different purposes (Table 1). The leaders in number of successfully launched RS satellites are the USA, Japan and Russia, putting into orbit three satellites each and China (2 satellites). Korea, Germany and the Eumetsat European organization have launched one satellite each. In 2005, like in the previous year, 14 RS satellites were launched, bringing forward three leading countries – USA (4), China (3) and Russia (2). In 2006, different countries planned to put the total of 22 satellites into the orbit. Some satellite launches were postponed to 2007 and two insertions of "Baumanets" and "Belka" satellites failed due to the Dnepr launch vehicle problems.

With reference to the mission, military imagery intelligence satellite launches prevailed in 2006, as before, followed by the meteo and civil RS satellites:

- military imagery intelligence – **6** satellites (Russia -2, USA, China, Germany and Japan – 1 each);
- hydro-meteorological survey – **5** satellites (USA – 2, Japan, China and Eumetsat with 1 satellite each), including 4 satellites to geostationary and 1 to polar orbits;
- civil and commercial RS satellites - **4** satellites (Japan, Israel, Russia, Korea).

In the preceding 2005, **7** military, 4 commercial and civil, as well as **3** meteo-satellites were launched. The leadership of Russia in military launches can be explained by the operation of short-term satellites with photo-equipment and descent capsules.

Table 1. Earth observation (civil and dual-purpose) satellites launch results in 2006

Satellite	Country / Operator	Function	Date	Launch site/vehicle	Sensor, resolution
ALOS (Daichi)	Japan/ JAXA	Global Earth survey	24.1	Tanegasima / H-2A	PCA (10 – 100m), PRISM (2,5m); AVNIR (10 m)
MTSat-2	Japan/ JAXA, JMA	Meteo- imagery from geostationary orbit	18.2	Tanegasima / H-2A	1 - 4 km
EROS-B	Israel/ ImageSat Int.	Extra high resolution imagery	25.4	Svobodny/ Start-1	0,7 m
Yuanwang -1 (YW-1)	China	SAR imagery for military purposes	26.4	T'ai Yuan / CZ-4B	submeter
Cosmos-2420	Russia / KB	Military	3.5	Plesetsk/ Soyuz-U	<1 m
GOES-N	USA / NOAA	Geostationary imagery	24.5	Cape Canaveral / Delta-4M+	1 - 4 km
Resurs-DK	Russia / FSA	High resolution imagery	15.6	Baikonur / Soyuz -U	1 - 3 m
Kompsat-2 (Arirang-2)	Korea /	High resolution imagery	28.7	Plesetsk / Rokot-Briz KM	1 - 4 m
IGS-O2	Japan / JDA	Military	11.9	Tanegasima / H-2A	<1 m

Cosmos-2423	Russia / KV	Military	14.9	Baikonur / Soyuz - U	<1 m
METEOR-1	Europe / Eumetsat	Low orbit meteo-imagery	19.10	Baikonur / Soyuz - 2.1A	1 - 4 km
Block-5D3 DMSP USA-191	USA / USAF NOAA	Low orbit meteo-imagery	4.11	Vandenberg / Delta-4M	0,6 - 2 km
FY-2D	China / CMA	Geostationary meteo-imagery	8.12	Xichang / CZ-3A	1 - 4 km
TacSat-2	USA / USAF	Military	16.12	Wallops / Minotaur-1	0,8 - 1 m
SAR-Lupe-1	Germany /	Military	19.12	Plesetsk / Cosmos-3M	0,7 - 1 m

Civil and commercial RS satellite launches results in 2006

The tendency for a faster development of the meter and submeter resolution space imagery market proved in 2006. Such satellites were launched by three countries – Israel, Russia and Korea.

Pursuant to the successful launch of the **EROS-B** satellite, **Israel** has created a commercial system of two orbiting high resolution satellites: EROS –A/B. The new satellite, after a short orbit testing, started to take ordered for the 0.7 m resolution imagery, thus making Israel the second world country after the USA, offering commercial images to the international market at a submeter resolution. EROS-B data are now available in Russia in real-time reception mode via the net of ScanEx ground receiving stations.

Russia, after multiple delays, has finally put into orbit its **Resurs-DK** satellite with the meter resolution imager instrument onboard. Orbital testing completion and successful operation startup were declared in September. However, free distribution of the new satellite images with the claimed productivity of up to 1 mln km^2 per day is still restricted due to the absence of corresponding law. The satellite operators will have to resolve some technical problems of Resurs-DK data distribution and marketing locally and abroad to allow for satellite high daily performance.

Korea, by launching the first national **KompSat-2** (Arirang-2) satellite with optical meter resolution sensor, asserted itself as the spacefaring nation, striving for the creation of all basic components of space infrastructure. Seoul sold the rights to the meter resolution data marketing to French Spot Image company for a better use of KompSat-2 data on the world market, where Korea was not even represented until recently.

Japan launched a multi-functional **ALOS** satellite with three sensors: radar of L-band frequency, multispectral scanner with 10 m resolution and a three-camera PRISM mapping system to receive triplets at a resolution of 2.5 m. The satellite delivers images via the stationary relay satellite, thus ensuring high survey performance.

Civil and commercial RS satellites launch plans for 2007

At least 14 civil and commercial RS satellites with a variety of onboard imager instruments are declared to be launched in 2007 by different countries (Table 2). The principle trend of the coming year will still be a fast development of the high and extra high resolution data market. Among the manifested insertions, there are two **US** satellites – **GeoEye-1** and **WorldView-1** with a resolution of 0.4-0.5 meters. GeoEye-1 satellite has an

extra high efficiency of the multispectral imaging sensor – up to 700 thousand km^2 per day and along with the WorldView-1 will encourage a further development of the data market and GIS.

India accomplished a successful launch of its **Cartosat-2** satellite with the meter resolution sensor onboard in January. As a result, India has created the world biggest RS satellites fleet, well-balanced in terms of tasks, spectral and resolution parameters and joined the RS operators of meter resolution systems (USA, Israel, Korea, Russia).

In 2007 radar images of 1-3 m resolution may appear on the market once the promising **Terra-SAR-X**, **RADARSAT-2** and **COSMO SkyMed** satellites will be put into orbit with all-weather high resolution radars. Consequently, the market segments, related to operational emergency situations monitoring, sea navigation and oil & gas production control will get a nudge in the direction of further development.

Among other significant events it should noted that **China** and **Brazil** might enter the international market after **CBERS-2B** satellite launch with three sensors on board, similar to the analog sensors of the Indian IRS-P6 (high, middle and low resolution). The German **RapidEye AG** company has plans to insert a 5-nanosatellite system for near real-time arable lands monitoring. Thailand scheduled the launch of its **THEOS** satellite by the yearend. Egypt, Vietnam, Indonesia and Malaysia look forward to joining the club of countries operating remote sensing satellites.

As a result of implementation though even part of the announced launches in 2007, and with due account for achieving the claimed productivity of the new satellites, a further price drop is expected owing to competition and fast development of high and extra high resolution data markets.

Table 2. Civil and commercial (plus several military) satellites launch plans for 2007

Satellite	Function	Country / Operator	Launch vehicle / site	Additional data
Cartosat-2	High resolution imagery	India / ISRO	PSLV-C / Sriharikota	**Launched on 10.1.2007**, Resolution up to 1 m
LAPAN-TUBSAT	High and middle resolution NRT imagery technology	Indonesia / LAPAN	PSLV-C / Sriharikota	**Nanosatellite (57 kg) launched on 10.1.2007**, Resolution 5 m & 200 m
RADARSAT-2	Commercial high resolution SAR imagery	Canada / MDA, CSA	Soyuz-FG / Baikonur	SAR C-band, resolution up to 3m
Egyptsat-1	High resolution imagery	Egypt / NARSS	Dnepr / Baikonur	Manufactured at Yuzhnoye production center, Ukraine
TerraSAR-X	Commercial imagery with SAR of meter resolution	Germany / Infoterra, DLR	Dnepr / Baikonur	SAR X-band with resolution up to 1m
Sumbandila	High resolution imagery	Republic of South Africa / SunSpace	Stil / submarine launched ballistic missile in Barents Sea	Nanosatellite (60 kg) with 6,5 m resolution camera
GeoEye-1	Commercial and military imagery of extra high resolution	USA / NGA, GeoEye	Delta-2 / Vandenberg	1st dual-purpose satellite with 0,4 m resolution

THEOS	High resolution commercial imagery	Thailand / GISTDA	Rokot-KM / Plesetsk	resolution up to 2 meters
WorldView-1	Extra high resolution commercial & military imagery	USA / NGA, DigitalGlobe	Delta-2 / Vandenberg	resolution 0,5 m in pan mode
CBERS-2B	High and middle resolution imagery	China/CAST, Brazil / INPE	CZ-4 / Wuzhai	First commercial satellite of China and Brazil
RazakSat (MACSAT)	High resolution imagery	Malaysia / ATSB	Falcon-1 / RTS	Nanosatellite with 2.5 m resolution
Thai-Paht-2	High resolution imagery	Malaysia / -	Cosmos-3M / Plesetsk	Nanosatellite SSTL
Vietnam DMC VNSat-1	Middle resolution imagery	Vietnam /	Cosmos-3M / Plesetsk	Nanosatellite will be part of DMC system
Rapid Eye	High resolution imagery	Germany / RapidEye AG	Dnepr / Baikonur	Five nanosatellites with 6 m resolution
Cosmo SkyMed-1	SAR high resolution imagery	Italy / ISA, MO	Delta-2 / Vandenberg	SAR with resolution <1 m
Tacsat-1	Imagery intelligence experiments	USA / DARPA	Falcon-1 / Vandenberg	Nanosatellite with 70m & 850m resolution
SAR-Lupe-2	SAR imagery intelligence	Germany / MO	Cosmos-3M / Plesetsk	2nd satellite in the pool of 5 satellites
IGS-2R	SAR imagery intelligence	Japan / MO	H-2A / Tanegasima	SAR with resolution around 1 m

Note: Classified unannounced launches of military satellites, as well as of meteo-satellites, are not included in the list. Some of the announced launches might be delayed till next year.
According to news agencies and Internet-sites data

Prepared by A. Kucheiko
(ScanEx R&D Center, phone: +7 (495)246-25-93 kucheiko@scanex.ru)