Royal Geographical Society with IBG
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Rural National Park

Investigating the carbon cycle

This example explores a practical approach to investigating the carbon cycle. It integrates primary and secondary data and has a lot of potential for further development.

Primary data

To collect soil samples, fieldwork is completed in the Easedale Valley, Cumbria, centred on Grid Reference NY 300083 (right). Samples are collected over 40,000m^2 at sites approx. 50m apart, as measured and geo-tagged using either a handheld GPS or ESRI's Collector app.

Ordnance Survey

Samples are weighed, then burnt in a muffle furnace (a piece of equipment that ensures samples are not contaminated with additional carbon) to remove water and organic matter. (An alternative method is possible as described by the Peak District National Park Authority). Samples are then weighed again.

Percentage carbon is calculated by subtracting the processed mass of the sample from the initial mass and dividing by 2.

Compile the location and carbon data into a CSV spreadsheet and import it into ArcGIS by dragging the CSV file onto a new basemap. The *drawing style* of the layer should show the *value* attribute, and be graphed using the *counts and amounts* drawing style.
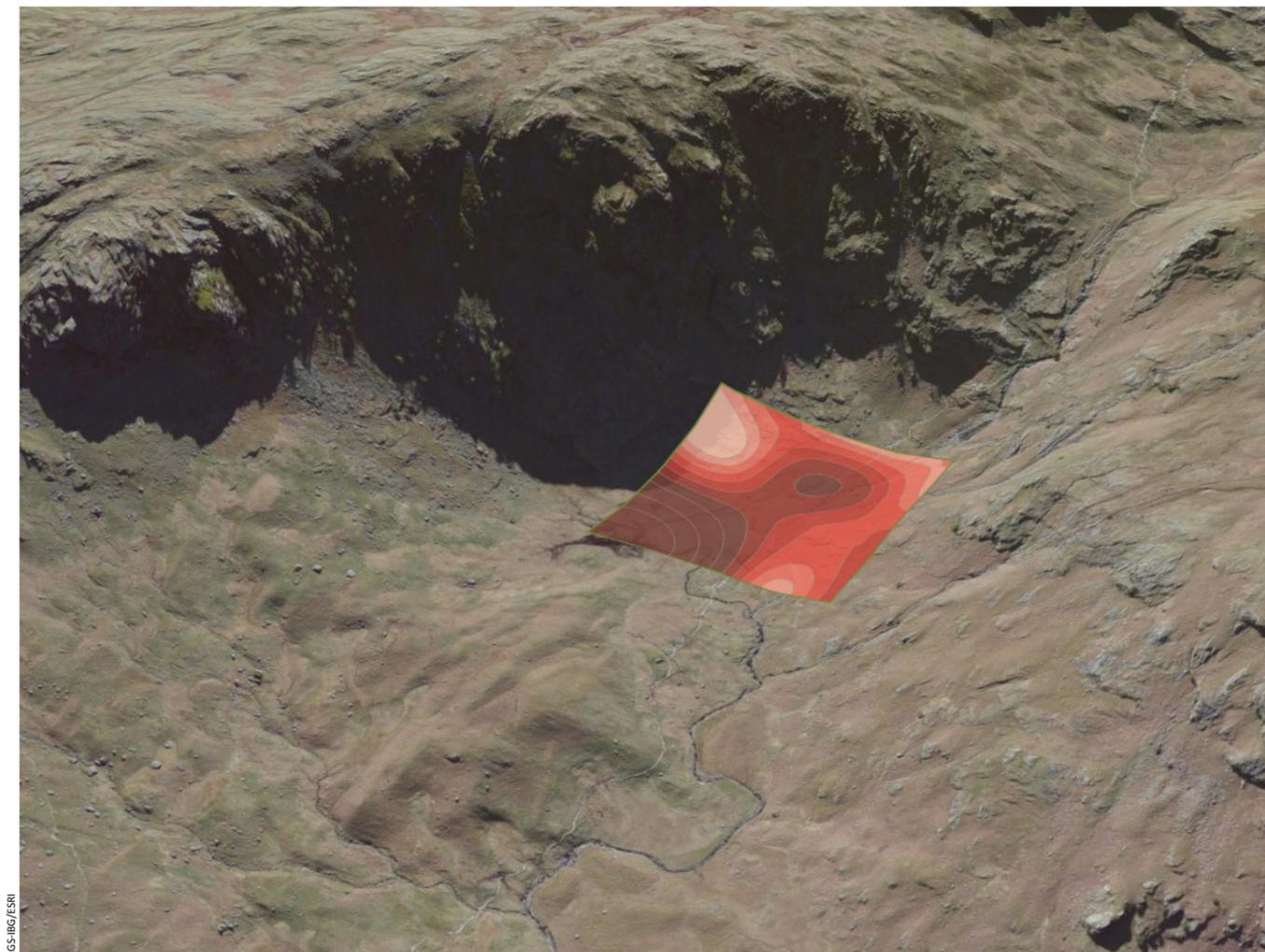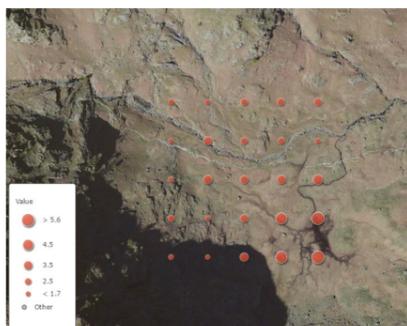
Analysis

If several groups complete similar fieldwork in nearby (potentially contrasting) locations it would be possible to statistically analyse differences to explore hypotheses of the determinants of soil carbon content. Additional primary data could be collected simultaneously, such as infiltration rates or soil compaction, to explore possible relationships.

Equally, students may wish to explore potential relationships using secondary data, such as geological data from the BGS, or hydrological data from the National River Flow archive. The Environment Agency, UK Soil Observatory, and field centres are further sources of a variety of data; field centres, in particular, may have data covering many years for sites you may be using.

Further development

- The number of sites and their spacing could be varied, though this would have a corresponding effect on the study area and interpolation error.
- The analysis could incorporate different land use types (e.g. pasture, woodland), variations within a land use type (deciduous/coniferous woodland), differences between two sites (e.g. geological, altitude, aspect, insolation, soil temperature, soil depth, percentage water) or consider rainfall and carbon in the drainage system.

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Value
> 5.6
4.3
3.5
2.5
< 1.7
Other

RGS-IBG/ESRI

RGS-IBG/ESRI

RGS-IBG/ESRI

*(Anti-clockwise from top left) The study area located in an ArcGIS 'scene'. Plotting the data using the attribute **value** (of carbon) generates located proportional symbols. Running **Analysis** to **Interpolate Points** subsequently predicts carbon content across the sample area classified by predicted values (10 categories—increasing the number of categories improves resolution but uses more processing credits). Another **Scene** can plot the data on 3D terrain to relate to other sites or the surrounding area.*
***Source**: RGS-IBG, (2017). ArcGIS.com. ESRI.*

- Interpolated values can complement and/or be compared to **isoline** maps.
- By incorporating other datasets (e.g. land use, slope) further analysis could be undertaken to generate heat map spatial patterns that could be further analysed with relation to other variables.

Further applications of interpolated data

- Interpolating values is widely applicable to any spatial data. Equally, analysis tools in ArcGIS online such as *finding outliers* complement the technique by identifying statistically significant anomalous data.
- Once data has been identified spatially it can be further analysed within ArcGIS online or *extracted* and statistically evaluated using an appropriate test.

Exploring the data

- Does the amount of carbon in soil vary spatially, or in relation to aspect?
- Is soil carbon content affected by land use? Do human impacts have any effect? Does it vary by soil type?
- Does sequestered carbon vary between deciduous and coniferous woodland? What mechanisms might explain this? Might forestry influence this? Might other physical variables influence this?
- Does sequestered carbon in soil vary by age of woodland? If you calculate the quantity of carbon sequestered in the trees does the total quantity of sequestered carbon vary?
- What assumptions have you made? Can you quantify the resulting errors?
- Does carbon load vary along the long profile?
- Is river carbon related to land use?

Have you seen the RGS-IBG student guide to the A Level independent investigation?

Before you start | Introduction | Data collection | Data presentation | Analysis | Conclusions | Evaluation