National Report of Great Britain 2021

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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), Newcastle University and NERC Space Geodesy Facility

Keywords. Ordnance Survey, British Isles continuous GNSS Facility (BIGF), Newcastle University, NERC Space Geodesy Facility.

1 Ordnance Survey activities

1.1 National GNSS network

The OS Net® network contains 114 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.

Following the upgrade of all receivers in 2019 a complete upgrade and reorganisation of the system servers has taken place.

Fig. 1 OS Net GNSS Network

A dedicated data management server now handles storage of RINEX and its delivery to users whilst a clustered pair of servers focus on “production” activities and real time data streams.

4G/5G back up communication links are still being trailled so as to ensure the highest availability of OS Net data.

1.2 EPN and EPOS data submissions

The current OS Net EPN submissions are hourly data from stations ADAR, ARIS, CHIO, DARE, INVR, LERI, PMTH, SCIL, SHOE, SNEO and SWAS; Unfortunately, the long-term station EDIN at Edinburgh has been lost.

The OS Net server upgrade (see section 1.1) has enabled “end to end” data flow in RINEX v3 format. So, all OS Net EPN stations now contribute GPS+GLO+GAL+BDS RINEX v3 format files and the RINEX v2 (GPS+GLO) files have been stopped.

Data from the entire OS Net network is also now submitted to the EPOS archive (https://gnss-epos.eu/) and all OS Net station log files are now managed and made available via the M3G facility (https://gnss-metadata.eu/).

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.

Non OS Net stations contributing hourly data to EPN are Natural Environment Research Council (NERC) stations HERS and HERT; Newcastle University station MORP and University of Nottingham station NEWL.

1.3 GNSS EVENT NOTIFICATION SERVICE (GENS)

GENS is an ESA sponsored project with support from the UK Space Agency under the NAVISP programme (https://navisp.esa.int/project/details/116/show). The project is creating an initial national demonstration capability for GNSS event notification. The current project will deliver a pre-operational capability to manage GNSS threats and vulnerabilities for a wide variety of stakeholders, including critical infrastructure.

Raw GNSS spectrum data from OS Net Trimble Alloy and Septentrio PolaRx5 receivers feeds directly into the GENS servers. The data is combined in a suite of nationally available sensors and other data sources to integrate multiple inputs to provide and enable GNSS service threat identification and response.

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 OSNet stations of OSGB plus stations of Ordnance Survey Ireland and Ordnance Survey 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.

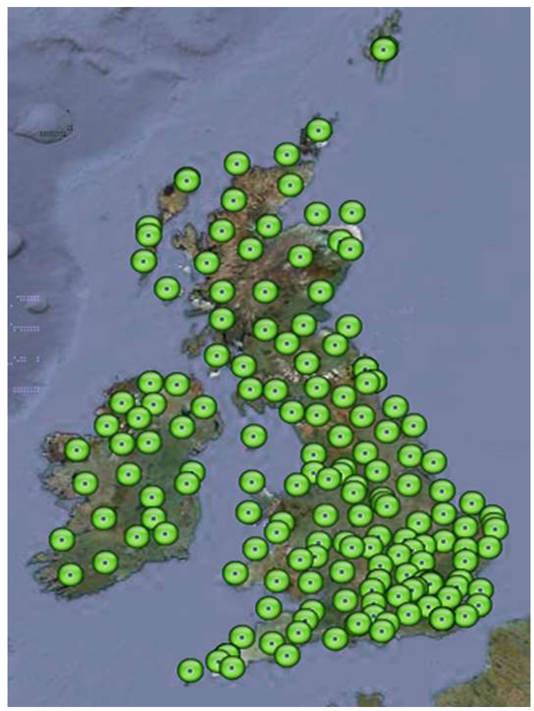

Fig. 2 The BIGF Network 2021

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 19 stations (ADAR, ARIS, CHIO, DARE, ENIS, FOYL, HERS, HERT, INVR, LERI, MORP, NEWL, PMTH, SCIL, SHOE, SNEO, SWAS, TLL1, VLN1) 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

Activities 2019 - 2021.

3.1 Techniques in Global Navigation Satellite Systems and Synthetic Aperture Radar

Albino et al (2020) presented an automated method for volume change detection using InSAR time series. Wang et al (2020a) also presented new methods of deformation analysis using InSAR. Meanwhile Luo et al (2019b, 2020) continued their work on DEM and feature identification in InSAR, and Wang et al (2019a, 2019b)on Ground-Based SAR.

Koulali & Clarke (2020) presented a method for removing the transient effects on position time series of seasonal snow intrusion into GNSS antenna radomes.

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.

3.3 Glaciological and cryospheric geodetic applications

Shepherd et al (2020) presented another analysis of Greenland 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 processes

Feng et al (2019), Song et al (2019), Roger et al (2020), and Wang et al (2020c) presented geodetic studies of earthquake deformation in various worldwide locations. Yongsheng et al (2020) also studied inter-seismic deformation in Tibet.

3.5 Geodynamics and surface mass loading

Wang et al (2020b) demonstrated that anelastic modelling of M2 ocean tide loading displacement led to significantly better agreement with GNSS observations around the East China Sea. Abbaszadeh et al (2020) showed the benefits of integrating GPS and GLONASS observations for the measurement of ocean tide loading at other tidal periods. Yu et al (2020c) demonstrated the effects of ocean tide loading in InSAR data.

Nicolas et al (2021) investigated hydrological loading models in the Amazon basin, while Meldebekova et al (2020) observed subsidence due to aquifer exploitation in Afghanistan.

3.6 Geotechnical applications of geodesy

Dai et al (2019, 2020) provided a study of the catastrophic 2017 Xinmo landslide in China, and a review of developments in landslide monitoring and early warning using Earth Observation techniques. Chen et al (2020) applied InSAR techniques to the understanding of coal mining subsidence.

3.7 Atmospheric studies in geodesy

Pearson et al (2020) used GNSS data to validate the ECMWF model for Sentinel-3A altimetric tropospheric delays inland.

Yu et al (2020b) considered the ways in which network RTK GNSS infrastructure should be improved in order to reduce tropospheric errors

3.8 Other geodetic applications

Zhou et al (2019) used L-band InSAR time series data to quantify degradation of topical peatlands

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4 NERC Space Geodesy Facility University

http://sgf.rgo.ac.uk/

The NERC (Natural Environment Research Council) Space Geodesy Facility operates multiple observational techniques. The SGF operates an SLR station, IGS sites HERS and HERT and a permanently installed absolute gravimeter. The site has also been chosen by the British Geological Survey to host one of its broadband seismometers (HMNX) that automatically contributes in realtime to BGS' British Isles seismic network.