Earth Observation for Agriculture and Rural Economy

Earth Observation has been used successfully for mapping and planning land use in rural areas as well as for monitoring management activities. This document presents case studies on crop mapping, area monitoring and the detection of slurry tanks for assessments of ammonia emissions.

Complexity

- Clear method and straightforward
- Clear method but complex
- Possible; needs research

Resource

- £ Low
- ££ Medium
- £££ High

Case Study I: Crop mapping

RESAS

The Rural and Environmental Sciences and Analytical Services (RESAS) make Scotland wide crop maps available as experimental statistics in an interactive map. The Scottish Crop Map uses time series data of Sentinel-1 and machine learning methods to classify crops in agricultural areas. The resulting crop map includes data on the major crop types in Scotland and aims to reduce the number of on-site visits and survey work for farmers.

The method is based on random forest classification which is well known and straightforward to implement. All code used by the RESAS team is made available via Github. Pre-processed Sentinel-1 data alongside ground observations are used as input data and are sourced from JNCC's ARD service and the Rural Payments and Inspections Division respectively. Currently, only major crops can be predicted with high accuracy due to a lack of training data for minor crop types. Overall, the model tends to underpredict area estimations for all mapped crop types and RESAS are currently improving their method further for annual crop mapping of Scotland.

A workflow for processing the required data is already in place and can be used by trained staff but improvement of the outputs would need a small expert team. Data storage and processing is already taking place in a cloud environment which comes with a small annual charge. Costs would increase if data with very high spatial resolution is purchased for this work only or if more complex data processing (e.g. coherence) is required to improve the method.

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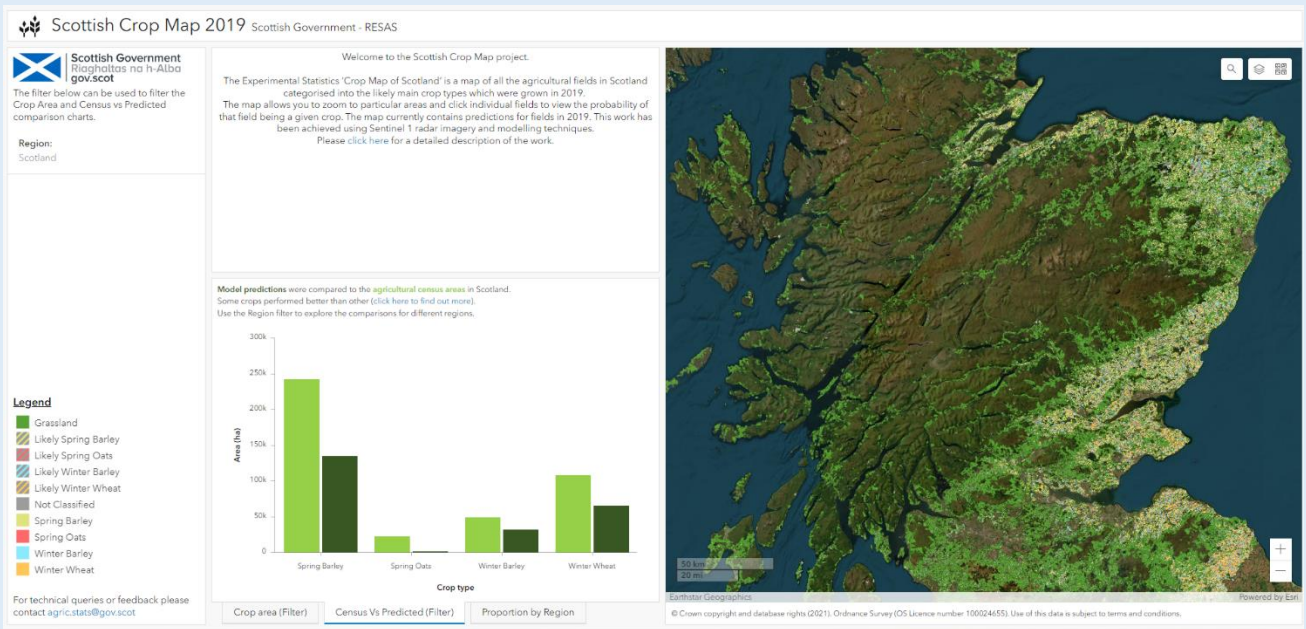

Case study I: Scottish crop map

Further products and applications

Livestock quantification/ Pollution assessment/ Landscape Evaluation Tool /Soil moisture/ Irrigation management

Case Study II: Detecting slurry tanks to assess ammonia emissions

SEGES INNOVATION

The Danish agricultural advisory institute (SEGES) use very high resolution (VHR) satellite data, aerial imagery and machine learning models to automatically detect the total number of slurry tanks in the country. The method uses a cloud-based, geospatial tool provided by the Swiss company Picterra and requires remarkably few ground data points to generate outputs which are used to estimate the country's ammonia emissions.

The method is based on machine learning models within a geospatial analysis platform owned by Picterra. Available ground data and some training of staff members would be required to use the platform and implement a similar model in Scotland. The Picterra infrastructure is designed to build custom detectors of a variety of features and the method could likely be adapted for mapping of other features if sufficient ground data for training and validation is available.

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Picterra provides access to a ready-to-use modelling infrastructure which is associated with a cost. Some staff training would be required but costs are hugely reduced compared to similar modelling workflows. Additional costs may arise if very high spatial resolution data is purchased for this work only.

Case study II: Detection of slurry tanks via Earth observation

Case Study III: Area monitoring

Rural Payments Agency

The Rural Payments Agency and Natural Resources Wales use Sentinel data alongside high-resolution satellite data to monitor agricultural activities on large scale. The developed machine learning models enable classification of fields into categories such as stubble, cover crops or bare earth and can therefore assist with compliance monitoring for subsidy schemes.

The method is based on machine-learning algorithms and is currently under development. Extensive ground surveys are used to train the models and outputs will require in-depth uncertainty analysis to understand the quality of the classifications. One limitation is caused by the scarcity of cloud free imagery, especially in winter. This could be improved by including commercial, high-resolution data into the analysis or investigating the use of Sentinel-1 data which is more complex but freely available.

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A workflow for processing the required data is currently under development in England and Wales but will be transferrable to other areas. Extensive ground surveys are needed to generate validation data for any new area. Once a complete workflow is available, all data storage and processing will take place in a cloud environment which comes with a small annual charge. Costs would increase if data with very high spatial resolution is purchased for this work only or if more complex data processing (e.g. coherence) is required to improve the method. Some staff training would be required for running the analysis and assessing the outputs.

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