State of the SLR in Russia

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Abstract

After lifting of some formal restrictions, the Russian SLR stations are now able to resume observation data delivery to the ILRS.
Examples are presented of LAGEOS observation data obtained at the upgraded Altay SLR station, as well as parameters and outlook of the station and its basic subsystems.

During a long period, the Russian SLR stations were unable to deliver measurement data to the ILRS. Currently, in accordance with a recent decision of the State Administration, it is permitted to deliver measurement data from two Russian stations (Altay and Baikonur) to the ILRS, as well as to resume data delivery from the Komsomolsk station.

The Altay SLR station has been recently upgraded: a new laser has been installed with a pulse repetition rate of 300 Hz (instead of 5 Hz), and a higher average output power (0.75 W instead of 0.25 W).

The basic functions of the Data Collection and Analysis Center are:

- Provision of ephemeris data for the SLR stations
- Collection and storage of measurement data from all stations
- Monitoring of measurement data accuracy, completeness, and correctness of data delivery
- Calculation of normal point data and their delivery to the ILRS Data Centers (during the first phase of operation)
- «Feedback» to SLR stations and ILRS concerning measurement data quality and completeness

In Tables 1 and 2, correction data for the Altay and Komsomolsk SLR station coordinates are presented.

Table 1. Correction of Altay Station Coordinates

Date	UTC	Dur	Inc	%	Ele	ME	RMS	ORMS	SCNAME
02:01:08	14:51	11	7	100	32:39	0.069	0.009	0.070	Lageos-1
05:01:08	14:17	7	5	100	39:45	0.045	0.011	0.046	Lageos-1
05:03:08	22:21	7	5	100	33:43	0.018	0.010	0.021	Lageos-1
13:03:08	22:01	9	6	100	31:43	0.015	0.004	0.015	Lageos-1
26:03:08	21:47	13	8	100	44:54	0.009	0.011	0.014	Lageos-1
19:04:08	20:46	8	5	100	52:54	0.019	0.015	0.024	Lageos-1
14:07:08	19:51	18	10	100	47:75	0.013	0.005	0.014	Lageos-1
24:07:08	16:49	9	6	100	50:56	-0.035	0.008	0.036	Lageos-1
13:08:08	21:21	13	7	88	30:51	0.012	0.008	0.014	Lageos-1
18:08:08	17:59	23	11	100	31:78	-0.007	0.012	0.014	Lageos-1
28:08:08	22:03	11	7	100	29:49	-0.022	0.006	0.023	Lageos-1
13:09:08	21:15	17	10	100	32:53	-0.023	0.008	0.025	Lageos-1
09:10:08	13:47	37	7	100	30:39	0.020	0.015	0.025	Lageos-1
28:01:08	00:07	5	4	100	51:55	-0.023	0.008	0.024	Lageos-2
16:02:08	22:13	9	6	100	40:57	0.031	0.010	0.033	Lageos-2
01:03:08	20:01	3	3	100	48:48	0.013	0.012	0.017	Lageos-2
08:03:08	18:45	14	8	100	38:42	0.005	0.012	0.013	Lageos-2
13:03:08	17:23	7	5	100	30:31	-0.016	0.006	0.017	Lageos-2
13:03:08	21:15	9	6	100	68:80	0.006	0.005	0.008	Lageos-2
13:04:08	18:54	8	5	100	55:78	0.013	0.008	0.015	Lageos-2
21:04:08	15:43	15	9	100	42:64	0.009	0.010	0.013	Lageos-2
24:04:08	17:45	17	10	100	36:80	0.017	0.009	0.020	Lageos-2
09:10:08	22:35	45	6	100	30:38	0.002	0.032	0.032	Lageos-2

Coordinates: X=543.406156; Y=3955.302241; Z=4957.821063

Table 2. Correction of Komsomolsk Station Coordinates

Date	UTC	Dur	Inc	%	Ele	ME	RMS	ORMS	SCNAME
02:01:08	11:03	16	9	90	31:40	-0.002	0.016	0.016	Lageos-1
11:01:08	09:23	6	5	100	55:63	0.009	0.012	0.015	Lageos-1
14:01:08	09:13	3	3	100	28:34	-0.035	0.024	0.043	Lageos-1
18:02:08	19:17	7	5	100	31:40	-0.002	0.008	0.008	Lageos-1
22:08:08	15:47	20	10	91	41:62	-0.001	0.017	0.017	Lageos-1
01:10:08	17:45	5	3	75	41:47	0.042	0.024	0.049	Lageos-1
03:02:08	19:11	11	4	67	44:49	0.024	0.014	0.028	Lageos-2
05:02:08	19:16	3	3	100	37:43	-0.015	0.039	0.042	Lageos-2
17:02:08	20:33	10	7	100	39:66	-0.014	0.011	0.018	Lageos-2
20:02:08	18:53	22	12	100	37:71	-0.015	0.011	0.019	Lageos-2
22:02:08	19:14	20	7	64	56:76	-0.016	0.016	0.023	Lageos-2
23:02:08	17:35	9	5	83	40:53	0.005	0.005	0.007	Lageos-2
25:02:08	17:39	14	9	100	50:60	-0.008	0.011	0.014	Lageos-2
27:02:08	17:59	11	7	100	47:65	-0.027	0.013	0.030	Lageos-2
06:03:08	18:41	9	6	100	56:81	0.010	0.006	0.012	Lageos-2
10:03:08	18:59	11	7	100	33:59	0.012	0.012	0.017	Lageos-2
05:04:08	14:03	17	9	90	58:70	-0.006	0.014	0.016	Lageos-2
15:04:08	11:19	11	7	100	41:46	-0.045	0.056	0.072	Lageos-2
01:10:08	18:03	26	11	85	38:63	0.050	0.016	0.052	Lageos-2

Coordinates: X=-2948.545480; Y=2774.313007; Z=4912.302412

Figure 1 shows an example of normal point data deviation from the smoothed LAGEOS-2 orbit obtained by the Altay SLR station.

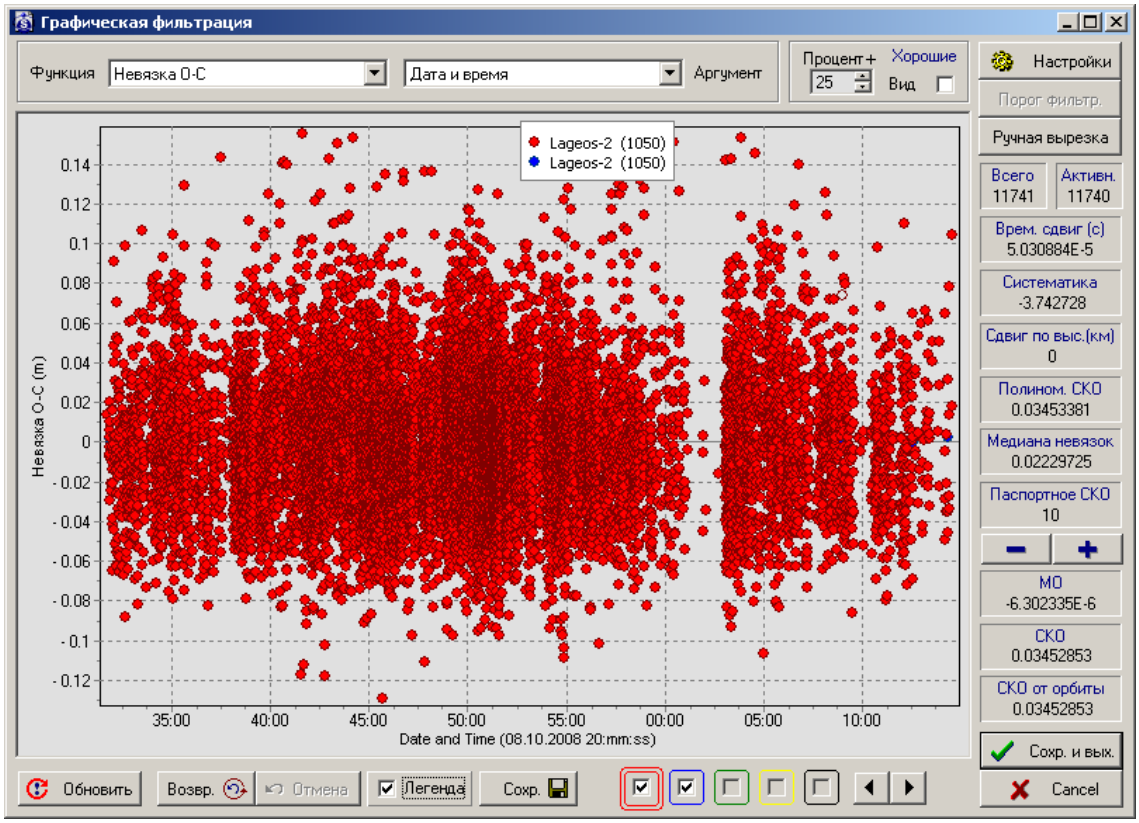
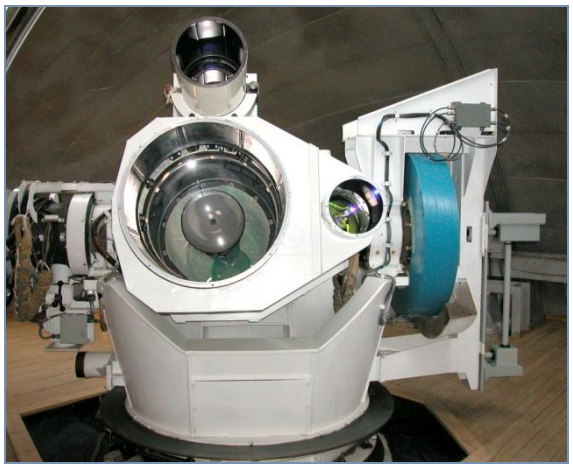


Figure 1. Normal point data deviations from the smoothed orbit (Altay SLR station, LAGEOS-2, 08.10.2008)

The overall view of the Altay station is presented in Figure 2, while Figure 3 shows the station telescope, and in the accompanying table the basic parameters of the station are shown for SLR, angle measurements, and photometry.

Figure 2. Current view of the Altay SLR station



BASIC PARAMETERS

- Receive aperture 60 cm
- Transmit aperture 20cm
- Tracking camera: ICCD, FOV 10'x12'
- Laser 2,5 mJ 150 ps 300 Hz
- Photometry: up to 15^m
- Angle measurements ±2″

Figure 3. Altay station telescope

On top of the main telescope, as seen in Figure 3, another instrument is based: a wide-FOV telescope WFT-35 (35 cm in diameter) used for sky observation, primarily in the GEO belt. In Figure 4, its outlook is presented together with a table of basic parameters and an example of sky fragment view, while the three bright points in the lower right corner are three GEO spacecraft.

BASIC PARAMETERS

- Aperture – 0,35 m
- CCD format: 4096x4096
- Angular FOV: 6.25 sq.deg
- Exposition time: up to 2.5 sec
- Minimum brightness for HEO SC: 16^m
- SC position measurement accuracy: ≤ 0.4 arcsec
- GEO area scanning rate 600 sq. deg/h

Purpose:

GEO SC search and angle measurement

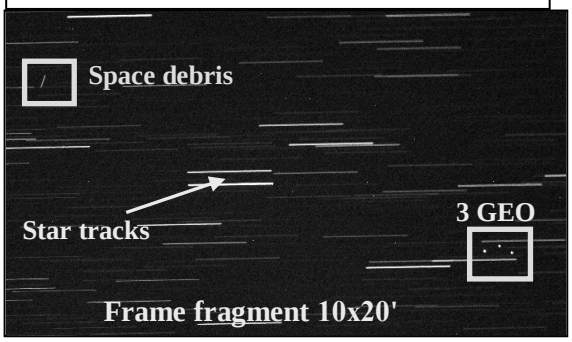


Figure 4. Wide field telescope

The Altay station main telescope is provided with an adaptive optical system used to improve the resolution of distant object images. As an example, four images of the International Space Station (ISS) are shown in Figure 5.

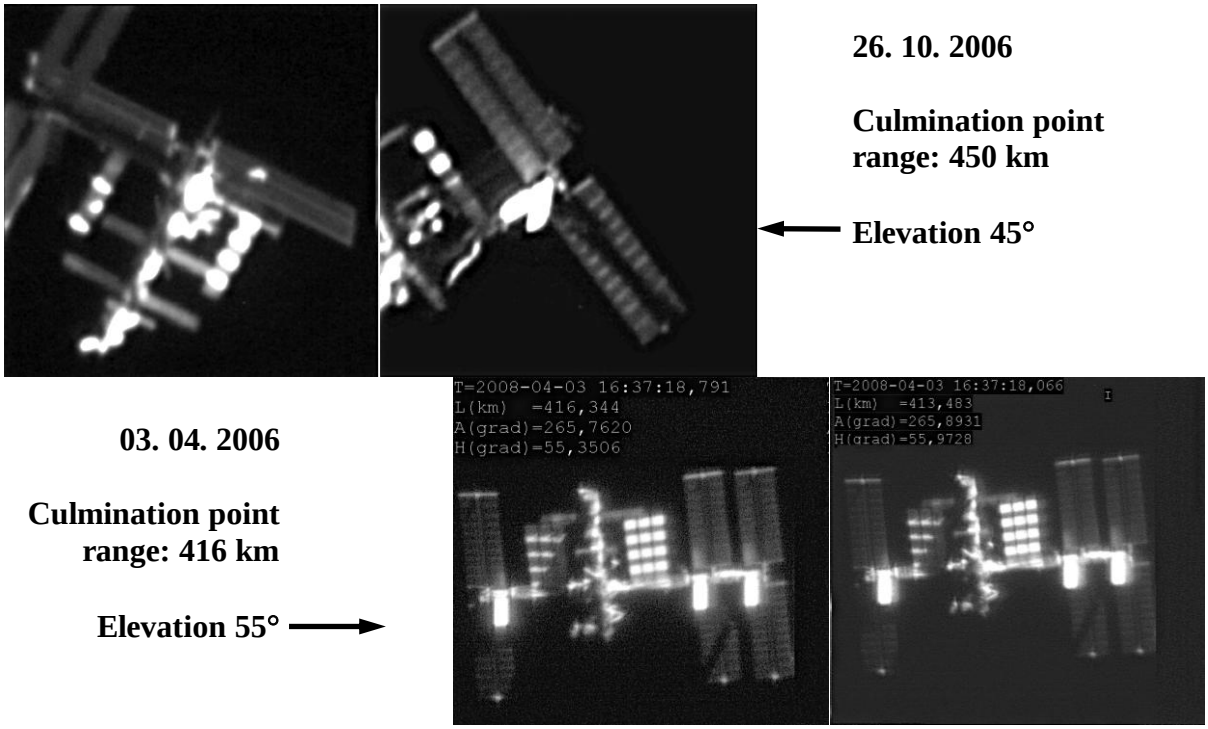


Figure 5. ISS images (with the adaptive optic system activated)

The Baikonur and Komsomolsk SLR station parameters and basic features have been described in earlier presentations (Workshop 14 and 15 accordingly).
In Figure 6, a map is presented with positions of current and future SLR stations which are and will be provided by the Institute for Precision Instrument Engineering (IPIE) for the Russian Academy of Sciences (RAS) and other services during the next few years.

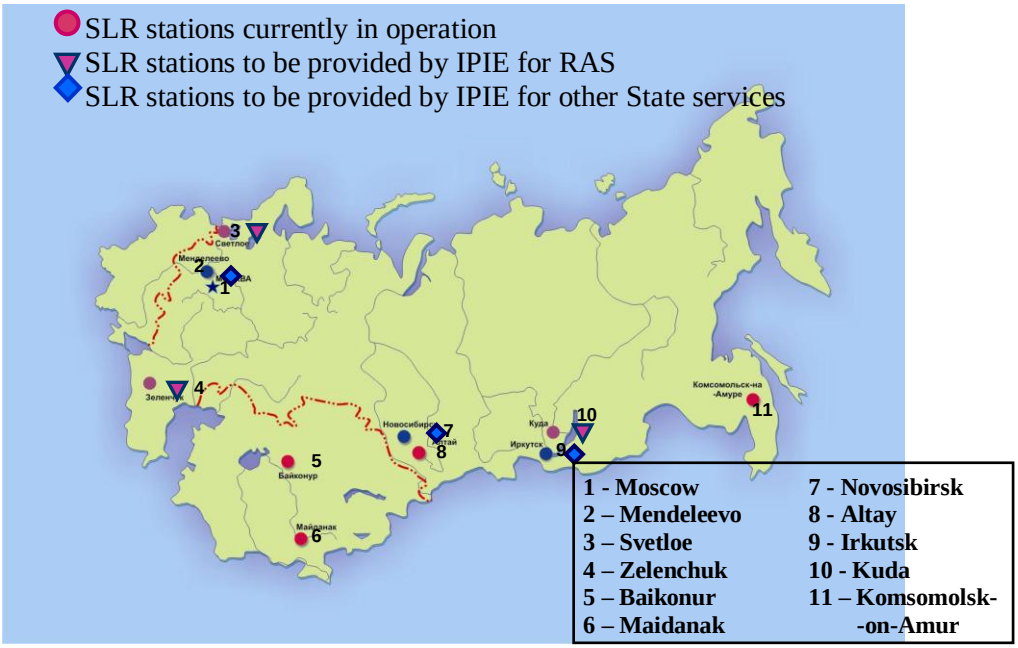


Figure 6. Russian SLR network