A Crop Production Forecasting Tool for Adaptation and Mitigation Strategies in Scotland

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The James Hutton Institute

Introduction: Background

The James Hutton Institute

- The most important row crop in Scotland is Spring barley (*Hordeum vulgare, spp*)
  - main usage of barley being for animal feed and the drinks industry (RESAS, 2016)
- These results are the first part of a study on using a simulation tool for adaptations and mitigation strategies as part of the Scottish Government's policy;
- And as a tool for risk-analysis of barley production at National level involving the Whisky Industry;
- One important aspect to the stakeholders (before using the tool) was the model spatial evaluation.

Methodology: Data

Weather data:

- Gridded data (5km x 5km; 1994-2014) UK Met Office for maximum and minimum Temperature, and rainfall (UKCP09). Solar radiation purchased from SolarGIS (www.solargis.com).

Soil data:

- James Hutton Soil database (50,000+ soil samples from 14,000 locations across Scotland dating back from the 1930s). Information used (0-100 cm) were: Soil texture, soil organic carbon, soil pH, soil N, coarse fraction. Data summarised by individual Soil Series (Taxonomic unit) to provide attribute data for each for a range of soil physical and chemical properties

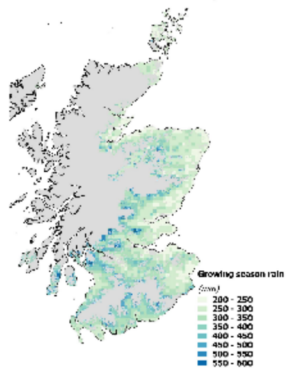
Land use and overlay soil properties:

- Land Capability for Agriculture Map (1:250 000)
- Identified 333 soil types that occur in the barley growing area.

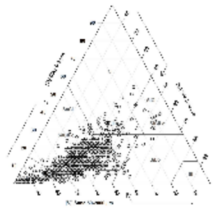
Crop model:

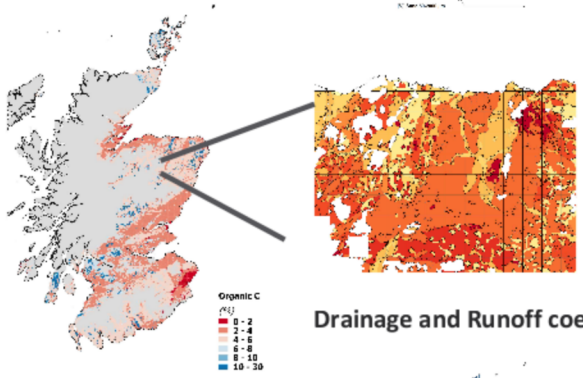
- DSSAT v4.6 was used (CERES-Barley)
- The crop was calibrated using the Barley growth guide (AHDB, 2015*)
- Evaluation will be discussed on the next slide.

Growing season rainfall

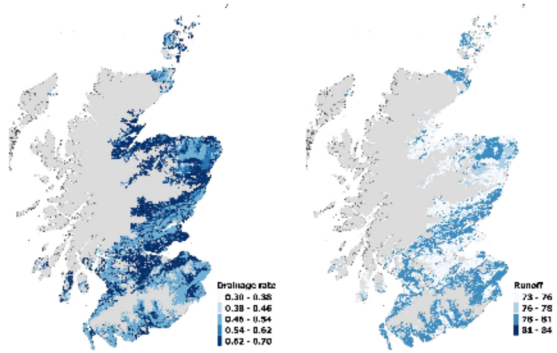


Soil Texture





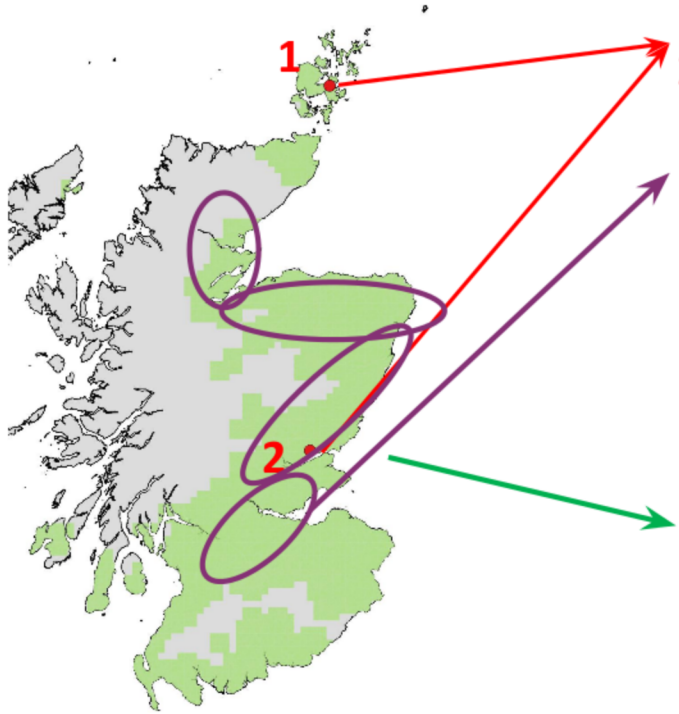
Drainage and Runoff coefficients (DSSAT-inputs)



Agriculture and Horticulture Development Board, 2015. The barley Growth Guide. Project#384

Methodology: spatial evaluation

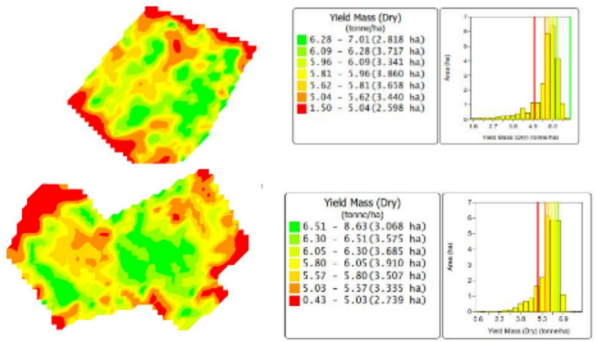
We will utilise observed yield data for the whole growing area. It is going to be aggregated at a given resolution (we cannot use point-based because of privacy issues we cannot identify farmers' fields). In addition, the following data will be used:



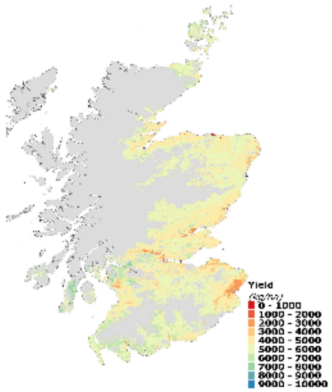
1. **Orkney College UHI: 58° 59'N; 2 ° 57 'W**
2. **Balruderry Experimental Farm JHI: 56 ° 28'N; 3 ° 4'W**

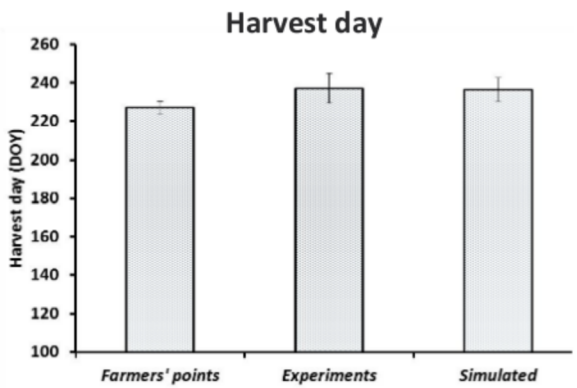
Data from real farms. So far we have used only 8 farms. Data collected by Agronomists from the Institute using science-based protocols.
There are more farms data to be used from this data collection.

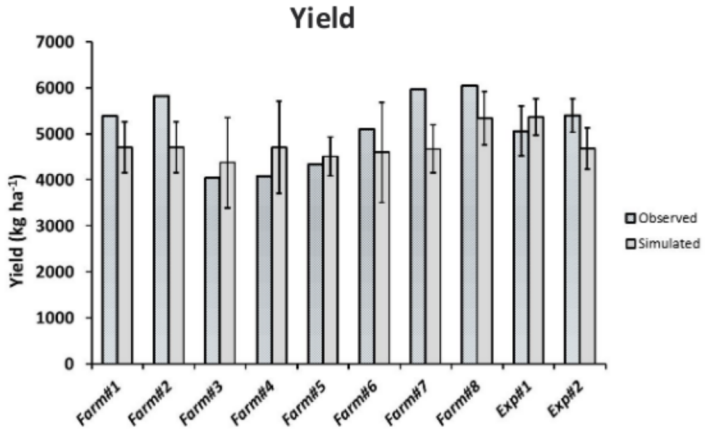
800 ha of spatially defined spring barley yield

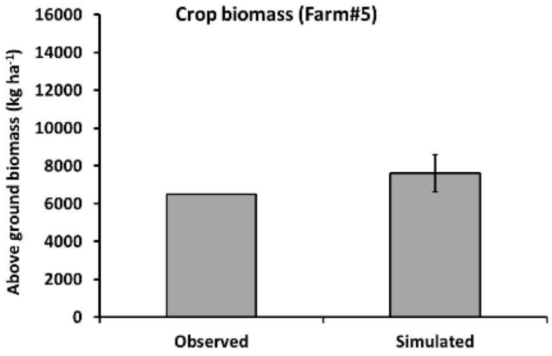


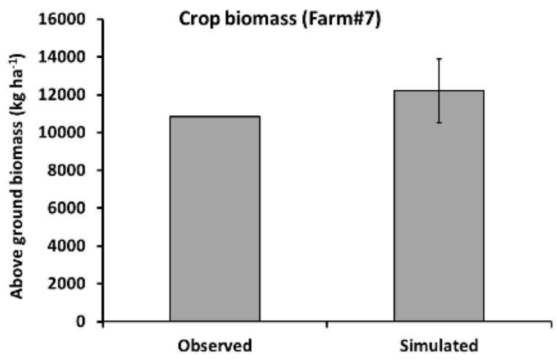
Results: spatial evaluation

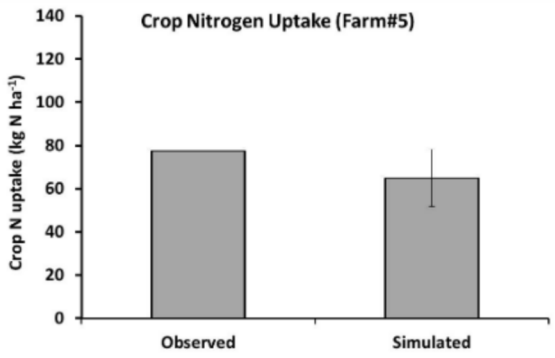


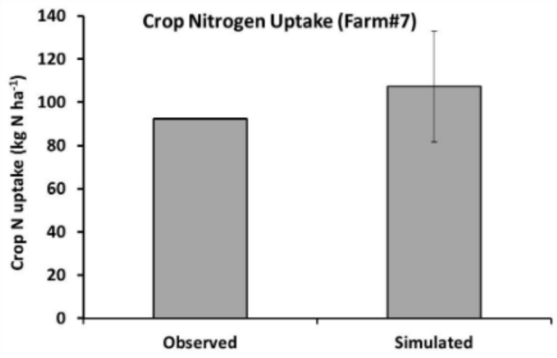




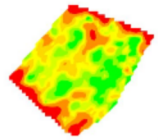








N.B. The observed yield is the average of 9 points. We will add the standard deviation (SD). By comparison, the spatial field showed a SD between 500 to 1200 kg ha^{-1}



Both Biomass and N uptake seems to be well estimated at farms #5 and #7

Results: example of simulations

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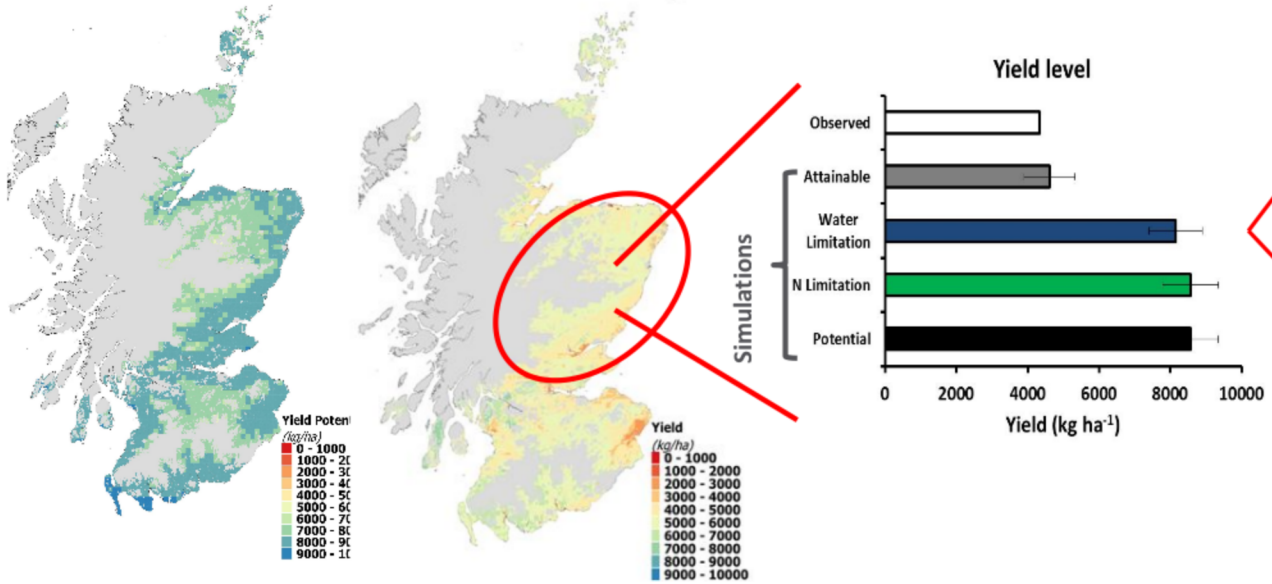
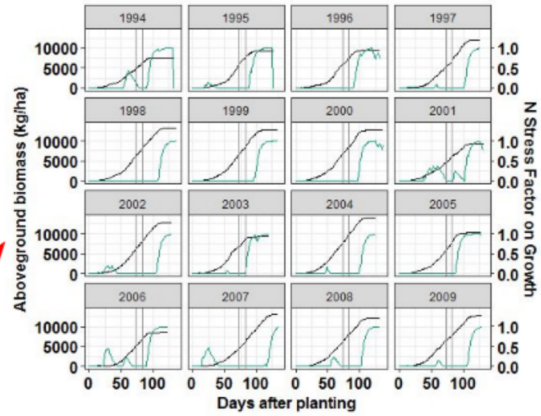
Nitrogen Stress on growth

Yield Potential

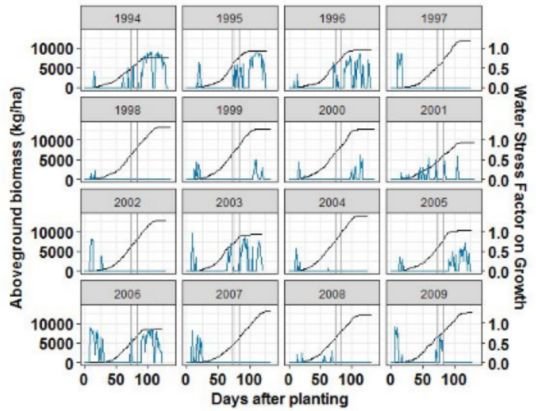
Yield Attainable

Farm #5





Water Stress on growth



If properly evaluated it can be also used to perform specific runs at given locations. In this example, a yield gap analysis at Farm#5 was performed.

Next steps:

- Next step is to finalize the spatial evaluation by May/June 2018;
- Beginning to demonstrate how this tool can be used for adaptation strategies and values of adaptation under current climate and future climate;
- Work along with the soil scientists from Aberdeen University and James Hutton Institute to study mitigations strategies for Scotland;

Acknowledgments:

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