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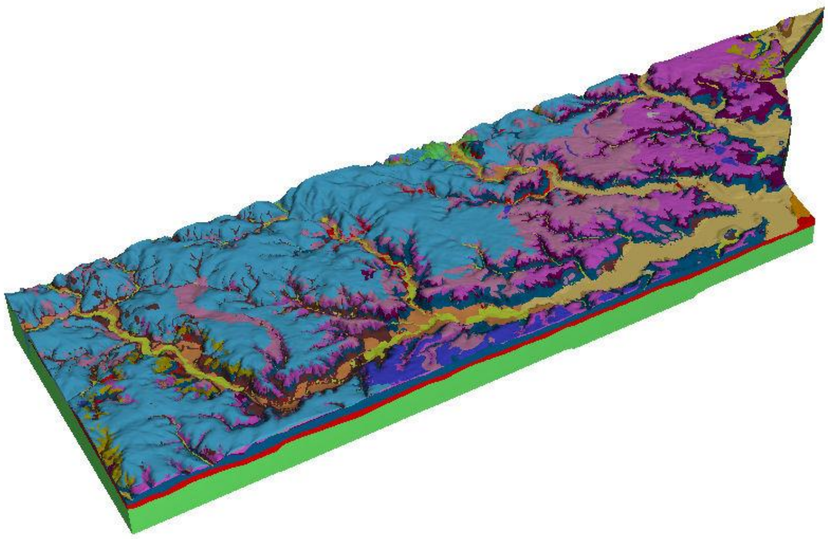
Model metadata summary report for the Ipswich-Sudbury LithoFrame 10-50 model

Geology and Regional Geophysics Programme

Open Report OR/12/080



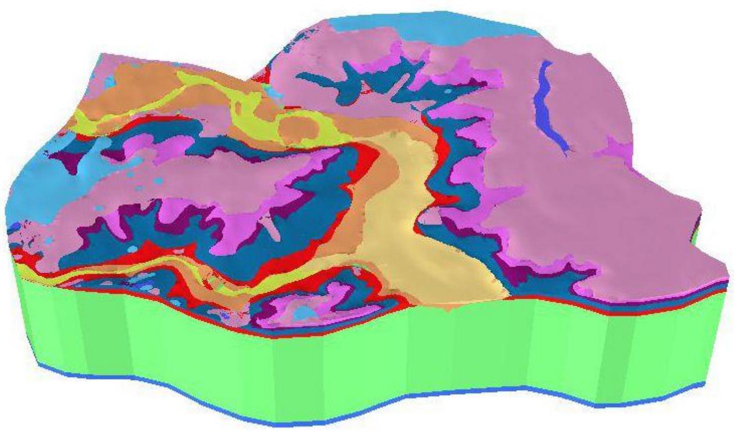
BRITISH GEOLOGICAL SURVEY

GEOLOGY & REGIONAL GEOPHYSICS PROGRAMME

OPEN REPORT OR/12/080

Model metadata summary report for the Ipswich-Sudbury LithoFrame 10-50 model.

S. Mathers



Keyworth, Nottingham British Geological Survey 2012

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Keywords

3D Modelling, metadata

National Grid Reference

SW corner 580000 230000
NE corner 646000 250000

Front cover& frontispiece

Cover picture the calculated block model of the Ipswich-Sudbury area.. *Frontispiece* cookie cut model of the Ipswich urban area.

Bibliographical reference

MATHERS, S.J.2012. Model metadata summary report for the Ipswich-Sudbury LithoFrame 10-50 model. *British Geological Survey Open Report*, OR/12/080. 12pp.

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Summary

This report is the published product of a regional GSI3D model of the Ipswich-Sudbury area of southern East Anglia and north Essex. The model was assembled between 2001-07 concurrently with surveying of the area by S.J. Mathers with a modelling contribution to the TL sheets by A. Benham.

1 Modelled volume, purpose and scale

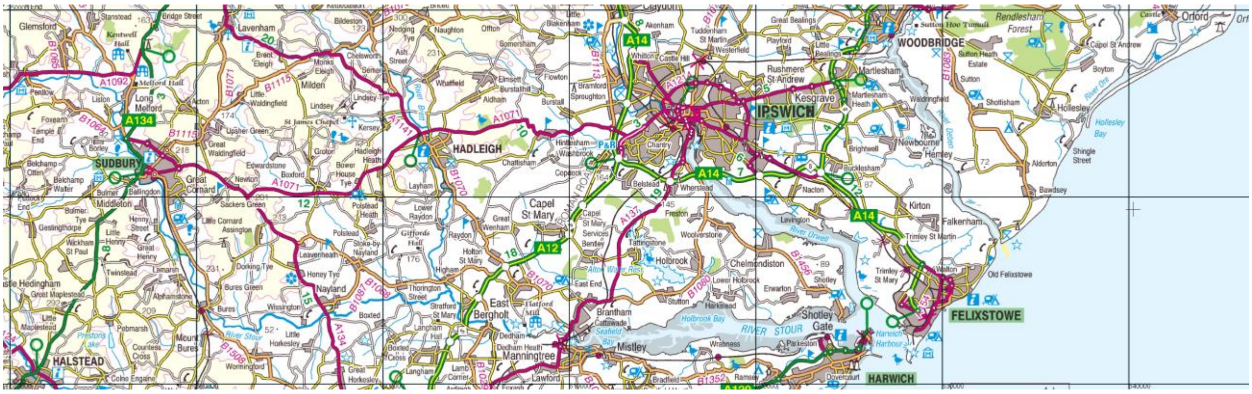

Figure 1. Extent of the Ipswich-Sudbury model OS topography © Crown Copyright

The model covers the 1: 25 000 sheets TL 83,84,93,94 and TM 03,04,13,14,23,24,33,34 and 44 (Figure 1). It was built in 2001-06 as a systematic model build using the 25K sheets as individual tiles and then amalgamating these components to produce a unified regional model in 2006. The model was constructed using 1: 10 000 digital linework with sheets TM 03, 04, 13, 14, 23, 24 produced as part of an integrated mapping-modelling resurvey. The TL portion of the model enabled revision of the approved 1: 10 000 superficial and bedrock linework, TM 33, 34 and 44 were based on linework from the survey completed in 1999. The simple linework means that the 50K maps of these areas included in the Sudbury, Braintree, Ipswich, Colchester, Woodbridge and Felixstowe sheets closely resemble the 10K dataset.

The model was funded as a science budget activity and comprises the first tiled model constructed using the GSI3D software anywhere. The model has been extensively used to test and advance the software methodology from version 1.5 onwards and has provided datasets and screen grabs for training, documentation (manual) and scientific publications.

The model extends to the base of the Cretaceous succession in the area at about -300m OD, the Gault Formation is the lowest modelled unit. The model contains 21 superficial and 8 bedrock units.

An early version of the amalgamated model bundled into the Sub-surface Viewer was licenced to the Environment Agency in January 2007 for onward use by their contractor ENTEC.

The final project file is saved as Ipswich-Sudbury_v4.GSIPR

The complete model takes over an hour to calculate on a Dell Precision M6700

2 Modelled surfaces/volumes

Table 1 Modelled units

code	*name*
QUATERNARY	
bsa	Blown sand
alvu	Alluvium upper layer
stobco	Shoreface and beach upper layer (along coast)
peat	Peat
alv	Main Freshwater Alluvium
itdu	Intertidal Deposits undifferentiated
stob	Shoreface and beach deposits lower layer
lde	Lake deposits
head	Head (thin at surface correlated in sections only)
brk	Brickearth (Stutton Formation)
rtdu	River Terrace Deposits undifferentiated
gsgu	**Glacial sand and Gravel upper**
loftu	**Lowestoft Till upper**
gstc	**Glacial Silt and Clay supramaintill**
gsg	**Glacial Sand and Gravel supramaintill**
gstc1	**Glacial Silt and Clay supratill 1**
loft	**Lowestoft Till (main sheet)**
gstcb1	**Glacial Silt and Clay below till 1**
gsgb1	**Glacial Sand and Gravel below till 1**
gstcb2	**Glacial Silt and Clay below tilll 2**
loftb	**Lowestoft Till basal**
gcd	**Glacial Channel deposits (Gipping-Orwell)**
kes	Kesgrave Sand and Gravel
BEDROCK	
cfc	Chillesford Clay Member (Norwich Crag Formation)
cfb	Chillesford Church Sand Member (Norwich Crag Formation)
rcg	Red Crag Formation
ccg	Coralline Crag Formation
tham	Thames Group (London Clay and Harwich Formation)
llte	Lower London Tertiaries
ck	Chalk Group (undifferentiated)
glt	Gault Formation

Multiple layers of alluvium and storm beach deposits were needed to cope with interdigitated sequences and Holocene evolution. The storm beach deposits change their attribution at the Deben mouth. Within the Anglian glaciation deposits layers of glacial sand and gravel and glacial silt and clay deposits occur both above and below the main Lowestoft Till sheet. Glacial Channel Deposits have been distinguished at depth beneath the valley of the River Gipping and the Orwell Estuary and these have been modelled as an independent unit due to their very variable composition. Elsewhere other channelized deposits are present of r example in the Stour valley but in these other cases it has been possible to model a distinct infill lithology of either Lowestoft Till or Glacial Silt and Clay. The suite of Anglian deposits are shown in blue in the Table above. Legend colours in many cases loosely correspond to the 50K published map sheets and is shown in Figure 2. Because of the difficulty in separating the thin and impersistant Thanet Sand Formation from the overlying Reading Formation (Lambeth Group) they are combined under the older term Lower London Tertiaries. Similarly the Harwich and London Clay formations cannot be mapped out separately and areconsidered together as the Thames Group.

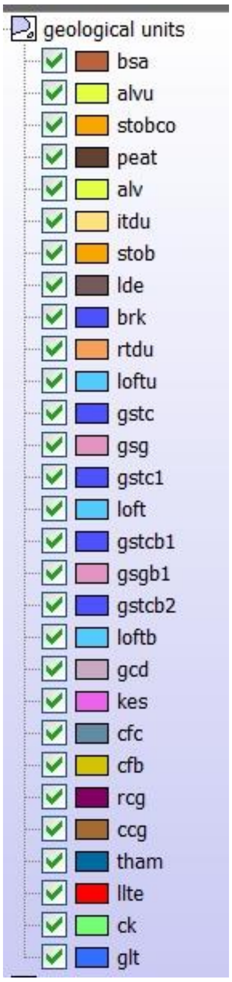

Figure 2. Colour schema used for geological units in the model

3 Modelled faults

The model does not contain any faults

4 Model datasets

GVS & GLEG files

These files were assembled in a combination of Notepad, Wordpad and Excel and iterated as the model expanded and new units were encountered. A regional catch all approach was adopted from the very start. The current files are Ipswich_12.gvs and Ipswich_v12.gleg.

Boreholes

Borehole records examined are as indicated in the3 early stages it was necessary to examine both Keyworth and Wallingford held logs before the two were amalgamated and scanned records were made available. Many start heights were revised in SOBI and some grid references corrected by the data management team. Closely clustered sets of boreholes were not all coded but the deepest and most representative were included; any significant local variation in sequence was also recorded by coding. Entries were all made directly into the corporate Boge data entry application with SJMA as the interpreter..

TM 03 borehole coding TM03NW 1-41 TM03NE 1-46 TM03SW 1-72 and TM03SE 1-19 by S J Mathers in 2003 All Wallingford holdings at 2003 also examined for SW and SE nothing added though.

TM04 coding TM04NW 1-26 TM04NE 1-67 TM04SW 1-87 and TM04SE 1-36 by S J Mathers in 2003

TM13 Borehole coding TM13NW 1-107 Coded Jan2003 and TM13NE 1-149 Coded Oct 2002 plus Wallingford holdings reviewed boreholes for SW and SE coded up August 2004 by S J Mathers

Boreholes examined 13SW 1-35, 13SE 1-15

TM14 coding TM14NW 1-536 TM14NE 1-91 TM14SW 1-427 and TM14SE 1-505 by S J Mathers in Dec2001 Wallingford holdings at 2001 also checked

TM23 Borehole coding TM23NW 1-32 Coded Oct 2002, TM23NE 1-35 Coded Oct 2002, TM23SE 1-85 Coded Feb 2003 S J Mathers, Wallingford holdings examined entered to BOGE by sjma. Remaining boreholes SW 1-88 coded up August 2004

TM24 coding TM24NW 1-281 TM24NE 1-149 in October 2001 TM24SW 1-356 and TM24SE 1-47 by S J Mathers in October 2002 Wallingford holdings checked at 2002

TM33 coding TM33NW 1-39 TM33NE none TM33SW 1-7 by S J Mathers in Feb 2003

TM34 coding TM34NW 1-60 TM34NE 1-78 TM34SW 1-28 and TM34SE 1-26 by S J Mathers in Feb 2003.

TM44 coding TM44NW 1-84 TM44NE 1-6 by S J Mathers in Feb 2003

TL 83 Borehole coding TL83NE 1-53, TL83NW 1-52, TL83 SE 1-49, TL83SW 1- 50. By S.J.. Mathers

TL84 Borehole coding TL84SE 1- 140, TL84 NE 1-95, TL84 NW 1- 60, TL84SW 1-56 By S.J.. Mathers

TL93 Borehole coding TL93NE 1-56, TL 93NW 1-43 TL93 SE 1-49, TL93SW 1-53. By S.J.. Mathers

TL94 Borehole coding TL93NE 1-33, TL94 NW 1-43 TL94 SE 1-46 TL94SW 1- 33 By S.J.. Mathers

Coded boreholes for each 25K tile by S J Mathers (SJMA) were extracted using the DGSM data portal forms, edits led to new downloads.

Geological Linework

Modern 1: 10 000 scale digital linework was used throughout. Sheets TM 03, 04, 13, 14, 23, 24 were surveyed by S.J. Mathers and M.H. Shaw in 1999-2003 the modelling was used to edit and produce the final approved linework, sheets TL 83, 84, 93,94 were revised and updated from the 1960-80's surveys as part of the modelling exercise and new approved 1: 10 000 superficial and bedrock versions were produced by S.J. Mathers in 2002-03. Sheets TM 33, 34 and 44 were surveyed by S.J. Mathers, J.A Zalasiewicz & M.H. Shaw in 1982-99.

DTM

Each 25K model tile was produced individually using a CEH or Nextmap DTM mainly with a 50m grid size. The merged model was initially capped by a CEH 100m dtm, this was then replaced by a Nextmap 100m and then final models has been tied to a BGS Bald Earth 50m DTM produced by combining elements of the OS Panorama dataset and the Nextmap 5M dataset. The data was extracted using the wizard provided within the software. Current file name Bald earth_50 [TIN].

5 Dataset integration

The individual 25K model tiles were aggregated into two sets one for the TL sheets and one for the TM sheets, these were subsequently merged into the complete model which covers approximately 1200 sq km. Consistency between tiles was achieved by the use of docker sections iterated between the two tiles and then envelope merging using the polygon editing tools. The final workspace was assembled to include all sections, standard, helper and dockers, merged envelopes for all units, and a regional Nextmap 50m dtm.

The overall network of constructed sections is shown in Figure 3 below. The two sections that extend beyond the model tiles were produced for the marginalia of the Ipswich 1: 50 000 sclae mapsheet published in 2006.

The model has been tied to the Colchester model to the south by sharing docking sections along the 40km long join as follows from west to east TL92 Dock North, TL 03, 13 and 23 Dock South

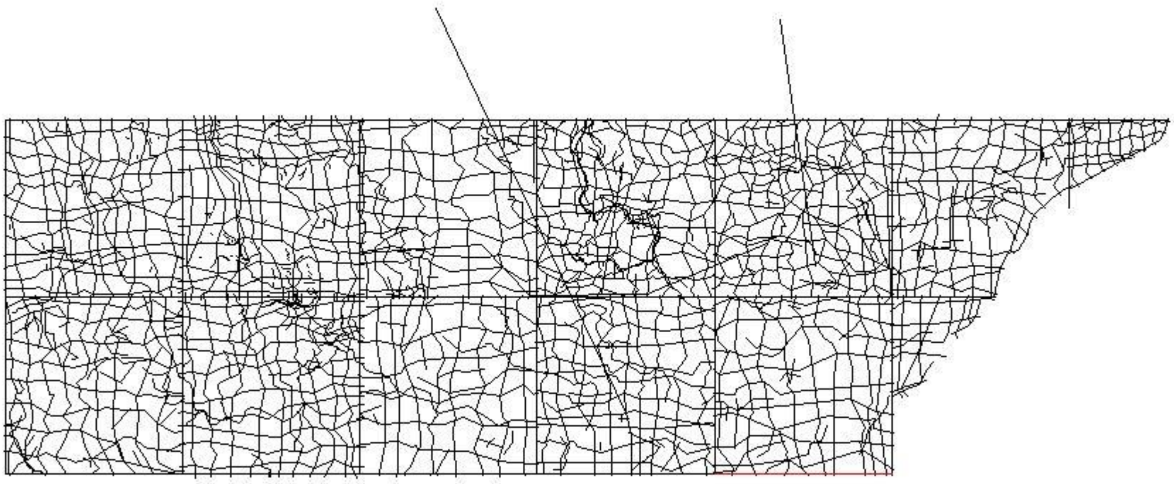

Figure 3 Cross sections in the Ipswich-Sudbury area

6 Model development log

The amalgamated model from July 2006 supercedes the 13 individual 25K sheet tiles constructed in 2001-06.

The individual tiles in their pre amalgamation form with supporting files are stored as archived versions. The subsequent editing of the amalgamated model has not been transmitted back to the earlier individual model tiles.

Once amalgamated sections IPSWICH_I, ,D,F3 and K were produced to provide marginalia for the Ipswich 50K map (2007). Some were extended beyond the current model area to take account of deep boreholes in closely adjacent areas together with helper sections to delimit the base of the Chalk Group and Gault Formation i.e. CHK_GLT_helper1 and glthelp.

13 July 2006

Whole model file Model4ENTEC_v22_no_artif.gxml and supporting files in Publishing folder were successfully bundled into the Viewer in January 2007. This was licenced to the Environment Agency in January 2007 for onward use by their contractor ENTEC.

24-25 January 2012

Extracted a fresh 50m bald earth dtm, checked all units for sections and envelope correspondence (not snapped). Decided to remove head from the model stack but it is still present in most sections, edited the gleg and gvs ejecting surplus entries. Many of the legend entries are used to accommodate the seeding of shape files provided at various stages by the CartoGIS staff.

Saved as TOTAL_WORKSPACE_v8.GSIPR

18-19 February 2013

Model revisions taking into account QA comments by Mark Barron

June-July 2013 Ian Cooke snaps model adn produces long check and edit list attaended to by S Mathers August 2013

7 Model workflow

A standard GSI3D workflow (Kessler & Mathers, 2004; Kessler et al. 2008) for superficial geological models was followed, in the parts of the model surveyed as an integrated exercise (TM 03,04, 13, 14, 23, 24) borehole coding was followed by the field survey, the 1: 10 000 geological lines were captured digitally by the Drawing Office from field slips and/or fair drawn linework on plastic. The resulting 1:10 000 scale provisional shape files were then provided for use in modelling. Edits to the shape files were made iteratively as a result of the modelling, in particular subcrops at rockhead were revised with the benefit of a 3D visualisation of the geology. This model was the first tile by tile model construction using the GSI3D software in BGS. It has been assembled and edited using the current versions of the GSI3D software (1.5 – 2 - 2.6 - 2011 and 2012 bedrock latest build)

8 Model assumptions, geological rules used etc

Buried river terrace deposits were assumed to extend beneath and match of the distribution of overlying alluvium and intertidal deposits in river channels except in estuaries were more confined buried channels are found. The deposits die out upstream and are not found in the upper reaches of small streams and brooks.

Head in its various forms has been drawn in many sections but no envelope made for calculation

Artificial ground and landslipped ground have not been included in many of the sections nor constructed as envelopes for calculation. Hence the uppermost geological deposit floods up to the dtm in sections

Helper sections usually only correlate the units they are intended to inform

The Chalk Group is treated as a single unit although some subdivision may be possible in future based on surface geological linework and borehole logs received for the Ipswich flood relief scheme after 2007.

The Lower London Tertiaries comprises mainly Reading Formation in this area thin and discontinuous deposits of the Thanet Sand Formation are present at the base as noted from surface outcrops and some boreholes.

The Thames Group comprises the London Clay and Harwich formations which are inseperable in this area as a mapping unit.

9 Model limitations

- Head in all forms has been excluded from the calculation of the model
- Sections cutting Alton Reservoir and nearshore - estuaries areas include a layer of water in sections but this has not been introduced as a calculated unit.
- Artificial deposits not modelled but inserted in some sections
- Chalk Group, Lower London Tertiaries and Thames Group and not subdivided in the model at this stage.
- No attempt has been made to classify levels of the River Terrace Deposits or the Kesgrave Sand and Gravel into distinct terrace levels..

- The model is suitable for use at resolutions higher than 100k but not beyond 5K or for any detailed site specific investigations.
- The model extends to the base of the Cretaceous across the whole area, in this area the Cretaceous rests with marked angular unconformity on Palaeozoic basement rocks

10 Model images

Screen grabs of the calculated model as generated in 2007 are as follows

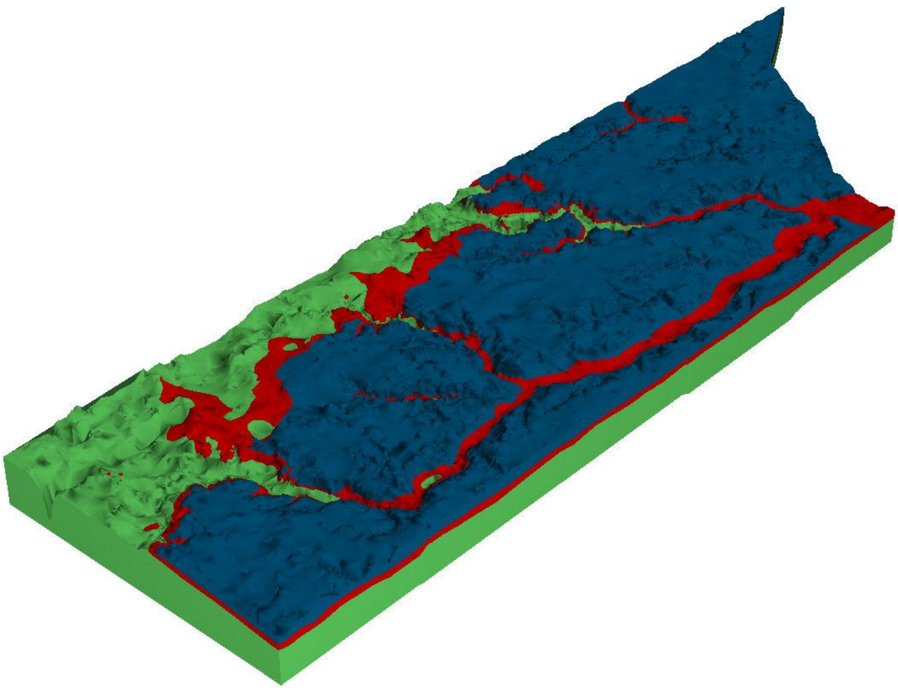

Figure 4. The Palaeogene strata resting on the Chalk.

(blue Thames Group, red Lower London Tertiaries and green Chalk).

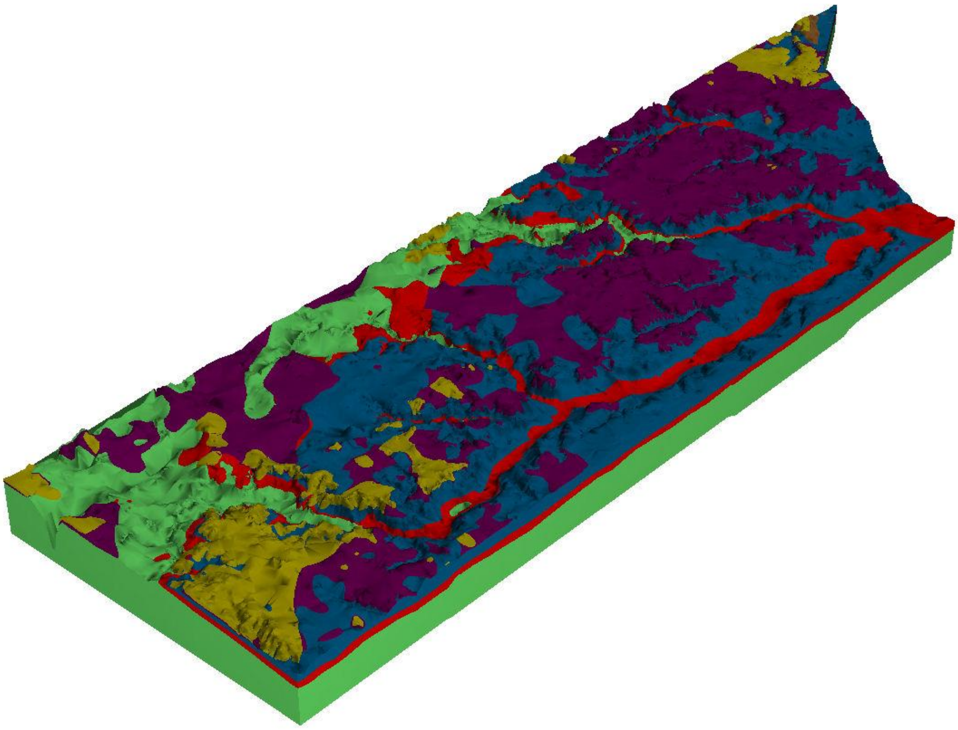

Figure 5 Bedrock geology

(colours as Figure 2 plus yellow Chillesford Sand, maroon Red Crag)

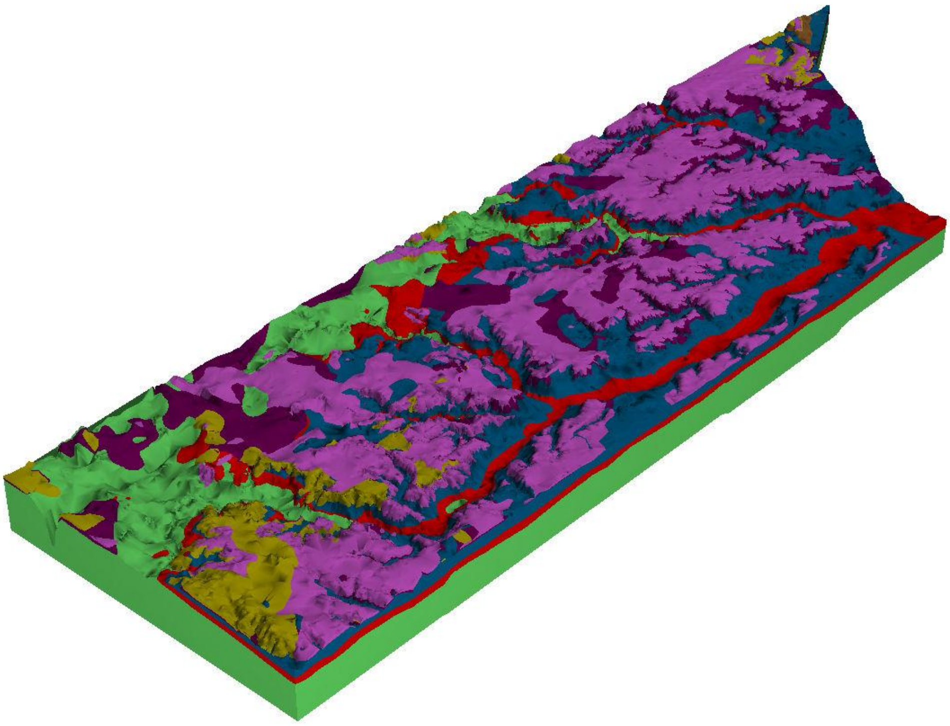

Figure 6. Pre Anglian glaciation units

(plus Kesgrave Sand and Gravel dark pink)

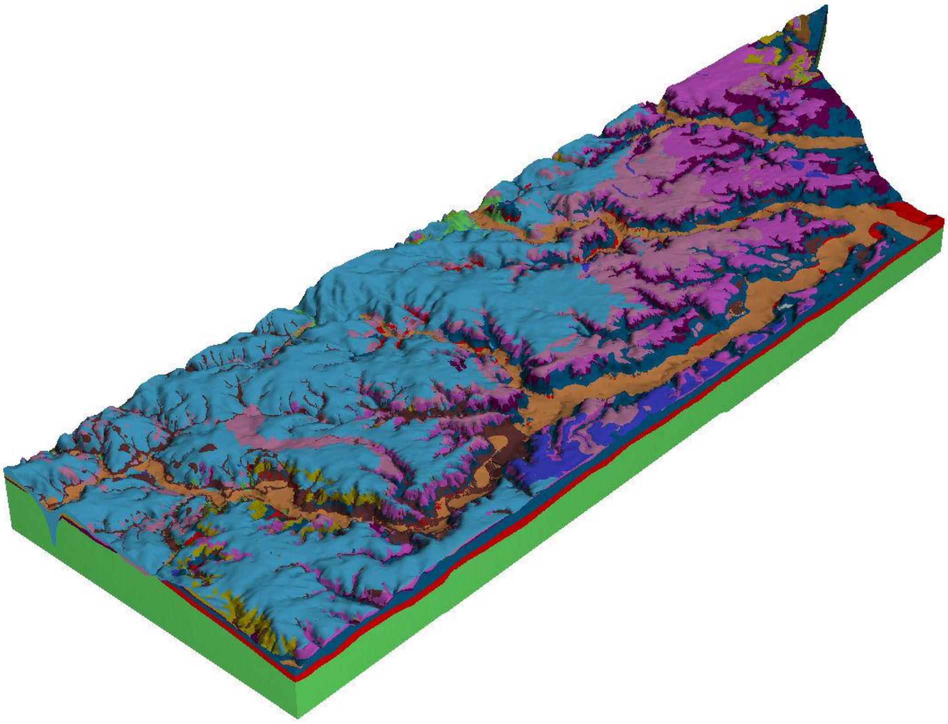

Figure 7 Including Anglian glaciation

(Lowestoft Till sky blue, Glacial sand and gravel layers all pale pink and Glacial Silt and Clay layers blue)

11 Model uncertainty.

To-date no attempt has been made to quantify the uncertainty in this model except with respect to the TM24 tile training version that has been used in a geostatistical analysis of the relative contributions to uncertainty of variation between geologist's interpretation and data distribution. (Lark et al. In Press)

Glossary

DTM	Digital Terrain Model – Model of surface of the solid Earth (generally the boundary between geosphere and atmosphere or hydrosphere). This is traditionally derived from OS contours and spot heights and should therefore exclude all buildings, trees, hedges, crops, animals etc. Sometimes also referred to as 'bald earth' models
Envelope	Defined here as the extent of a geological deposit in plan view (2D): forming a distribution map of the particular unit, a presence – absence map.
GSI3D	Geological Surveying and Investigation in 3D

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