SERVICES & FACILITIES ANNUAL REPORT - FY April 2010 to March 2011

SERVICE	FUNDING	AGREEMENT	ESTABLISHED as S&F	TERM
BIGF	BLOCK	R8/H10/59	2002 (operating since 1998)	5 years

TYPE OF SERVICE PROVIDED:

BIGF provides a unique and secure repository for quality assured data (raw data and derived products), from a network of continuous GNSS (CGNSS) stations throughout the British Isles, and the interface with the scientific community, in serving demand for these data to carry out research. Raw data are supplied free-of-charge to the archive by 9 collaborators, giving BIGF unequalled access to £3.5 m of infield data collection hardware. Users can request quality assured data using an online form at the Facility website. The product line is undergoing advanced testing, with first availability in mid-2011. The fundamental value of BIGF is in the secure archive of 30 second and 1Hz GNSS RINEX data, currently supplied from about 155 CGNSS stations. The archive comprises 1,150 station-years of 30 second, primarily GPS data, with some stations operating since 1996/7; and since 2009, 30 second GPS+GLONASS and 1Hz GPS+GLONASS data from about 100 CGNSS stations.

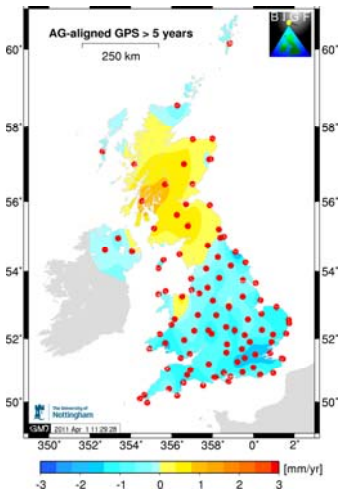
The service provided can be summarised in a 4-part Facility remit:

1.To reduce the costs of specific research and wider research costs, so enabling a larger volume of research to be done with the same funding budget, by providing an assured repository of raw data and derived products when users bid for funding for new research, in which the costs of setting up and manning an ad-hoc observation network are reduced or eliminated.

2.To facilitate the least time delay in the examination of environmental and other minable variables, by providing extensive backward tracts of raw data and derived products, improving the rate of return on invested funds and the rate of project completion.

3.To provide a failsafe resource to protect researchers from the costs and delays of having to repeat failed data collection exercises, and its impact on research and to improve the positioning quality obtained in historic or current research.

4.To stimulate research across the spectrum of science using various media.



First BIGF map of vertical land movements

ANNUAL TARGETS AND PROGRESS TOWARDS THEM

1. To increase the quantity of data in the archive: Daily data files from up to 155 CGNSS stations continued to be uploaded, at a nominal annual rate of 58k station-days. Negotiations with OS Ireland (OSi) for access to 16 stations, whose data have been archived daily since March 2007, have advanced and an agreement in principle has been reached, with a MoU imminent.

2. To improve metadata: To support user decision making when requesting data we provide a map, station log files and data listing by year and station. The veracity of all updated log files is monitored, assuring an accurate record of any change at each station. Over the last year we have also developed further metadata including cycle slips and multipath.

3. To increase archive uptake: Demand in 2010/11 was 268k station-days, cumulatively 2.75m station-days since archival commenced. Unique projects enabled increased from 8 in 2002/3 to 98 by 2010/11, with an average of about 70 scientific type projects a year, indicating an increasing awareness of the Facility, influenced by our varied activities to promote the archive's existence and to demonstrate its utility by example.

4. To meet the 'future developments/strategic forward look' from the 2009/10 annual report:

a. The new hardware installation was completed, with data storage now in two separate locations, and access via a dedicated server.

b. Extended MoUs (to 2014, 1Hz data) await signature by OSGB before distribution to other collaborators, including OSi.

c. Procedures to handle requests for 1Hz data are in place at the new website.

d. The first 'releasable' derived products (long term trends in station coordinates and troposphere, and near real-time tropospheric parameters) have been developed, and examples are available at the new website, along with procedures to handle requests.

e. The majority (105) of the 109 OSGB stations are now capable of tracking of Galileo, when satellites and signals become available.

SCORES AT LAST REVIEW (each out of 5)			Date of Last Review:	2008
Need	**Uniqueness**	**Quality of Service**	**Quality of Science & Training**	**Average**
4.5	5.0	4.0	4.5	4.5

CAPACITY of HOST ENTITY FUNDED by S&F	Staff & Status	Next Review (March)	Contract Ends (31 March)
100%	Professor A Dodson, Director, 3% NERC; Dr R Bingley, Deputy Director, 22% NERC; Dr D Baker, Manager, 60% NERC; Ms D Hansen, Developer, 60% NERC	2013	2014

FINANCIAL DETAILS: CURRENT FY						
Total Resource Allocation £k	**Unit Cost £k**			**Capital Expend £k**	**Income £k**	**Full Cash Cost £k**
	Unit 1	**Unit 2**	**Unit 3**			
115.64	0.000487			0	0	130.42

FINANCIAL COMMITMENT (by year until end of current agreement) £k				
2011-12 117.20	**2012-13** 117.80	**2013-14** 118.36	**2014-2015**	**2015-2016**

STEERING COMMITTEE	Independent Members	Meetings per annum	Other S&F Overseen
NSGSC	6	1	NSGF

APPLICATIONS: DISTRIBUTION OF GRADES (current FY — 2010/11)								
	α5	α4	α3	α2	α1	β	R*/Pilot	Reject
NERC Grant projects*		1						
Other academic		26						
Students		4						
Pilot								
TOTAL		31						
APPLICATIONS: DISTRIBUTION OF GRADES (per annum average previous 3 financial years —2007/2008, 2008/2009 & 2009/2010)								
	α5	α4	α3	α2	α1	β	R*/Pilot	Reject
NERC Grant projects*		1.00						
Other Academic		9.33						
Students		4.67	0.33					
Pilot								
TOTAL		15.00	0.33					

PROJECTS COMPLETED (current FY – 2010/11)							
	α5	α4	α3	α2	α1	β	R*/Pilot
NERC Grant projects*							
Other Academic		4 [+1 PR]					
Students		8	1				
Pilot							

Project Funding Type (current FY – 2010/11) (select one category for each project)											
Grand Total	Infrastructure					PAYG					
	Supplement to NERC Grant *	PhD Students		NERC C/S	Other	NERC Grant*	PhD Students		NERC C/S	Other
		NERC	Other				NERC	Other		
98	1	2	3	4	88					
Project Funding Type (per annum average previous 3 financial years - 2007/2008, 2008/2009 & 2009/2010)										
Grand Total	Infrastructure					PAYG				
	Supplement to NERC Grant *	PhD Students		NERC C/S	Other	NERC Grant*	PhD Student		NERC C/S	Other
		NERC	Other				NERC	Other		
100	1.33	0.33	6.33	2.67	89.33					

User type (current FY – 2010/11) (include each person named on application form)				
Academic	NERC Centre/Survey	NERC Fellows	PhD Students	Other
31	4	0	5	Non-PhD students 9 Central and local Govt 13 Collaborators 11 OS user 25
User type (per annum average previous 3 financial years - 2007/2008, 2008/2009 & 2009/2010)				
Academic	NERC Centre/Survey	NERC Fellows	PhD Students	Other
27.33	2.67	0.00	6.67	Non-PhD students 4.67 Central / local Gov 20.33 Collaborators 17.33 OS user 21.00

OUTPUT & PERFORMANCE MEASURES (current year)										
Publications (by science area & type) (calendar year 2010)										
SBA	ES	MS	AS	TFS	EO	Polar	Grand Total	Refereed	Non-Ref/ Conf Proc	PhD Theses
0	11	1	8	8	1	0	29	6	13	10
Distribution of Projects (by science areas) (FY 2010/11)										
Grand Total	**SBA**	**ES**	**MS**	**AS**	**TFS**	**EO**	**Polar**			
98	**3.50**	**13.83**	**13.50**	**14.00**	**50.83**	**2.33**	**0.00**			
OUTPUT & PERFORMANCE MEASURES (per annum average previous 3 years)										
Publications (by science area & type) (Calendar years 2007, 2008 &2009)										
SBA	ES	MS	AS	TFS	EO	Polar	Grand Total	Refereed	Non-Ref/ Conf Proc	PhD Theses
0.17	12.67	1.33	2.83	7.33	1.50	0.17	26.00	6.33	13.33	6.33
Distribution of Projects (by science areas) (FY 2007/2008, 2008/2009 & 2009/2010)										
Grand Total	**SBA**	**ES**	**MS**	**AS**	**TFS**	**EO**	**Polar**			
100	1.33	12.58	16.86	10.68	54.68	3.70	0.17			

Distribution of Projects by NERC strategic priority (current FY 2010/11)								
Grand Total	Climate System	Biodiversity	Earth System Science	Sustainable Use of Natural Resources	Natural Hazards	Environment, Pollution & Human Health	Technologies	Not classified
98	5.33	3.50	15.17	1.83	16.00	3.67	10.50	42.00

**Combined Responsive Mode and Directed Programme grants*

OVERVIEW & ACTIVITIES IN FINANCIAL YEAR (2010/11):

Data archival: Daily data archival continued from about 155 CGNSS stations, with a current volume of about 1,150 station-years of 30 second, primarily GPS data, with some stations operating since 1996/7; and since August 2009, 30 second GPS+GLONASS and 1Hz GPS+GLONASS data from about 100 CGNSS stations.

Network development: Minor changes have taken place at many sites, but the Facility station log file monitoring system continues to enable 'clean' metadata to be stored; this is crucial to users interested in the extraction of long-term environmental signatures.

Product development : The development of derived products is well advanced, focussing initially on long term trends (LTT) in station coordinates and velocities, and LTT and near real-time (NRT) trends in tropospheric parameters. The first 'releasable' LTT products are based on time series computed from 1997-2010 data with an in-house modified version of Bernese Software version 5.0, using a global network, ITRF2008, 1st order ionosphere and GPT/GMF for troposphere. These have been QA'd through comparison with parallel in-house processing using GIPSY/OASIS II.

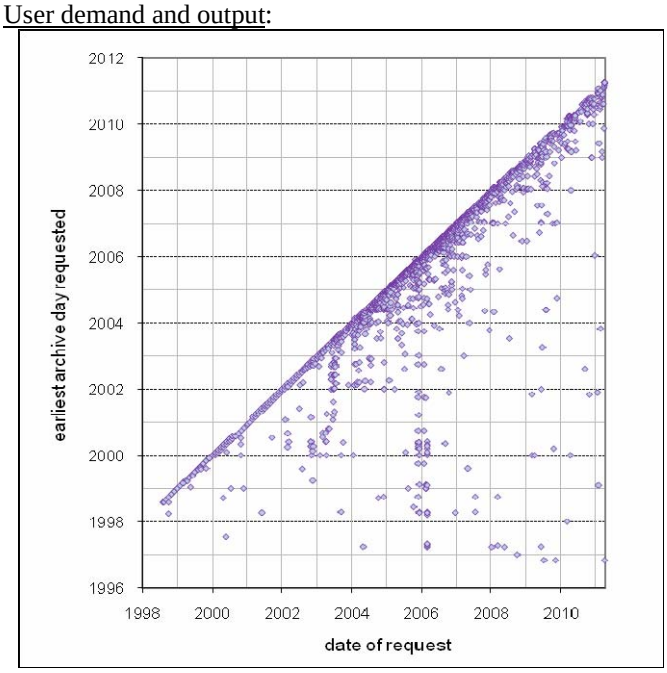
Website development: The website, which will go live in mid-2011, has been completely restructured and rewritten, both to improve the user interface and to include information on and access methods to high rate GPS+GLONASS data and derivative products.

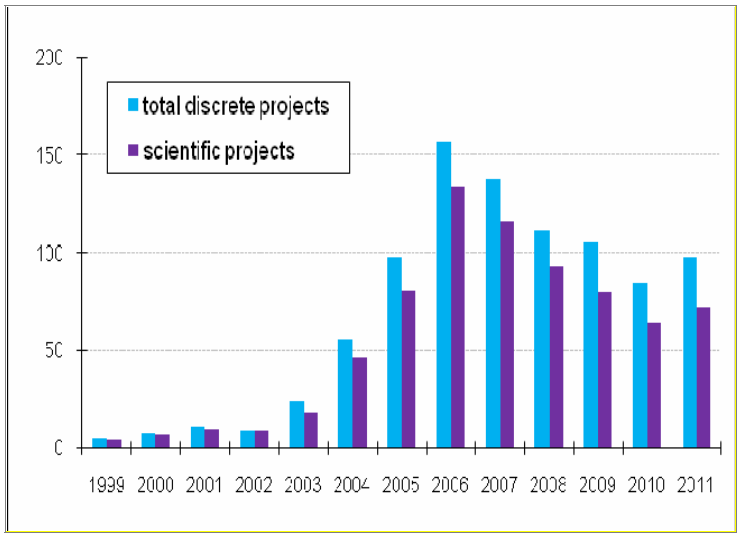
Archive access: Access to the archive is via online request forms. The request and delivery process is intentionally maintained as a personalised transaction, with capacity for verbal and e-mail dialogue on aspects of supply, data processing and field operations, and to enable the easy gathering of user information to support NERC's reporting needs. During 2010/11a number of major research projects led by national and international scientists, were automatically served daily data. These included: Densification of the European permanent GNSS network (EPN) for ionospheric studies [139 stations]; the European GNSS water vapour programme (E-GVAP) [up to 16 stations]; the European permanent GNSS network (EPN) [1 station]; the European Sea Level Service (ESEAS) [4 stations]; the International GNSS Service (IGS) tide gauge project (TIGA) [6 stations]; Ionospheric research using total electron content over Europe [139 stations]; Impacts of climate change on navigation and waterways [10 stations]; Near real-time atmospheric water vapour for numeric weather prediction in the UK [133 stations]; Towards a global ambiguity resolved precise point solution and time series [52 stations]. Additionally, a major NERC-funded research project at Newcastle University was supplied with 50,000 station-days of historic data for *global loading and deformation at tidal time scale*.

Advice to Government: The Facility has provided advice to the Environment Agency on the establishment of a new CGNSS station at the Thames Barrier, and to OSGB on the development of revised active station coordinates, and of the associated height corrector-surface employed by many BIGF users.

Archive accounting: This is underpinned by a database designed to fulfil NERC's reporting needs in respect of user, project and data request information, NSGSC peer review, publications, and so on.

User demand and output:





Project support (Financial year ending)

The left hand figure clearly demonstrates a continuous need for the archive through the significant number of users requiring data of several years vintage, and in a number of cases to its full temporal extent. The right hand figure shows project usage since the archive was created in 1999. Since becoming a Facility in 2002, there have been on average about 70 scientific type projects a year, and this level has been maintained for the last 3 years.

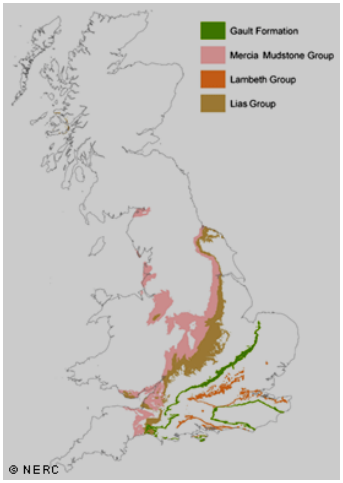
SCIENCE HIGHLIGHTS:

There were72 scientific user-projects supported in 2010/11, and an output of 10 PhD theses, 12 refereed and 5 non-refereed publications, of which the 3 most significant (with their ISI 2009 JCR impact factors shown in [ ]) were:

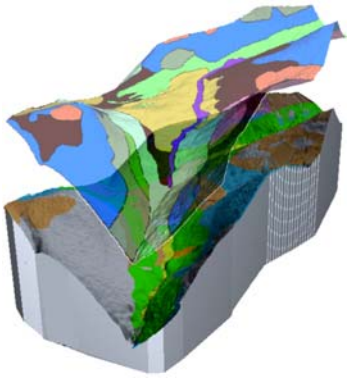
- Bouin, M-N., Wöppelmann, G. Land motion estimates from GPS at tide gauges: a geophysical evaluation? Geophysical Journal International, 180, 193-209, doi:10.1111/j.1365-246X.2009.04411.x., 2010. [2.435].
- Collilieux, X., Wöppelmann, G. Global sea level rise and its relation to the terrestrial reference frame definition. Journal of Geodesy, doi:10.1007/s00190-010-0412-4., 2010. [2.429].
- Quinn, J.D., Rosser, N.J., Murphy, W., Lawrence, J.A. Identifying the behavioural characteristics of clay cliffs using intensive monitoring and geotechnical numerical monitoring. Geomorphology, 2010, doi 10.1016/j.geomorph.2010.03.004, 2010. [2.119].

The remainder of this section provides brief summaries of 5 significant research projects supported by BIGF in 2010/11:

Physical properties and behaviour of UK rocks and soils
(NERC BGS)
BGS, as part of the UK Geo-engineering Properties and Processes Team, is characterising geological formations in terms of their lithological and engineering properties. These can provide information on potential engineering behaviour, such as problem ground conditions and geological hazards; and may be used to assist ground engineers and planners in undertaking feasibility studies, site investigation design for engineering projects, and land-use planning for regional development. All geotechnical data from these studies are stored in the National Geotechnical Properties Database. BIGF data were used to improve the accuracy of bedrock outcrop orientation, to be used in turn to assess bedrock discontinuities and mass properties.



Talla Earth Observatory
(NERC BGS)
This project is investigating the relationship between soils and underlying geology in a typical area of British upland, to better understand processes involved in climate change and flooding. A highly detailed physical model of the soil-geoscape has been produced of this small part of the Southern Uplands of Scotland. It is the second such UK site to be investigated, following a study of a riverine terrain developed on sedimentary rocks at Shelford in the Trent Valley. Talla represents a typical glaciated upland soil-geoscape developed on resistant meta-sedimentary rocks. BIGF data facilitated landscape evolution monitoring via geo-referencing of terrestrial laser scanning.



THESEUS [www.theseusproject.eu]
(University of Wales, Bangor, funded by EU FP-7)
This project concerns coastal flooding risk and options for mitigation in Europe and research on the process of coastal erosion and the role of natural ecosystems and engineering in coastal protection. Ultimately, the aim is to inform on a systematic approach to deliver a low-risk environment for coastal people and nature. As part of the project, wave energy, sediment, erosion, ripple formation and vegetation parameters are being sampled in 7 marshlands with a maximal range of wave exposure, across Wales and NW England. Samples are taken at regular points along vertical transects, between spring tide low and high water levels, each point being fitted with a wave sensor, sediment erosion station and transplant of salt marsh vegetation. In this way the relationship between marsh establishment and wave energy along the intertidal profile can be examined. BIGF data were used to improve the positioning accuracy of the samples.

Predicting salmonid population ecology from individual fish responses to environmental change
(Bournemouth University, Conservation Ecology)
This research aims to develop and test a salmonid-specific individual-based model in predicting population ecology response to the two common management regimes of in-stream weed removal and predator control. In the individual-based model, fish will show fitness-maximising adaptive behaviour derived from a function of food intake and bio-energetic cost. Both factors are dependent on river hydrology, for which model inputs of water height and flow measurement location were improved using BIGF data, by way of coordinating a local reference station for a real-time kinematic bed survey.

Woodland bird habitat modelling with integrated remotely sensed data
(Bournemouth University, Ecology)
This research aims to quantify the effects of habitat structure and composition on bird reproductive success in deciduous woodland, and how this is influenced by patch and landscape metrics, and larger-scale climate effects. Studies utilising remotely sensed data in woodland depend on establishing accurate spatial relationships between habitat variables and the ecological parameters of interest, for example tree, nest site or census plot locations. This cannot be achieved with direct use of GPS because of signal blockage by tree canopy, even in winter. So a multi-technology approach is used: by establishing a series of real-time kinematic benchmarks at woodland margins, using BIGF data, from which total-station surveys of nest-box locations are made. This approach has been successfully used to locate a large number of nest-boxes with sub metre error.

FUTURE DEVELOPMENTS/STRATEGIC FORWARD LOOK

1. To finalise extended MoUs (to 2014, 1Hz data) with existing collaborators and OSi by 30/09/2011.
2. To complete and launch the new website with procedures to handle requests for 1Hz data and derived products by 30/09/2011.
3. To put in place procedures to self-create RINEX data directly from the OSGB real-time data streams, by 31/12/11.
4. To develop the second ‘releasable’ derived products, focussing on long term trends (LTT) in station coordinates and velocities, and LTT and near real-time trends in tropospheric parameters, by 31/12/2011.
5. For the long term future, to expand data collection to include Galileo in addition to GPS and GLONASS.