



# Making Good Use of Satellite Data: The Vegetation Modeller's Perspective



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# Veg Modeller Questions



Impacts of

- Rising CO<sub>2</sub>
- Temperature
- Water availability
- Nutrient availability ..

On vegetation

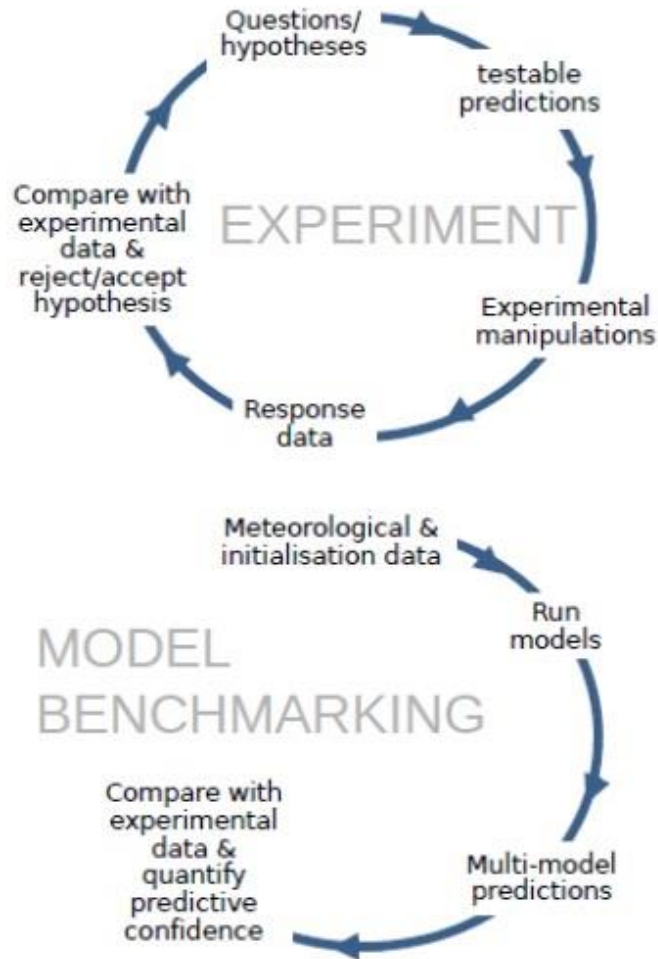
- Productivity
- C storage
- Water use
- Distribution ..

Consequences for

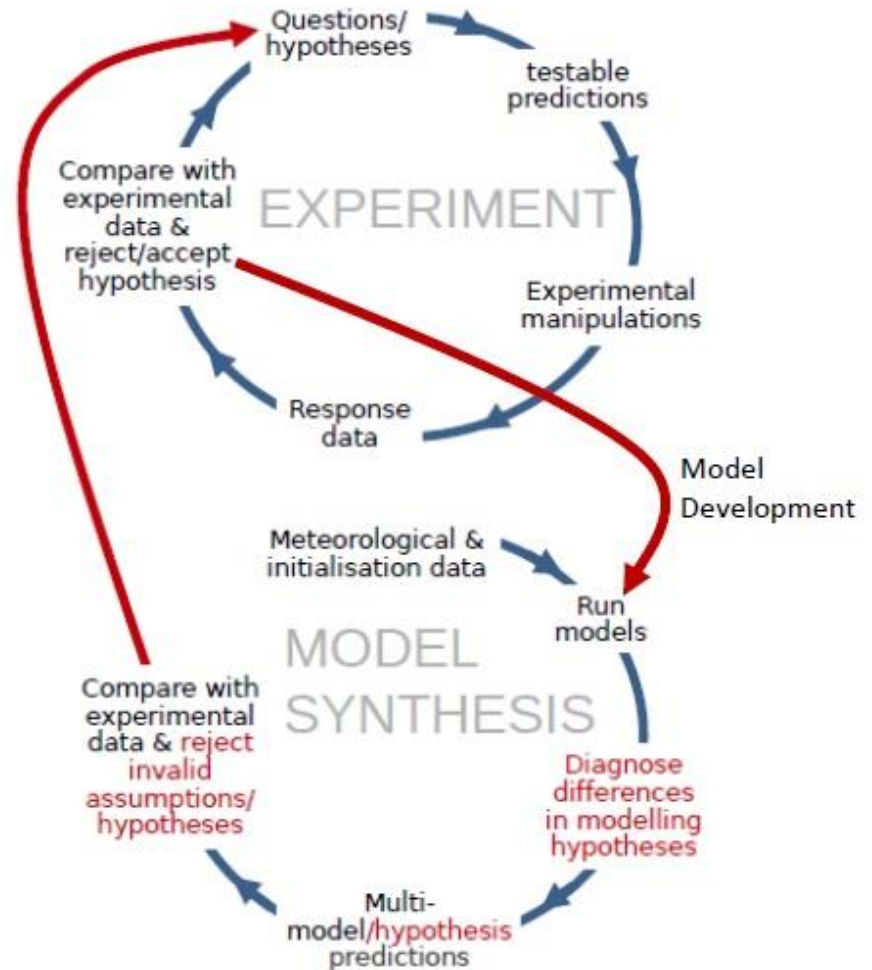
- climate
- biodiversity
- streamflow
- fire regimes ..

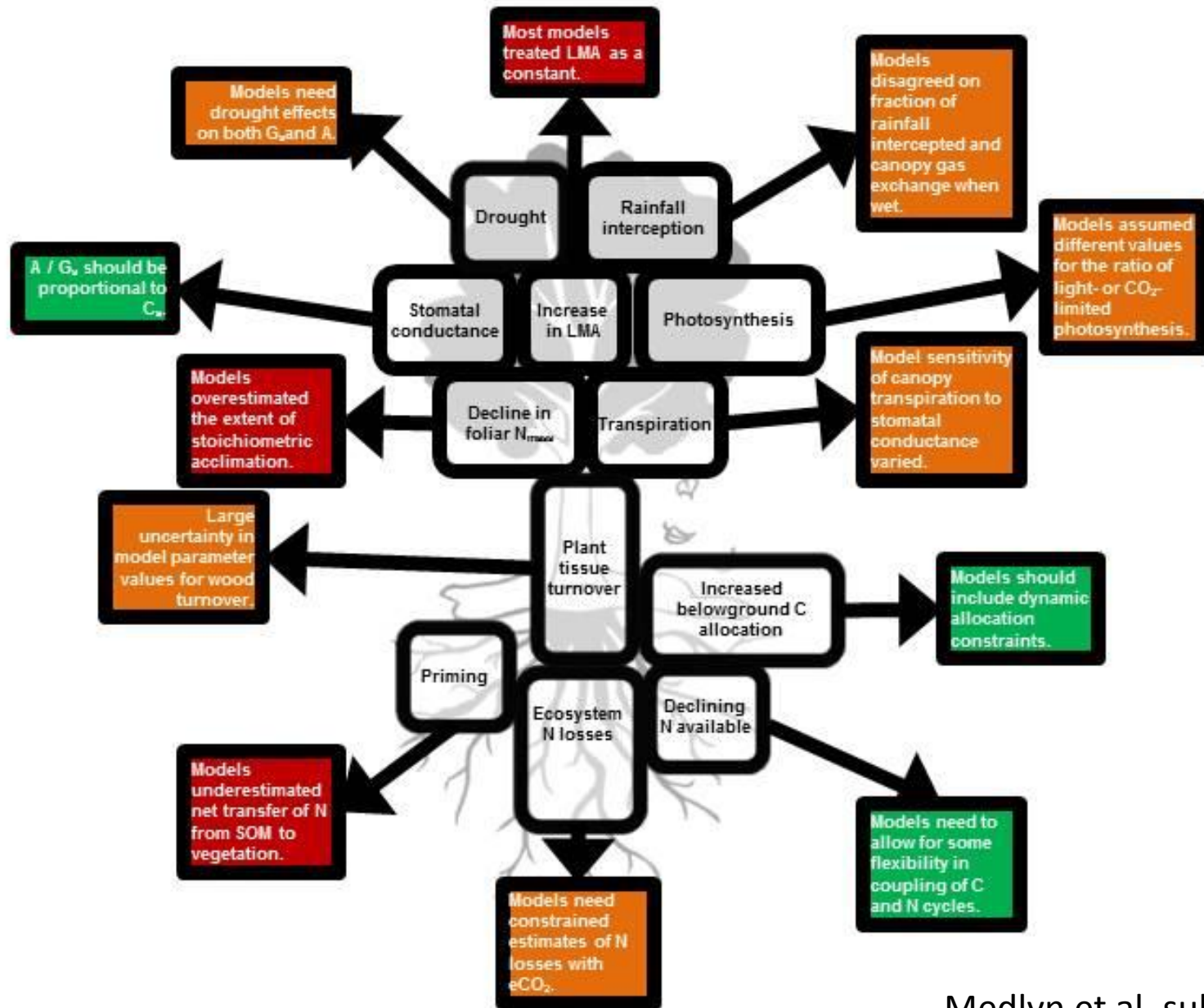
# FACE Model-Data Synthesis

a) Model benchmarking/validation

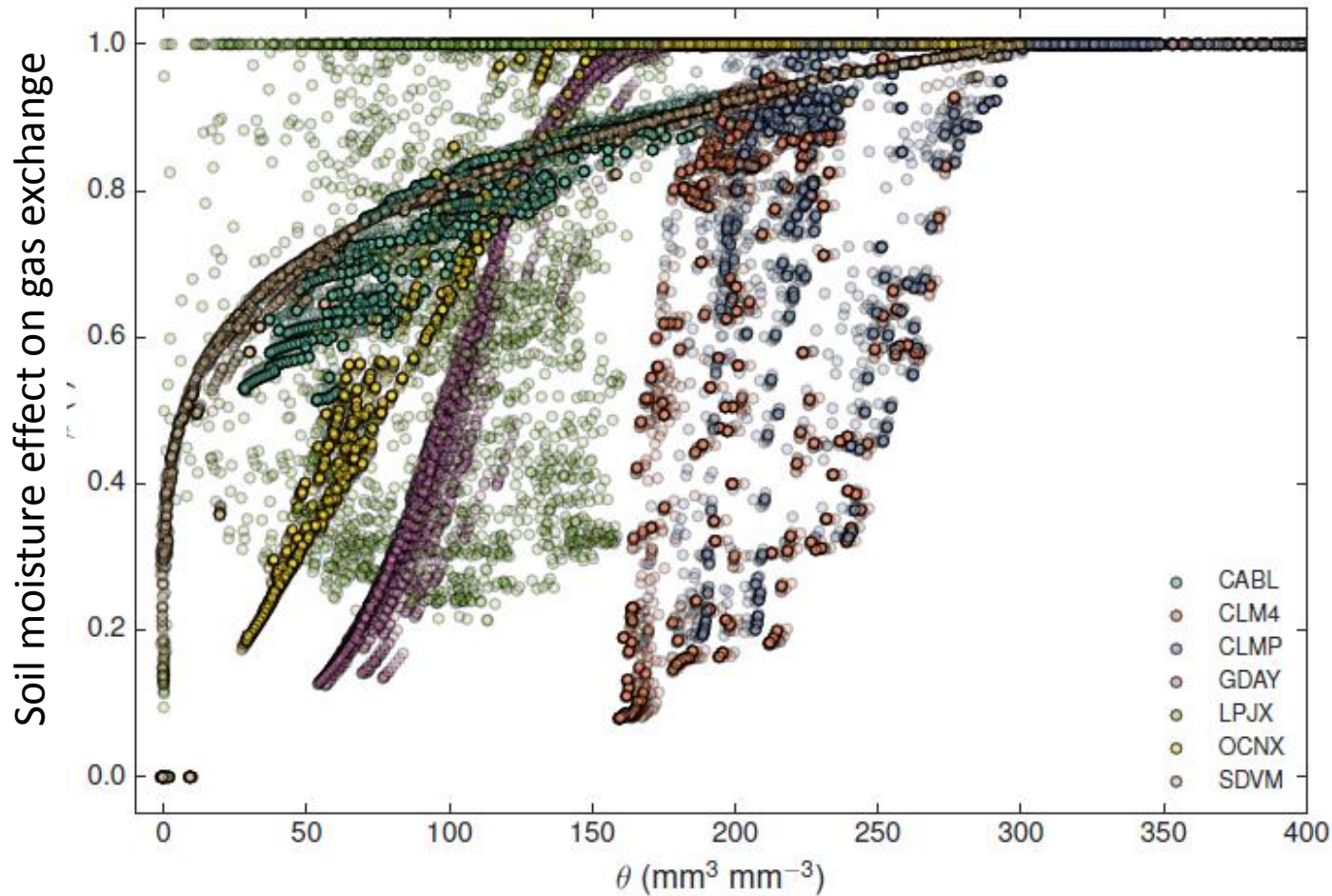


b) Model-experiment synthesis

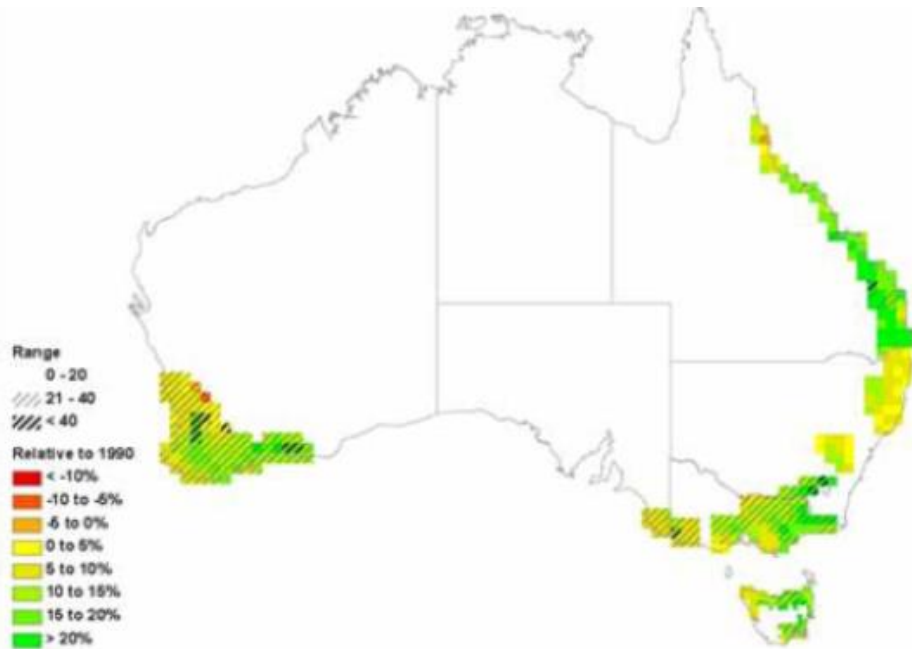




# EucFACE-MDS

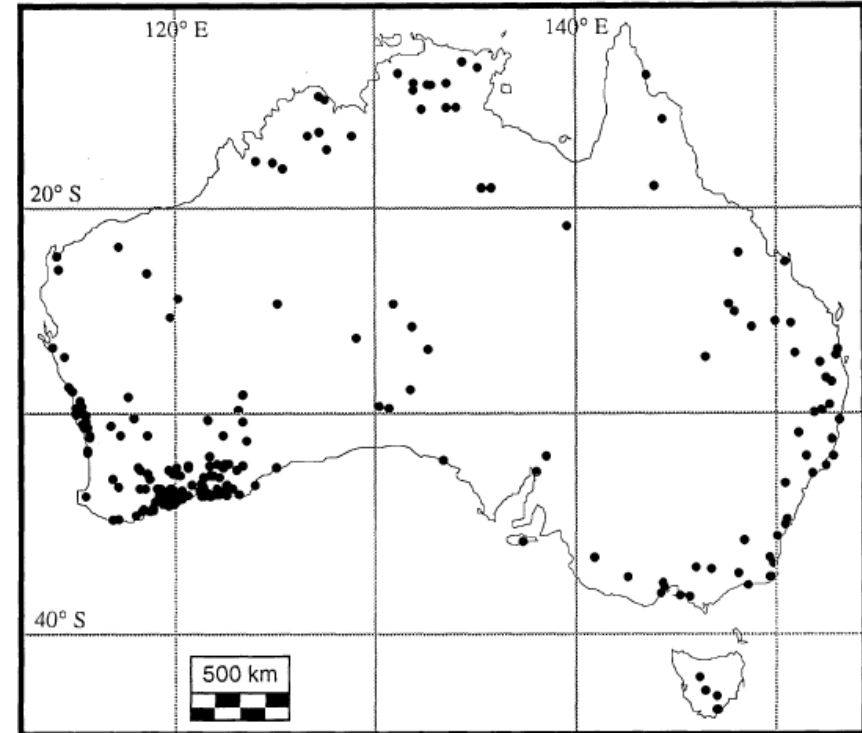


# Different Model Types



## Process-based model

Battaglia et al. 2009: Modelled average percentage change in production for 2030 for six plantation species



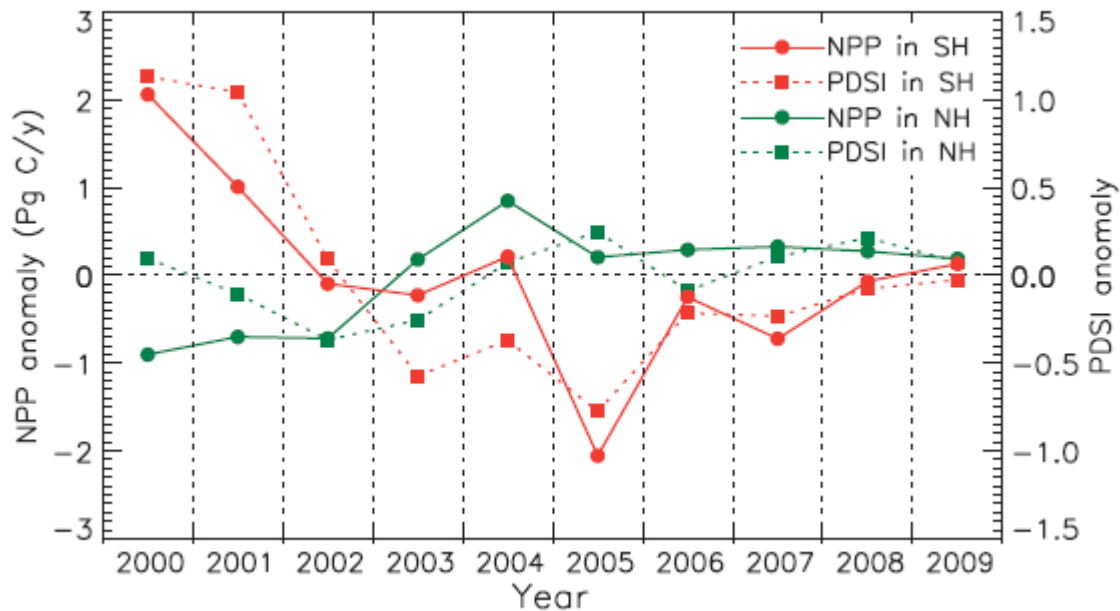
## Species distribution model

Hughes et al. 1996: Location of eucalypt species with mean annual temperature range < 1°C

# Making Bad Use of Satellite Data #1

## Drought-Induced Reduction in Global Terrestrial Net Primary Production from 2000 Through 2009

Maosheng Zhao\* and Steven W. Running



“a drying trend in the Southern Hemisphere has decreased NPP in that area”

Citations to date: 574

*“It is not that drought is causing a reduction in NPP; rather, both NPP and drought severity are assumed to vary with temperature.”*

# Making Bad Use of Satellite Data #2

*Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2009) 18, 280–290*

RESEARCH  
PAPER



## Global pattern of NPP to GPP ratio derived from MODIS data: effects of ecosystem type, geographical location and climate

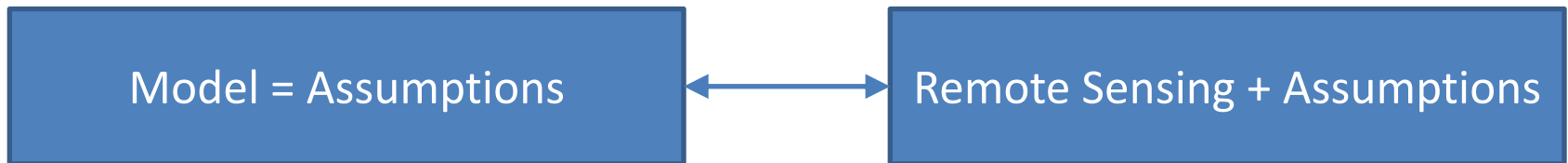
Yangjian Zhang<sup>1\*</sup>, Ming Xu<sup>2,1\*</sup>, Hua Chen<sup>3</sup> and Jonathan Adams<sup>4</sup>

“The NPP/GPP ratio exhibited a pattern depending on the main climatic characteristics such as temperature and precipitation and geographical factors such as latitude and altitude. The findings of this research **challenge the widely held assumption** that the NPP/GPP ratio is consistent regardless of ecosystem type.”

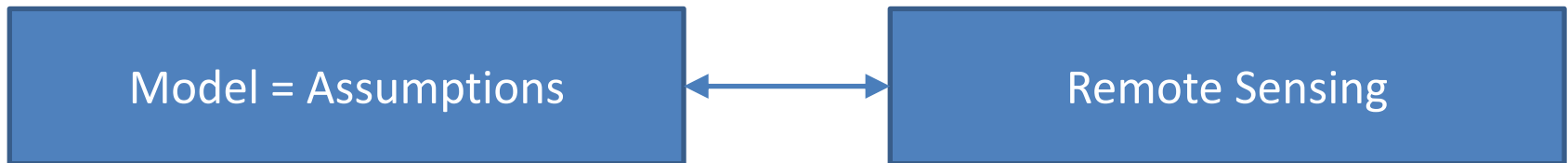
Citations: 55



# Importance of Independence

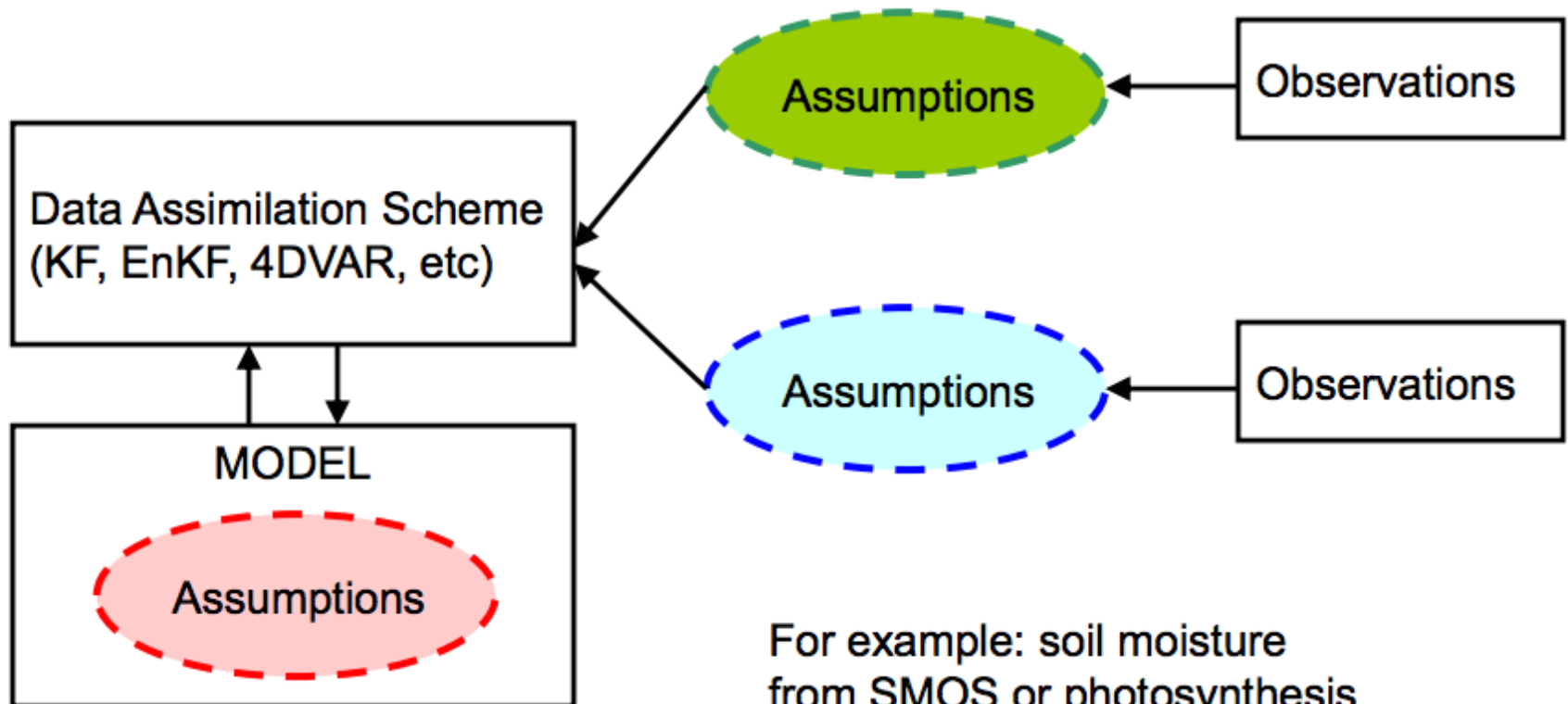


Agreement if assumptions are similar



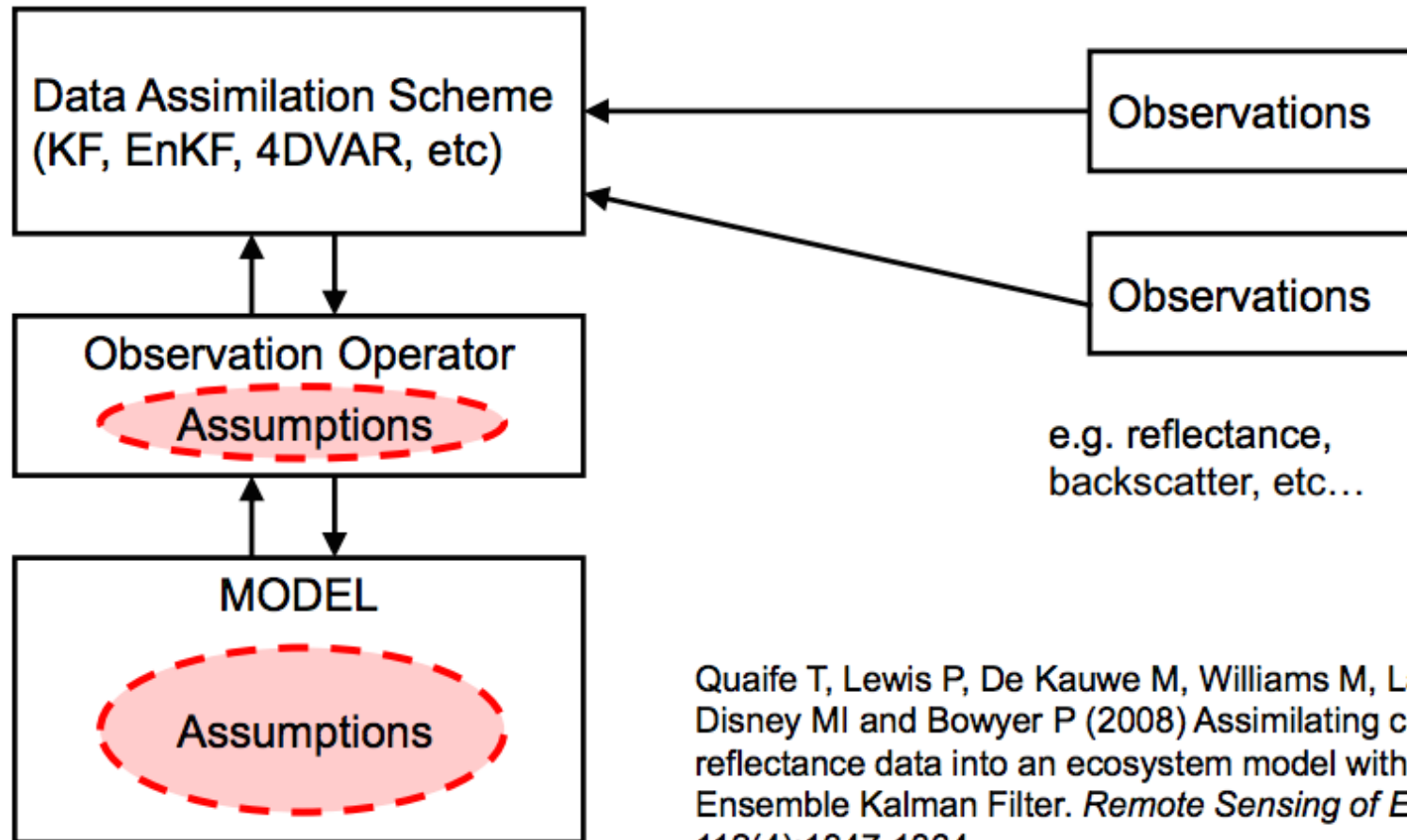
Agreement if assumptions are correct

# Assimilating products



For example: soil moisture  
from SMOS or photosynthesis  
(GPP) from MODIS

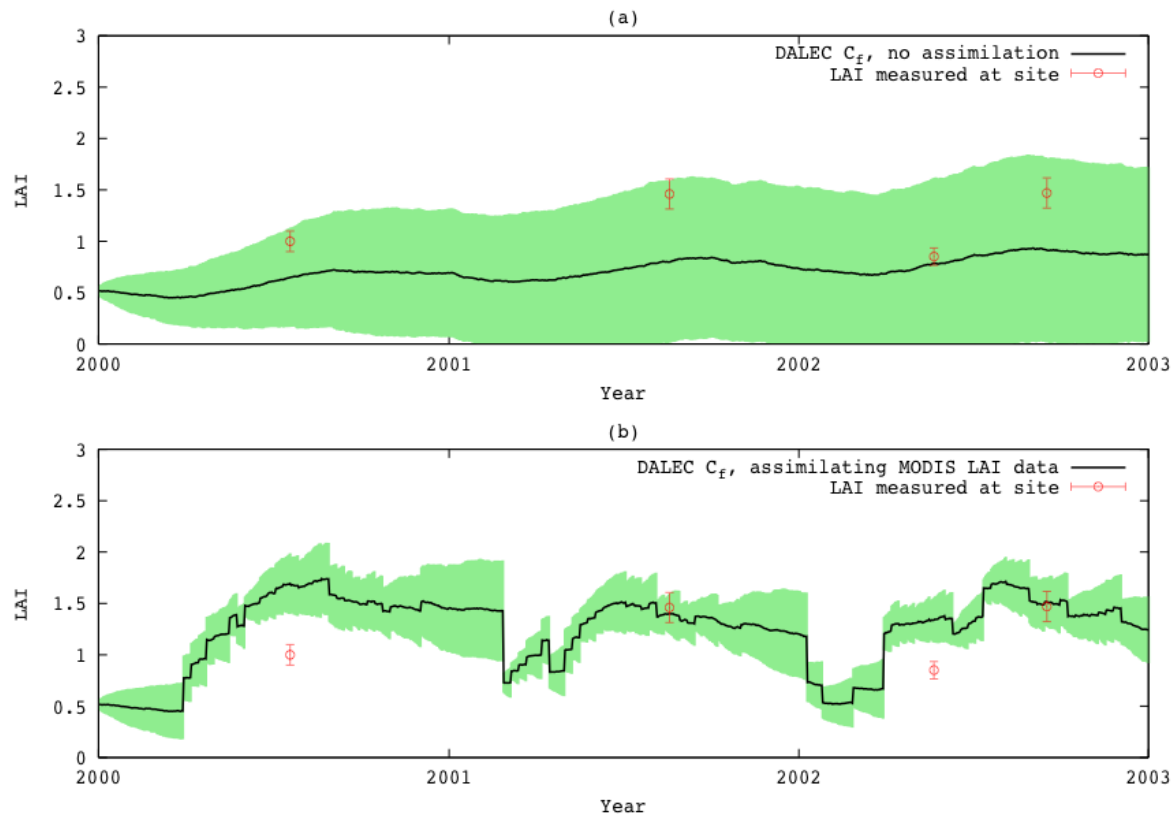
# Assimilating low level data



Quaife T, Lewis P, De Kauwe M, Williams M, Law BE, Disney MI and Bowyer P (2008) Assimilating canopy reflectance data into an ecosystem model with an Ensemble Kalman Filter. *Remote Sensing of Environment*. 112(4):1347-1364

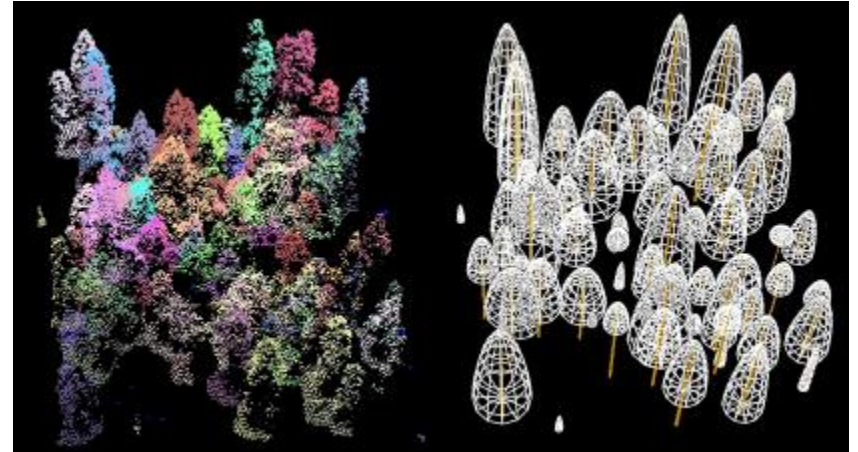
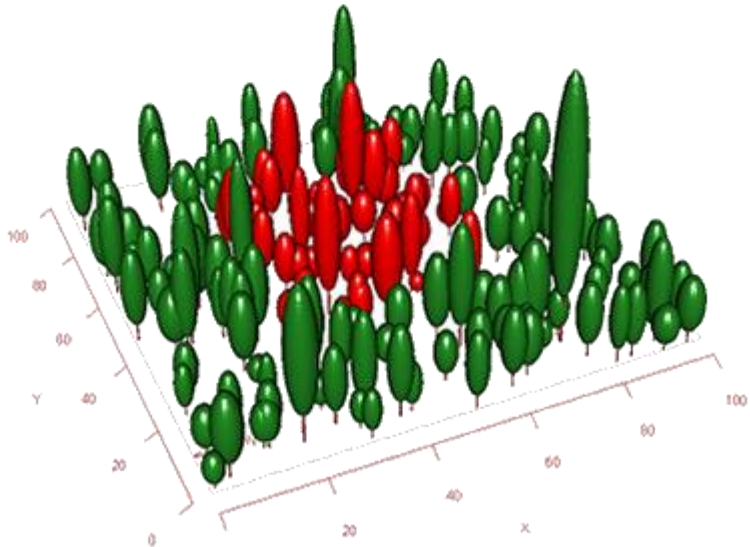
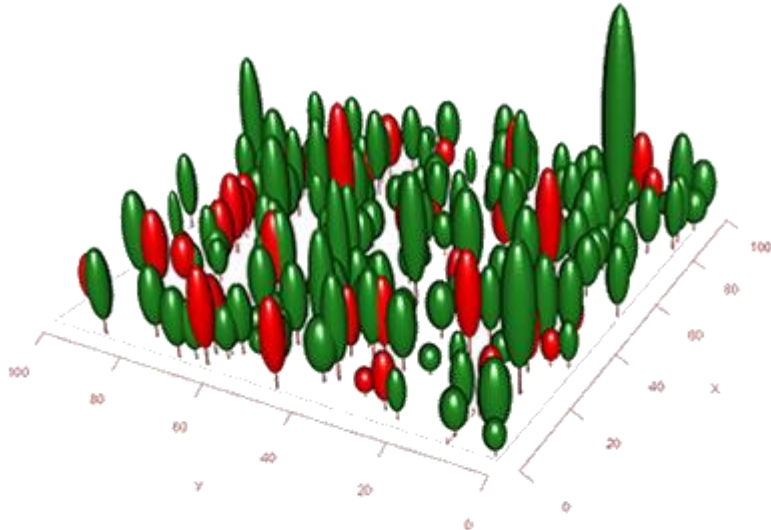
# Making Good Use of Satellite Data

## 1) Present-day: data assimilation



Data assimilation into DALEC ecological model (Martin De Kauwe)

## 2) Parameterising models



Extracting forest data from Lidar  
(van Kane, U. Washington)

MAESPA model (Duursma & Medlyn 2012)

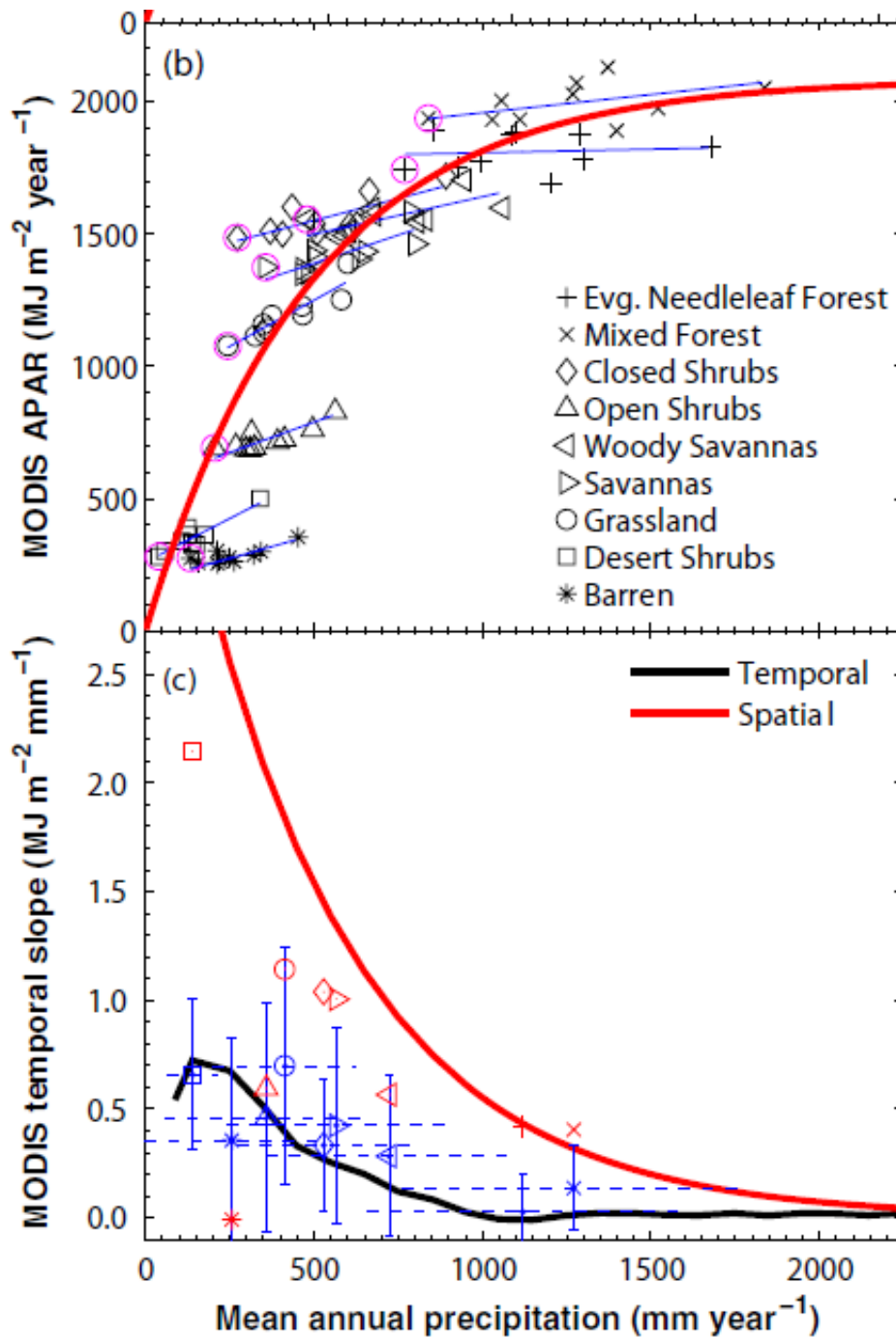
# 3) Monitoring

Drought / pest attack / disturbances



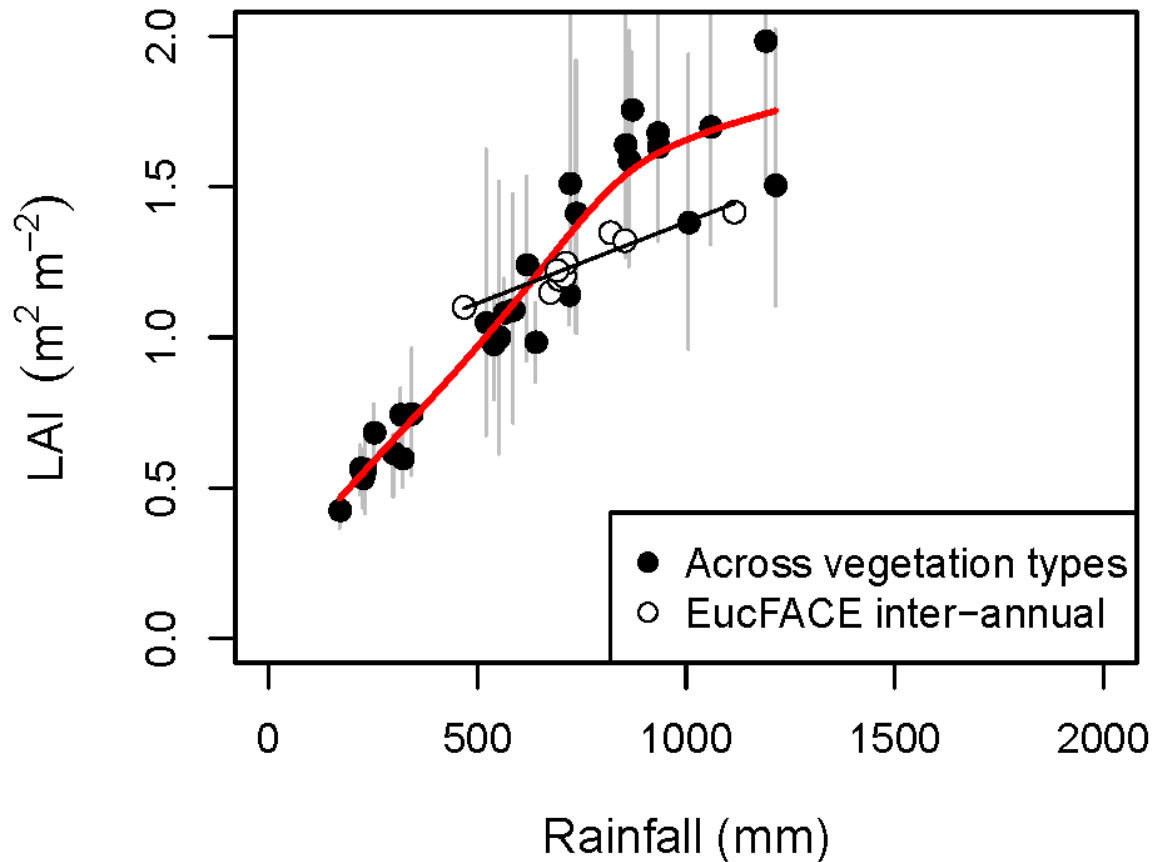
*Image: Brad Evans*

# 4) Comparing spatial and temporal scales



# 4) Comparing Scales

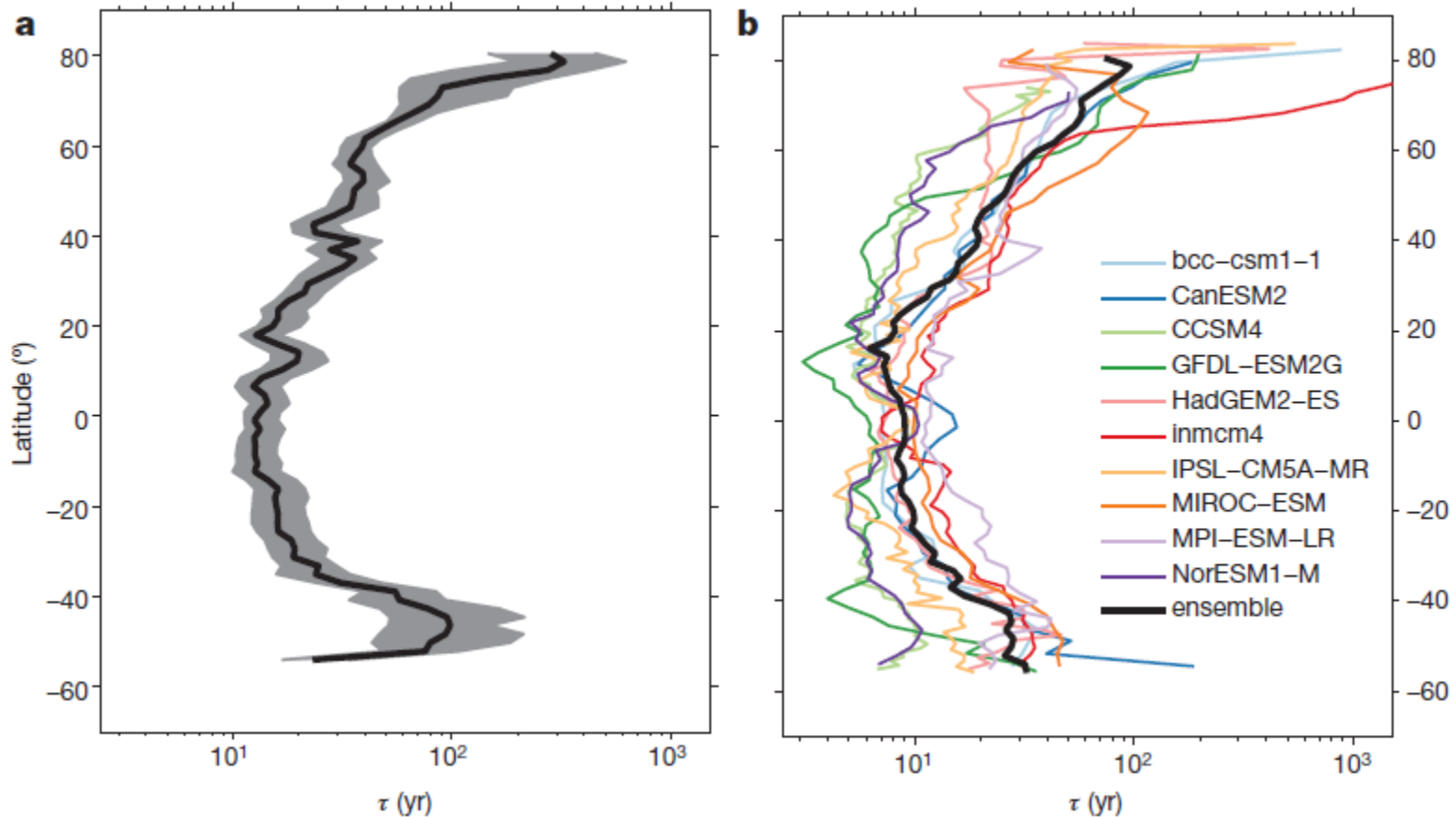
LAI estimated from MODIS 8day  $f_{PAR}$  product.  
30,000 1km<sup>2</sup> pixels across SE Australia



Remko Duursma  
& Matthias Boer



# 5) Testing Models

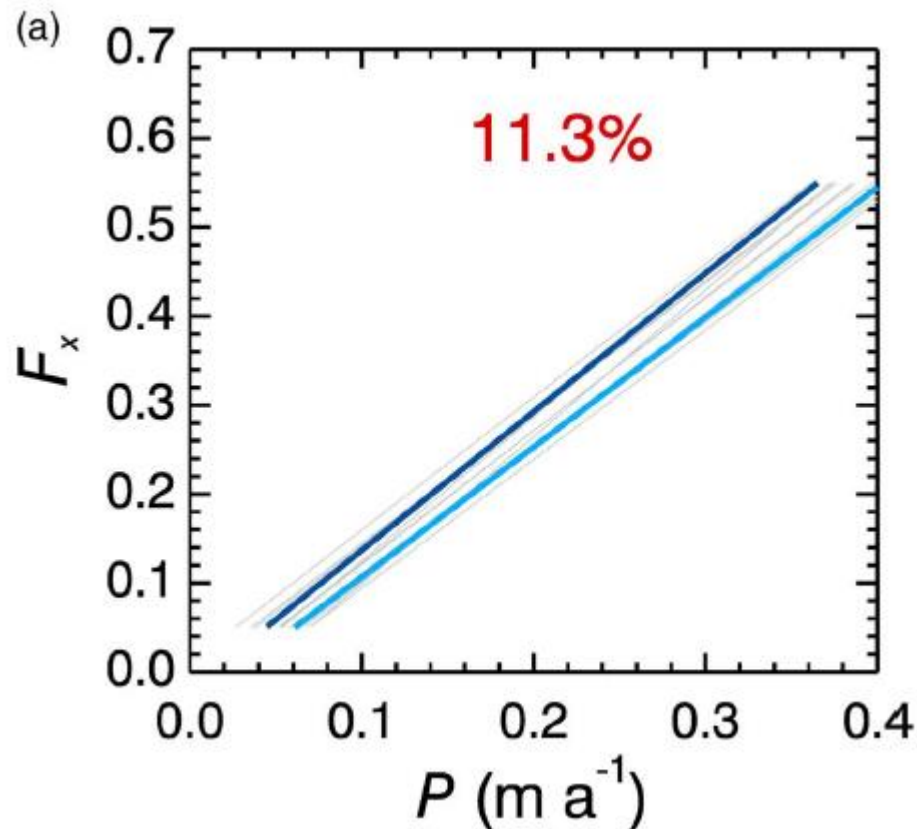


Turnover estimated from remotely-sensed biomass, soil C map, and FLUXNET GPP  
Carvalhais et al. 2014 Nature

# 5) Testing Models

**Impact of CO<sub>2</sub> fertilization on maximum foliage cover across the globe's warm, arid environments**

Randall J. Donohue,<sup>1</sup> Michael L. Roderick,<sup>2,3,4</sup> Tim R. McVicar,<sup>1</sup> and Graham D. Farquhar<sup>2</sup>



# Good Uses vs Bad Uses

- Data reflect actual measurements – not overly processed
- Assumptions made are clear

# Veg Modeller Questions



Impacts of

- Rising CO<sub>2</sub>
- Temperature
- Water availability
- Nutrient availability

On vegetation

- Productivity
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- Water use
- Distribution

Consequences for

- climate
- biodiversity
- streamflow
- fire regimes ..

# Do We Still Need Ground Msmts?

Absolutely!!

- Ground-truthing
- Things that can't be measured remotely – fluxes, growth rates, soil processes, species composition
- Comprehensive ecosystem measurements to aid in understanding processes
- Need to use (but not fuse!) as many sources of info as possible