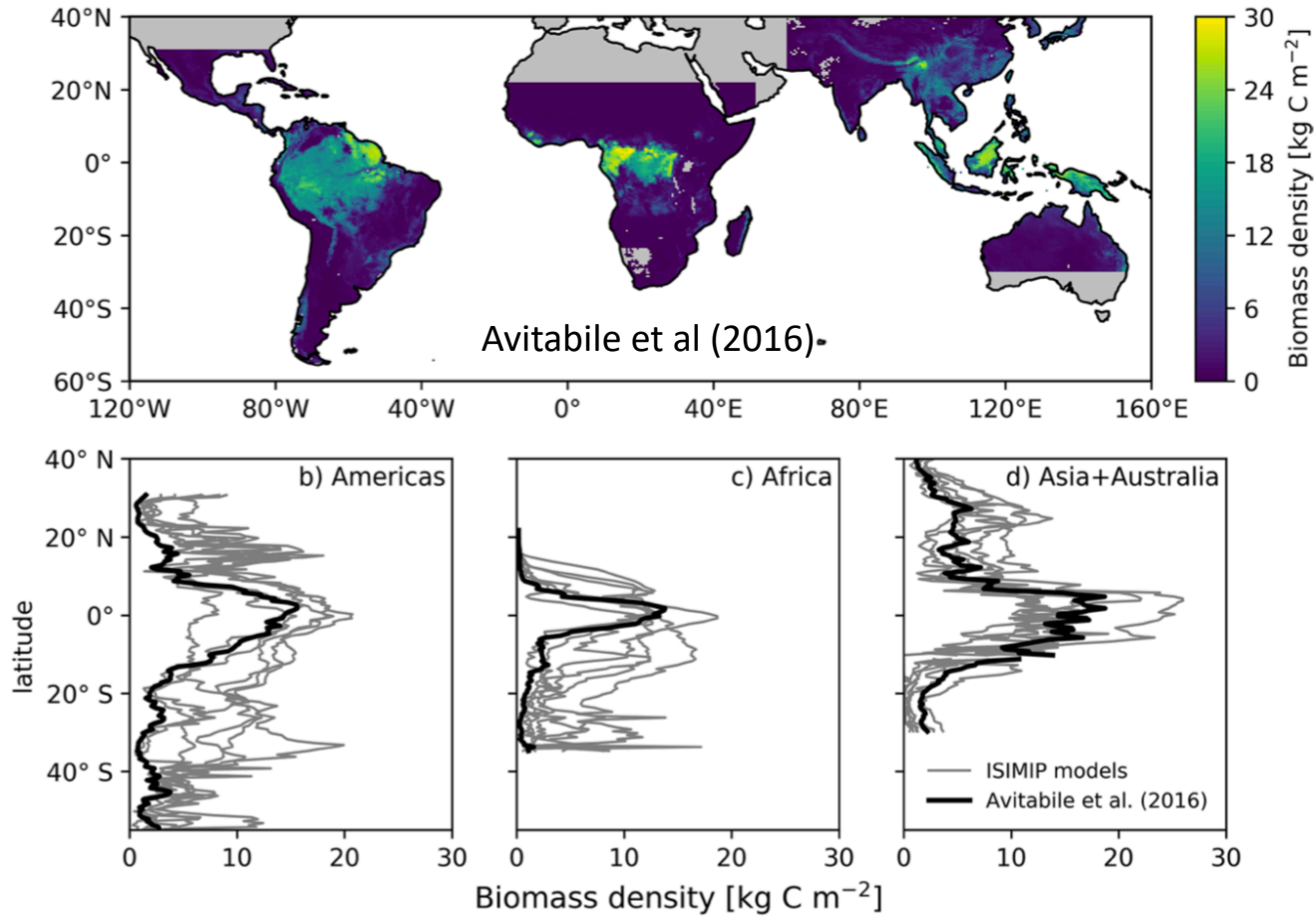# Brazilian C cycling

Luke Smallman

David Milodowski & Mathew Williams

University of Edinburgh and NCEO, Edinburgh, UK.

Why?

- Large carbon (C) store

- Large potential as both source and sink C

- Existing models disagree on Brazilian C cycling

Model biomass diverges from EO estimates
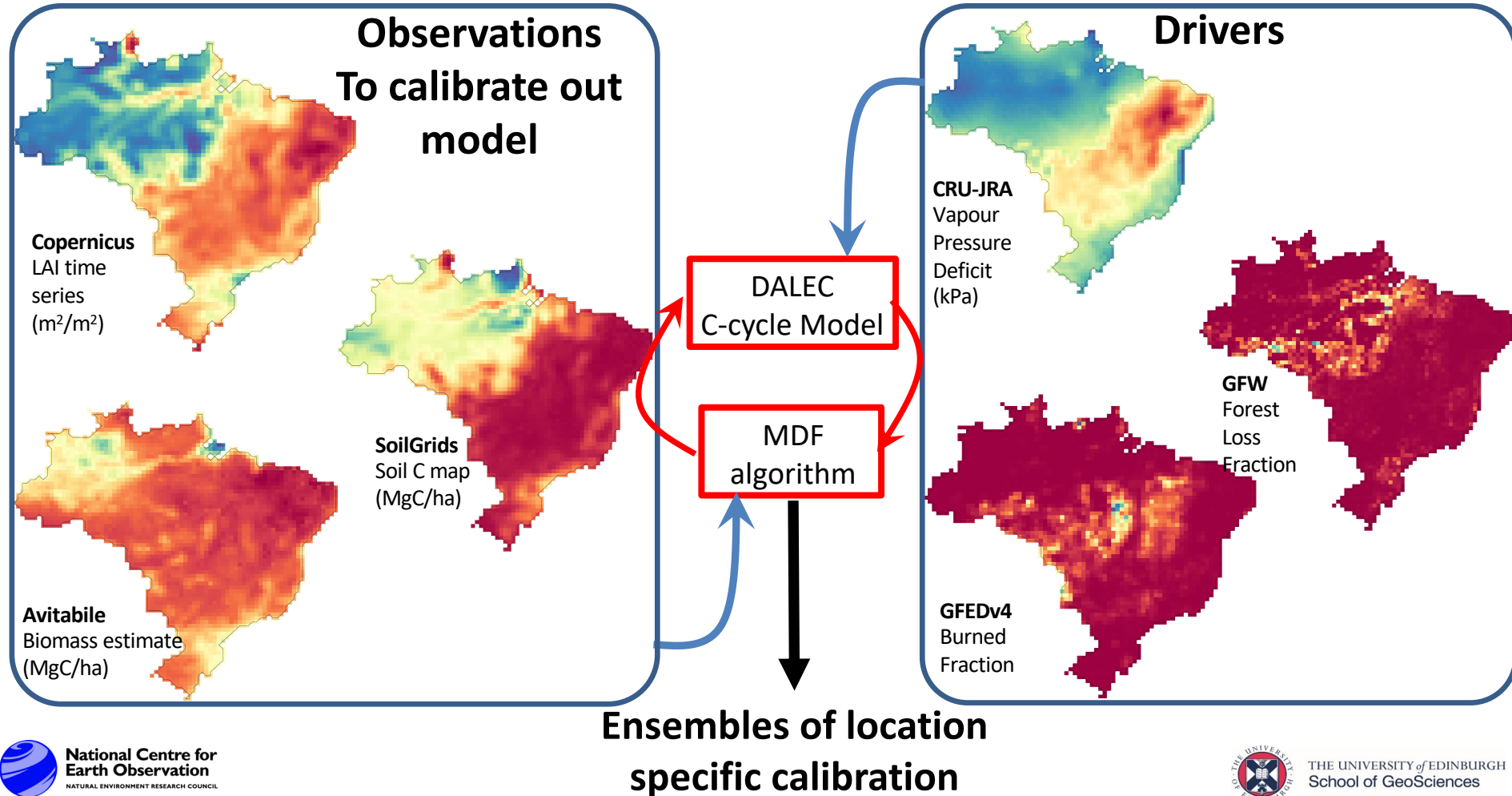

Avitabile et al (2016)

Exbrayat et al. 2019

Why?

- Large carbon (C) store

- Large potential as both source and sink C

- Existing models disagree on Brazilian C cycling

- Can we model the distribution and dynamics of major carbon pools across Brazil?
  - Climate sensitivity?
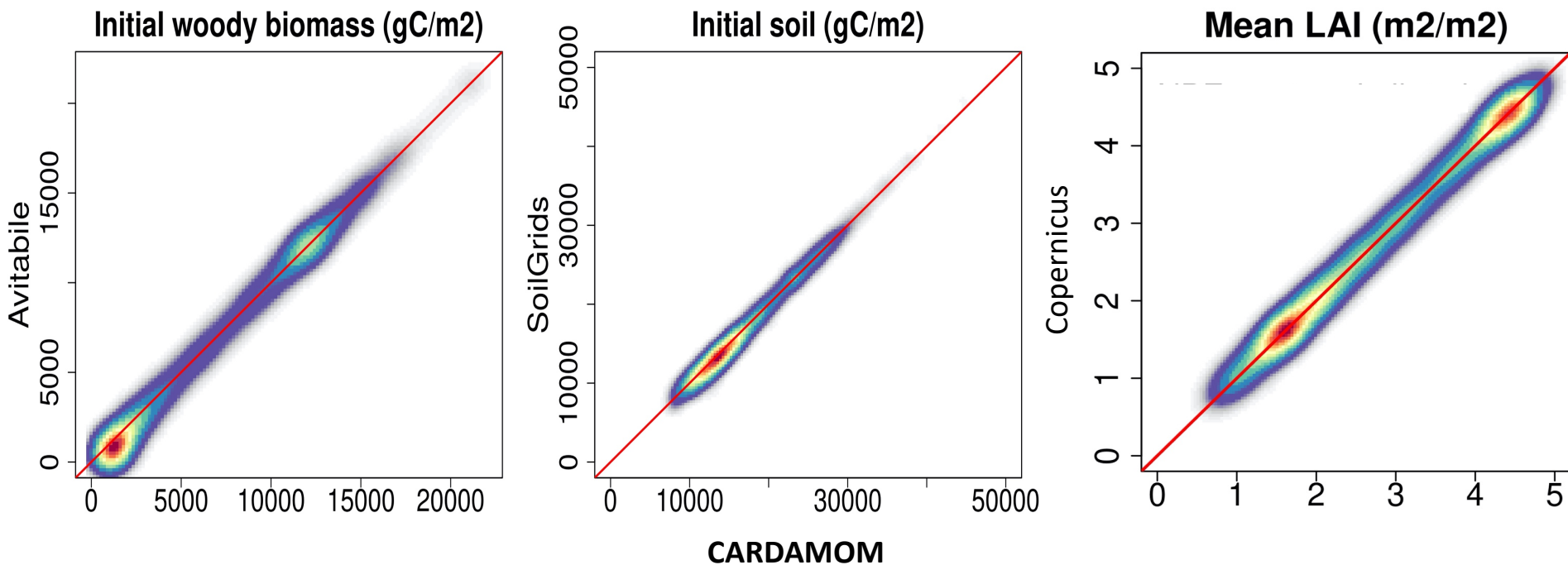 - Management effects
  - Disturbance, fire

Our solution

A model-data fusion framework to estimate ensembles of location specific parameters
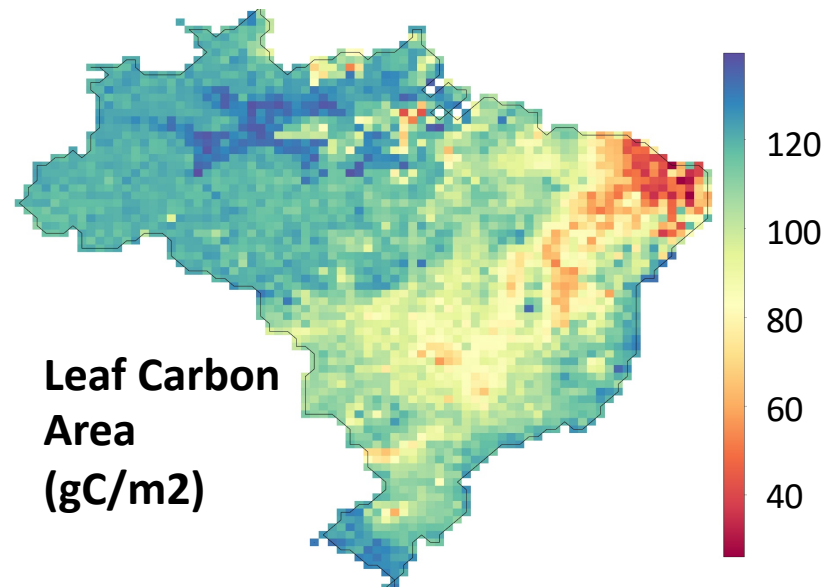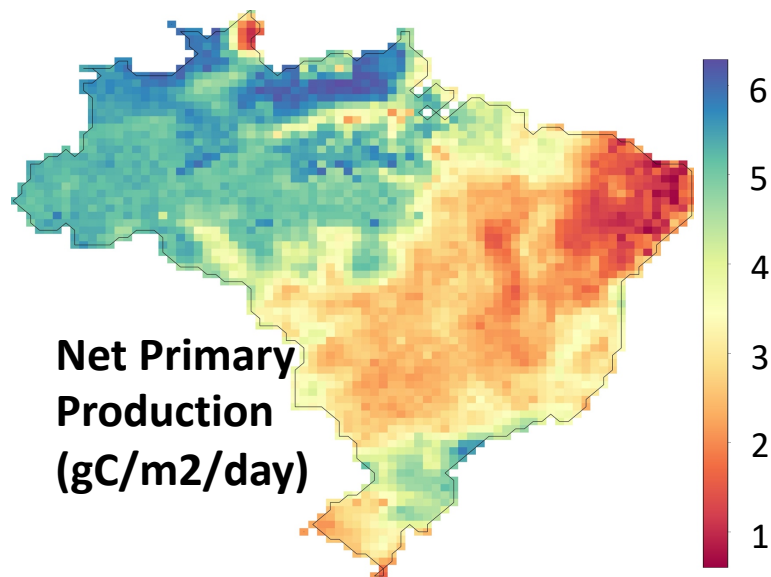
CARbon DAta MOdel fraMework (CARDAMOM)

Observations To calibrate out model

Copernicus
LAI time series (m²/m²)

SoilGrids
Soil C map (MgC/ha)

Avitabile
Biomass estimate (MgC/ha)

DALEC C-cycle Model

MDF algorithm

Drivers

CRU-JRA
Vapour Pressure Deficit (kPa)

GFW
Forest Loss Fraction

GFEDv4
Burned Fraction

Ensembles of location specific calibration

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

THE UNIVERSITY of EDINBURGH
School of GeoSciences

Comparison of CARDAMOM and assimilated observations

CARDAMOM ecosystem estimates
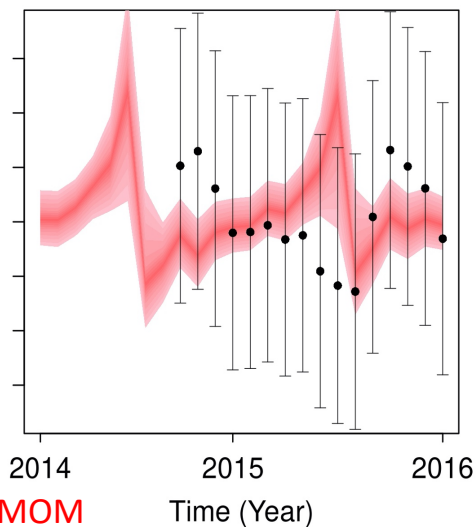

Net Primary Production (gC/m2/day)

Leaf Carbon Area (gC/m2)

Independent Validation

Against Net Biome Exchange of CO_2 estimated from atmospheric inversion

NBE Correlation

CARDAMOM
GeoChem
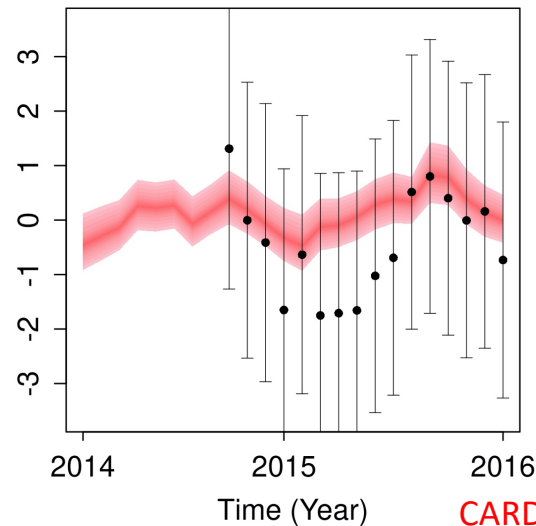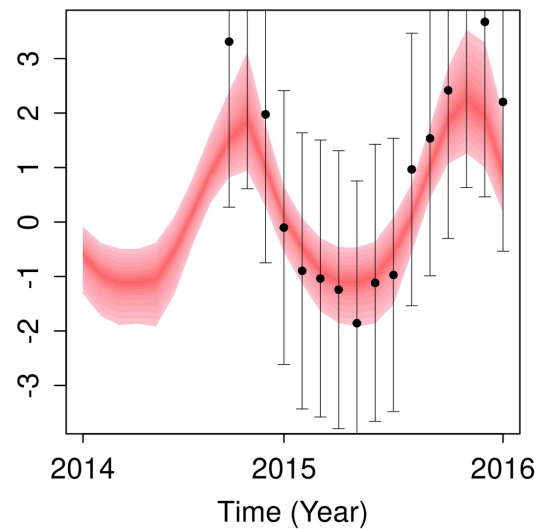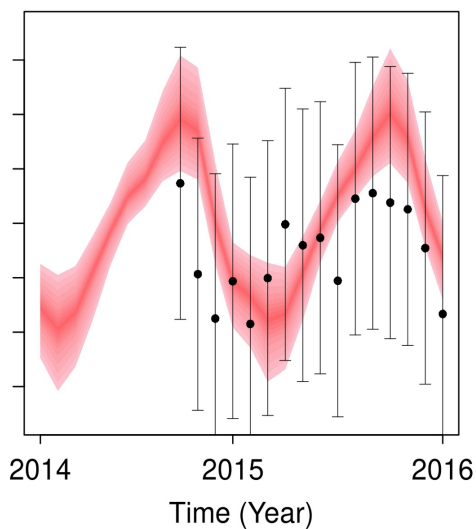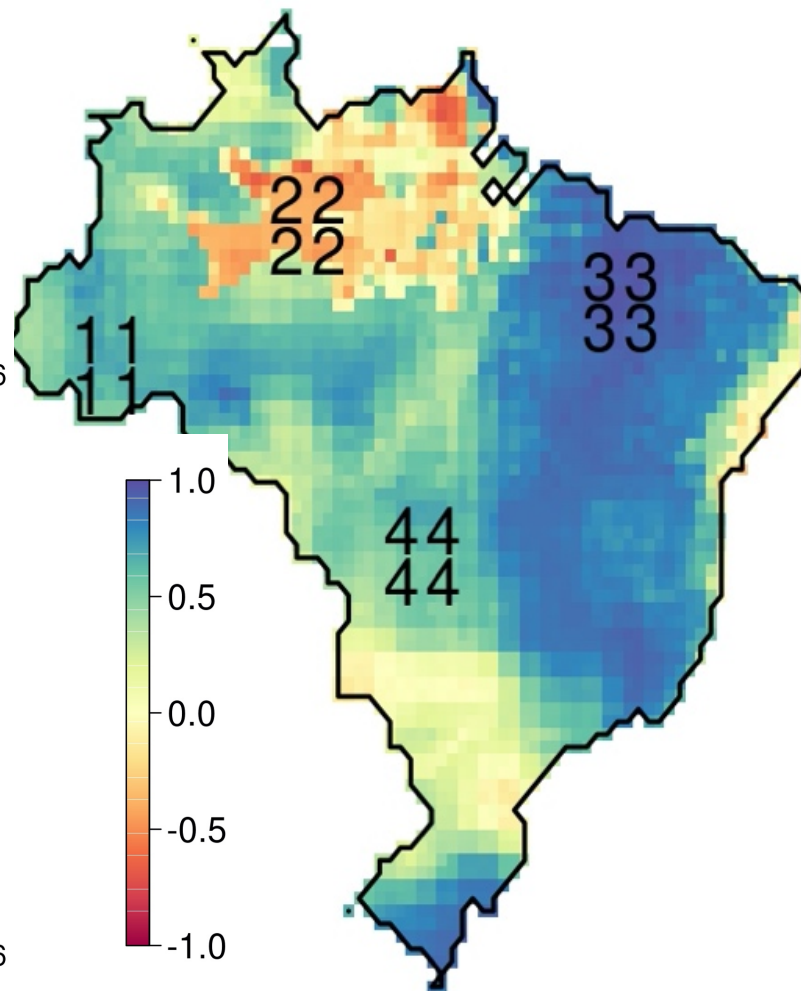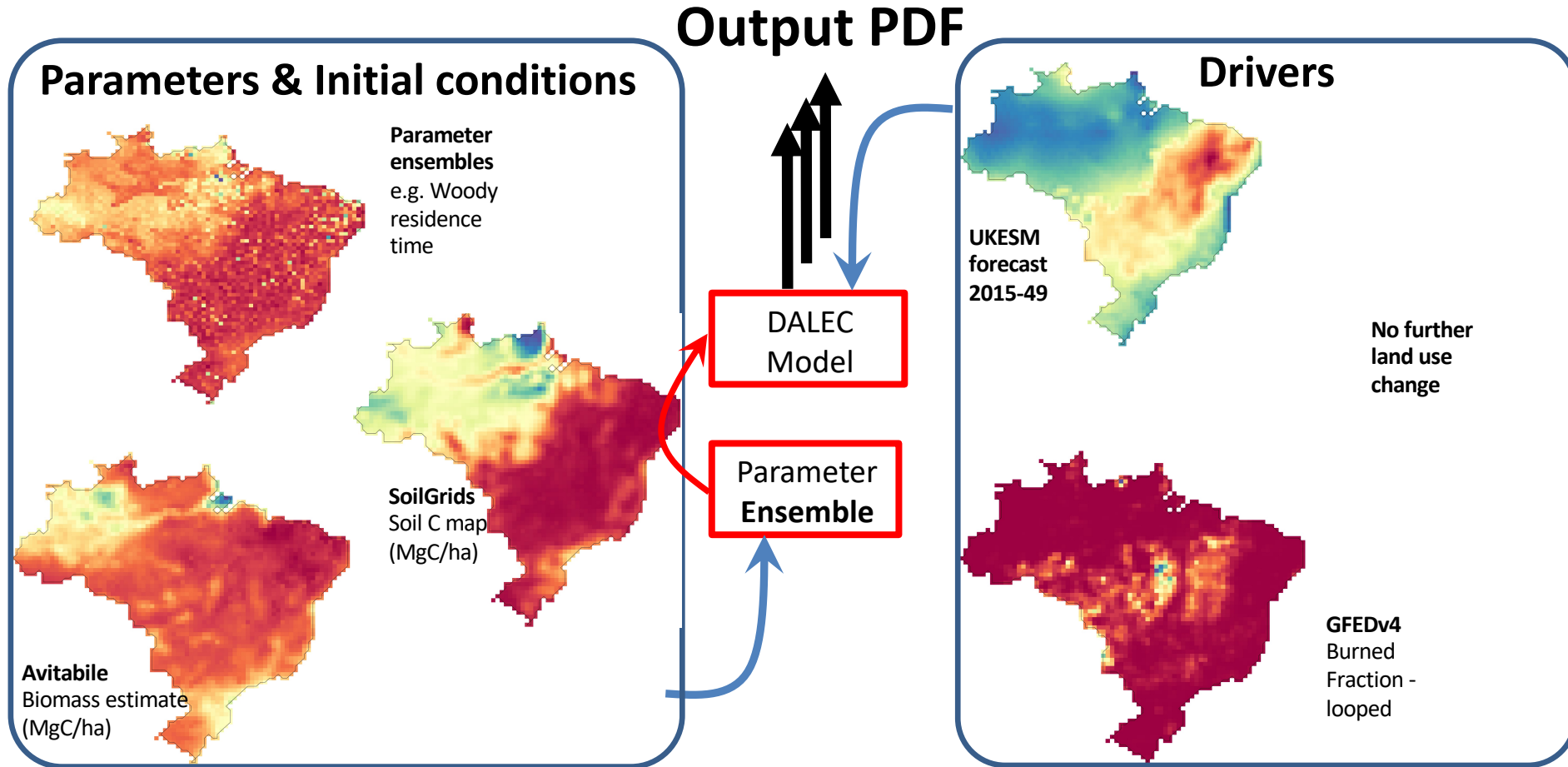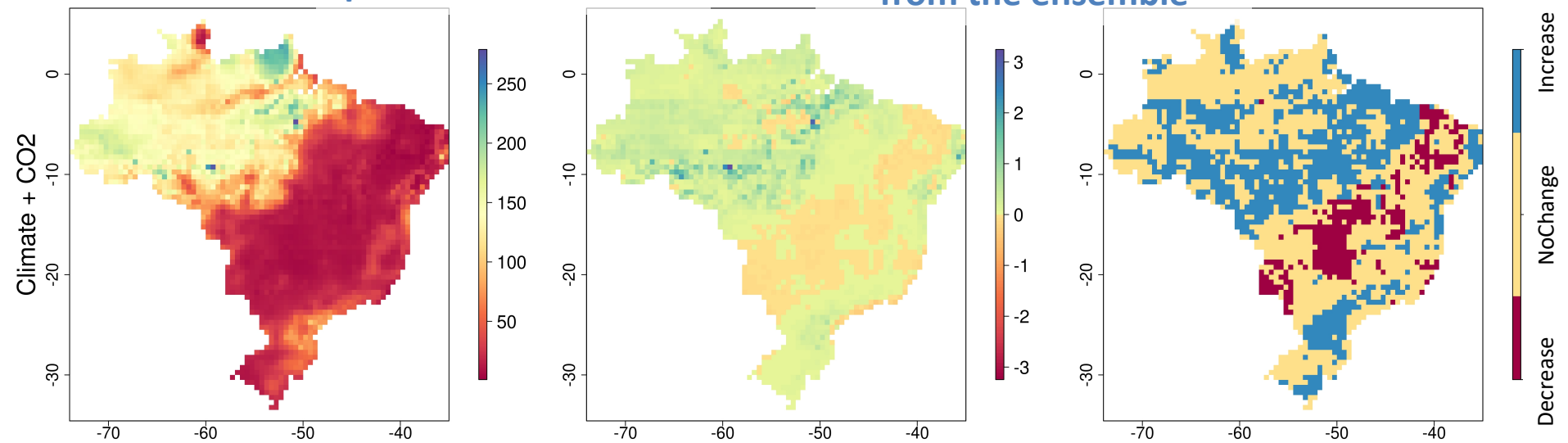
GEOSCHEM NBE estimates provided by Liang Feng

A data constrained future?

Simulating our constrained parameter ensembles to 2050 using CMIP6 drivers

Simulate DALEC parameter ensemble to 2050

Output PDF

Parameters & Initial conditions

Parameter ensembles e.g. Woody residence time

SoilGrids Soil C map (MgC/ha)

Avitabile Biomass estimate (MgC/ha)

DALEC Model

Parameter **Ensemble**

Drivers

UKESM forecast 2015-49

No further land use change

GFEDv4 Burned Fraction - looped

National Centre for Earth Observation NATURAL ENVIRONMENT RESEARCH COUNCIL

THE UNIVERSITY of EDINBURGH School of GeoSciences

Wood stock 2050 (MgC ha^{-1}) | Wood increment 2050 (MgC ha^{-1} yr^{-1}) | Wood increment significance

Climate only (row label)

Climate + CO2 (row label)

Median estimate of parameter ensemble

At 50% CI drawn directly from the ensemble
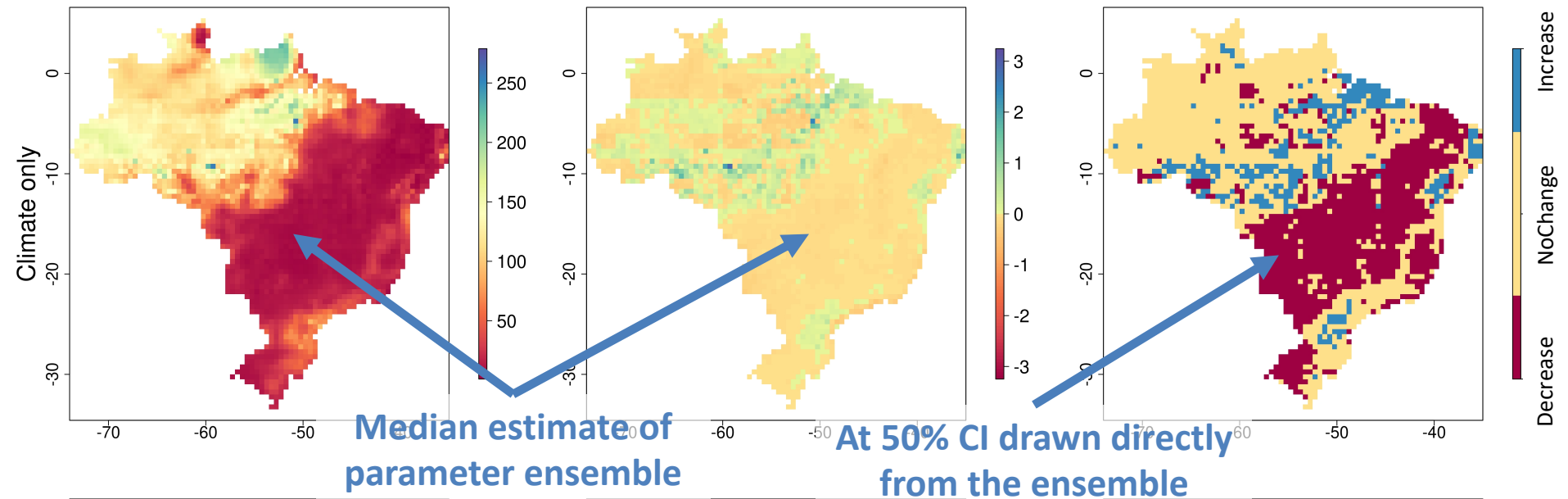
Next steps?

- Current system only includes water stress implicitly through vapour pressure deficit

- We will run regional analyses using our new coupled C & H_2O model

- Conduct disturbance scenarios – ISIMIP / CMIP6

Thanks you
&
Questions?