JISC DEVELOPMENT PROGRAMMES

Project Document Cover Sheet

USE-CASE COMPENDIUM of DERIVED GEOSPATIAL DATA

Project

Project Acronym	GRADE	**Project ID**	
Project Title	Scoping a Geospatial Repository for Academic Deposit and Extraction		
Start Date	June 2005	**End Date**	April 2007
Lead Institution	EDINA		
Project Director	David Medyckyj-Scott		
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Partner Institutions	Arts and Humanities Research Council Research Centre for Studies in Intellectual Property and Technology Law, School of Law, University of Edinburgh National Oceanography Centre, University of Southampton		
Project Web URL	http://edina.ac.uk/projects/grade		
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Document

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Use Case Compendium of Derived Geospatial Data

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Submitted to:	David Medyckyj-Scott EDINA
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Contents

Executive Summary

The realisation that “everything happens somewhere” has driven widespread commercial and non-commercial thirst for geospatial data. The ability to collect, handle and distribute geospatial information has proven of major benefit to companies who can now analyse their own spatial context, in addition to offering geospatial services to a technologically mobile clientele. Within academia, a disparate variety of disciplines realise the importance in adding spatial dimensions to their research work. These drivers for data input are now coupled with a mandate from government to disseminate academic research outputs.

With a natural workflow formulated for the input of original/derived data in to research projects, with output for dissemination and downstream application in other areas, the academic climate is ready for the establishment of data repositories. The principle barriers to the implementation of repositories are cultural (academic data creators), legal (data copyright) and to a lesser extent technical (hardware/software). It is the complexities surrounding legal issues that form the subject of this report.

Through the provision of eleven (geospatial) use-case scenarios describing the main actors, stakeholders, data sets and outputs, a basis for the investigation of copyright issues surrounding the use and dissemination of derived data sets is given. In particular, the importance of the inheritance of copyright licensing for derived data sets is established. The interaction of a variety of stakeholders with varying implicit and explicit licensing conditions makes the definition of precise copyright boundaries difficult to establish. The requirement to adhere to the *most severe* licensing restriction poses significant problems to data repository establishment.

The Ordnance Survey plays a central role in the supply of geospatial data within the United Kingdom. The current JISC/Ordnance Survey negotiated licence was developed before today’s academic focus on repositories and therefore researchers are uncertain over the legal position on making their derived data available for reuse. The exploration of Creative Commons style licensing for geospatial data is suggested. Other key issues worthy of investigation include an assessment of the qualitative/quantitative use of input data and their subsequent importance in any output data. This could allow the development of the idea of “proportional copyright” that establishes relative rights based upon the importance of input data.

The arrival of data repositories (for derived data) to improve data access and encourage data reuse is imminent and it is therefore timely that the cultural, legal and technological issues surrounding their establishment are investigated.

1. Introduction

1.1 Geospatial Data and Digital Repositories

The use of geospatial data is acquiring new significance as many academic disciplines realise that spatial relationships in the phenomena they study are vital to their understanding. Subject areas range from traditionally spatial disciplines such as geography and geology, through to biology, business, archaeology, epidemiology and history. The relevance of these relationships means that many research projects now collect, analyse and output geospatial data (through the use of a geographic information system or GIS) that can be of relevance and use to other researchers and organisations. It is this backdrop of the wide and increasing use of geospatial data and, more importantly, its' reuse, that is driving the JISC to investigate the use of digital repositories[1]. This all encompassing programme is designed to drive forward the "development of digital repositories, in terms of their technical and social (including business) aspects."

Although implementation of such a system is principally technical, the main barriers to its' establishment come from social issues relating to data lodgement. In particular, the reluctance of authors' to lodge data and copyright issues pertaining to the data itself. These issues are under investigation through the JISC funded GRADE (Scoping a Geospatial Repository for Academic Deposit and Extraction) project[2]. Specifically GRADE will "report on the technical and cultural issues around the reuse of geospatial data" focussing upon three main units:

1. Geographical Data: different types of repositories, including thematic and institutional. Current software to perform these tasks will be investigated, including peer-to-peer options.
2. Digital Rights Management: exploration of rights management of derived and original data sets.
3. Interoperability: geospatial meta-data and wrappers.

Project partners for GRADE include the AHRC Research Centre for Studies in IP and IT Law[3] and the National Oceanography Centre[4], Southampton University, who provide expertise pertaining to digital rights management and digital repositories respectively. Specifically GRADE wishes to develop a conceptual framework for resolving digital rights issues raised in relation to sharing geospatial data within repositories. Initial focus for GRADE is in the provision of "use-cases" (i.e. examples in the use of geospatial data) as input to the digital rights management work unit.

It is pertinent to note that there is a general distinction made between "data" and "maps". Although maps can be considered to be "data", both commercial and non-commercial licences negotiated by the Ordnance Survey make a clear distinction between them. This report therefore defines geospatial "data" to represent the original recorded locations of spatial phenomena, within the constraints of a particular product description. "Maps" differ in that they are a *representation* of the original data and are produced for presentational purposes. There may be a significant reduction in the amount of original data retained during map production, such that only visually important aspects are depicted.

[1] http://www.jisc.ac.uk/index.cfm?name=programme_digital_repositories
[2] http://www.jisc.ac.uk/index.cfm?name=project_grade
[3] http://www.law.ed.ac.uk/ahrb/aboutus.asp
[4] http://www.soc.soton.ac.uk/

1.2 Development of Use-Cases

The Journal of Maps has extensive experience relating to copyright issues of geospatial data within a publishing environment and has therefore been commissioned by EDINA to develop and provide use-cases for the digital rights management work unit of the GRADE project. This report is principally based around the presentation of eleven use-case examples from a variety of geographic disciplines, using national and international data sets from both third parties and collected by the individual authors. The use-cases are intended to outline how a project uses a variety of input data sets to perform a research task in order to produce an output data set. It is assumed that one of the primary outcomes of such a project is the production of a new data set that may then be lodged with a digital data repository. However it should be noted that not all authors intend, or are willing, for their data sets to be distributed (and therefore lodged), although publication of their results (which may include their data in full) is often an end-result. Each use-case is based around a template (Appendix 1) which outlines the following criteria:

- Authors
- Summary details
- Actors
- Stakeholders
- Data sets
- Outputs
- Brief description

Given the broadly UK-centric approach of the project, there is a UK national bias. However the use-cases are not restricted to the UK, with many international data sets incorporated in the report.

1.3 Data Availability

Subjects aligned with geographic analysis, and the use of geospatial data, have traditionally struggled to acquire data that is suitable for specific applications. Early GIS based approaches relied upon either the acquisition of original data by the user or the conversion of analogue (paper based) data through scanning or digitising. Problems related to data availability have largely evaporated, such that users are now presented with an overwhelming array of products from a variety of governmental and commercial organisations. It is not whether a data set exists that can be suitably used for a given project, but rather which data set is fit-for-purpose. Secondary issues relate to cost and copyright, requiring close scrutiny by the end-user. The licencing of Ordnance Survey digital products by JISC, and their subsequent distribution through EDINA, has opened up large quantities of data to academic institutions, providing extensive access that had previously been unavailable.

The explosion in the acquisition of satellite imagery during the last 20 years has literally inundated the market with large volumes of data providing an extensive catalogue with global coverage. Not only is this data timely, but it also provides a back-catalogue allowing the historic use of data sets. Many of the important earth observation programmes are run by NASA who operate a copyright-free licensing model for their data sets (e.g. Landsat, ASTER, SRTM). When this is coupled with open-access, internet based, digital

repositories (e.g. Global Land Cover Facility[5]), the availability of data becomes a powerful resource.

Within the UK alone, the Ordnance Survey has dramatically expanded its digital data portfolio and globally has one of the most detailed national mapping products available with Mastermap™. The UK remains the most mapped nation in the world with organisations such as GeoInformation Group, Environment Agency, NERC, InfoTerra, Get Mapping and Intermap all providing extensive data sets, often at a national level. For example, there are currently ten *different* digital elevation model (DEM) data sets nationally available for the UK.

With data availability so extensive and wide ranging, the derivation of *new* data sets is commonplace across many disciplines. Nationally, universities, the government, JISC and Research Councils UK all realise that these new data sets form an important part of the rich research culture amongst universities and that their archival forms part of the dissemination of research findings, particularly in encouraging "downstream applications." Digital repositories are clearly seen as a solution to digital data archival, however copyright issues are one of the principal legal barriers to implementation.

1.4 Copyright Issues

Copyright protects the fundamental right of an individual or organisation to protect its products and ideas from misuse by others. It enshrines the right of an entity to use and sell their own material, whilst requiring others to license the use of such products. The enforcement of copyright is *good* as it allows individuals and organisations to commit resources to the development of material, knowing that their work will be fully recompensed. However it is not *always* appropriate or desirable and can, in many instances, stifle research and innovation. Indeed it is often desirable to retain copyright, whilst allowing more extensive and variable use of materials. Such licensing is complex and not automatically defined within a standard copyright license.

Within the context of geospatial data usage in universities, copyright is fundamental to both research and teaching, ultimately defining which data sets can be freely distributed through a digital repository. Data sets often have different copyright license agreements pertaining to them and these define the usage to which they can be put. In fact the fusion of data sets, particularly in the production of derived products, naturally requires the adherence to the *most restrictive* license that applies to *any* of the data sets. It is paramount that researchers therefore select data based upon the *technical* capabilities of the data set, as well as any copyright *restrictions*.

Distribution of digital data sets has, until recently, been left to individual researchers to organise. However there have been several powerful drivers within the research community that are now forcing the issue of research publication and, more specifically, digital data sets. These drivers include:

- **Government**: the House of Commons Science and Technology Committee (2004) recommended greater access to research findings, particularly those funded by the government. As over 70% of university research within the UK is funded directly by government, there was considerable concern over costs of journal subscriptions and access to results.

[5] http://glcf.umiacs.umd.edu

- **Research Councils UK**: Research Councils UK (2005) now require that results from funded research be deposited in local e-print repositories. This initiative is likely to be extended to data sets. For example, NERC already requires all data produced by grant holders to be deposited in the NERC Earth Observation Data Centre[6].
- **JISC**: JISC is well positioned within UK higher education, potentially enabling it to archive and distribute the results of research. Indeed, many recent initiatives (e.g. Open Access initiatives[7]) address issues related to this.

The increase in the amount of geospatial data available, and its subsequent use in research, means that more data will be derived for future downstream use. As a significant proportion of the data is copyright, issues of lodgement and distribution need to be carefully addressed (Smith, 2005, discusses many of these issues within the context of the UK).

1.4 Metadata

Directly related to issues of copyright, but aligned with the technical implementation of a digital repository, is the issue of metadata. Metadata, or information about data, allows both a distributor and end user to decide whether a data set is fit-for-purpose or distribution. Recent initiatives (e.g. Go-Geo[8], GIGateway[9]) have developed internet portals allowing individuals to search and locate appropriate data sets. Metadata has a vital role to play in the archival of copyright information that can then be used to appropriately enforce copyright restrictions.

Metadata is seen as a chore by many researchers. The more exact a metadata schema is, the greater the amount of detail required in order to complete. The use-case template (Appendix 1) developed for this report is relatively simple, yet its completion is prone to error and not seen as important by researchers. Mandatory data lodgement is the only method that can be satisfactorily used to ensure data deposition and metadata completion.

1.5 Summary

The introduction to this report has briefly outlined the current position in the use of geospatial data and urgent initiatives that are in place to find solutions to the archival of data sets created as part of research projects. The GRADE project is tasked with scoping geospatial repositories. The initial work for this project investigates digital rights management, specifically with the production of use-case examples demonstrating the use of geospatial data in research environments. These will form the basis for further investigation. Given the wide array of geospatial data sets currently available, and variable licensing restrictions, the complex interaction of copyright licensing between data sets in any research investigation means that the management of digital rights will need to incorporate these complexities, with a particular emphasis upon the supply and use of metadata.

The next section presents eleven use-case examples, based around a simple metadata template. These examples illustrate a wide range of data sets, copyright interactions, analyses and outputs that can be used as a basis for investigating digital rights. The report is concluded with a discussion section that summarises and illustrates important points arising from the use-cases.

[6] http://www.neodc.rl.ac.uk/
[7] http://www.jisc.ac.uk/index.cfm?name=pub_openaccess
[8] http://www.gogeo.ac.uk/
[9] http://www.gigateway.org.uk/

2. Use-Cases

Use Case 1: Glacial Geomorphological Mapping

Authors

Author 1	Mike J Smith

Use case details

Name	Geomorphological mapping from remotely sensed data
Date	2002
Application Area	Creation of maps of glacial landforms using remotely sensed data
Summary	A researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Mike J Smith
	Goals:	Completion of research for PhD Publication of final map Deposit data in a geospatial repository
Secondary	Type:	End-user
	Goals:	Research (glacial reconstruction) Teaching (example of geomorphological mapping)

Stakeholders

Ordnance Survey	Type:	creator
	Goals:	Sales Consumer adherence to license restrictions Marketing
EDINA	Type:	Distributor
	Goals:	Distribution Consumer adherence to license restrictions
Ordnance Survey of Ireland	Type:	Creator, distributor
	Goals:	Sales Consumer adherence to license restrictions Marketing
University of Sheffield	Type:	Grant body
	Goals:	Advancement of research Promotion of university name
NASA	Type:	Creator
	Goals:	Dissemination of satellite data
ERA Maptec	Type:	Distributor
	Goals:	Sales Consumer adherence to license restrictions

Dataset Details

Dataset 1	Name:	Land-form PANORAMA®
	Owner:	Ordnance Survey
	Distributor:	EDINA
	Licensing:	©, JISC negotiated agreement until 2009
	Processing:	Quantitative (8), qualitative (1)
	Type:	Raster elevation
	Area:	Derived

Dataset 2	Name:	Landsat Thematic Mapper
	Owner:	NASA
	Distributor:	ERA Maptec
	Licensing:	Creative Commons, perpetual
	Processing:	Quantitative (1), qualitative (1)
	Type:	raster satellite imagery
	Area:	Derived

Dataset 3	Name:	1:50,000 DEM
	Owner:	Ordnance Survey of Ireland
	Distributor:	Ordnance Survey of Ireland
	Licensing:	©, Annual license
	Processing:	Quantitative (8), qualitative (1)
	Type:	raster satellite imagery
	Area:	Derived

Output Data

Type	Vector
Format	ESRI SHP

Descriptives

Context

Geomorphological field mapping (e.g. Rose, 1977) is a common technique used to map landscape morphology, often focusing on landforms of a common genesis (e.g. glacial). Using a standard topographic base map, field researchers mark changes in slope to produce a detailed outline of morphology in a study area. Recent emphasis has been on the use of remotely sensed data products to perform landform mapping as it allows cheaper and faster coverage of larger areas. The generation of geomorphological field maps from remotely sensed data requires the visualisation of data available, prior to on-screen interpretation and digitising of pertinent features.

Processing

Smith (2003) performed mapping of the following suites of glacial landforms:

1. Cumbria, UK
    - Ordnance Survey Land-form PANORAMA®
2. Irish Midlands
    - Ordnance Survey of Ireland DEM
    - Landsat Thematic Mapper

Pre-processing of the DEM and satellite imagery is required in order to best visualise the data for landform mapping. The recommendations developed by Smith *et al* (2001) and Smith and Clark (2005) were followed. DEM processing involved the derivation of the data sets listed below:

- relief shaded (Figure 1). This step involved the generation of 72 images at varying solar azimuths that were used individually and later animated.
- gradient (Figure 2)
- curvature (Figure 3)
- principal component 1
- local contrast stretch (Smith and Clark, 2005)
- texture filter (Irons and Peterson, 1981)
- fabric filter (Guth, 2001)
- openness filter (Yokoyama *et al*, 2002)

All of the data sets listed above are quantitatively derived, based upon software algorithms. Once generated, the images were used as a visual backdrop within a GIS and subsequently interpreted by an experienced observer. Interpretation involved the digitisation of landforms to create a data set of glacial landforms from which a glacial geomorphological map was created (Figure 4). Depending upon landform type, these were digitised as points, lines or areas.

Key Points

- The data set generated from this research is a two step process. After the acquisition of Ordnance Survey Land-form PANORAMA® data, *quantitative* procedures are used to generate eight different data sets. These then form the basis from which the final output data set of glacial geomorphology is *qualitatively* interpreted by an experienced observer.

- A further complication involves the *inheritance* of copyright conditions from Land-form PANORAMA®. The JISC/Ordnance Survey licence agreement (EDINA, 2005) state that, for map publication in electronic form on an internet facing site, the *maximum publishable area* allowed for a single Land-form PANORAMA® image is 200 cm^2 (~A5). In addition the *maximum ground coverage* is 50 km^2 (i.e. equivalent to a square ~7 km by 7 km). Whilst the former restriction is designed for illustrations in academic publications, it virtually prevents the publication of research based maps. The latter restriction precludes regional/national based studies as results are unpublishable (see Clark *et al*, 2004 for a perfectly acceptable use of Land-form PANORAMA® that grossly breaks the ground coverage restriction).

- Copyright inheritance is particularly problematic for data repositories with respect to annual licensing. As soon as a license expires, the derived data set can no longer be used and should be deleted.

- Copyright inheritance also causes problems with initial lodgement of data with a digital repository. As the copyright is inherited, **no redistribution** of data is allowed to non-authorised users.

- If a researcher derives a new dataset from original Ordnance Survey data distributed by EDINA and then, at a future date, their institution ceases their licence to the Ordnance Survey data, all data and its' derivatives must be deleted.

- The decision by the US government to charge a simple distribution cost for all Landsat data, with no restrictions on use or redistribution, means that there are no issues relating to the publication of original or derived data sets.

References

Clark, C.D. et al., 2004. Map and GIS database of glacial landforms and features related to the last British Ice Sheet. Boreas, 33: 359-375.

EDINA (2005) Digimap: Ordnance Survey Data Sub-licence Agreement [online]. Available from: http://www.edina.ac.uk/digimap/osterms.html [Accessed 14th July 2005].

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Irons, J.R. and Peterson, G.W., 1981. Texture transforms of remote sensing data. Remote Sensing of the Environment, 11: 359-370.

Rose, J. and Letzer, J., 1977. Superimposed drumlins. Journal of Glaciology, 18: 471-480.

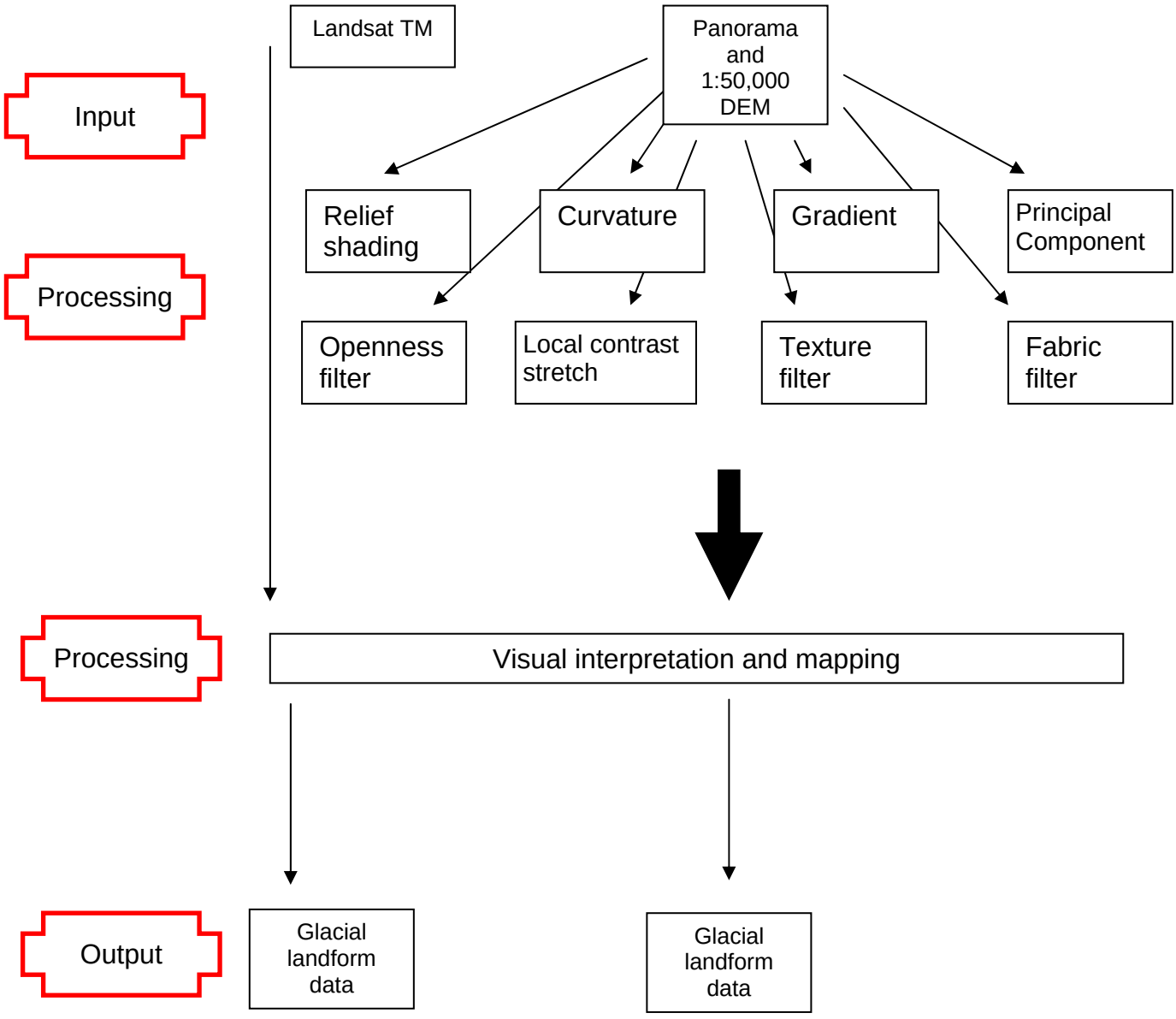
Smith, M.J., 2003. Technical Developments for the Geomorphological Reconstruction of Palaeo Ice Sheets from Remotely Sensed Data. PhD Thesis, University of Sheffield.

Smith, M.J. and Clark, C.D., 2005. Methods for the visualisation of digital elevation models for landform mapping. Earth Surface Processes and Landforms, 30(7): 885-900.

Smith, M.J., Clark, C.D. and Wise, S.M., 2001. Mapping glacial lineaments from satellite imagery: an assessment of the problems and development of best procedure. Slovak Geological Magazine, 7: 263-274.

Yokoyama, R., Shirasawa, M. and Pike, R.J., 2002. Visualizing topography by Openness: a new application of image processing to digital elevation models. Photogrammetric Engineering and Remote Sensing, 68(3): 257-265.

Flow Chart


Input
Processing
Processing
Output
Landsat TM
Panorama and 1:50,000 DEM
Relief shading
Curvature
Gradient
Principal Component
Openness filter
Local contrast stretch
Texture filter
Fabric filter
Visual interpretation and mapping
Glacial landform data
Glacial landform data

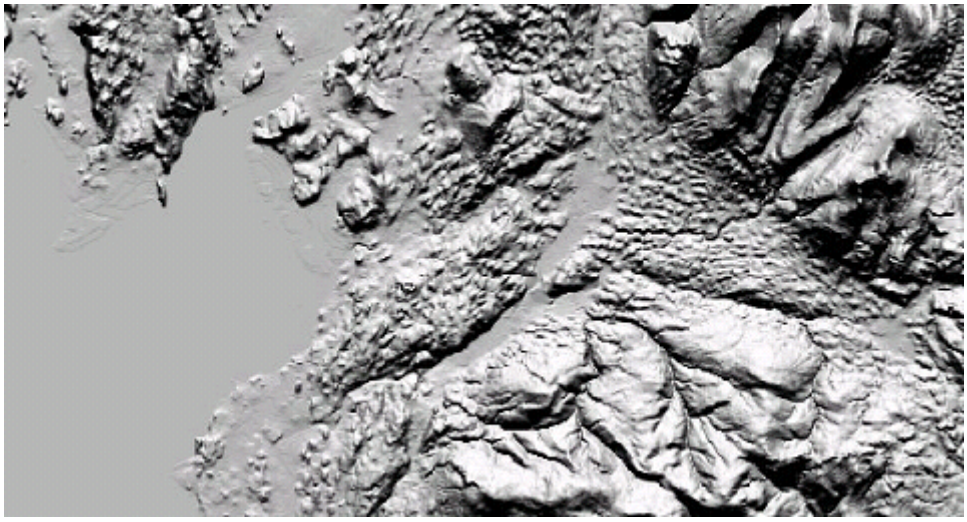


Figure 1 Relief shaded image from Cumbria, derived from Ordnance Survey Land-Form PANORAMA®. © Crown Copyright/database right 2005. An Ordnance Survey/EDINA supplied service.

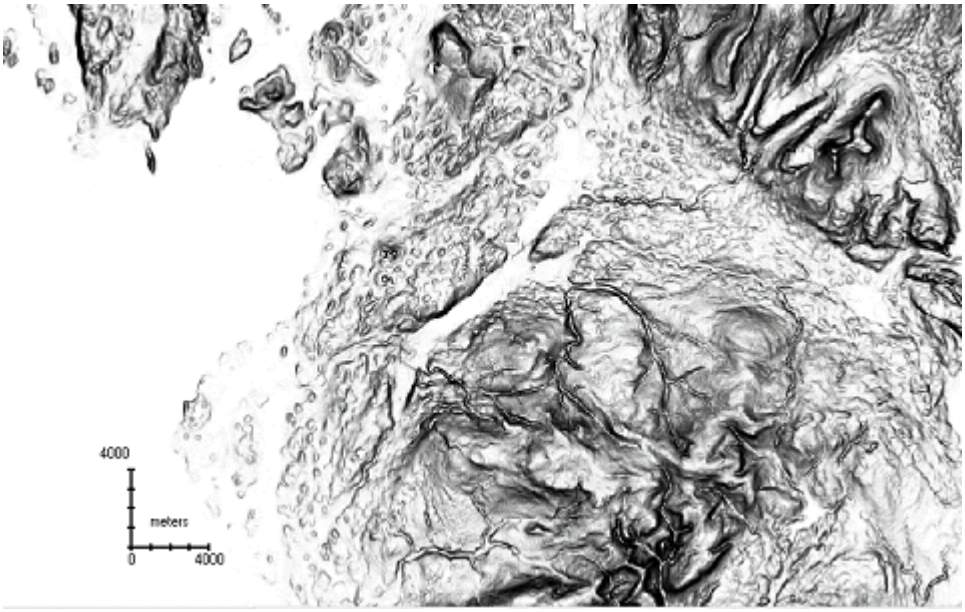


Figure 2 Gradient image from Cumbria, derived from Ordnance Survey Land-Form PANORAMA®. © Crown Copyright/database right 2005. An Ordnance Survey/EDINA supplied service.

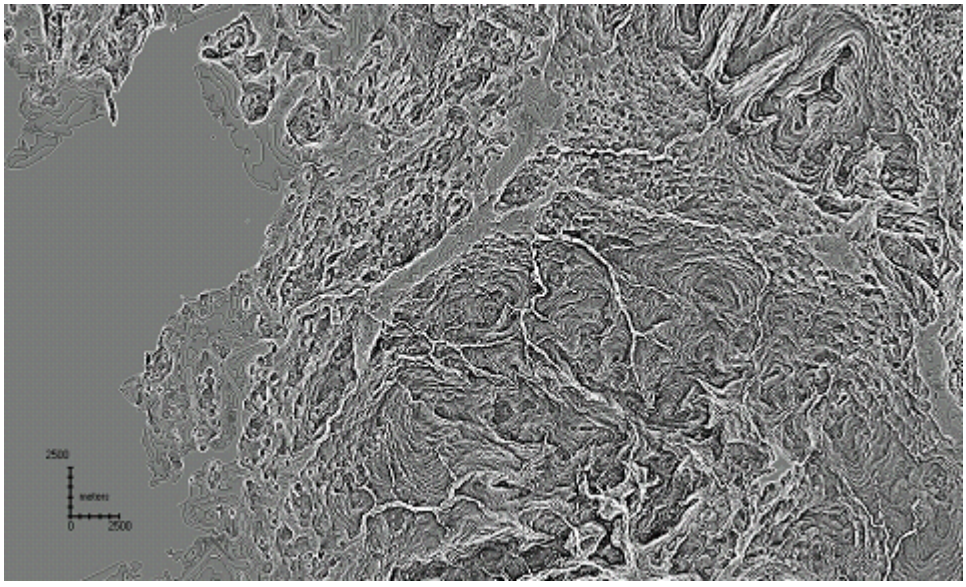


Figure 3 Curvature image from Cumbria, derived from Ordnance Survey Land-Form PANORAMA®. © Crown Copyright/database right 2005. An Ordnance Survey/EDINA supplied service.

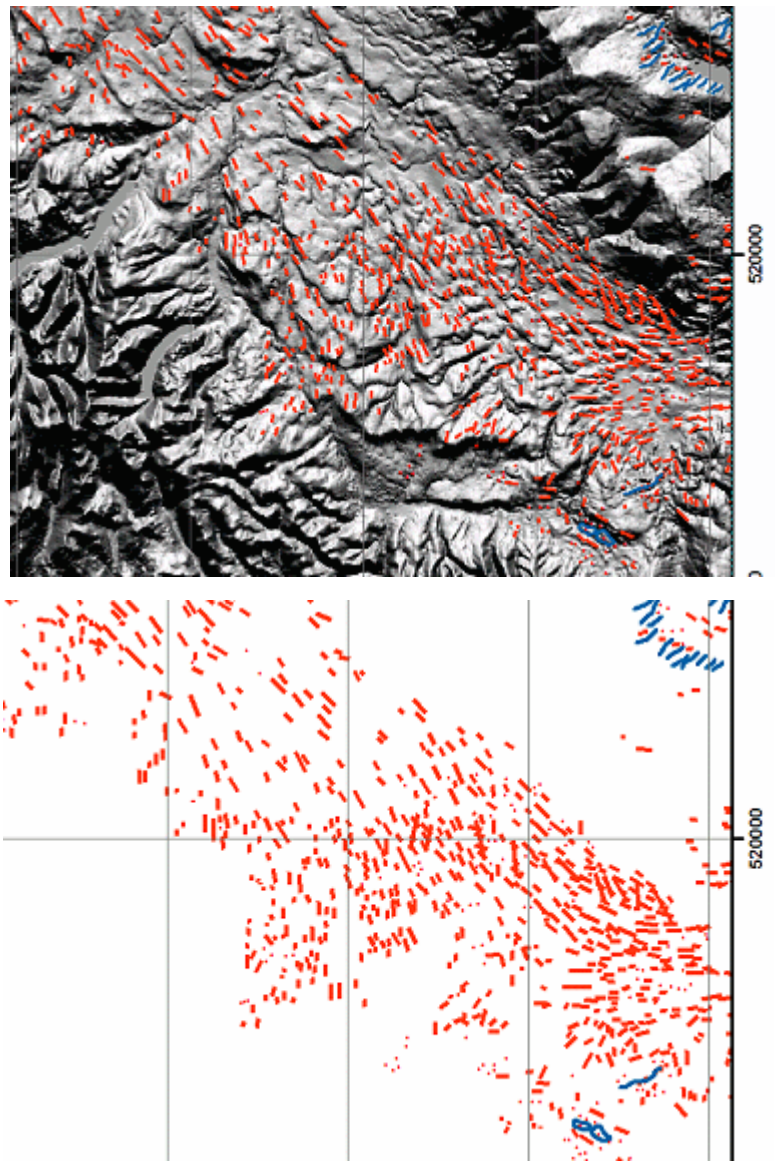


Figure 4 a) Extract from glacial landform map of Cumbria showing output vector data, derived from Ordnance Survey Land-Form PANORAMA®, overlaid on to a relief shaded image derived from Ordnance Survey Land-Form PANORAMA®. B) Raw output vector data of glacial landforms.

Use Case 2: Search for Blandings

Authors

Author 2	Daryl Lloyd

Use case details

Title	The search for Blandings
Date	2002
Application Area	Multi-criteria evaluation
Summary	A researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Daryl Lloyd and Ian Greatbatch
	Goals:	Publication of final map Deposit data in a geospatial repository
Secondary	Type:	End-user
	Goals:	Personal (interest in PG Wodehouse) Teaching (example of MCE)

Stakeholders

Ordnance Survey	Type:	creator
	Goals:	Sales Consumer adherence to license restrictions Marketing
EDINA	Type:	Distributor
	Goals:	Distribution Consumer adherence to license restrictions
University College of London	Type:	Educational Institution
	Goals:	Research Curriculum development Promotion of University to external agencies
ESRC	Type:	creator
	Goals:	Sales Consumer adherence to license restrictions Marketing

Dataset Details

Dataset 1	Name:	Land-form PANORAMA™
	Owner:	Ordnance Survey
	Distributor:	EDINA
	Licensing:	©, JISC negotiated agreement until 2009
	Processing:	Quantitative (1)
	Type:	Raster elevation
	Area:	Derived

Dataset 2	Name:	1:50,000 Colour Raster
	Owner:	Ordnance Survey
	Distributor:	EDINA
	Licensing:	©, JISC negotiated agreement until 2009
	Processing:	None
	Type:	Raster topographic
	Area:	Presentation

Dataset 3	Name:	County Boundaries
	Owner:	Licencee ESRC
	Distributor:	EDINA
	Licensing:	ERSC/National Census Office agreement
	Processing:	Quantitative (1)
	Type:	Vector
	Area:	Derived

Dataset 4	Name:	Meridian2™
	Owner:	Ordnance Survey
	Distributor:	EDINA
	Licensing:	©, JISC negotiated agreement until 2009
	Processing:	Quantitative (3)
	Type:	Vector
	Area:	Derived

Dataset 5	Name:	Strategi®
	Owner:	Ordnance Survey
	Distributor:	EDINA
	Licensing:	©, JISC negotiated agreement until 2009
	Processing:	None
	Type:	Vector
	Area:	Presentation

Output Data

Type	raster
Format	ESRI GRID

Descriptives

Context

Multi-criteria evaluation (MCE) is designed to combine disparate data sets to produce possible solutions based upon input criteria. The authors were interested in determining if geographical analysis, based upon MCE, could help determine the possible location of the

fictional Blandings Castle, created by the writer P.G. Wodehouse, using locational evidence from his novels. The output of the analysis is a raster data set which identifies "hot spot" areas showing the most likely locations of Blandings (Figure 7).

Processing

The input data sets listed above were processed in the following manner:

- UKBorders – clipping of Meridian2 and Land-form PANORAMA® data sets to exclude all data *outside* Shropshire.
- Meridian2™ – editing of the road network, followed by the generation of two new raster layers identifying time/distance drive times (from Shrewsbury; Figure 5) and linear distance from the roads. Extraction of rivers and generation of raster layer identifying linear distance from the River Severn.
- Land-form PANORAMA® - viewshed analysis (all areas visible from a given location; Figure 6).

Key Points

Copyright inheritance operates with this use-case with electronic publication restrictions as follows:

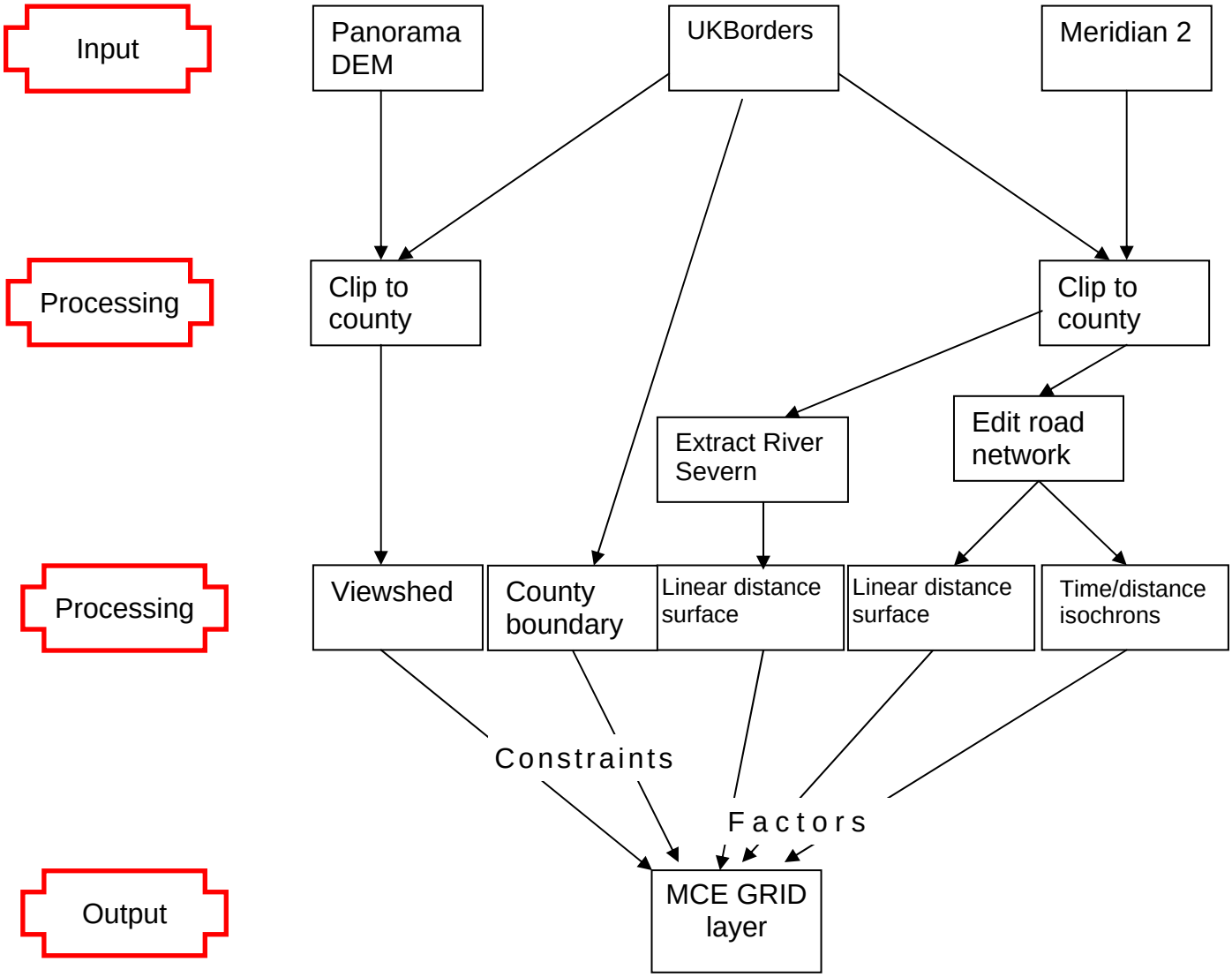
Product	**Max Publishable Area (cm^2)**	**Max Ground Area (km^2)**
Land-form PANORAMA®	200	50
UKBorders	None	None
Meridian2™	200	50
Strategi®	200	1250
1:50,00 Colour Raster	200	50

- The map produced from this work broke both the maximum publishable area and maximum ground area and could therefore not be published.

References

Lloyd, D.A. and Greatbatch, I.D. 2004. The Search for Blandings. Journal of Maps, Unpublished map.

Flow Chart


Input
Processing
Processing
Output
Panorama DEM
UKBorders
Meridian 2
Clip to county
Clip to county
Extract River Severn
Edit road network
Viewshed
County boundary
Linear distance surface
Linear distance surface
Time/distance isochrons
Constraints
Factors
MCE GRID layer

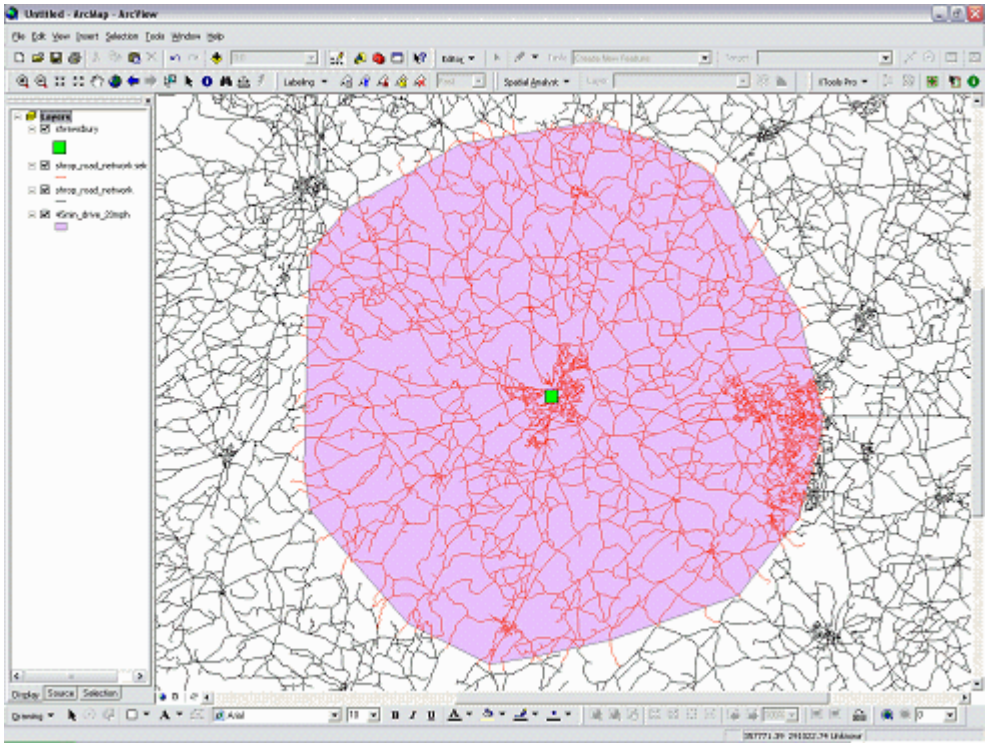


Figure 5 Travel isochrons (45 minutes at 20 mph) displayed in ArcGIS 8 (originally calculated in ArcView 3).

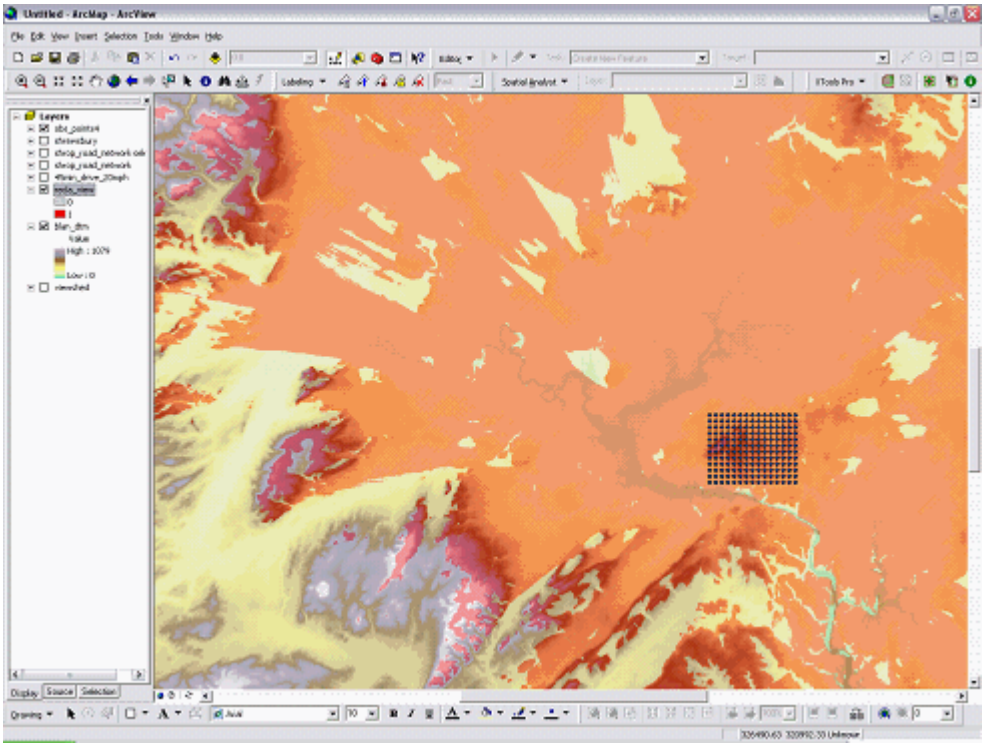


Figure 6 Viewshed of the Wrekin, displayed in ArcGIS8, overlaid on a DEM of Shropshire (dotted grid represents Shrewsbury).

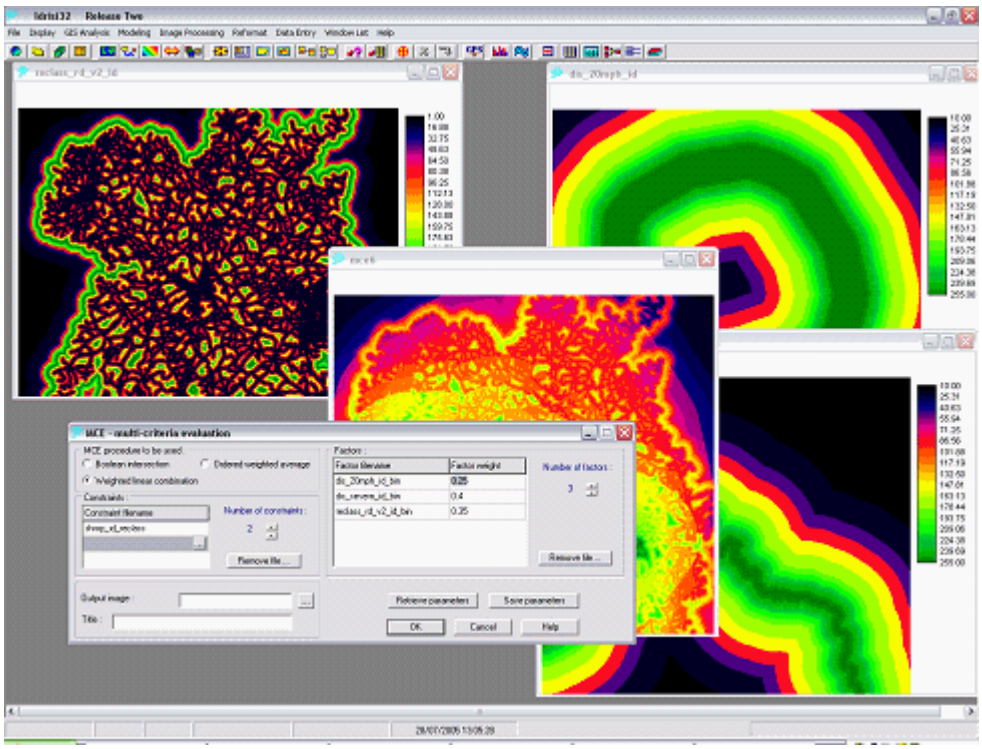


Figure 7 IDRISI MCE interface and factors displayed with MCE output.

Use Case 3: Winter Snow Accumulation

Authors

Author 1	Richard Hodgkins

Use case details

Title	Inter-Annual Variability in the spatial Distribution of Winter Accumulation at a High-Arctic Glacier (Finsterwalderbreen, Svalbard), and its Relationship with Topography
Date	August 2004
Application Area	Glaciological research
Summary	A researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Richard Hodgkins
	Goals:	Terrain-based analysis of spatial distribution of snow depth
Primary	Type:	Researcher
	Name:	Adrian Fox
	Goals:	DEM generation
Secondary	Type:	End-user
	Goals:	Hydrological and glaciological forecasting Teaching

Stakeholders

Royal Holloway, University of London	Type:	Distributor, creator
	Goals:	Advancement of research Dissemination of data
Natural Environment Research Council	Type:	Grant body
	Goals:	Advancement of research Dissemination of data
British Antarctic Survey	Type:	Distributor
	Goals:	Advancement of research Dissemination of data
Norwegian Polar Institute	Type:	Creator
	Goals:	Advancement of research Dissemination of data

Dataset Details

Dataset 1	Name:	Finsterwalderbreen 1990 Aerial photos
	Owner:	Norwegian Polar Institute
	Distributor:	Norwegian Polar Institute
	Licensing:	© Perpetual
	Processing:	Quantitative (4)
	Type:	Raster elevation (Figure 8)
	Area:	Derived

Dataset 2	Name:	Snow depth data
	Owner:	Royal Holloway, University of London
	Distributor:	Royal Holloway, University of London
	Licensing:	©
	Processing:	Quantitative (1)
	Type:	Vector depth (Figure 9)
	Area:	original

Output Data

Type	raster
Format	DEM elevation

Type	vector
Format	Snow depth point measurements (two years)

Type	vector
Format	Text (for statistical analysis)

Descriptives

Context

Glacier mass balance and hydrology are strongly influenced by the distribution of snow accumulation at the start of the melt season. Two, successive end-of-winter snow cover surveys at the glacier Finsterwalderbreen in Svalbard are here used to investigate the inter-annual variability in the spatial distribution of accumulation, and its relationship with topography.

Processing

Principal Components (PC) analysis of the topographic variables elevation, slope, N-S and E-W aspects, derived from the Finsterwalderbreen 1990 DEM referred to above, shows that only 2 of 6 PCs, determined for two years' sampling locations, had maximum loadings on altitude; aspect was more important, with maximum loadings on 4 PCs. Hierarchical cluster analysis was then applied to these PCs: significant correlations with accumulation in each of 2 terrain clusters were given by (1) elevation and slope, (2) E–W aspect only (1999); (1) elevation only, (2) no significant correlations (2000).

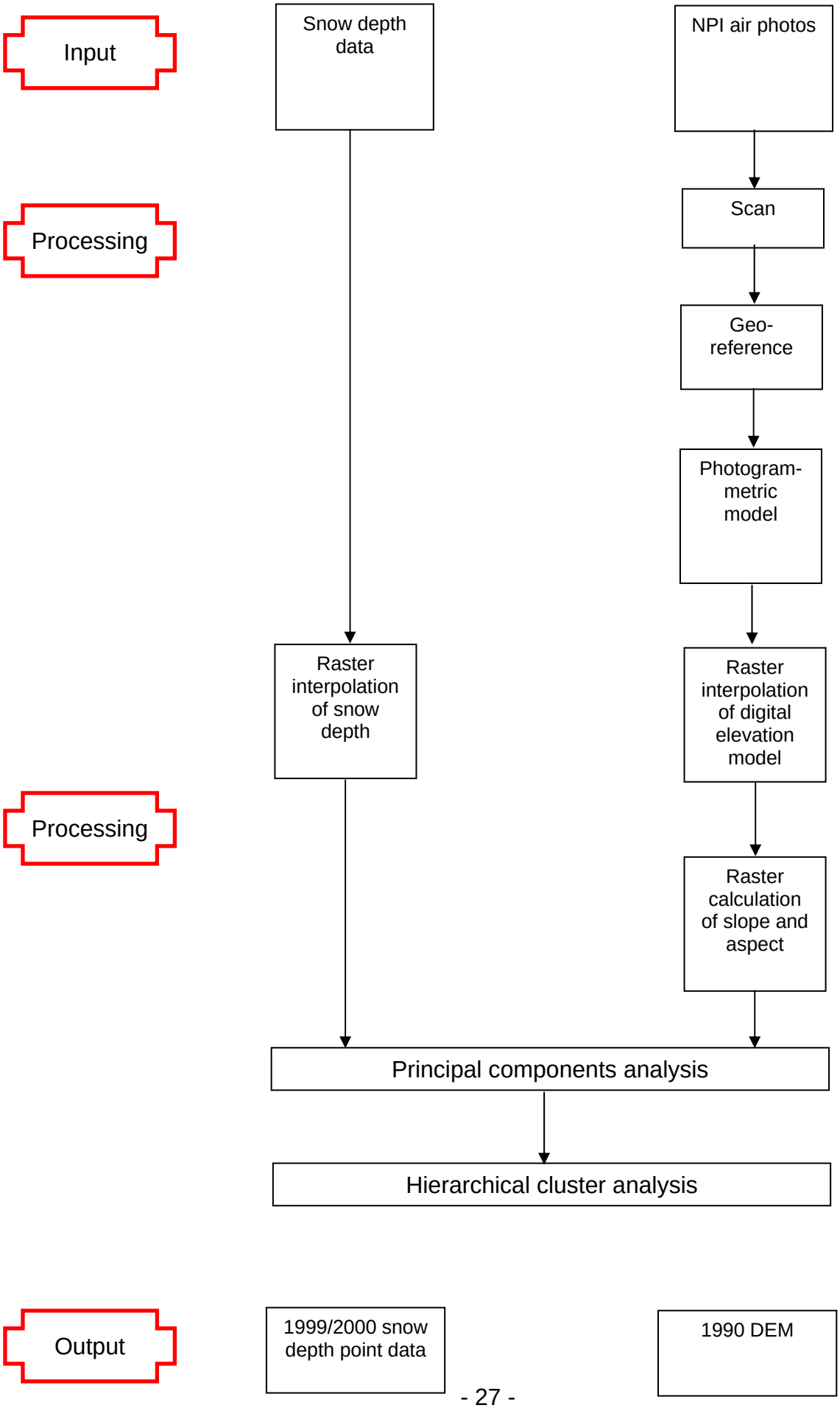
Key Points

- DEM data are copyright-free; their use was negotiated informally.

References

Hodgkins, R., Cooper, R., Wadham, J., Tranter, M. in press. Inter-annual variability in the spatial distribution of winter accumulation at a High-Arctic glacier (Finsterwalderbreen, Svalbard), and its relationship with topography. Annals of Glaciology, 42.

Flow Chart


Input
Snow depth data
NPI air photos
Processing
Scan
Geo-reference
Photogram-metric model
Raster interpolation of snow depth
Raster interpolation of digital elevation model
Processing
Raster calculation of slope and aspect
Principal components analysis
Hierarchical cluster analysis
Output
1999/2000 snow depth point data
1990 DEM

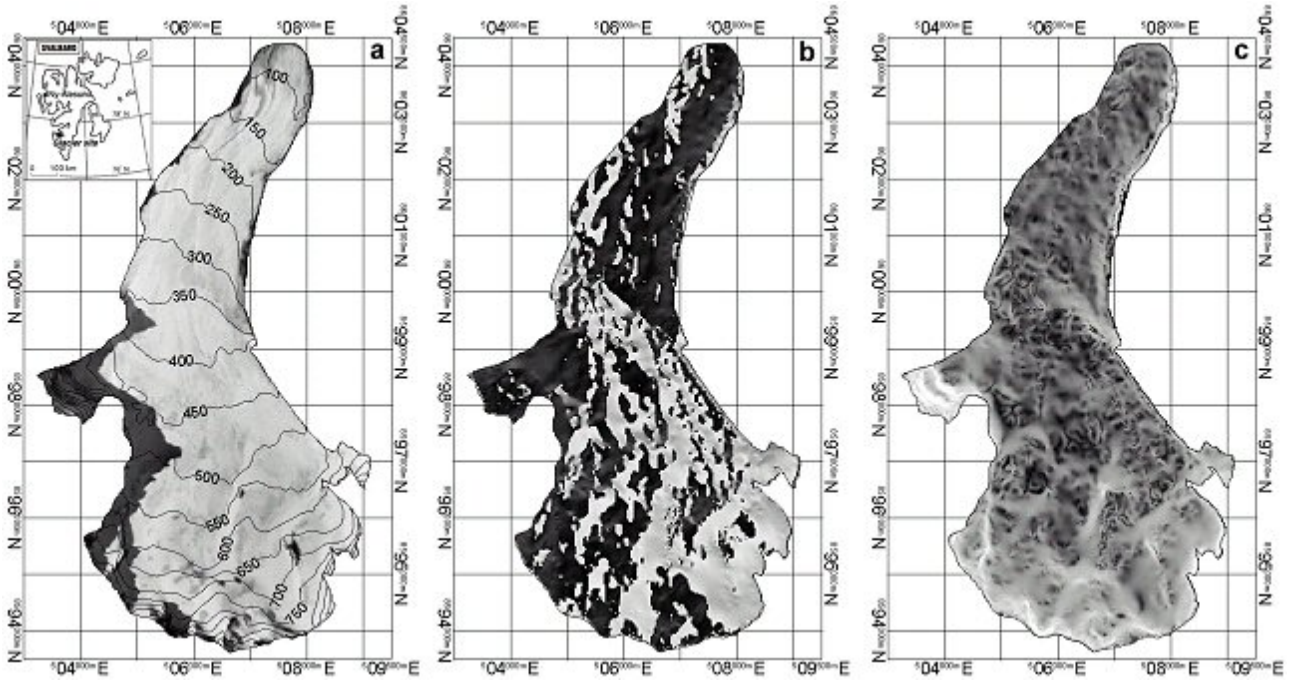


Figure 8 (a) Surface topography (m a.s.l.) of Finsterwalderbreen. Image is subset of aerial photographs S90 3741–3744 © Norwegian Polar Institute. Inset shows location within Svalbard. (b) Distribution of aspect over the Finsterwalderbreen surface. Lighter shading denotes a westerly aspect. (c) Distribution of slope over the Finsterwalderbreen surface. Lighter shading denotes steeper surfaces. Scale and north direction are given by an underlying 1 km UTM grid.

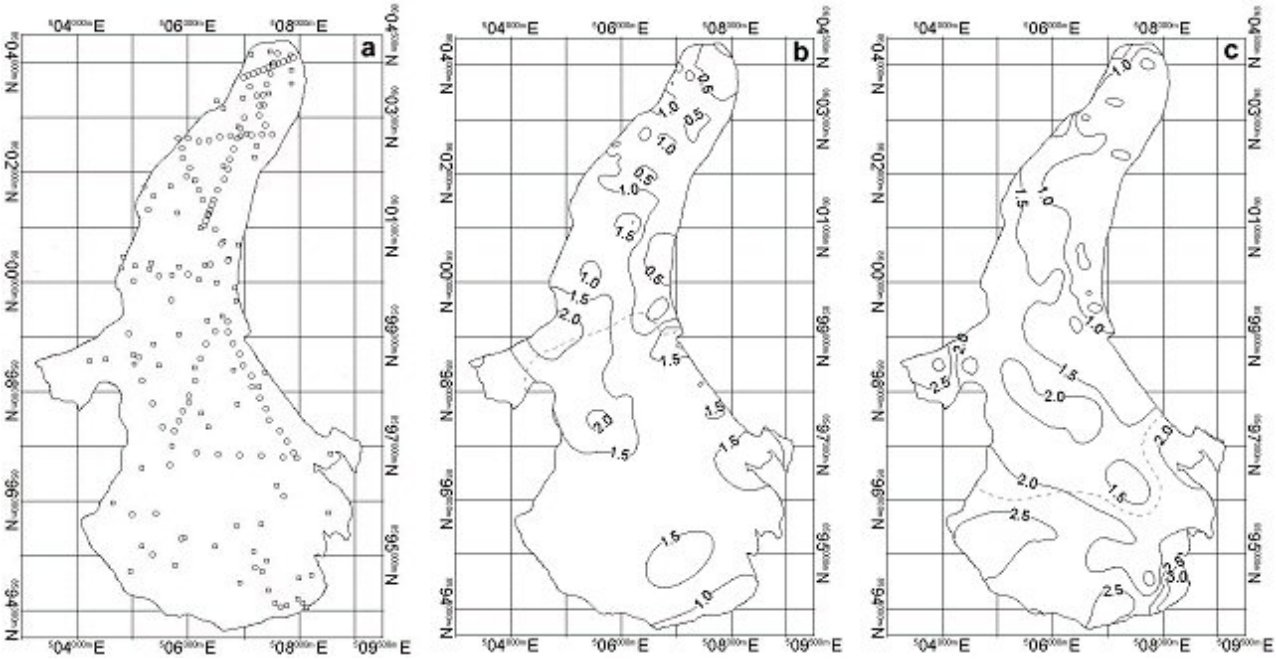


Figure 9 (a) Snow depth measuring locations, 1999 (circles), 2000 (squares). Distribution of accumulation/snow depth (m) over Finsterwalderbreen in (b) 1999, (c) 2000. Point snow depth measurements have been interpolated to a continuous surface using an iterative minumum curvature method, then contours have been located by linear interpolation of the resulting raster values. The dashed line is the boundary between terrain clusters (see text for further explanation). Scale and north direction are given by an underlying 1 km UTM grid.

Use Case 4: Land Use Mapping in Malta

Authors

Author	Kenneth Field

Use case details

Title	Land use mapping in Malta
Date	June 2005
Application Area	Creation of land use maps using published orthophotos and primary data gathering techniques
Summary	The researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Teacher
	Name:	Kenneth Field
	Goals:	Preparation of datasets for teaching
Secondary	Type:	End-user
	Goals:	Teaching: Use of prepared datasets for student use

Stakeholders

Malta Environment and Planning Authority (MEPA)	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Dissemination of data Tourist promotion of Malta
Kingston University	Type:	Educational Institution
	Goals:	Curriculum development Promotion of University to external agencies

Dataset Details

Dataset 1	Name:	2004 digital orthophoto
	Owner:	MEPA
	Distributor:	MEPA
	Licensing:	©, Perpetual
	Processing:	Quantitative (6)
	Type:	Raster, TIFF
	Area:	Derived

Dataset 2	Name:	Land use mapping
	Owner:	Kingston University
	Distributor:	Kingston University
	Licensing:	©
	Processing:	Original
	Type:	Vector
	Area:	Original

Output Data

Type	Raster
Format	MrSID

Type	Vector
Format	ESRI shapefile

Descriptives

Context

Land use mapping is commonplace on geography fieldwork. Traditionally, it involves annotating paper maps and overprinting land use zones. With the advent of Global positioning Systems (GPS), the availability of remotely sensed imagery and the improvements in mobile technologies (Bluetooth wireless connectivity, portable PCs and GPS receivers) it is possible to replicate and extend mapping capabilities in the field by using digital technologies. The exercise takes place in northern Malta, around Mellieha bay. Students are provided with bluetooth GPS receivers, portable PCs running ESRI ArcPad and digital orthophoto base data. Their task is to navigate the environment using the orthophoto and to digitally, and interactively, map land use zones and create a topographic map using a mixture of GPS derived locational data and observation input directly into their portable PC. The data requirement for this project is to provide students with base information to assist navigation in the field, a context for their own data collection and to assist post-fieldcourse map production.

Processing

The 2004 digital orthophoto data was commercially supplied by MEPA in 1km tiles. Four full colour, 15cm resolution, tiles were obtained in TIFF format covering the study area. Processing of the data was required to provide a derived dataset covering the study area and in a format capable of good refresh rates on portable PCs. Each tile was re-sampled to 30cm resolution and then converted to greyscale. The orthophotos were georeferenced to UTM zone 33N. The four tiles were then joined to create a single file. The format of each file was converted to Lizardtech's MrSID to provide a smaller file format capable of use with ESRI ArcPad on a portable PC (Figure 10). A version of the greyscale, resampled, data set was also converted to ESRI shapefile format for use on laptops during post-data collection phases and for map production by the students (Figure 11).

Key Points

- The data derived for this project was based upon published data, but needed to be compressed and output in a different format to make it useable in a practical context.

- Clarification was sought from MEPA regarding the extent of the licence agreement; the commercial licence covers use of the data for fieldwork or subsequent publication in academic journals. There are no barriers resulting from copyright restrictions associated with the standard licence arrangement.

- No redistribution or selling on of the original (or derived) data is permitted under the copyright licence agreement. This would cause problems if the data were to be lodged with a digital repository.

- The use of a published data set from which to digitise new spatial data was clarified and the licence agreement covers the derivation of information provided the source of

the original data is correctly attributed in any circumstances where data is published in academic journals (however further distribution is not allowed).

Flow chart

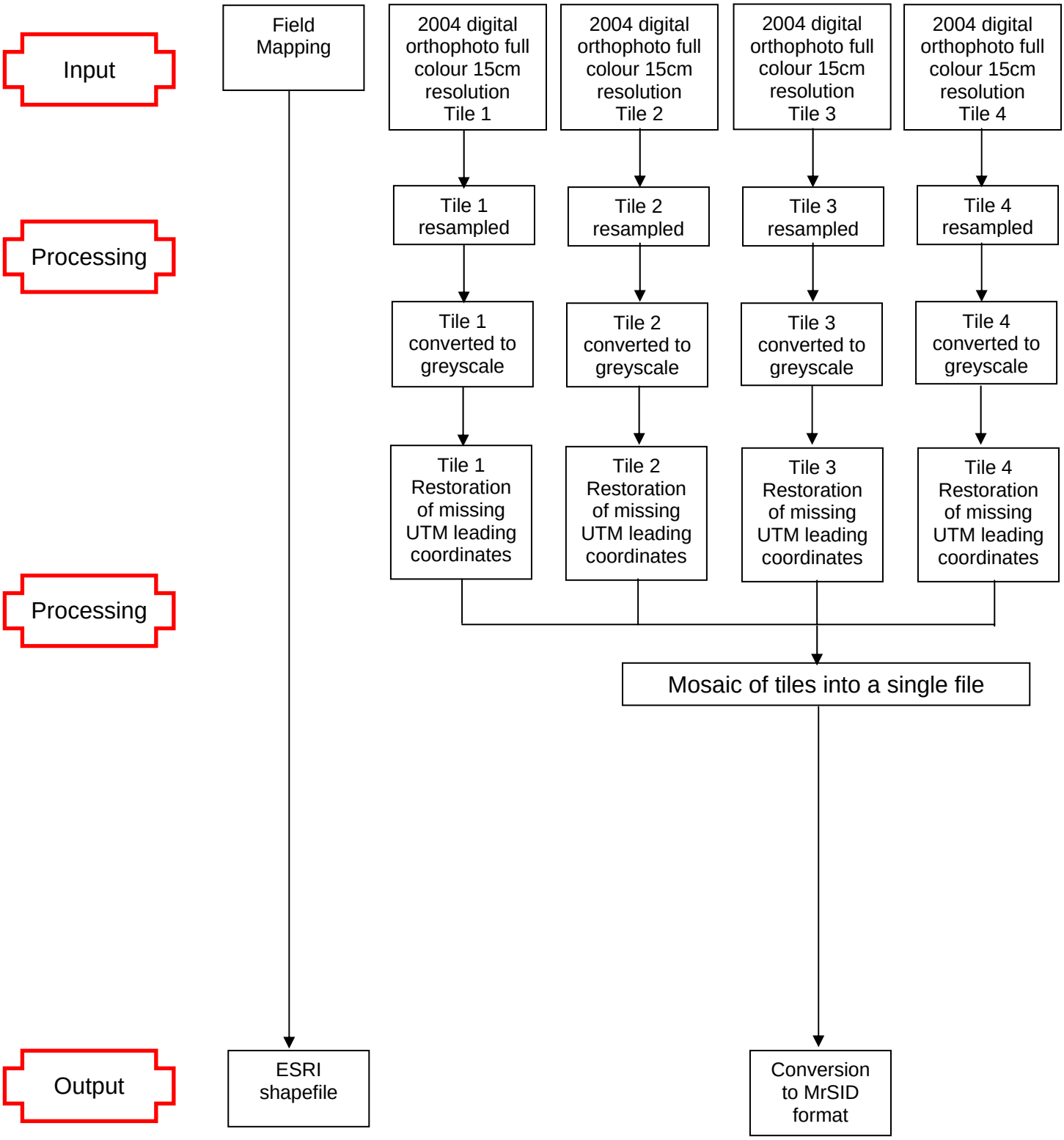

Input
Processing
Processing
Output
Field Mapping
2004 digital orthophoto full colour 15cm resolution Tile 1
2004 digital orthophoto full colour 15cm resolution Tile 2
2004 digital orthophoto full colour 15cm resolution Tile 3
2004 digital orthophoto full colour 15cm resolution Tile 4
Tile 1 resampled
Tile 2 resampled
Tile 3 resampled
Tile 4 resampled
Tile 1 converted to greyscale
Tile 2 converted to greyscale
Tile 3 converted to greyscale
Tile 4 converted to greyscale
Tile 1 Restoration of missing UTM leading coordinates
Tile 2 Restoration of missing UTM leading coordinates
Tile 3 Restoration of missing UTM leading coordinates
Tile 4 Restoration of missing UTM leading coordinates
Mosaic of tiles into a single file
ESRI shapefile
Conversion to MrSID format

Figure 10. Full colour 2004 digital orthophoto tiles (three as a mosaic) © MEPA 2004

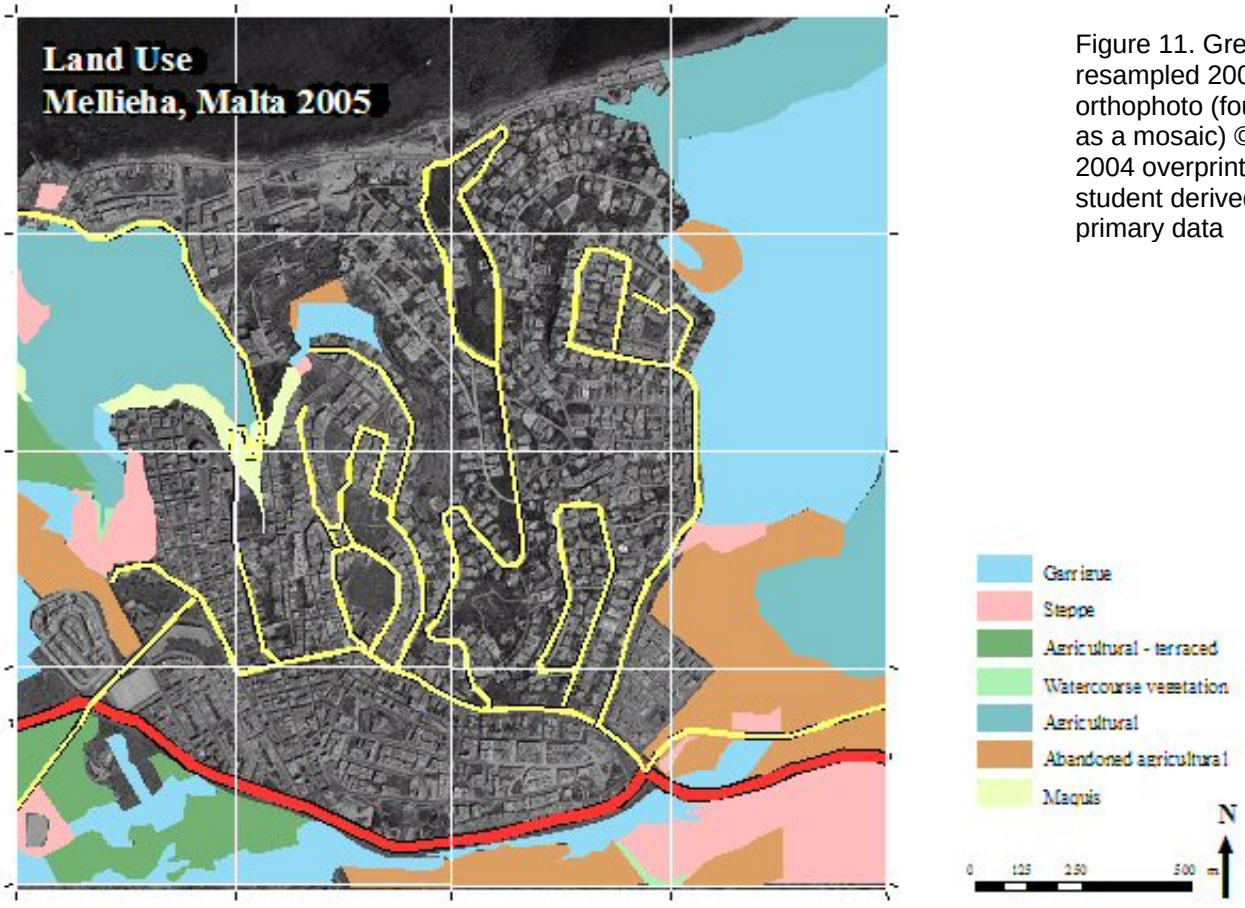


Figure 11. Greyscale, resampled 2004 digital orthophoto (four tiles as a mosaic) © MEPA 2004 overprinted with student derived primary data

Use Case 5: Soil Erosion Estimation

Authors

Author 1	Paul Zukowskyj

Use case details

Title	Farmers' perceptions of soil erosion hazard: strategies towards soil conservation in the post-Common Agricultural Policy (CAP) era
Date	August 2005
Application Area	Perceptions of soil erosion hazard
Summary	A researcher has received funding and wishes to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Hazel Faulkner
	Goals:	Determining how farmers' perception of soil erosion hazard differs from researcher assessed hazard
Secondary	Type:	End-user
	Goals:	Revising EU policy to address soil sustainability

Stakeholders

Ordnance Survey	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Marketing
British Geological Survey	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Marketing
Infoterra	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Marketing
Cranfield University	Type:	Creator
	Goals:	Research Advancement of knowledge
Brighton University	Type:	Collaborator & previous end-user
	Goals:	Research Advancement of knowledge
NASA JPL	Type:	Creator
	Goals:	Research Advancement of knowledge Marketing
Middlesex University	Type:	Creator
	Goals:	Research Advancement of knowledge Marketing
University of Hertfordshire	Type:	Creator
	Goals:	Research Advancement of knowledge Marketing

Dataset Details

Dataset 1	Name:	1:25,000 colour raster (possibly others)
	Owner:	Ordnance Survey
	Distributor:	EDINA
	Licensing:	©, JISC negotiated agreement until 2009
	Processing:	Qualitative (1)
	Type:	Raster Map
	Area:	Derived
Dataset 2	Name:	Geological Mapping
	Owner:	British Geological Survey
	Distributor:	British Geological Survey
	Licensing:	© To be negotiated
	Processing:	Quantitative (1)
	Type:	Raster Map
	Area:	Derived
Dataset 3	Name:	Soils Mapping
	Owner:	Cranfield University
	Distributor:	Cranfield University
	Licensing:	©, negotiated perpetual licence
	Processing:	Quantitative (1)
	Type:	Raster or vector map
	Area:	Derived
Dataset 4	Name:	Ortho-corrected aerial photo mosaic
	Owner:	Infoterra / English Nature (contractor)
	Distributor:	Brighton University
	Licensing:	© Infoterra. Royalty rights retained
	Processing:	Quantitative (3+) AND Qualitative (1+)
	Type:	Raster imagemap
	Area:	Derived
Dataset 5	Name:	Landuse survey
	Owner:	English Nature / Brighton University
	Distributor:	Brighton University
	Licensing:	© Infoterra and commons
	Processing:	Quantitative (2+) AND Qualitative (1+)
	Type:	Vector map
	Area:	Derived
Dataset 6	Name:	SRTM DEM
	Owner:	NASA / JPL
	Distributor:	ESDI
	Licensing:	Creative Commons, Perpetual
	Processing:	Quantitative (1+)
	Type:	Raster elevation data
	Area:	Derived

Output Data

Type	Vector
Format	ESRI Shapefile

Descriptives

Context

This long-term study aims to explore the soil conservation strategies that farming enterprises adopt as Common Agricultural Policy (CAP) subsidies are 'decoupled' from production. Two European settings, with serious soil erosion hazards (Sussex, England; and SE Almería, Spain), are studied. Project outputs are expected to be a new set of tools targeted at agri-environmental planners in the context of post-CAP reforms to agricultural subsidy structure in these and other settings. This project deals solely with the UK component of the study and aims to address the following questions:

- How do farmers' perceptions of soil erosion hazard differ from scientific perceptions of hazard mapping?
- How can erosion hazard mapping methodologies and soil conservation recommendations be adapted to take into consideration farmers' perceptions of their own 'sustainable livelihoods'?

Processing

In the initial stages of the project, physical soil erosion hazard maps will be prepared for a 100 km^2 study area centred on previous physical hazard research in the area. Preparing the hazard maps will require information about topographic position (elevation, aspect and angle data from SRTM), current landuse (already derived from aerial photography by Brighton University), geology (BGS data) and soils (Cranfield University). Boardman (2003) has determined how these data sets can be combined to produce soil erosion hazard mapping, albeit for other areas of the country.

These maps (soil erosion hazard) will then be used to compare quantitative analyses with qualitative information by farmer interview and evaluation of their knowledge of erosion hazard on their farm and comparison with the mapped risk. This research will inform the debate on sustainable farming practices through assessing whether short-term gain through production-based CAP subsidy is promoting long term environmental damage.

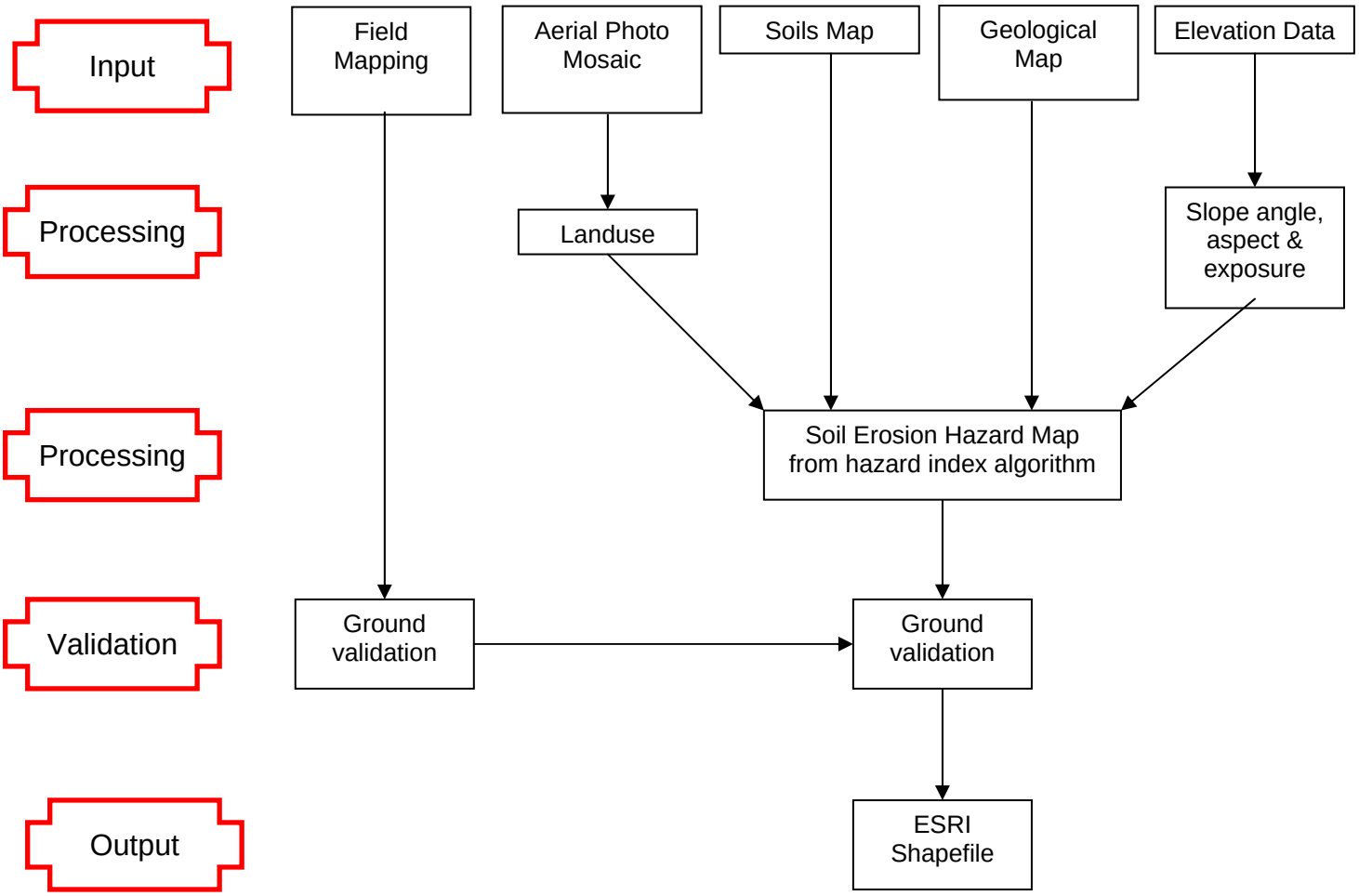
Key Points

- The project is currently in its planning stages and therefore no analysis has been performed.
- All data sets have been identified.
- Negotiating with all the stakeholders, particularly the data copyright holders, for disparate components of this project is complex and challenging, involving extensive investment in time. The complex copyright issues mean that the objectives of the project are attainable, however it is unlikely that the output data will be made widely available.

References

Boardman J. (2003). Soil erosion and flooding on the eastern South Downs, southern England, 1976-2001. Tran. Inst. Brit Geographers. 28 (2): 176-196.

Flowchart


Input
Processing
Processing
Validation
Output
Field Mapping
Aerial Photo Mosaic
Soils Map
Geological Map
Elevation Data
Landuse
Slope angle, aspect & exposure
Soil Erosion Hazard Map from hazard index algorithm
Ground validation
Ground validation
ESRI Shapefile

Use Case 6: Historical Coastal Retreat

Authors

Author	Uwe Dornbusch

Use case details

Title	Monitoring chalk cliff retreat
Date	2004
Application Area	Use of historic maps and contemporary orthophotos to measure coastal cliff retreat
Summary	The researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Uwe Dornbusch
	Goals:	Cliff retreat monitoring Deposit data in a geospatial repository
Secondary	Type:	End-user
	Goals:	Dissemination to general public Input into environmental management Teaching: Use of prepared datasets for student use

Stakeholders

Ordnance Survey	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Dissemination of data
University of Sussex	Type:	Educational Institution
	Goals:	Curriculum development Promotion of University to external agencies
European Union Regional Development Fund	Type:	Grant body
	Goals:	Dissemination of data Advancement of research
Landmark	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Dissemination of data

Dataset Details

Dataset 1	Name:	2001 digital orthophoto
	Owner:	Environment Agency
	Distributor:	Environment Agency
	Licensing:	Freely available at http://www.channelcoast.org/
	Processing:	Quantitative (2)
	Type:	Raster, TIFF
	Area:	Derived

Dataset 2	Name:	First Edition 6“ Ordnance Survey Maps
	Owner:	Ordnance Survey
	Distributor:	Copies held in University of Sussex library Copies purchased from Landmark
	Licensing:	Out of copyright © Landmark
	Processing:	Quantitative (1)
	Type:	Raster, TIFF scanned from paper maps
	Area:	Derived

Dataset 3	Name:	Ordnance Survey Land-Line
	Owner:	Ordnance Survey
	Distributor:	EDINA
	Licensing:	©, JISC negotiated agreement until 2009
	Processing:	Quantitative (1)
	Type:	Vector
	Area:	Derived

Dataset 4	Name:	GPS Surveys
	Owner:	University of Sussex, author
	Distributor:	author
	Licensing:	©
	Processing:	Quantitative
	Type:	Vector control points
	Area:	Original

Dataset 5	Name:	Ground Survey Maps
	Owner:	Lewes District Council
	Distributor:	Lewes District Council
	Licensing:	©
	Processing:	Quantitative
	Type:	Raster, TIFF
	Area:	Derived

Output Data

Type	Vector
Format	ESRI shapefile

Descriptives

Context

Coastal retreat is a key research area with respect to both an understanding of the processes involved and management of the environment. First order understanding of the rates of cliff retreat are paramount to furthering understanding that can then be used to inform management. This project was concerned with the use of historic and modern geospatial data sources to calculate erosion rates over ~130 years for 35 km of English coastline along the eastern English Channel (Dornbusch *et al*, in press).

Processing

Primary data sources included original historic Ordnance Survey 6" maps dating from the 1870's (Figure 12) and orthophotos supplied (fully georeferenced) by the Environment Agency, forming the data sets (respectively) for the start and end points of the study period. The historic maps were scanned and georeferenced. They were then compared to contemporary Ordnance Survey Land-Line data and minor positional corrections applied (Figure 12). The orthophotos were assessed for their accuracy against GPS surveys carried out by the primary actor. Finally, for one section of cliff which had coastal defences, pre-defence ground surveys were supplied by Lewes Borough Council; these maps were scanned and georeferenced.

The coastline position was then digitised from the fully georeferenced historic and orthophoto data sets. The resultant coastline positions were then used to calculate average erosion rates for 50 m sections of cliffs along the entire 35 km stretch (Figure 13).

Key Points

- Fully licenced, out-of-copyright and original data sets are used throughout the study.
- Only at the stage of positional correction is modern Ordnance Survey Land-Line used. However the positional corrections introduced produce a new, derived, data set that now inherits full Ordnance Survey copyright restrictions. This single data set is then used to calculate overall cliff retreat rates.
- As a result of the introduction of Ordnance Survey Land-Line data, the historic maps and digitised coastline inherit full Ordnance Survey copyright, as do final calculations of cliff retreat.
- It **assumed** that the areal publication restrictions imposed by the Ordnance Survey related to a *bounding box* on the data set in question. In this instance, although only derived coastline position is used (rather than the full Ordnance Survey Land-Line data set), coverage is based upon a bounding box. Does this also cover the publication of non-geospatial cliff retreat rate data?

References

Dornbusch, U., Robinson, D.A., Moses, C. and Williams, R.B.G., (in press). Chalk coast erosion and its contribution to the shingle budget in East Sussex. Zeitschrift für Geomorphologie.

Flow Chart

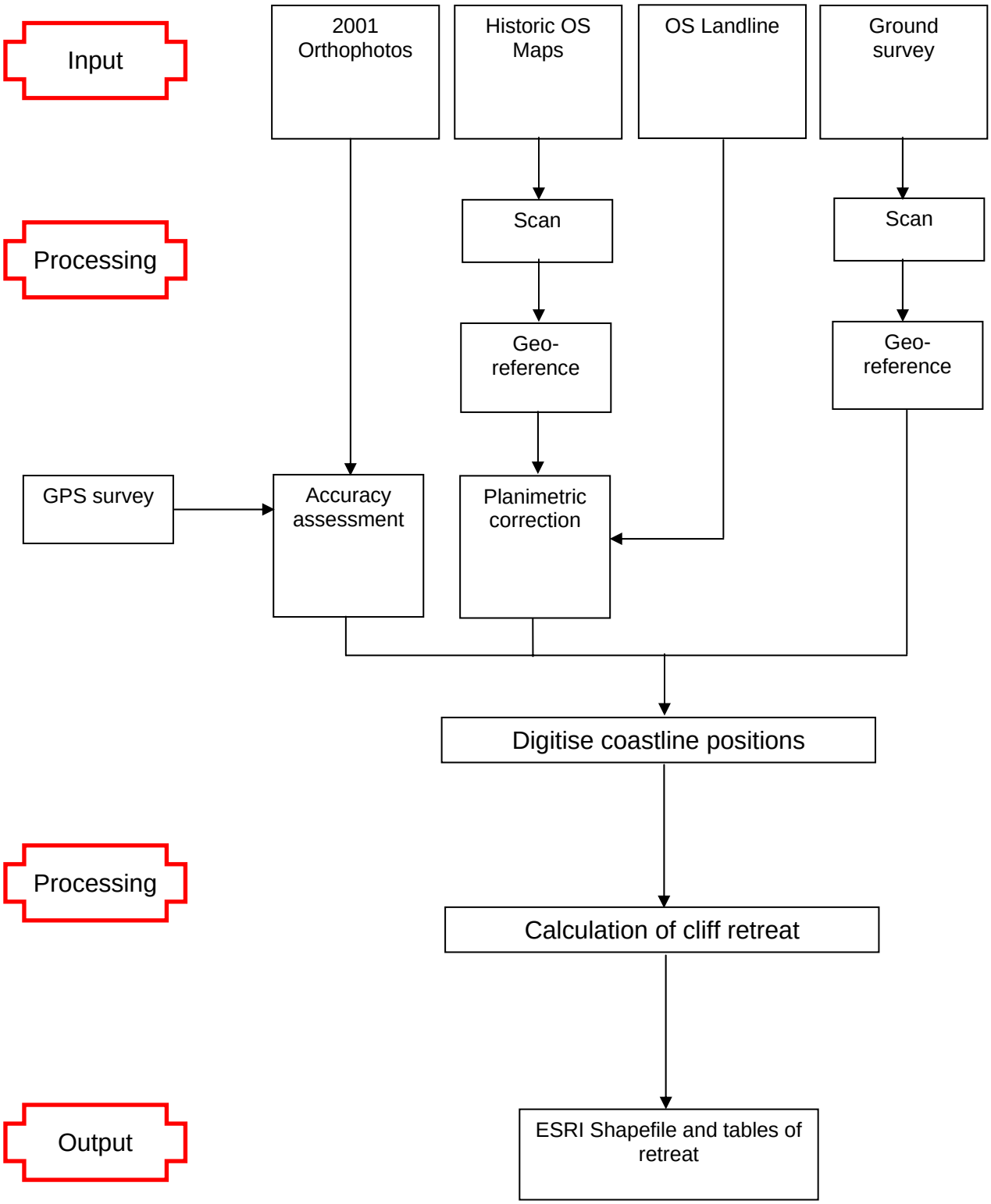

Input
2001 Orthophotos
Historic OS Maps
OS Landline
Ground survey
Processing
Scan
Scan
Geo-reference
Geo-reference
GPS survey
Accuracy assessment
Planimetric correction
Digitise coastline positions
Processing
Calculation of cliff retreat
Output
ESRI Shapefile and tables of retreat

Figure 12 Scanned example of Ordnance Survey First Edition maps, overlain with Ordnance Survey Landline to illustrate the rectification control using building outlines and road alignments © Crown Copyright/databases 2005. An Ordnance Survey/EDINA supplied service.

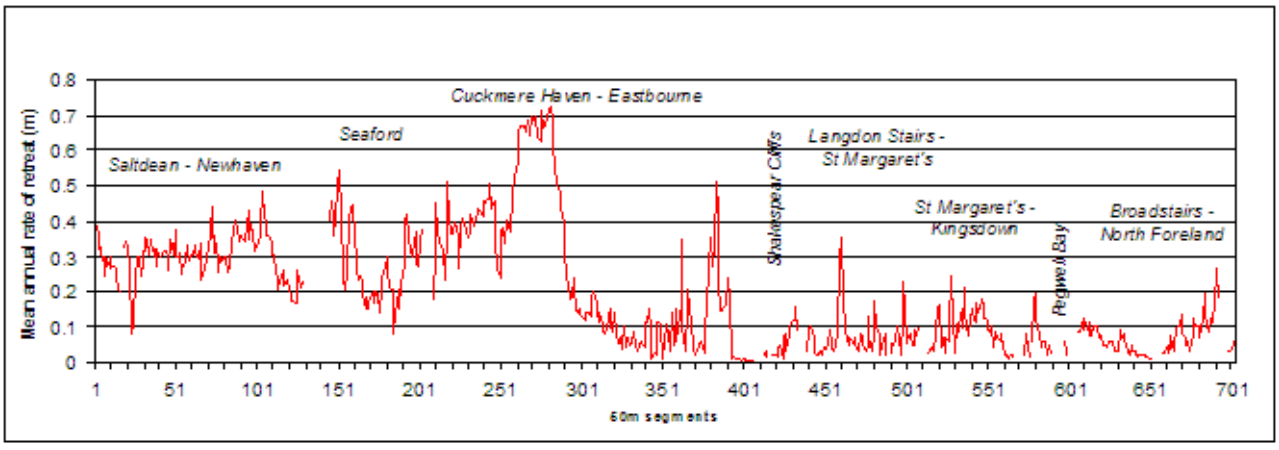


Figure 13 Mean annual rate of chalk cliff retreat along the East Sussex and Kent frontage for the period 1870s to 2001

Use Case 7: River Characterisation

Authors

Author	Stephen Rice
Author	Jim Chandler
Author	Michael Church

Use case details

Title	Environmental monitoring, Fraser River, British Columbia, Canada
Date	August 2005
Application Area	High resolution aerial photography used to monitor fish habitat and characterise river channel morphology
Summary	The researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Stephen Rice
	Goals:	Characterise channel bar morphology Deposit data in a geospatial repository
Secondary	Type:	End-user
	Goals:	Dissemination to general public Input into environmental management Teaching: Use of prepared data sets for student use

Stakeholders

NSERC	Type:	Grant body
	Goals:	Dissemination of data Advancement of research
Loughborough University	Type:	Educational Institution Grant body
	Goals:	Research Curriculum development Promotion of University to external agencies
University of British Columbia	Type:	Educational Institution
	Goals:	Research Curriculum development Promotion of University to external agencies

Dataset Details

Dataset 1	Name:	Colour digital aerial photography
	Owner:	authors
	Distributor:	Loughborough University / University of British Columbia
	Licensing:	©
	Processing:	Quantitative (2)
	Type:	Raster imagery
	Area:	Original

Dataset	Name:	Digital elevation model
	Owner:	authors
	Distributor:	Loughborough University / University of British Columbia
	Licensing:	©
	Processing:	Quantitative (2)
	Type:	Raster elevation
	Area:	Original

Output Data

Type	Raster (orthophoto, classified river morphology, elevation)
Format	Imagine image file

Descriptives

Context

Satellite imagery is often used for regional scale mapping (100's km^2), with aerial photography typically employed to acquire imagery at higher resolutions for smaller areas (10's km^2), or where stereoscopic data is required. There is increasing interest in the use of very high resolution imagery (1's km^2) to help characterise the environment. This project funded the bespoke acquisition of low altitude, heliborne, imagery in order to characterise environment for a small area (120 x 80 m) of the Lower Fraser River, British Columbia. Project aims were:

- investigation of airborne methods for obtaining river bed grain-size information
- classification of fish habitat
- characterisation of river bar morphology

The first item forms the initial project outputs and focus of this example.

Processing

Field work in the form of ground surveying collected over 3000 elevation points for the study area. These were subsequently interpolated to 1 m (80 x 40 m) and 2 m (120 x 80 m) resolution digital elevation models (DEMs).

Multi-resolution (1:10000, 1:5000, 1:3000, 1:2000, 1:1000) imagery was acquired and, using the generated DEM data, rectified to orthophotos of the river stretch if interest. The

orthophotos were then used in a supervised classification to identify river bed material (Figure 14).

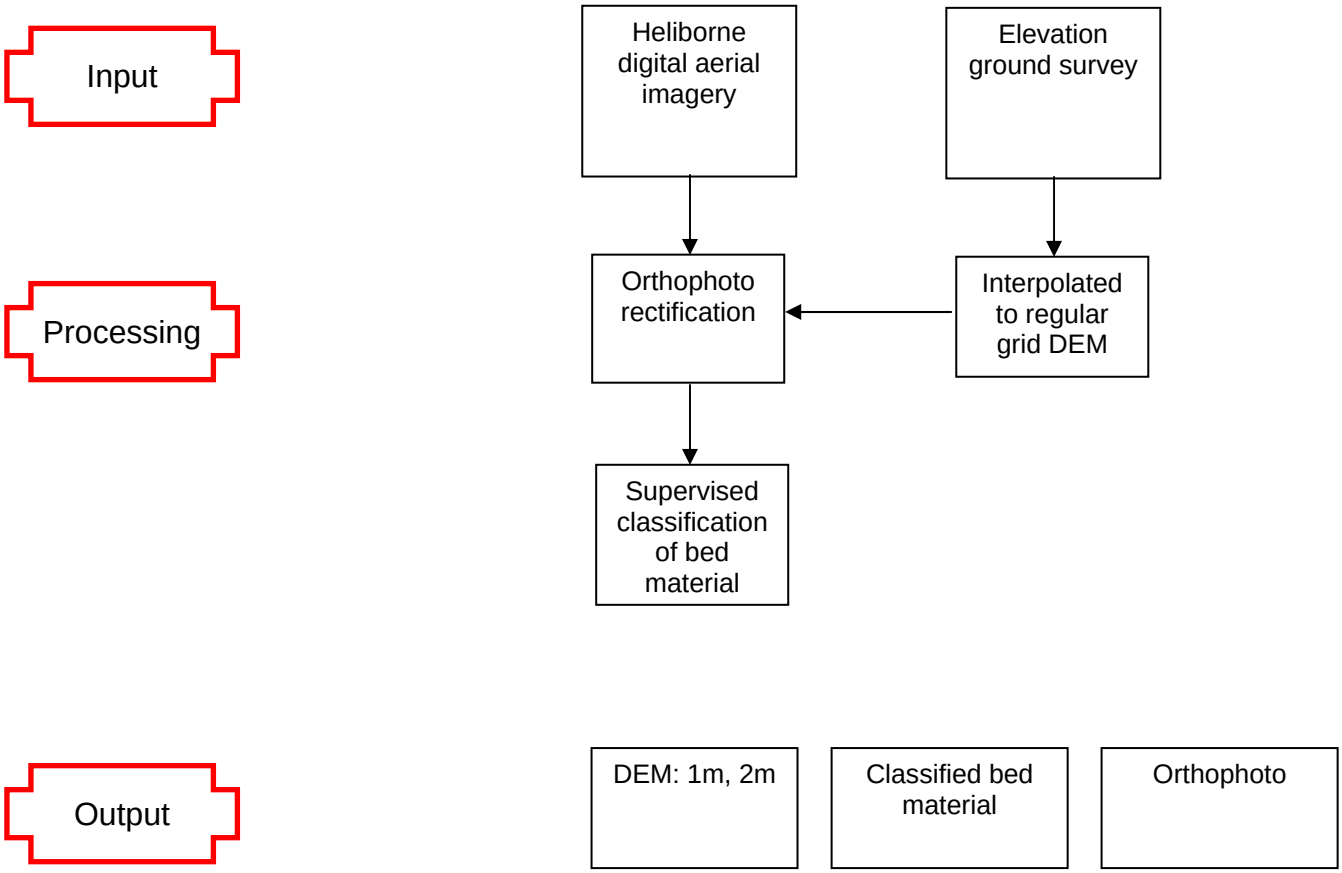
Key Points

- the heliborne and DEM data were acquired entirely by the authors.

References

Chandler, J.H., Rice, S. and Church M. (2004) “Colour aerial photography for riverbed classification.” The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, V34, Commission 7, Istanbul, 1079-1085.

Flow chart


Input
Heliborne digital aerial imagery
Elevation ground survey
Processing
Orthophoto rectification
Interpolated to regular grid DEM
Supervised classification of bed material
Output
DEM: 1m, 2m
Classified bed material
Orthophoto

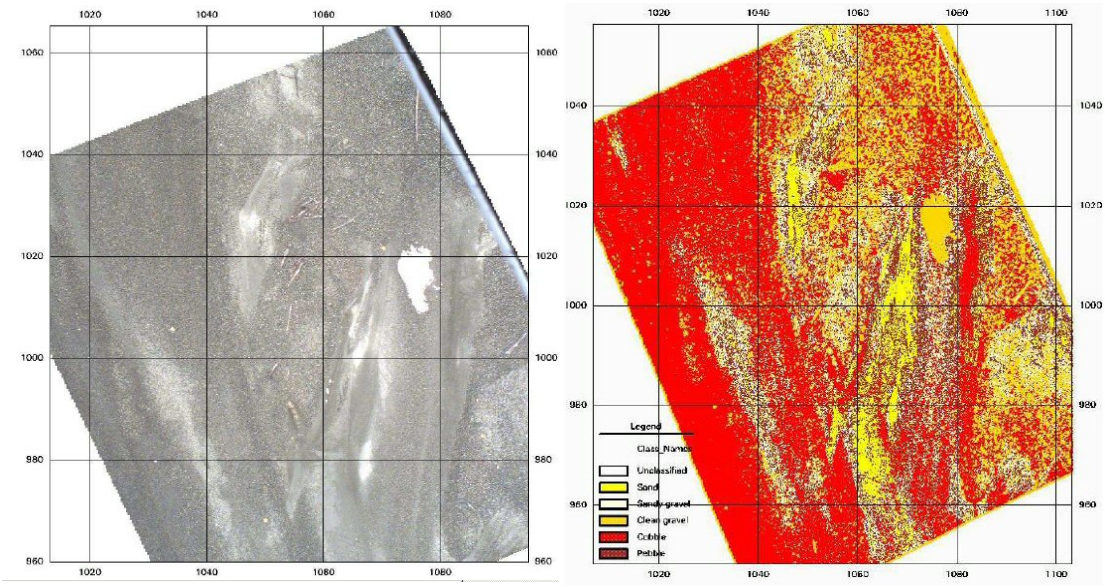


Figure 14a. Orthophoto generated from low altitude heliborne digital photography. 1b River morphology classified from aerial photography.

Use Case 8: Small Area Geographies

Authors

Author 1	Nigel S Walford

Use case details

Title	Reconstructing the Small Area Socio-economic Geography of Mid-Wales, 1961-1991
Date	2000/01
Application Area	Creation of a set of consistent polygons and associated Population Census counts
Summary	A researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Nigel S Walford
	Goals:	Publication of journal paper Methodological development
Secondary	Type:	End-user
	Goals:	Use of output data

Stakeholders

Ordnance Survey	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Marketing
EDINA	Type:	Distributor
	Goals:	Consumer adherence to license restrictions Dissemination of data
MIMAS	Type:	Distributor
	Goals:	Consumer adherence to license restrictions Dissemination of data
Data Archive	Type:	Distributor
	Goals:	Consumer adherence to license restrictions Dissemination of data
National Statistics	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Marketing Dissemination of data
Nuffield Foundation	Type:	Grant body
	Goals:	Advancement of research
Kingston University	Type:	Grant body
	Goals:	Advancement of research Promotion of university name

ESRC	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Marketing Dissemination of data

Dataset Details

Dataset 1	Name:	Digital Boundary File for Welsh Communities 1991
	Owner:	Licensee ESRC
	Distributor:	EDINA
	Licensing:	©, ESRC/National Census Office agreement
	Processing:	Quantitative (3)
	Type:	Vector
	Area:	Derived

Dataset 2	Name:	Digital Boundary File for enumeration districts in 1981
	Owner:	Licensee ESRC
	Distributor:	EDINA
	Licensing:	©, ESRC/National Census Office agreement
	Processing:	Quantitative (5)
	Type:	Vector
	Area:	Derived

Dataset 3	Name:	1991 Population Census Small Area Statistics
	Owner:	National Statistics
	Distributor:	MIMAS
	Licensing:	©, negotiated licence through EDINA
	Processing:	Quantitative (2)
	Type:	Statistical
	Area:	Derived

Dataset 4	Name:	1981 Population Census Small Area Statistics
	Owner:	National Statistics
	Distributor:	EDINA
	Licensing:	©, negotiated licence through EDINA
	Processing:	Quantitative (2)
	Type:	Statistical
	Area:	Derived

Dataset 5	Name:	1971-81 Population Census Change File Statistics
	Owner:	National Statistics
	Distributor:	Data Archive
	Licensing:	©, negotiated licence through EDINA
	Processing:	Quantitative (2)
	Type:	Statistical
	Area:	Derived

Dataset 6	Name:	1961 Parish Population Counts
	Owner:	HMSO
	Distributor:	University library
	Licensing:	Published statistics
	Processing:	Quantitative (1)
	Type:	Statistics
	Area:	Derived

Dataset 7	Name:	1951 Parish Population Counts
	Owner:	HMSO
	Distributor:	University library
	Licensing:	Published statistics
	Processing:	Quantitative (1)
	Type:	Statistics
	Area:	Derived

Output Data

Type	Vector
Format	MapInfo TAB

Descriptives

Context

Using information from the decennial Population Census to analyse demographic and socio-economic change is regarded as a key objective that is facilitated by the regularity and rigor of the enumeration (Rees, 1998). Census information comprises the statistical counts and, for those interested in the geospatial component of population change, the digital representations of the boundaries corresponding with the associated geographical units. Since the mid-1970s increased use of information and communication technologies to host distribution services for data resources arising from the British Population Census, and a shift towards a more open access policy, have encouraged and facilitated such analysis. Initially the British census authorities defined user communities (e.g. academic, commercial and local government) to manage access to census data resources, but for the 2001 enumeration free access across the Internet has become the norm in line with similar developments in other countries. Despite the importance of using census information to investigate population change there are frustrating inconsistencies within the both the geography and statistical content of successive enumerations.

Processing

Walford (2001) performed mapping of population changes in consistent small areas (parishes/communities) between the 1951 and 1991 Population Censuses with respect to a case study area in Mid-Wales. The relative stability in parish boundaries in British administrative geography and the constraint requiring areas defined for the decennial Population Census to conform to parishes mean that they represent a set of units that are reasonably consistent over the period 1951-81. Following the 1981 Census the census authorities in England and Wales defined a set of hybrid geospatial units linking the 1971 and 1981 enumerations known as Census Tracts, which were either single identical enumeration districts, or combinations of two or more enumeration districts in either or

both years. In rural areas, such as localities covered by the present case study, these Census Tracts equated with parishes. There were 403 census tracts covering the study area. Revision of the administrative geography of Wales in the 1980s resulted in the replacement of 308 parishes in the study area (Figure 15a) by 186 communities (Figure 15b). Figure 15c illustrates where these boundaries are consistent and inconsistent.

Geospatial analysis of the boundary files and associated population counts involved the following series of data processing operations to harmonise the census and administrative geographies of the area across this discontinuity:

- The subset of 1991 communities covering the study area were selected and saved as a separate GIS database, those lying entirely outside the area were discarded.
- 1981 enumeration district digital boundaries and associated census counts covering the study area were re-aggregated to parishes combining the objects by reference to the parish definitions contained in the Area Master File look-up table to create the 308 1951-1981 parishes.
- Determination of the 1971-81 census tract population-weighted centroids, substituting the 1981 enumeration district centroids when the areas were identical areas (i.e. single 1981 EDs).
- A point-in-polygon search was carried out using these census tract population-weighted centroids (derived from the enumeration district and census tract data) with respect to the boundaries of the 186 1991 communities to make an initial assignment of the old to new areas. Figure 16 shows an inset of the study area: open circles denote 1981 enumeration district centroids that fall within the same 1991 community as the census tract to which they belong; and with solid circles represent are those lying in a different 1991 community.
- The digital boundaries for the 1951-1981 parishes were overlain with the 1991 communities boundaries to make a second assignment by means of proportionate allocation.
- Re-aggregation of the split 1951-1981 parish boundaries with their associated census counts to the 1991 community boundaries.

The combination of point-in-polygon and polygon overlay with proportionate assignment spatial analyses and re-aggregation allowed parts of the 1981 enumeration districts to be allocated to a different 1991 community to the one containing their census tract (parish) centroid, if a 1981 enumeration district's own centroid fell in another 1991 community.

The datasets used in this analysis are all quantitatively derived and the processing is based on algorithms contained in standard GIS software. The set of consistent polygons for the study area were used to investigate and visualise micro-scale population change over a period of 30 years. Relative differences in population totals were examined to identify communities experiencing prolonged growth, decline or a more varied history of change. Classification of communities into these provided the starting point for undertaking a stratified household survey in the region.

Key Points

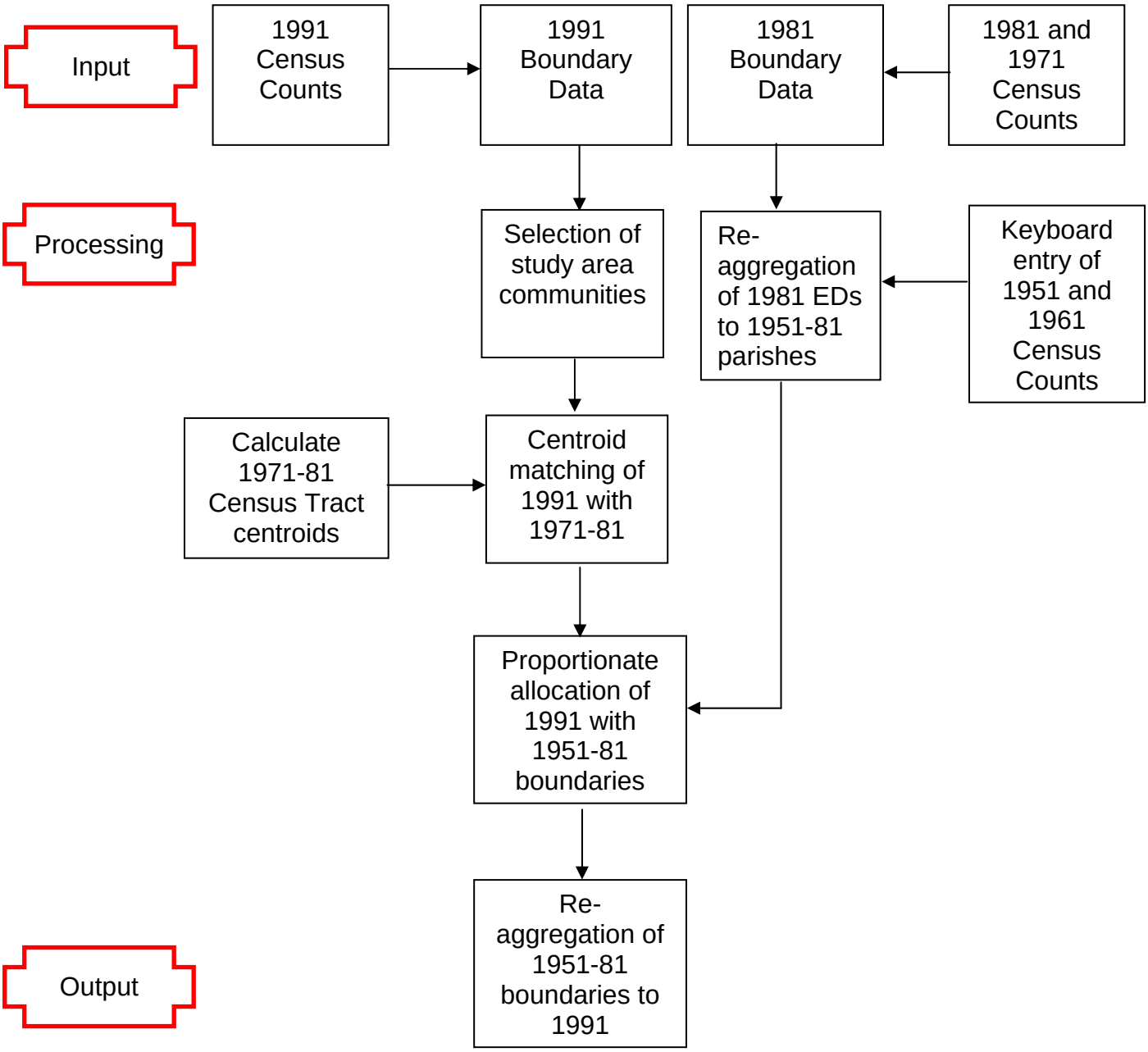
- The sequence of data processing procedures generated a number of intermediate datasets before the final digital boundary data with associated census counts is obtained.
- In the case of the 1991 data the digital boundary and census datasets were obtained together as a GIS database (MapInfo TAB files), whereas the equivalent datasets for 1981 were obtained separately and joined as part of the analysis.

- The population counts for 1951 and 1961 were sourced from statistical volumes published under HMSO copyright and these were then captured digitally through keyboard entry.

References

Rees P. 1998. What do you want from the 2001 Census? Results of an ESRC/JISC survey of user views. *Environment and Planning A*, 30: 1775-1796.
Walford, N. S. 2001. Reconstructing the small area geography of Mid-Wales for an analysis of population change 1961-95, *International Journal of Population Geography*, 7: 311-338.

Flow Chart


Input
1991 Census Counts
1991 Boundary Data
1981 Boundary Data
1981 and 1971 Census Counts
Processing
Selection of study area communities
Re-aggregation of 1981 EDs to 1951-81 parishes
Keyboard entry of 1951 and 1961 Census Counts
Calculate 1971-81 Census Tract centroids
Centroid matching of 1991 with 1971-81
Proportionate allocation of 1991 with 1951-81 boundaries
Re-aggregation of 1951-81 boundaries to 1991
Output

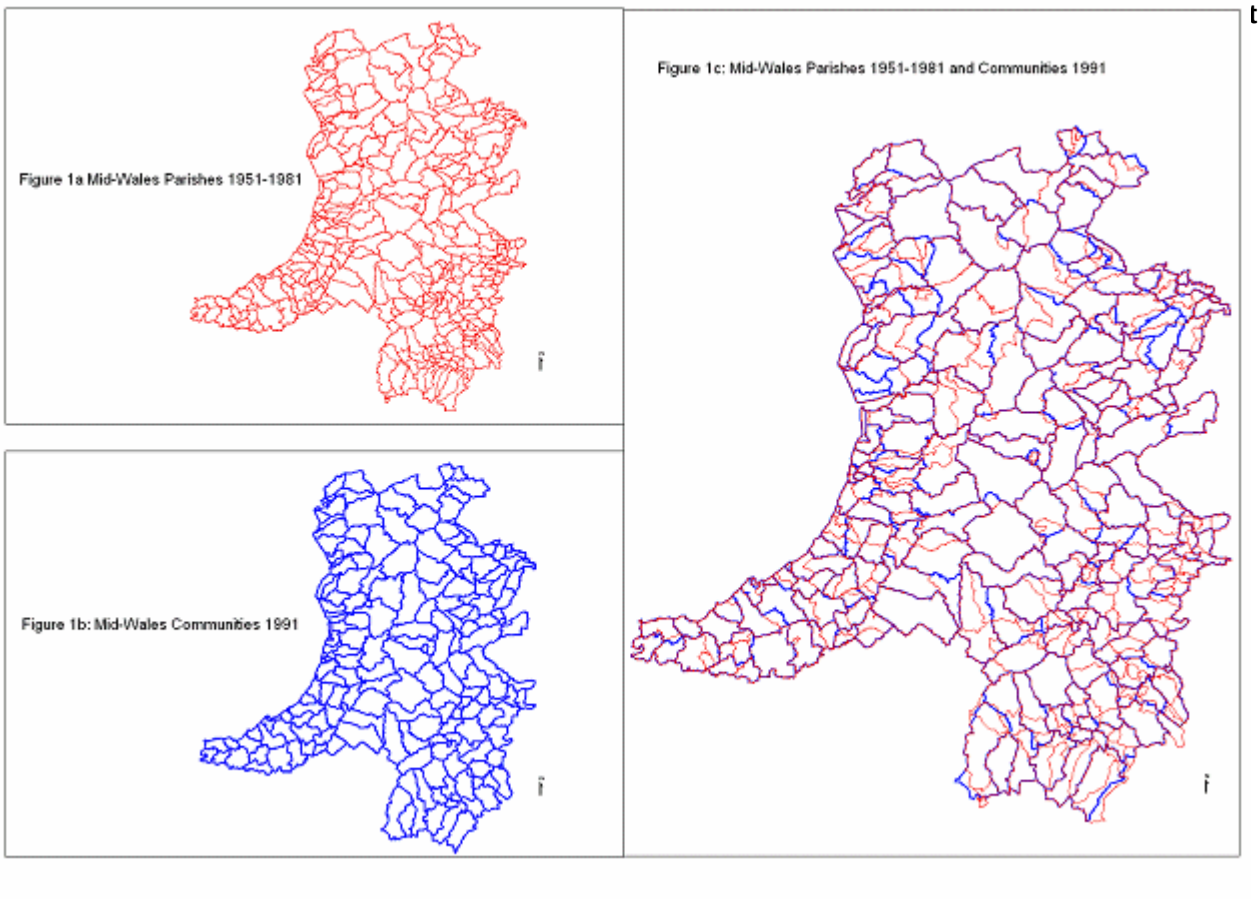


Figure 15a. Mid-Wales parishes 1951-1981. 1b. Revision of the administrative geography of Wales in the 1980s resulted in the replacement of 308 parishes in the study area. 15c Illustration of boundary consistency/ inconsistency.

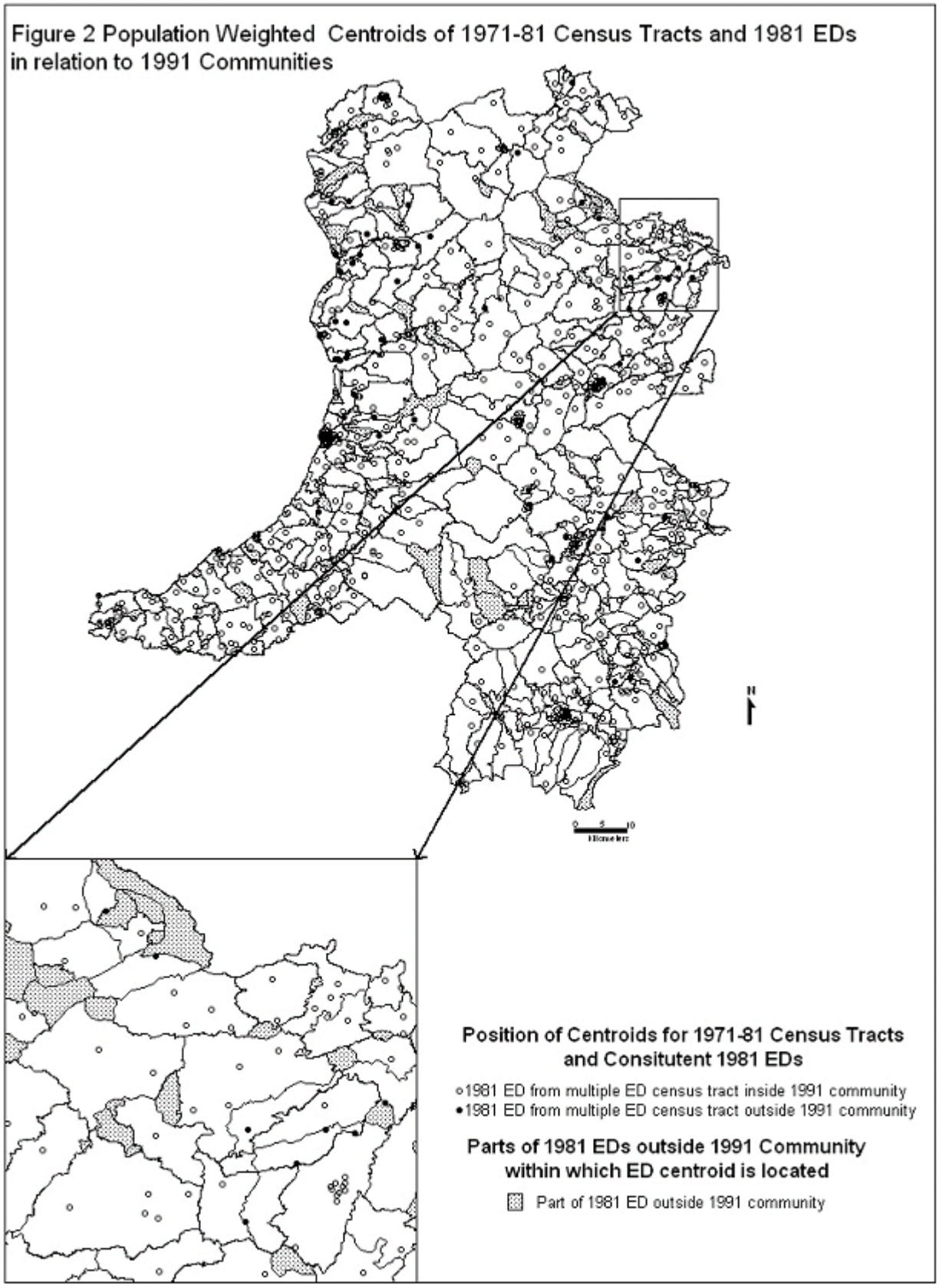


Figure 16 Inset depicts the study area: open circles denote 1981 enumeration district centroids that fall within the same 1991 community as the census tract to which they belong. Solid circles represent those lying in a different 1991 community.

Use Case 9: Deprivation Mapping

Authors

Author	Kenneth Field

Use case details

Title	Deprivation mapping
Date	2004
Application Area	Preparation of data sets for student practical work in cartography
Summary	A researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Teacher
	Name:	Kenneth Field
	Goals:	Preparation of data sets for teaching
Secondary	Type:	End-user
	Goals:	Teaching: Use of prepared data sets for student use

Stakeholders

Office of the Deputy Prime Minister	Type:	Distributor
	Goals:	Consumer adherence to license restrictions Dissemination of data
ESRC	Type:	Creator
	Goals:	Dissemination of data Support and enhancement of teaching and research
Kingston University	Type:	Grant body
	Goals:	Curriculum development Course content
EDINA	Type:	Distributor
	Goals:	Distribution Consumer adherence to license restrictions

Dataset Details

Dataset 1	Name:	Census 2001 Super Output Area boundaries
	Owner:	Licencee ESRC
	Distributor:	EDINA
	Licensing:	©, ESRC/National Census Office agreement
	Processing:	Quantitative (2)
	Type:	Vector boundaries
	Area:	Derived
Dataset 2	Name:	2004 Indices of deprivation
	Owner:	Office of the Deputy Prime Minister (ODPM)
	Distributor:	ODPM (online)
	Licensing:	© Crown copyright
	Processing:	Quantitative (3)
	Type:	Attribute data
	Area:	Derived

Output Data

Type	Vector
Format	ESRI shapefile

Type	Attribute Database
Format	DBF

Descriptives

Context

Choropleth mapping is a well established thematic mapping technique. Geography students require tuition in the process of map design and production. Teaching the principles of data classification and symbolisation can effectively be done using any dataset that provides area based measurements with the requirements being an available source of spatial data (boundaries) and the numerical data itself. Choropleth maps are commonly created to view census data so this exercise uses Super Output Area (SOA) boundaries and the 2004 Indices of Deprivation (at SOA level; Figure 17). This level of census geography also allows the consideration of issues relevant to scale such as those associated with depicting a large area comprising a variety of Super Output Areas of differing sizes.

Processing

SOA boundary data (UKBorders) was accessed via EDINA. The case study area was extracted based on a query and select analysis relating to county codes for the East Midlands area

Indices of deprivation data (attribute data supplied in Microsoft Excel format) were downloaded from Office of the Deputy Prime Minister (ODPM) web site. The data was stripped to reduce its volume to SOA codes and the overall deprivation index. Additionally, it was edited to omit areas not covered by the mapped area and then converted to DBF format.

Both the derived shapefile boundary and DBF file were imported into ArcMap and the attribute tables were joined. The student mapping exercise could then be undertaken.

Key Points

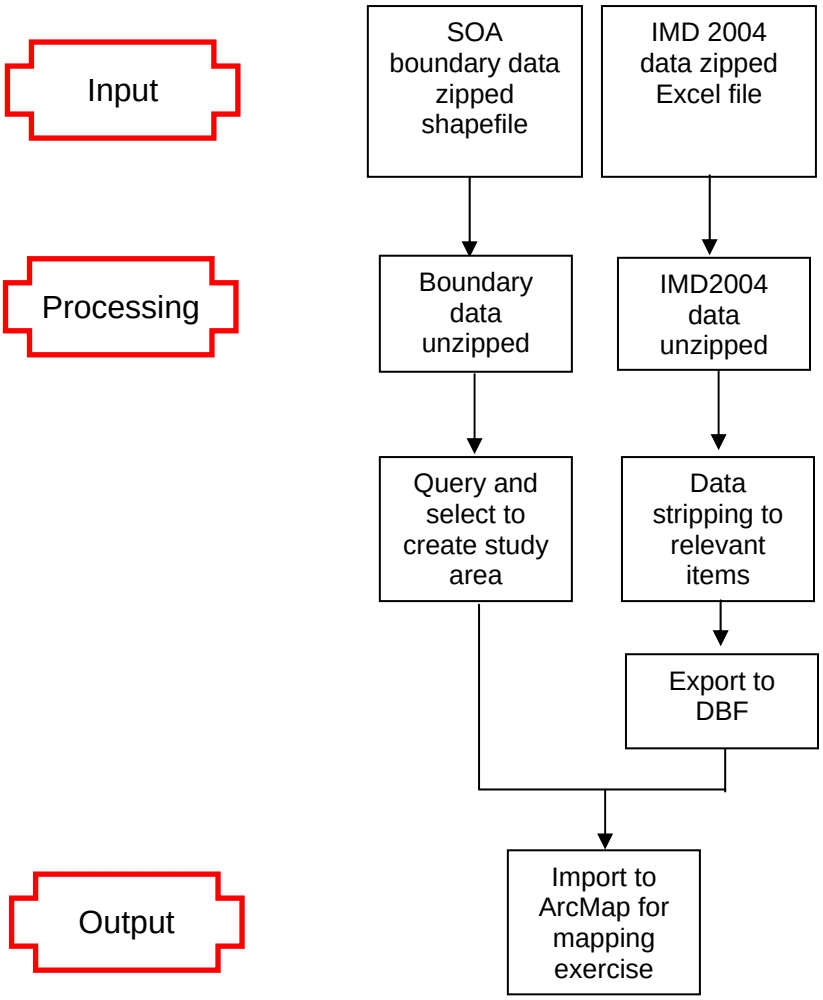
- Data downloaded from UKBorders for teaching and research purposes provides much less copyright restriction than if the same boundary data is supplied directly from National Statistics (on CD).

- There is considerable ease of use when using the boundary data for teaching and research.

- The copyright situation becomes confusing when using the same data set obtained from National Statistics given the need for click user licences. This provides a slightly different set of restrictions than if using the same data set under an end user licence agreement via UKBorders.

- The use of the Indices of Deprivation are less restrictive on the provision that all data can only be reproduced if the source (ODPM, Indices of Deprivation 2004) is fully acknowledged.

Flow chart


Input
Processing
Output
SOA boundary data zipped shapefile
IMD 2004 data zipped Excel file
Boundary data unzipped
IMD2004 data unzipped
Query and select to create study area
Data stripping to relevant items
Export to DBF
Import to ArcMap for mapping exercise

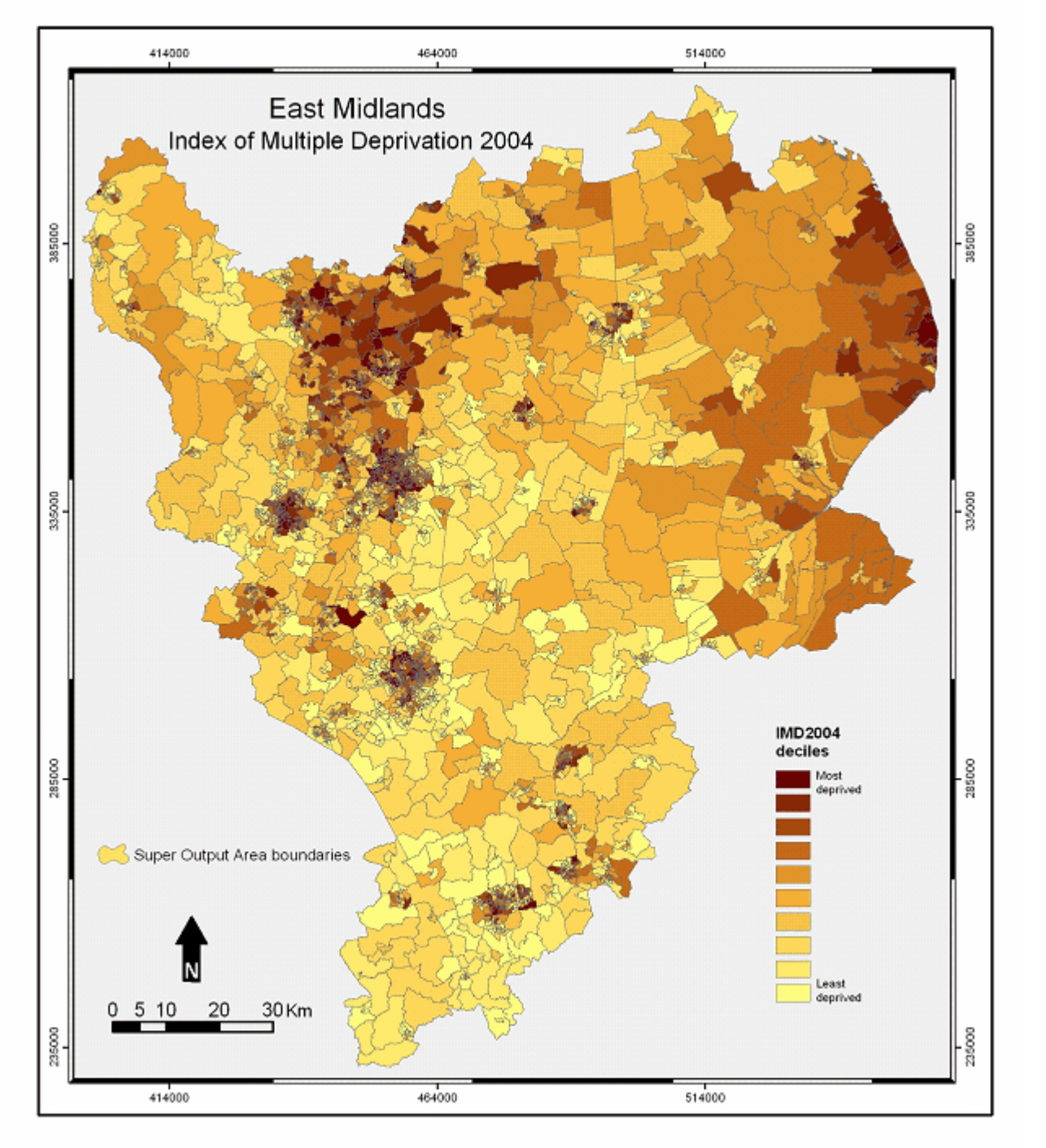


Figure 17. Indices of Deprivation 2004 by Super Output Area for the East Midlands (IMD Data sourced from Office of the Deputy Prime Minister, Indices of Deprivation 2004. SOA data derived from UKBorders via EDINA).

Use Case 10: Radionuclide Contamination Monitoring

Authors

Author 1	Paul Goldsmith

Use case details

Title	Remote Sensing Radionuclide Contamination
Date	04/09/05
Application Area	Remote sensing and mapping contaminated land
Summary	The researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Paul Goldsmith
	Goals:	Publication of results Production of contamination/risk map Completion of PhD
Secondary	Type:	End-user
	Goals:	Research Use of contamination /risk map

Stakeholders

Kingston University	Type:	Grant body
	Goals:	Publications (RAE) Completion of PhD University Publicity (e.g. at conferences)
NASA	Type:	Creator
	Goals:	Dissemination of satellite data
NERC	Type:	Grant body
	Goals:	Dissemination of results

Dataset Details

Dataset 1	Name:	Hyperion Digital Imagery
	Owner:	NASA
	Distributor:	USGS
	Licensing:	Creative Commons
	Processing:	Quantitative (2)
	Type:	Raster image (HDF format)
	Area:	Derived

Dataset 2	Name:	Analytical Spectral Devices: field spectra
	Owner:	Paul Goldsmith
	Distributor:	Paul Goldsmith
	Licensing:	Usage subject to NERC acknowledgement
	Processing:	Quantitative (2)
	Type:	Point Data
	Area:	Original

Output Data

Type	Raster
Format	ESRI GRID

Type	Spectra Data
Format	Spreadsheet

Descriptives

Context

Remote sensing has not been utilised in monitoring areas of radioactive contamination, and may be a useful tool. To determine whether this is possible, field spectra have been collected in southern Belarus (affected by radionuclides after the 1986 Chernobyl accident) along with biochemical analyses in the UK, and acquisition of high spectral resolution Hyperion imagery. The combination of these data will allow an assessment to be made as to the possibility of using remote sensing to monitor radionuclide contamination and may in turn allow the production of a map showing contamination levels and/or risk in Belarus.

Processing

The input data sets listed above were processed in the following manner:

- Analytical Spectral Devices spectrometer used to collect field spectra – processed to absolute reflectance, along with methods of feature selection to identify useful areas of the spectrum.
- Hyperion Imagery – geometrically and radiometrically corrected prior to using in analyses and map production.

To determine whether remote sensing (specifically imaging spectrometry) offers potential for monitoring radioactive land, the spectra collected in the field were processed to absolute reflectance. Feature selection was then used to identify areas of the spectra which warranted further analysis. The biochemical analysis of vegetation samples was undertaken with a view to coming to one of the following conclusions:

a. The spectra are not affected by radionuclide contamination and therefore imaging spectrometry does not hold potential as a monitoring technique
b. The spectra are affected by radionuclide contamination and therefore imaging spectrometry might be used as a monitoring technique.

Once preliminary analysis showed differences in spectra and therefore pointed to potential in the use of imaging spectrometry, a data acquisition request was submitted to USGS to collect Hyperion imagery of three areas in Belarus, each known to have a different level of

contamination. Before Hyperion imagery can be analysed, it is geometrically and radiometrically corrected and then used in combination with field-based analysis to extract useful information from the image and classify the contamination levels. The Hyperion imagery is still in the process of being collected and analysed, therefore production of a contamination map is in progress and not yet complete.

Figures 18 and 19, below show examples of the data used in this study.

Key Points

- NASA imagery is used to extend analyses used from field data
- NASA imagery, after initial purchase, is free from copyright.
- Complex analyses combine both imagery and field data.

References

Boyd, D.S., Entwistle, J.A., Flowers, A.G, Armitage, R.P and Goldsmith, P.C. (in press) Remote Sensing the Radionuclide Contaminated Belarusian Landscape: A Potential for Imaging Spectrometry, International Journal of Remote Sensing.

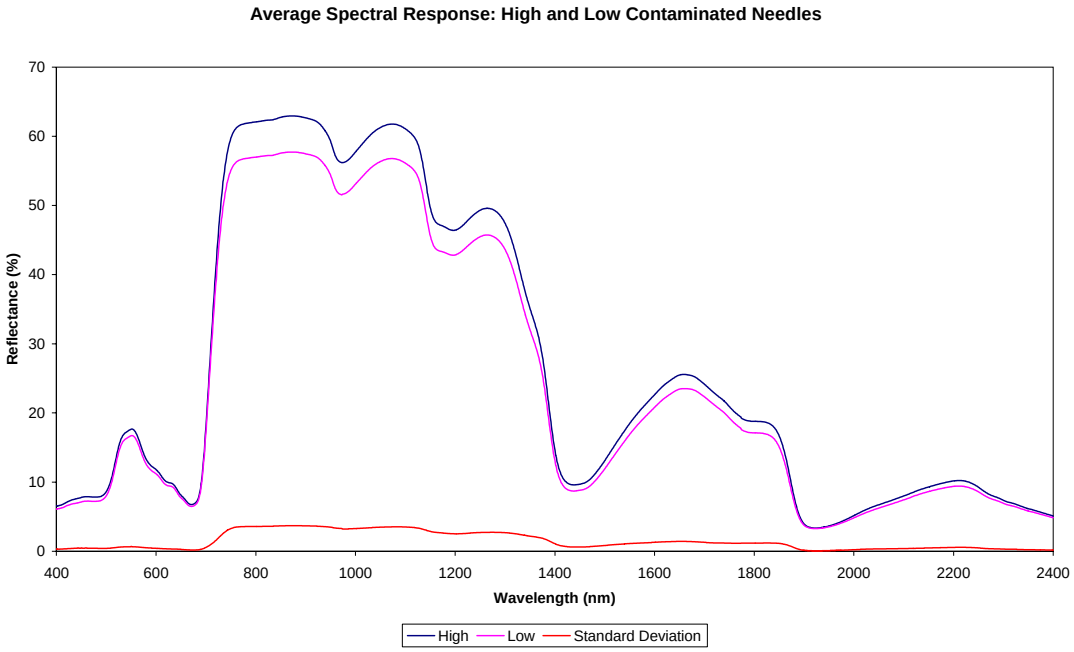


Figure 18 Mean spectra for high and low sites collected during field radiometry work in Belarus.

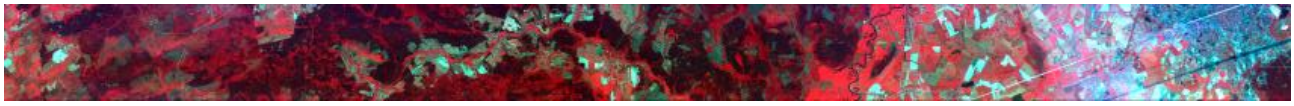
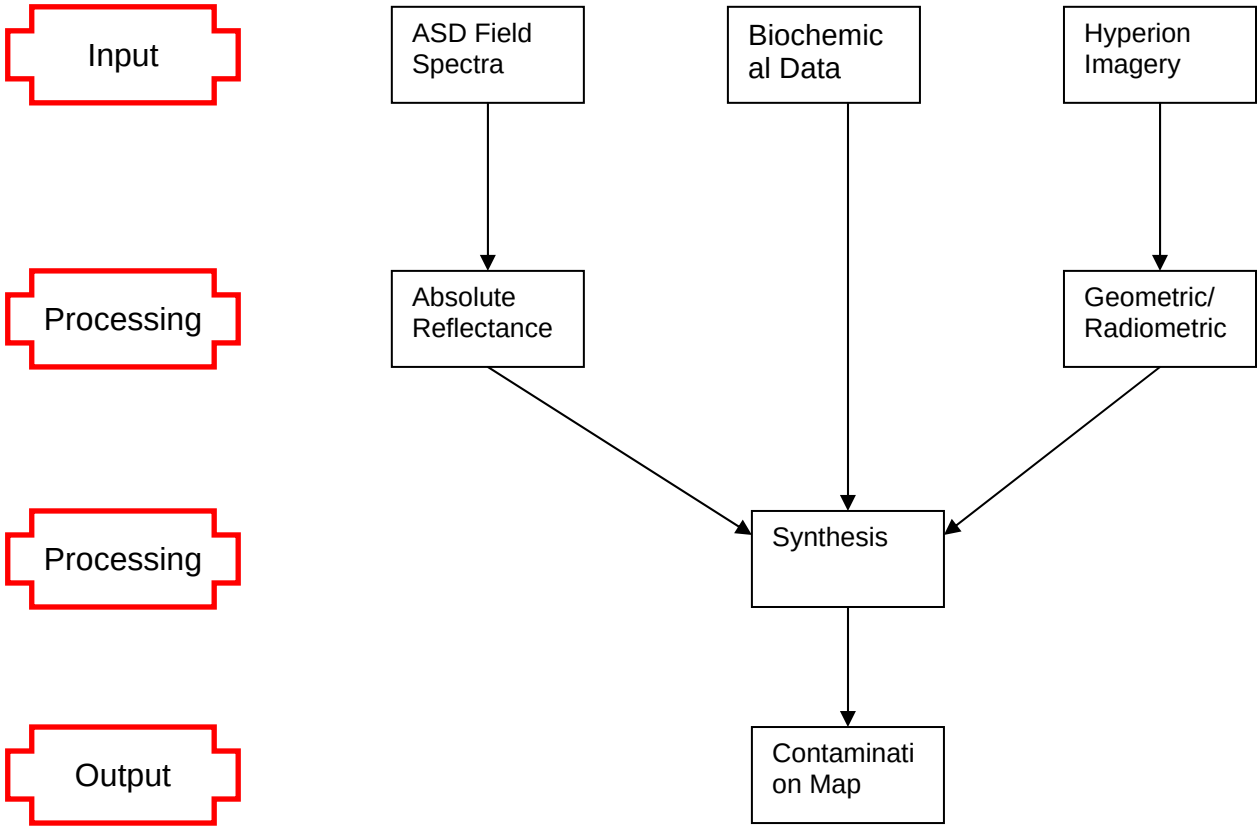


Figure 19 A strip of Hyperion data (above), acquired for a forested area in Belarus.

Flow Chart


Input
Processing
Processing
Output
ASD Field Spectra
Biochemical Data
Hyperion Imagery
Absolute Reflectance
Geometric/ Radiometric
Synthesis
Contamination Map

Use Case 11: Argicultural Characterisation

Authors

Author 1	Katherine J Taylor

Use case details

Title	Reconstructing the agricultural environment of part of East Sussex from 1935-1959 using aerial photographs and the National Farm Survey
Date	October 2002-June 2008 (approx)
Application Area	Historical GIS
Summary	A researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher
	Name:	Katherine J Taylor
	Goals:	Complete PhD Make a contribution to knowledge
Secondary	Type:	End-user
	Goals:	Potential use of output data Researcher with interest in East Sussex Researcher with interest in the theoretical debate around pre- and post-productivism. Researcher looking at land use change over time (work could be extended into the past or present)

Stakeholders

Ordnance Survey	Type:	Creator
	Goals:	Sales Consumer adherence to license restrictions Marketing
The National Archives	Type:	Distributor
	Goals:	Sales Consumer adherence to license restrictions Marketing
Kingston University	Type:	PhD Awarding Body
	Goals:	Advancement of research Promotion of university name
EDINA	Type:	Distributor
	Goals:	Distribution Consumer adherence to license restrictions
University of Sussex	Type:	Distributor
	Goals:	Distribution Consumer adherence to license restrictions

Dataset Details

Dataset 1	Name:	The National Farm Survey
	Owner:	The National Archives (TNA)
	Distributor:	Inspected in person at TNA
	Licensing:	Public Domain
	Processing:	Quantitative (3)
	Type:	Raster
	Area:	Derived
Dataset 2	Name:	Dudley Stamp Land Utilisation Survey Maps (1935)
	Owner:	?
	Distributor:	University of Sussex Geography Resource Centre
	Licensing:	Public Domain
	Processing:	Quantitative (2)
	Type:	Raster
	Area:	Derived
Dataset 3	Name:	1940 aerial photograph (no.48) originally taken by the Luftwaffe
	Owner:	?
	Distributor:	University of Sussex Geography Resource Centre
	Licensing:	Public Domain
	Processing:	Quantitative (3)
	Type:	Raster
	Area:	Area
Dataset 4	Name:	1947 aerial photographs (various)
	Owner:	?
	Distributor:	East Sussex Record Office, Lewes
	Licensing:	Public Domain
	Processing:	Quantitative (3)
	Type:	Raster
	Area:	Derived
Dataset 5	Name:	1959 aerial photographs
	Owner:	?
	Distributor:	English Heritage/University of Sussex
	Licensing:	Public Domain
	Processing:	Quantitative (3)
	Type:	Raster
	Area:	Derived
Dataset 6	Name:	Ordnance Survey Historic Mapping (1935)
	Owner:	Landmark
	Distributor:	EDINA
	Licensing:	©, JISC negotiated agreement until 2009
	Processing:	Quantitative (1) (used as background for digitising)
	Type:	Raster
	Area:	Area

Output Data

Type	Vector
Format	MapInfo Tables

Descriptives

Context

The purpose of the project is to look at 4 snapshots (1935, 1940, 1947 and 1959) of agriculture in East Sussex, thereby classifying the agricultural landscape during these four epochs. For each of these dates land use will be identified across the study area (which corresponds to the area included in aerial photograph in Figure 20).

This project, currently in its initial stages, has the following objectives:

- provide a baseline (1940) survey against which subsequent agricultural changes can be compared.
- Characterise the pre-war (1935) landscape.
- identify and quantify changes in the study area over time.
- apply a quantitative approach to land use change and the theories that surround it

Much debate, centred on the use and characterisation of agricultural land, has focused on productivism and beyond, whilst little attention has been paid to the pre-productivist era. This study will attempt to define pre-productivism, focusing on the use of GIS as a tool for undertaking historical reconstruction.

Processing

A detailed outline of the proposed processing is presented in the flow chart. It involves the scanning (historic Ordnance Survey maps supplied digitally) and rectification of:

- historic Ordnance Survey maps
- Dudley Stamp farm survey (Figure 21)
- 1940 Luftwaffe aerial photo (Figure 20)
- 1947 aerial photos
- 1959 aerial photos

Farmland and buildings will then be digitised for the most complete survey period (1940) using the historic map base (~12,000 polygons). Each data source will then be used to add land use (and crop type) over each of the four epochs, producing vector layers that characterise the rural landscape. Land use classes include buildings and agriculturally unproductive land, various types of woodland and grassland and a number of arable crops. Polygons will be classified using the aerial photographs, the 1935 land use survey and National Farm Survey data. Once a complete classification has been produced for each of the years in question, these can be compared and changes and similarities noted and discussed.

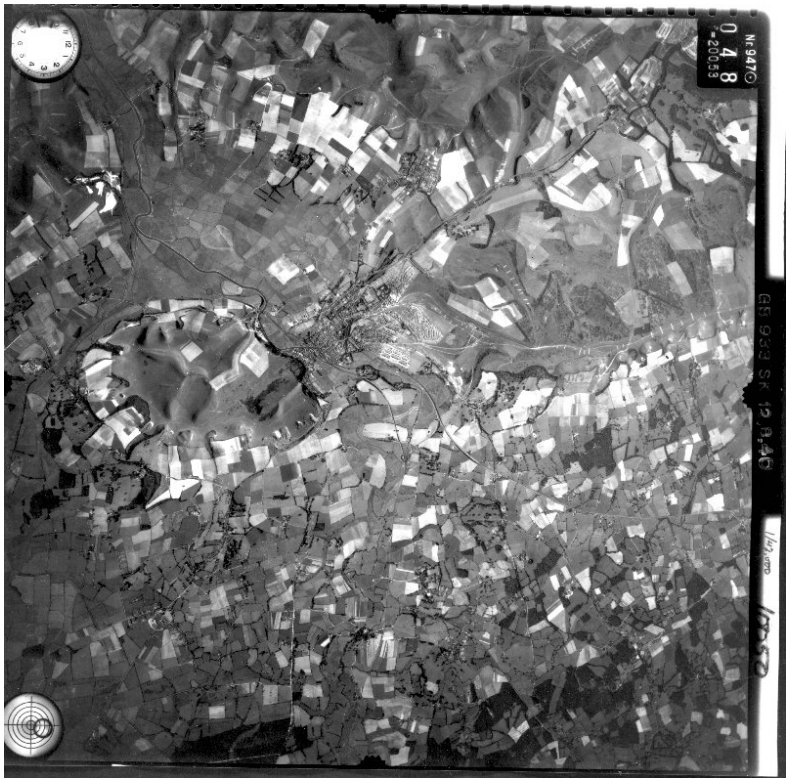


Figure 20 Scanned copy of 1940 Luftwaffe photo 48

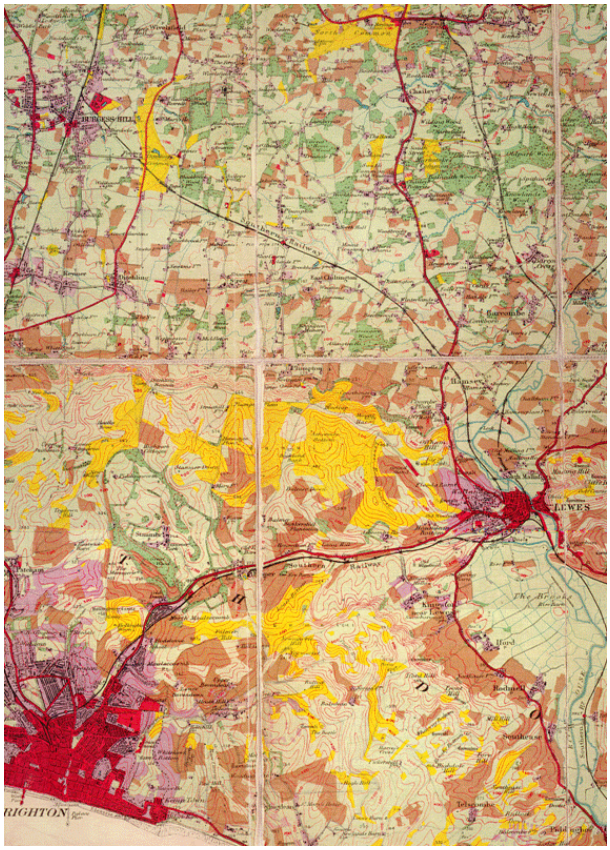
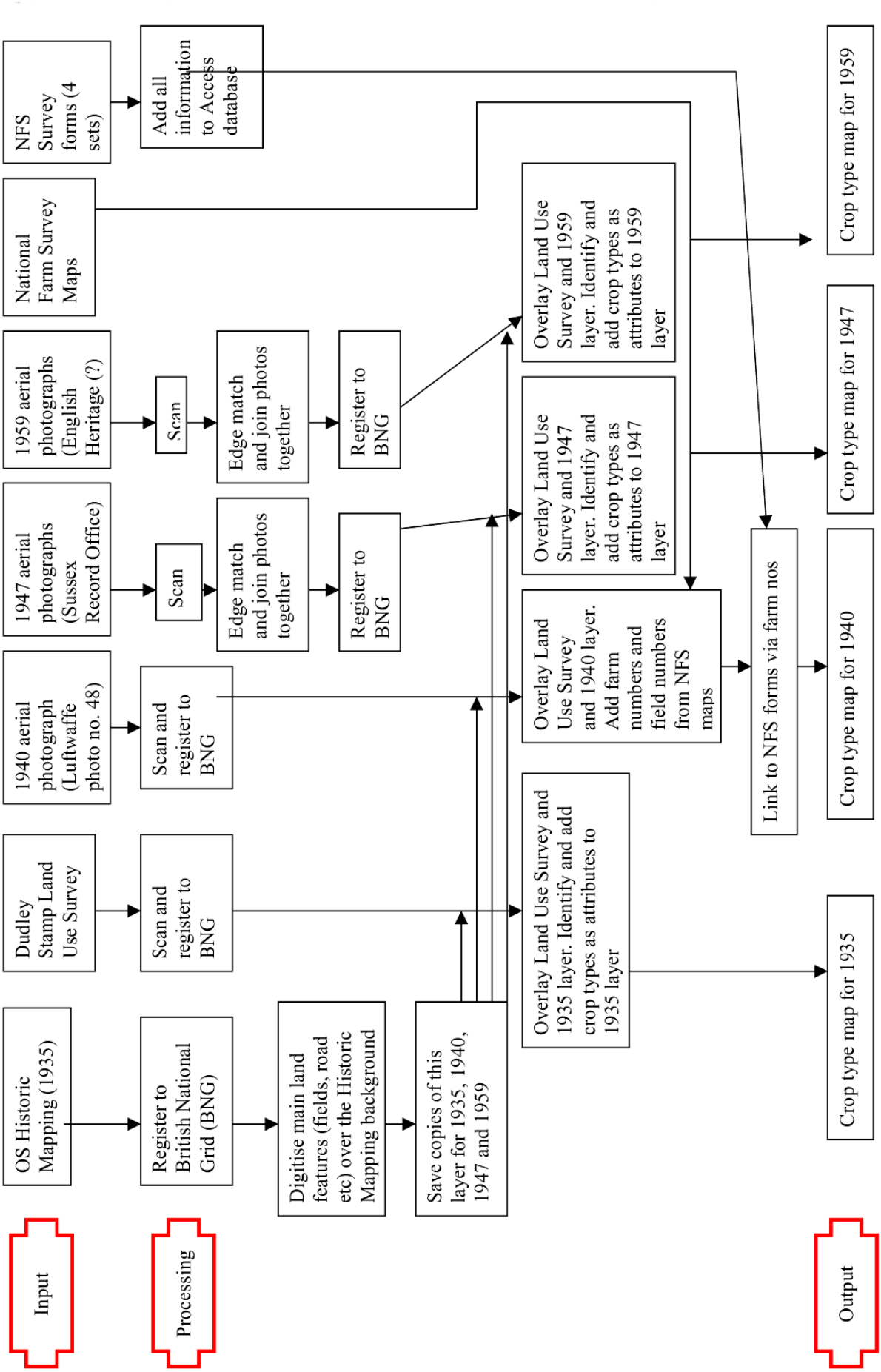


Figure 21 Scanned extract of Dudley Stamp's 1948 landuse survey map

Flow Chart


Input
Processing
Output
OS Historic Mapping (1935)
Register to British National Grid (BNG)
Digitise main land features (fields, road etc) over the Historic Mapping background
Save copies of this layer for 1935, 1940, 1947 and 1959
Dudley Stamp Land Use Survey
Scan and register to BNG
1940 aerial photograph (Luftwaffe photo no. 48)
Scan and register to BNG
1947 aerial photographs (Sussex Record Office)
Scan
Edge match and join photos together
Register to BNG
1959 aerial photographs (English Heritage (?)
Scan
Edge match and join photos together
Register to BNG
National Farm Survey Maps
NFS Survey forms (4 sets)
Add all information to Access database
Overlay Land Use Survey and 1935 layer. Identify and add crop types as attributes to 1935 layer
Overlay Land Use Survey and 1940 layer. Add farm numbers and field numbers from NFS maps
Overlay Land Use Survey and 1947 layer. Identify and add crop types as attributes to 1947 layer
Overlay Land Use Survey and 1959 layer. Identify and add crop types as attributes to 1959 layer
Link to NFS forms via farm nos
Crop type map for 1935
Crop type map for 1940
Crop type map for 1947
Crop type map for 1959

3. Discussion

3.1 Outline

The use-cases illustrated in section 2 highlight the variety and complexity in the use of geospatial data and how the interplay of different licensing terms produces a landscape of diverse usage restrictions. This section is intended to highlight some of the key points that can be drawn from these use-cases, drawing together the main threads that they illustrate.

3.2 Copyright Inheritance

Perhaps the most fundamental aspect to draw attention to is that the derivation of a *new* data set from an existing, copyright, one is that

new data sets **inherit** licensing conditions

This is fundamental to the desire to distribute research outputs. As the introduction described, any newly generated data set must adhere to the *most restrictive* licensing conditions of any of the input data sets. This feature, termed **copyright inheritance**, is the most important measure that leads to uncertainty in the distribution of research outputs. It is perhaps most severely illustrated in Case Study 6 where even the incorporation of minor planimetric adjustments results in the derived data set inheriting copyright conditions from the data used for those adjustments. The following comments are general in nature, drawing principally from experiences with the Ordnance Survey, however for specific application they should be verified against, where available, individual data set licences. Several key points (illustrated in Case Study 1) arise from copyright inheritance:

- the boundaries of legally correct distribution of a derived data set are unclear
- there is a maximum publishable ground area (dependent upon the input data set used)
- upon expiration of a licence agreement, the (derived) data set would need to be destroyed

This may mean that, for example, a research output generated from JISC licenced data set would be available to other JISC licencees. However, if the researcher's institution ceased licensing Ordnance Survey data through JISC, then the researcher would have to destroy any data set that they had created and deposited within a repository. Similarly, if JISC ceased licencing data from the Ordnance Survey, then all original and derived data sets would have to be destroyed.

3.3 Stakeholders

The number of stakeholders involved in any single project is relatively large (e.g. Case Study 5). Beyond the vested interests of the individual researchers working on a single project, the institutions that they work for, the granting bodies and the data set copyright holders all have a vested interest. The interplay of each individual stakeholder makes visualising a "landscape" of copyright interests difficult to define and implement. Whilst commercial data suppliers may well have clearly defined licensing conditions, the interests of individuals and academic institutions is far less clear and will remain difficult to define. In some instances, the copyright is potentially so complex that it is easier to decide **not** to make a data set available for reuse thus never realising its' full potential (e.g. Case Study 5).

3.4 Geospatial Data Providers

Although the following comments are necessarily general in nature, broadly applying to all geospatial data providers, it is important to note that the Ordnance Survey has a special relationship in the UK with the supply of geospatial data. Almost all UK oriented research is dependent upon the supply and use of Ordnance Survey data. Whilst access to, and use of, Ordnance Survey data is open and straightforward, uncertainty exists over the publication and dissemination of research outputs (e.g. Case Study 2). There are several general issues concerning the use of geospatial data that should be considered:

- Non-commercial research, that is underpinned by geospatial data, drives forward use and innovation and should therefore have flexible licencing arrangements that reflect today's academic environment, specifically the growing trend of utilising repositories to improve access to and encourage the reuse of research data
- The JISC-Ordnance Survey license restricts both the publication (Case Study 2) and leads to uncertainty over the distribution (e.g Case Study 6) of Ordnance Survey derived data. This would appear to conflict with the requirements of Research Councils UK who require grant holders to disseminate their findings

The Ordnance Survey is the main provider of geospatial data in the UK and, as a result, its' procedures have a large influence on the nation as a whole. It also means that the Ordnance Survey comes under closer scrutiny than other data providers. The above comments are generally applicable to all data suppliers that impose licensing restrictions. However, other suppliers can be less restrictive about both the academic use of their products and dissemination of subsequent findings. Outside of the UK, both the Irish Ordnance Survey (Case Study 1) and the Maltese Environment and Planning Authority (Case Study 4) retain full copyright of their products whilst being far less restrictive in the publication of research findings. In the UK, Intermap distribute their NEXTMap GreatBritain product and make a clear distinction between standard derived works and thematically derived works (Intermap, 2005). The latter principally requires that a data set cannot be reverse-engineered and therefore provides considerable scope for the distribution and publication of thematically derived data. The dissemination of derived data remains a difficult issue to deal with, such that some research projects (e.g. Case Study 5) may never be able to disseminate their research findings.

3.5 Possible Solutions

The growing trend towards the use of repositories is leading to a focus on the issues of publication and dissemination of derived (and original) geospatial data and will require a great deal of thought and testing. In particular the diverse licensing arrangements (implicit and explicit) makes it difficult to generalise without discussion on a case by case basis. However several key threads have emerged that deserve further discussion.

1. Map Publication: some data licences greatly restrict the publication of maps within academic journals. It is desirable for licences to allow greater freedom for the publication of non-commercial research work.
2. Derived data set type: it is desirable that a distinction be made between *quantitatively* and *qualitatively* derived data sets (Case Study 1). Qualitatively derived data sets could be licenced under less restrictive terms (e.g. the thematic licencing used by Intermap).
3. Proportional Copyright: Case Study 6 highlighted that the imposition of copyright, based upon the lowest common denominator can render research findings unpublishable. The influence exerted by input data licensing restrictions can be

inversely proportional to the use that is made of them within a project. Whilst the use of any copyright data deserves recognition (and appropriate recompense), this shouldn't be to the detriment of the overall project. Licensing restrictions that are proportional to the use made of a data set may present a solution and could be integrated with an assessment of the degree to which derivation has occurred (e.g. how many quantitative or qualitative steps were involved between the original and derived data).

4. Research Councils: the UK government (through the research councils) funds the majority of university research in the UK. Requirements for open-access to the results of government funded research may require the re-negotiation of geospatial data licences.
5. Creative Commons[10]: the realisation that copyright does not address the full range of activities that may be performed with a data set has led to the establishment of a new type of licensing that allows the copyright owner to specify exactly how their data may be used. Creative Commons is one implementation of this type of licence that aims to address this issue. It has been actively endorsed by the Creative Archive Group[11] (British Broadcasting Corporation, Channel 4, bfi, Open University), Public Library of Science and the Journal of Maps amongst others, as a way to retain copyright whilst gaining maximum exposure and public use of their data.

[10] http://creativecommons.org/
[11] http://creativearchive.bbc.co.uk/

4. Conclusions

- There has been a dramatic growth in the academic use of geospatial data across many disciplines.
- Geospatial data is now endemic to society and widely available within the academic community.
- There is considerable demand for the establishment of geospatial data repositories within the UK.
- Demand for geospatial data repositories is indirectly driven by the British government and research councils requesting the lodgement of research outputs.
- Barriers to the implementation of geospatial data repositories include cultural, legal and technological.
- The Ordnance Survey is one of the most influential geospatial data organisations in the United Kingdom; its' policies are therefore central to the adoption and use of geospatial data in the UK.
- The interplay of implicit and explicit copyright licences between research project stakeholders produces a complex landscape of data set rights.
- **Copyright inheritance** is the single most important restriction preventing the distribution of derived data sets. It also influences publication of results and longevity of data.
- The investigation of Creative Commons style licensing for geospatial data is one option to consider in addressing the current uncertainties that exist amongst researchers as to what they can and can't do with their derived geospatial data.
- Issues of *quantitative/qualitative data derivation* and *proportional copyright* offer further avenues of investigation.

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Appendix 1: Use-Case Template

All text in 10-point type refers to content areas. Within these areas, text in *italic* are variables that need to be completed by the author. Normal text or fixed variables that should not be changed. The use of **bold** denotes different selection options.

Authors

Author 1	*Author name*

Use case details

Title	*Title of project/work*
Date	*Date*
Application Area	*Subject area of application*
Summary	A researcher has received funding and wishes, or is required, to deposit output data from the project in a digital repository that can then be searched and accessed by other researchers.

Actors

Primary	Type:	Researcher **or** Teacher
	Name:	*Name of primary actor*
	Goals:	*Goals for completing the work*
Secondary	Type:	End-user
	Goals:	*Potential use of output data* Broad areas to include research, teaching, class, institution or personal.

Stakeholders

Ordnance Survey	Type:	Creator **or** distributor **or** grant body
	Goals:	Sales **or** Consumer adherence to license restrictions **or** Marketing **or** Advancement of research **or** Dissemination of data

Dataset Details

Dataset 1	Name:	*Dataset name*
	Owner:	*Dataset owner*
	Distributor:	*Dataset distributor*
	Licensing:	© **or** Creative Commons **or** Public Domain Annual *or* Perpetual
	Processing:	Quantitative (*number of processes*) **or** qualitative (*number of processes*)
	Type:	Raster *type* **or** vector
	Area:	Derived *or* original *or* presentation

Output Data

Type	Vector **or** raster
Format	*File type*

Descriptives

Context

Context for the generation of the dataset.

Processing

Processing performed

Key Points

Any key points raised concerning copyright/distribution issues.

References

List of references