

SERVICES & FACILITIES ANNUAL REPORT - FY April 2014 to March 2015

SERVICE BIGF	FUNDING BLOCK	AGREEMENT R8/H10/59	ESTABLISHED as S&F 2002 (Operating since 1998)	TERM 8 years
------------------------	-------------------------	-------------------------------	--	------------------------

TYPE OF SERVICE PROVIDED:

The British Isles continuous GNSS Facility (BIGF) is a unique and secure repository of archived GNSS data, dating back as far as 1997. All data are in RINEX** files, which are quality-assured and accompanied by metadata, and also form the basis of derived products. BIGF serves all of these data, metadata and derived products to the complete user-spectrum - nationally and internationally across academia, government, and business - with impact on research and development, policy and the wider societal good. BIGF provides reference station data for positioning needs but also acts as a regional natural environmental laboratory, as demonstrated through facilitated studies - of horizontal and vertical land motion, the ionosphere, and the troposphere - carried out at regional, continental and global scales over the decadal extent of the archive.* The data are sourced from a network of 158 continuously recording GNSS stations, sited throughout the British Isles. The archive comprises 1,730 station-years of 30 second (GPS, GPS+GLO) data, and 617 station-years of 1Hz (GPS+GLO) data. The data are provided to BIGF free-of-charge by a number of collaborators, including the three national Ordnance Surveys and the Met Office. Users can request data and products using an online form. The service provided can be summarised in a 4-part Facility remit:



BIGF station network

1. To provide an assured repository of data and derived products, so that the costs of users setting up an ad-hoc observation network and/or deriving their own products for research are reduced or eliminated;
2. To facilitate improvements in positioning quality for historic or current research, by providing reference station data, protecting researchers from the costs and delays of having to repeat data collection exercises;
3. To facilitate the least time delay in the examination of environmental and other variables, by providing extensive backward tracts of data and/or derived products for research;
4. To inform and stimulate the research community across the spectrum of science using various media.

ANNUAL TARGETS AND PROGRESS TOWARDS THEM

1. To increase the quantity of data in the archive: hourly and daily RINEX files from 158 CGNSS stations currently continue to be uploaded, as a nominal 58k station-days a year.
2. To improve metadata: to support users we provide an interactive network map, station log files and data listing by year and station. The veracity of log files is monitored, assuring accurate station history.
3. To increase archive usage: 831k, 6k, and 2,086k station-days of 30 second data, 1Hz data, and derived products were supplied in 2014/15, with a notable increase in the uptake of derived products compared to 2013/14. There were 72 scientific-user projects this year (and about 71 scientific-user projects a year for the last 5 years), indicating awareness of the Facility, influenced by our varied activities to promote and demonstrate its utility. There were 35 publications this year, including 3 completed PhD theses.
4. To meet the 'future developments/strategic forward look' from the 2013/14 annual report:
 - a) Of the 158 CGNSS stations, 5 have now been upgraded to track GPS+GLO+GAL+BDS, including the 4 at tide gauges funded by NERC S&F capital in 2011/12 and installed in late 2013 and the first new station of several to be installed by the Met Office.
 - b) A fifth 'releasable' set of 'long term trend (LTT) derived products' at Levels 1, 2 and 3, related to station coordinates, tropospheric parameters and station velocities, have been created based on Bernese GNSS software version 5.2 (BSW5.2) and time series from 1997 to 2014:180, but new 'LTT derived products' at Level 1, related to ionospheric parameters, have yet to be created.
 - c) 'Near real-time (NRT) derived products' at Levels 1 and 3, related to tropospheric parameters, and at Levels 1 and 2, related to ionospheric parameters, have continued/started to be created based on BSW5.0, and the implementation and testing of BSW5.2 for the creation of enhanced 'NRT derived products' at Levels 1 and 3, related to tropospheric parameters, and new 'NRT derived products' at Levels 1 and 2, related to ionospheric parameters, has been started but not completed.
 - d) The creation of enhanced 'LTT derived products' at Level 3, through collaboration with BGS on maps of vertical motions based on station velocities, and the creation of new 'LTT and NRT derived products' at Levels 2 and 3 through the further development of tools for the creation of time series and maps related to tropospheric and ionospheric parameters, has been started but not completed.

* Global Navigation Satellite Systems: GPS, Glonass (GLO), Galileo (GAL), Beidou (BDS). ** Receiver INdependent EXchange format.

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

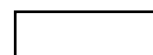
CAPACITY of HOST ENTITY FUNDED by S&F 100%	Staff & Status Dr Richard Bingley, Head of Facility, 10% NERC Dr David Baker, Manager, 60% NERC Ms Dionne Hansen, Developer, 75% NERC	Next Review (March) 2016	Contract Ends (31 March) 2017
--	---	------------------------------------	---

FINANCIAL DETAILS: CURRENT FY						
Total Resource Allocation £k 115.00	Unit Cost £k			Capital Expend £k	Income £k	Full Cash Cost £k 137.70
	Unit 1 (Products) 0.000047	Unit 2 (30s data) 0.000047	Unit 3 (1Hz data) 0.000047			

FINANCIAL COMMITMENT (by year until end of current agreement) £k					
2014-15	115.000	2015-16	114.000		

STEERING COMMITTEE NGGFSC	Independent Members 12	Meetings per annum 2	Other S&F Overseen GEF and NSGF
-------------------------------------	----------------------------------	--------------------------------	---

APPLICATIONS: DISTRIBUTION OF GRADES (current FY — 2014/15)



	10	9	8	7	6	5	4	3	2	1	0	R*	Pilot
NERC Grant projects*			5										
Other academic			21	1.33									
Students			5	1.33									
TOTAL			31	2.66									

APPLICATIONS: DISTRIBUTION OF GRADES (per annum average previous 3 financial years —2011/2012, 2012/2013 & 2013/2014)

	10	9	8	7	6	5	4	3	2	1	0	R*	Pilot
NERC Grant projects*			1.00										
Other academic			21.33	1.33									
Students			4.00	1.33									
TOTAL			26.33	2.66									

PROJECTS COMPLETED (current FY – 2014/15)

	10 (α5)	9	8 (α4)	7	6 (α3)	5 (α2)	4	3 (α1)	2	1 (β)	0 (Reject)	Pilot
NERC Grant projects*			1									
Other Academic			7	1								
Students			2									

Project Funding Type (current FY – 2014/15) (select one category for each project)

Grand Total	Infrastructure					PAYG					
	Supplement to NERC Grant *		PhD Students		NERC Centre	Other	NERC Grant*	PhD Students		NERC Centre	Other
	NERC	Other	NERC	Other			NERC	Other			
83	5		1	6	4	67					

Project Funding Type (per annum average previous 3 financial years - 2011/2012, 2012/2013 & 2013/2014)

Grand Total	Infrastructure					PAYG					
	Supplement to NERC Grant *		PhD Students		NERC Centre	Other	NERC Grant*	PhD Student		NERC Centre	Other
	NERC	Other	NERC	Other			NERC	Other			
89.667	0.667		1.000	5.000	3.333	79.667					

User type (current FY – 2014/15) (include each person named on application form)

Academic	NERC Centre	NERC Fellows	PhD Students	Other
32	4	0	7	Non-PhD students 6 Collaborators 10 Central and local Govt 13 OS user 11

User type (per annum average previous 3 financial years - 2011/2012, 2012/2013 & 2013/2014)

Academic	NERC Centre	NERC Fellows	PhD Students	Other
26.333	3.333	0.000	6.000	Non-PhD students 9.667 Collaborators 7.333 Central/local Govt 17.333 OS user 19.667

OUTPUT & PERFORMANCE MEASURES (current year)

Publications (by science area & type) (calendar year 2014)*

SBA	ES	MS	AS	TFS	EO	Polar	Grand Total	Refereed	Non-Ref/ Conf Proc	PhD Theses
0.00	15.75	2.25	13.5	3.00	0.5	0.00	35	17	15	3

Distribution of Projects (by science areas) (FY 2014/15)

Grand Total	SBA	ES	MS	AS	TFS	EO	Polar
83	2.5	17	17	11.5	29	6	0

OUTPUT & PERFORMANCE MEASURES (per annum average previous 3 years)*

Publications (by science area & type) (Calendar years 2011, 2012 & 2013)

SBA	ES	MS	AS	TFS	EO	Polar	Grand Total	Refereed	Non-Ref/ Conf Proc	PhD Theses
0.000	25.083	1.083	15.25	2.917	.333	0.000	44.667	17.000	25.000	2.667

Distribution of Projects (by science areas) (FY 2011/2012, 2012/2013 & 2013/2014))

Grand Total	SBA	ES	MS	AS	TFS	EO	Polar
89.667	0.667	14.722	19.889	15.000	35.833	3.556	0.000

Distribution of Projects by NERC strategic priority (current FY 2014/15)

Grand Total	Climate System	Biodiversity	Earth System Science	Sustainable Use of Natural Resources	Natural Hazards	Environment, Pollution & Human Health	Technologies	Unclassified
83	13.583	2.500	16.747	1.500	24.583	2.833	0.250	21

*Either Discovery Science (Responsive Mode) or Strategic Science (Directed Programme) grants

NOTE: All metrics should be presented as whole or part of whole number NOT as a %

Note: From 1998 to 2014 there were 131 related publications in Web of Science, generating 1465 citations; and a total output of 551 publications, including 54 PhD theses. From 2012 to 2014 there were 49 publications in Web of Science, generating 228 citations.



OVERVIEW & ACTIVITIES IN FINANCIAL YEAR (2014/15):

BIGF supported not only frontline UK academic research (36% of projects) and EU/International academic research (23%), but also the wider community in projects related to UK government and policy (28%) and UK industry (13%). This support positively impacts and benefits the society it serves in relation to important current issues such as conservation; coastal management; marine, air, road and rail transport and safety; renewable energy; aspects of pollution related to public health; flood risk, alert and management and river restoration; weather forecasting; and threats to industry and society from cyclical solar activity.

BIGF activities provide support through: archival and access; network, product and website development; and archive accounting.

Data archival: Hourly and daily data archival continued from 158 CGNSS stations, comprising two data sets: 30 second (GPS, GPS+GLO) with a current volume of about 1,730 station-years, and some stations operating since 1996/7; and 1Hz (GPS+GLO) from 114 CGNSS stations, with a current volume of about 617 station-years and some stations operating since August 2009.

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 creation of derived products has continued to advance. A fifth 'releasable' set of 'long term trend (LTT) derived products' at Levels 1, 2 and 3, related to station coordinates, tropospheric parameters and station velocities, have been created based on Bernese GNSS software version 5.2 (BSW5.2) and time series from 1997 to 2014:180. Near real-time (NRT) derived products' at Levels 1 and 3, related to tropospheric parameters available hourly and sub-hourly, and at Levels 1 and 2, related to ionospheric parameters available hourly, have continued/started to be created based on BSW5.0.

Website development: This continues to adapt to accommodate derived products as they are developed and launched; text and graphic content and FAQs are similarly enhanced to improve the user experience.

Archive access: Access to the archive is via an online request form. The request and delivery process is intentionally maintained as a personalised transaction, with capacity for verbal and e-mail dialogue on all aspects of supply, data processing and field operations, and to enable the easy gathering of user information to support NERC's reporting needs. An increasing number of major research projects led by national and international scientists are automatically served a continuous data stream.

Archive accounting: This is underpinned by a database designed to fulfil NERC's reporting needs, with user demand summarised as:

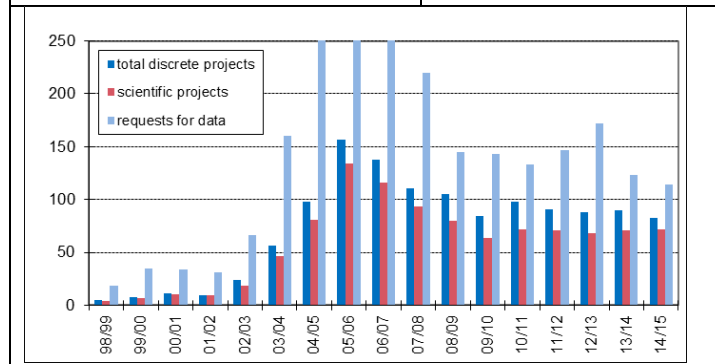
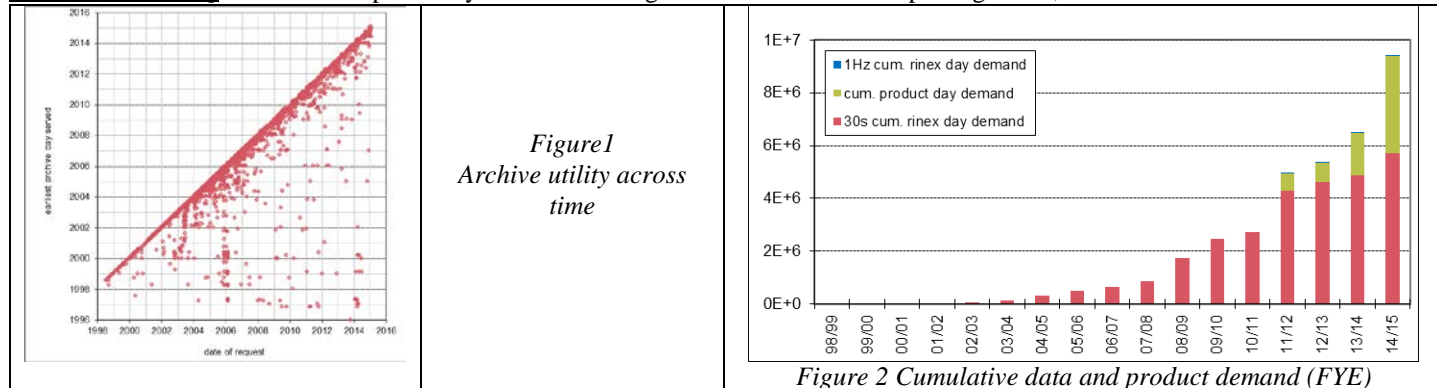


Figure 3 Projects enabled and number of requests (FYE)

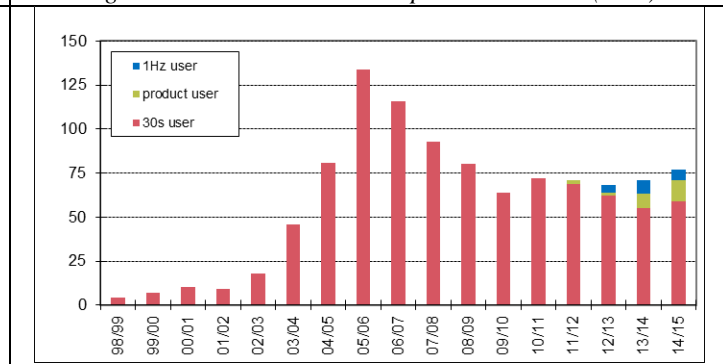


Figure 4 Scientific user - data and product break down (FYE)

Fig. 1 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. Fig.2 shows a continued, year-on-year demand for 30 second data and 1Hz data and a clear growing demand for derived products since their first availability 4 years ago. Fig.3 shows that there has been a consistent level of about 71 scientific-user projects a year over the last 5 years, and Fig.4 illustrates the arrival and increasing uptake of both 1Hz data and derived products.

SCIENCE HIGHLIGHTS:

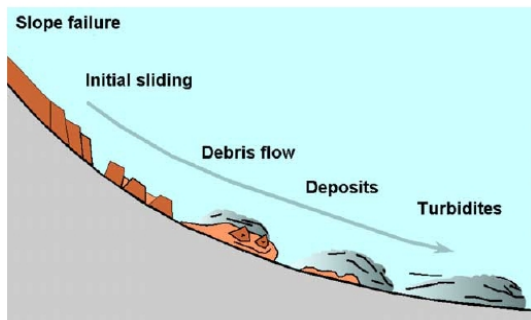
There were 72 scientific-user projects supported in 2014/15, and an output of 3 PhD theses (with another 16 in progress), 17 refereed and 15 non-refereed publications, of which the 3 most significant refereed (with their ISI 2013 JCR impact factors shown in []) were:

1. Barlow, N., Long, A., Saher, M. et al. Salt-marsh reconstructions of relative sea-level change in the North Atlantic during the last 2000 years. *Quaternary Science Reviews*, Vol.99, pp.1-16, doi:10.1016/j.quascirev.2014.06.008, September 2014. [4.076].
2. Woppelmann, G., Marcos, M., Santamaria-Gomez, A., et al. Evidence for a differential sea level rise between hemispheres over the twentieth century. *Geophysical Research Letters*, doi:10.1002/2013GL059039, available online March 2014. [3.982].
3. Sheridan, P., Vosper, S., Brown, A. Characteristics of cold pools observed in narrow valleys and dependence on external conditions. *Quarterly Journal of the Royal Meteorological Society*, Volume 140, Issue 679, Part B, pp.715–728, doi:10.1002/qj.2159, January 2014. [3.327].

The remainder of this section provides brief summaries of four significant research projects supported by BIGF in 2014/15:



Will climate change in the Arctic increase the landslide-tsunami risk to the UK? - modelling seismicity due to ice loading and unloading. University of Ulster. NERC funded research ref. NE/K000160/1.



(Image credit NERC)

This project includes the development of a finite element model of the solid earth to model stress change due to deglaciation in the upper crust in NW Europe and Greenland, to allow the researchers to try to regionally delineate ice unloading seismicity against possible back ground seismicity and to identify areas of possible strong ground acceleration that could potentially trigger future tsunamigenic landslides. BIGF derived products of observed long term station velocity trends in the UK and Ireland are being used to provide a measure of the current strain-rate field that can be used as a constraint in this model. Additionally, relative differences in long term station velocity trends between GPS stations will be used to evaluate the loading of structural faults in the UK and Ireland.

Brattleby field campaign (part of the GREENHOUSE project). University of Edinburgh. NERC funded research ref. NE/K002619/1.



(Image credit University of Edinburgh)

This project aims to integrate and compare greenhouse gas flux estimates from local to national level. The objectives of the field campaign were to measure greenhouse gas emissions (CO₂, CH₄ and NO₂) from a commercial oil seed rape field, on multiple scales and over several weeks in order to observe spatial and temporal variations in these emissions in relation to events such as fertilisation. BIGF data were used to improve the accuracy of GPS positional data for both sensing equipment and measurement locations.

FUTURE DEVELOPMENTS/STRATEGIC FORWARD LOOK

- a) To expand data collection to include more Galileo and Beidou, in addition to GPS and Glonass, whenever possible.
- b) To create a sixth 'releasable' set of 'long term trend (LTT) derived products' at Levels 1, 2 and 3, related to station coordinates, tropospheric parameters and station velocities, based on Bernese GNSS software version 5.2 (BSW5.2) and extended time series from 1997 to 2016:040, and to create new 'LTT derived products' at Level 1, related to ionospheric parameters.
- c) To continue to create 'near real-time (NRT) derived products' at Levels 1 and 3, related to tropospheric parameters, and at Levels 1 and 2, related to ionospheric parameters, based on BSW5.0, and to implement and test BSW5.2 for the creation of enhanced 'near real-time (NRT) derived products' at Levels 1 and 3, related to tropospheric parameters, and at Levels 1 and 2, related to ionospheric parameters.
- d) To create enhanced 'LTT derived products' at Level 3, through collaboration with BGS on maps of vertical motions based on station velocities, and new 'LTT and NRT derived products' at Levels 2 and 3 through the further development of tools for the creation of time series and maps related to tropospheric and ionospheric parameters, with concurrent developments to the website.

Using microclimate to adapt conservation to climate change. University of Exeter. NERC funded research ref. NE/L00268X/1.



(Image credit Charles J Sharp)

This work, on a site of interest on the Lizard Peninsula, aims to establish the influence of microclimate on wildlife, its implications for global change analyses, and its potential value in helping conservation organisations adapt their policies to climate change. It is a knowledge exchange grant designed to foster cooperation on microclimate between conservation organisations and scientists. BIGF data were used to improve the positional accuracy of fine-scale vegetation structure.

Dynamic Humber. University of Hull. HEFCE-HEIF funded research.



(Image credit the Humber Bridge Board)

The Dynamic Humber project is investigating the impact of environmental change on the long-term physical, social and economic state of the Humber estuary and East coastal margin. The project aims to produce high definition surveys to quantify physical fluxes within the Humber, in areas that are central to the sustainability and management of the estuary. This will enable the development of novel numerical modelling simulations of physical fluxes, with the further aim of forecasting the influence of future environmental change over a range of spatial (1-50 km) and temporal (10-100 years) scales and in a range of scenarios. BIGF data were used to improve the positional accuracy of field survey and sampling location data.

