

**Land Cover: To standardise or not to standardise?
Comment on “Evolving standards in land cover characterization”
by Herold *et al.***

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Abstract

A recent article advocated the adoption of a single standard for all land cover classifications. The authors argued that variations in classification were problematic, standards solve problems related to classification heterogeneity and land cover is the fundamental land variable. This letter challenges these arguments:

- 1) methods exist for integrating disparate data, many based around data semantics;
- 2) standards are themselves problematic as they are frequently revised (e.g. soils) and because they always lag behind current activities cannot represent the depth of knowledge held within a community such as land cover;
- 3) scientists working in other disciplines may view land use as the elemental variable driving many other processes and they construct land cover in a very different way

This letter argues that as most geographic data and especially land cover is a socially mediated construct (there are no agreed fundamental units), fixing a specific conceptualisation of land cover into the ‘aspic’ of a formal standard does not represent a scientific advance.

1. Introduction

In a recent paper in the *Journal of Land Use Science*, Herold *et al.* (2006) advocate the adoption of a single standard land cover legend in order to overcome variations in the way that land cover features are recorded. They propose that the UN Land Cover Classification System (LCCS – Jansen and Di Gregorio 2004) be adopted as the standard and their arguments can be summarised thus:

- 1) Variation between different land cover mappings (legends, concepts, semantics, etc) is problematic to the user and research community;
- 2) A standard classification system solves this problem and placing it within the ISO suite of standards legitimises its use;
- 3) Land cover is the fundamental land variable and therefore most urgent for standardisation.

In the following sections we attempt to rebuff these arguments.

We would like to establish at the first that we are not opposed to the LCCS system advocated in that paper. It is one among a number of useful classification schemes all-be-it one with a large number of proposed classes. We are, however, opposed to standardisation in this area, regarding it as a false paradigm ignoring as it does the validity of personal opinion, scientific advances and human practice.

2. Diversity of classifications

Currently data producers use a classification that is appropriate for their context and related to their specific socio-political and technical setting. This approach allows the data producer to embed subtle distinctions in their classification and to generate a classification that is responsive to their context (that is it is useful and not just usable). Changes in policy, sensors, method and environment encourage the use of subtle variations in classifications. Imposition of a standard would either loose that subtlety of conceptualisations through the granularity of its specification or become impossibly detailed referring to little more than parameters of the original data.

The LCCS imposes a view of land cover categorisation which is strictly and precisely hierarchical. It imposes crisp distinctions between categories, for instance distinguishing between shrubs and trees based on a single overlapping variable, height. For example, Ahlqvist (forthcoming) discusses the differences between the UNESCO (>5m height, >40% cover) and the Netherlands (>6m height, >20% cover) forest definitions. Similarly, the user is forced to place the land cover into a category of canopy density, where they have to select closed (>65%), open (65-15%) or sparse (<15%). These granularity distinctions result in the loss of descriptive richness.

There are “good” reasons for using different classifications in different contexts which arise from scientific, technical, organisational, institutional and political influences and those contexts should not be ignored. In response to these variations the research community has developed a number of possible solutions to deal with inconsistent semantics and conceptualisations. For land cover these include using expert opinion to compare the global land cover classification schemes of GLC-2000 and MODIS (Fritz and See, 2005), modelling the semantic relations between national land cover data in the UK (Comber *et al.*, 2004), comparing the semantics of classifications systems of the US National Vegetation Classification Standard and the European CORINE Land Cover System (Ahlqvist, 2005), and expanding the metadata to include semantic and conceptual aspects associated with land cover information to facilitate translation (Schuurman and Leszczynski, 2006). All these methods allow the fusion of data from diverse semantic backgrounds and which exploit the heterogeneous semantics of land cover datasets conforming to the historical working practices of people. They do not impose the fixed constraints of standardisation.

3. Towards a standard

To describe the principal endeavour Herold *et al.* use the terms land characterisation, land cover characterisation, land cover assessment and land observation repeatedly and apparently interchangeably to describe the recording of land cover. There is an implication that there may be some deeper distinction between the terms but it is never clarified, so the reader wonders whether there is a distinction. This is not

appropriate for writing on standards where the terms should be clearly defined and when use of synonyms with technical meaning should be clearly indicated.

Standards are theoretically useful because they provide a common language, enabling parties to exchange data without misunderstandings. However as their specification is a compromise between interested parties and because they lag behind activity, they can not represent the depth of knowledge held within a community. Standards are further problematic because of their scientific background which permeates the endeavour and which denies the socially constructed nature evident in most geographical information, including land cover (Comber *et al.*, 2005). Herold *et al.* are promoting the adoption of LCCS as a standard and describe various steps they are taking to help it become a standard. However, it is apparent that developing LCCS as a standard involves a very narrow set of land cover mapping practitioners – principally those involved in various United Nations and European activities. References cited in the paper are limited to FAO/UNEP and European global mapping initiatives such as IGBP-LUCC and GLP involving GLCN, GOF-C-GOLD, GTOS, UNEP and ESA. Essentially, Herold *et al.* are arguing for an application specific standard.

Herold *et al.* suggest that they are proposing a similar approach to that used in soil science (soil mapping) since the 1960's. However, soil scientists in many different countries have developed alternative classification schemes (Taxonomies), just as have land cover mappers, and they continue to do so. Secondly, there are actually at least two international schemes: the US Soil Taxonomy (Soil Survey Staff, 1999) and the FAO UNESCO Legend of the Soil Map of the World (FAO/UNESCO, 1990). Herold *et al.* suggest that the latter is the international standard. However, it is actually based on the Soil Taxonomy system of diagnostic properties which predated it. It was first published in 1974 identifying 26 Great Groups of soils, and re-published and revised in 1988 with 28 Great Groups (some groups being removed and others introduced) and finally adopted as the World Reference Base (cited by Herold *et al.*) for soils. Therefore, it is not true to say that a standard has been in use for soils since the 1960s since it is neither a standard (not everyone uses it, Eswaran *et al.*, 2003) and nor has it been unchanged. The fact of the matter is that soil classification is still a national pastime with a heterogeneity of approaches and discordant classifications, with international classifications existing in the background to which any local classification scheme is compared, just as for land cover mapping.

Changes in classification schemes reflect the changing conceptualisation of the underlying phenomenon. Such change is inevitable as scientific understanding is not static. Indeed, at different times the way a phenomenon should be viewed, and the basis of any taxonomy, can change dramatically. Whilst standards are built on a particular paradigm, changes in scientific paradigms are a necessary and desirable part of the advance of science.

4. Land Cover as the Basis of Land Information

Herold *et al.* assert that “it is essential to base a common system for land use classification on existing land cover standards to ensure full compatibility between them” and that “land cover and land use transitions have to be interoperable” (p162). This is a conceptually flawed argument. We might agree that at any time and place

there is a land cover to some level of observable granularity. However, land use is more dynamic. Any piece of land may have multiple uses associated with it – a woodland can be used simultaneously for recreation, timber production and hunting. Other land uses are alternate (e.g. the field with cows may be the village football pitch at weekends). Other uses take place on more than one type of land cover. Therefore, because there may be more than one activity taking place and any given use may take place on more than one cover, the relationships between land use and land cover may not be one to one, but many to one, one to many or many to many. These multiple relationships, representing different dimensions in land recording make full and direct compatibility and interoperable transitions between land use and cover problematic.

The statement that “Land cover provides the common ground for different focus areas in land assessment” (p 162) not only assumes that there is a common understanding of land assessment but also that land cover is the elemental variable. When viewed from a socio-economic perspective, clearly land use is much more important and, in spite of multiple uses of the same land, more appropriate as an elemental variable than land cover. Even within natural resource survey, however, many people might think that soil information is the basis of scientific land assessment while others believe that geology is the basic unit. The perception of precedence of mappable phenomena depends on personal training, not on any natural order as implied by Herold *et al.* That some might consider ecosystems as the basic variable is even suggested in Herold *et al.*'s view that “an ecosystem reference classification system should be fostered, but has to be linked to land cover as [a or the] common land surface feature to allow compatibility” (p162). This mistakenly assumes that land cover is conceptually important to ecosystems, although it is not at all clear how this will facilitate compatibility or even what will be compatible. We suggest that land cover as a concept is actually unknown to many researchers in ecosystems, and to suggest that ecosystems are synonymous with land cover types is fundamentally mistaken. Indeed the whole argument for standardisation of land mapping based on land cover ignores the work on standards for ecosystem recording and description by the Taxonomic Databases Working Group for Biodiversity Information Standards (<http://www.tdwg.org/>).

5. Interoperability: research areas & guiding principals

We agree with Herold *et al.* that the different conceptualisations in how to represent land cover can be problematic. Our fundamental difference appears to be that we wish to recognize, acknowledge and perhaps even celebrate that diversity. What we are concerned with is that people (data producers and users) recognize that most geographic data and especially land cover is a socially mediated construct: there are no agreed fundamental units. We want producers to acknowledge the influence of changing scientific knowledge, available technology and societies needs; we want users to realise that their conceptual model of the world may differ from the data producers. We do not believe that fixing one conceptualisation from a narrow (albeit highly experienced) subset of expert producers into the “aspic” of a formal standard represents a scientific advance.

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