

## Space Geodesy Facility (SGF)

Interim report to NERC Space Geodesy Steering Committee, 2007 June to December

### 1. Introduction

This report lists the main achievements at SGF since the Operational and Annual Reports were presented to NSGSC in 2007 June.

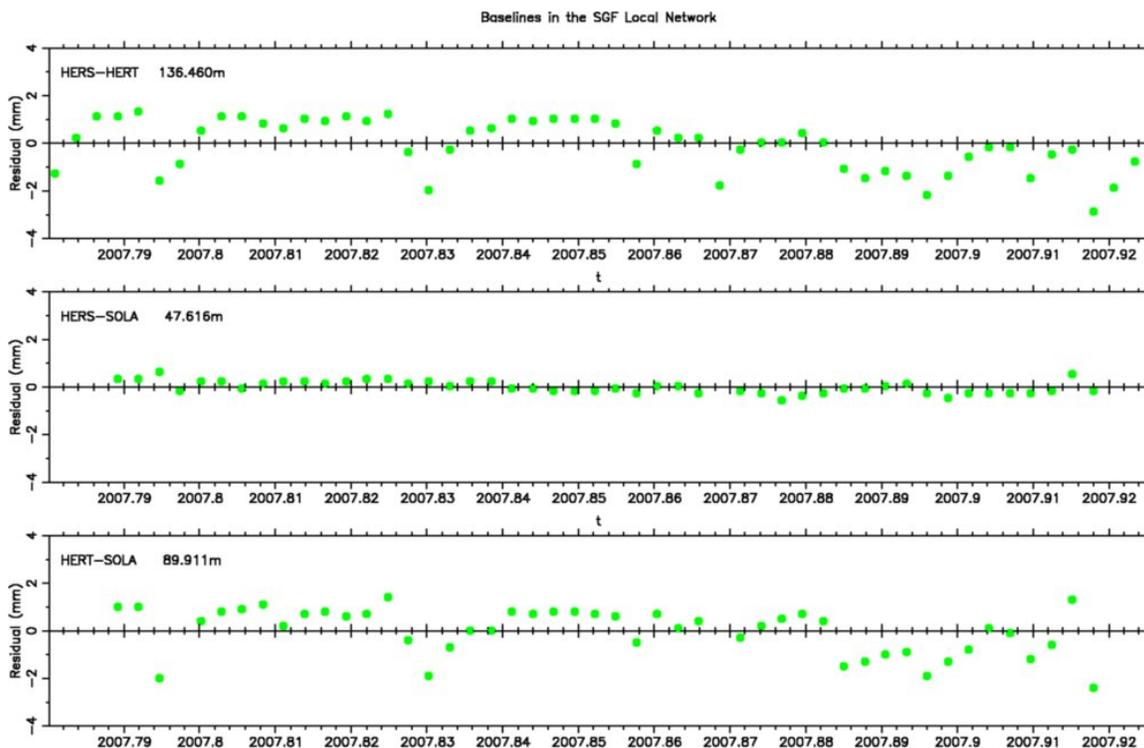
### 2. Satellite Laser Ranging

- a. Standard SLR activities.** The poor summer weather has played a significant part in our performance over the last six months, but despite this we have improved on our 2006 totals for the year, helped by a very productive period in the spring.
- b. Progress towards kHz rate ranging.** With the event timer HET in place we have collected data with a temporary system requiring two observers (one to concentrate fully on safety issues) pending the build of the hardware safety interfaces. The ultimate aim of these interfaces is to allow us to switch between the 10Hz and kHz systems via software. The electronics and software is now complete and working. Our remaining obstacle is to get the optical alignments of both lasers the same at the telescope emitter. This work is nearing completion.
- c. Analysis.** Work to determine corrections to re-calibrate the SGF laser data for the period 1992 to 2007 is complete and, in addition, the Stanford counters from two other European stations have been calibrated on site. These results, plus our estimates of corrections to range data from some ten other sites that use or have used Stanford counters, are being implemented by all the ILRS Analysis Centres, including SGF, in a re-analysis effort that will ultimately use LAGEOS data from 1976 onwards. It is quite possible that this work will to some extent address the existing scale 'problem' in the current ITRF2005, where the VLBI and SLR solutions appear to be incompatible at the 0.5ppb level.

### 3. GNSS.

- a. Tracking.** HERS and HERT both continue to operate routinely, subject to the HERT GLONASS tracking and reliability issues as previously discussed. To improve upon this situation, and following discussions within NSGSC and with the GEF, we have purchased a replacement for the HERT Ashtech Z-18 receiver. This new receiver (Leica GRX1200 GGPRO) tracks more GLONASS satellites, as well as the newer GPS signals. Following the experimental work outlined under 'b' below, the Leica receiver is now installed at the HERT point and data submission to the databases, including realtime streaming via the Internet, continues.
- b. Analysis.** The new Leica receiver has been in a two-month test operation phase at the solar pillar monument (SOLA), nearly mid-way between HERS and HERT, in potentially a very valuable configuration to add to our investigation into systematic, sub-mm HERS-HERT baseline signals. The data collected during this test phase produced the baseline plot below which appears to show that the HERS-HERT baseline is largely affected by characteristics from the HERT (Z-18) receiver or its location; the HERS-SOLA baseline is extremely stable, but the HERT-SOLA results are much noisier. Further results, using the Z18 on the SOLA

pillar should discriminate receiver-based as opposed to location-based problems, and the results will certainly be informative in terms of possible multi-path effects. Also the close-to-annual, millimeter-level variations seen in the HERS-HERT baseline may be further examined, the cause of which is being discussed with colleagues at Newcastle University.



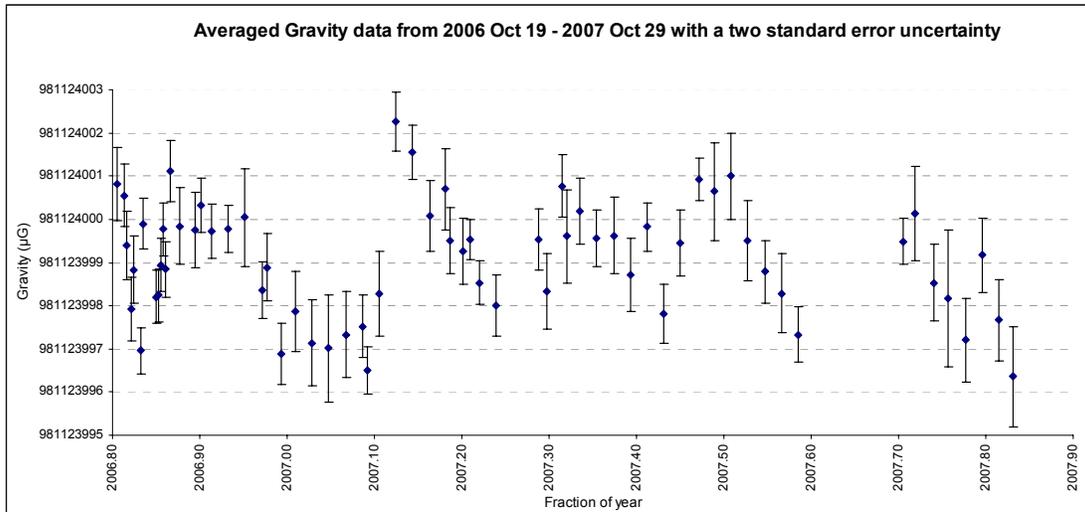
#### 4. Gravimetry

**Absolute Gravimeter Update.** The absolute gravimeter has been operating each Wednesday, as usual, to provide a mid-GPS-week data series. August was excluded from data gathering due to building work being carried out close by in the basement meeting room which necessitated sealing the gravimeter room.

In 2007 November the gravimeter was moved to Luxembourg to participate in a week-long international inter-comparison campaign. The purpose of the inter-comparison is to verify the accuracy of the Herstmonceux gravimeter compared to other AG's. Seventeen absolute gravimeters were involved in this meeting. The results of this inter-comparison are not yet published but will be posted on the following web address when available;

[http://nercslr.nmt.ac.uk/gravimetry/grav\\_sgf.html](http://nercslr.nmt.ac.uk/gravimetry/grav_sgf.html)

The time series of gravimetry data from 2006 October to 2007 November is shown below; some interesting signatures are present and comparisons with our space geodetic and environmental results are starting.



## 5. LIDAR

The LIDAR capability, ultimately to run concurrently with satellite laser ranging measurements, is advancing. Our interest is in monitoring atmospheric pollution, boundary layer heights and cirrus properties over the site. The concept has been tested using the existing single-photon ranging system to perform a number of experiments to determine cloud base height, and the system will be used to determine cirrus height and thickness and particulates. Both hardware and software has been obtained by Christopher Potter to mount on the telescope to make it a true LIDAR system. Details of the preliminary work undertaken can be found at <http://nercslr.nmt.ac.uk/> under LIDAR.

## 6. Meetings

### ILRS Technical Workshop in Grasse in September

**a. Papers presented.** Graham Appleby (GA) and Matthew Wilkinson (MW) attended and helped organize this ‘hands-on’ technical meeting. GA co-chaired a workshop session called “Counters performance, calibrations, and upcoming event timers”, which included much discussion of the recent work by Philip Gibbs at the SGF on Stanford counter calibrations. MW presented his work on automatic track detection and also co-chaired the “kHz SLR” session. The SGF is the second SLR station to operate at kHz repetition rates and in this session MW presented a full account of the Herstmonceux experiences.

**b. Highlights.** Several SLR stations presented plans to operate at high repetition rates in the future. They included plans by a number of stations to upgrade to 100Hz, which was considered advantageous because of the relatively high laser pulse energy achievable at these slower rates. Stations are also preparing for challenging future projects including time transfer to the Jason-2 satellite and one-way range transponder measurements to the Lunar Reconnaissance Orbiter. Both missions are to be launched next year, with potential interest to SGF. In particular the unique design of the SGF system, with ultimately rapid switching between lasers, will be of interest to the LRO mission since it can use only repetition rates lower than about 28Hz.

### **Technical meeting with MoD programme managers and customers at Herstmonceux in November**

Presentations on general and MoD-specific ongoing work were given by SGF to a visiting party of five, followed by a tour of the Facility. New programmes were discussed, including development of a monitoring system using a CCD camera attached to the ex-PIMS 40cm reflecting telescope. Tracking and data processing software for this project, named 'GEOF', is now underway.

### **NCEO and EODAB meetings in London in November/December**

Along with other EO-related NERC Services and Facilities, SGF was invited to give a presentation on the role of SGF in Earth Observation to the Director (Prof Alan O'Neill) of the newly formed NERC National Centre for Earth Observation. Prospects for involvement of SGF in a more joined-up UK EO profile appear promising. A presentation of SGF work was also given to NERC's Earth Observation Director's Advisory Board.

### **Unified Analysis Workshop, Monterey in December**

For the first time, a technical workshop was organised by the International Earth Rotation and Reference Frame Service (IERS) to get together for a few days representatives from all the geodetic Services to consider mutual strengths and weaknesses. The meeting was held in Monterey in December and GA was one of six invited ILRS representatives; he discussed the status of LAGEOS centre-of-mass correction work, an important parameter for true mm-level ranging accuracy, as well as Stanford correction issues. The work towards fully-combined, multi-technique products appears to be gaining pace, with greater understanding of the issues to be resolved. GA also attended GGOS Steering Committee and Ground Networks WG meetings held in association with the AGU in San Francisco following the UAW.

### **Remote Lecture**

A remote lecture on space geodesy to Japanese science under-graduates was given using Skype, a webcam and wireless LAN at SGF early on the morning of December 20 (following SGF's Christmas meal the evening before). The lecture was arranged with colleague and collaborator Dr Toshi Otsubo, now a lecturer at Hitotsubashi University near Tokyo and included a demonstration of laser ranging operations as well as applications, background information and history of the RGO.