

Satellite Laser Ranging Tracking through the Years

C. Noll

NASA Goddard Space Flight Center, Code 690, Greenbelt, MD 20771, USA.

Carey.Noll@nasa.gov/Fax: 301-614-6015

Abstract

Satellites equipped with retroreflectors have been tracked by laser systems since 1964. Satellite laser ranging supports a variety of geodetic, earth sensing, navigation, and space science applications. This poster will show the history of satellite laser ranging from the late 1960's through the present and will include retro-equipped satellites on the horizon.

Satellite Tracking History

Initial laser ranges to a satellite in Earth orbit took place in 1964 with the launch of Beacon Explorer-B (BE-B), the first satellite equipped with laser retroreflectors. Since that time, the global network of laser ranging sites has tracked over eighty satellites including arrays placed on the Moon. Satellite and Lunar laser ranging continue to make important contributions to scientific investigations into solid Earth, atmosphere, and ocean processes. SLR also provides Precise Orbit Determination (POD) for several Earth sensing missions (e.g., altimetry, etc.), leading to more accurate measurements of ocean surface, land, and ice topography. Several of these missions have relied on SLR when other radiometric tracking systems have failed (e.g., GPS and DORIS on TOPEX/Poseidon, PRARE on ERS-1, GPS on METEOR-3M and GFO-1) making SLR the only method for providing the POD required for instrument data products. A list of satellites equipped with retroreflectors (past, current, and future) and tracked by SLR is shown in Table 1. The table summarizes the data yield (approximate through fall 2008) and includes a list of any co-located instrumentation (e.g., GNSS, DORIS, or PRARE). Figure 1 shows this rich history in graphical format, as well as future plans, from mid-1960 through 2015. The satellite missions supported by laser ranging are shown in four categories: geodetic, Earth sensing, navigation, and space science or engineering applications.

The data generated by the laser ranging stations tracking these satellites, as well as products derived from these data, are available from the Crustal Dynamics Data Information System (CDDIS, <http://cddis.nasa.gov>). The CDDIS is NASA's active archive and information service of space geodesy data and products and currently serves as a key global data center for the ILRS. For over 25 years, the CDDIS has provided continuous, long term, public access to the data and product sets required for many interdisciplinary studies of the global Earth Science community,

Table 1. ILRS Satellite Tracking Information

Satellite	Start Date	End Date	Number of Years	Number of Passes	Co-Located Instrument?
<i>Current and Past Satellites</i>					
ADEOS-1	Oct-1996	Aug-1997	2	750	
ADEOS-2	Dec-2002	Jan-2003	2	180	
Ajisai	Aug-1986	---	23	152,260	
ALOS	Aug-2006	Aug-2006	1	90	
ANDERR-Active	Jan-2007	Dec-2007	1	430	
ANDERR-Passive	Jan-2007	May-2008	2	650	
BE-C	Jan-1976	---	21	66,790	
CHAMP	Jul-2000	---	9	13,650	GNSS
DIADEM-1C	Apr-1997	Nov-1997	1	2,350	
DIADEM-1D	Apr-1997	Nov-1997	1	2,590	
Envisat	Apr-2002	---	7	34,820	DORIS
ERS-1	Jul-1991	Mar-2000	9	26,080	PRARE*
ERS-2	Apr-1995	---	14	66,620	GNSS
Etalon-1	Jan-1989	---	20	15,890	
Etalon-2	Jul-1989	---	20	15,720	
ETS-8	Mar-2007	---	2	390	
FIZEAU	Jun-1995	Oct-1998	4	4,790	
GEOS-3	Oct-1998	May-1999	2	2,130	
GFO-1	Apr-1998	Aug-2008	11	43,070	GNSS*
GFZ-1	Apr-1995	Jun-1999	5	5,140	
GIOVE-A	May-2006	---	3	1,590	GNSS
GIOVE-B	May-2008	---	1	140	GNSS
GLONASS (31 sats.)	Oct-1994	---	15	47,980	GNSS
GP-B	Jul-2004	Jun-2006	3	2,910	GNSS
GPS-35	Oct-1993	---	16	7,440	GNSS
GPS-36	Apr-1994	---	15	6,500	GNSS
GRACE-A	Mar-2002	---	7	12,550	GNSS
GRACE-B	Mar-2002	---	7	11,860	GNSS
ICESat	Mar-2003	---	6	5,320	GNSS
Jason-1	Dec-2001	---	8	48,110	GNSS, DORIS
Jason-2	Jun-2008	---	1	990	GNSS, DORIS
LAGEOS-1	May-1976	---	33	152,350	
LAGEOS-2	Oct-1992	---	17	88,750	
LARETS	Nov-2003	Aug-2008	6	19,740	
LRE	Dec-2001	Mar-2002	2	40	
METEOR-3	Jan-1994	Nov-1995	2	6,280	PRARE*
METEOR-3M	Dec-2001	Mar-2006	6	1,800	GNSS*
MOON	Jun-1996	---	13	1,210	
MSTI-2	Jun-1994	Oct-1994	1	60	
OICETS	Apr-2006	---	1	120	
Reflector	Dec-2001	Aug-2004	4	3,620	
RESURS	Dec-1995	Oct-1998	4	2,020	
Starlette	Jan-1976	---	33	123,160	
STARSHINE-3	Oct-2001	Jun-2003	3	50	
Stella	Sep-1993	---	16	62,990	
SUNSAT	May-1999	May-2001	3	1,800	
TerraSAR-X	Jun-2007	---	2	3,070	GNSS
TiPS	Jun-1996	Oct-1997	2	1,680	
TOPEX	Jan-1992	Dec-2005	14	105,060	GNSS*, DORIS*
WESTPAC	Jul-1998	Jan-2002	5	5,480	
ZEIA	Mar-1997	Jul-1997	1	150	

Table 1. ILRS Satellite Tracking Information (continued)

<i>Future Satellites</i>		
Satellite	Launch Date	Co-Located Instrument
COMPASS-M1	2008	GNSS
GOCE	2009	GNSS
SOHLA-1	2009	GNSS
LRO-LR	2009	
PROBA-2	2009	GNSS
GIOVE-A2	--	GNSS
QZS-1	2009	
TanDEM-X	2009	GNSS
Galileo	2009	GNSS
NPOESS	2012	GNSS

Note: * indicates co-located instrument failure

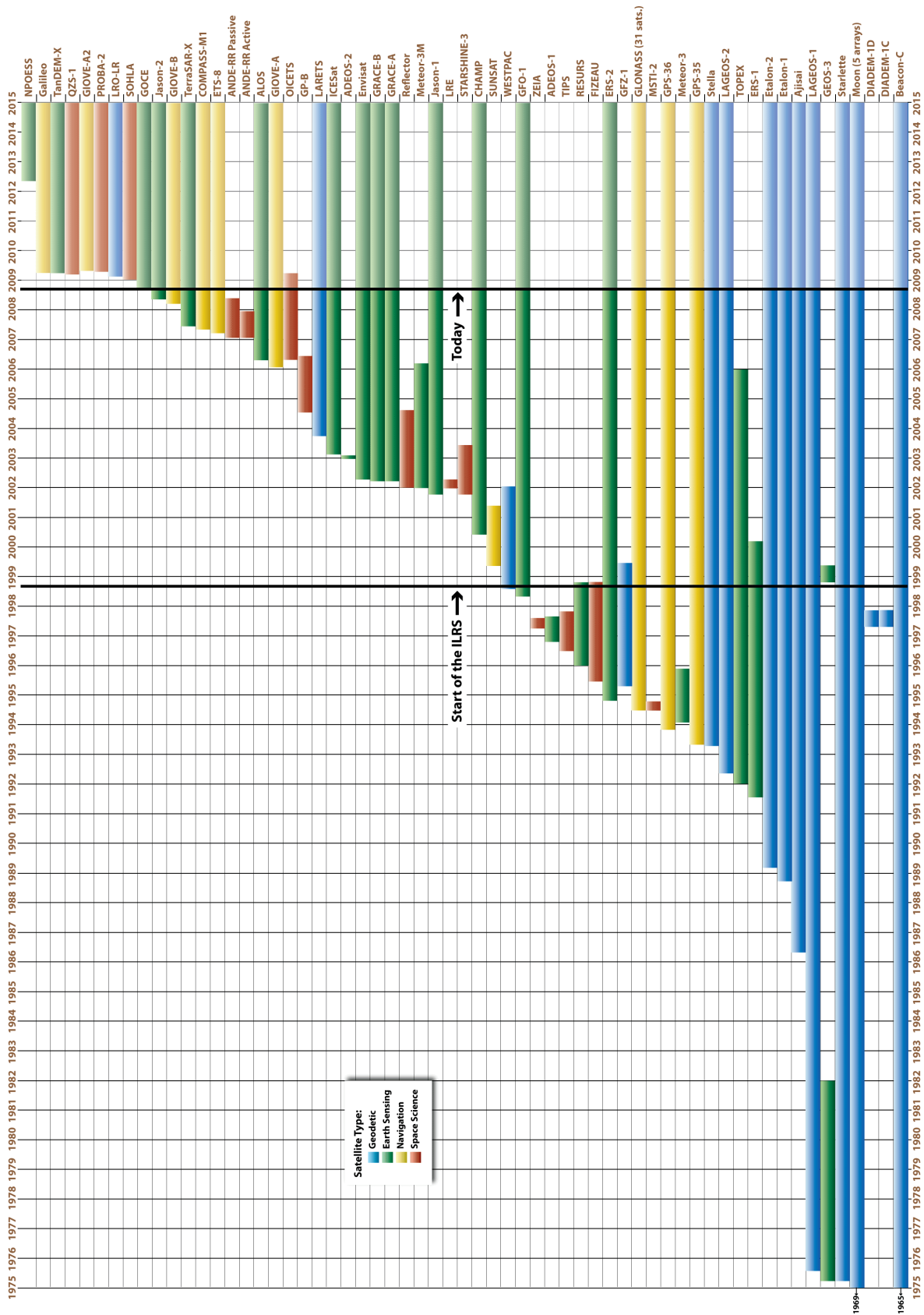


Figure 1. Satellite and Lunar Laser Ranging Tracking History