

Identification and Assessment of Data

Deliverable D1.4a for the

Project D5-2 Climate Change Impacts on Natural Capital

1st June 2023



Summary

This report provides details on several datasets that are relevant to Natural Capital typology, mapping and monitoring in Scotland. This work links not only to other deliverables within the D5 project, but also to C5 Large Scale Modelling. One of the milestones in C5 (M3.1: Data requirements for Work Package 3) is led by Mike Rivington and identifies several data requirements for specific modelling activities. These data requirements are listed below and have in many cases direct linkages to datasets listed in the above tables. In the C5 milestone there are further tables describing specific data characteristics of importance for specific modelling purposes, and it may be useful to consider these two reports together to gain additional benefit.

Key Messages:

- There is a large number of datasets either already held by JHI or available under licence (or free to download and use) that are relevant for Natural Capital assessment.
- Expertise/experience with the data is just as important as access to the data; interpretation and use of individual datasets has been highlighted in many cases as having already been carried out by specific JHI staff members.
- Field observations are vital to allow interpolation or digital mapping of Natural Capital features/classes. Field work is recognised as being expensive and time-consuming, but without it there is often very little point in having the spatial datasets mentioned here.

Advances in Technical Capabilities

What this development means is that we have improved understanding of the existence, availability and potential use of a range of spatial datasets that are relevant to Natural Capital assessment/mapping/characterisation.

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Introduction

The purpose of this report is to provide improved understanding and detail about existing datasets relevant to Natural Capital in Scotland.

The context is to build an understanding of what projected climatic changes may mean for Natural Capital in Scotland. This report is a Deliverable for the Strategic Research Programme project 'Climate Change Impacts on Natural Capital' (JHI-D5-2).

The aim is to provide harmonised and consistent information about each of the identified datasets (the focus has been on spatial data). Each dataset has a table in the Appendix at the end of this report with consistent interpretation and evaluation structure.

This serves as an underpinning ability to provide risk and opportunity assessments of climate change impacts on Natural Capital assets at both a high spatial and temporal resolution. Please note: a follow-on Deliverable (D2.1b) assesses issues of changes in extremes.

Details and outputs from the project are available here:

[Climate Change Impacts on Natural Capital | The James Hutton Institute](#)

Advancing analytical capability

To facilitate further climate change impacts analysis on Natural Capital assets, technical developments in the project have advanced the analytical capability by providing consistent, harmonised assessment of available data.

The benefits of this technical development are to identify which datasets can be used for specific purposes in relation to Natural Capital and what their limitations and processing requirements are.

Expertise is just as important as access

As noted in many of the below tables, the limitation to using a dataset is not getting access to it, but making sure that the use itself is appropriate and well-informed. Every dataset is generated with specific functions in mind and further interpretation or use often requires skill and experience in the handling of that dataset. As such, it is just as important to identify the individuals who have this skill and experience and to make sure that this framework of knowledge is resilient and available.

Spatial datasets are no use without field observations

It has been, and always will be true, that spatial datasets (particularly remote sensing data) are no good for mapping features of interest unless they either (1) contain information about the features of interest already, or (b) can be linked in some way to other observations of those features. Datasets can be translated into variables that answer a specific question, but that translation relies on training data.

It is also true that gathering field data is generally much more expensive and time-consuming than gathering spatial datasets that already exist on the internet. This is the reason scientists, land managers and policymakers are always looking for ways to reduce the amount of field work required so that information can be more cost-effectively generated. We are currently in a situation where many spatial datasets exist at high resolution and for almost no cost beyond the computing power and staff time required to gather and process the data (often the processing burden can also be

significantly reduced using freely available computer libraries/functions in R or Python). So in many cases and for many applications, the bottleneck is not access to datasets, but access to staff time and resources for developing the necessary field data.

Appendix A: Data description tables

Dataset name	National Soil Map of Scotland
Creator	James Hutton Institute (Macaulay Institute for Soil Research)
Date	1981
Scale	1:250,000
Online reference	https://soils.environment.gov.scot/maps/soil-maps/national-soil-map-of-scotland/
Availability	Yes (from link above) as download or WMS
Processing requirements	Interpretation of mapped categories into biophysical characteristics is technically challenging but can be achieved by linking to the Scottish Soil Database. David Donnelly at JHI has developed online tools and apps allowing this (e.g. SIFSS). Many of the terms used in the associated property table for this dataset are qualitative and assume previous knowledge of soil survey work in Scotland; for the uninitiated this can be quite a challenge to identify the necessary (often quite old) publications associated with these terms.
Limitations	Mixed mapping unit polygons, so not spatially explicit about which soil lies where. Also, proportion of soils in each map unit was estimated using expert knowledge and above-ground observation rather than direct survey.
Assessment of utility	Map units have multiple characteristics that are generally well-defined; can be used not only as a dataset but as a reference to these defined properties/categories. As the only national-level soil map (1:25k does not cover all of Scotland) provides useful information about map unit boundaries and likely properties of soils within these map units. If digital soil mapping (DSM) or other high-resolution mapping is required, modern DSM approaches using the Scottish Soil Database would be recommended as an alternative. Additional datasets and soil categorisations associated with e.g. soil hydrology (Hydrology of Soil Types – HOST) are linked to this dataset.
Assessment of uncertainty	Within each map unit, uncertainty about the soil type present at each location (except for map units that are 100% one soil type).

Dataset name	Soil Map of Scotland (partial cover)
Creator	James Hutton Institute (Macaulay Institute for Soil Research)
Date	2022
Scale	1:25,000
Online reference	https://soils.environment.gov.scot/maps/soil-maps/soil-map-of-scotland-partial-cover/
Availability	Yes (from link above) as download or WMS
Processing requirements	Similar requirements to the 1:250,000 soil map in terms of terminology and description, with much of the necessary information being contained in the same definitions and publications.
Limitations	Covers only the 'agricultural' areas of the country.
Assessment of utility	Map units are smaller and more precise and are assumed to have the same soil type across each unit. This makes the mapping more useful within the areas where data is available, but the dataset cannot be used for national-level mapping efforts.
Assessment of uncertainty	Because of smaller mean map units, there is less variability across each polygon than for the 1:250k soil map. However, the boundaries of each map unit are still subjective in many cases and there will be some (unquantified) variability across each map unit. The main drivers of variability across each map unit are likely to be parent material (hard to assess) and topography (easy to assess).

Dataset name	National Soil Inventory of Scotland (NSIS)
Creator	James Hutton Institute (Macaulay Institute for Soil Research)
Date	1978 – 1987 (partially repeated 2007 – 2009)
Scale	Point data only
Online reference	https://soils.environment.gov.scot/maps/point-data/national-soil-inventory-of-scotland-nsis-1978-88/
Availability	Yes (from link above, although only at 10 km points) as download or WMS. The 5 km points can be extracted from National Soil Profile Database (see Malcolm Coull).
Processing requirements	An understanding of the methods and definitions used for each sample property is required to make full use of this dataset; relatively stringent recording procedures have ensured that this information is readily available, but it does require soil science expertise to interpret in many cases (and to understand the utility and limitations of the data).
Limitations	Multiple physical and chemical soil properties, and qualitative assessments, have been made for each horizon/sample. There have also been some measurements made that are indicative of biological factors but not enough for many purposes (e.g. microbial diversity). For older samples, the geolocation will be less accurate than for recent samples.
Assessment of utility	Points on 5km grid national grid. Actual soil type identified in the field by surveyor.
Assessment of uncertainty	One of the main sources of uncertainty in this dataset is the change in analytical methods over time. Different codes are given for different methods of measuring the same variable, to allow this uncertainty to be recognised; however, quantification of the bias and range of each analytical method has not been fully explored meaning that the dataset cannot be considered fully harmonised. Additionally, the sampling was carried out by a team of surveyors and while the sampling and analysis protocols remove most subjectivity, there will have been some variability introduced through different surveyors (e.g. horizon boundaries).

Dataset name	Carbon and peatland map
Creator	NatureScot (Scottish Natural Heritage)
Date	2016
Scale	1:25,000
Online reference	https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/
Availability	Yes (from link above) as download or WMS
Processing requirements	Clear definitions of the classes are given, and the map is spatially explicit and easy to process within a GIS (Geographical Information Systems). The classes are quite broad and require some habitat/ecological experience to properly understand.
Limitations	Contains eight broad classes with different peat soil/vegetation characteristics. The vegetation characteristics are derived from the LCS88 dataset and so are quite out of date; in places they will still be correct but in others there has been significant change over the last 35 years. Where the peat soil data is derived from the 1:250,000 soils map, the spatial resolution is quite coarse; because highly organic soils tend not to overlap with areas of intensive agriculture, this implies that a significant amount of the map is spatially questionable.
Assessment of utility	Derived from 1:25,000 and 1:250,000 soils maps and the Land Cover of Scotland 1988 dataset. Shows 'a value to indicate the likely presence of carbon-rich soils, deep peat and priority peatland habitat for each individually mapped area, at a coarse scale.' Additional datasets available from this site include topsoil organic carbon concentration, available water capacity, soil texture in Nitrate Vulnerable Zones (NVZs) and soil phosphorus sorption capacity. Each of these datasets was derived from the same underlying data as the carbon and peatland map.
Assessment of uncertainty	The uncertainty in this dataset will be compounded largely from the 1:250k soils map and the LCS88 land cover map. It is therefore quite out of date and not recommended for use in identifying specific peatland areas of interest for restoration or condition mapping.

Dataset name	Modelled peat distribution I
Creator	Matt Aitkenhead, James Hutton Institute
Date	2018
Scale	100 metre grid
Online reference	https://bsssjournals.onlinelibrary.wiley.com/doi/abs/10.1111/ejss.12916
Availability	Yes, at Soil profile depth, bulk density and carbon stock of Scotland - Dataset - Natural Asset Register Data Portal (hutton.ac.uk)
Processing requirements	For producing polygons of peat (defined here as 50 cm depth organic matter), would need further processing.
Limitations	Dataset was derived using combined Scottish Soil Database and peat depth survey data from Peatland Action. As such, the accuracy of the peat depth modelling component is dependent on the reliability of the Peatland Action sampling. This has not been quantified but is recognised (because of the nature of Peatland Action) to be biased towards degraded peats.
Assessment of utility	Supersedes earlier work by Aitkenhead in mapping peat presence/absence. Does not rely on strict definitions of organic depth for defining peat presence/absence and so if and when these definitions change, the dataset's use will not be compromised.
Assessment of uncertainty	Based on trained neural network using remote sensing data and spatial covariates. The accuracy of the underlying models has been quantified and recorded in the published journal paper linked above. At 100-meter resolution, this dataset is definitely better for mapping large areas of peatland and is known to have missed or over/underestimated smaller areas in places (particularly in topographically variable regions).

Dataset name	Modelled peat distribution II
Creator	Laura Poggio and Alessandro Gimona, James Hutton Institute
Date	2019
Scale	100 metre grid
Online reference	https://www.sciencedirect.com/science/article/abs/pii/S0016706118317002
Availability	Yes, from Alessandro Gimona
Processing requirements	Some interpretation required of the mapped categories, with their definitions being somewhat subjective. However, the methodology is clearly laid out and sources of uncertainty are well identified.
Limitations	Provides an estimate of presence/absence of peat, with associated uncertainties around the edges of areas where peat depth is closer to the 50cm definition. If peat depth definition changes, the map will no longer represent the technical definition of peat presence/absence.
Assessment of utility	Mapping of presence/absence of peat using RS technology that is not affected by cloud; as such, the method could be more readily repeated and adapted for other areas than methods that rely on visible RS.
Assessment of uncertainty	Based on neural network, random forest and statistical models using Sentinel-1 (radar) data and spatial covariates.

Dataset name	Digimap 50 geological map
Creator	British Geological Survey
Date	2011
Scale	1:50,000
Online reference	https://www.bgs.ac.uk/datasets/bgs-geology-50k-digmapgb/
Availability	Yes (under Open Government License); however, the data access through GeoIndex appears to have been disabled. Possibly this data is now available through another route.
Processing requirements	GIS-ready data (if available). Mapped classes are defined in geological terms but would require detailed and subjective interpretation to convert to specific functional classes or metrics.
Limitations	The chemical and physical properties and behaviour of each of the mapped geological categories is not clearly known; as such, the usefulness of the data for quantified natural capital assessment is questionable.
Assessment of utility	Provides bedrock, superficial deposit and other geological information. With sufficient expert knowledge and interpretation, this dataset could provide useful information on soil formation rates and chemical composition. However, it would need to be factored alongside a host of other spatially variable considerations such as topography, climate and land use.
Assessment of uncertainty	Much of the mapping is believed to have been carried out through expert identification of map units from above-ground observations of landscape forms and features. As this work is carried out by a large team of experts with varying expertise and experience, the subjective nature of the mapping is likely to be a factor (and is likely to vary from place to place).

Dataset name	BEIS (Business, Energy & Industrial Strategy) Peat Map
Creator	Consortium led by UKCEH (UK Centre for Ecology & Hydrology)
Date	2014
Scale	1:50,000
Online reference	https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1904111135_UK_peatland_GHG_emissions.pdf
Availability	Through request from Rebekka Artz
Processing requirements	GIS-capable data but requires detailed explanation of the methodology used to create it. Pages 20 and 28 of the above-linked work provide some of this information but much of the mapping was carried out using the best available expert knowledge and so may be somewhat difficult to replicate.
Limitations	Created through integration of multiple existing datasets. While it is the 'recognised dataset' for UK Gov as mentioned below, it may act as a barrier to adoption of more recent and more accurate datasets; the adoption of any new dataset inevitably means some of the older data is contradicted, with the effect of changing policy implementations throughout the affected areas without seeming good reason to do so on the ground.
Assessment of utility	This is the spatial dataset used by DEFRA and UK Government for peat carbon and GHG (Greenhouse gas) emission inventories. As such, it aligns strongly with current GHG inventory data and with policy across soils and climate as of 2023.
Assessment of uncertainty	Derived from multiple spatial datasets of soil, topography and land use/land cover, this dataset will have incorporated many of the uncertainties of its parent datasets. As such, proper assessment of uncertainty is difficult. Additionally, some of the datasets used (e.g. the Land Cover of Scotland 1988) is now quite old and a lot of peatland sites will no longer have the same condition.

Dataset name	National Soil Map disaggregation
Creator	Zisis Gagkas
Date	2022
Scale	1:250,000
Online reference	Work still ongoing, reporting not completed
Availability	Not currently available (as of 6 th March 2023) - refer to Z. Gagkas for updates
Processing requirements	GIS-capable dataset that aligns with the 1:250,000 soils map.
Limitations	Difficult to assess at this stage.
Assessment of utility	Disaggregation of the National Soil Map units by digital soil modelling techniques.
Assessment of uncertainty	Difficult to assess at this stage. Will be an improvement on the 1:250,000 soils map as it provides disaggregation and some improvement in spatially explicit identification of soil type.

Dataset name	Forest estate landholdings
Creator	JHI (James Hutton Institute) on behalf of Forestry Commission Scotland
Date	2021 and ongoing
Scale	Unknown
Online reference	n/a
Availability	Unsure when data will be published, refer to David Donnelly at JHI
Processing requirements	Soil survey and technical expertise required to understand the work.
Limitations	Does not provide a national coverage as it is restricted to FCS land holdings.
Assessment of utility	Ongoing contract undertaken by JHI surveyors to survey FCS land holdings. They have a bespoke GIS system based on Arc Collector (?) and soil polygons are updated based on field data collection. Only covers land owned by FCS.
Assessment of uncertainty	Many of the survey and analytical methods used for this work will be the same as for previous soil survey work in Scotland; as such, this data will likely be harmonised with the Scottish Soils Database to some degree. It will also incorporate some of the same factors causing uncertainty, such as surveyor subjectivity.

Dataset name	3D modelling of soil organic carbon stocks
Creator	Laura Poggio and Alessandro Gimona
Date	2014
Scale	1 km resolution grid, five depth layers (0–5, 5–15, 15–30, 30–60 and 60–100 cm)
Online reference	Poggio, L., Gimona, A. (2014). National scale 3D modelling of soil organic carbon stocks with uncertainty propagation — An example from Scotland. <i>Geoderma</i> . 232–234. 284 - 299. 10.1016/j.geoderma.2014.05.004.
Availability	Contact Alessandro Gimona at JHI
Processing requirements	Standard GIS raster
Limitations	Some data currently misplaced (40-100 cm)
Assessment of utility	Currently not usable due to missing data, and at 1 km resolution there are other datasets that would be more effective.
Assessment of uncertainty	Useful information about how uncertainty propagates through to the final data from the datasets used. The data layers themselves are relatively coarse but the work provides good insight into which inputs provide the most reliable and useful information to drive this kind of work.

Dataset name	Scottish Soils Database
Creator	James Hutton Institute/Macaulay Institute
Date	Ongoing
Scale	Composed of three datasets at 5, 10 and 20 km OS grid points and additional survey datasets with multiple georeferenced points.
Online reference	Some database elements and associated / derived maps are available at Scotland's Soil Data Soils@Hutton The James Hutton Institute
Availability	Data available on request from Malcolm Coull at JHI
Processing requirements	Raw Database contains numerous elements requiring soils expertise and are linked to further technical definitions. Additional knowledge of how the data was captured and samples analysed is of benefit to any user.
Limitations	Georeferenced points only – not a map
Assessment of utility	Could be used for Digital Soil Mapping of soil properties/indicators
Assessment of uncertainty	Soil descriptors and variables are quantified to the highest available standard, using accredited laboratory methods. As such, the data can be considered the 'gold standard' of soils data for Scotland. However, there is some disparity between different methods used to measure the same properties over time (see table for National Soil Inventory of Scotland).

Dataset name	Soil maps on Natural Asset Registry/Hutton Open Data portal
Creator	James Hutton Institute
Date	Ongoing
Scale	Multiple (includes 1:250k polygons, 100 metre grids and others)
Online reference	Soil and other datasets available at Welcome - Natural Asset Register Data Portal (hutton.ac.uk) under licence.
Availability	Freely available to download
Processing requirements	GIS skills required. Metadata provided for each dataset to provide comprehension.
Limitations	Each of the datasets has its own limitations, but all are largely derived from legacy soil survey work carried out by JHI between the 80's and 2007. In some cases, this means that the datasets are becoming out of date and may no longer be reliable.
Assessment of utility	Wide range of potential uses from direct mapping to Digital Soil Mapping alongside other spatial data.
Assessment of uncertainty	Each of the datasets has its own drivers of uncertainty. As mentioned above, changes over time since the datasets were produced are likely to be the biggest cause of uncertainty.

Dataset name	Peatland condition map
Creator	James Hutton Institute
Date	2021
Scale	100 metre resolution raster
Online reference	Peatland restoration and potential emissions savings on agricultural land: an evidence assessment (climatexchange.org.uk)
Availability	From Matt Aitkenhead upon request
Processing requirements	GIS rasters with peatland condition classes and emission factors. Development made use of multiple spatial datasets and involved an evidence synthesis approach that requires some comprehension of each of these datasets.
Limitations	The peatland condition classes are somewhat out of date as DEFRA is publishing new classes and emission factors in 2023. The spatial data is not the 'recognised' one used for GHG inventories and so any summary of emissions will not align with the official values.
Assessment of utility	Created for CXC in 2022, map of peatland condition emissions. Not aligned with DEFRA/UK Government official mapping
Assessment of uncertainty	Main driver of uncertainty in this mapping is the reliance on LCM land cover mapping to provide evidence for specific land uses on peat. On seminatural land, the LCM data is known to have high misclassification rates between heath, bog and extensive grassland.

Dataset name	Met Office gridded climate data (historical)
Creator	Met Office
Date	Ongoing
Scale	1km grid
Online reference	HadUK-Grid - Met Office
Availability	Freely available to download
Processing requirements	Multiple weather variables with daily, monthly etc. averages.
Limitations	Derived from a network of climate observatories, interpolated to 1km.
Assessment of utility	Impact of current climate on Natural Capital. Can be used for plant growth and soil process modelling as well as direct estimates of e.g. evapotranspiration and other factors.
Assessment of uncertainty	Unsure of uncertainty, but these are the best available datasets for current and historical UK climate. Localised variability due to topography is likely to take place over the 1km grid scale.

Dataset name	Remote Sensing direct measurements of soil moisture (Planet etc.)
Creator	Planet labs
Date	Ongoing
Scale	3m multispectral imagery
Online reference	Satellite Imagery Analytics Planet
Availability	Purchased under license from Planet
Processing requirements	Time-series of imagery for Scotland at 3 metre resolution. Will require sufficient processing power to work with, likely to involve HPC (High Performance Computing) or Google Earth Engine (hence specific skill sets associated).
Limitations	Calibration will require ground observations made during recent surveys, for model development. Without quality and quantity of recent ground observations, the Planet data will not be very useful.
Assessment of utility	We are currently negotiating access to this data and until it has been explored fully, cannot determine how useful the data will be for this specific purpose. However, at 3 metre resolution it is almost definitely going to provide useful information for LULUCF and NC mapping.
Assessment of uncertainty	Unable to determine currently.

Dataset name	Scottish Public Sector LiDAR (light detection and ranging) Dataset
Creator	Scottish Government, Amazon Web Services
Date	Ongoing (last update March 2022)
Scale	Approximately 4 points per m ²
Online reference	Scottish Public Sector LiDAR Dataset - Registry of Open Data on AWS LiDAR Composite - Coverage and Extents for Scotland - data.gov.uk
Availability	Freely available under Open Government Licence v3 (for the most part)
Processing requirements	Requires skills and software package relevant to processing LiDAR data
Limitations	Not full Scottish coverage
Assessment of utility	LiDAR (light detection and ranging) datasets for monitoring vegetation change/recovery/seasonality. There are plans to provide full Scottish cover in the medium term – currently approx. 35% national cover has been achieved.
Assessment of uncertainty	Unknown – datasets are added by different contractors over time so standards/data configurations may not be consistent.

Dataset name	Sentinel-1
Creator	Copernicus Programme
Date	2016-present
Scale	5x20 metre
Online reference	Open Access Hub (copernicus.eu)
Availability	Freely available
Processing requirements	Specific software/skills required to process radar data, although some products reduce this requirement.
Limitations	12-day repeat cycle, enabling seasonal variability in vegetation development. Sensor mode is not affected by cloud cover.
Assessment of utility	Biomass, habitat type/monitoring
Assessment of uncertainty	Absolute accuracy of less than 10m in DEM; however, for localised variability the variation is significantly more accurate, allowing vegetation growth from one year to the next to be detected.

Dataset name	Sentinel-2
Creator	Copernicus Programme
Date	2015-present
Scale	10-60 metre resolution depending on spectral band
Online reference	Open Access Hub (copernicus.eu)
Availability	Freely available
Processing requirements	Standard GIS raster layers; multiband (12 band) processing; revisit time approximately every 10 days.
Limitations	Data itself is high performance and consistent. However, mapping of specific LULUCF or NC (Natural Capital) features requires training data (i.e. ground observations).
Assessment of utility	Mapping of land use activities (e.g. burning, land cover change)
Assessment of uncertainty	Good georeferencing of spatial data and access pipelines to allow automated processing. Uncertainty in terms of spectral response of specific LULUCF or NC features of interest which might limit the use of the data for monitoring or measuring individual environmental properties.

Dataset name	GetMapping aerial photography
Creator	GetMapping
Date	Rolling 4–5-year programme across Scotland
Scale	25cm RGB-NIR
Online reference	Getmapping GSaaS Aerial Imagery and Geospatial Content
Availability	Data is available through a Web Mapping Service by defining areas of interest and downloading. Margaret McKeen and David Donnelly have experience in handling this. Licence was purchased by JHI through SG (Scottish Government).
Processing requirements	GeoTIFF datasets provided as rasters; significant memory requirements for medium/large areas. Can be used for identification of small artificial/landscape features using CNN image analysis and cloud-based computing (e.g. Google Earth Engine).
Limitations	Steps to access the data are a bit more convoluted than normal ‘select an AOI and download’ but the access pipeline has improved over the last couple of years. Availability of recent data for an AOI is dependent on the flight scheduling. Like other RS data, mapping of features or properties of interest requires ground observations.
Assessment of utility	RGB-NIR 25cm imagery for detection of microtopography and other features. Potential use in CNN (Convolutional Neural Network) for recognition of specific NC features/objects.
Assessment of uncertainty	Appears to be georeferenced accurately. Some issues with elevation and reprocessing of imagery on slopes/terrain where distance to sensor changes rapidly over short distances.

Dataset name	Land Cover of Scotland 1988 (LCS88)
Creator	James Hutton Institute/Macaulay Land Use Research Institute
Date	1988
Scale	1:24,000
Online reference	lcs88_executive_summary.pdf (hutton.ac.uk) Land Cover of Scotland (LCS88) Exploring Scotland The James Hutton Institute
Availability	Freely available on SDE
Processing requirements	Map units with associated legend; the legend itself is quite detailed.
Limitations	More focussed on artificial or lowland classes than upland peat condition classes. However, where features have not changed much in seminatural landscapes the accuracy is still impressive.
Assessment of utility	Land cover/land use mapping with specific map units. Original imagery is no longer available meaning that reinterpretation with a different legend cannot be carried out.
Assessment of uncertainty	Age is the main issue here; the dataset is now 35 years old and a lot of Scotland's land cover has changed in that time. It is difficult to know where those changes have taken place without direct observation.

Dataset name	LCM (series)
Creator	UKCEH
Date	1990-2021, maps are now updated annually
Scale	Vector and raster (varies across maps – most recent has 10m raster).
Online reference	UKCEH Land Cover Maps UK Centre for Ecology & Hydrology
Availability	Multiple years of land cover maps freely available; the only requirement is a user account. AOI definition is followed by a link to download the data.
Processing requirements	Legend of 22 classes which are a blend of land use and land cover; more useful for some applications than others.
Limitations	Better for lowland and coastal land cover/land use classes than for upland seminatural; the legend is very broad for ‘bog’ and ‘heath’ for example.
Assessment of utility	Habitat/vegetation/broad land use. Despite the limitations mentioned above and uncertainty factors below, this is still the best (and practically only) land cover map for Scotland and the rest of the UK.
Assessment of uncertainty	From one map to the next, some land cover classes are counted quite differently (underlying method is consistent; the issue appears to be with the accuracy of the automated RS interpretation). This has the effect of moving boundaries between classes and increasing/decreasing the presence of some classes in an unrealistic manner.

Dataset name	AgCensus
Creator	Scottish Government
Date	Annual
Scale	Data returned at land holding scale
Online reference	Scottish Agricultural Census: results - gov.scot (www.gov.scot)
Availability	Raw livestock density numbers are available to some people within JHI (e.g. the Land Use team) but only under restricted circumstances. A discussion about getting improved access to this data would be useful but would need to be had in a sensitive manner as the data is considered commercially sensitive.
Processing requirements	Needs to be integrated with land holding/land parcel boundary information. Requires experience and careful handling of the data – Land Use team staff (e.g. Dave Miller, Douglas Wardell-Johnson) have this experience.
Limitations	Cannot be used to identify how many cows/sheep etc. are in each field at any one time – the data is a bit coarser than that. But can be used successfully to identify areas at risk of overgrazing, if integrated carefully with other data by people that are familiar with the dataset's limitations.
Assessment of utility	Grazing/maintaining habitats, risk of grazing; combined with LCM data can be used to provide agricultural stocking density at a relatively coarse but still useful resolution (2km was achieved with AgCensus 2015).
Assessment of uncertainty	Interpretation needs to be careful as livestock movements and land holding ownership can be difficult to disentangle from existing data about 'who owns the land'.

Dataset name	IACS (Integrated Administration and Control System) data
Creator	Scottish Government
Date	Annually
Scale	Field scale
Online reference	IACS - SINGLE APPLICATION FORM (SAF) 2007 - The Integrated Administration And Control System: explanatory booklet - gov.scot (www.gov.scot) https://www.ruralpayments.org/topics/all-schemes/schemes-overview/
Availability	Restricted; collaboration with JHI Land Use team recommended as they have a lot of experience accessing and working with the data.
Processing requirements	Data is generated using a Single Application Form by land managers, to inform farm payment claims. Data is considered confidential and commercially sensitive so tends to be handled by a small team within JHI (Land Use team led by Keith Matthews).
Limitations	The IACS system has been in place with little functional change for over 15 years (some schemes within the overall system have been introduced or dropped during that period). There are likely to be significant updates and changes through the introduction of a new post-Brexit agri-environment scheme in Scotland in 2024.
Assessment of utility	Impact of land management on NC
Assessment of uncertainty	Farmer-led entry of details, with a percentage (5%) of auditing throughout the year. Some terms in the entry forms are subjective, and there are some details that might be considered useful that are not required. This includes fertiliser application which would be particularly useful.

Dataset name	Topography (various)
Creator	Ordnance Survey
Date	2022
Scale	Finest scale is 5m resolution grid – others exist at 10m and 50m resolution
Online reference	OS Terrain 5 Data Products Ordnance Survey
Availability	Best person to speak to about accessing the data is David Donnelly, although the data is freely available on the SDE (which is being updated and moved to a more accessible and better-structured format by Andrew Thorburn).
Processing requirements	National-level processing of the 5- and 10-metre DEMs (Digital Elevation Model) requires significant computational power. One of the best tools for creating topographic metrics is the SAGA plugin on QGIS.
Limitations	Limitations are generally due to computational power or the need to convert the ‘basic’ DEM into more meaningful topographic metrics. Experience in what these are and how to create them is necessary. Within the Geoinformatics Group, several people have worked with this kind of data.
Assessment of utility	Multiple topographic metrics at 10m resolution (and other scales). Useful for DSM (Digital Soil Mapping) and for hydrological modelling.
Assessment of uncertainty	n/a - the data is considered accurate. There can be issues when creating new topographic metrics that incorporate flow, as basins that fill can be given erroneous or meaningless values. Careful processing of the data can avoid these issues.

Dataset name	OneGeology
Creator	OneGeology
Date	2023 and ongoing
Scale	Country-specific; UK might be limited to 1:625,000 although other data layers with better resolution may be available through BGS.
Online reference	OneGeology Portal
Availability	Freely available under open licence
Processing requirements	GIS-ready data (if available). Mapped classes are defined in geological terms but would require detailed and somewhat subjective interpretation to convert to specific functional classes or metrics.
Limitations	The chemical and physical properties and behaviour of each of the mapped geological categories is not clearly known; as such, the usefulness of the data for quantified natural capital assessment is questionable.
Assessment of utility	Provides bedrock, superficial deposit and other geological information. With sufficient expert knowledge and interpretation, this dataset could provide useful information on soil formation rates and chemical composition. However, it would need to be factored alongside a host of other spatially variable considerations such as topography, climate and land use.
Assessment of uncertainty	Much of the mapping is believed to have been carried out through expert identification of map units from above-ground observations of landscape forms and features. As this work is carried out by a large team of experts with varying expertise and experience, the subjective nature of the mapping is likely to be a factor (and is likely to vary from place to place).

Dataset name	Time series RS (Remote Sensing) data (e.g. Landsat, MODIS)
Creator	Numerous
Date	1980-current
Scale	10-1000 metre
Online reference	USGS (United States Geological Survey), Copernicus, others
Availability	Almost always freely available to download; recent developments in portal design allow automated grabbing of AOIs for specific dates/periods/cloud cover criteria.
Processing requirements	Experience with the specific peculiarities of each programme and RS platform is recommended; georeferencing and access to ready-processed 'products' can make life easier with caveats that you are dependent on the processing skills of others.
Limitations	Older datasets tend to have coarser resolution; the Landsat programme has been providing data since around 1980 but the data from back then is at 100 metre resolution at best. There are also data gaps and registration errors to deal with.
Assessment of utility	Land use/cover changes at a local, national and international level.
Assessment of uncertainty	Newer datasets are generally more consistent in terms of technology and quality, also in terms of spatial resolution. Within the Geoinformatics Group (and elsewhere in ICS), several staff have experience working with data from different platforms – Alessandro Gimona is a good place to start.

Dataset name	Historical land use data (Historic Scotland?)
Creator	Historic Environment Scotland
Date	Ongoing
Scale	Variable – looks to be between 1:25k and 1:100k depending on source maps. Claims to be digitised at 1:25k.
Online reference	Scotland - Land Use - Split screen viewer - Historic Environment Scotland and National Library of Scotland (nls.uk) HLA (hlapmap.org.uk)
Availability	Freely available to view and download
Processing requirements	Context is very important with these historical land use maps, and it is strongly recommended that anyone working with them first spend time learning how they were developed and reading all the relevant materials.
Limitations	This is an ongoing project that does not yet provide full national coverage in a consistent manner.
Assessment of utility	Maps of LULUCF (Land Use, Land Use Change, and Forestry) going back centuries
Assessment of uncertainty	The older maps are more subjective and subject to interpretation. The georeferencing looks good but it should be born in mind that the accuracy of mapping pre-digital and pre-GPS was poorer in terms of geolocation of features.

