Land surface modelling for ACCESS in Australia

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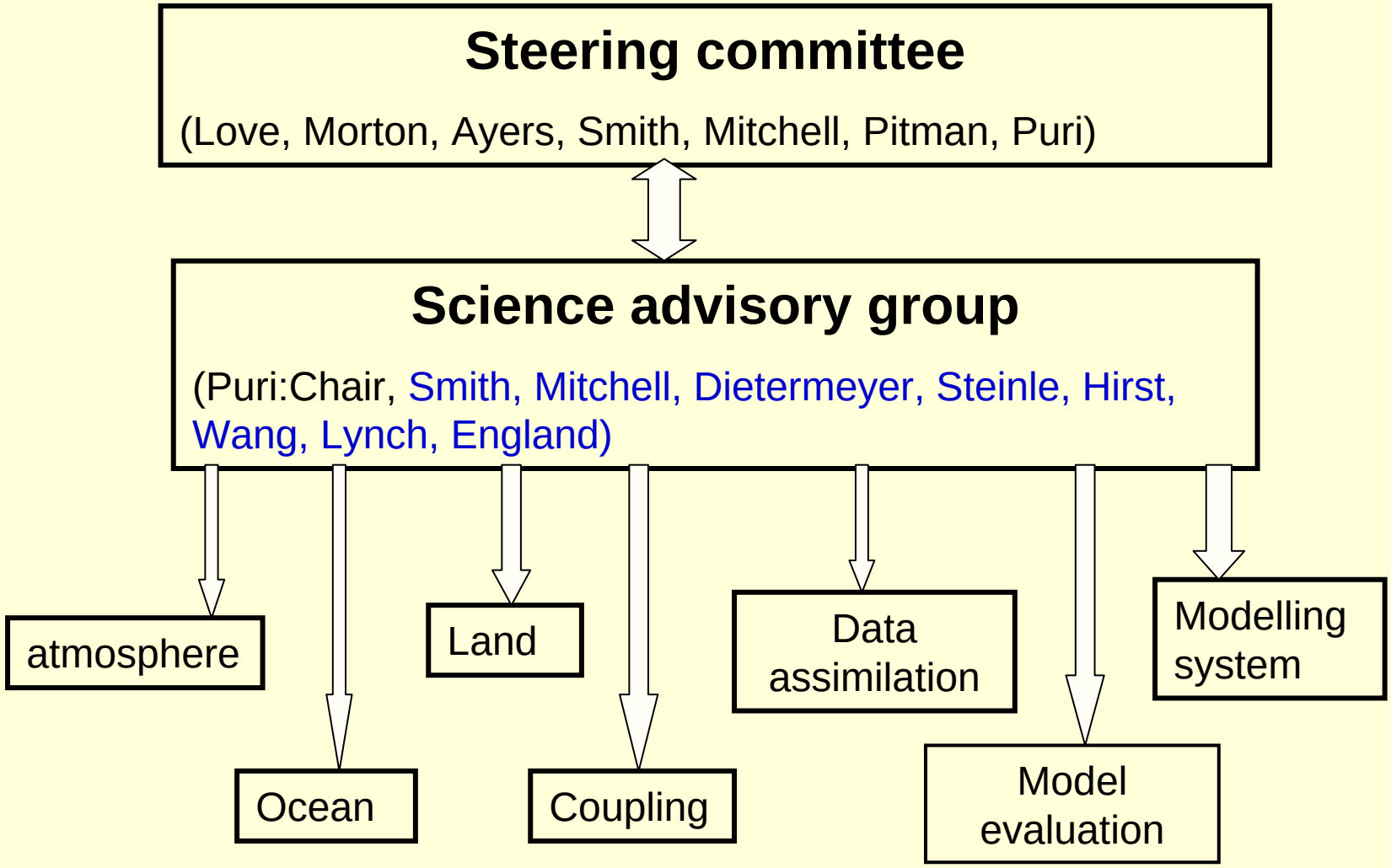
ACCESS

- **The Australian Community Earth-System Simulator;**
- **It is based on HADGEM 1 that was imported to Australia last year;**
- **Modifications will be made to nearly all components of the model by BoM and CSIRO scientists;**
- **We shall use JULES framework for developing and testing our LSM.**

ACCESS – Operational structure



The LSM team

Yingping Wang (Team leader)

- Seven staff members from CSIRO
- One from the Bureau of Meteorology
- With strong connection to universities through ARC-earth system science network led by Andy Pitman
- We want to an effective collaborator on JULES

Current efforts in ACCESS

- A full biogeochemical model (C, N and P cycles)
- River routing and land surface model for NWP
- A systematic model calibration framework
- Passive tracers: CO2, O2 and isotopes
- Fire and disturbance

Key science issues:

- feedbacks at different time scales;
- Improving the understanding of underlying processes, such as
  - role of soil P: important for Australian terrestrial biosphere;
  - nutrient competition and vegetation dynamics;
- model calibration: synthesis of observations at different time and spatial scales.

Our plan (2006-2011)

- By June 2007
  - Implementing CABLE to HADGAM
  - First version of plant phenology, growth and death
  - A modeling framework
- By June 2008
  - Global model of biogeochemical cycle of C, N and P
  - Soil hydrology and river routing assessed by 2008
  - Calibrate the terrestrial C cycle
- By June 2009
  - Parameter estimated for C,N P cycle
  - Modify the soil hydrology if necessary
  - Couple terrestrial C and marine C cycle and calibrate
- By June 2010
  - Couple all with HADGAM and obtain the initial C, N and P pool sizes

Progress so far

- Going through the HADGAM, particularly the coupling of land surface model;
- A preliminary version of global phenology, growth and death is being developed;
- A version of global biogeochemical model of C and N cycle has been developed; P cycle will be added soon;
- We are about 4-6 months behind.

Major technical issues encountered

- Global soil P amount data are not available;
- Phenology of subtropical and tropical biomes is difficult to model;
- Coupling components with systematic errors and lack of global estimates of some key model parameters;
- How to utilize the resources in the universities.

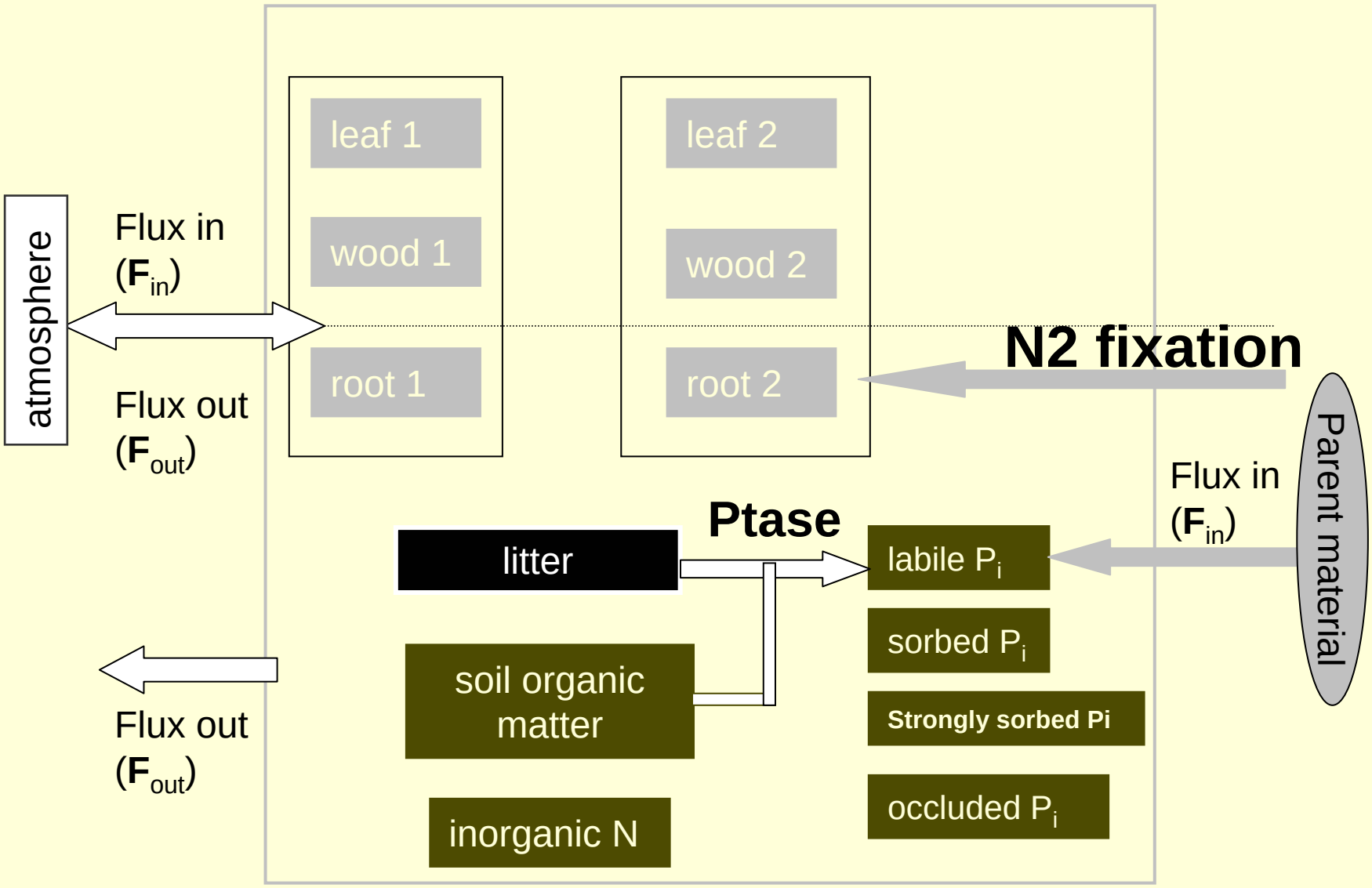
In addition

- Very tight timeline and inadequate resources

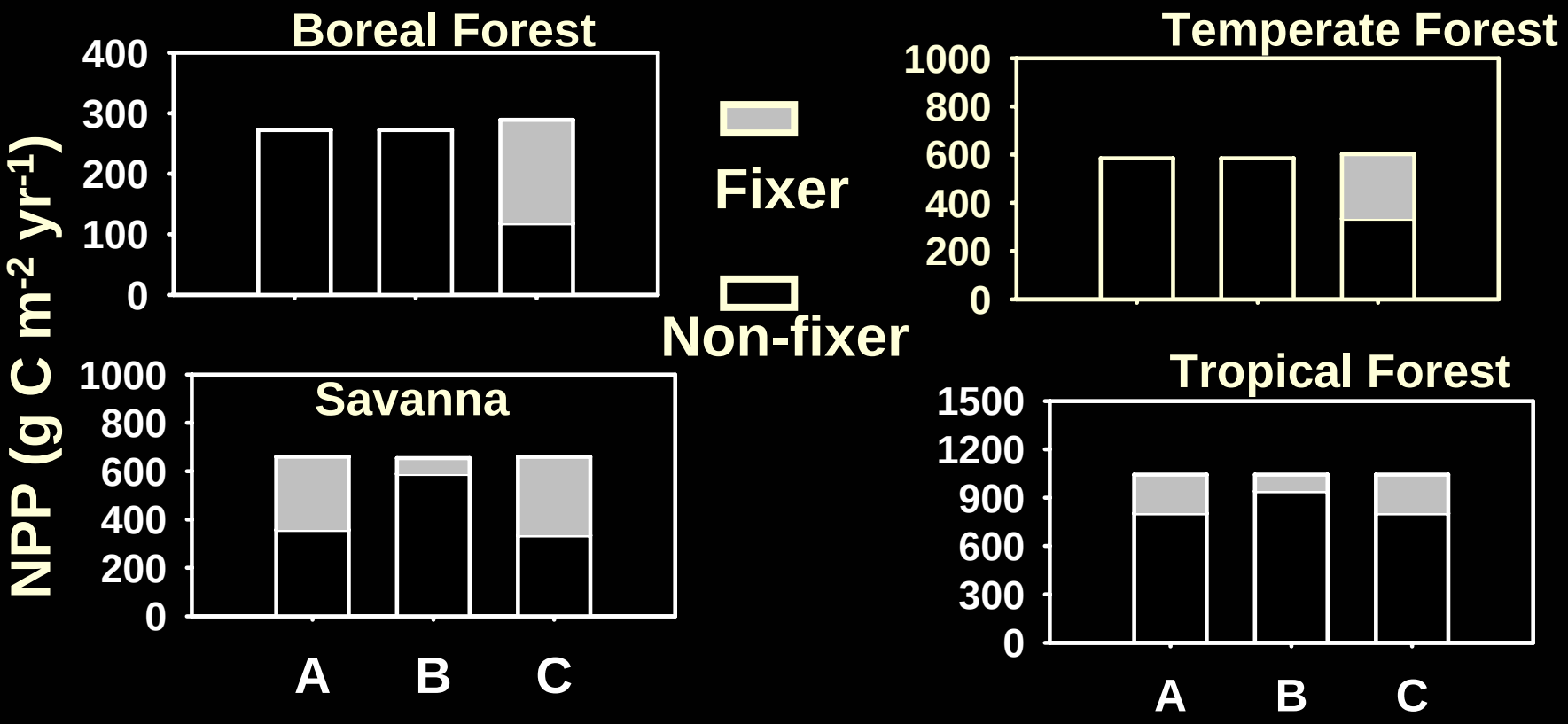
Phenology model

- We use the global phenology model of Botta et al. and Krinner et al.
- Model was calibrated using the estimates from MODIS satellite measurements.
- Phenology of biomes north of 45^{o} is well modelled; BUT
- Phenology of tropical and subtropical biomes are poorly predicted.

The model: CASACNP



Simulation Results

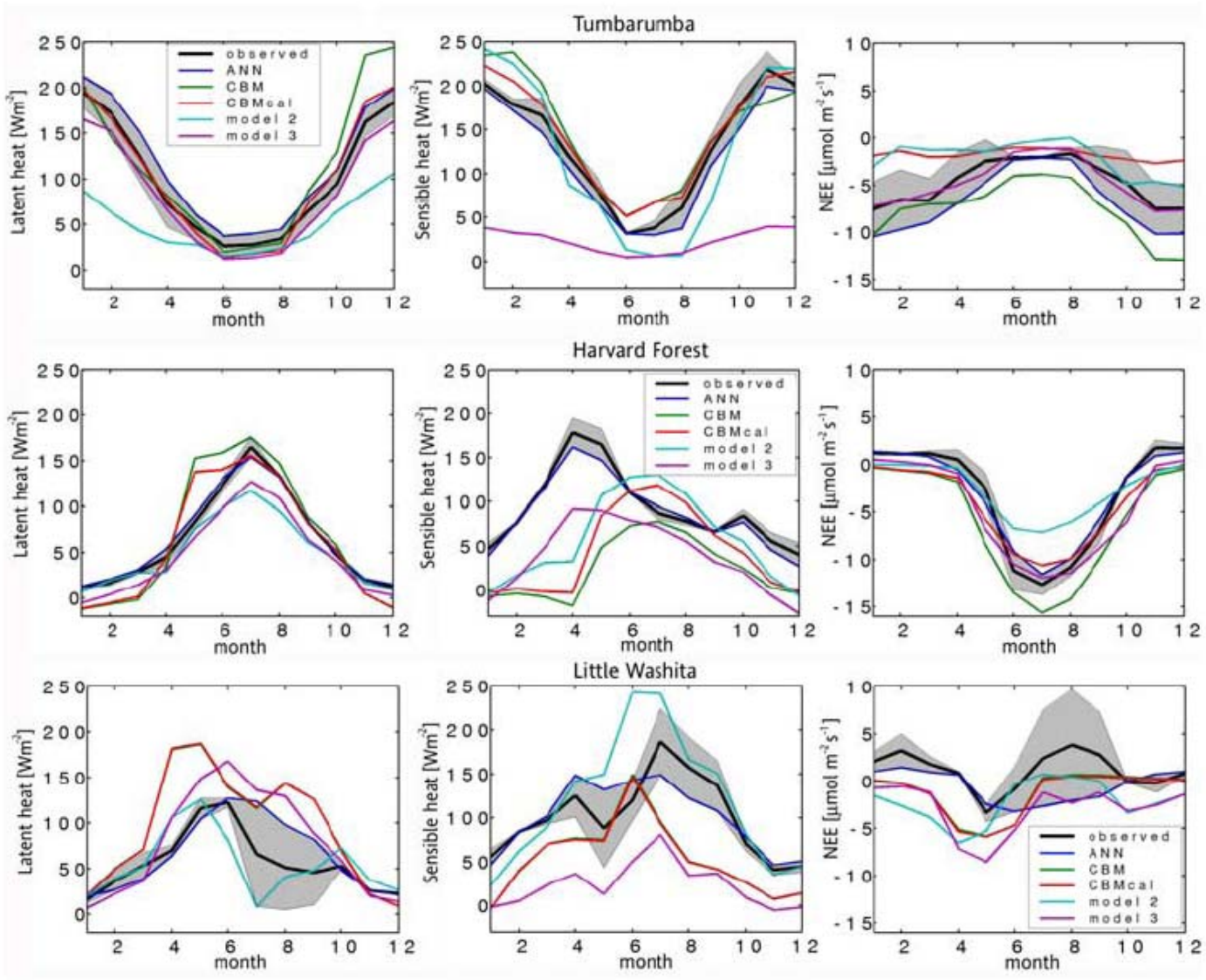


Simulation	N fixation varies with soil temp	Labile P from phosphatase shared
A	Yes	No
B	Yes	Yes
C	No	No

Calibration strategy

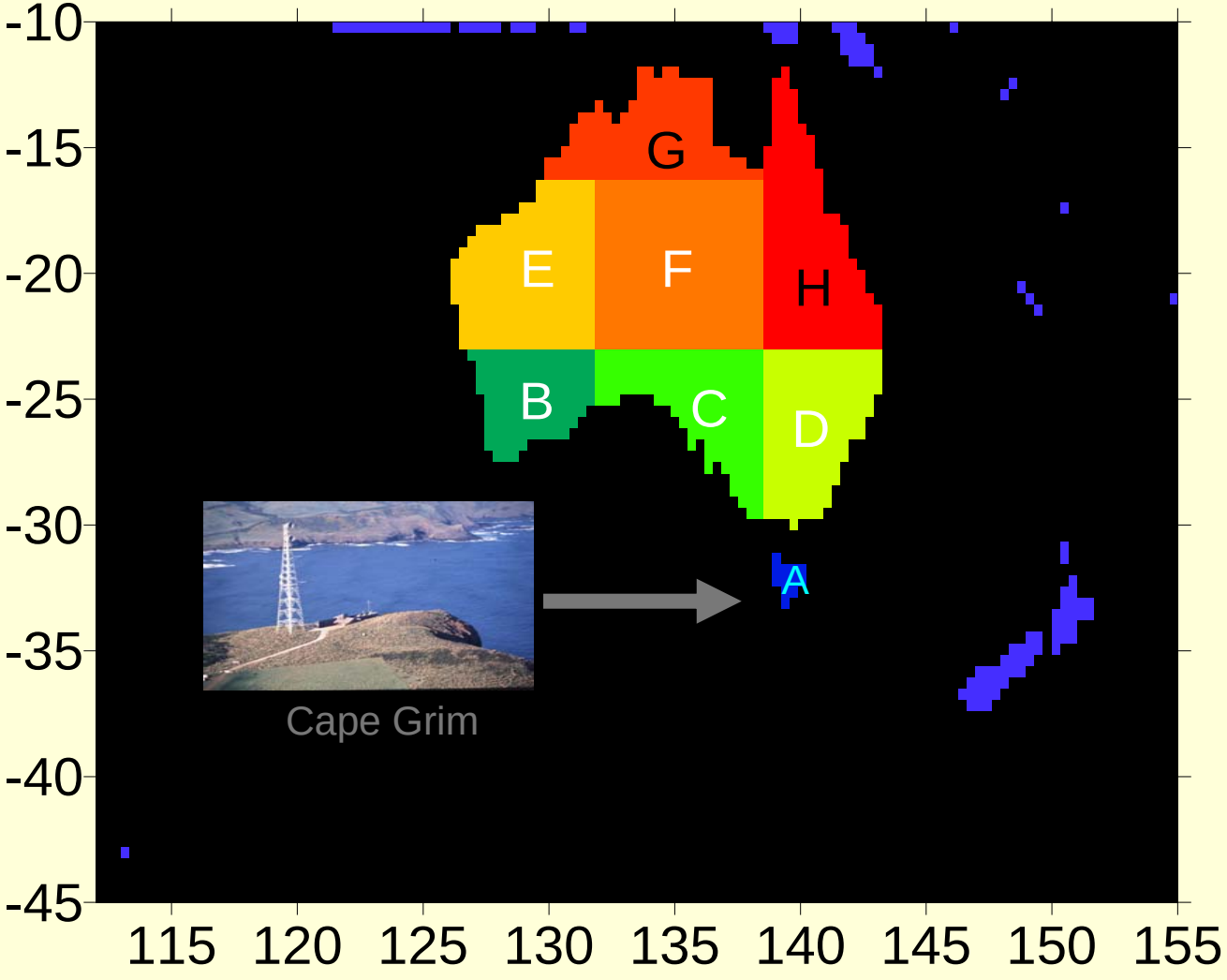
- Flux module (CABLE): using eddy flux data
- Biogeochemistry: using site and regional data
- Phenology: using global dataset
- All above together are calibrated using atmospheric CO2 concentration and isotope measurements, Global calibration using multiple tracers is important.
- Dynamic vegetation model??

How good are our land surface models?



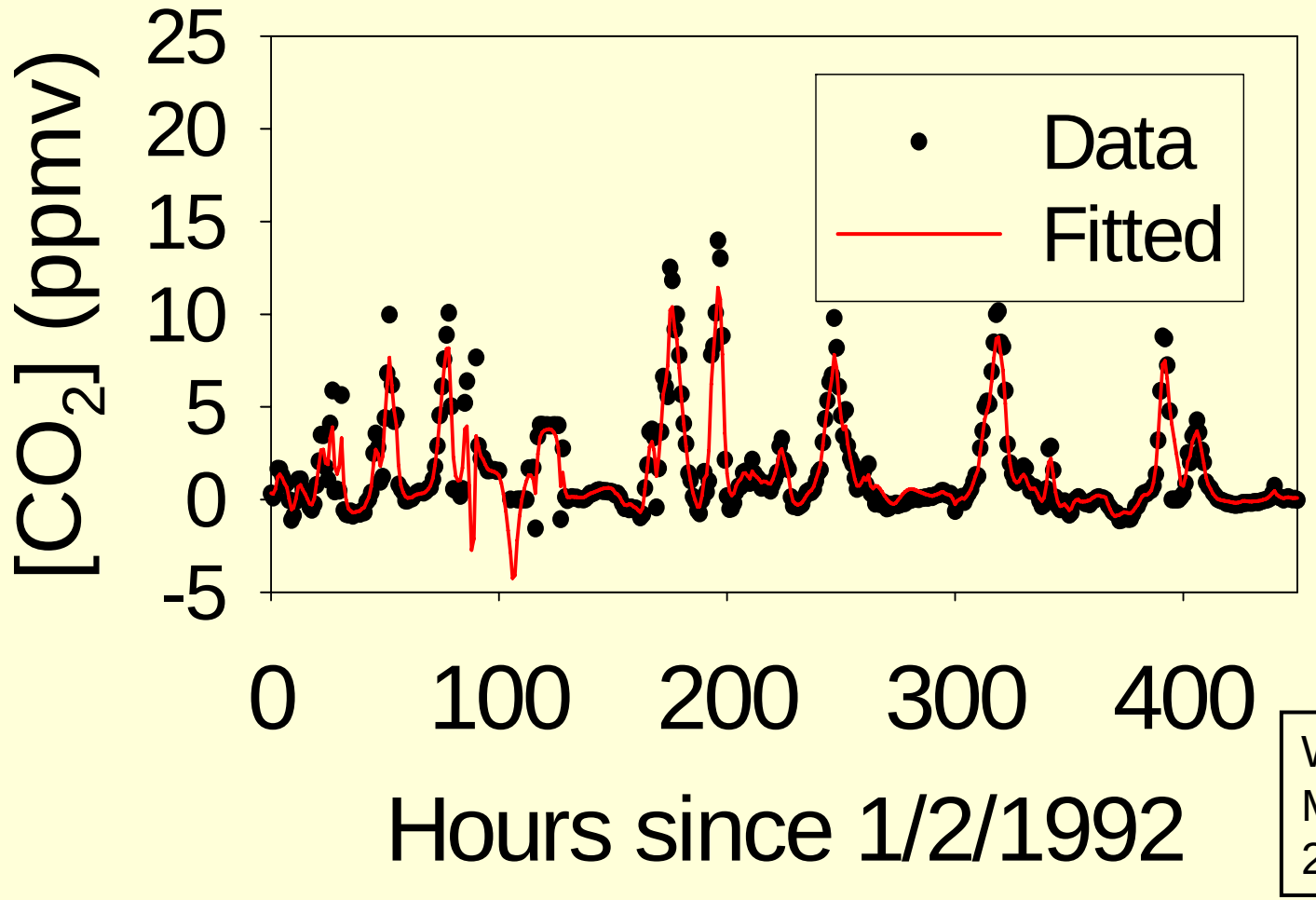
Abramowitz 2005

Domain of the transport model (DARLAM)



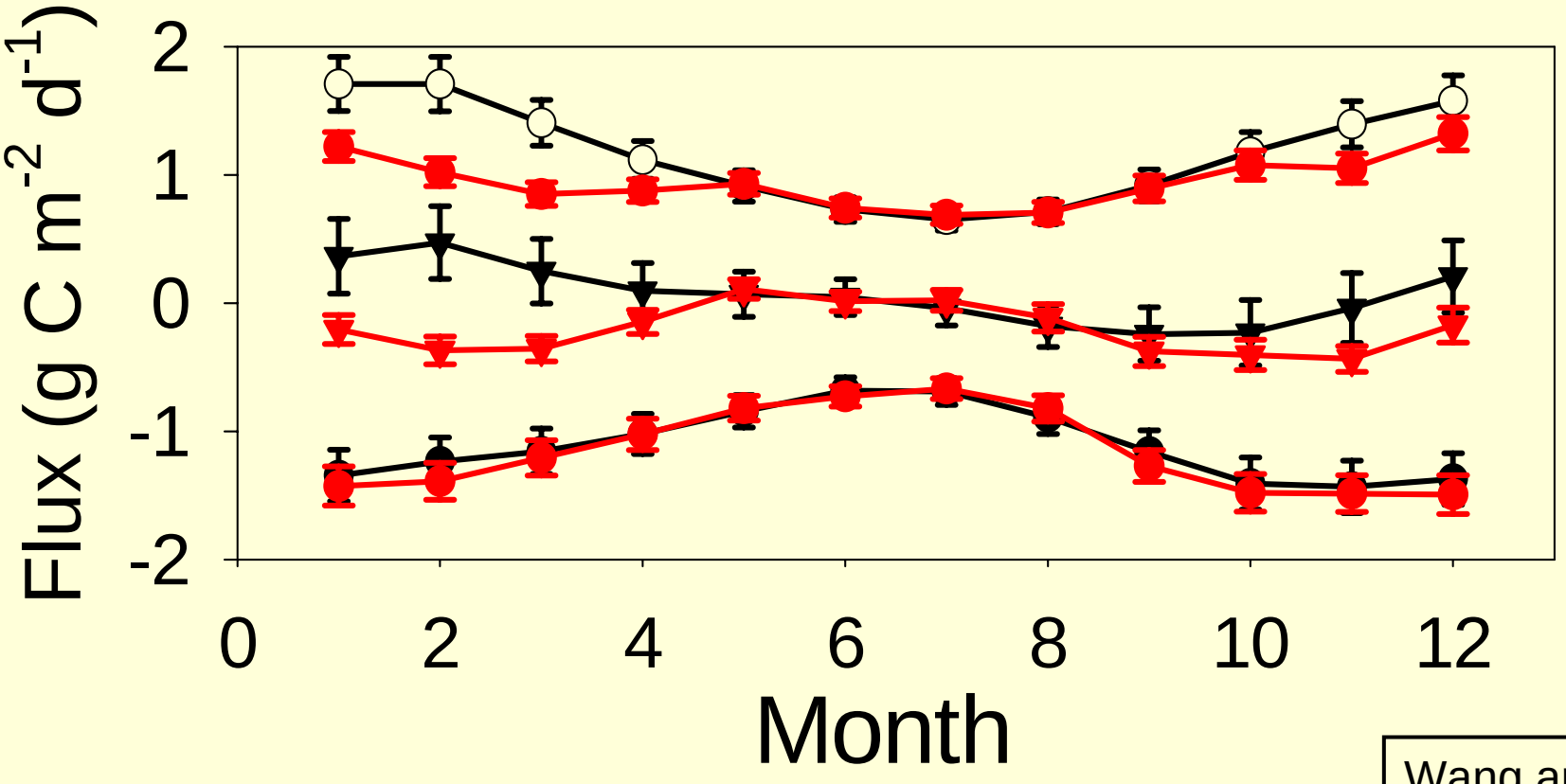
Wang and McGregor 2003)

Fit to the observed atmospheric CO_2 data at Cape Grim using KF technique



Wang and McGregor 2003)

Improved the prior estimates (white) using hourly CO2 data at Cape Grim (red)



Wang and McGregor 2003)