Introduction:
Research in the top few metres of the ground beneath our feet has traditionally been split between soil science, geology and several sub-disciplines. This has led to different working practices, classifications and boundaries as well as inconsistent approaches to databasing and modelling (Figure 1). A significant uncertainty lies within the ‘transition zone’ between the pedosphere and geosphere. The BGS sets out to investigate this zone through a multidisciplinary field study, combining spatial soil and geoscientific findings in a 3D model at site specific and catchment scale in representative soil-geoscapes across the UK. In undertaking these studies we were particularly interested in investigating this zone through a multidisciplinary field survey, combining spatial soil and geoscientific findings in a 3D model at site specific and sub-disciplines. This has led to different working practices, classifications and boundaries as well as inconsistent approaches to databasing and modelling.

Methods and site study:
The project comprised of two main stages. Firstly a site survey (Figure 2) and secondly data processing and assembly and the construction of a 3D spatial soil-geology model. The site study was carried out on an area of agricultural land approximately 2km² near Shef ord, Nottinghamshire, UK. The site is located adjacent to the River Trent leading up to a gentle slope of Triassic mudstone. The majority of the site is underlain by up to 5m thick Pleistocene river terrace deposits as well as younger Holocene alluvial and colluvial deposits. Soils found in the study area vary from deep and permeable (gleyic) brown earths and slowly permeable stagnogley soils to groundwater gley soils. Fieldwork was orientated along several parallel traverses/catenas running from the hilltop, downslope towards the River Trent.

Construction of 3D models
Developing a spatial 3D soil-geology model in GS3D® utilises a Digital Terrain Model, geological (and in this case soil) mapped line-work, downhole borehole and augerhole data and geophysical data (Figures 3 and 4). Once this data is digitised and assembled in the software, it enables the geoscientists to construct regularly spaced intersecting cross-sections by correlating boreholes and the outcrops-subcrops of units to produce a fence diagram of the area (Figures 5 and 6). Mathematical interpolation between the nodes along the sections and the limits of the units or horizons produces a solid model comprised of a series of stacked triangulated volume objects (Figure 7). Below shows the workflow from data acquisition to the construction of a 3D spatial soil-geology model.

Result
The 3D soil geology model (Figure 7) shows calculated volumes for top and subsoil horizons in conjunction with underlying Holocene and Pleistocene superficial deposits and solid bedrock of Triassic mud, silt and sandstone. The total volume of the 3D model is approx. 0.08 km³. In the BGS, the modelling software has so far only been used in geological modelling correlating layers of usually >1m. Soil horizons therefore appear as only thin veneers/blanks.

Conclusions: Further software development to improve the correlation and combination of soil and geological information in GS3D® is on the way. A model as this can aid better understanding of the transition zone and help to visualise, understand and interpret processes like movement of water, nutrients and soil particles. Given sufficient geological and soil information in xy and z a soil geology model can be built in any size and for any location.

Science and research outlook
● Connection and integration of spatial subsurface models with numerical hydraulic models
● Pathways and behaviour of nutrients and contaminant in 3 and 4D

Model application
● Ground and surface water management (GW flow vulnerability and storage assessment)
● Wetland and catchment management
● Geotechnical and engineering assessments
● Geoarcheology, historical geology