THE SLR TRACKING DATA QUALITY CONTROL DURING THE OPERATIONAL PROCESSING

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Abstract

Since June 2003 DGFI participates in the test phase of the operational production of station coordinates and earth orientation parameters of the ILRS Analysis Working Group. On a weekly basis we process tracking data to LAGEOS-1 and LAGEOS-2 and since March 2004 additionally to ETALON-1 and ETALON-2. During this processing we accomplish a number of quality checks, mainly detection of outliers and biases. The final biases and statistics are based on precise orbits. We will reveal the processing scheme and show some of the actual results.

Introduction

The ILRS analysis centre at DGFI processes on a weekly basis SLR tracking data to LAGEOS-1/2 and ETALON-1/2 to process combined solution containing earth orientation parameters (X-, Y-pole and LOD) and station coordinates. These solutions will be combined at the ILRS combination centres (ASI, DGFI) to compute weekly combined solutions. During this processing a number of checks were performed to guarantee a good reliable product. The quality control covers the incoming data sets, the single satellite arcs and the history of the generated products. It also includes the generation of a bias report for all four satellites, which can be accessed from our home page at **http://ilrsac.dgfi.badw.de/**..

Processing Scheme

Every Tuesday all tracking data from the previous week, Sunday to Saturday, were collected from the Eurolas Data Center at DGFI. In a first step we perform formal checks on the incoming data sets, like double passes or wrong fields, and report problems back to EDC. For the next steps we use the DGFI developed s/w package DOGS (DGFI orbit and geodetic parameter estimation software). First we compute weekly single satellite arcs, solving for range and time biases to detect possible time biases. In a second run we solve for range biases only. For the actual processing those

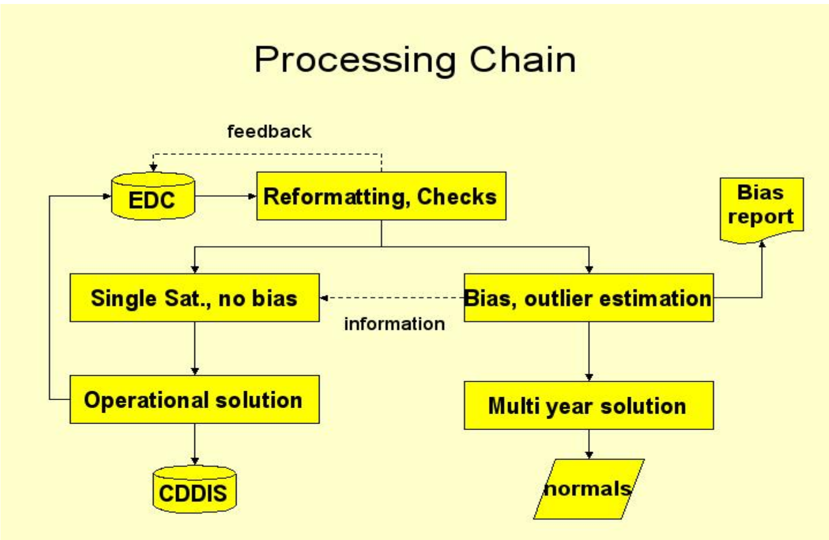
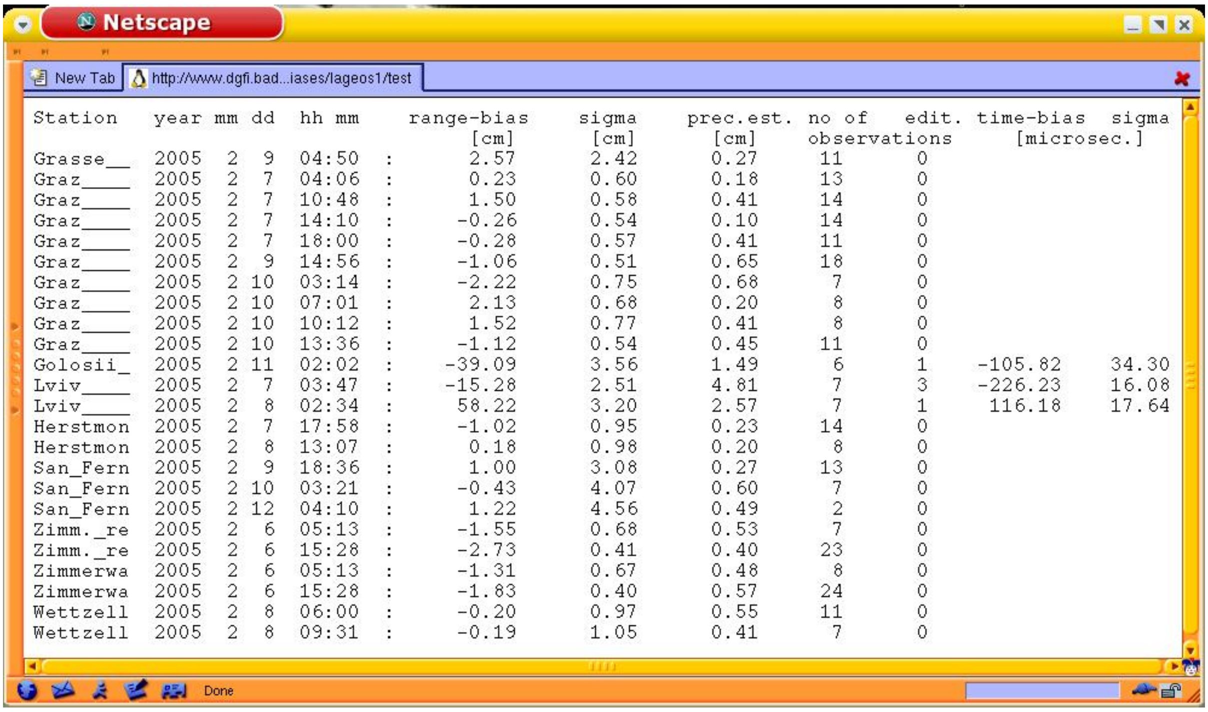


Figure 1: Processing chain of operational weekly processing

passes with range biases greater than 10 cm and time biases greater than 0.2 milliseconds were eliminated. The result of this check is listed in bias reports which contain the bias information for all stations, there are two reports per satellite and week, one with range and time bias and one with range bias only. In future there will only be one report with all range biases and only the significant time biases (see Figure 2). After that we compute four single satellite arcs and generate free normal equations. For a better analysis we visualise trends of biases and station coordinates.



Station	year	mm	dd	hh mm		range-bias [cm]	sigma [cm]	prec.est. [cm]	no of observations	edit.	time-bias [microsec.]	sigma
Grasse__	2005	2	9	04:50	:	2.57	2.42	0.27	11	0		
Graz____	2005	2	7	04:06	:	0.23	0.60	0.18	13	0		
Graz____	2005	2	7	10:48	:	1.50	0.58	0.41	14	0		
Graz____	2005	2	7	14:10	:	-0.26	0.54	0.10	14	0		
Graz____	2005	2	7	18:00	:	-0.28	0.57	0.41	11	0		
Graz____	2005	2	9	14:56	:	-1.06	0.51	0.65	18	0		
Graz____	2005	2	10	03:14	:	-2.22	0.75	0.68	7	0		
Graz____	2005	2	10	07:01	:	2.13	0.68	0.20	8	0		
Graz____	2005	2	10	10:12	:	1.52	0.77	0.41	8	0		
Graz____	2005	2	10	13:36	:	-1.12	0.54	0.45	11	0		
Golosii_	2005	2	11	02:02	:	-39.09	3.56	1.49	6	1	-105.82	34.30
Lviv____	2005	2	7	03:47	:	-15.28	2.51	4.81	7	3	-226.23	16.08
Lviv____	2005	2	8	02:34	:	58.22	3.20	2.57	7	1	116.18	17.64
Herstmon	2005	2	7	17:58	:	-1.02	0.95	0.23	14	0		
Herstmon	2005	2	8	13:07	:	0.18	0.98	0.20	8	0		
San_Fern	2005	2	9	18:36	:	1.00	3.08	0.27	13	0		
San_Fern	2005	2	10	03:21	:	-0.43	4.07	0.60	7	0		
San_Fern	2005	2	12	04:10	:	1.22	4.56	0.49	2	0		
Zimm._re	2005	2	6	05:13	:	-1.55	0.68	0.53	7	0		
Zimm._re	2005	2	6	15:28	:	-2.73	0.41	0.40	23	0		
Zimmerwa	2005	2	6	05:13	:	-1.31	0.67	0.48	8	0		
Zimmerwa	2005	2	6	15:28	:	-1.83	0.40	0.57	24	0		
Wettzell	2005	2	8	06:00	:	-0.20	0.97	0.55	11	0		
Wettzell	2005	2	8	09:31	:	-0.19	1.05	0.41	7	0		

Figure 2: Example of the new bias report at DGFI.

As a following step we combine these normal equations and solve for station coordinates and earth orientation parameters. The results are compared with USNO Bulletin A values, ITRF2000 coordinates and produce time series of transformation parameters respectively station positions and generate plots with time series of these results. Finally we generate sinex files which will be uploaded at CDDIS and EDC. The normal equations for all satellites will be used to update the multi year solution for station coordinates and velocities.

Results

Following only an excerpt of the plots and statistics which will be generated during the weekly processing will be presented. Figure 3 shows the series of similarity transformation parameters to ITRF2000. These series will be updated weekly and are generated from the weekly transformations, see table 1. We produce bias statistics and plots for all stations. Figure 4 is an example for the tracking station Yarragadee in Australia which has a good tracking history. The biases plot shows all range biases to

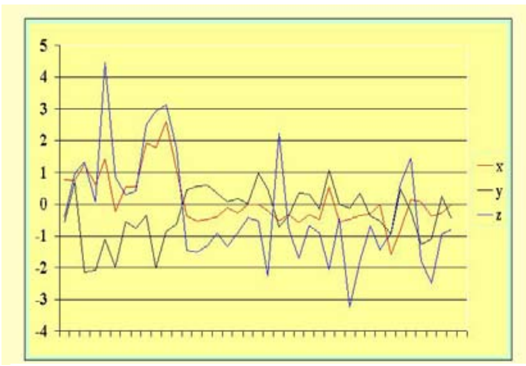


Figure 3: Similarity transformation parameters, x,y,z in centimetre of the weekly solution to ITRF2000

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tx  [cm]:       -0.27    +-    0.50
ty  [cm]:       -0.48    +-    0.48
tz  [cm]:        0.88    +-    0.46
rx [µrad]:       0.07545 +-    0.00090   [cm]:        48.12
ry [µrad]:       0.01844 +-    0.00094   [cm]:        11.76
rz [µrad]:       0.02222 +-    0.00084   [cm]:        14.17
sc [ppm]:        0.00124 +-    0.00072   [cm]:         0.79
residuals
parametername, Phi-  Lamda-, Height- coordinate in [cm]
7839 A1  11001S002 Graz, fixed                 0.20    -0.19     0.94
7811 A1  12205S001 Borowiec, fixed            -2.10     0.20    -0.31
1884 A1* 12302S002 Riga, Latvia               -0.17    -0.18     0.10
7840 A1  13212S001 Herstmonceux , fix.        -0.87    -0.96    -0.05
8834 A1  14201S018 Wettzell, Germany           0.62    -0.36     1.33
7832 A1* 20101S001 Riyad, Saudi Arabia        17.60     6.56    13.55
7837 A1  21605S001 Shanghai, China             0.31     1.57     0.03
7237 A1* 21611S001 Changchun, China           -2.39     5.77    -0.79
7838 A1  21726S001 Simosato, Japan            -1.83    -0.29    -2.93
7501 A1  30302M003 Hartebeesthoek mobil       -0.29    -1.04    -0.31
7080 A1  40442M006 Fort Davis CDP7080          0.65     1.64    -0.58
7105 A1  40451M105 Washington, Moblas-7        2.82    -0.41    -0.94
7110 A1  40497M001 Monument Peak, CA          -1.87    -1.34     0.49
7090 A1  50107M001 Yarragadee, Moblas-5        2.43     1.24     1.65
7124 A1* 92201M007 Tahiti, French Polyn       -2.48    -3.49    -1.00
7941 A1  12734S008 Matera New system           0.71    -0.47     0.67
estimated  standard deviation [cm]:    1.37277
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Table 1: Example of the weekly similarity transformation to ITRF2000, * indicates that the station was not used for the transformation.

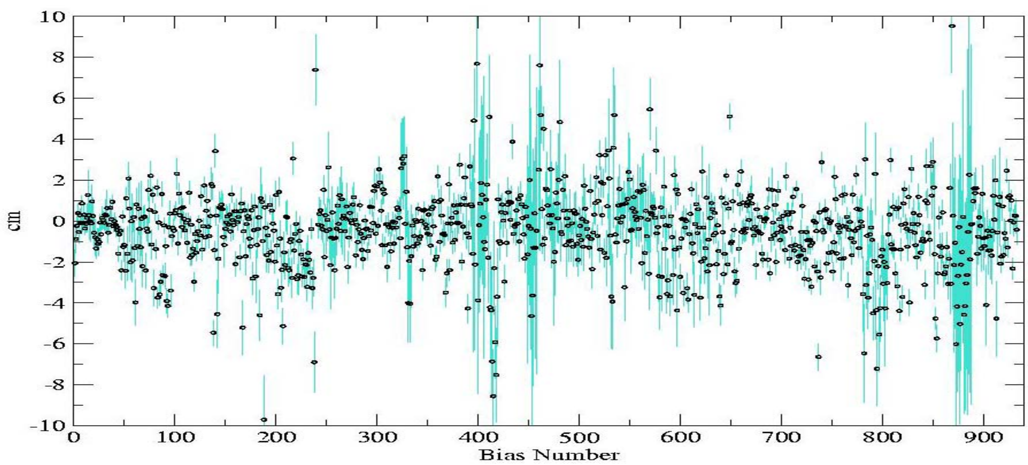

Figure 4: LAGEOS-1 **b**ias history for Yarragadee with error bars (blue)

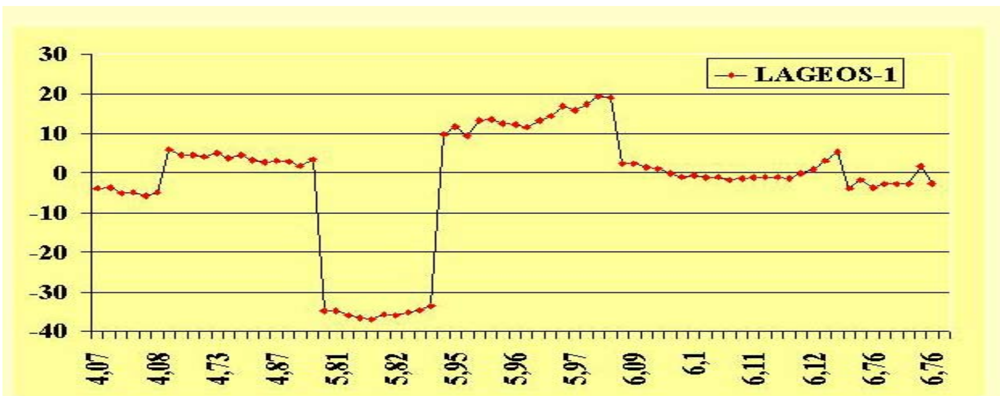

Figure 5: Residuals during one week for SLR station Riga

LAGEOS-1 from November 2003 till March 2005 with formal error bars. There are only a few biases above 5 cm which shows the stability of the station. Because of the free solution do not use produce plots of station positions. The residuals after the similarity transformation (see table 1) are available. Figure 6 shows the history for Yarragadee from June 2004 to March 2005.

In

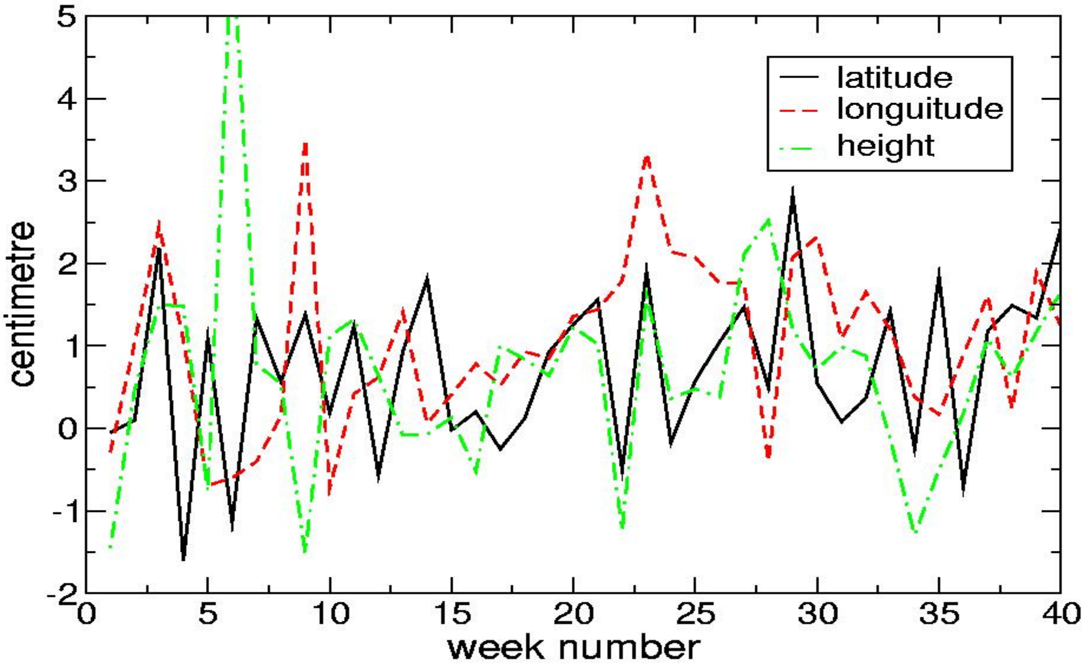

Figure 6: History of Yarragadee coordinates relative to ITRF2000

figure 5 the residuals of all observations during one week from the Riga tracking station. We use these graphics for a quick overview on the weekly arcs. In this example the bias of the third pass can identified whereas pass number four remained in the processing.

Conclusion and Outlook

Our results, as well as the results from the combination centres show the quality of the generated solutions. The plots help to detect outliers and problems. For the ETALON satellites a realistic estimation of biases is not possible because of the small number of observations and we have to develop new methods to get a realistic bias information.
Because of the ongoing work at the analysis centre we will continue to generate the bias reports, with the modification that only one bias report per satellite and week with range biases for all stations, and only significant time biases will be generated (see figure 2). A MYSQL based data bank will be installed to allow access to all plots of the station performance and transformation parameters. For a quicker overview on the station performance and the quality of the DGFI weekly solution we will add tables and plots in near future.