

NATIONAL HEIGHT IN GREAT BRITAIN

Colin Fane
2nd June 2015

GB agency stakeholders:

Sea Height datum (Chart Datum) – UK Hydrographic Office (UKHO)

Tide gauges – National Oceanographic Centre (NOC) (was OS until 1984)

Gravity – British Geological Survey (BGS)

Land Height datum – Ordnance Survey (OS)

OS (GB) vertical datums

GB National datum:

Newlyn (ODN)

Local (island) datums:

St. Marys (Scilly Isles)

Stornoway (Outer Hebrides)

St Kilda

Lerwick (Shetland Isles)

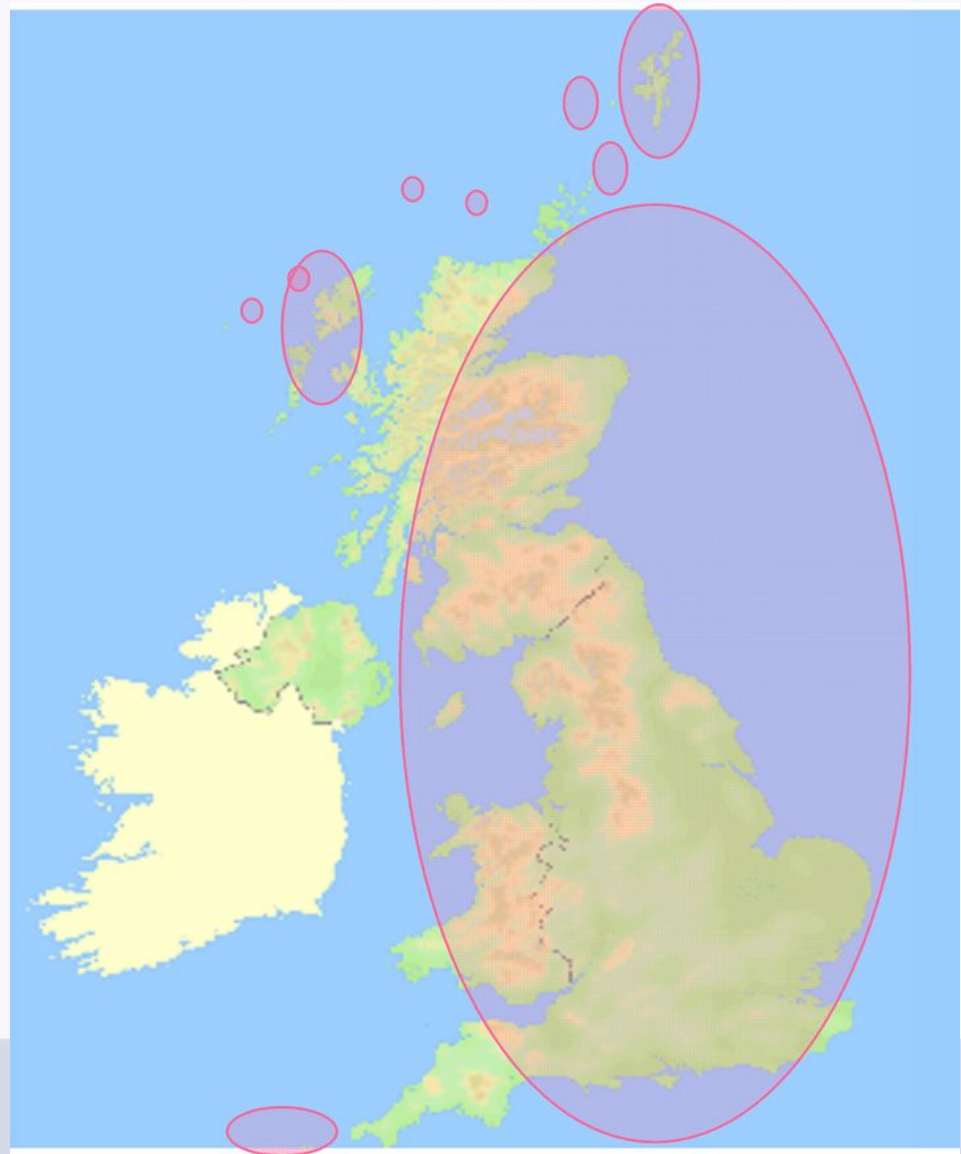
Fair Isle

Flannan Isles

North Rona

Sule Skerry

Foula



Ordnance Survey responsibilities

Define (realise) National CRS on the land

Via public website, enable users to access the national CRS and where necessary provide tools to allow users to realise their own surveys relative to the national CRS :

- Free 30sec RINEX data from CORS

- Free access to precise transformations: OSTN02 (2D) and OSGM02 (height)

- Provide free access to legacy databases (benchmarks, triangulation stations, passive GPS stations) with **BIG**

CAVEAT - use at own risk!

Vertical CRS (ODN)

Realised by Fundamental Bench Mark (FBM) network (1912-1952)

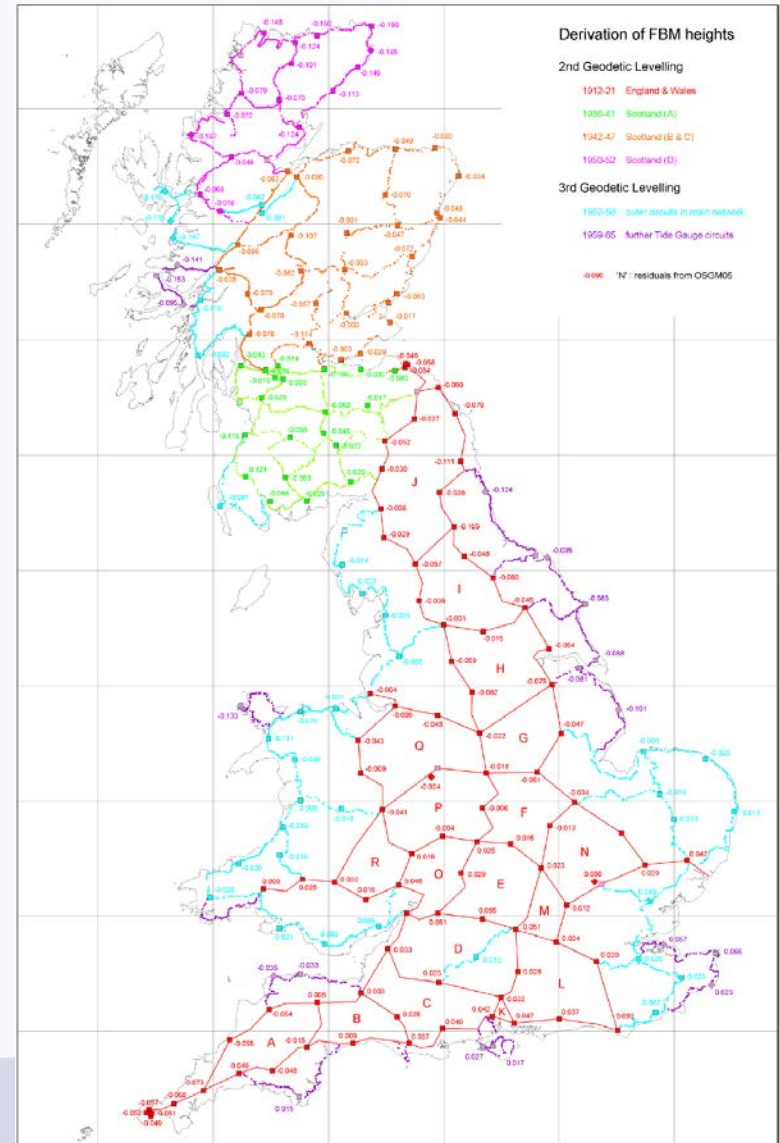
Approx 200 monuments

Observed and adjusted in blocks

Orthometric corrections based upon normal gravity, latitude and height

Therefore ODN heights are *Normal Orthometric* heights

Over 500,000 lower order BMs



Datum

At outset of 2nd Geodetic Levelling intended to set vertical datum as mean sea level as determined across 3 purpose built tide gauges: Newlyn (SW), Dunbar (NW) and Felixstowe (SE)

Good agreement between Newlyn and Felixstowe

Apparent difference of mean sea level between Newlyn and Dunbar was 0.247m, far higher than the estimated probable error $\pm 0.048\text{m}$

It was concluded that there must be a real difference in mean sea level between Newlyn and Dunbar, even allowing for different meteorological effects at both stations.

It was decided to fix the levelling datum to mean sea level as observed at Newlyn alone, for the period 1st May 1915 to 30th April 1921.

Differences between 2nd (1912-1952) and 3rd (1951-1958) Geodetic Levellings much higher than the estimated probable errors

Suspected systematic errors causing 'slope' in both levellings

Could not determine cause of differences between 2nd and 3rd Geodetic Levellings

Fourth Geodetic Levelling planned but never undertaken

Rise of GNSS levelling has made traditional levelling on a National scale (arguably) redundant

Users realisation of vertical CRS

OS have not maintained BM network for >30 years

OS recommend ODN altitudes in GB are realised via GNSS levelling (ETRS89 GNSS observations transformed using quasi-geoid model OSGM02)

OS collaborated with professional bodies (RICS, TSA) to promote GNSS levelling as best method to realise ODN

RICS and TSA both provide guidelines on best use of GNSS and NRTK
(<http://www.rics.org/Global/Virtually%20Level.pdf>
<http://www.tsa-uk.org.uk/for-clients/guidance-notes/>)

OSGM02

Current official 'geoid model' for GB and Ireland

Created by consortium of KMS (Denmark), UCL (UK) and University of Copenhagen

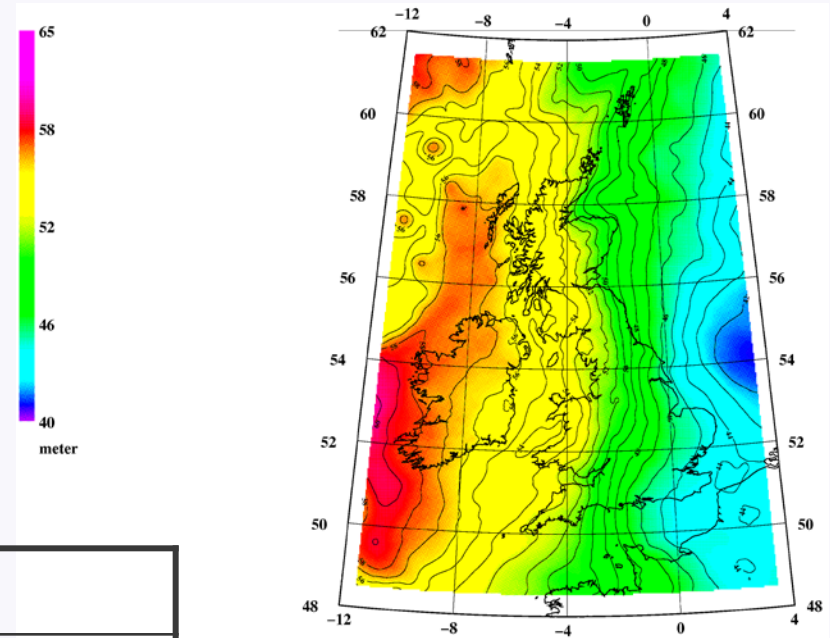
Gravimetric geoid determined from detailed elevation and gravity data (land and marine gravity data, EGM96 and KMS98 satellite gravity model)

Actually 'height corrector' model – models difference between ETRS89 and Ordnance Datum

Gravimetric geoid fitted to GPS/FBM network in GB with an r.m.s of 0.032m [Forsberg et al 2002]

OSGM05

OSGM02 recomputed by DNSC using the GRACE geopotential model GGM02S to provide better long-wavelength information



Harmonic Degree	coefficients
0 – 90	GGM02S
90-100	Mixed GGM02S and EGM96 (linear transition between the two sets)
100-360	EGM96

OSGM02-OSGM05

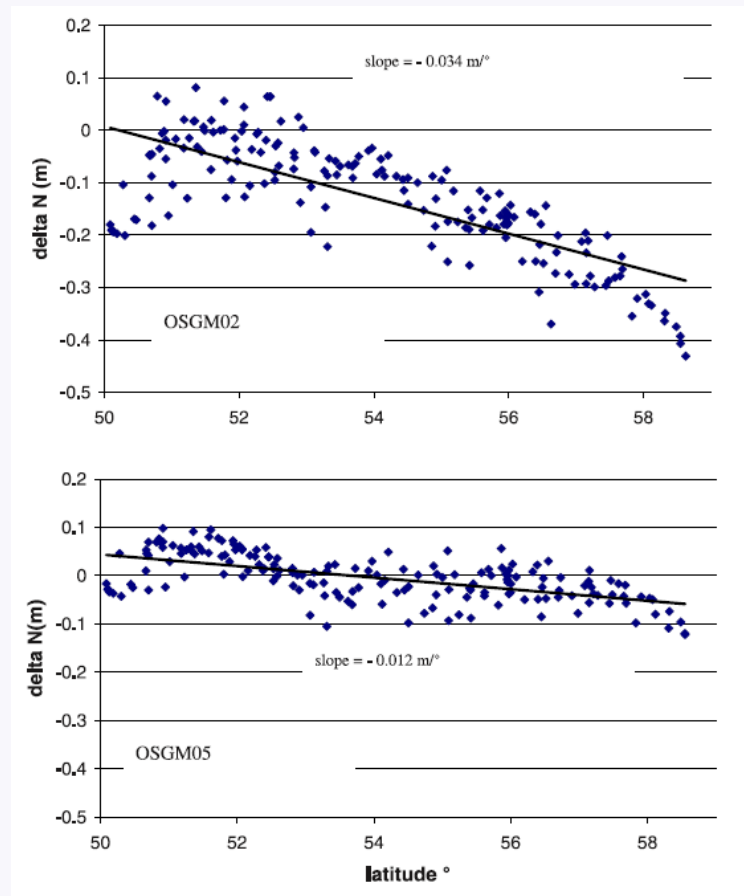
Levelling and GPS data not changed

Changes in gravity field model have systematically aligned gravimetric geoid with the levelling datum

Significant and systematic reductions in tilt and rms differences between N_l and N_g

Given residual tilt would be interesting to see effects of GOCE data

[Ziebart et al 2008]

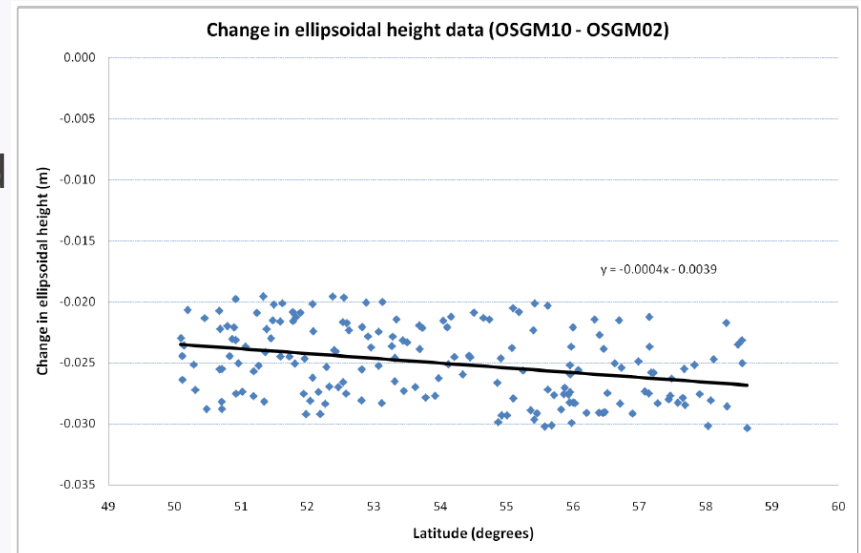


OSVRF10

OSGM05 fitted to FBM network and other selected BMs

Addresses weaknesses in OSGM02 particularly west coast of Scotland, Hebrides, Scilly Isles

Systematic difference between input ellipsoidal heights due to redefinition of reference frame (EUREF GB 2001 – ITRF97) (EUREF IE/UK 2009 – ITRF2005)



Mean	-0.025 m
Sigma	0.003 m
Maximum	-0.020 m
Minimum	-0.030 m

Future?

Given poor state of benchmark network and that GB users are already used to GNSS levelling, already looking at replacement for OSVRF10 and possibility of introducing purely gravimetric geoid incorporating GOCE data

Policy is always to enable forwards compatibility with superseded models (eg provide tools to go from OSGM02 to OSGM10)

Colin Fane
Colin.fane@os.uk
023 8005 5506

OS is Britain's mapping agency. To find out more about us, go to os.uk. If you'd like to talk to us, call +44 (0)3456 050505. For the hard of hearing, use Textphone +44 (0)2380 056146. Ordnance Survey © Crown copyright 2015



[insert protective marking - see QSP 032]