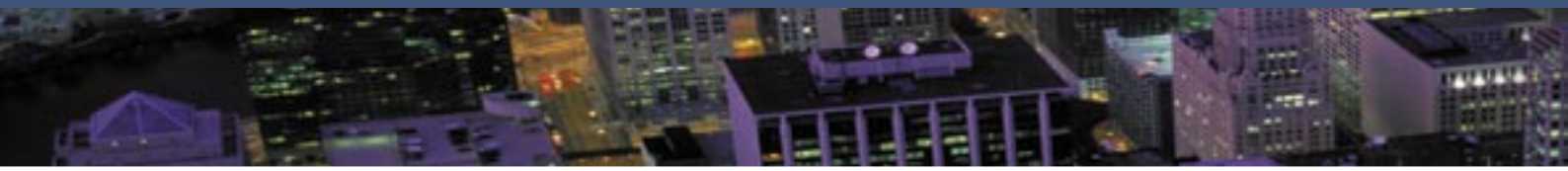
1Spatial

CASE STUDY

Laying the Foundations: Generalising OS MasterMap® for the Centre for Ecology and Hydrology (CEH)



The Centre for Ecology and Hydrology (CEH) is the UK's Centre of Excellence for research in the land and freshwater environmental sciences. CEH specialises in a wide range of environmental disciplines and covers scales from the gene to whole Earth systems. Their research is aimed at improving understanding both of the environment and of the natural processes that underlie the Earth's support systems, for example climate and water resources. CEH has undertaken a joint feasibility study with 1Spatial and Ordnance Survey Great Britain to generalise OS MasterMap® data as a potential foundation for its Land Cover Map (LCM) 2007.

Background

CEH LCMs provide a snapshot census of land cover types. Because of the dynamic nature of land use it is important that LCMs are updated regularly. CEH LCMs are used in a wide range of applications designed to assist socioeconomic and ecological decisions. The latest LCM, LCM2000, is a database for use within a GIS system and features areas of land known as 'parcels'. Parcels are classified individually, and contain lists of features and statistical information. The completed maps are used by high-profile governmental and commercial organisations and are vital in securing and managing environmental data.

For the first digital land cover map of Great Britain (LCM1990) CEH used satellite images and the pixel-based information within them to derive a 25m-resolution raster dataset representing 25 land cover types. However, the pixelated view of the landscape characteristic of satellite images resulted in feature boundaries becoming blurred or misrepresented by the pixel edge. This was largely the result of a simplifying assumption used when classifying land areas; the contents of individual pixels can be classified under single categories. In reality pixels often contain more than one land cover type; for example a road and an adjacent field. To overcome classification difficulties, a parcel-based approach was adopted for the production of LCM2000. This approach took account of the mixed pixels and produced a vector dataset of classified land parcels.

The land cover parcels of LCM2000 were derived independently of existing commercially available digital cartography, and consequently there is no direct link between them. Blurred satellite images can result in the creation of inaccurate or artificial feature boundaries. As the premier provider of UK environmental map data, CEH needs the LCM to be as accurate as possible: users of the LCM base important business decisions on information derived from it.

The prototype

The inspiration behind the feasibility study came from a previous CEH project where the entire Ordnance Survey Land-Line® data for Jersey was generalised by hand in 1997. Although a labour-intensive (3 months for a single operator), the project produced 15,770 polygons and was dubbed by CEH the "Rolls-Royce" of parcel-based land cover mapping. CEH's customers found the LCM to be far more accurate since it was tied to real-world information provided by OS Land-Line. From this, the decision was made that the impending LCM2007 for Great Britain should be based on OS MasterMap data. With many organisations in the UK already using OS MasterMap, CEH could ensure increased consumer confidence in its products.

OS MasterMap is a very data-rich product containing a level vector of information more than sufficient for the creation of the LCM; it would be impossible to accurately classify all the land parcels of OS MasterMap using available satellite data. Therefore, CEH, 1Spatial and Ordnance Survey (GB) collaborated in a feasibility study to investigate the generalisation OS MasterMap. A 20km x 20km OS MasterMap sample was used and CEH set three main objectives:

1. To generalise OS MasterMap data into a spatial framework for land parcels, providing LCM users with real-world points of reference
2. To use attribute data contained within OS MasterMap as an additional layer of intelligence when classifying land parcels, rather than just relying on satellite imagery
3. The land parcels created needed to be at least 0.5 ha in size with a minimum width of 25m

"The automatically generalised OS MasterMap data produced by 1Spatial match the spatial specifications required for the parcel-based analysis of satellite data for land cover mapping. This result is very encouraging for the development of the next UK land cover map which will therefore be more closely aligned to the national mapping base and user requirements."

Dr. Geoff Smith, Head of Integrated Applications Group at the Section for Earth Observation at the Centre for Ecology & Hydrology

1Spatial classified the OS MasterMap features into discrete types, ranging from low to high complexity, based primarily on their geometries but also using other attributes. Rules based on these complexity types were then designed to automatically split, merge or change the data into land parcels with simplified boundaries. A rule example is: "All road boundaries should collapse into the nearest field." (In general roads have little influence on the final classification as CEH is only interested in establishing the main element of a 25m-wide land parcel). After applying the rules the resulting parcels were reclassified. The rules were repeatedly applied until further simplifications of the data were no longer feasible.

"This is one of the best applications of generalisation I have seen; in how it was approached and in what has been achieved in the time available."

Dr. Paul Watson, Chief Scientist, 1Spatial

Putting theory into practice: the prototype results

The spatial framework envisaged by CEH and 1Spatial was realised. The sample data was reduced from 120,000 objects to 10,000 objects.

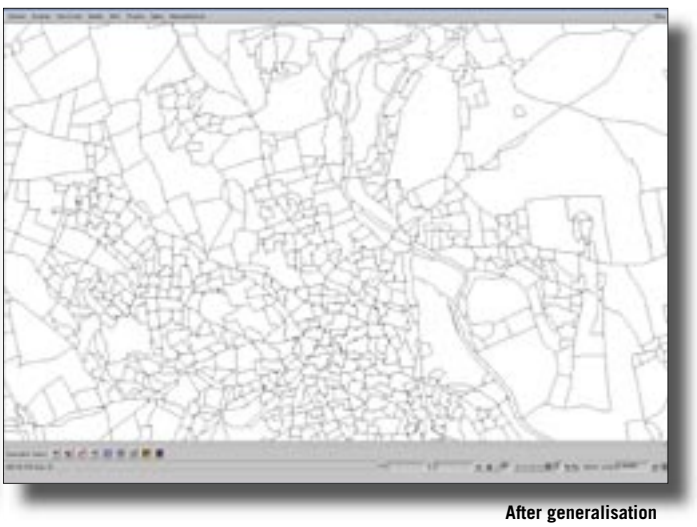
- The generalised land parcels retain links to OS MasterMap objects from which they were derived. This allows for rapid classification of the land parcels into their dominant elements, saving CEH time and production costs.
- The use of OS MasterMap as the base data ensures a link with industry-standard cartography. Providing a UK-wide LCM in this manner will greatly increase usefulness and user confidence of the product.
- Variability can now be recorded in land parcels; there is the potential for CEH's customers to query and verify the different types of land within a single parcel immediately, rather than sending out surveyors at a high cost.
- Using the generalised data, the CEH's LCM2007 complete creation time has been estimated as down from 3 years to 1 year.
- The prototype allows the move to complete digital cartography, eliminating the need for paper-based data collection. CEH will benefit from time and cost savings by using the OS MasterMap data, which is updated frequently and to a greater degree of accuracy than was previously possible with CEH's tools.

Future Foundations

CEH now plan to use a completed version of the generalised OS MasterMap data, which will be created by 1Spatial. The next stages of the project involve further data reduction; 1Spatial aims to reduce OS MasterMap data for Great Britain from 100 million objects to 5 million objects, effectively removing 95% of the data. This data reduction is essential for CEH's customers. The complete OS MasterMap requires mainframe support; after generalisation customers will be able to easily load the complete LCM onto their desktops or hand-held field devices and have instant access to business-ready data.

On a wider scale, the prototype opens up a range of opportunities for use within other organisations. 1Spatial is researching OS MasterMap generalisation for a variety of bespoke specifications and can now, for example, provide generalised OS MasterMap data for regional land use patterns that conform to the requirements of the CAP (Common Agricultural Policy) Reform. Central government organisations in particular stand to reap the benefits from quality business decisions based on generalised OS MasterMap data, but the technology is of value to any organisation that requires large-scale analysis and decision support.

before generalisation



After generalisation

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