

The UK land cover map 2000: Planning, construction and calibration of a remotely sensed, user-oriented map of broad habitats

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Abstract

Land cover map 2000 (LCM2000) is a comprehensive survey of UK broad habitats giving vector digital maps from segment-based classification of remotely sensed satellite data. This paper examines the influence of users in designing LCM2000 and the difficulties in applying a user-defined classification. It assesses problems and successes through comparisons with a sample-based field survey. These suggest that LCM2000 accuracy at broad habitat level may be around 80–85%; however, it was not possible fully to discriminate errors in LCM2000 from those of the field survey or from mismatches in scales, resolutions and survey dates. Calibration generated broad habitat cover statistics from LCM2000 data to field survey equivalence. These take full account of the heterogeneity of a study area, helping to generate accurate statistics, including those at local level where the field survey cannot operate effectively. The paper concludes that the comprehensive and extensive coverage from remote sensing comes closer than alternative methods to meeting users needs. However, it recognises that producers of remotely sensed information need to understand better the needs of users, and users need to appreciate what the technology can and cannot deliver. This paper adds some benefits of hindsight to the process of communication.

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1. Introduction

Land cover map 2000 (LCM2000) is a comprehensive survey of UK land cover, part-funded by users. It updates and substantially upgrades (Smith and

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Fuller, 2000) the land cover map of Great Britain (LCMGB) (Fuller et al., 1994a), offering improvements in structure, thematic detail (Fuller et al., 2002) and associated metadata (Smith and Fuller, 2002).

Thematic mapping from remote sensing inevitably balances the needs of users and the ability of image data and analysts to deliver. Emissions and reflectances of radiation from the earth's surface cannot discern all thematic classes. Users may demand finer spatial resolution, even mixing resolutions, measuring fine scale linear features and coarser areal ones. Classification schemes may confuse land cover and use, the latter being difficult to discern through remote sensing. Maps can be made to emulate user needs or producers might focus on spectrally distinct classes. The former strategy compromises accuracy, the latter risks constructing maps which are unfit for purpose.

2. Aims

This paper explains the problems faced and solutions derived in mapping Great Britain. It offers an account where the both the users' and the producer's perspectives are prominent. It outlines the evolution of methods, the many and varied influences which came to bear, and the resultant products. It describes the process of calibration to ground reference data collected to user-defined standards. It gives an insight to inform producers of similar products elsewhere.

3. Background

Land cover mapping from remotely sensed satellite images is becoming established (Cihlar, 2000). Much of the work involves coarse resolution approaches (Defries and Belward, 2000). Finer scale surveys include: the US National Land-Cover Database (Homer et al., 2004); the European CORINE Land Cover programme (European Environment Agency, 1999); the LGN land cover database for the Netherlands (Thunnissen and De Wit, 2000) and LCMGB and LCM2000. Fuller et al. (1994a) describe the production of LCMGB. Inter-comparisons of field and LCMGB data were made by Wyatt et al. (1994), Cherrill et al. (1994, 1995) and Fuller et al. (1998).

Several papers give a background (Comber et al., 2003), context (Fuller et al., 2002) and description for LCM2000 (Fuller et al., 2002, 2004; Smith et al., 2000). While accuracy assessment is widely applied, methods vary considerably. Reviews by Congalton (1991) and Foody (2002) give more general context for the present work. Example applications over large area studies are given by Edwards et al. (1998), De Wit and Clevers (2004) and Van Oort et al. (2004).

3.1. LCMGB

LCMGB is a classification of spectral data from earth resources satellites (Fuller et al., 1994b). Landsat Thematic Mapper (TM) data, mostly of 1988–1989, were registered to the British National Grid (BNG) with 25 m output pixels. Red, near-infrared (NIR) and middle infrared (MIR) data from summer and winter were combined into six-band composite images (Fuller et al., 1994b). A maximum likelihood classification (Schowengerdt, 1997) labelled each pixel in each scene with one of 25 classes (Fuller et al., 1994a). A mosaic of classified scenes covered all of Britain.

The Institute of Terrestrial Ecology (ITE), later the Centre for Ecology and Hydrology (CEH) produced LCMGB with science budget funds and a grant from the British National Space Centre (BNSC). Concurrently, the then Department of the Environment (DoE) was planning to part-fund ITE in the sample-based Countryside Survey (CS) 1990 (Barr et al., 1993). The comprehensive if generalised coverage of LCMGB would clearly complement the sample-detail of the CS1990 field survey. DoE gave funds to 'integrate' LCMGB into CS1990, allowing inter-comparison with the field survey (Fuller et al., 1998). Since production, LCMGB data have been licensed to over 500 users, researchers, policy makers and commercial organisations, with wide ranging uses.

LCM2000 had the 'benefits of hindsight' that followed production and use of LCMGB, but there were still lessons to learn. Given the scope for comparisons to identify changes or the alternative potential to upgrade the product, there were new issues to consider. Users variously demanded greater thematic accuracy, increased thematic detail or improved spatial resolution. LCMGB had been completed as geographical information systems

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