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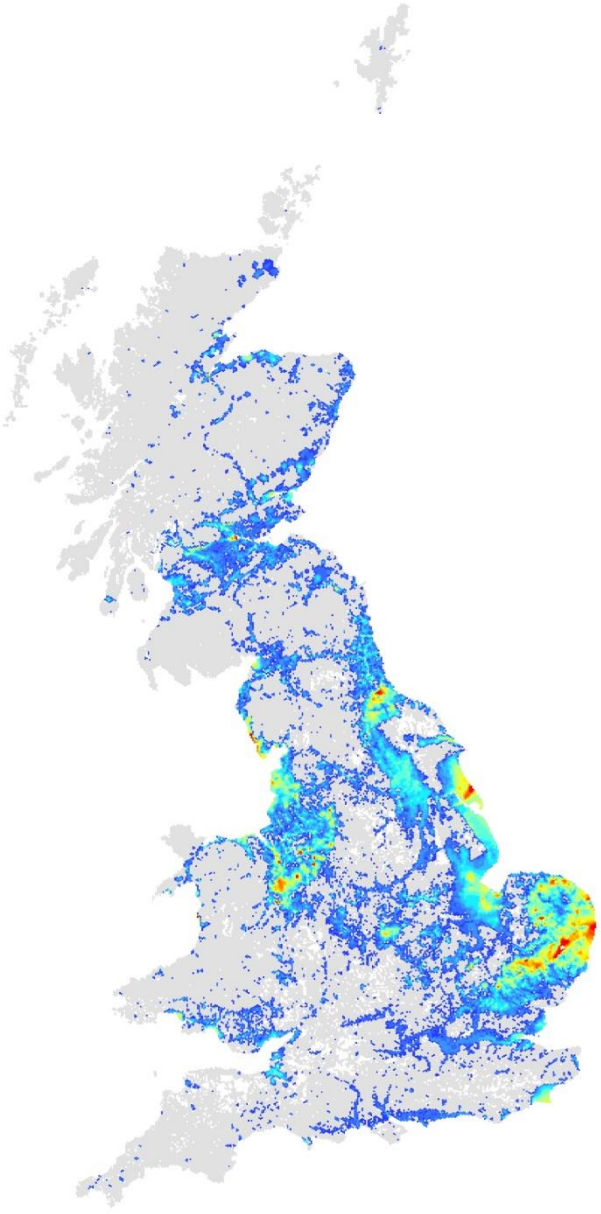
User Guide for the British Geological Survey Superficial Deposit Thickness (1Km Hex-Grid) dataset

Open Report OR/16/057



BRITISH GEOLOGICAL SURVEY

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User Guide for the British Geological Survey Superficial Deposit Thickness (1Km Hex-Grid) dataset

R Lawley

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National Grid Reference

SW corner 999999,999999
Centre point 999999,999999
NE corner 999999,999999

Map

Sheet 999, 1:99 000 scale, Map name

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Foreword

This report is the user-guide to the content and application of the 1km Hex-grid version of national Superficial Deposits Thickness Model (SDTM_1k) produced by the British Geological Survey (BGS). The model demonstrates the variation in thickness of Quaternary-age superficial deposits across Great Britain at an areal resolution of c.2.6km^2. The purpose of this user guide is to enable those downloading this dataset to have a better appreciation of how the data set has been created and therefore better understand the potential applications and limitations that the dataset may have.

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Summary

This report presents a description and review of the methodology developed by the British geological Survey (BGS) to produce a national scale assessment of superficial deposit thickness i.e. the thickness variation of all unconsolidated material deposited in the last 2.6 million years. The methodology for the original 50m resolution model is summarised by BGS technical report OR/09/049. This version of the dataset summarises thickness information via spatial statistics (zonal statistics) on the basis of a regular 1km-sided hexagon grid distributed across the surface of Great Britain.

Acknowledgements

A number of individuals in the Environmental Modelling directorate have contributed to the project and helped compile this report. This assistance has been received at all stages of the study. In addition to the collection and processing of data, many individuals have freely given their advice, and provided the local knowledge.

1 Introduction

Founded in 1835, the British Geological Survey (BGS) is the world's oldest national geological survey and the United Kingdom's premier centre for earth science information and expertise. The BGS provides expert services and impartial advice in all areas of geoscience. Our client base is drawn from the public and private sectors both in the UK and internationally.

Our innovative digital data products aim to help describe the ground surface and what's beneath across the whole of Great Britain. These digital products are based on the outputs of the BGS survey and research programmes and our substantial national data holdings. This data coupled with our in-house Geoscientific knowledge are combined to provide products relevant to a wide range of users in central and local government, insurance and housing industry, engineering and environmental business, and the British public.

Further information on all the digital data provided by the BGS can be found on our website at http://www.bgs.ac.uk/data/digitaldata/digitaldata.cfm or by contacting:

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2 About the BGS_SDTM_1Km Dataset

2.1 BACKGROUND

The dataset shows the modelled variation in thickness of unconsolidated deposits, less than 2.6 million years old across Great Britain (known as Quaternary-age, Superficial deposits). Superficial deposits include everything that is fluvial, glacial, marine, residual, aeolian or anthropogenic in origin. The thickness of these deposits also represents the depth to top of bedrock (rocks older than Quaternary in age). The thickness variation across Great Britain partly reflects how these deposits were laid down and also their preservation since deposition. The distribution of these deposits is not uniform, sometimes they are laid down in thin veneers, sometimes they are laid down as large irregular masses and sometimes they are laid down as infill to deeply incised, narrow valleys. The complexity of the thickness variation is a function of the complex, pre-quaternary terrain hidden by these units and their mode of deposition.

2.2 WHO MIGHT REQUIRE THIS DATA?

This dataset is for users who are seeking some summary information about the average depth (and maximum depth) to bedrock/thickness of superficial deposits across Great Britain. The layer of contact between Superficial and Bedrock units is known as 'geological rockhead' and is

an important surface for geologists, civil engineers, hydrogeologists and environmental scientists because it is where most physical and chemical properties of the deposits dramatically change. Strength, lithology, conductivity, porosity, permeability are most strongly affected by this transition surface, so an understanding of how deep it lies beneath ground level is important to establish.

The Superficial thickness models have been created by interpolating values derived from borehole and map information held in BGS archives.

This dataset provides a summarised set of statistics suitable for a national overview of thickness variation. Users seeking information about specific locations should consult the full resolution dataset here: http://www.bgs.ac.uk/products/onshore/superficialThickness.html

2.3 WHAT THE DATASET SHOWS?

This dataset shows the variation of the thickness of Superficial (Quaternary – age) deposits across Great Britain.

The data are presented as a vector map of interlocking hexagon cells (side length 1km, area c.2.6 Km^2) covering the landmass of Great Britain as a regular grid (see figure 1).

Each hexagon cell is attributed with a series of statistics about the thickness of the underlying Quaternary units (e.g. average); additional information relating to the thickness models and the coverage of underpinning data is provided (see figure 2).

The data is all derived by spatially summarising the information originally created for the high-resolution Superficial Deposit Thickness Model (50m cell size).

Depending upon the type of GIS software you are using to view the data you should be able to visualise three of the attributes as colour maps (BGS supplies vector data with appropriate colour styling for a range of software platforms). This data can only be viewed within a GIS as a vector layer of information.

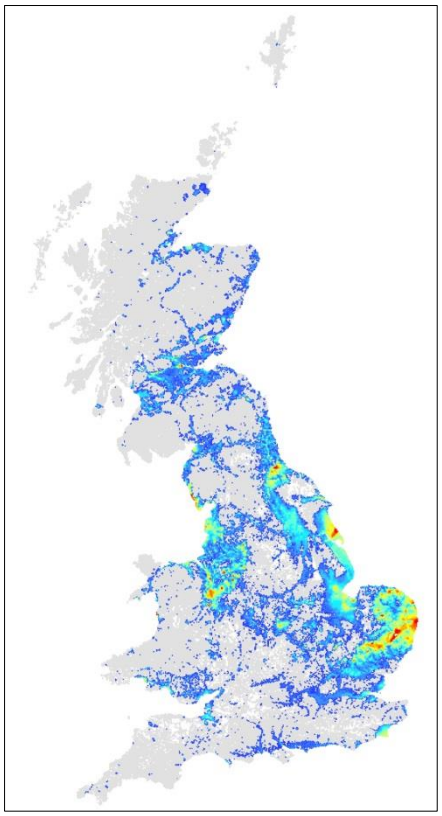
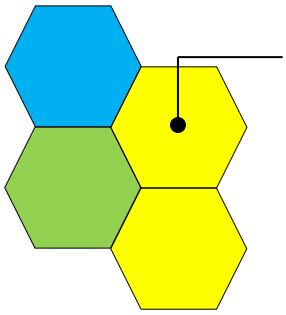


Figure 1 Hex-Grid coverage of mean thickness of Quaternary deposits

Example of a cell of data :



BSTM_MEAN	7
BSTM_MAX	23
COVER_PCT	0.33
VERSION	V1
UID	bgsn:SDTM_hexv1_9433

Figure 2 Attribution of the Hexagon cells

Full details about the attribution are provided below in section 3.3.

3 Technical Information

3.1 DEFINITIONS

This dataset summarises information from one component of the original, high resolution superficial deposit thickness model, (the BSTM variant). The following definitions may help users decide how to use the information held within the SDTM_1Km dataset.

BSTM: The BSTM (Basic Superficial Thickness Model) is a model of thickness variation directly derived from archive borehole records and map records, it represent the simplest method of interpolating data points of thickness.

SUPERFICIAL: Unconsolidated deposits that mantle bedrock. Typically formed in the last 2.588 million years

QUATERNARY: a geological period of time extending back to 2.588 million years ago

BEDROCK: Lithified rocks, generally older than Quaternary in age.

MEAN: The "average" (sum/n) of a collection (n) of values. In this context the average thickness of deposits for any given hexagon cell (each hexagon covering an area of c.2.6 km^2)

MAXIMUM: The maximum value of a collection of values. In this context the greatest thickness of deposits encountered beneath any given hexagon cell.

3.2 SCALE

The SDTM_1K dataset provides summary statistics at a ground resolution of c.2.6 km^2 per cell.

3.3 FIELD DESCRIPTIONS

The SDTM_1K dataset contains five attributes per hexagon cell. These are described in table 1 below. Users should note that these attributes are all "summary" statistics and derive simple mean, maximum and totals of aggregated values held within the higher resolution SDTM _V5 models. Further details about the aggregated data can be found in section 3.4 below.

Table 1 Attribute table field descriptions

FIELD NAME	FIELD TYPE	DESCRIPTION
BSTM_MEAN	Float value e.g. 7.0	The mean value of thickness in metres (rounded to nearest m), per cell as derived from the original BSTM thickness model. This is the recommended attribute to use to derive a mean thickness of superficial materials (using a model based on borehole-proven thicknesses). **Note that the data includes a generic minimum value of 1m thickness for any area where superficial material is present, but is unproven by boreholes (typically shown in maps by a grey colour)**
BSTM_MAX	Float value e.g. 23	The maximum value of thickness in metres (rounded to nearest m), per cell as derived from the original BSTM thickness model. This value provides an indication of the maximum thickness underlying the hexagon (using a model based on borehole-proven thicknesses).). **Note that the data includes a generic minimum value of 1m thickness for any area where superficial material is present, but is unproven by boreholes (typically shown in maps by a grey colour)**
COVER_PCT	Float value e.g. 0.33 (33%)	The percentage (expressed as a decimal) of the cell for which superficial thickness has been modelled (this value provides an indication for the amount of superficial cover present beneath the cell). A value of 0 indicates bedrock (or water/sea) at surface across the entirety of the hexagon.

VERSION	Text value (2 chars) e.g. V1	The version of the HEX grid model. All data within this model is based upon the original SDTM_V5 dataset created in 2010.
UID	Text value (25 chars) e.g. **bgsn:SDTM_hexv1_9433**	The unique identifier of the cell.

Colour map examples of each of above attributes (excluding version and UID) are provided in Appendix 1.

3.4 CREATION OF THE DATASET

The data in the SDTM_1Km dataset has been generalised (using spatial statistics) from the original, high resolution BGS Superficial Deposit Thickness Models (first published in 2010). Details of how the original models were made can found in their downloadable user guide here:

(http://www.bgs.ac.uk/products/onshore/superficialThickness.html).

To make this dataset, the original BSTM (Basic Superficial Thickness Model) have been spatially summarised by aggregating the original, 50m resolution raster, data into vector hexagons of 2.6 km^2 area. Figure 3 below demonstrates the differences between the original and summarised dataset.

A typical 2.6 Km^2 hexagon cell contains the equivalent of just over one thousand raster cells (each is 50m by 50m) from the original models. This means that each hexagon can extract its summary values from up to c. 1000 input cells. However, users should note that some hexagon cells occur in areas where the underlying data is only partially available i.e. where bedrock or water is present. For these hexagons the summary statistics are captured from number of input cells available (1 – 999). The Cover_pct attribute provided in the data provides an indicator of the percentage of the hexagon that is underlain by the original models 1.4 a value of 0.2 indicates only 20% of the hexagon has superficial deposits for which averages/maxima can be calculated).

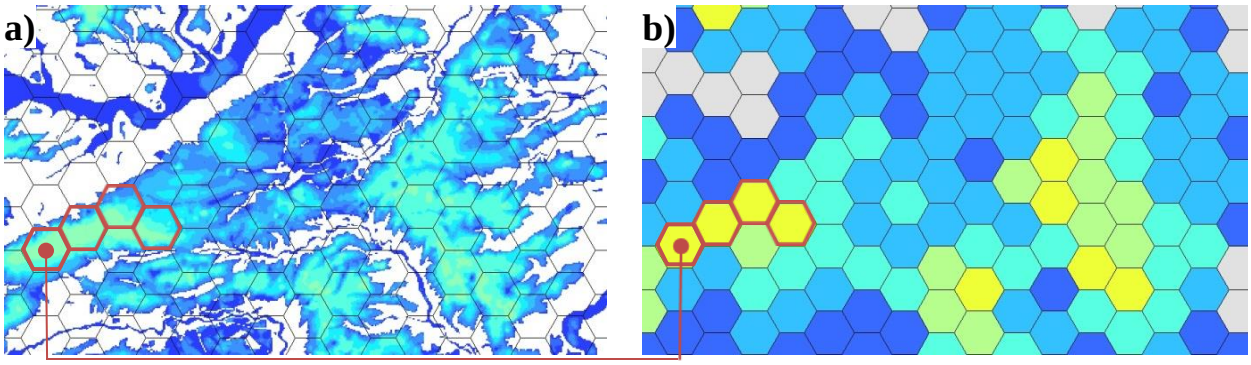


Figure 3 full resolution dataset (a), equivalent generalised hexagon data (b)

Summary statistics are created in ESRI's ARCGIS using its zonal statistics tool. The tool is used to extract mean and maximum values from the BSTM model. Minimum values are not extracted by default. This is because many parts of the UK have bedrock or water/sea at surface (which returns a minimum thickness of 0m) and also because of the way the original models are seeded with a "nominal" value of 1m for where superficial deposits are mapped (by our survey) but are

unproven by boreholes (therefore they are potentially much thicker than 1m, but we currently cannot prove it). Users need to be aware that summary statistics derived in areas where superficial deposits are absent, or have unproven thickness (i.e. no boreholes) are likely to under represent actual thickness of materials. As can be seen in figure 3, the generalisation significantly reduces the spatial precision of the model in areas of complex superficial cover and can lead to a degree of smoothing of the represented values (the example in figure 3 is for mean values, and so will be significantly smoothed anyway).

3.5 COVERAGE

This dataset covers Great Britain, but excludes the Isle of Man (see also Appendix 1).

Figure 4 Coverage of the dataset

3.6 DATA FORMAT

The SDTM_1Km dataset has been created as vector polygons and are available in a range of GIS formats, including ArcGIS (.shp) and MapInfo (.tab). More specialised formats may be available but may incur additional processing costs.

3.7 LIMITATIONS

There are several factors to consider when using the SDTM. It is a summarisation of mathematical models based on three data sources. As such it is subject to a number of practical limitations and sources of error as follows:

- Data content
- Data density
- Data artefacts
- Limitations of scale
- Limitations of interpolation and errors of methodology.
- The SDTM is based on, and limited to, an interpretation of the records in the possession of The British Geological Survey at the time the data set was created.
- Conversion to a hexagon grid generalises the data altering perception of the spatial distribution. Results of any analysis and subsequent interpretation should be viewed with care.
- Comparison with the underlying source data will reveal variations due to the generalisation process applied.

4 Licensing Information

To encourage the use and re-use of this data we have made it available under the Open Government Licence (www.nationalarchives.gov.uk/doc/open-government-licence/version/3/), subject to the following acknowledgement accompanying the reproduced BGS materials: "Contains British Geological Survey materials ©NERC [year]".

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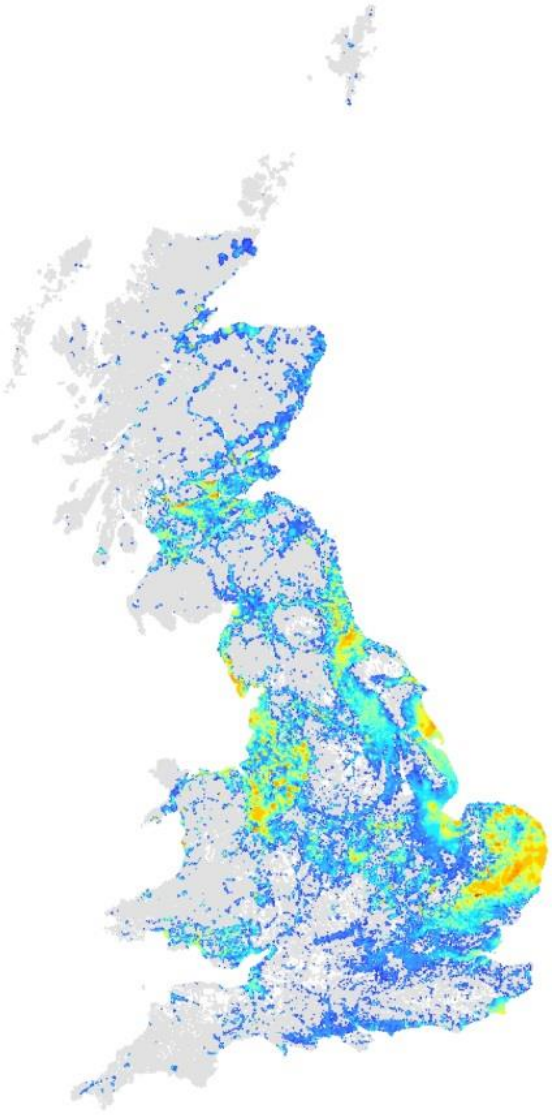
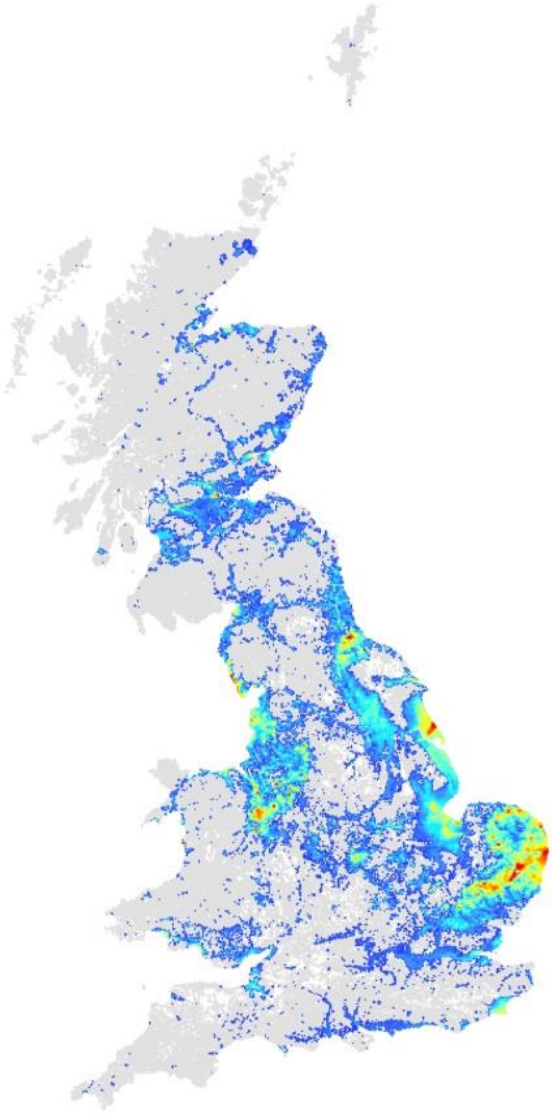
- Map viewers
- Apps
- Downloadable data
- Web services
- Photos and images
- Publications
- Scanned records
- Collections

Please refer to OpenGeoscience (www.bgs.ac.uk/Opengeoscience) for more information and for a full listing of datasets and services available under this service.

Appendix 1



BSTM_Mean: Average thickness of deposits as modelled in the BSTM dataset.



BSTM_Max: Max thickness (per hexagon cell) of deposits as modelled in the BSTM dataset

Cover_PCT: The coverage (per hexagon cell), for which a BSTM/ASTM model exists (also represents an approximation for coverage of Superficial deposits)