

National Report of Great Britain, 2003

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1. Introduction

National geodetic activity in the past year has included:

- the ongoing development of Ordnance Survey's GPS networks;
- the start of EPN data submission from 3 Ordnance Survey CORS sites and 1 Newcastle University site;
- the full release of the definitive OSTN02 transformation and OSGM02 geoid model;
- RTK network developments;
- The development of the BIGF, British Isles GPS archive Facility by the Institute of Engineering Surveying & Space Geodesy (IESSG) at the University of Nottingham.

2. GPS networks

The Ordnance Survey CORS network currently consists of 32 permanently installed geodetic quality GPS receivers throughout Great Britain, figure 1 shows their distribution. Two of these stations are actually owned and operated by the Isle of Man Government and a further 9 by the General Lighthouse Authority (GLA). All of the active stations record dual-frequency GPS data and one-hour packets of data from each CORS are sent via ISDN line every hour for internal and external access approximately 18 minutes after the end of each hourly period.

In the past year two stations have been removed from the network. SCP1 (a GLA station) was removed because network monitoring showed that the lighthouse was on subsiding land. WOR1 (an inland station belonging to the GLA) was removed due to being redundant.

Two new stations have been added. SCAR to eventually replace the near by GLA station FLA1. STI1 is a new site owned by the GLA.

Daily positions of the CORS's are computed using the Bernese software and this is used to monitor the positions of the stations.

The raw RINEX data is freely available through www.gps.gov.uk.

A EUREF campaign on the CORS network was ratified at EUREF 2002 (resolution No. 1) as EUREF GB 2001. The second order "passive" network of approximately 900 ground markers with coordinates in

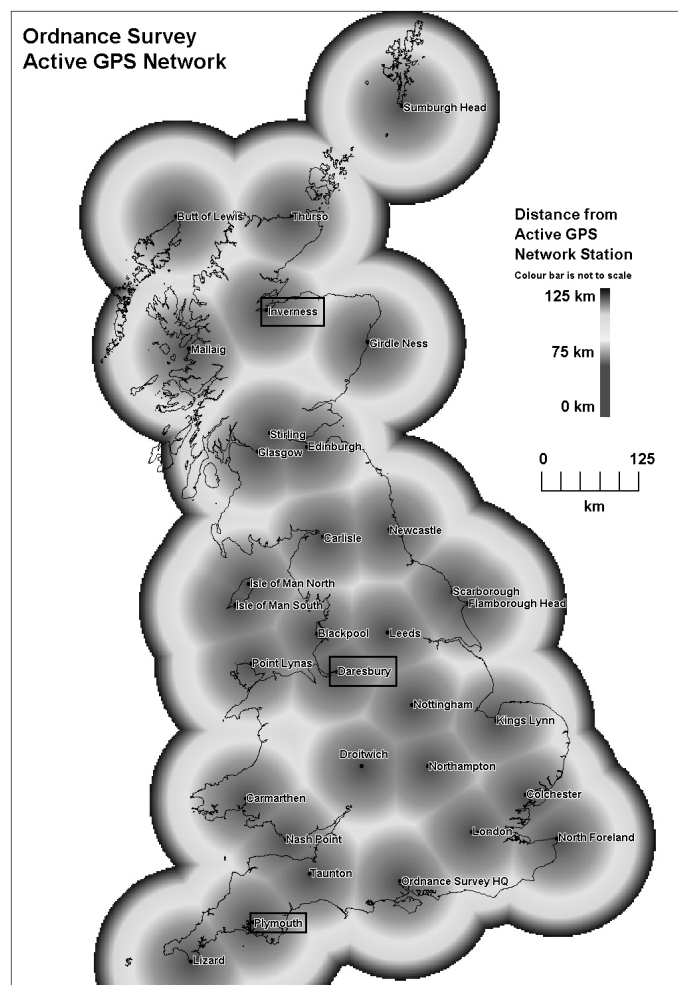


Figure 1. Distribution of Ordnance Survey's CORS's. Highlighted stations submit data to the EPN.

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ETRS89 was subsequently improved and readjusted using EUREF GB 2001 as fixed control. This adjustment of the passive network is known as OSGPS2002. Details of all passive stations are available through www.gps.gov.uk.

3. EPN data submissions

Ordnance Survey has recently begun data submissions from its CORS network to the EPN. Stations DARE, INVE and PLYM submit daily 24 hour files. These stations are highlighted (by a box around the name) on Figure 1. In the next year, depending on developments in the CORS communication infrastructure, hourly data submissions from these stations and others may be possible.

The station MORP operated by the School of Civil Engineering and Geosciences at the University of Newcastle has also started to submit data to the EPN. MORP is contributing daily and near-real-time data.

4. National transformation and geoid model

The plan transformation model (OSTN97) and geoid model (OSGM91) which have provided the linkage between ETRS89 coordinates and OSGB36 and the height datums in Great Britain were updated and released to the public as OSTN02 and OSGM02 respectively.

OSTN02 is also known as the *Definitive Transformation*. In the past, despite having a CORS network and transformation (OSTN97), the mapping system of Great Britain (OSGB36) was still defined by the National Grid positions of the original triangulation points. Now that the Definitive Transformation (OSTN02) is released, it *defines* the National Grid in conjunction with the ETRS89 positions of the National GPS Network stations. This is a subtle change in definition only and will not mean that existing OSGB36 coordinates need to be changed in any way. The original archived OSGB36 National Grid coordinates and the new OSGB36 National Grid coordinates agree on average to better than 0.1 m.

OSGM02 is a new geoid model which covers the land areas and inshore waters of the United Kingdom, the Republic of Ireland and the Isle of Man and allows ETRS89 to local height datum conversion. The model was produced by a consortium consisting of KMS – Denmark (R Forsberg & G Strykowski), UCL - UK (P Cross, M Ziebart & J Iliffe) and the University of Copenhagen (C Tscherning). A gravimetric geoid model was computed from a 100m spaced DEM and gravity at an approximate spacing of 1.5km. The model was computed by remove-restore techniques, using spherical FFT and RTM prism integration, using EGM96 as a reference field. The gravimetric geoid was computed rigorously as a quasi-geoid, and then converted to a classical geoid consistent with the use of Helmert orthometric heights. The model was then related to the relevant local height datums. The new model has an overall error of 2cm rms in the UK, 4cm in other areas.

Both models are available on line at www.gps.gov.uk. The models can be used online or a software program can be downloaded free of charge. Developers can obtain a pre-written dll for implementing the models or can download the raw data and algorithms, again free of charge.

5. Network RTK Development

The implementation of RTK from local base stations has helped Ordnance Survey towards achieving over 40% efficiency improvement in its field surveying operations. Efforts now continue to develop a national network RTK solution.

A test network established in the north of England to investigate the network RTK concept is being developed to begin trials of different network RTK software solutions in the summer of 2003. 23 CORS are sited and will send data in real-time down to the processing centre in Southampton. The data server can be partitioned such that different network RTK software can use the incoming data stream simultaneously. This allows direct comparison of the different solutions.

6. BIGF British Isles GPS archive Facility (www.bigf.ac.uk)

The British Isles GPS archive Facility (BIGF) is operated by the Institute of Engineering Surveying and Space Geodesy (IESSG) at the University of Nottingham, through funding from the UK Natural Environment Research Council (NERC). BIGF archives data from a network of 50+ continuous GPS

(CGPS) stations, including the 30+ Ordnance Survey active stations (detailed above) and 20+ 'scientific stations'. The scientific stations have been established by various agencies and organisations including the Department for the Environment, Food and Rural Affairs (DEFRA), the Environment Agency, the Met Office, the National Physical Laboratory, NERC Space Geodesy Facility, Proudman Oceanographic Laboratory, the University of Newcastle-upon-Tyne and the IESSG.

The systematic archival of data from CGPS stations in the British Isles was started in 1997, as part of the NERC Earth Observation Science Initiative (EOSI). The original network of about 10 scientific stations was established in 1997/98 to enable the investigation of changes in ground level in the Thames Estuary and Greater London, the monitoring of vertical land movements at tide gauges and studies of tropospheric delay. Since then the network density has increased significantly through the establishment of other scientific stations and, since 2000, the inclusion of the Ordnance Survey active stations. A map of the current network of 53 stations is shown below.

To date there have been three major users of BIGF data:

- the IESSG for research on vertical land movements at tide gauges, as part of UK 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 on ocean tide loading, funded by NERC.
- the Geodetic Observatory Pecny (GOPE) in the Czech Republic, for research on near real-time tropospheric water vapour estimation as part of EC COST Action 716.

In 2002, the strategic importance of the archive was recognised through the formal establishment of BIGF as an official NERC Facility. Other related NERC Facilities include the Airborne Remote Sensing Facility and the NERC Space Geodesy Facility. BIGF is seen as a major benefit to scientists considering the use of GPS to sense a particular parameter, since the cost of setting up an otherwise ad hoc network may be mitigated and, perhaps more importantly, the period of investigations can be increased by reaching backwards in time.

Three of the stations in the archive (HERS, MORP and NPLD) are already part of the IGS and EPN and others have recently been submitted for inclusion in the EPN. Five of the stations (ABER, MORP, NEWL, NSTG and SHEE) are contributing to the IGS TIGA Pilot Project and four of the stations (HERS, IESG, MORP and NEWL) have been submitted to the ECGN project.

BIGF is on the Internet at www.bigf.ac.uk, providing information on data holdings and archive usage, and allowing requests for data to be made.

7. Other activities

Following the call for participation in the EUVN Densification Action (EUVN_DA) Ordnance Survey assessed its GPS stations to see if any met the requirements for action A of EUVN_DA. Ordnance Survey also consulted IESSG and the University of Newcastle on the suitability of their stations for action A. It was concluded that no current stations in GB meet the action A requirements. However Ordnance Survey is planning to fully participate in action B of EUVN_DA and is currently investigating the selection of suitable stations for this action.

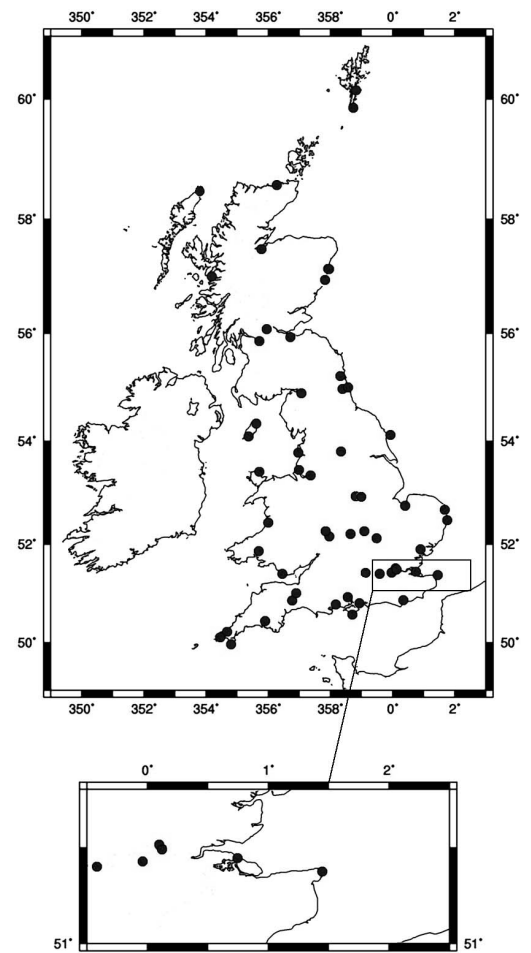


Figure 2. The BIGF network.

In a bid to resolve the remaining issues surrounding the levelling link through the Channel Tunnel, 28 days of continuous GPS data have been observed at the Eurogauge bench mark at Dover. This mark is linked by geodetic levelling to the tide gauge mark which in turn is linked to the levelling through the tunnel. It is proposed that the computed ellipsoidal height of the Eurogauge mark is converted to an Ordnance Datum Newlyn (ODN) height using the new OSGM02 geoid model and that this height is used to close the levelling through the tunnel.

8. EUREF non-permanent station maintenance

As requested by the EUREF Technical Working Group, this section contains information on the maintenance of the non-permanent EUREF stations in GB.

There have been 3 EUREF campaigns in GB:

- EUREF GB 92, the original campaign that fixed 26 stations in GB;
- EUREF EIR/GB 95, a campaign to fix a EUREF network in Northern Ireland and the Republic of Ireland that included 4 stations in GB (2 new and 2 existing from EUREF GB 92);
- EUREF GB 2001, the most recent campaign of mostly CORS but also including 2 stations that were part of both EUREF EIR/GB 95 and EUREF GB 92 and 1 station that was just part of EUREF GB 92.

The table below summarises the information requested by the TWG

No. non-permanent EUREF stations	Average dist. between	Coherence with EUREF database	Internal use	Maintenance strategy
3 current 25 superseded	Between 3 current: $(225+442)/2 = 333$ km	EUREF GB 92 and EUREF EIR/GB 95 are in the database but EUREF GB 2001 is not, although the data has been submitted.	All stations considered part of 2 nd order "passive" network. 1 st order network is EUREF GB 2001 CORS	Majority of points are marked with a plaque stating their purpose and giving contact information. No specific maintenance strategy involving regular re-occupation.