National Report of Great Britain 2019

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Abstract. Activities of Ordnance Survey, the national mapping agency of Great Britain. Also, activities from British Isles continuous GNSS Facility (BIGF) and Newcastle University.

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1 Ordnance Survey activities

1.1 National GNSS network

The OS Net® network contains 118 stations, runs on the Trimble Pivot Platform (TPP)™ software and delivers RTK corrections via GSM and GPRS to approximately 200 Ordnance Survey surveyors. Public services are also available via Ordnance Survey commercial partners.

Commercial partners take the raw GNSS data streams from OS Net servers via NTRIP and use them to generate their own correction services.

Current commercial partners offering RTK service in Great Britain are AXIO-NET, Leica, Soil Essentials, Topcon and Trimble. Current partner details can be found at :
http://www.ordnancesurvey.co.uk/business-and-government/products/os-net/index.html.

A complete receiver upgrade was carried out in the last year. Only a small number of stations (in remote islands) remain to be changed but should be completed by end of June 2019. Half the network is now equipped with Septentrio PolarX5 receivers and the other half is Trimble Alloy receivers. There is also a small number of Leica GR50 receivers. The receiver types are mixed evenly across the whole network to mitigate against total network failure in the (rare) event of a problem effecting one type of receiver.

Fig. 1 OS Net GNSS Network

A number of new antennas have also been purchased and, as part of a maintenance

programme, will be used to replace costal location antennas that have been badly corroded.

The entire network is now streaming data for all four main GNSS constellations (GPS, GLONASS, Galileo and BeiDou) to our commercial partners.

Four constellation data will also be recorded to RINEX but this development is currently on hold pending an upgrade of the server hardware and also of the server configurations. A dedicated data management server is being planned and this will allow for reliable storage of RINEX and its delivery to users.

A trial is underway to test 4g back up communication links so as to ensure the highest availability of OS Net data.

1.2 EPN data submissions

The current EPN submissions from GB are hourly data from: OS Net stations ADAR, ARIS, CHIO, DARE, EDIN, INVR, LERI, PMTH, SCIL, SHOE, SNEO and SWAS; Natural Environment Research Council (NERC) stations HERS and HERT; Newcastle University station MORP. University of Nottingham station NEWL contributes 24 hour files.

Once the OS Net server upgrade is complete (see section 1.1) all OS Net EPN stations will contribute GPS+GLO+GAL+BDS RINEX v3 format files along side the existing RINEX v2 (GPS+GLO) files.

Stations DARE, INVR, HERT and SHOE provide also real time data. Real time data from any other OS Net station is not possible due to conflict with OS Net partner's commercial operations.

1.3 Geodetic activity

A geodetic policy and strategy document will be published soon. It will set out OS policies on OS Net operation and provision of data to users and geodetic activities. The document will also include planned activities including the planned OS Net improvements and trials detailed in section 1.1.

A consultation is planned on changing the national mapping coordinate reference system, OSGB36 National Grid, to a new grid sourced from ETRS89. A consultation is also planned on the possibility of adopting a purely gravimetric height system in replacement to the current "height corrector surface" model aligned to old benchmarks.

2 BIGF – British Isles continuous GNSS Facility

BIGF archives quality-assured RINEX data and creates derived products, based on a network of continuous GNSS stations sited throughout the British Isles. This network includes the OS Net stations of OSGB plus stations of Ordnance Survey Ireland and Land & Property Services Northern Ireland. It also includes a number of 'scientific' stations established by: the UK Met Office; the University of Nottingham; the UK Environment Agency Thames Region; the Space Geodesy Facility at Herstmonceux; Newcastle University; and the University of Hertfordshire, with the University of Nottingham's contribution being carried out in collaboration with the National Oceanography Centre, Liverpool.

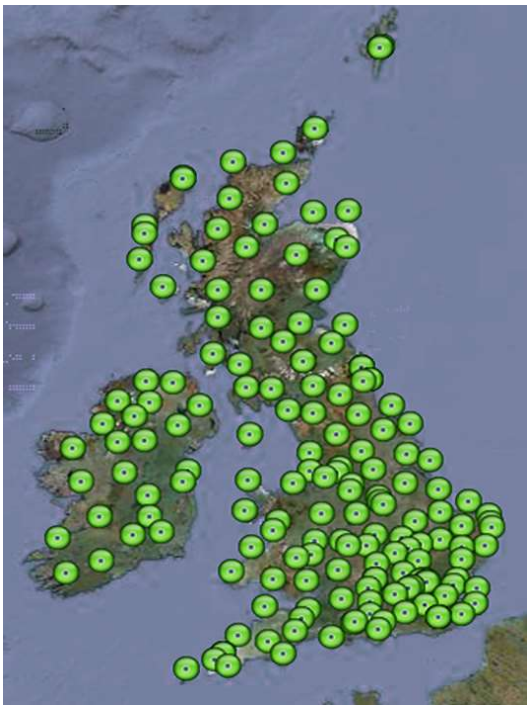

Fig. 2 The BIGF Network 2019

Figure 2 shows the current network of around 150 continuous GNSS stations, which includes three stations (HERS, HERT, MORP) that are part of the IGS, and 21 stations (ADAR, ARIS, BELF, CHIO, CSTB/CASB, DARE, EDIN, ENIS, FOYL, HERS, HERT, INVR, LERI, MORP, NEWL, PMTH, SCIL, SHOE, SNEO, SWAS, TLLG) that are part of the EPN. In addition, archived data from ten stations at tide gauges (ABER, DVTG, LWTG, LIVE, LOWE, NEWL, NSTG/NSLG, PMTG, SHEE, SWTG) are included in the IGS TIGA

Project, and all current stations are included in the EUMETNET (Network of European Meteorological Services) GNSS water vapour programme (E-GVAP).

BIGF is operated from the University of Nottingham, and has been since 1998. From 2004 to 2018 it was funded as part of the Natural Environment Research Council (NERC) Services and Facilities portfolio. Then, in 2018 it was incorporated into British Geological Survey (BGS) core activities and is funded through UK Research and Innovation (UKRI). For more information, see www.bigf.ac.uk.

3 Newcastle University

3.1 Techniques in Global Navigation Satellite Systems and Synthetic Aperture Radar

Grayson et al. (2018) investigated the use of GPS kinematic Precise Point Positioning (PPP) of a drone as an alternative to the traditional survey of ground control points; Guo et al. (2018) carried out a related methodological study into the improved performance of multi-GNSS PPP compared with GPS-only PPP, with precision agriculture applications in mind.

Long et al. (2018) and Wang et al. (2018a, 2018b) have developed a number of novel data analysis methods for ground-based synthetic aperture radar (GB-SAR) deformation monitoring. Luo et al. (2019) have derived a new range split spectrum method that permits satellite InSAR measurements of ground deformation in the presence of high strains.

3.2 National and international geodetic networks

Newcastle University has continued to operate IGS sites 'MORP' (Morpeth, England) and 'ROTH' (Rothera, Antarctica) and TIGA site 'NSLG' (North Shields Tide Gauge, England). MORP and NSLG both contribute to the NERC 'BIG F' data repository www.bigf.ac.uk; the former is also part of the EUREF Permanent Network.

Parker et al. (2017) reviewed the requirements and operational considerations for GNSS and InSAR monitoring of vertical land motions at tide gauges.

3.3 Glaciological and cryospheric geodetic applications

Sasgen et al. (2017, 2018) derived a new multi-technique geodetic dataset comprising GPS deformation monitoring, radar altimetric snow surface elevation change, and GRACE time-variable gravimetry and applied it to the problem of separating present-day ice mass change from bedrock mass change in Antarctica. Shepherd et al. (2018) presented another analysis of Antarctic ice mass change in the modern satellite era, based on the elevation change, gravity change, and input-output methods.

3.4 Geodetic measurement of tectonic strain

Walters et al. (2018) used InSAR measurements of the 2016 central Italy earthquake sequence to develop a model of fault interaction. Yu et al. (2018) provided another study of co-seismic ground deformation, showing that small displacements could be observed effectively by InSAR with the aid of an assimilative tropospheric model.

3.5 Other geodetic deformation monitoring

Deng et al. (2018) measured city subsidence in Beijing using PS-InSAR; Liu et al. (2018) performed similar investigations in Shenzen with InSAR time series analysis. Al-Husseinawi et al. (2018) carried out the first InSAR-based study of post-seismic dam deformation.

3.6 Atmospheric studies in geodesy

Yu et al. (2017) have continued their work on high-resolution tropospheric water vapour delay corrections from GPS observations and numerical weather models, which could be used in near-real-time to correct InSAR measurements.

3.7 Other geodetic applications

Zhuang et al. (2016) used InSAR in support of studies of loess redistribution and landslides following the 1920 Haiyun (NW China earthquake).

Clement et al. (2018) have developed an SAR-based method for the characterisation of flooding. Moore et al. (2018) have derived a new method for the analysis of Cryosat altimetry data as a means of gauging inland water levels and river flow.

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