

National Report of Great Britain, 2004

M. Greaves¹, R. Bingley² & D. Baker² and C. Allinson³

1 Introduction

National geodetic activity in the past year has included:

- the ongoing development of Ordnance Survey's RTK GPS network;
- the ongoing submission of data to the EPN;
- the continued development of the BIGF, British Isles GPS archive Facility by the Institute of Engineering Surveying & Space Geodesy (IESSG) at the University of Nottingham;
- research into ocean tide loading effects in the British Isles by the School of Civil Engineering and Geosciences at the University of Newcastle upon Tyne.

2 National GPS network

The Ordnance Survey National GPS Active Network (www.gps.gov.uk) has been stable and largely unchanged since last year. There was the unexpected loss of the station PLYM (Plymouth) at short notice and station TAUN (Taunton) is to be moved from the local Ordnance Survey office to the headquarters of the United Kingdom Hydrographic Office (UKHO).

3 Network RTK GPS developments

During the summer of 2003 Ordnance Survey's RTK test network of 23 stations in the north of England (see Figure 1) was used to trial different network RTK software. The contract was recently awarded to Trimble to supply their GPSNet VRS software suite.

The RTK network will now expand across the country and should cover all urban areas by April 2005 with complete coverage of GB by April 2006. The full network is planned to consist of approximately 110 stations.

Initially RTK correction data will only be available for use by Ordnance Survey surveyors but a service for the Public will be developed as the network is being rolled out. The intention is that a Public service will be available by the time the network is fully established.

¹Ordnance Survey, Romsey Road, Southampton, SO16 4GU, UK.
mark.greaves@ordnancesurvey.co.uk

²IESSG, Nottingham University, University Park, Nottingham, NG7 2RD, UK.
richard.bingley@nottingham.ac.uk, david.baker@nottingham.ac.uk

³School of Civil Engineering and Geosciences, Cassie Building, University of Newcastle upon Tyne, Newcastle, NE1 7RU, UK.
C.R.Allinson@newcastle.ac.uk

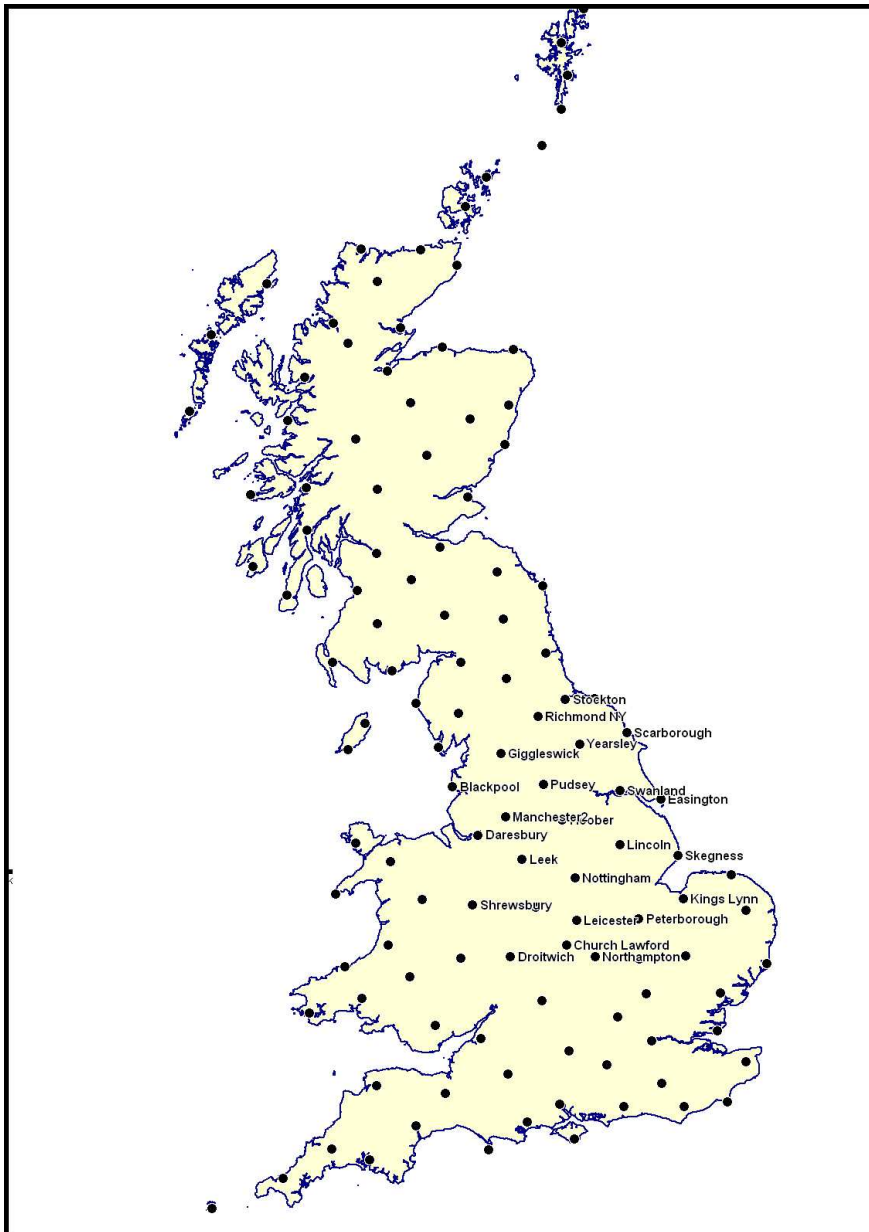


Figure 1. Current RTK network stations (named) and planned stations (unnamed).

4 EPN data submissions

Current submissions from GB are hourly data from HERS, HERT and MORP plus 24 hour files from DARE, INVE and NPLD. Unfortunately in December 2003 PLYM (Plymouth) had to be unexpectedly removed at short notice. However a new station NEWL at Newlyn, approximately 100 km south west of PLYM, should soon be submitting data to the EPN. NEWL is operated by IESSG and is very close to the tide gauge that is the source of mean sea level on the GB mainland.

With the establishment of the RTK network and a greater number of stations submitting data in real time to the network hub in Ordnance Survey HQ, it should soon be possible to make more timely delivery of the data from DARE and INVE and to eventually move to hourly data submissions from these and other stations.

5 BIGF British Isles GPS archive Facility

The British Isles GPS archive Facility (BIGF) is operated from the IESSG (Institute of Engineering Surveying and Space Geodesy) at the University of Nottingham, with funding from the UK Natural Environment Research Council (NERC).

BIGF is the long-term national archive for CGPS data, from a network of 60 CGPS stations sited throughout mainland UK, some of which started operation as early as 1997. The network comprises 30+ Ordnance Survey active stations and 20+ scientific stations. The scientific stations have been established by various agencies and organisations, namely: the Department for the Environment, Food and Rural Affairs (Defra); the Environment Agency; the Met Office; the National Physical Laboratory; NERC Proudman Oceanographic Laboratory (POL); NERC Space Geodesy Facility; the University of Newcastle-upon-Tyne and the IESSG. Since the start of data archival there has been a steady net growth in the BIGF network to the current live complement of 55 stations (a further 5 ceased operation but data are preserved in the archive). In 2004 a further 10 scientific stations will be installed. The current status of the network is shown on Figure 2.

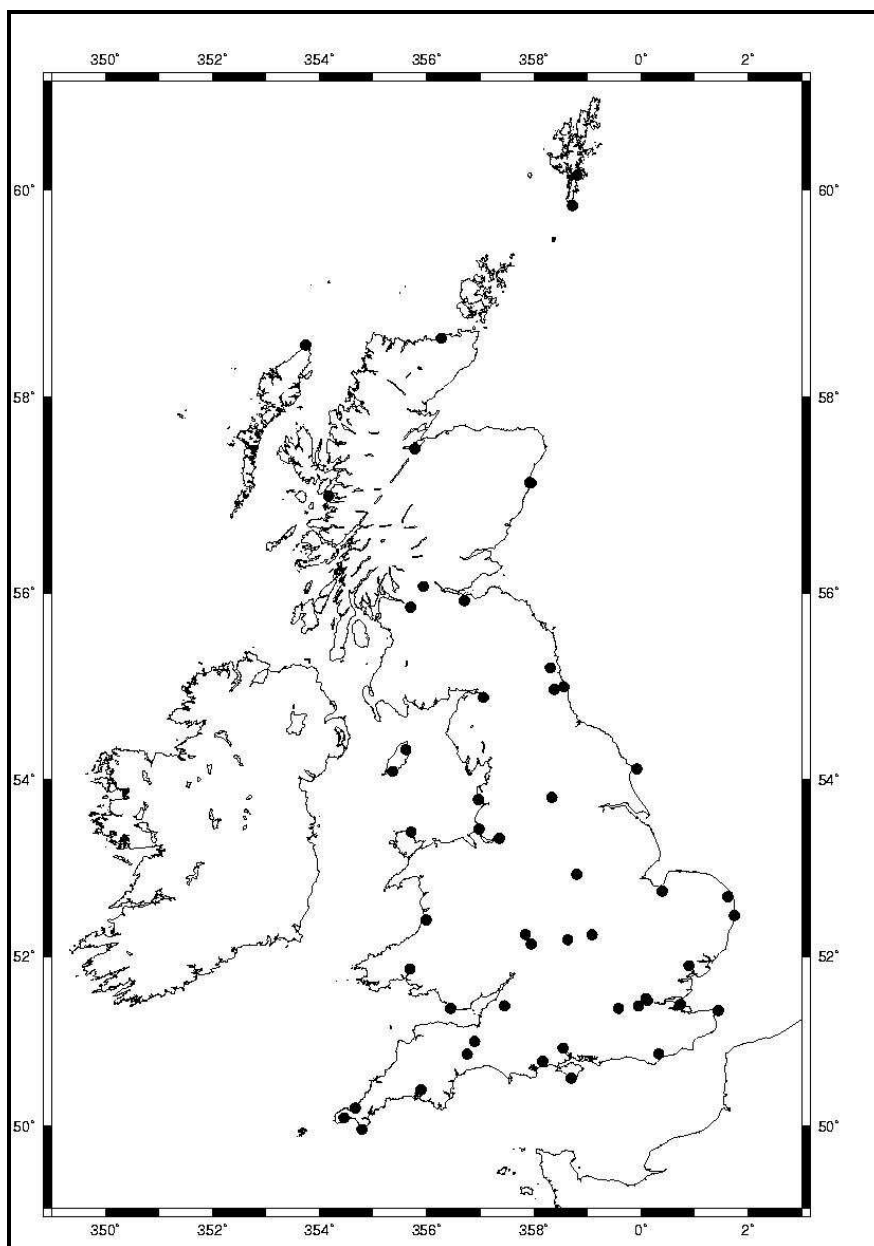


Figure 2. BIGF network, April 2004.

Cumulative demand on the archive since has now exceeded 150,000 station-days. More importantly the number of scientists making use of the archive increased from 4 to 55 per annum, over the period from 1998 to 2004.

In 2003/4 there were five major users of BIGF data:

- the IESSG for research on vertical land movements at tide gauges, as part of Defra-funded work being carried out in collaboration with POL, and EC-funded work being carried out as part of the European Sea Level Service (ESEAS).
- the University of Newcastle upon Tyne for research into ocean tide loading, funded by NERC.
- the Geodetic Observatory Pecny (GOPE) in the Czech Republic, for research on near real-time tropospheric water vapour estimations as part of EC COST Action 716.
- the Geodetic Institute of the Norwegian Mapping Authority, for research into the use of GPS humidity measurements in meteorology, as part of the TOUGH project, funded by the EC under Framework V.
- the IESSG for research into near real-time estimation of atmospheric water vapour content, in collaboration with the Met Office.

Other recent research supported by archive data include:

- Control for archaeological, erosion monitoring and many engineering type surveys.
- Deformation monitoring.
- High-accuracy height determination.
- Real-time engineering monitoring.
- Space weather.
- Wildlife tracking of red deer in Scotland and foxes in Bristol.

Three of the stations are part of the IGS network (HERS, MORP and NPLD), six are part of the EPN (DARE, HERS, INVE, MORP, NEWL and NPLD) and four CGPS@TG stations contribute data to the IGS TIGA Pilot Project (ABER, NEWL, NSTG and SHEE).

BIGF has a website at <http://www.bigf.ac.uk> providing detail of the archive's history, archive users, and the current network. Data can be requested using an online form at this site.

6 Ocean tide loading research

The University of Newcastle upon Tyne is currently working on a NERC sponsored research project in conjunction with the Ordnance Survey to investigate ocean tide loading (OTL) in the British Isles. Current models of OTL in the British Isles can predict site displacement but they have currently only been validated using sparse gravimetric and short-term GPS data. With the large amount of GPS data currently managed by the BIGF, along with Ordnance Survey Ireland (OSI) and Ordnance Survey Northern Ireland (OSNI), a means of directly measuring the OTL from GPS observation is now possible at a large number of well-distributed sites.

The aim of the project is to quantify OTL displacements for a range of tidal frequencies at each of these locations by solving for fixed period OTL signals directly in daily GPS analysis. These initial OTL estimates are inaccurate, but by using a large dataset and applying a least squares adjustment to these estimates, it is possible to remove much of the noise in the data, therefore improving the accuracy of the OTL displacements.

Initial results generated from approximately 1000 days of GPS data show good agreement with predictions from some of the ocean tide models. For the more dominant semi-diurnal tidal signals (e.g. M_2 and S_2), estimates have shown good agreement with the FES99 model with differences of only ~5% of the total magnitude of the signal. In contrast, predictions from the TPXO.2 model consistently gives the worst level of agreement, which are typically ~20% of the total magnitude of the signal. For the (generally) smaller magnitude diurnal tidal signals (especially K_1 and P_1), it is much more difficult to achieve the same level of accuracy, resulting in more inconsistencies between the model predictions, and the estimates. The level of confidence achieved with the estimates is very site dependent (multipath and other sources of noise are detrimental), but it does improve as larger quantities of data are used in the least-squares method. Tests have shown that it is possible to estimate the larger magnitude signals (M_2 , S_2) with only 90-days of GPS data, whereas more than 2000-days are required to sufficiently resolve the smaller magnitude diurnal signals (K_1 , P_1).

Although large amounts of data are required to sufficiently resolve these displacements, they will lead to much improved OTL modelling throughout the British Isles. This will benefit the wider scientific community, by enabling better GPS heighting and estimation of tropospheric water vapour. The research has been ongoing for the past two years and is expected to be complete by September 2004.