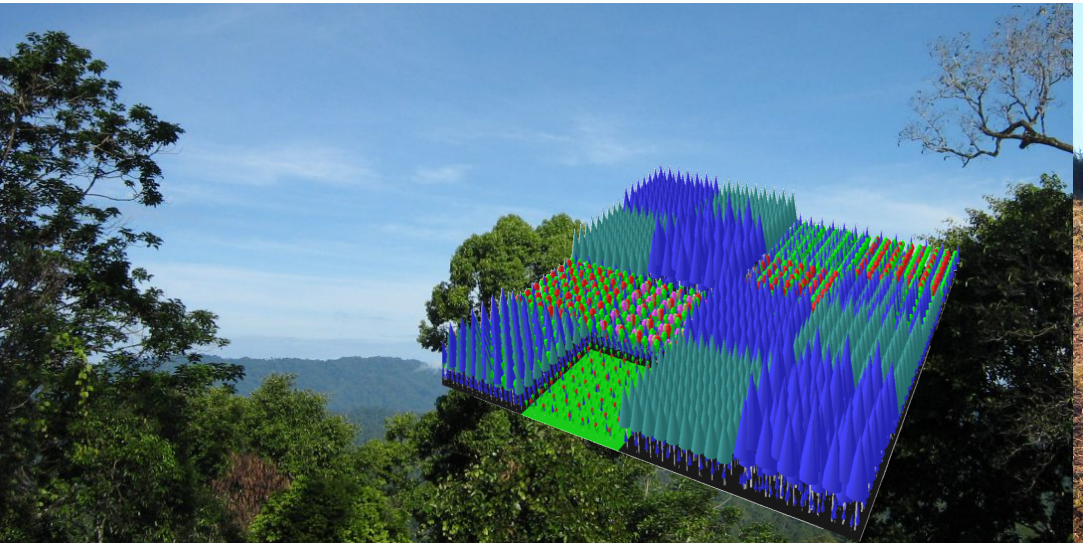
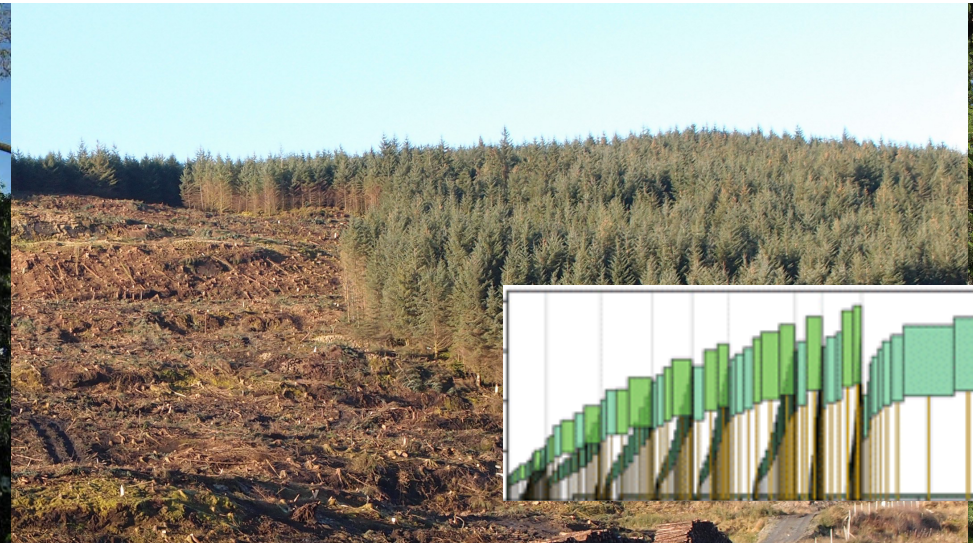
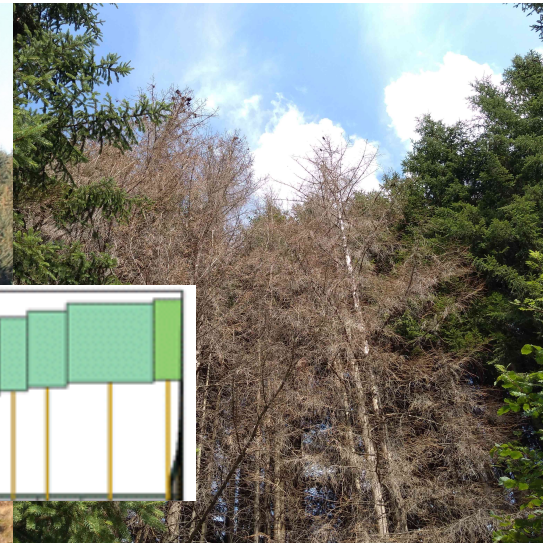
Processes in models, how they are different, and their carbon sequestration implications

Tom Pugh

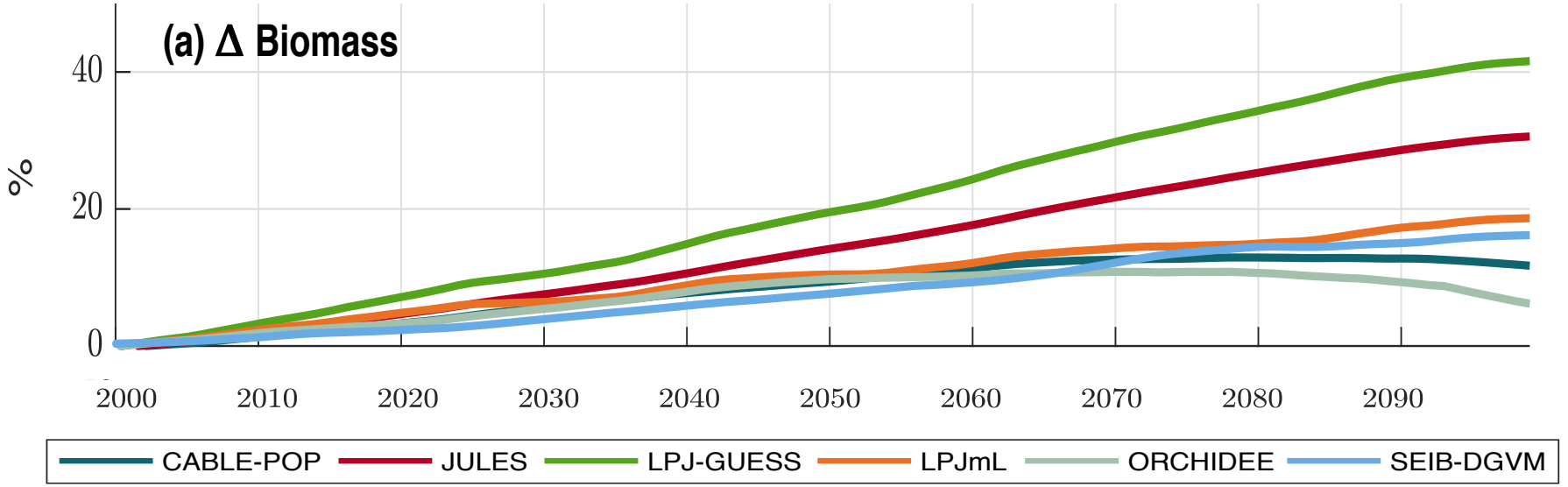
Based on work from: *Sarah Shafer, Tim Tito Rademacher, Almut Arneth, Ben Smith, Anna Harper, Vanessa Haverd, Markus Kautz, Anja Rammig, Hisashi Sato, Jens Heinke, Jörg Steinkamp, Brian Beckage, Kazuya Nishima, Stijn Hantson, Thomas Hickler, Benjamin Quesada, Jonathan Barichivich, Kirstin Thonicke, Ben Poulter, Adriane Esquivel-Muelbert*







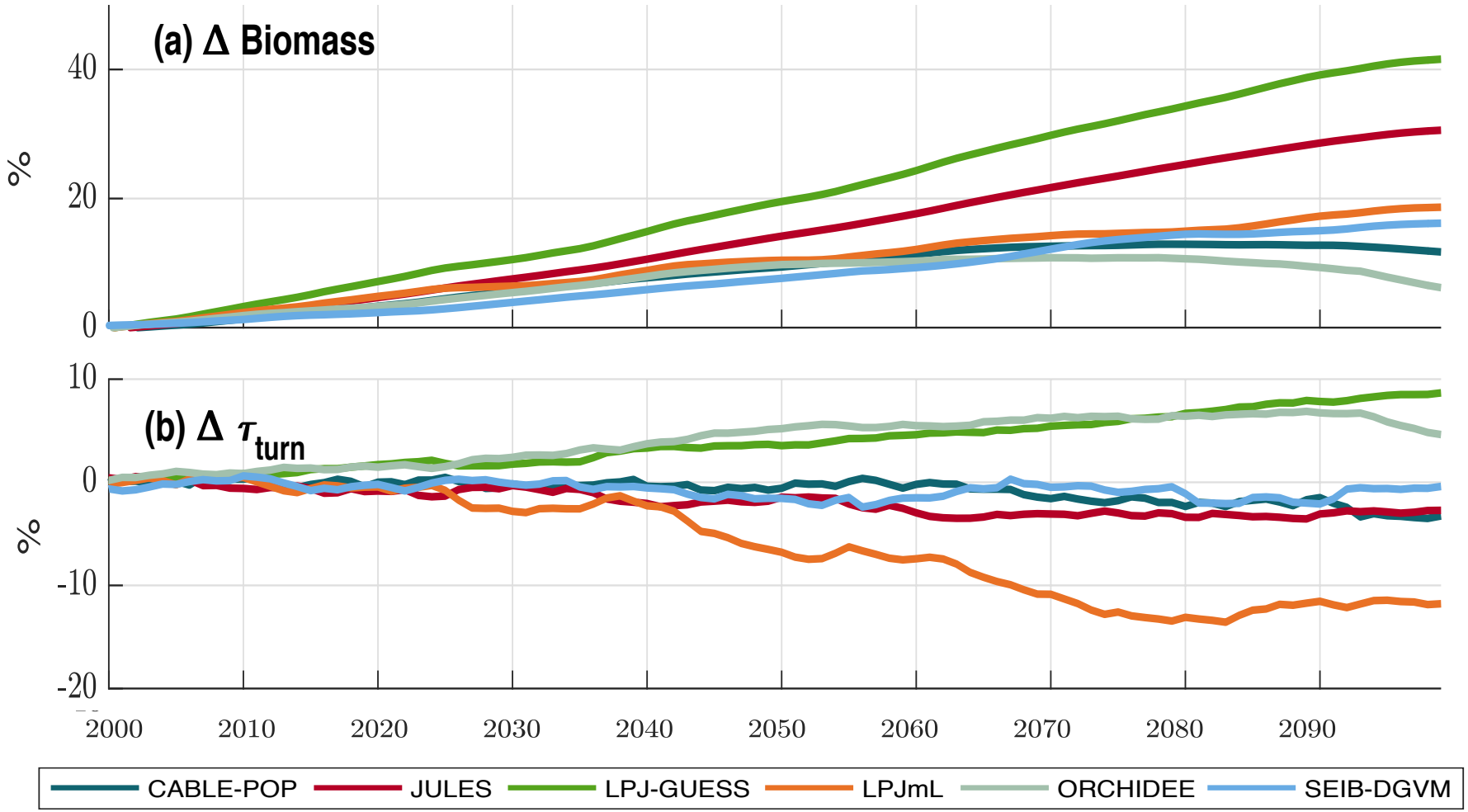
Status (snapshot ca. 2016…)



RCP 8.5
Strong climate change

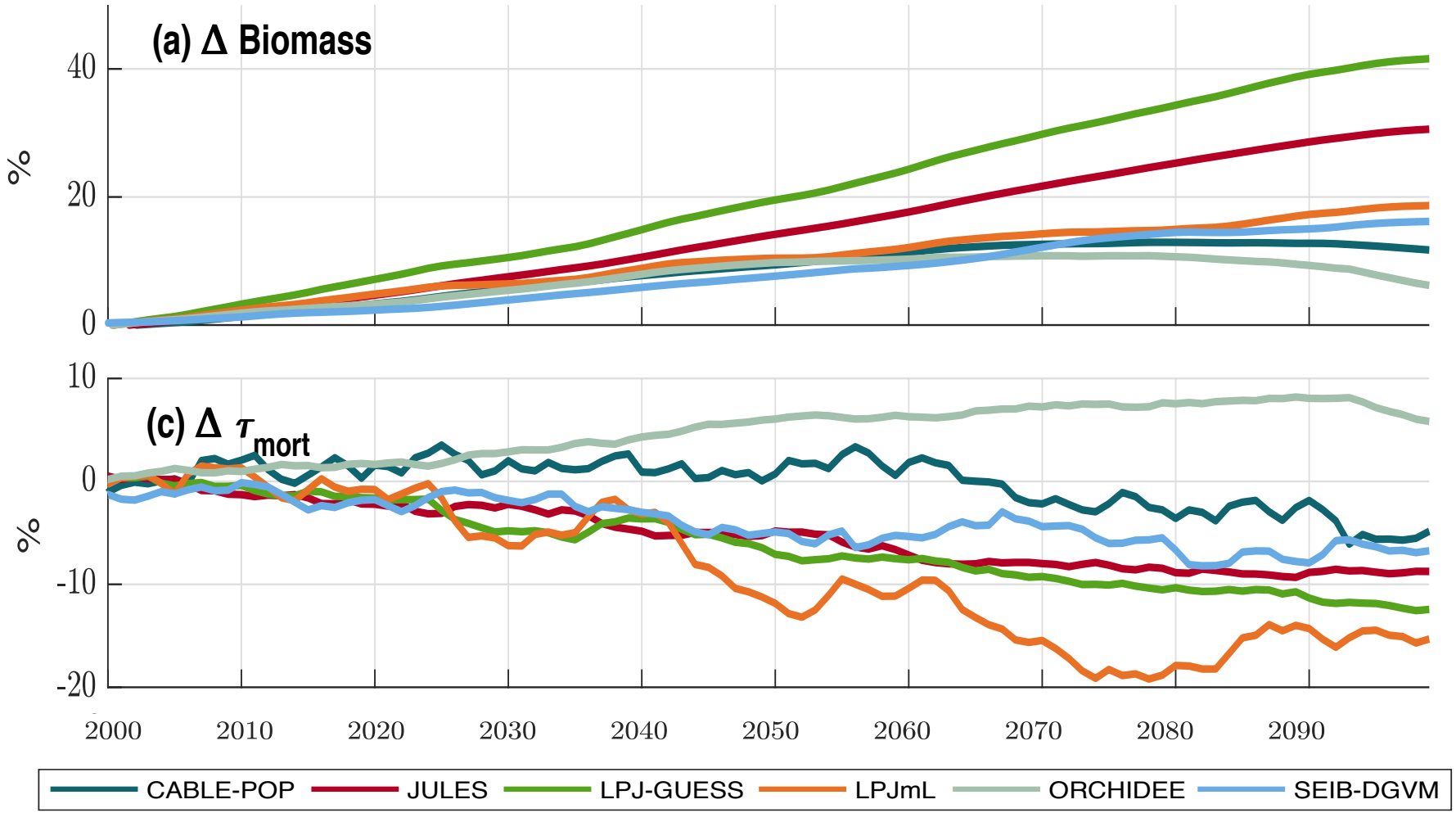
Status (snapshot ca. 2016…)

RCP 8.5
Strong climate change



Carbon turnover time
(Cveg/NPP)

Status (snapshot ca. 2016…)



RCP 8.5
Strong climate change

Carbon turnover time in wood

1 Where do I put my carbon?

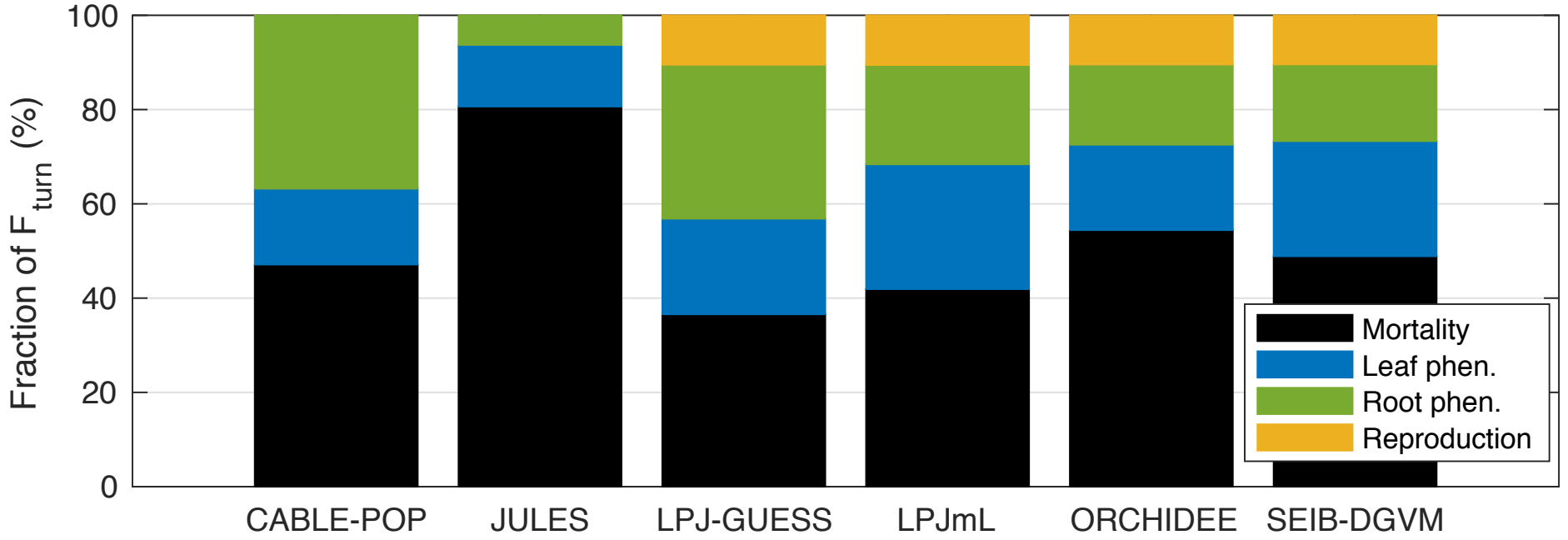
2 How long do I keep it?

3 How old am I?

1 Where do I put my carbon?

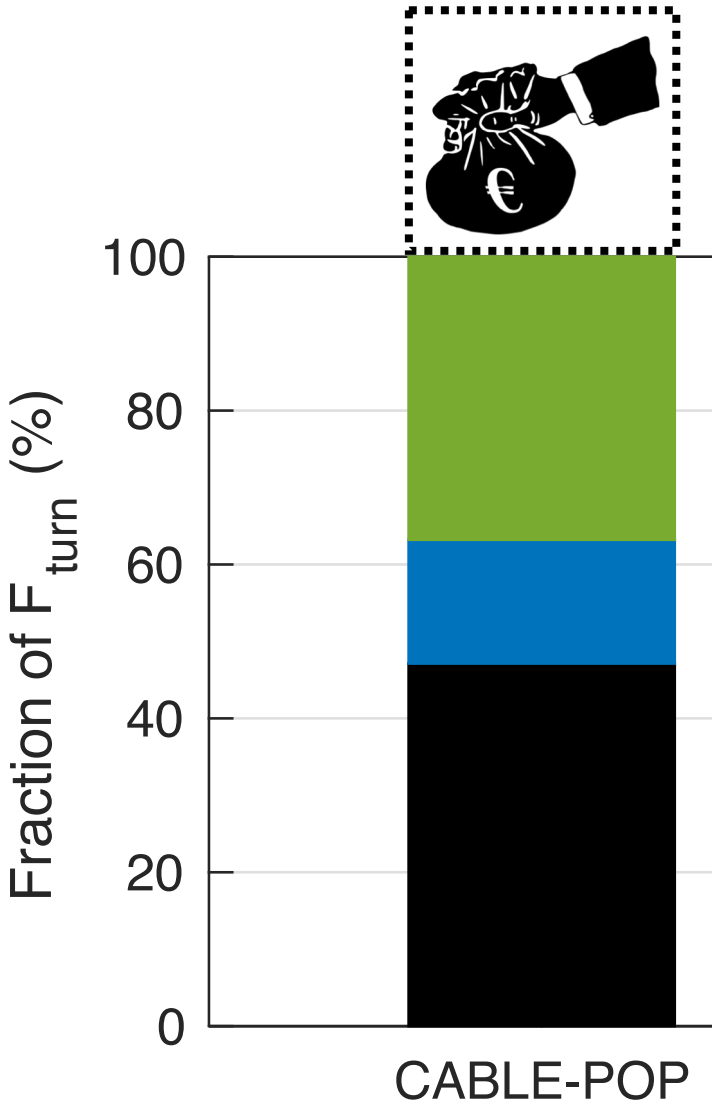
Soft tissues?

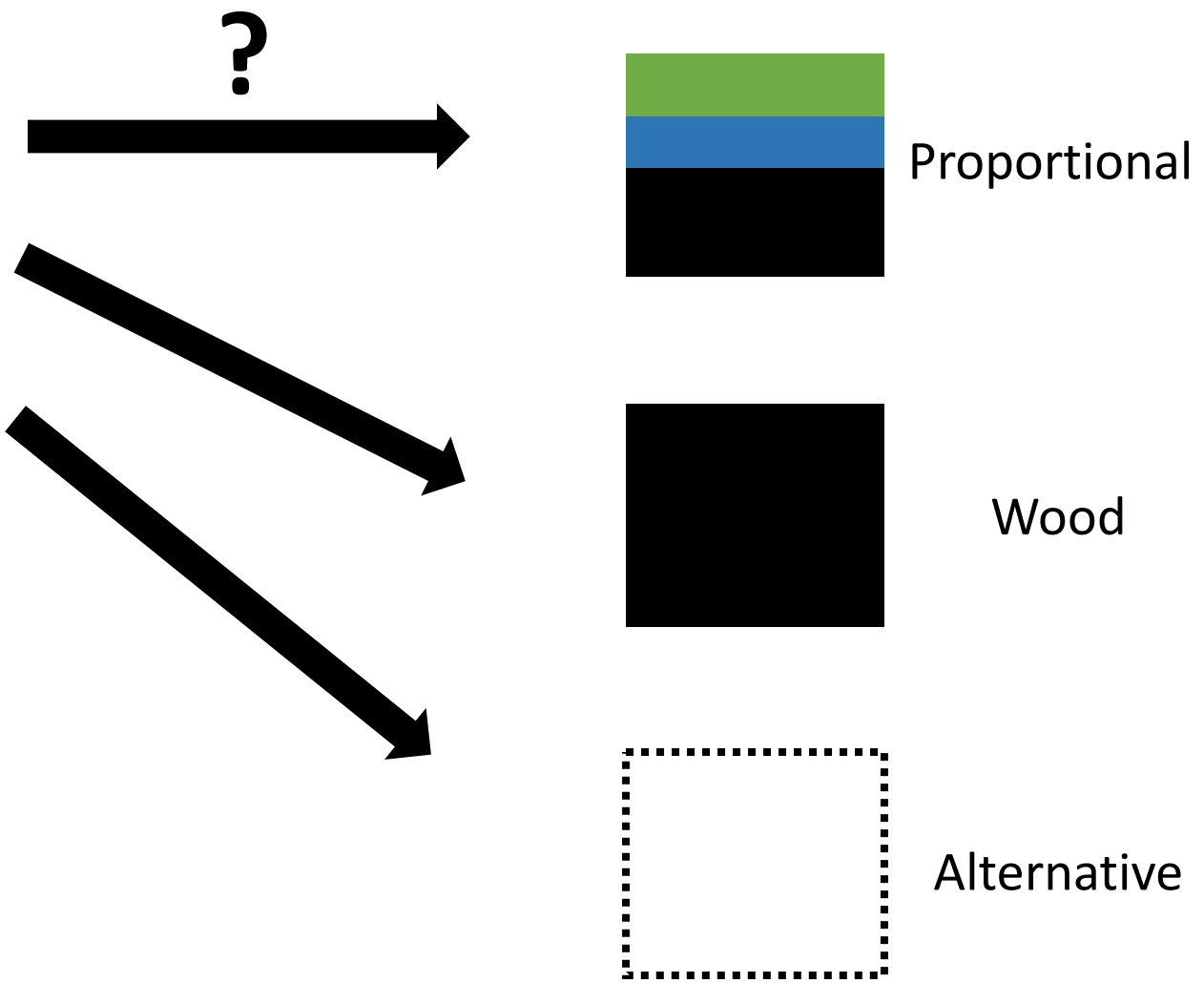
Wood?



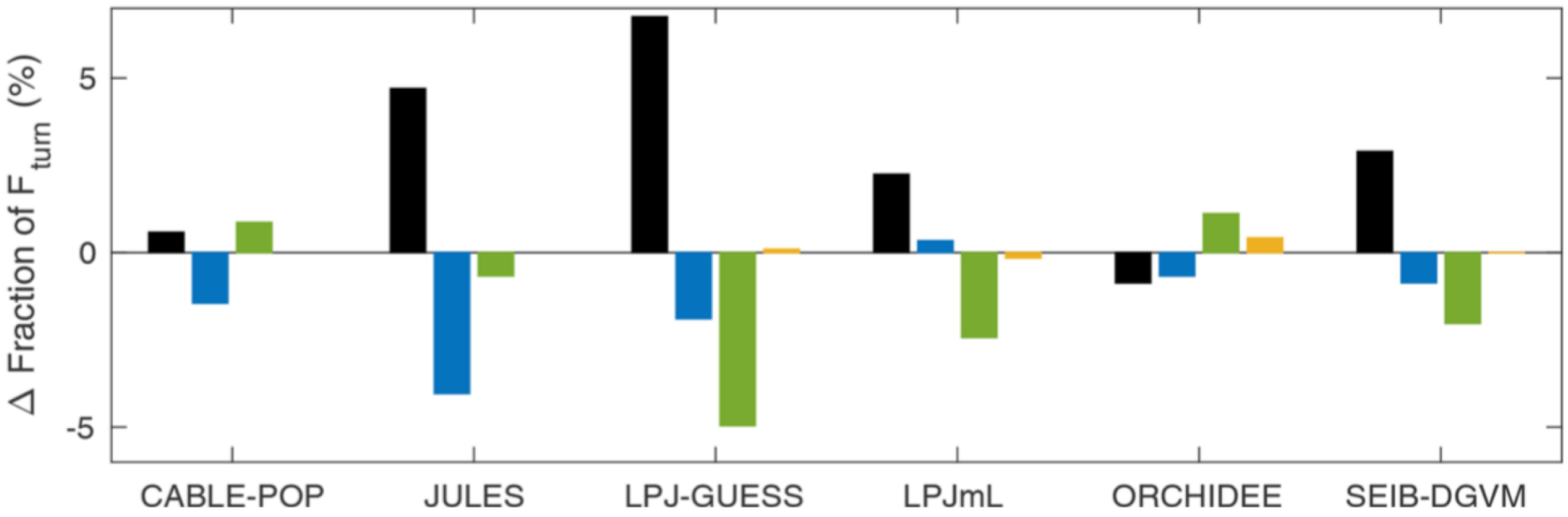
1985-2014

1 Where do I put my carbon?

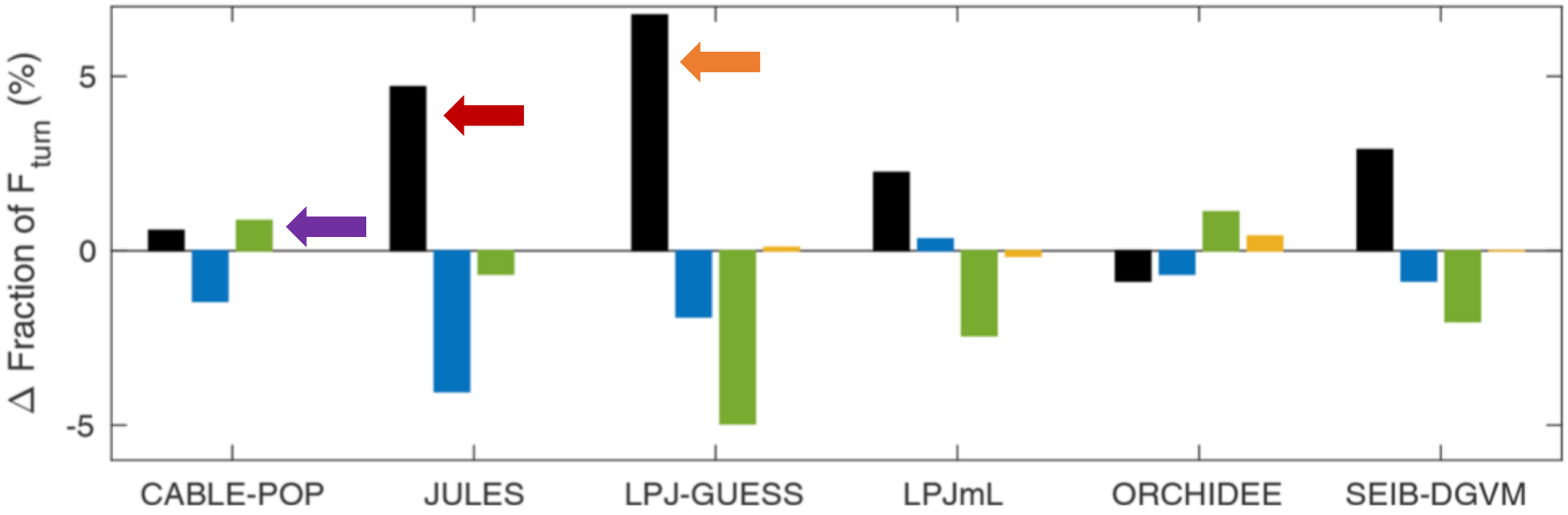


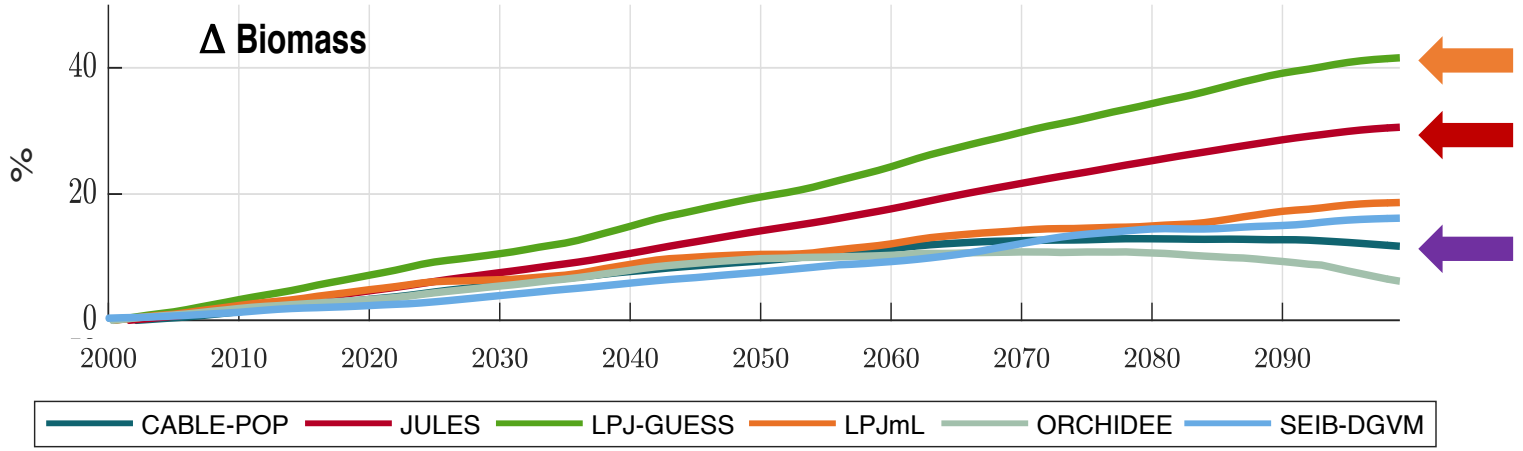


1 Where do I put my carbon?

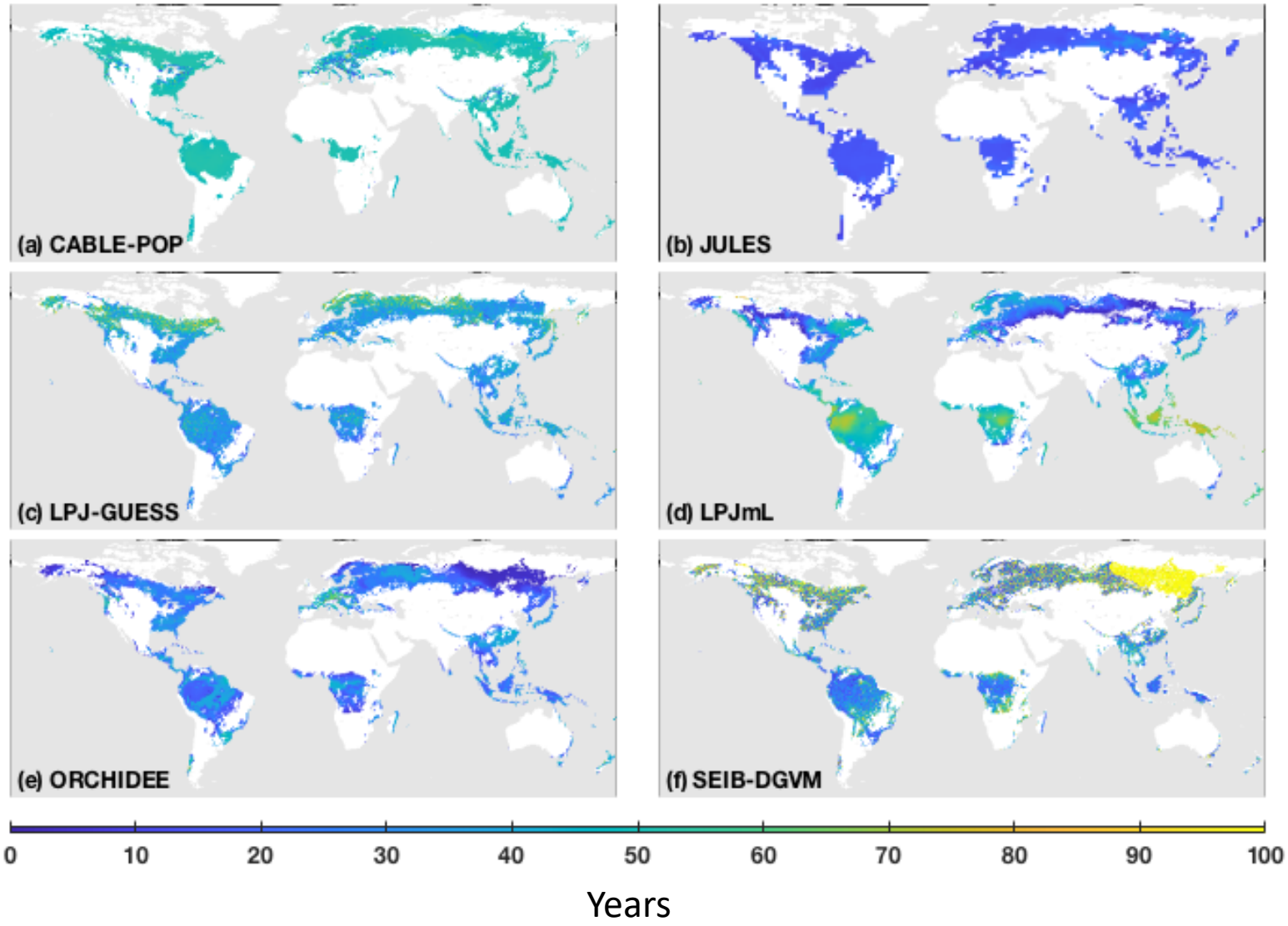


1 Where do I put my carbon?



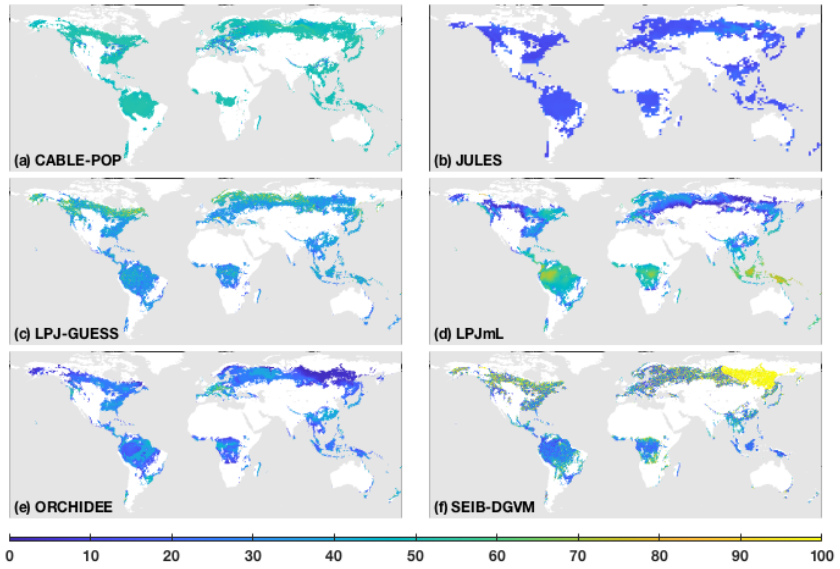


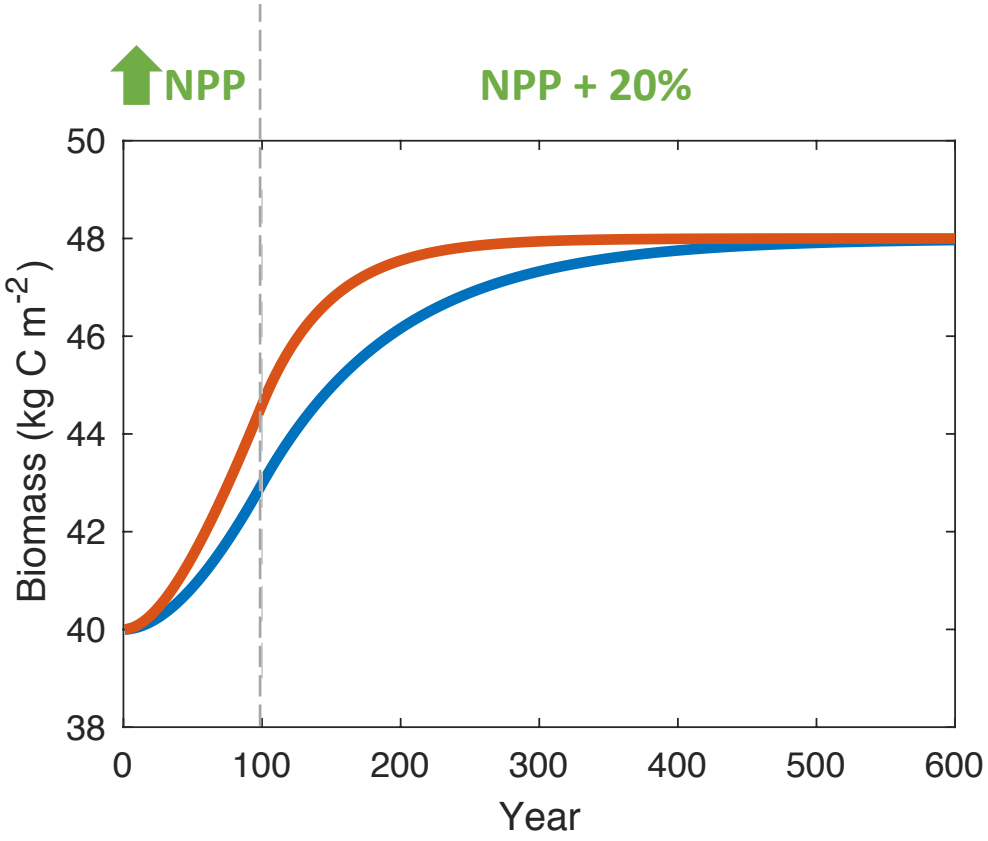
2 How long do I keep it? (and what does this imply?)



Woody turnover time in models

2 How long do I keep it? (and what does this imply?)





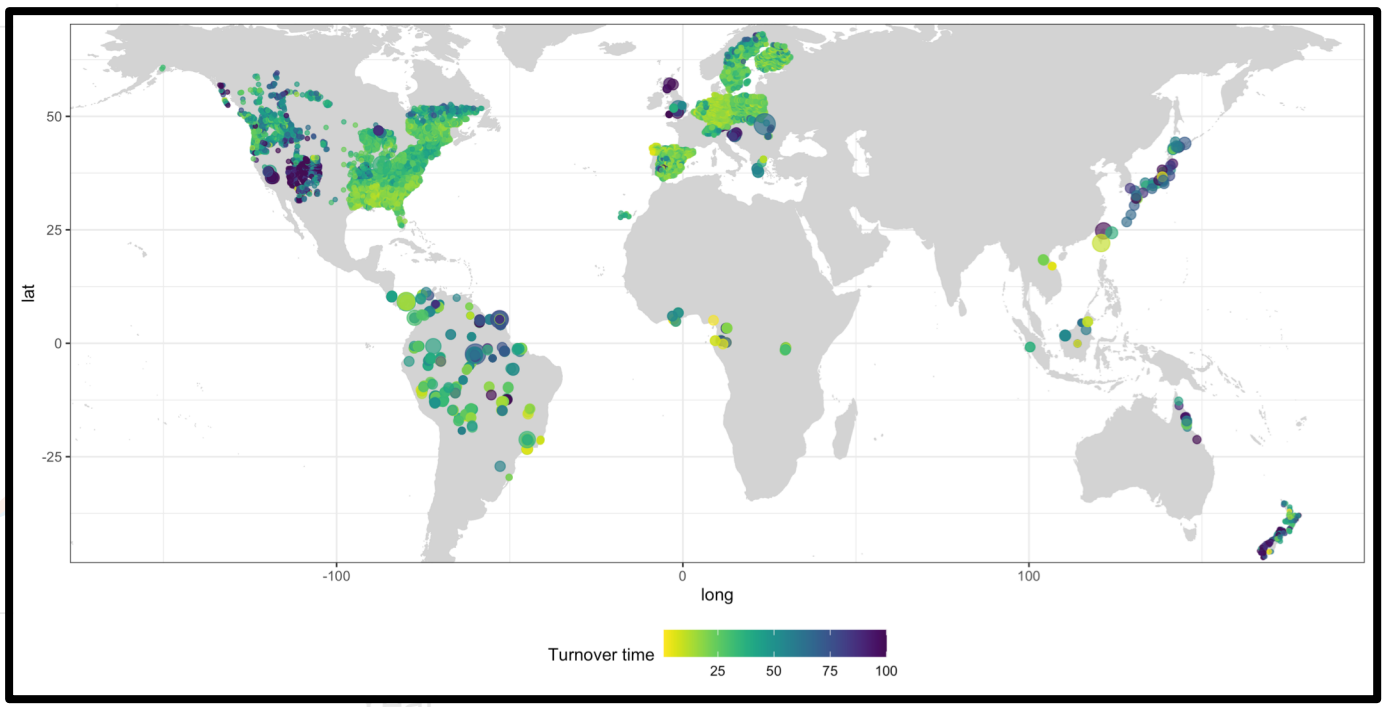
NPP_{Wfrac} = 0.2
τ_{wood} = 100 years

NPP_{Wfrac} = 0.4
τ_{wood} = 50 years

Propagates to very different uptake rates under eCO_2

2 How long do I keep it? (and what does this imply?)

We don’t benchmark woody dynamics enough (although we can)



Adriane Esquivel-Muelbert

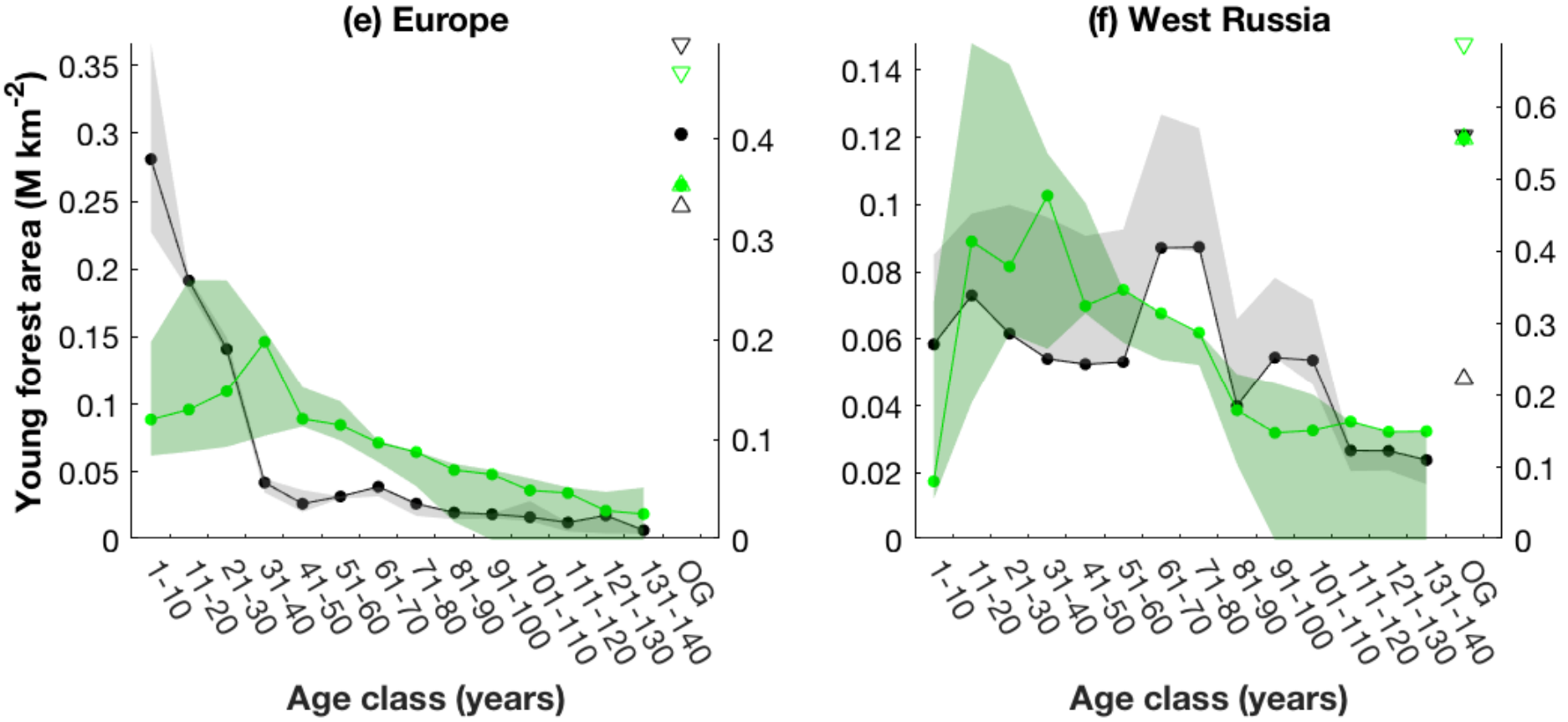
3 How old am I?

Demographics show the failure of the equilibrium assumption

GFAD

Constant 2001-2014 rate

3 How old am I?



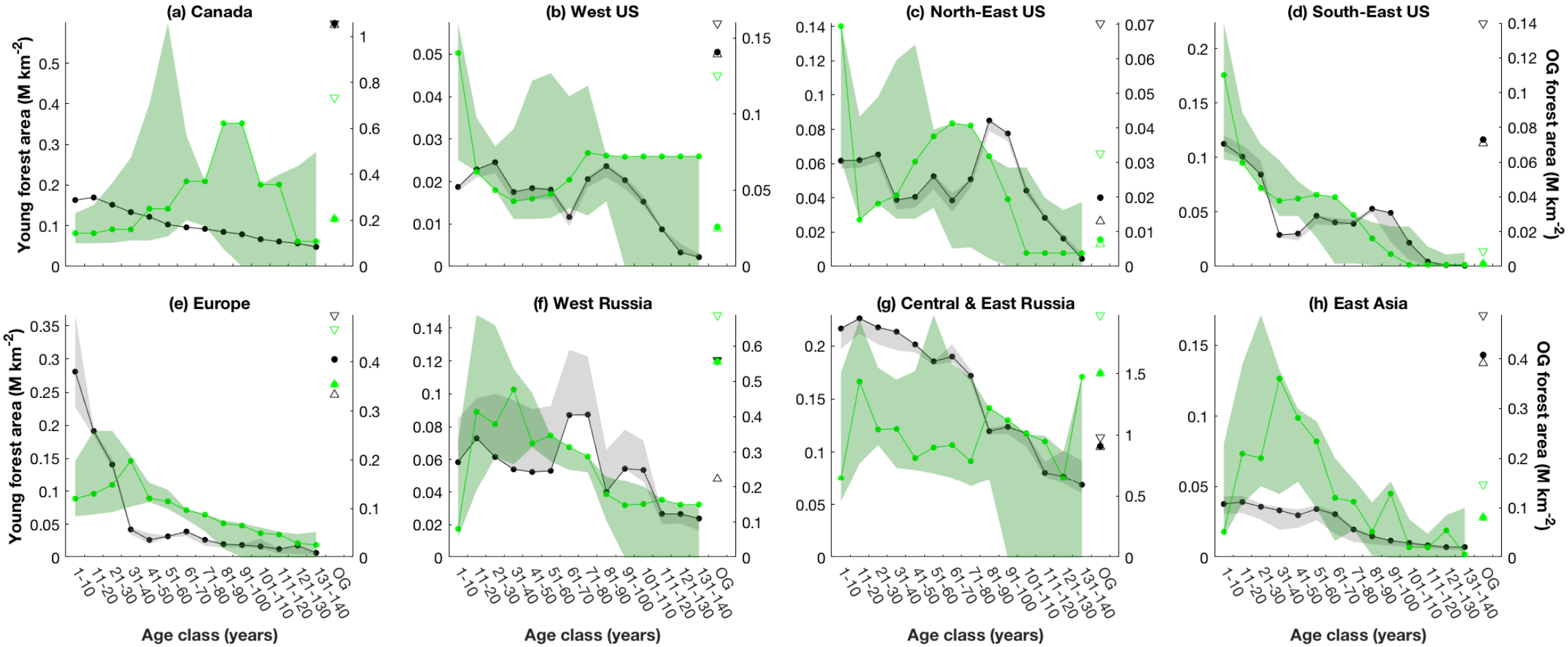
GFAD

LUH2

(via LPJ-GUESS)

Big uncertainty on what structure should be

3 How old am I?


(a) Canada
(b) West US
(c) North-East US
(d) South-East US
(e) Europe
(f) West Russia
(g) Central & East Russia
(h) East Asia
Young forest area (M km-2)
OG forest area (M km-2)
Age class (years)
1-10
11-20
21-30
31-40
41-50
51-60
61-70
71-80
81-90
91-100
101-110
111-120
121-130
131-140
OG

Summary…

Allocation of extra resources is a big driver of differences in model responses

Lack of woody dynamics benchmarking leaves too many degrees of freedom

Age structure is hugely influential, but uncertainty in it is underconsidered