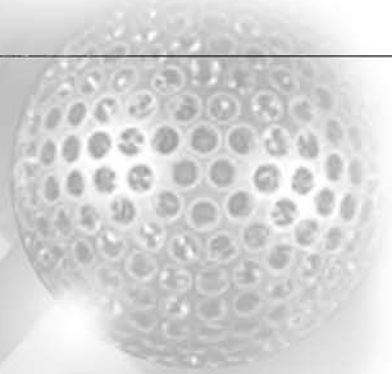

SECTION 4

INFRASTRUCTURE



PRINCIPALS



ARCHITECTS



SECTION 4

INFRASTRUCTURE

Carey Noll/GSFC

Web Site Developments

The ILRS Web site, <http://ilrs.gsfc.nasa.gov>, is the central source of information for all aspects of the service. The Web site provides information on the organization and operation of ILRS and descriptions of ILRS components, data, and products. Links are provided to extensive information on the ILRS network stations including performance assessments and data quality evaluations. Descriptions of supported satellite missions (current, future, and past) are available to aid in satellite acquisition and data analysis.

During the 2007-2008 timeframe, the Central Bureau made several improvements to the ILRS Web site. New reports and plots have been added to help monitor network performance; information is updated as needed. Station operators, analysts, and other ILRS groups can view these reports and plots to quickly ascertain stations performance as well as mission support. All plots and reports can be accessed through the station pages on the ILRS Web site at URL: <http://ilrs.gsfc.nasa.gov/stations>.

Station-Specific Performance Charts

To further aid analysis by station operators and users, the ILRS Central Bureau generates data plots summarizing station performance and environmental parameters. These plots, created for each active station in the network, are accessible through the “LAGEOS Performance” tab in the Stations Section on the ILRS Web site. These plots summarize station performance on LAGEOS including data RMS, calibration RMS, system delay, observations per normal point, and full-rate observations per pass. For each parameter, two plots are generated, one covering the last year and a second showing the information from 2000 to the present. Examples of these plots for selected stations in the network are shown in Figure 4-1.

The “Satellite Data Info” tab shows a table of plots providing statistics on all currently tracked satellites as a function of time; full-rate observations per normal point and normal point rms are also computed as a function of range and time. Examples of these satellite plots for a selected station in the network are shown in Figure 4-2. These plots are also accessible through the Satellite Missions section of the ILRS Web site (organized by mission, matrix of all stations tracking mission).

The “Meteorological Data” tab presents plots of environmental parameters: temperature, humidity, and pressure; plots spanning the last year and since 2000 are also created for this category. Examples of these met data plots are shown in Figure 4-3.

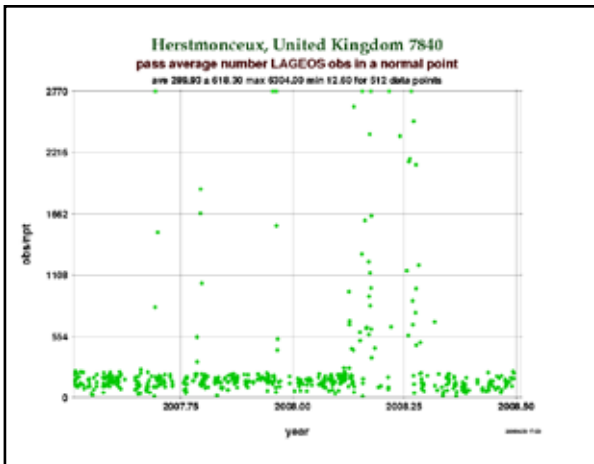


Figure 4-1a. Average number of LAGEOS observations per normal point at Herstmonceux for the past year.

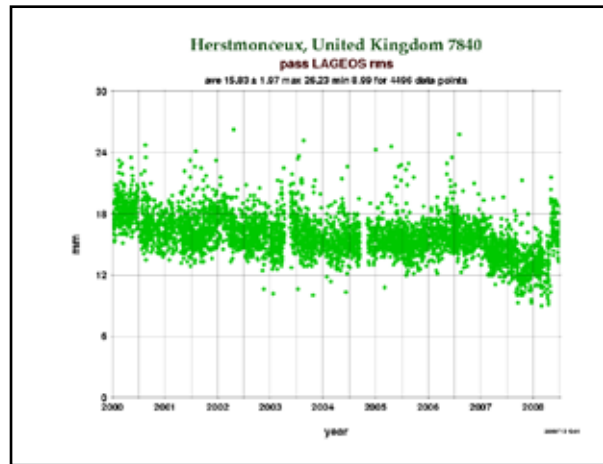


Figure 4-1b. Average LAGEOS pass RMS at Herstmonceux for the past ten years.

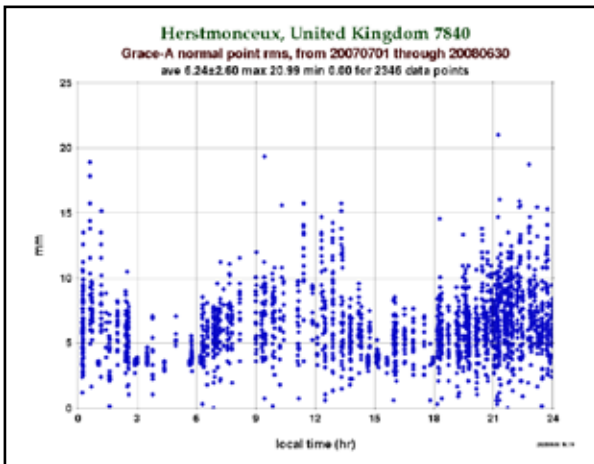


Figure 4-2a. GRACE-A normal point RMS at Herstmonceux (as a function of local time) for the past year.

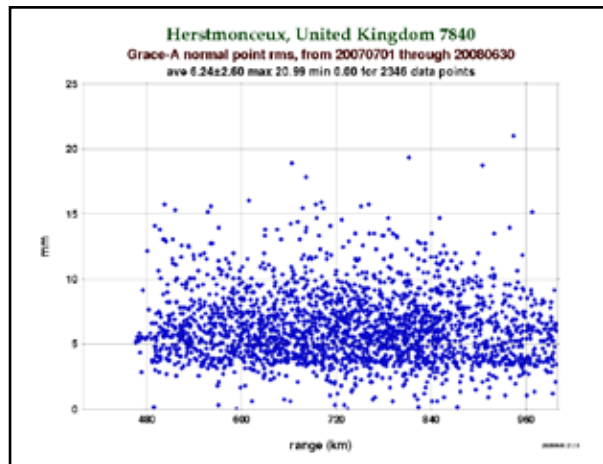


Figure 4-2b. GRACE-A normal point RMS at Herstmonceux (as a function of range) for the past year.

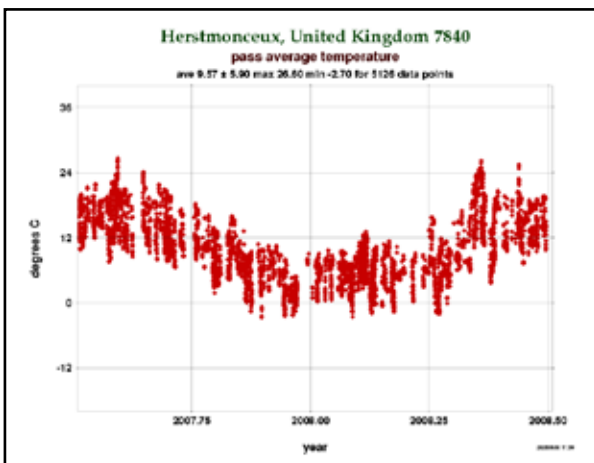


Figure 4-3a. Average temperature at Herstmonceux for the past year.

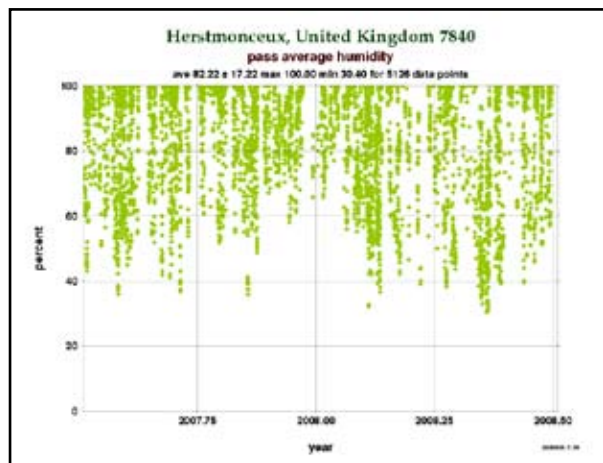


Figure 4-3b. Average humidity at Herstmonceux for the past year.

ILRS Reporting

Station Performance Report Cards

The ILRS performance “report cards” are issued quarterly by the ILRS Central Bureau (CB). These reports are issued every three months and tabulate the previous 12 months of data quality, quantity, and operational compliance by station. The statistics are presented in one set of tables (one for artificial satellites and a second for lunar reflectors) by station and sorted by total passes in descending order (Figure 4-4). Plots of data volume (passes, normal points, minutes of data) and RMS (LAGEOS, Starlette, calibration) are created from this information and available on the report card Web site. A second table (Figure 4-5) summarizes independent assessments of station performance (see example in Figure 4-6) from several of the ILRS analysis/associate analysis centers (DGFI, JCET, Hitotsubashi University, MCC, SAO). The report cards are available on the ILRS Web site at http://ilrs.gsfc.nasa.gov/stations/site_info/global_report_cards/index.html.

Site Information		Data Volume									Data Quality		
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Location	Station Number	LEO pass Tot	LAGEOS pass Tot	High pass Tot	Total passes	LEO NP Total	LAGEOS NP Total	High NP Total	Total NP	Minutes of Data	Cal. RMS	Star RMS	LAG RMS
Baseline		1000	400	100	1500								
Yarragadee	7090	10460	2078	1496	14034	211998	26440	13824	252262	176895	4.8	8.9	9.6
San_Juan	7406	5939	1121	1458	8518	95627	12872	9660	118159	100806	8.4	10.8	11.6
Mount_Stromlo_2	7825	5971	1246	443	7660	78010	12809	3618	94437	68583	8.9	7.6	6.2
Graz	7839	4735	653	538	5926	91480	7138	4589	103207	60632	2.1	3.4	5.2
Zimmerwald	7810	4254	830	798	5882	77529	10904	6889	95322	75844	5.0	8.0	11.0
Zimmerwald_423		266	74	46	386	5323	946	362	6631	5061			
Zimmerwald_532		3988	756	752	5496	72206	9958	6527	88691	70783	5.9	9.0	12.0
Zimmerwald_846		265	73	46	384	5243	1022	329	6594	5048			
Wetzell	8834	4453	1011	366	5830	48720	7492	1604	57816	39061	5.1	12.7	18.5
Herstmonceux	7840	3952	870	426	5248	58544	10653	1780	70977	45460	5.4	10.3	13.5
Changchun	7237	3982	605	435	5022	42011	4090	2025	48126	30121	9.1	10.9	12.4

Figure 4-4. Table 1 of the ILRS Report Card for the fourth quarter of 2008.

Site Information		DGFI Orbital Analysis				Hitotsubashi Univ. Orbital Analysis				JCET Orbital Analysis				MCC Orbital Analysis				SHAO Orbital Analysis			
Station Location	Station Number	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP	LAG NP RMS (mm)	short term (mm)	long term (mm)	% good LAG. NP
Baseline		10.0	20.0	20.0	95	10.0	20.0	20.0	95	10.0	20.0	20.0	95	10.0	20.0	20.0	95	10.0	20.0	20.0	95
Yarragadee	7090	3.4	29.4	2.9	99.7	2.2	11.0	1.6	99.9	3.8	17.4	3.1	98.4	1.5	15.0	4.2	97.5	2.2	12.7	2.9	95.4
San_Juan	7406	6.0	37.0	6.2	99.7	3.9	20.2	9.2	99.3	6.3	16.0	3.7	93.6	3.7	16.7	10.3	96.8	4.2	26.0	11.5	94.6
Mount_Stromlo_2	7825	2.7	29.3	6.1	99.9	2.5	10.0	3.6	100.0	3.5	20.4	5.0	94.7	1.8	8.5	5.9	98.1	2.3	16.8	3.0	95.6
Graz	7839	2.2	18.9	5.4	99.8	1.3	7.6	3.0	100.0	2.4	8.9	4.9	100.0	1.9	10.9	4.2	98.7	1.5	14.1	3.4	96.2
Zimmerwald_532	7810	2.6	17.7	3.1	100.0	1.6	6.9	2.2	100.0	2.5	11.8		95.7	1.0	5.3	6.8	99.2	1.6	10.9	2.9	96.9
Wetzell	8834	3.2	30.6	7.7	100.0	2.7	11.2	2.5	100.0	3.4	18.1	3.7	91.1	1.7	10.6	1.2	97.6	1.8	16.0	3.5	95.3
Herstmonceux	7840	2.9	23.4	4.1	99.8	1.7	7.5	1.7	100.0	3.4	18.2	4.2	98.6	1.8	8.8	3.6	98.7	1.9	11.2	2.2	96.2
Changchun	7237	7.6	37.1	14.6	99.7	6.4	17.3	8.4	99.4	6.3	17.5	6.4	97.8	2.2	16.9	9.1	96.5	4.1	25.2	13.3	97.0
Riyadh	7832	3.4	35.2	5.9	99.9	2.7	13.1	5.0	100.0	3.6	20.9	7.2	100.0	1.9	15.5	7.0	96.0	3.0	26.5	9.0	95.9
Greenbelt	7105	3.2	23.9	5.7	100.0	2.1	12.8	4.8	99.9	3.1	16.6	3.2	91.7	1.6	16.9	8.1	98.0	2.0	12.7	3.6	95.3

Figure 4-5. Table 2 of the ILRS Report Card for the fourth quarter of 2008.

Example plots from the last 2008 report card are shown in Figure 4-7-a, -b, and -c.

```

# #createdAt 2008/08/13 00:31:48
#
# each line contains:
# sat = 4-char satellite name
# site = 4-char site name (CDP ID)
# date/time = pass starting time
# dur = pass duration (min)
# rb = estimated range bias (mm) with 1-sigma error
# tb = estimated time bias (microsec) with 1-sigma error
# prec = post-fit scattering rms (mm)
# bad/total = number of bad/total normal-points
# rms = single-shot rms (mm)
# pres/temp/humi = pressure (hPa), temperature (K) and humidity (%)
# sdelay = applied system delay (mm)
# shft = system delay shift (mm)
# rms = calibration single-shot rms (mm)
# cfg = system configuration flag; SCH and SCT
# r = data release flag
# wlen = laser wavelength (nm)
#
# 1824 = KIEV
# sat site date time dur rb mm error tb us error prec bad total rms pres temp hum sdelay shft rms cfg r wlen
ENVI 1824 2008/07/29 18:38 5 -141 ( 65 ) -56.2 ( 15.8 ) 28 0 / 16 41 998.6 289.1 59 16638 19 39 0 2 0 532
ERS2 1824 2008/07/29 19:09 4 -101 ( 71 ) -60.3 ( 19.5 ) 28 0 / 19 42 998.6 289.5 61 16637 14 39 0 2 0 532
ENVI 1824 2008/07/29 20:19 4 21 ( 140 ) -54.9 ( 72.5 ) 111 1 / 0 45 999.3 289.3 60 16637 14 39 0 2 0 532
ERS2 1824 2008/07/29 20:51 1 -9 ( ----- ) ----- ( ----- ) 0 1 / 2 39 999.3 288.0 61 16644 0 42 0 2 0 532
STEL 1824 2008/07/30 00:04 3 -98 ( 46 ) -33.5 ( 19.3 ) 14 0 / 9 42 999.3 286.2 71 16637 22 43 0 2 0 532
LAG1 1824 2008/07/30 00:41 2 -36 ( 79 ) ----- ( ----- ) 62 0 / 3 53 999.9 286.0 71 16638 20 43 0 2 0 532
ENVI 1824 2008/07/30 18:08 4 -25 ( 23 ) -43.2 ( 7.0 ) 5 1 / 8 42 996.6 291.4 51 16554 0 25 0 2 0 532
LAG2 1824 2008/07/30 18:37 14 223 ( 52 ) -22.4 ( 85.6 ) 14 0 / 9 69 996.7 291.3 51 16554 0 25 0 2 0 532
LAG1 1824 2008/07/30 19:09 20 178 ( 60 ) -38.1 ( 53.6 ) 32 0 / 12 58 996.8 291.3 52 16554 0 25 0 2 0 532
ENVI 1824 2008/07/30 19:46 5 -100 ( 35 ) -51.3 ( 8.8 ) 17 0 / 24 44 997.0 291.2 53 16554 0 25 0 2 0 532
ERS2 1824 2008/07/30 20:21 1 -317 ( 118 ) ----- ( ----- ) 31 0 / 6 54 997.3 290.1 53 16554 0 25 0 2 0 532
LAG1 1824 2008/07/30 22:45 22 15 ( 67 ) -74.5 ( 41.1 ) 18 1 / 11 55 997.0 288.5 59 16631 0 29 0 2 0 532
ENVI 1824 2008/07/31 19:20 1 -450 ( 14 ) ----- ( ----- ) 4 0 / 7 35 1002.6 290.6 58 16384 0 36 0 2 0 532
ERS2 1824 2008/07/31 19:45 5 -130 ( 22 ) -54.4 ( 4.3 ) 9 0 / 15 39 1002.6 290.5 59 16377 15 30 0 2 0 532
STEL 1824 2008/08/01 00:50 6 -89 ( 44 ) -29.3 ( 8.8 ) 25 0 / 14 31 1002.6 287.9 68 16364 10 28 0 2 0 532
STEL 1824 2008/08/01 01:18 3 -65 ( 50 ) -43.1 ( 21.9 ) 13 0 / 8 30 1002.6 287.7 68 16364 10 28 0 2 0 532
ENVI 1824 2008/08/01 18:45 2 -73 ( 6 ) ----- ( ----- ) 2 0 / 10 38 998.3 292.3 47 16395 0 29 0 2 0 532
.
.
.
    
```

Figure 4-6. Example of weekly station bias report from Hitotsubashi University.

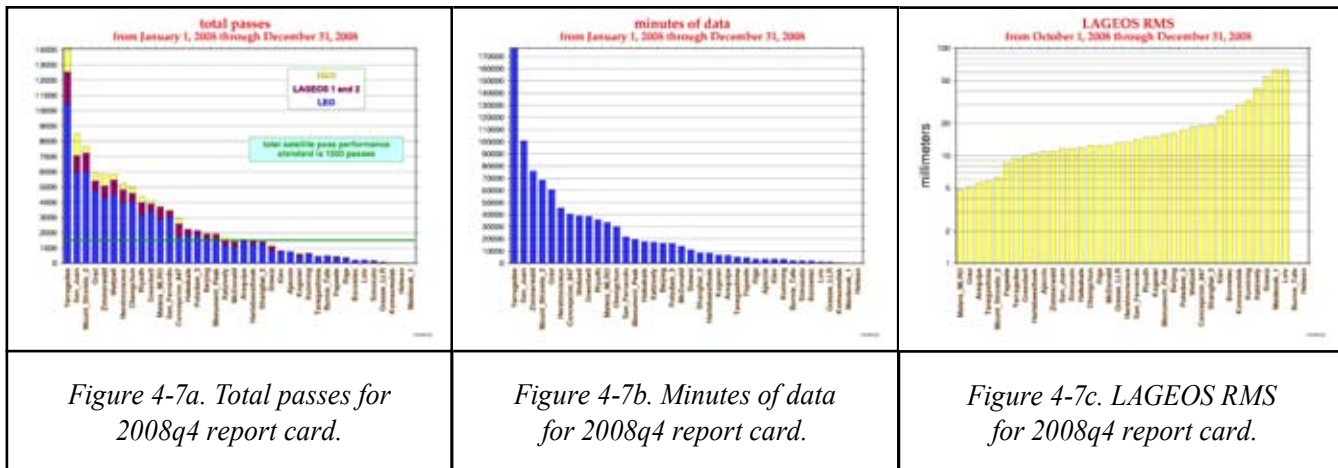


Figure 4-7a. Total passes for 2008q4 report card.

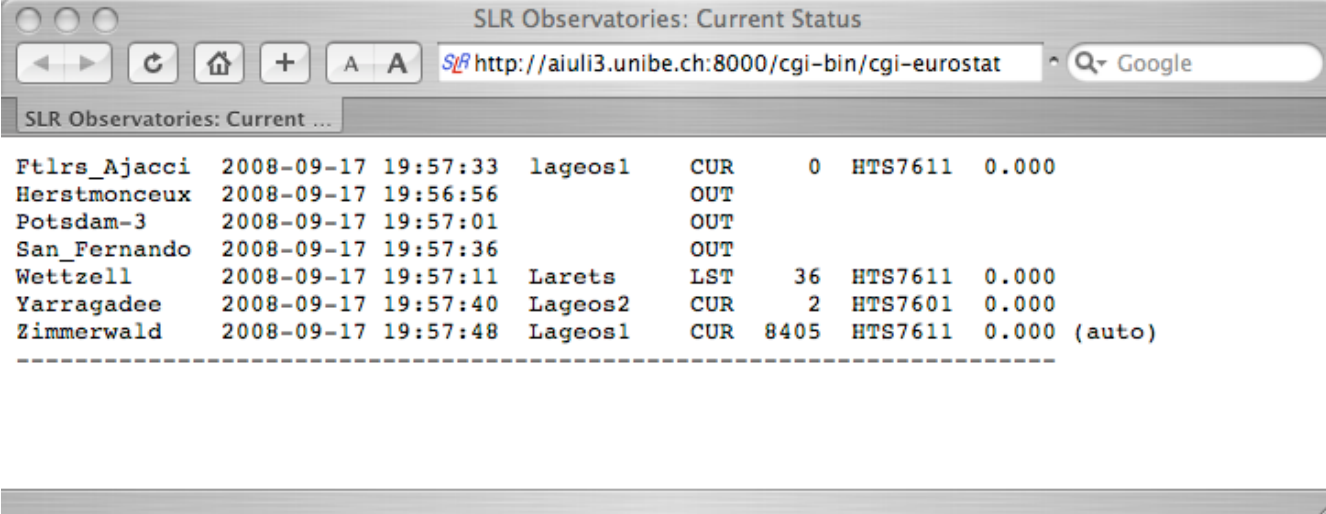
Figure 4-7b. Minutes of data for 2008q4 report card.

Figure 4-7c. LAGEOS RMS for 2008q4 report card.

The report card is used to assess the performance of the stations in the ILRS network. The Central Bureau maintains lists of the operational and associate stations, classified according to the results posted in the ILRS report cards. Performance guidelines, defined on the ILRS Web site, cover yearly data quantity (number of passes), data quality (normal point precision and short and long term bias stability) and operational compliance factors (timely data delivery, correct data formatting, required station documentation). Current operational vs. associate status can be viewed on the ILRS Web site at: <http://ilrs.gsfc.nasa.gov/stations/>.

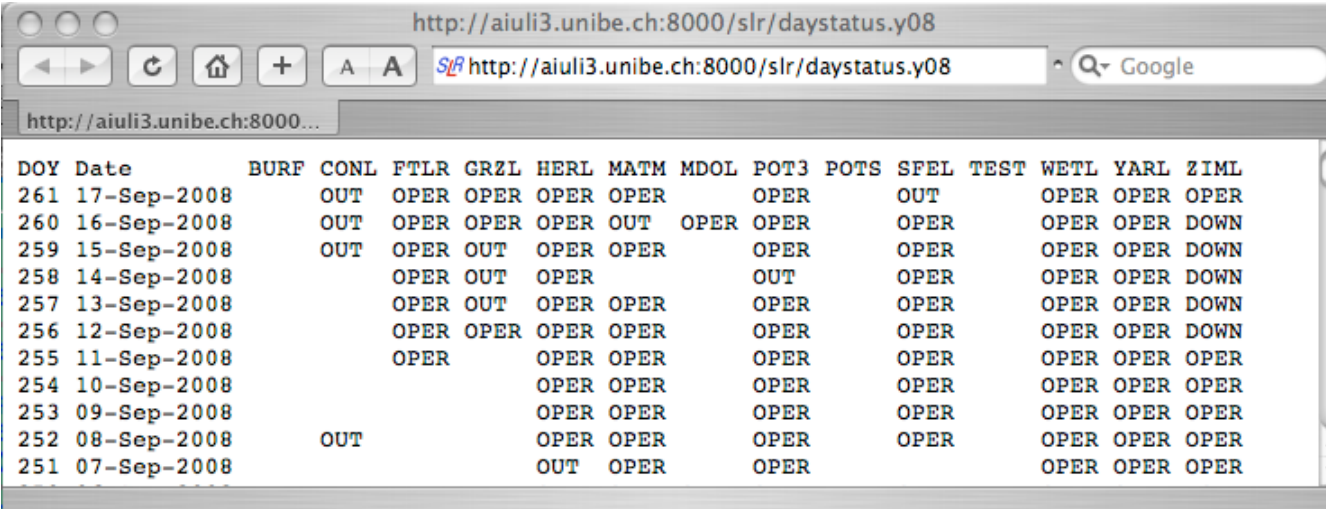
Real-Time Daily Station Status Reports

Station status information is available on a daily and near-real time basis through the EUROSTAT utility. These reports allow the ILRS community to quickly view the status of the stations in the tracking network. ILRS stations can automatically upload status information to EUROSTAT (maintained by the Astronomical Institute of the University of Berne, AIUB) that is then used to generate an overview of the current activities of the tracking stations. The real-time report (Figure 4-8) shows actual station operations at that point in time. The daily report (Figure 4-9) provides a one-line entry per day showing if stations are currently staffed, operational, off-shift, off-line because of system problems, etc. The ILRS encourages all stations in the network to participate in the daily and, if possible, real-time exchange of status information so that experience can be shared in a timeframe to help performance other stations.



Station Name	Date	Time	Station	Status	Count	HTS	Value
Ftlrs_Ajacci	2008-09-17	19:57:33	lageos1	CUR	0	HTS7611	0.000
Herstmonceux	2008-09-17	19:56:56		OUT			
Potsdam-3	2008-09-17	19:57:01		OUT			
San_Fernando	2008-09-17	19:57:36		OUT			
Wettzell	2008-09-17	19:57:11	Larets	LST	36	HTS7611	0.000
Yarragadee	2008-09-17	19:57:40	Lageos2	CUR	2	HTS7601	0.000
Zimmerwald	2008-09-17	19:57:48	Lageos1	CUR	8405	HTS7611	0.000 (auto)

Figure 4-8. EUROSTAT real-time station status report.



DOY	Date	BURF	CONL	FTLR	GRZL	HERL	MATM	MDOL	POT3	POTS	SFEL	TEST	WETL	YARL	ZIML
261	17-Sep-2008		OUT	OPER	OPER	OPER	OPER		OPER		OUT		OPER	OPER	OPER
260	16-Sep-2008		OUT	OPER	OPER	OPER	OUT	OPER	OPER		OPER		OPER	OPER	DOWN
259	15-Sep-2008		OUT	OPER	OUT	OPER	OPER		OPER		OPER		OPER	OPER	DOWN
258	14-Sep-2008			OPER	OUT	OPER			OUT		OPER		OPER	OPER	DOWN
257	13-Sep-2008			OPER	OUT	OPER	OPER		OPER		OPER		OPER	OPER	DOWN
256	12-Sep-2008			OPER	OPER	OPER	OPER		OPER		OPER		OPER	OPER	DOWN
255	11-Sep-2008			OPER		OPER	OPER		OPER		OPER		OPER	OPER	OPER
254	10-Sep-2008					OPER	OPER		OPER		OPER		OPER	OPER	OPER
253	09-Sep-2008					OPER	OPER		OPER		OPER		OPER	OPER	OPER
252	08-Sep-2008		OUT			OPER	OPER		OPER		OPER		OPER	OPER	OPER
251	07-Sep-2008					OUT	OPER		OPER				OPER	OPER	OPER

Figure 4-9. Daily station status report (for Sept. 17, 2008).

ILRS 2005-2006 Report

The 2005-2006 ILRS Report was issued and can be viewed on the ILRS Web site (http://ilrs.gsfc.nasa.gov/reports/ilrs_reports/ilrsreport_2005.html). ILRS analysis center reports and inputs are used by the Central Bureau for weekly review of station performance and to provide feedback to the stations when necessary. These reports as well as special weekly reports on on-going campaigns are issued by e-mail. A catalogue of diagnostic methods, for use along the entire data chain starting with data collection at the stations, has emerged from this process and will be made available on the ILRS Web site. The evaluation process has been helpful in comparing results from different analysis and associate analysis centers, a role soon to be assumed by the Analysis Working Group.

Data Center Developments

The archives of the ILRS data centers at CDDIS and EDC were updated to include new products generated by the ILRS Analysis Centers. These products currently under evaluation included daily “pos+eop” SINEX solutions and derived orbits from selected satellites.

The data centers, as well as the entire ILRS infrastructure, transitioned to a new format for satellite predictions, the Consolidated Prediction Format (CPF). Predictions in the older Tuned IRV format were discontinued in late 2007.

The ILRS also introduced the Consolidated Ranging Data (CRD) format during 2008. CRD provides a flexible, extensible format for ILRS full-rate, sampled engineering, and normal point data. The new format will accommodate new missions, e.g., transponder experiments, and station capabilities such as high-repetition rate lasers. The data centers began support of CRD tests by creating directories and updating data flow procedures. The complete transfer to the CRD format is scheduled for early 2010.