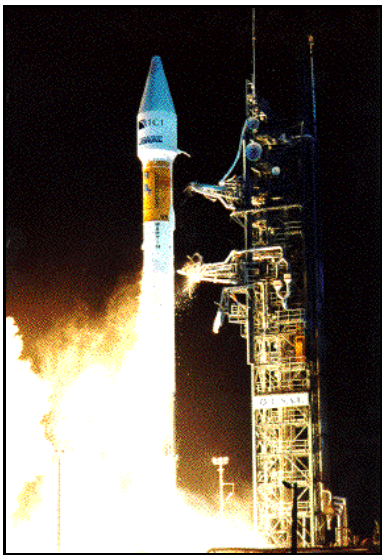


COMMERCIAL SPACE TRANSPORTATION: 1997 YEAR IN REVIEW

Associate Administrator for
Commercial Space Transportation (AST)

January 1998

Cover Photo Credits (from top):

International Launch Services (1997). Image is of the Atlas 2A launch on March 8, 1997, from Cape Canaveral Air Station. It successfully orbited the Tempo direct broadcast satellite for Space Systems/Loral.

McDonnell Douglas (1997). Image is of the Delta 2 7920 launch on May 5, 1997, from Vandenberg Air Force Base. It successfully orbited the first five Iridium communication satellites for Iridium Inc.

Orbital Sciences Corporation (1997). Image is of the Pegasus XL that launched from Vandenberg Air Force Base on August 1, 1997. It successfully orbited the OrbView 2 (Seastar) remote sensing satellite.

Lockheed Martin (1997). Image is of the Athena 1 that launched from Vandenberg Air Force Base on August 23, 1997. It successfully orbited the NASA Lewis experimental imaging satellite.

INTRODUCTION

In 1997, U.S. launch service providers conducted 17 launches licensed by the Federal Aviation Administration (FAA), an increase of 55 percent over the 11 launches conducted in 1996. Of these 17, 14 were internationally competed commercial launches, resulting in a 40 percent share of the world's market for commercial launches. Revenues from these FAA-licensed commercial space launches reached $940 million in 1997, an increase of 48 percent over 1996 revenues of $635 million. Over the past five years, revenues have increased by more than a factor of three, up from $295 million in 1993.

The FAA issued seven new launch operator licenses and license renewals in 1997, bringing the total number of licenses issued to 38. The FAA also issued two launch site operator licenses to the Spaceport Florida Authority and the Virginia Commercial Space Flight Authority.

In addition, 1997 saw the emergence of the market for launches to deploy the world's first low Earth orbit (LEO) communication systems. In 1997, both Iridium and Orbcomm began full-scale deployment of their respective communications constellations. Forty-six satellites of the 66-satellite Iridium constellation were deployed in 1997. In December, Orbital Sciences launched eight satellites of the 28-satellite Orbcomm constellation.

Commercial Space Transportation: 1997 Year in Review summarizes U.S. and international launch activities for calendar year 1997 and provides a historical look at the past five years of commercial launch activities. This report has three parts:

- 1997 U.S.-Licensed Commercial Activity
- 1997 Worldwide Launch Activity
- Five-Year Space Transportation Trends

ABOUT THE ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION (AST)

The Federal Aviation Administration's Associate Administrator for Commercial Space Transportation (AST) licenses and regulates U.S. commercial space launch activity as authorized by Executive Order 12465, *Commercial Expendable Launch Vehicle Activities,* and the *Commercial Space Launch Act of 1984*. AST's mission is to regulate the U.S. commercial launch industry and license commercial launch operations to ensure public health and safety and the safety of property and to protect national security and foreign policy interests of the United States during commercial launch operations. In addition, the *Commercial Space Launch Act of 1984* and the *1996 National Space Policy* directs the Federal Aviation Administration to encourage, facilitate, and promote commercial space launches.

1997 U.S.-LICENSED COMMERCIAL ACTIVITY

In 1997, U.S. launch service providers conducted 17 launches licensed by the Federal Aviation Administration (FAA) (see Table 1). This is the largest number of FAA-licensed launches conducted in any one year and represents a 55 percent increase over the 11 FAA-licensed orbital launches in 1996 (Figure 1). Of the United States' 17 FAA-licensed launches, 14 were internationally competed launch events.[1] A total of 38 orbital launch events were conducted in 1997 by U.S. launch providers, including launches of the Space Shuttle and other civil and military payloads.

Record Revenues

Last year was also a record year for U.S. commercial space transportation revenues. Revenues from FAA-licensed launches totaled an estimated $940 million, a 48 percent increase over 1996 revenues of $635 million (Figure 2). Over the past five years, revenues have increased by more than a factor of three, up from $295 million in 1993.

Table 1. 1997 FAA-Licensed Orbital Launch Events

Date	Vehicle	Payload	Launch Outcome	Orbit
Feb. 15	Atlas 2AS	JCSAT 4	Success	GEO
Mar. 8	Atlas 2A	Tempo 2	Success	GEO
Apr. 21	Pegasus XL	Minisat 01 Celestis 1	Success	LEO
May 5	Delta 2 7920	Iridiums 1-5	Success	LEO
May 20	Delta 2 7925	Thor 2	Success	GEO
Jul. 9	Delta 2 7920	Iridiums 13-17	Success	LEO
Jul. 27	Atlas 2AS	Superbird C1	Success	GEO
Aug. 1	Pegasus XL*	OrbView-2 (SeaStar)	Success	LEO
Aug. 20	Delta 2 7920	Iridiums 18-22	Success	LEO
Aug. 23	Athena 1*	Lewis	Success	LEO
Sep. 4	Atlas 2AS	GE 3	Success	GEO
Sep. 26	Delta 2 7920	Iridiums 34-38	Success	LEO
Oct. 5	Atlas 2AS	EchoStar 3	Success	GEO
Nov. 8	Delta 2 7920	Iridiums 39-43	Success	LEO
Dec. 8	Atlas 2AS	Galaxy 8I	Success	GEO
Dec. 20	Delta 2 7920	Iridiums 44-48	Success	LEO
Dec. 23	Pegasus XL*	Orbcomms 5-12	Success	LEO

* Not internationally competed.

Figure 1. U.S.-Licensed Orbital Launch Events

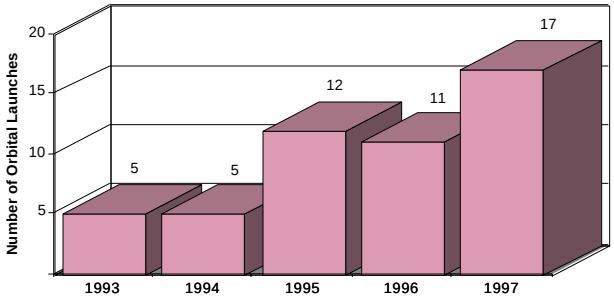
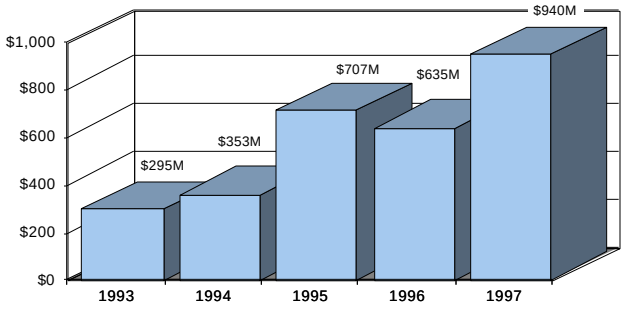


Figure 2. Revenues for U.S.-Licensed Orbital Launch Events (in U.S. millions)



New Launch Licenses Issued in 1997

The Federal Aviation Administration issued seven new launch operator licenses and license renewals in 1997, bringing the total number of licenses issued by AST since its inception to 38. A total of 84 licensed launches have been conducted as of December 31, 1997.

Spaceport Licenses Issued in 1997

The FAA also issued two launch site operator licenses: one to the Spaceport Florida Authority and one to the Virginia Commercial Space Flight Authority. The Spaceport Florida Authority was issued a license to operate a commercial launch site on Cape Canaveral Air Station.[2] The Virginia Commercial Space Flight Authority was issued a license to operate the Virginia Space Flight Center at Wallops Island. A third spaceport, the California Spaceport, was licensed in 1996.

[1] "Internationally competed" refers to launch opportunities available, in principle, to international launch providers, and not captive to one company or country's vehicle.

[2] The first FAA-licensed spaceport launch was NASA's Lunar Prospector aboard Lockheed Martin's new Athena-2 on January 6, 1998 from Spaceport Florida.

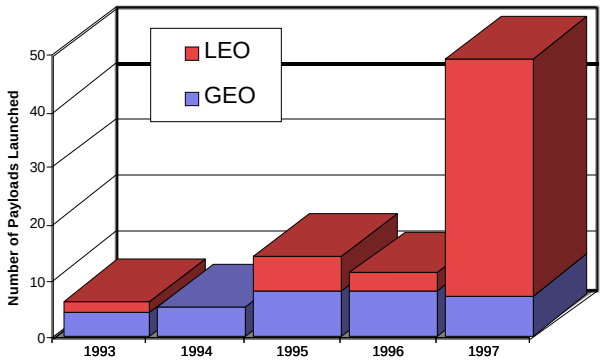
LEO Market Emerges

The sharp increase in U.S. commercial launch activities in 1997 can be attributed to the emergence of the market for launches to low Earth orbit (LEO), which accounted for 10 of the 17 FAA-licensed launches. A total of 42 payloads were launched to LEO on these FAA-licensed launches in 1997 (Figure 3).

Six of the seven U.S. commercial launches to LEO were Delta 2 launch vehicles, deploying 30 Iridium satellites. Iridium, owned by Motorola and a number of international partners, will provide seamless, global, mobile telephone services. A total of 46 satellites of the planned 66-satellite constellation were deployed in 1997 by six launches of the Delta 2 (five Iridium satellites per launch), two launches of Russia's Proton vehicle (seven per launch), and one launch of China's Long March 2C (two satellites).

On December 23, a Pegasus began full-scale deployment of the Orbcomm system with the launch of eight satellites. The 28-satellite Orbcomm system will provide two-way narrowband data communications worldwide.

Figure 3. Payloads Launched on U.S.-Licensed Launches, by Orbit (1993-1997)

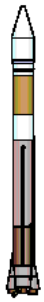
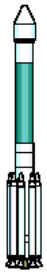
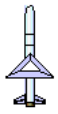
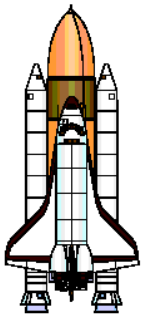


Other U.S. Launch Activities

U.S. launches in 1997 were conducted by seven launch vehicle families (see Table 2 below). Noteworthy events include Lockheed Martin's first successful launch of the Athena launch vehicle (formerly the Lockheed Martin Launch Vehicle, or LMLV), deploying NASA's Lewis remote sensing spacecraft on August 23.

The United States experienced only one launch failure in 1997: an Air Force Delta 2 on January 17 in a non-commercial launch. The accident, due to a failure in one of nine solid rocket boosters, caused a four-month hiatus in Delta 2 launches.

Table 2. United States Launch Vehicle Performance in 1997

	UNITED STATES						
							
Vehicle	**Athena 1**	**Atlas 1 & 2**	**Delta 2**	**Pegasus**	**Shuttle**	**Titan 2**	**Titan 4**
1997 Launches:							
FAA Licensed	1	6	7	3	0	0	0
Total Launches	1	8	11	5	8	1	4
Reliability 1997	1/1 (100%)	8/8 (100%)	10/11 (90.9%)	5/5 (100%)	8/8 (100%)	1/1(100%)	4/4 (100%)
Last 10 Years	1/2 (50%)	42/44 (95.5%)	64/65 (98.5%)	16/19 (84.2%)	64/64 (100%)	6/6 (100%)	22/23 (95.7%)
First Launch	1995	1990	1989	1990	1981	1964	1989
Launch Sites	CCAS, VAFB	CCAS, VAFB	CCAS, VAFB	VAFB, Wallops	KSC	VAFB	CCAS, VAFB
LEO (lb./28.5°/100 nm)	1,760	19,050	11,220	1,015	47,300	7,900	47,800
GTO (lb.)	N/A	8,150	4,060	N/A	13,000	N/A	19,000

1997 WORLDWIDE LAUNCH ACTIVITY

Worldwide, a record 35 internationally competed commercial launches took place in 1997, nearly double the number of commercial launches in 1996. Of these, 14 were conducted by U.S. launch vehicles and 21 were conducted by foreign launch vehicles (Table 3). The United States had the largest share of the commercial launch market last year, capturing 40 percent (Figure 6).

Overall, there were a total of 89 orbital launch events and 150 payloads launched worldwide in 1997 for commercial, civil, and military purposes. These launches are summarized and listed in an appendix to this report. The United States conducted more launches than any other nation in 1997 with 38 launches, as well as the largest number of commercial launches. Russia followed with 29 launches, two more than in 1996. Europe's Arianespace conducted the second largest number of commercial launches with 11, a commercial record for the Ariane 4 launch vehicle.

Table 3. 1997 Non-U.S. Commercial Launch Events

Date	Vehicle	Payload	Launch Outcome	Orbit
Jan. 30	Ariane 44L	GE 2 Nahuel 1A	Success	GEO
Feb. 28	Ariane 44P	Intelsat 8 F1	Success	GEO
Apr. 16	Ariane 44LP	BSAT 1 Thaicom 3	Success	GEO
May 24	Proton SL-12	Telstar 5	Success	GEO
Jun. 3	Ariane 44L	Inmarsat 3 F4 Insat 2D	Success	GEO
Jun. 18	Proton SL-12	Iridiums 6-12	Success	LEO
Jun. 25	Ariane 44P	Intelsat 8 F2	Success	GEO
Aug. 8	Ariane 44P	PAS 6	Success	GEO
Aug. 19	Long March 3B	Agila 2	Success	GEO
Aug. 28	Proton SL-12	PAS 5	Success	GEO
Sep. 2	Ariane 44LP	Hot Bird Plus 3 Meteosat 7	Success	GEO
Sep. 14	Proton SL-12	Iridiums 27-33	Success	LEO
Sep. 23	Ariane 44P	Intelsat 8 F3	Success	GEO
Oct. 17	Long March 3B	APStar 2R	Success	GEO
Nov. 12	Ariane 44L	IndoStar 1 Sirius 2	Success	GEO
Dec. 2	Ariane 44P	JCSAT 5	Success	GEO
Dec. 3	Proton SL-12	Astra 1G	Success	GEO
Dec. 8	Long March 2C	Iridiums 25 - 26	Success	LEO
Dec. 21	Ariane 44P	Intelsat 8 F4	Success	GEO
Dec. 23	Proton SL-12	Asiasat 3	Failure	GEO
Dec. 24	START 1	EarlyBird 1	Success	LEO

Figure 4. 1997 Worldwide Orbital Launch Events

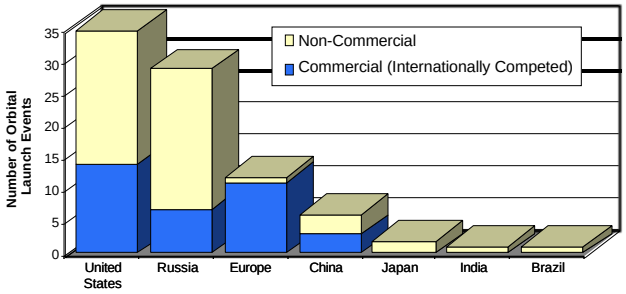


Table 4. Orbital Launch Events in 1997

	Non-Commercial Launches	Commercial Launches	TOTAL Launches
United States	24	14	38
Russia	22	7	29
Europe	1	11	12
China	3	3	6
Japan	2	0	2
India	1	0	1
Brazil	1	0	1
TOTAL	54	35	89

Figure 5. Total Worldwide Market Share for 1997

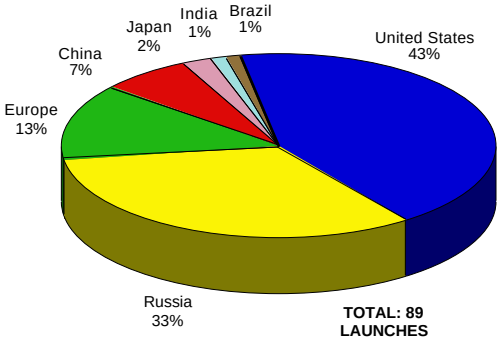
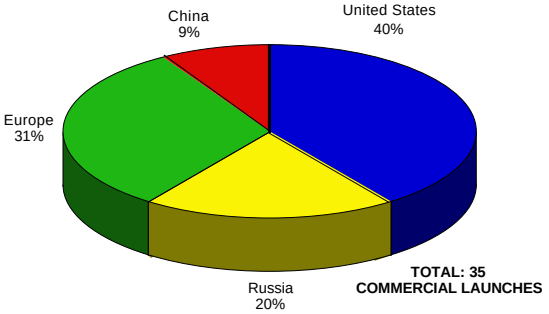


Figure 6. Worldwide Commercial Market Share for 1997



Worldwide Payload Summary

More than 75 commercial payloads[3] were launched into orbit in 1997, three times that of 1996. In fact, there were more worldwide commercial payloads launched last year than military and civil government payloads.

The United States had, by far, the greatest number of commercial payload deployments in 1997, launching 39 commercial satellites and a total of 68 payloads. In fact, more than half of the commercial payloads last year were launched by U.S. launch service providers (Figure 9). Most of these payloads were Iridium satellites (30 in all for the United States) to low Earth orbit. Similarly, Russia launched a high percentage of commercial payloads last year, carrying 14 Iridium satellites to orbit on two Proton launches. After the United States, Russia launched the most payloads in 1997, carrying a 33 percent of the total (Figure 8).

Launch Activities by Country

Russia – In its second year of commercial launch activity, Russia became firmly established in 1997 as a commercial launch provider, conducting six commercial Proton launches and one commercial START-1 launch. In 1997, Russia conducted 29 launches overall for 33 percent of the world's total launches.

Launches for Russia's civil and military space programs continued a post-Cold War decline, falling to only 22 launches from a high of nearly 100 launches annually in the mid-1980s. Russia conducted six missions to the Mir space station and five launches of civil government payloads. The remaining 11 non-commercial launches were of Russian military satellites.

[3] "Commercial payload" numbers do not include the eight Orbcomm and one OrbView satellites, which were launched on FAA-licensed vehicles but were not launched as the result of an international competition.

Figure 7. 1997 Worldwide Payloads Launched

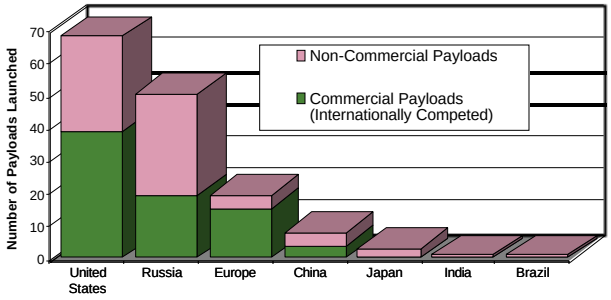


Table 5. Payloads Launched in 1997

	Non-Commercial Payloads	Commercial Payloads	TOTAL Payloads Launched
United States	29	39	68
Russia	31	19	50
Europe	4	15	19
China	4	4	8
Japan	3	0	3
India	1	0	1
Brazil	1	0	1
TOTAL	73	77	150

Figure 8. Total Worldwide Payload Launch Market Share for 1997

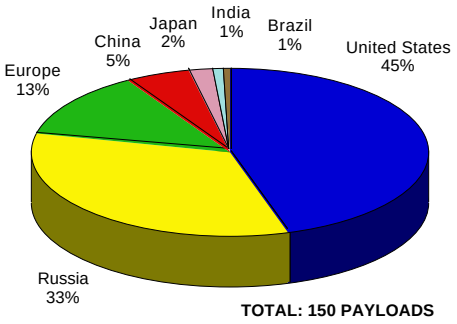
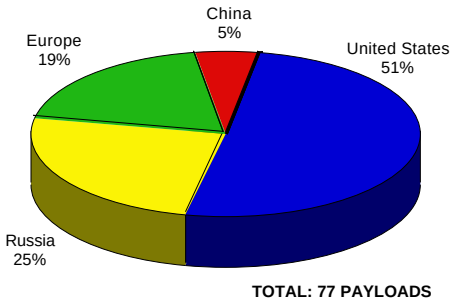


Figure 9. Worldwide Commercial Payload Launch Market Share for 1997



Of the six commercial Proton missions, four were contracted through U.S.-based International Launch Services (ILS), a marketing partnership originally established in 1993 by Lockheed Martin of the United States and Proton's manufacturers, Khrunichev and Energia of Russia. All four launches carried payloads to GEO. The two remaining commercial Proton missions delivered seven Iridium satellites each into LEO and were contracted directly with Khrunichev. Russia also suffered its first commercial launch failure on December 23. The Proton's Block DM upper stage failed, leaving Asiasat 3 in a useless orbit.

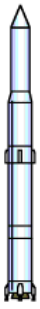
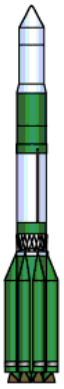
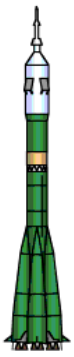
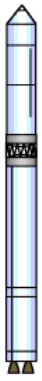
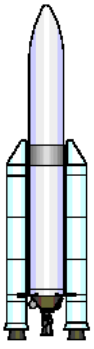
On December 24, a Russian START-1 launched EarthWatch's commercial remote sensing spacecraft, EarlyBird, in the first dedicated commercial launch of a non-U.S. small launch vehicle. Although the launch was successful, contact with EarlyBird was lost and its status remains uncertain. The launch was also the first commercial launch from Russia's new Svobodny launch site in the Russian far east.

Europe – In 1997, Arianespace's Ariane 4 conducted 11 launches, deploying 15 commercial GEO payloads (see Tables 4 & 5, above) and two civil satellites. This is an increase over 13 payloads in 1996. Despite a record number of commercial launches, Europe's Arianespace held, for the first time ever, a smaller share of the commercial launch market in 1997 (31 percent) than did the United States (40 percent).

Europe's Ariane 5 conducted its first successful launch on October 30. However, premature shutdown of the main stage resulted in lower than expected performance. The Ariane 5, designed as a successor to the Ariane 4, failed in its first launch attempt in June 1996. The third flight of the Ariane 5, expected for mid-1998, is expected to carry a commercial payload.

China – China conducted six launches in 1997, three of which were internationally competed commercial launches. China conducted two commercial GEO launches, the same as in 1996, and one launch of two Iridium satellites to LEO,

Table 6. Russian and European Launch Vehicle Performance in 1997

	RUSSIA								EUROPE	
										
Vehicle	**Cosmos**	**Cyclone 2**	**Cyclone 3**	**Molniya**	**Proton**	**Soyuz**	**START**	**Zenit**	**Ariane 4**	**Ariane 5**
1997 Launches	2	1	1	3	9	10	2	1	11	1
Reliability 1997	2/2 (100%)	1/1 (100%)	1/1 (100%)	3/3 (100%)	8/9 (88.9%)	10/10 (100%)	2/2 (100%)	0/1 (0%)	11/11 (100%)	1/1 (100%)
Last 10 Years	66/67 (98.5%)	20/20 (100%)	51/53 (96.2%)	63/63 (100%)	88/94 (93.6%)	218/221 (98.6%)	3/4 (75%)	13/17 (76.5%)	71/74 (95.9%)	1/2 (50%)
First Launch	1964	1966	1977	1961	1967	1963	1993	1985	1988	1996
Launch Sites	Plesetsk	Baikonur	Plesetsk	Plesetsk, Baikonur	Baikonur	Plesetsk, Baikonur	Plesetsk, Svobodny	Baikonur	Kourou	Kourou
LEO (lb./28.5°/100 nm)	3,100	8,820	8,820	3,970	46,000	15,400	1,540	30,300	21,100	39,600
GTO (lb.)	N/A	N/A	N/A	N/A	12,100	N/A	N/A	N/A	9,965	15,000

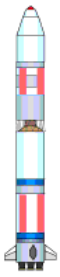
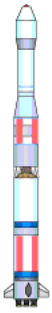
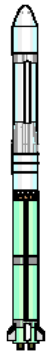
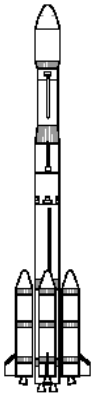
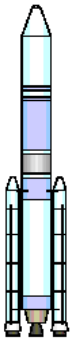
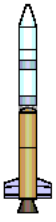
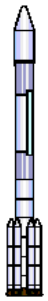
for a total of four commercial payloads (see Table 5) and five percent of the world's total payloads launched (see Figure 8). China also conducted a non-commercial launch of two dummy Iridium satellites to demonstrate the Long March's multiple-payload launching capability. All six of China's Long March launches were successful in 1997, which stands in contrast to the Long March's poor performance during the previous two years (Long March had a 57-percent success rate for that period). Two of four launches in 1996 and one of three launches in 1995 resulted in failure.

Japan – Japan's National Space Development Agency (NASDA) launched the H2 rocket in November 1997, carrying the Japanese ETS-7 and Japanese/NASA TRMM satellites to GEO. NASDA also successfully launched a sub-orbital vehicle, Test Rocket for Space Experiment (TR-1A), in September. The Japanese Institute of Space and Astronautical Science (ISAS) had the first launch of the new M5 vehicle in 1997, successfully launching the Muses-B satellite into an elliptical orbit.

India – India's Polar Satellite Launch Vehicle (PSLV) launched the IRS-1D satellite into a lower than intended orbit in September 1997, in the fourth launch of the PSLV since its introduction in 1993. Although the PSLV is offered commercially, it has yet to launch any commercial payloads or sign any commercial launch contracts.

Brazil – On November 2, Brazil attempted to launch its first indigenously developed launch vehicle, the Veiculo Lancador de Satellites (VLS) from its Alcântara launch site. The first flight of the VLS small launch vehicle ended in failure when one of the four solid boosters failed to ignite, and the vehicle was destroyed. The VLS would have deployed Brazil's SCD-2A data relay satellite for use in climate monitoring. Had the VLS been successful, Brazil would have become the ninth nation to place a satellite in orbit by its own efforts and the first South or Central American nation to achieve this goal. Brazil plans to launch one VLS rocket per year for the next few years and intends to eventually begin selling VLS launch services commercially.

Table 7. Chinese, Japanese, Indian, and Brazilian Launch Vehicle Performance in 1997

	CHINA				JAPAN		INDIA	BRAZIL
								
Vehicle	**LM 2C**	**LM 3**	**LM 3A**	**LM 3B**	**H2**	**M5**	**PSLV**	**VLS**
1997 Launches	2	1	1	2	1	1	1	1
Reliability 1997	2/2 (100%)	1/1 (100%)	1/1 (100%)	2/2 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	0/1 (0%)
Last 10 Years	6/6 (100%)	8/9 (88.9%)	3/3 (100%)	2/3 (66.7%)	5/5 (100%)	1/1 (100%)	3/4 (75%)	0/1 (0%)
First Launch	1975	1984	1994	1996	1994	1997	1993	1997
Launch Sites	Jiuquan	Xichang	Xichang	Xichang	Tanegashima	Kagoshima	Sriharikota	Alcântara
LEO (lb./28.5°/100 nm)	7,040	11,023	15,800	29,900	23,000	5,500	6,400	440
GTO (lb.)	2,200	3,100	5,500	9,900	8,800	2,680	990	N/A

FIVE-YEAR SPACE TRANSPORTATION TRENDS

The global commercial space transportation industry has experienced consistent and aggressive growth since 1993 (Figure 12). From 1993 to 1997, worldwide commercial launches have increased at a rate of approximately 41 percent each year, while overall launch rates have remained steady over the past five years (approximately 84 launches per year). Nineteen ninety-seven saw a record increase, 66 percent from the previous year, and a record 35 commercial orbital launch events (Table 8). Commercial launches in 1997 accounted for about 43 percent of total worldwide launches, while 1996 commercial launches made up only 31 percent of the total.

Worldwide commercial launch revenues for the same period showed comparable growth. Combined worldwide commercial revenues were $2.4 billion last year, a 57-percent jump from revenues in 1996. Russia nearly tripled its commercial revenues last year at $351 million from $120 million in 1996. The United States showed a 76 percent growth last year in revenues over 1996 for internationally competed launches.

Nineteen ninety-seven also saw the largest number of payloads to orbit, 150 total, a more than 50 percent increase over 1996. The vast majority of payloads in 1997 went to low Earth

Figure 11. Launch Revenues for Commercial Launch Events (in U.S. millions)

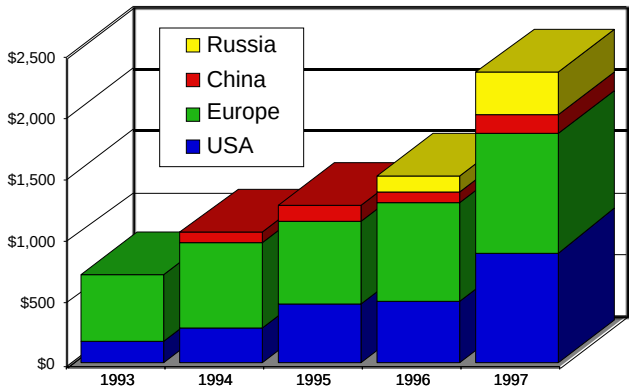


Figure 12. Five-Year Summary (1993 - 1997) Launches by Launch Event Type

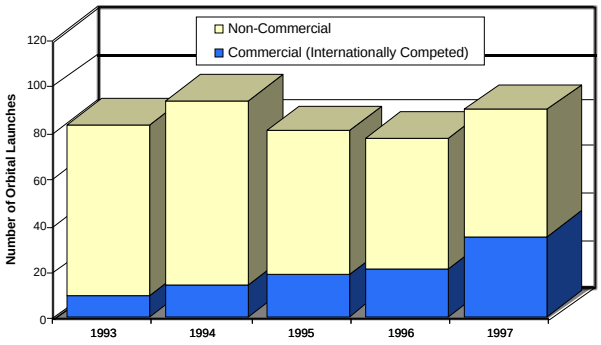


Table 8. Five-Year Summary (1993 - 1997) Launches by Launch Event Type

	Non-Commercial	Commercial	TOTAL
1993	74	9	83
1994	79	14	93
1995	62	18	80
1996	56	21	77
1997	54	35	89

Figure 13. Five-Year Summary (1993 - 1997) Commercial Payloads Launched, by Orbit

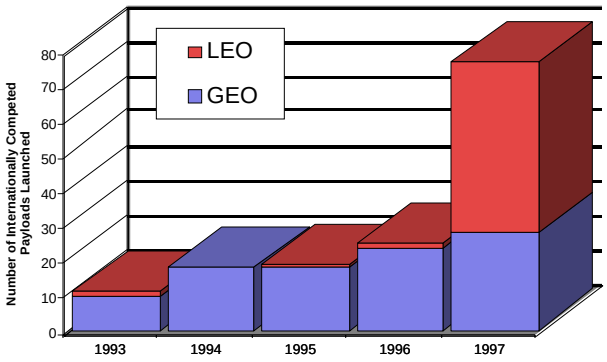


Table 9. Five-Year Summary (1993 - 1997) Commercial Payloads Launched, by Orbit

	GEO	LEO	TOTAL
1993	10	1	11
1994	18	0	18
1995	18	1	19
1996	24	1	25
1997	28	49	77

orbit (LEO), most notably because of the 46 Iridium satellites launched. In fact, 1997 saw more than double the number of LEO payloads than in the previous year.

For the past five years, from 1993 through 1997, the United States and Russia have led the world in total orbital launch events (see Figure 14). Russia has conducted the most launches during this period with 186 (see Table 10) with U.S. launch service providers closely behind at 153. Russia's launch rate has been dropping, however, at an average annual rate of 11 percent each year, in part due to Russia's waning economic support for space activities.

Europe remains a distant third with only 49 orbital launch events. Yet, Europe's Arianespace is noted as having conducted the largest number of commercial launches for this period, with 42 internationally competed launch events, for a 44 percent share of the commercial market (Figure 16). Europe's Arianespace commercial launches outnumbered non-commercial launches by a ratio of six to one. U.S. launch service providers performed 36 commercial launch events during this period, which is close in number to that of Arianespace, and amounts to a 37 percent commercial market share.

In terms of overall launch activity for the period 1993 through 1997, Russia holds the largest share of the world's total launches with 44 percent (see Figure 15) but the smallest share in terms of commercial launches (only nine percent). Nineteen ninety-seven was Russia's second year of commercial launch activity, but Russia's launch providers have already captured nearly as many commercial launches as China, which has been conducting commercial launches since 1990.

Figure 14. Five-Year Worldwide Launch Totals (1993 - 1997)

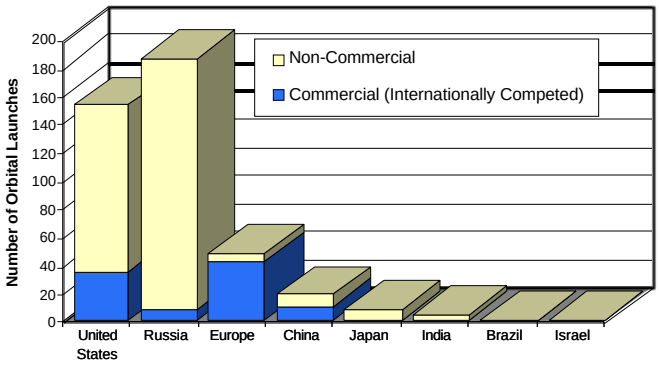


Table 10. Five-Year Worldwide Launch Totals (1993 - 1997)

	Non-Commercial Launches	Commercial Launches	TOTAL
United States	117	36	153
Russia	177	9	186
Europe	7	42	49
China	9	10	19
Japan	8	0	8
India	5	0	5
Brazil	1	0	1
Israel	1	0	1
TOTAL	325	97	422

Figure 15. Five-Year Worldwide Orbital Launch Share (1993 - 1997)

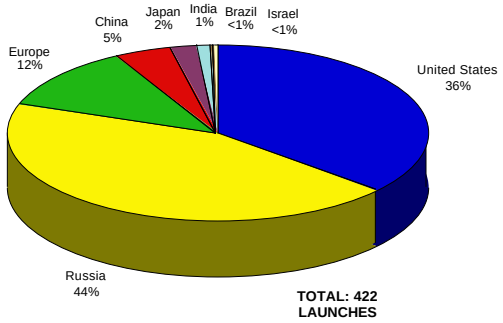
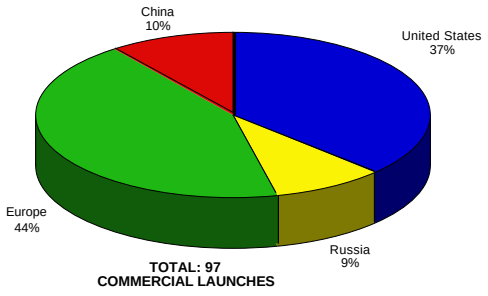


Figure 16. Five-Year Worldwide Commercial Launch Share (1993 - 1997)



1997 Launch Events

	DATE	VEHICLE	SITE	PAYLOAD	OPERATOR	MANUFACTURER	USE	LAUNCH $	OUTCOME L	OUTCOME M
	1/12/97	Shuttle Atlantis	KSC	STS 81	NASA	Rockwell International	Crewed	~188.3M	S	S
	1/17/97	Delta 2 7925	CCAS	Navstar GPS 2R- 1	DoD	Rockwell International	Navigation	~47.5M	F	F
√	1/30/97	Ariane 44L	Kourou	GE 2	GE Americom	Lockheed Martin	Communication	~100M	S	S
				Nahuel 1A	Nahuelsat	Aerospatiale	Communication			
	2/10/97	Soyuz SL-4	Baikonur	Soyuz TM-25	RKK Energia	RKK Energia	Crewed	~18.5M	S	S
	2/11/97	Shuttle Discovery	KSC	STS 82	NASA	Rockwell International	Crewed	~188.3M	S	S
	2/12/97	M 5	Kagoshima	Muses B	ISAS	NEC	Scientific	~44.0M	S	S
	2/14/97	Cyclone SL-14	Plesetsk	Gonets D1 04-06 (3 sats)	Smolsat (NPO PM, et. al)	NPO PM	Communication	~12.5M	S	S
				Kosmos 2337 - 2339	Russian MoD	AO Polyot	Communication			
√	2/15/97	Atlas 2AS	CCAS	JCSAT 4	JAST	Hughes	Communication	~95M	S	S
	2/23/97	Titan 4B/IUS	CCAS	DSP 18	DoD	TRW	Military	N/A	S	S
√	2/28/97	Ariane 44P	Kourou	Intelsat 8 F1	Intelsat	Lockheed Martin	Communication	~82.5M	S	S
	3/4/97	START 1	Svobodny	Zeya	Russian MoD	Russia	Geodesy	~7.5M	S	S
√	3/8/97	Atlas 2A	CCAS	Tempo 2	TCI	Space Systems/Loral	Communication	~72.5M	S	S
	4/4/97	Shuttle Columbia	KSC	STS 83	NASA	Rockwell International	Crewed	~188.3M	S	P
	4/4/97	Titan 2	VAFB	DMSP 5D-2-F14	DoD	Lockheed Martin	Meteorological	~43.9875M	S	S
	4/6/97	Soyuz SL-4	Baikonur	Progress M-34	RKK Energia	RKK Energia	Supply	~18.5M	S	S
	4/9/97	Molniya SL-6	Plesetsk	Kosmos 2340	Russian MoD	NPO Lavotchkin	Military	N/A	S	S
√	4/16/97	Ariane 44LP	Kourou	BSAT 1	Telecom. Advan. Org.	Hughes	Communication	~87.5M	S	S
				Thaicom 3	Shinawatra Sat. Ltd.	Aerospatiale	Communication			
	4/17/97	Cosmos SL-8	Plesetsk	Kosmos 2341	Russian MoD	NPO PM	Navigation	~10M	S	S
√	4/21/97	Pegasus XL	Spain	Celestis 1	Celestis	Celestis	Other	~13M	S	S
				Minisat 01	INTA	INTA	Scientific			
	4/25/97	Atlas 1	CCAS	GOES 10	NOAA	Space Systems/Loral	Meteorological	~65M	S	S
√	5/5/97	Delta 2 7920	VAFB	Iridiums 1-5	Iridium, Inc.	Lockheed Martin	Communication	~45.7M	S	S
	5/11/97	Long March 3A	Xichang	DFH 3-2	Chinese Brdcst. Sat. Corp.	CAST (CAST)	Communication	~40M	S	S
	5/14/97	Molniya SL-6	Plesetsk	Kosmos 2342	Russian MoD	NPO Lavotchkin	Military	N/A	S	S
	5/15/97	Shuttle Atlantis	KSC	STS 84	NASA	Rockwell International	Crewed	~188.3M	S	S
	5/15/97	Soyuz SL-4	Baikonur	Kosmos 2343	Russian MoD	TsSKB Progress	Military	~18.5M	S	S
	5/20/97	Zenit 2 SL-16	Baikonur	Kosmos F1-1997	Russia	Russia	Military	~32.5M	F	F
√	5/20/97	Delta 2 7925	CCAS	Thor 2	Telenor A.S.	Hughes	Communication	~47.5M	S	S
√	5/24/97	Proton SL-12	Baikonur	Telstar 5	AT&T	Space Systems/Loral	Communication	~60M	S	S
√	6/3/97	Ariane 44L	Kourou	Inmarsat 3 F4	Inmarsat	Lockheed Martin	Communication	~100M	S	S
				Insat 2D	ISRO	ISRO	Communication			
	6/6/97	Proton SL-12	Baikonur	Kosmos 2344	Russian MoD	Russian MoD	Military	~60M	S	S
	6/10/97	Long March 3	Xichang	FY 2-B	CAST	Shanghai Inst. of Sat. Eng.	Meteorological	~37.5M	S	S
√	6/18/97	Proton SL-12	Baikonur	Iridiums 6-12	Iridium, Inc.	Lockheed Martin	Communication	~60M	S	S
√	6/25/97	Ariane 44P	Kourou	Intelsat 8 F2	Intelsat	Lockheed Martin	Communication	~82.5M	S	S
	7/1/97	Shuttle Columbia	KSC	STS 83R	NASA	Rockwell International	Crewed	~188.3M	S	S
				Wake Shield Facility 4	Space Vacuum Epitaxy Center	Space Industries, Inc.	Microgravity			
	7/5/97	Soyuz SL-4	Baikonur	Progress M-35	RKK Energia	RKK Energia	Supply	~18.5M	S	S
√	7/9/97	Delta 2 7920	VAFB	Iridiums 13-17	Iridium, Inc.	Lockheed Martin	Communication	~45.7M	S	S
	7/23/97	Delta 2 7925	CCAS	Navstar GPS 2R- 2	DoD	Lockheed Martin	Navigation	~47.5M	S	S
√	7/27/97	Atlas 2AS	CCAS	Superbird C1	Space Communications Corp.	Hughes	Communication	~95M	S	S
√	8/1/97	Pegasus XL	VAFB	OrbView-2 (SeaStar)	OSC	OSC	Remote Sensing	~13M	S	S
	8/5/97	Soyuz SL-4	Baikonur	Soyuz TM-26	RKK Energia	RKK Energia	Crewed	~18.5M	S	S
	8/7/97	Shuttle Discovery	KSC	CRISTA SPAS 2	NASA/DARA	MBB Erno	Scientific	~188.3M	S	S
				SEDSat 1	NASA	U. of Ala./Huntsville	Scientific			
				STS 85	NASA	Rockwell International	Crewed			
√	8/8/97	Ariane 44P	Kourou	PAS 6	PanAmSat	Space Systems/Loral	Communication	~82.5M	S	S
	8/14/97	Proton SL-12	Baikonur	Kosmos 2345	Russian MoD	Russian MoD	Military	~60M	S	S
√	8/19/97	Long March 3B	Xichang	Agila 2	Mabuhay Phil. Sat. Corp.	Space Systems/Loral	Communication	~65M	S	S
√	8/20/97	Delta 2 7920	VAFB	Iridiums 18-22	Iridium, Inc.	Lockheed Martin	Communication	~57.1M	S	S
√	8/23/97	Athena 1	VAFB	Lewis	NASA	TRW	Remote Sensing	~15M	S	F

√ = Commercial Launch Event

1997 Launch Events

	DATE	VEHICLE	SITE	PAYLOAD	OPERATOR	MANUFACTURER	USE	LAUNCH $	OUTCOME L	OUTCOME M
	8/25/97	Delta 2 7920	CCAS	ACE	NASA	NASA	Scientific	~47.5M	S	S
√	8/28/97	Proton SL-12	Baikonur	PAS 5	PanAmSat	Hughes	Communication	~60M	S	S
	8/29/97	Pegasus XL	VAFB	FORTE P94-1	DoD	Los Alamos National Laboratory	Military	~13M	S	S
	9/1/97	Long March 2C	Taiyuan	Iridium MFS 1 - 2	China Aerospace Corp.	Lockheed Martin	Test	~17.5M	S	S
√	9/2/97	Ariane 44LP	Kourou	Hot Bird Plus 3	Eutelsat	Matra Marconi	Communication	~87.5M	S	S
				Meteosat 7	Eumetsat	Aerospatiale	Meteorological			
√	9/4/97	Atlas 2AS	CCAS	GE 3	GE Americom	Lockheed Martin	Communication	~95M	S	S
√	9/14/97	Proton SL-12	Baikonur	Iridiums 27-33	Iridium, Inc.	Lockheed Martin	Communication	~43.4M	S	S
√	9/23/97	Ariane 44P	Kourou	Intelsat 8 F3	Intelsat	Lockheed Martin	Communication	~82.5M	S	S
	9/23/97	Cosmos SL-8	Plesetsk	Faisat 02V	Final Analysis Inc.	Final Analysis Inc.	Communication	~10M	S	S
				Kosmos 2346	Russian MoD	AO Polyot	Navigation			
	9/25/97	Shuttle Atlantis	KSC	STS 86	NASA	Rockwell International	Crewed	~188.3M	S	S
	9/25/97	Molniya SL-6	Plesetsk	Molniya 3-49	Russian PTT	NPO PM	Communication	N/A	S	S
	9/25/97	TR 1A	Tanegashima	Takesaki 6	NASDA	NASDA	Microgravity	N/A	S	S
√	9/26/97	Delta 2 7920	VAFB	Iridiums 34-38	Iridium, Inc.	Lockheed Martin	Communication	~47.5M	S	S
	9/29/97	PSLV	Sriharikota	IRS 1D	ISRO	ISRO	Remote Sensing	N/A	P	S
√	10/5/97	Atlas 2AS	CCAS	EchoStar 3	EchoStar Satellite Corp.	Lockheed Martin	Communication	~95M	S	S
	10/5/97	Soyuz SL-4	Baikonur	Progress M-36	RKK Energia	RKK Energia	Supply	~18.5M	S	S
	10/9/97	Soyuz SL-4	Plesetsk	Foton N-11	Space Research Institute (IKI)	KB Photon	Microgravity	~18.5M	S	S
				Mirka	DLR	Kayser-Threde	Scientific			
	10/15/97	Titan 4B/Centaur	CCAS	Cassini	NASA	Jet Propulsion Laboratory	Scientific	N/A	S	S
				Huygens	ESA	Aerospatiale	Scientific			
√	10/17/97	Long March 3B	Xichang	APStar 2R	APT Satellite Co., Ltd.	Space Systems/Loral	Communication	~65M	S	S
	10/22/97	Pegasus XL	Wallops Flight Facility	STEP 4	DoD/USAF	TRW	Development	~13M	S	F
	10/23/97	Titan 4	VAFB	USA 133	U.S. Government	Lockheed Martin	Military	~170M	S	S
	10/24/97	Atlas 2A	CCAS	DSCS III 3-10	DoD	Lockheed Martin	Communication	~72.5M	S	S
				Falcon Gold	AF Academy/U. of Col.	AF Academy/U. of Col.	Experimental			
	10/30/97	Ariane 5	Kourou	Maqsat H	Arianespace	Arianespace	Experimental	~129.06M	S	S
				Teamsat 1	ESA	ESA	Scientific			
	11/2/97	VLS	Alcantara	SCD 2A	IAE	IAE	Communication	N/A	F	F
	11/5/97	Delta 2 7925	CCAS	Navstar GPS 2-28	DoD	Rockwell International	Navigation	~47.5M	S	S
	11/7/97	Titan 4/Centaur	CCAS	USA 136	U.S. Government	Boeing	Military	~255M	S	S
√	11/8/97	Delta 2 7920	VAFB	Iridiums 39-43	Iridium, Inc.	Lockheed Martin	Communication	~47.5M	S	S
	11/12/97	Proton SL-12	Baikonur	Coupon/Bankir 1	Global Information Systems, Inc.	NPO Lavotchkin	Communication	~60M	S	S
√	11/12/97	Ariane 44L	Kourou	IndoStar 1	PT MediaCitra IndoStar	OSC (OSC)	Communication	~100M	S	S
				Sirius 2	NSAB	Aerospatiale	Communication			
	11/18/97	Soyuz SL-4	Plesetsk	Resurs-F 1M	Russian MoD	TsSKB	Remote Sensing	~18.5M	S	S
	11/19/97	Shuttle Columbia	KSC	STS 87	NASA	Rockwell International	Crewed	~188.3M	S	S
				Spartan 201-04	NASA	NASA	Scientific			
	11/28/97	H 2	Tanegashima	ETS 7	NASDA	Toshiba	Development	~191.2M	S	S
				TRMM	NASDA/NASA	NASA Goddard	Remote Sensing			
√	12/2/97	Ariane 44P	Kourou	Equator-S	NASA/DARA	Max Planck Institute	Scientific	~82.5M	S	S
				JCSAT 5	JAST	Hughes	Communication			
√	12/3/97	Proton SL-12	Baikonur	Astra 1G	SES	Hughes	Communication	~60M	S	S
√	12/8/97	Atlas 2AS	CCAS	Galaxy 8I	PanAmSat	Hughes	Communication	~95M	S	S
√	12/8/97	Long March 2C	Taiyuan	Iridiums 25-26	Iridium, Inc.	Lockheed Martin	Communication	~17.5M	S	S
	12/9/97	Cyclone SL-14	Baikonur	Kosmos 2347	Russian MoD	NPO Kometa	Military	~12.5M	S	S
	12/16/97	Soyuz SL-4	Plesetsk	Kosmos 2348	Russian MoD	Russia TBA	Military	~18.5M	S	S
	12/20/97	Soyuz SL-4	Baikonur	Progress M-37	RKK Energia	RKK Energia	Supply	~18.5M	S	S
√	12/20/97	Delta 2 7920	VAFB	Iridiums 44-48	Iridium, Inc.	Lockheed Martin	Communication	~47.5M	S	S
√	12/21/97	Ariane 44P	Kourou	Intelsat 8 F4	Intelsat	Lockheed Martin	Communication	~82.5M	S	S
√	12/23/97	Proton SL-12	Baikonur	Asiasat 3	Asia Sat. Telecom. Ltd.	Hughes	Communication	~60M	F	F
√	12/23/97	Pegasus XL	VAFB	Orbcomms 05-12	Orbcomm	OSC	Communication	~13M	S	S
√	12/24/97	START 1	Svobodny	Earlybird 1	Earthwatch, Inc.	CTA (now OSC)	Remote Sensing	~7.5M	S	TBA

√ = Commercial Launch Event