



RETINA and the Predictive Ecosystem Analyzer

Assessing greenhouse gas predictions
with accessible tools for on-demand model-data synthesis

ISCRAES 2022

Elizabeth Cowdery

Matt Aitkenhead, David Cameron,
David Donnelly, Pete Smith,
Jagadeesh Yeluripati

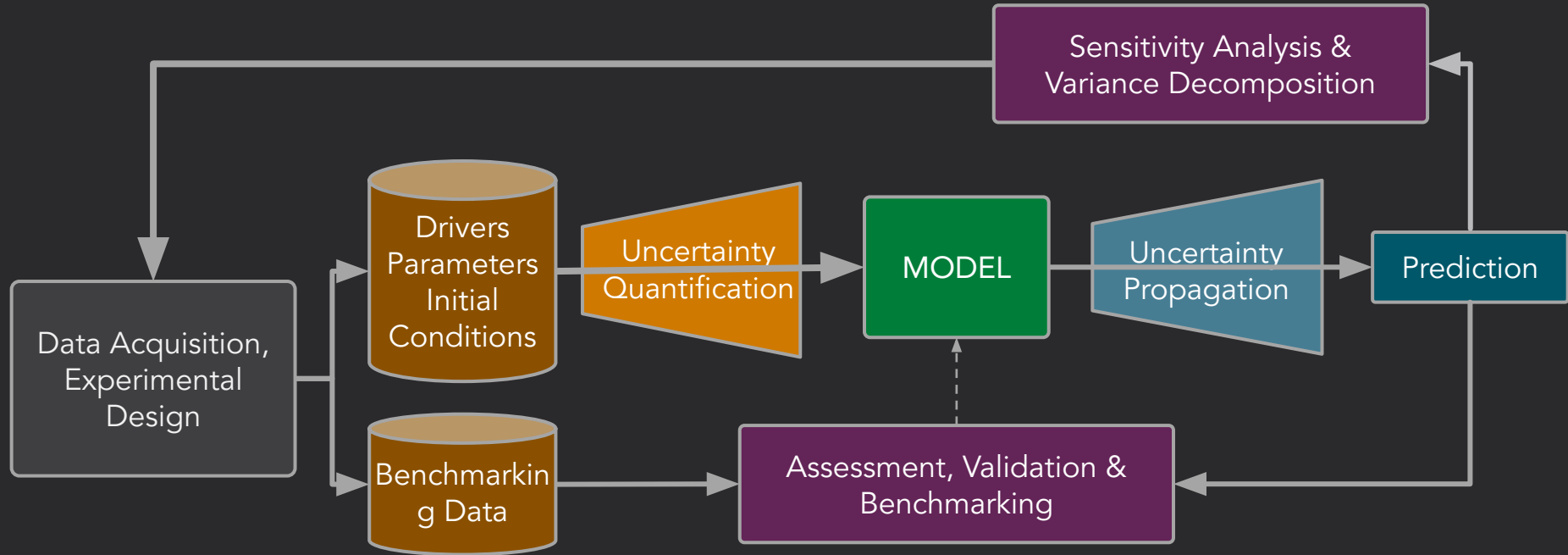


The James
Hutton
Institute

Background:

- The amount of data being collected and openly distributed is increasing daily, but only a fraction of this data is being used to constrain models.
- We lack cost effective, reliable, robust, transparent and accessible tools to bring together existing models, data and the people who best understand them.

The Feedback Between Model and Data



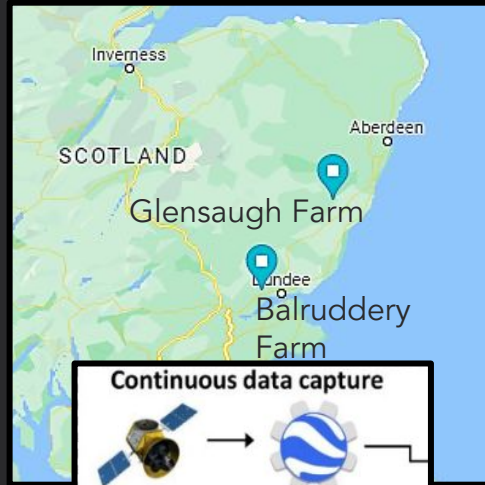
RETINA

- Bring together models and data to improve predictions of soil carbon sequestration in agricultural systems.
- Inform landowners when making management decisions.

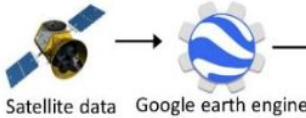
Study Sites

Glensaugh Farm

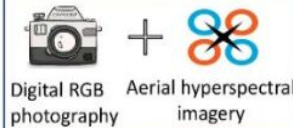
- 6 x Decentlab soil moisture & T probes on LoraWAN
- 1 x DecentLab weather station
- 1 x DecentLab CO₂ sensor



Continuous data capture



Landscape level sensors



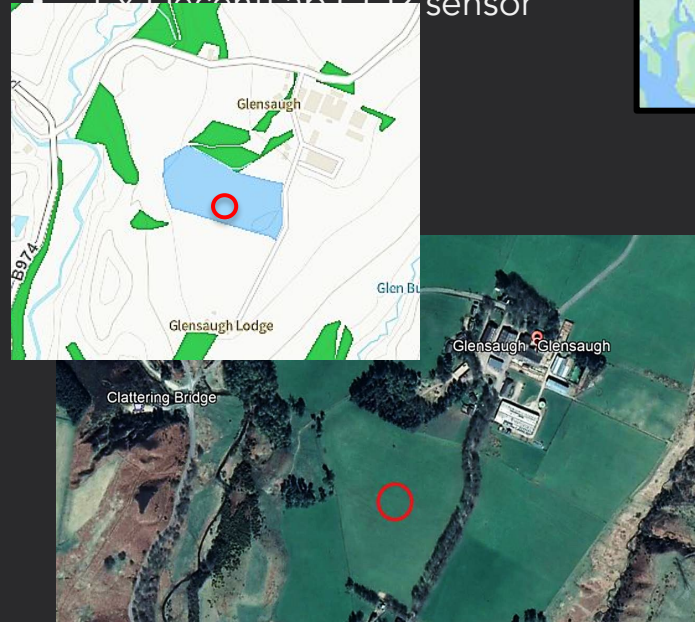
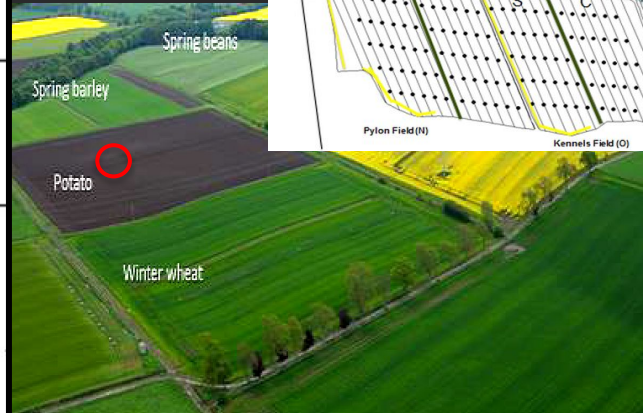
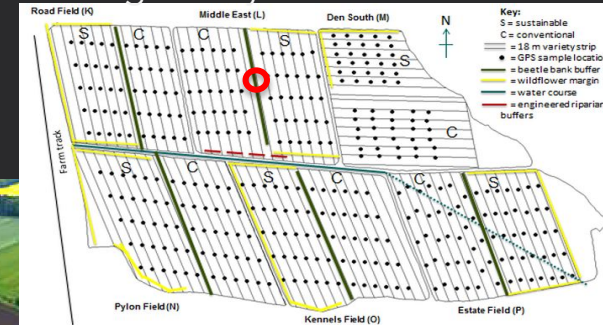
Soil carbon stock estimation

Physical sensor network at plot scale

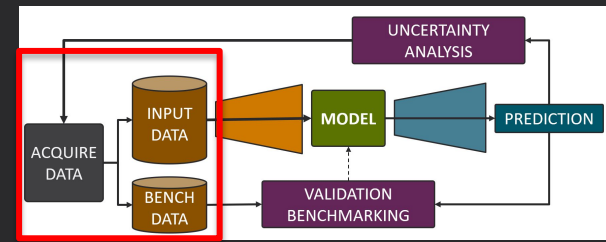


Balruddery Farm

- EC Mast with met instruments
- 2 x Campbell Scientific soil moisture probes
- 4 x DecentLab soil moisture probes
- 1 x DecentLab CO₂ sensor
- LoraWAN gateway/4G



Data: Model Drivers and Parameters



Meteorological Data

- CHESS-SCAPE for future & historical projections
- Observed climate

Soil characteristic data

- James Hutton Institute soil maps

Management Data

- User inputs via the RETINA mobile app capturing changes in agriculture management



Management menu

Planting

- NO TILL
- RED PREP
- MULCH SEED
- DIRECT SEED

Tillage

- SLURRY 12 CM
- SLURRY 12 CM
- WHEAT BEARD
- KEEP 1ST CM
- WHEAT 1ST CM
- CROP TERMINATE

MULCHING

Manure type

- FARM VAND
- SLURRIES
- POULTRY
- TREATED SEWAGE SLUDGE
- COMPOST

Manure method

- BROADCAST
- HAND SPREAD - TILLAGE WIDE
- MULCHING
- HAND SPREAD - TILLAGE WIDE

LIME APPLICATION

- COVER CROP

GRAZING

- NUTRIFICATION INHIBITORS

Nitrogen in kg per Ha

NO FERTILIZATION (kg N/ha)

OPEN FERTILIZATION MENU

Harvesting

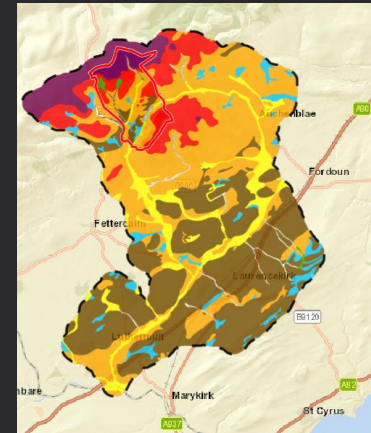
- COMBINE
- HARVESTER
- MOWER

Percentage of leaves and stems left on ground (0-100)

0 to 100

Farm Activity - select your crop

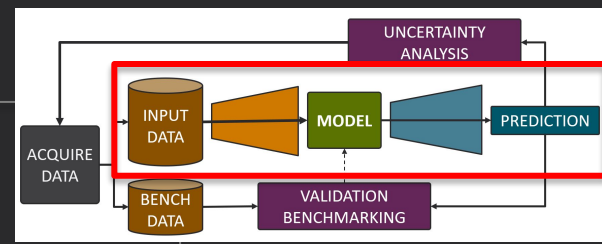
- FALLOW
- WHEAT
- POTATOES
- DATE
- RAPE SEED
- SPRING BARLEY
- WINTER BARLEY
- SUGAR BEET
- CARROTS
- STRAWBERRIES
- CUCUMBERS
- OTHER VEGETABLES
- GRASSLAND - 0 YEARS
- GRASSLAND - 1 YEARS



Prediction Phase



The James
Hutton
Institute

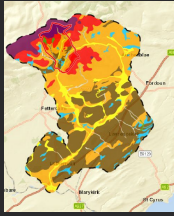


Models:

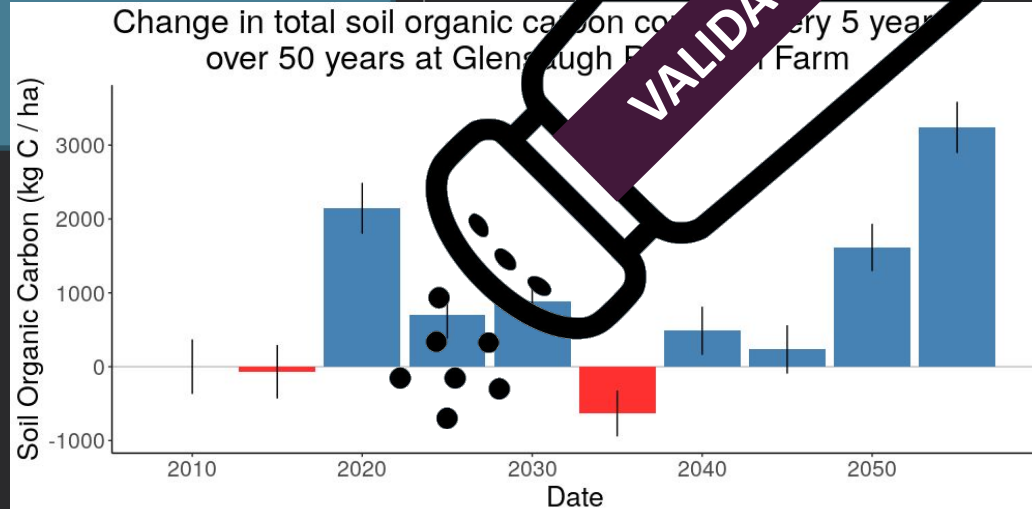
DNDC
BASGRA
ECOSSE

Model Predictions:

GHG Emissions
Soil Carbon Change



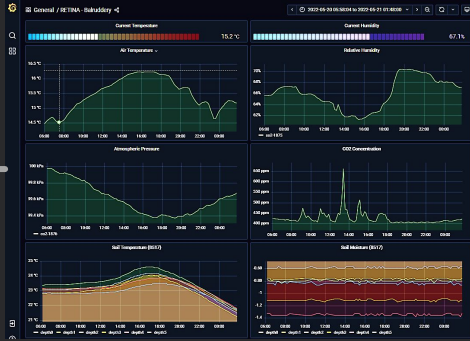
Using the Predictive Ecosystem Analyzer for data preparation and model initialization



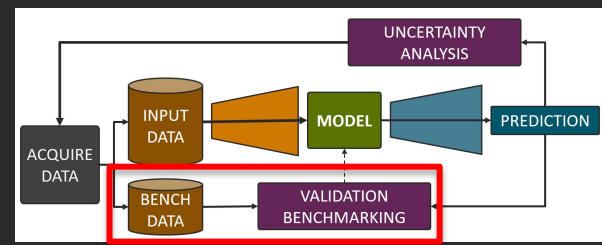
Continued Work



The James
Hutton
Institute

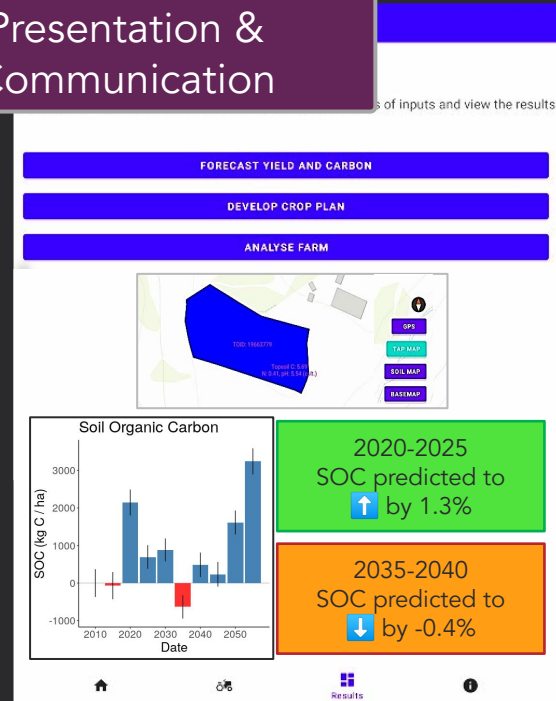
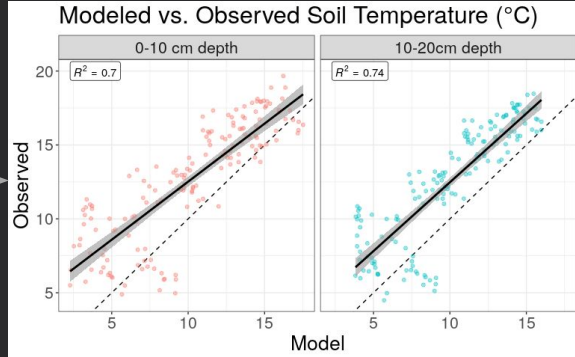


- Observed soil moisture and temperature
- Estimated biomass



Presentation & Communication

Assessment,
Validation,
Benchmarking &
Uncertainty
Analysis



Thank you

elizabeth.cowdery@hutton.ac.uk

