Absolute and Relative Spatial References in Crop Production Standards

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INTRODUCTION

Crop production regulations and standards are playing an increasingly important role in agriculture, both guiding farmers towards best-practice and limiting their options. Such standards, which may be legally regulated and binding for all farmers (e.g. fertiliser regulations), legally regulated but voluntary (e.g. EU Organic Standard, 2007) or voluntary industry standards (e.g. GlobalGap, 2007), typically mandate or prohibit particular actions or limit the amount of substances which may be applied to crops, and farmers must therefore adjust their practices to conform to the rules defined by the relevant standards. Simultaneously, information-driven agriculture is becoming increasingly widespread: both precision agriculture and conventional lower-technology are increasingly reliant on computer-aided decision support. This may be directly used by a farmer, as part of a farm management service or through online advisory portals, or may be provided as a service by farm advisors. Although spatial data plays a major role in precision agriculture, its more widespread relevance to agriculture has not necessarily been appreciated.

ABSOLUTE SPATIAL REFERENCES

There are many explicit spatial references in crop production standards, although they are usually defined using names rather than coordinates. An obvious example is in the regional implementation of regulations – EU regulations are implemented in national or federal state law and therefore each nation or state has a different set of rules for each regulation. By use of a gazetteer, the coordinates of the region to which each standard applies may be found. For large agricultural enterprises, which may operate in multiple regions, it is therefore necessary to adjust decision-support systems such that the relevant rules for each location are adhered to by algorithms generating operational plans (e.g. a fertilisation map). This is here termed absolute spatial referencing as the region to which the rules apply may be directly determined using a single lookup, e.g. in a gazetteer using a region name.

RELATIVE SPATIAL REFERENCES

Crop production standards also contain relative spatial references. For instance, to prevent pollution of water bodies, the German national fertiliser regulations (DüV, 2007) specify that the sprayed area for fertilisers with a high content of nitrogen or phosphor must have a minimum 3m gap to the top edge of the bank. Furthermore, if the average slope of the first 20m above the top bankline is 10% or greater, the region from 3m-10m may only be fertilised if the fertiliser is directly applied into the soil and the region 10m-20m only depending on the type of fertilisation, cultivation and tillage. In order to plan an optimum fertilisation operation which is conformant to DüV it is therefore necessary to not only know the crop type, soil, etc., but also to identify the zones in which no fertiliser must be applied and the zones in which only certain forms of fertilisation and work practices are allowed. These may be generated given the top banklines and a DGM of suitable resolution. Such data is therefore termed here relative spatial references as to identify the regions affected requires the use of spatial processing operations and access to suitable geographic base data to form a location complex (Donnelly, 2005).

IMPLEMENTING SPATIAL REFERENCES

In order to implement an agricultural DSS which can, without arduous and complex manual configuration and geoprocessing by the user, produce operational plans in compliance to relevant rules, it is necessary to identify which rules affect a given region. The direct and indirect spatial references are therefore critical to producing a valid plan. Within the FutureFarm project[1] an architecture is being developed to allow interoperable access to machine-readable definitions of crop production standards via webservice interfaces, allowing agricultural DSS to be dynamically and largely automatically configured. It is expected that both the direct and indirect spatial references may be resolved by binding OGC-conformant web services. Thus a WFS-G (Fitzke & Atkinson, 2005) may be used to resolve region names which will be encoded as such within an XML definition of each standard. For indirect spatial references, an appropriate WFS or WCS must be found which provides the required base data. This is complicated by problems of semantics, i.e. the term used within a crop production standard may not match the term used to for the feature within a spatial data set, and for international standards the geographic data is likely to be provided using a local natural language whilst the standard is defined in English. Since much of the data which is required for agriculture is, broadly speaking, environmental data then it is hoped that such problems will be addressed and solved within the framework of INSPIRE.

CURRENT AND FUTURE WORK

Current work is focussing on producing a machine-readable encoding for crop production standards. An important aspect of this is the encoding of explicit and implicit spatial references in a form which can later be resolved using geospatial webservices: it should not be necessary to encode coordinate data within the agricultural standard, and nor is this realistic in cases such as the DüV. In future work, proof-of-concept software will be developed to demonstrate how future agricultural DSS may combine agricultural and geospatial webservices to inform and assist farmers in complying with standards.

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[1] http://www.futurefarm.eu