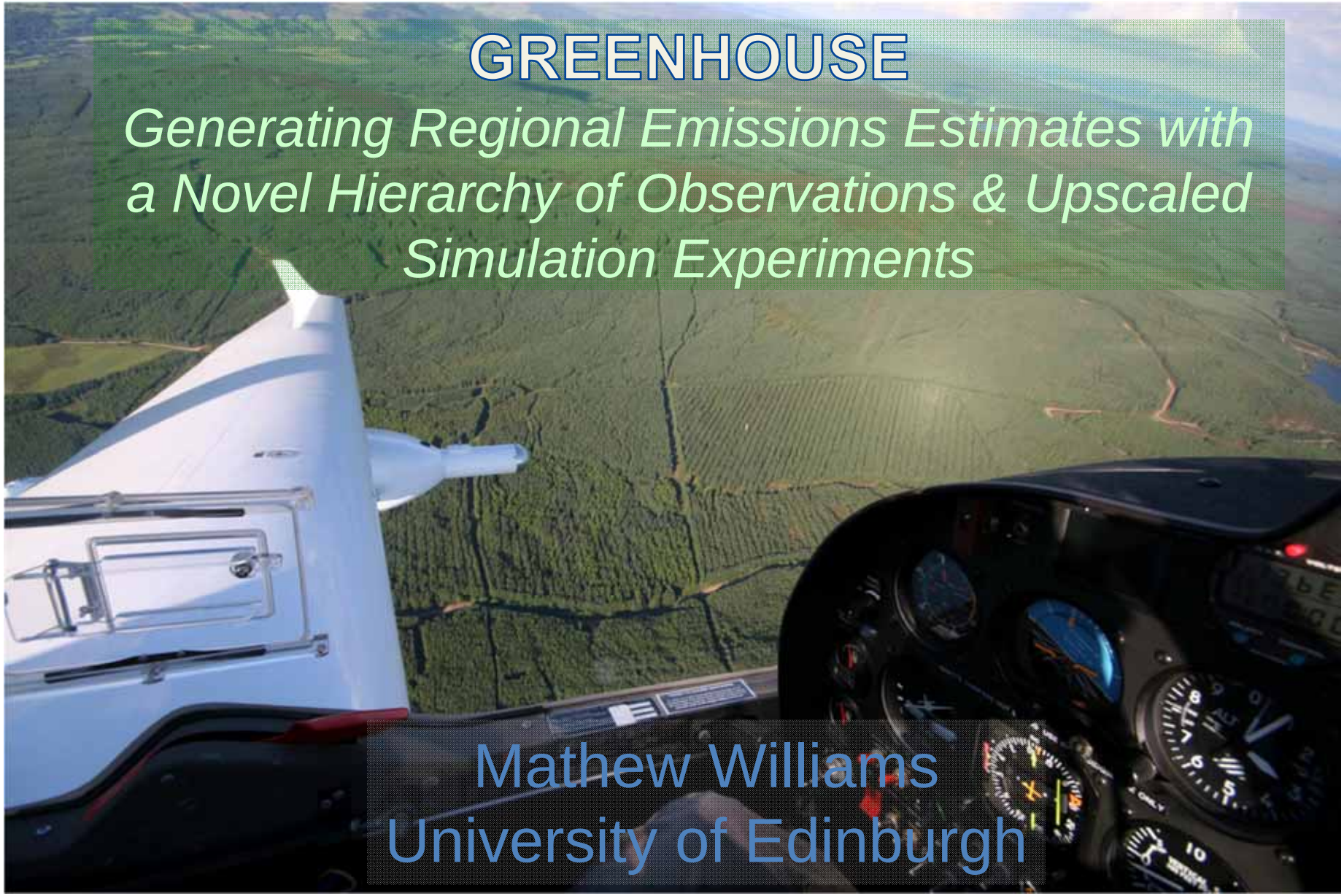


GREENHOUSE

Generating Regional Emissions Estimates with a Novel Hierarchy of Observations & Upscaled Simulation Experiments

Mathew Williams
University of Edinburgh

Challenges for quantifying UK biogenic GHG emissions

- Complex plant-soil-microbial interactions
- Land management effects
- Varied landscapes at field scale
- Uncertain process understanding in current models

NERC GHG Programme Aims

- "To develop the capability to **measure** and **predict** sources and sinks of the major anthropogenic greenhouse gases"
- "To integrate knowledge… to deliver improved resolution and accuracy in **estimates** and **predictions** of GHG sources and sinks for the UK, … and improve **modelling** of the feedbacks between climate and the major GHGs".

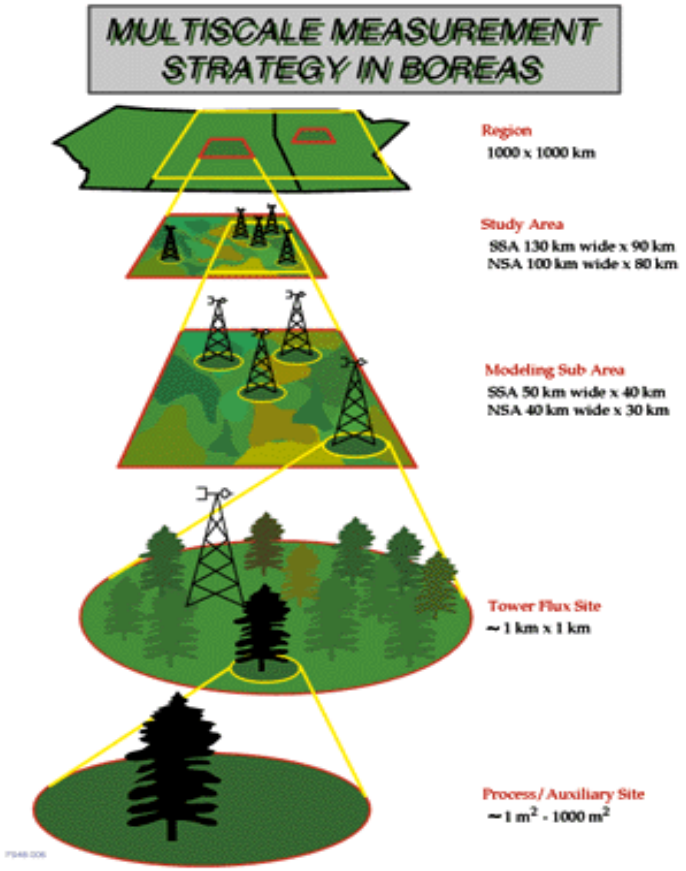
GREENHOUSE – terrestrial focus

- Over-arching goal:
  - To develop spatio-temporal upscaling frameworks for terrestrial GHG fluxes over dominant UK land-covers and land-uses
- Address process uncertainties:
  - How do terrestrial biogenic fluxes of GHGs in the UK vary in response to meteorological drivers, land use and management?
  - How does uncertainty of regional biogenic GHG flux estimates change as model complexity and scale are varied?

The wider context

Historical

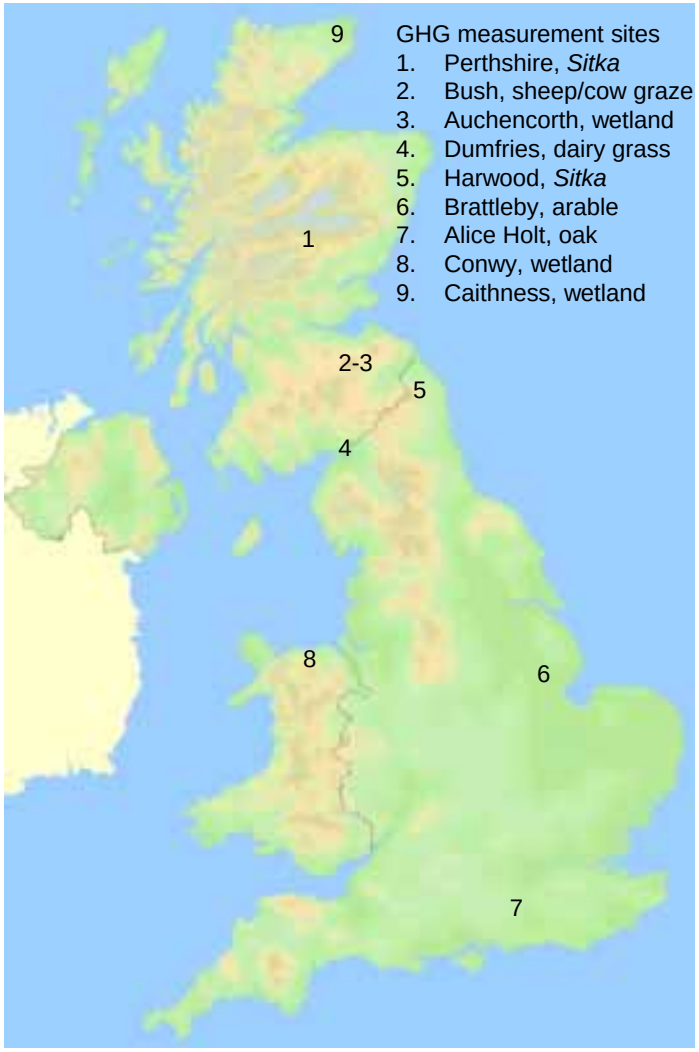
Current/Future



Deliverables: we will -

- Operate a hierarchy of observations in representative areas of the UK landscape
  - Assess up-scaling uncertainties related to fine scale heterogeneity
- Parameterise JULES and CTESSEL models for UK ecosystems
  - Evaluate model error
- Create a framework capable of reconciling the top-down, national-scale estimates of GHG fluxes with the bottom-up inventory and process modelling
- *Activity from April 2013 - March 2017*

Using long term measurements for temporal upscaling



GHG measurement sites
1. Perthshire, *Sitka*
2. Bush, sheep/cow graze
3. Auchencorth, wetland
4. Dumfries, dairy grass
5. Harwood, *Sitka*
6. Brattleby, arable
7. Alice Holt, oak
8. Conwy, wetland
9. Caithness, wetland

Quantum cascade lasers
Licor and Los Gatos CH_4 analysers

Auto chambers

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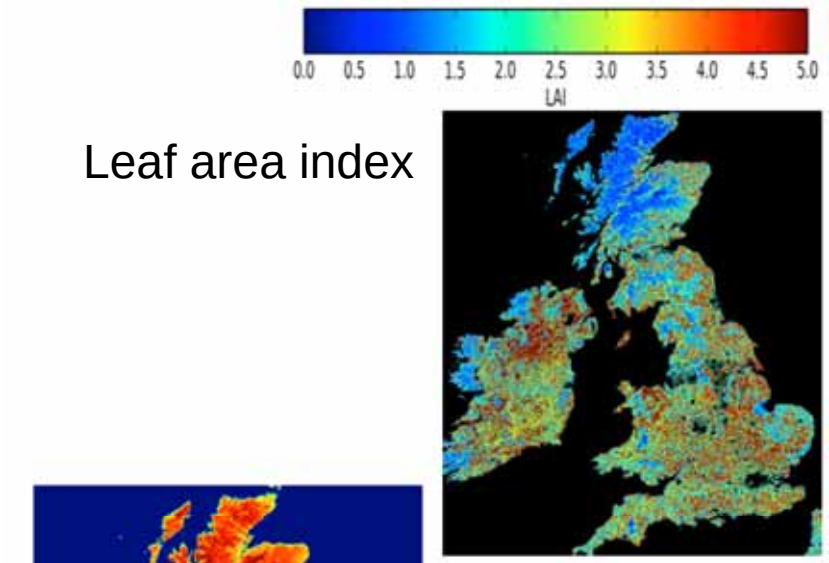
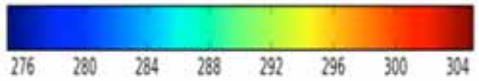
Using satellite and airborne data for spatial upscaling



Leaf area index

Land surface temperature



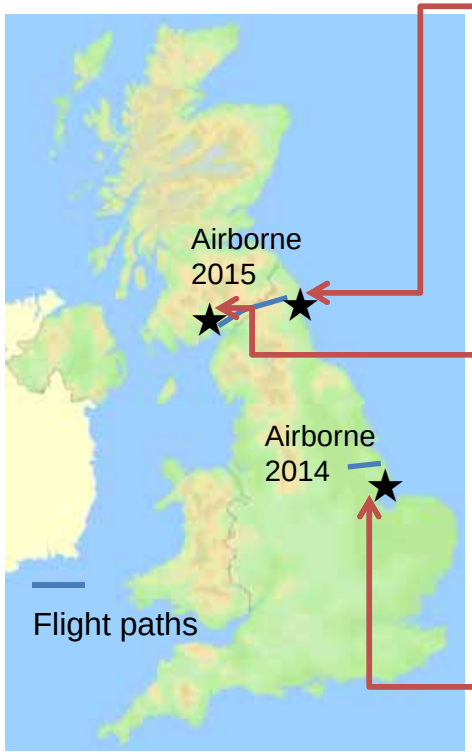
LST (K)

Multi-scale observational campaigns

Auto and manual chambers

Eddy covariance towers

Airborne fluxes & sampling



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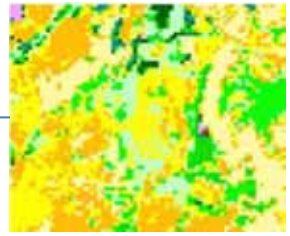
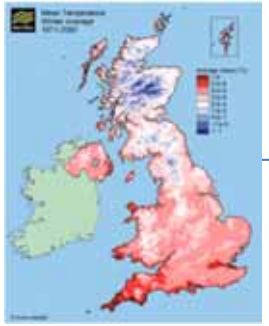
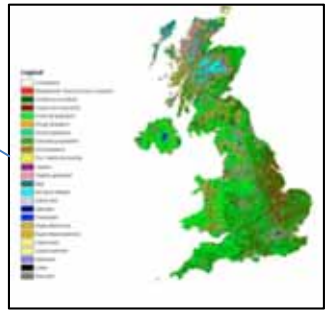
Upscaling



Soil sensor networks
aerial photos
ecological surveys
farm surveys
weather stations

Upscaling





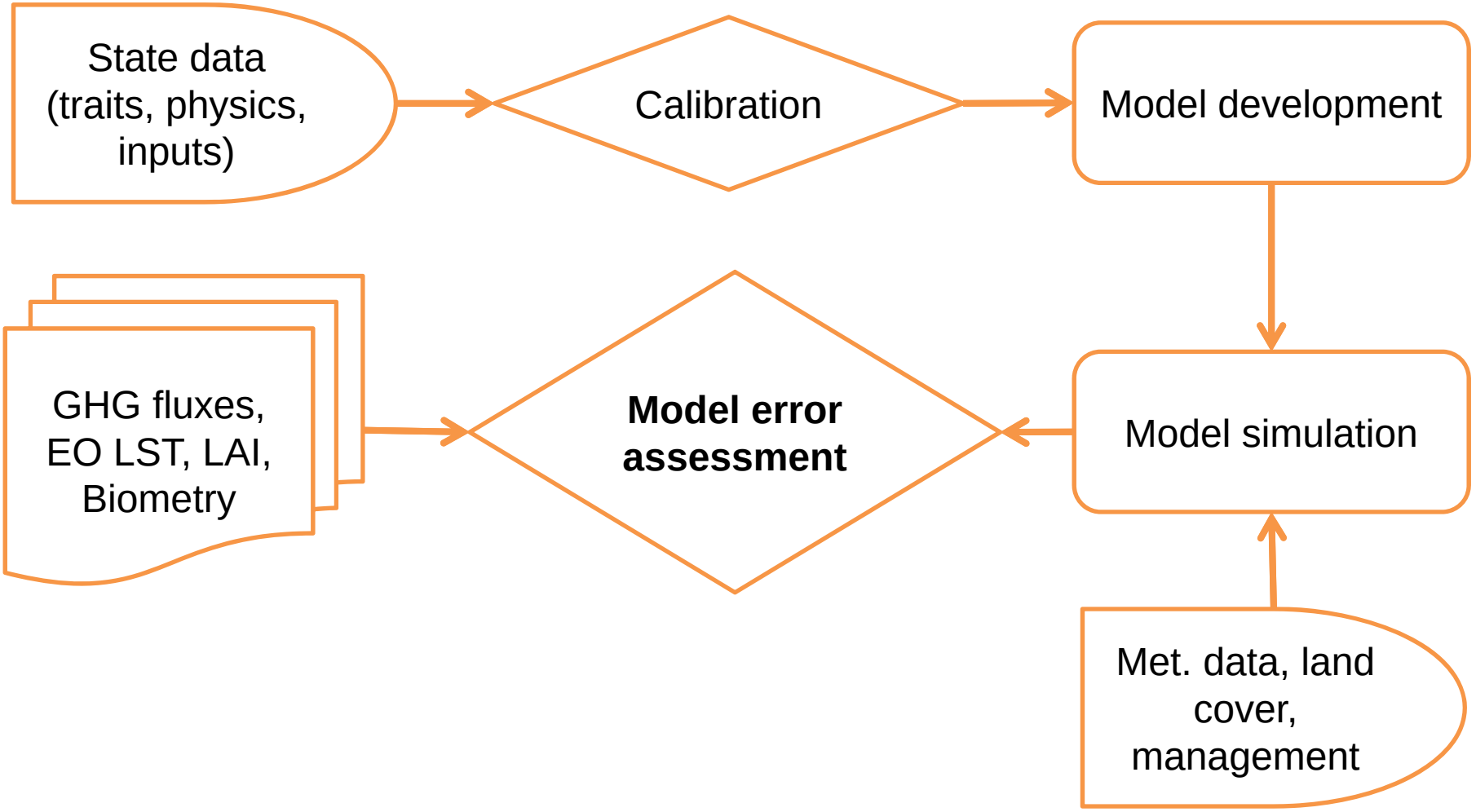
Satellite imagery
Land cover maps
Climate re-analyses

Linked to multi-scale environmental, ecological and management data...

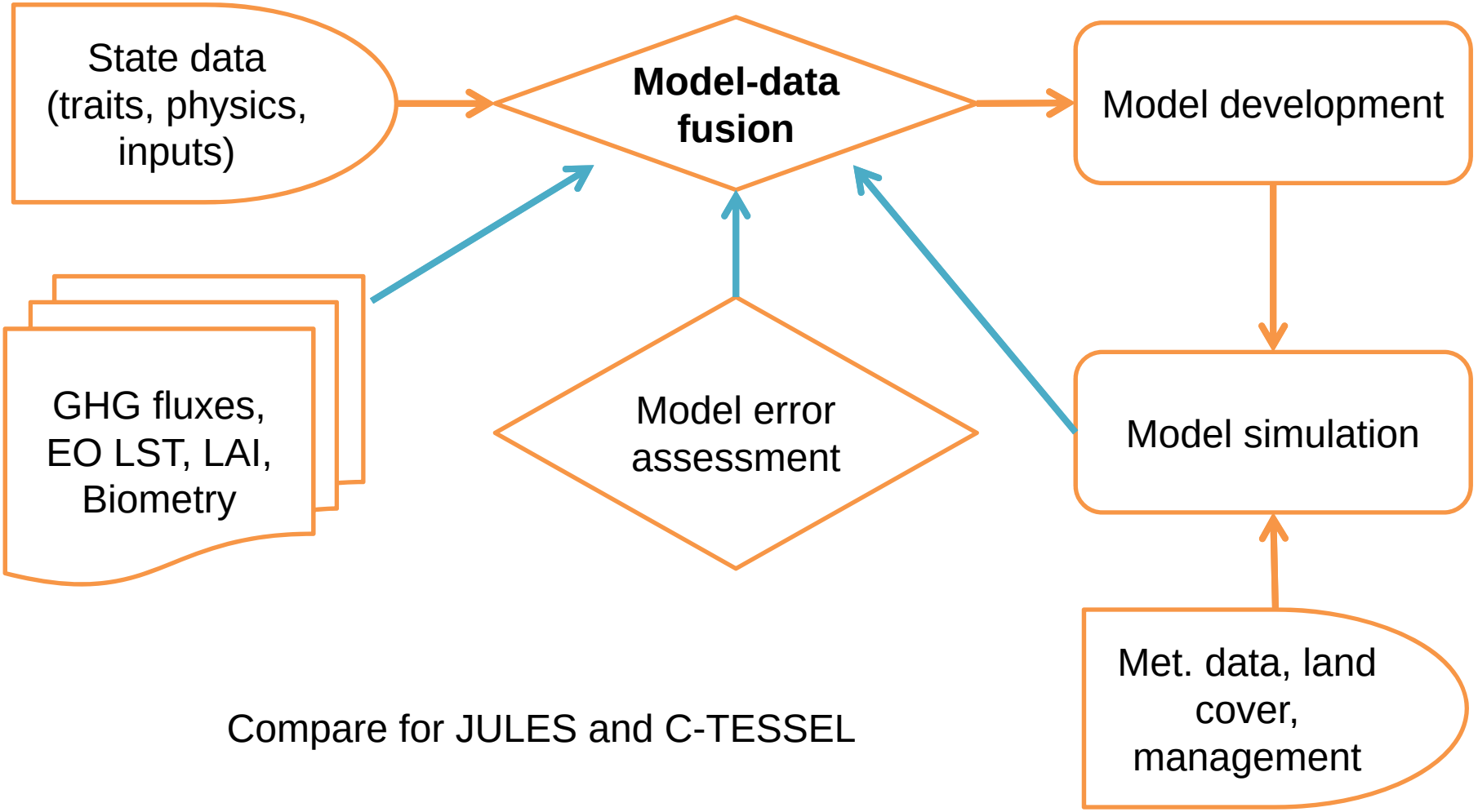
Inputs

We use data to calibrate models...

...to assess model error...

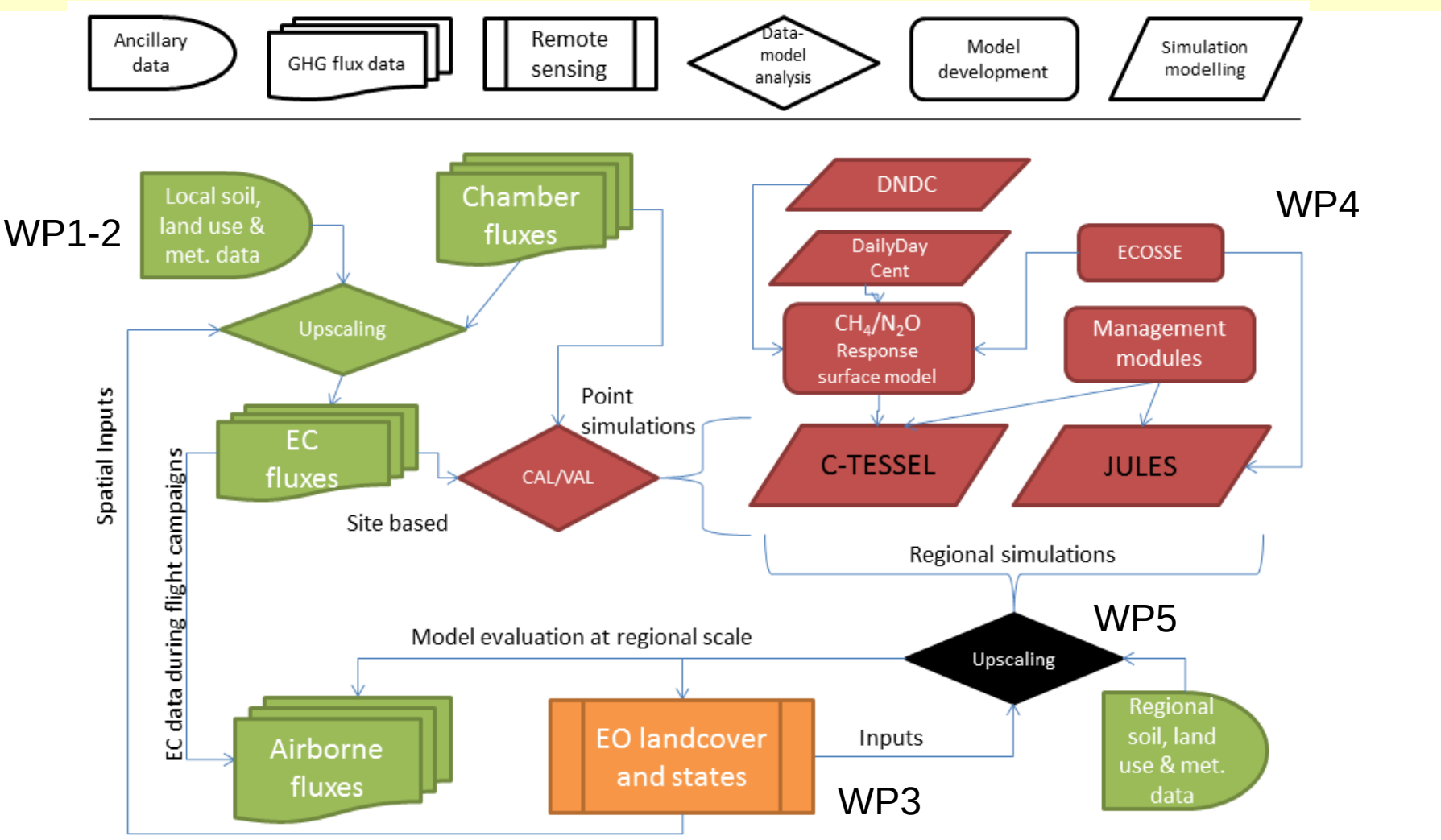


and to improve process representation



Compare for JULES and C-TESSEL

Project framework



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Stakeholder impact plan

- A framework for validating the UK GHG emissions inventory. We will report to DECC, Defra, and the DAs.
- Report to land managers on management links to GHG emissions (FC, SNH, SEPA, Natural England, AIC, UPM-Tilhill, RSPB, IUCN, CCC, ClimateXchange).
- Upgraded models for UK Met Office and ECMWF.
- Data contribution to ICOS, international activities.
- Presentations to local UK communities, website and social media.
- Activities with schools, presentation at Edinburgh International Science Fair (2016).

Any questions?







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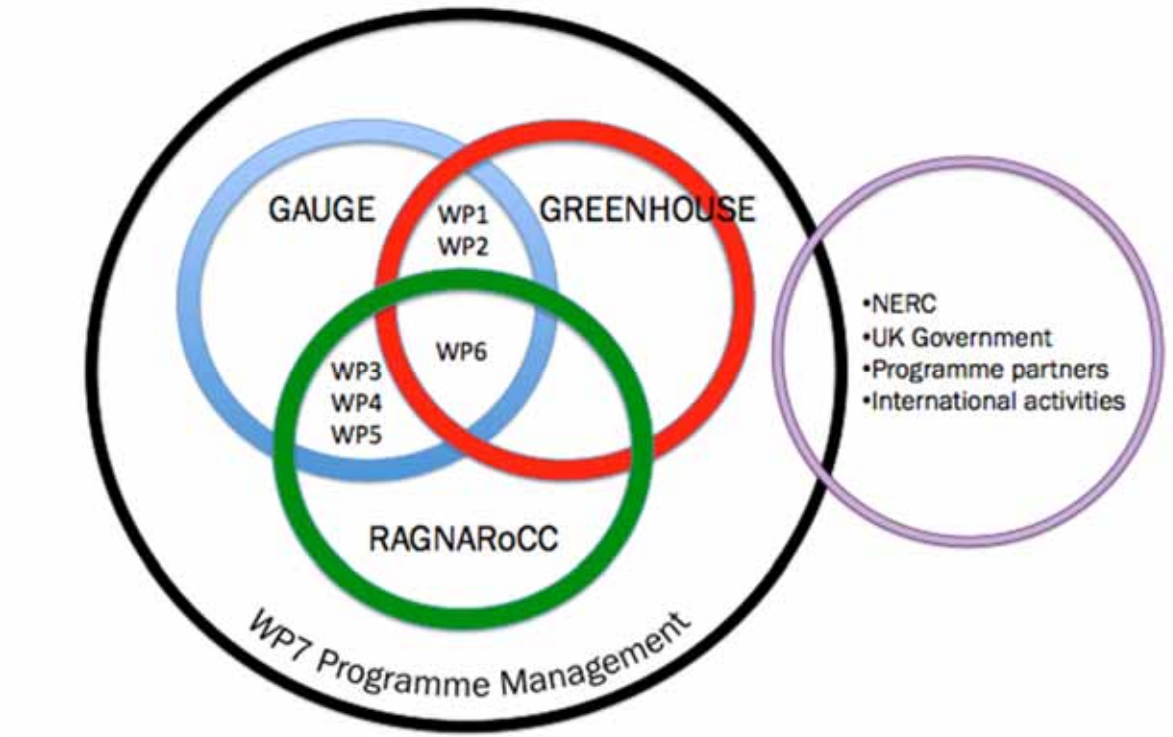
GHG: INTEGRATIVE ACTIVITIES



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Work packages

1. Terrestrial UK GHG emissions and uncertainties
2. Improved characterisation of UK emission Hotspots
3. Shelf seas: modelling and integration
4. Precision ship measurements of atmos. GHGs
5. Improving inverse estimates of UK and N Atlantic GHG fluxes
6. Summer school in GHG measurement and models
7. Project management