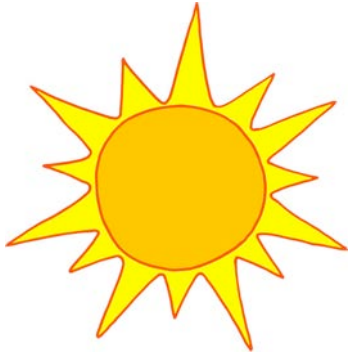


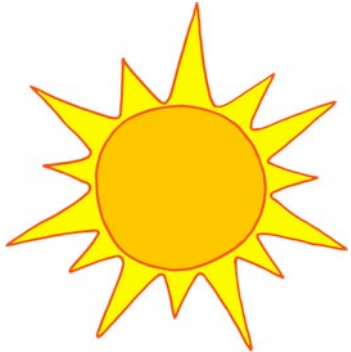
Carbon cycle changes in the 21st century in response to temperature acclimation



Danica Lombardozzi

Photo: J. DeCoste

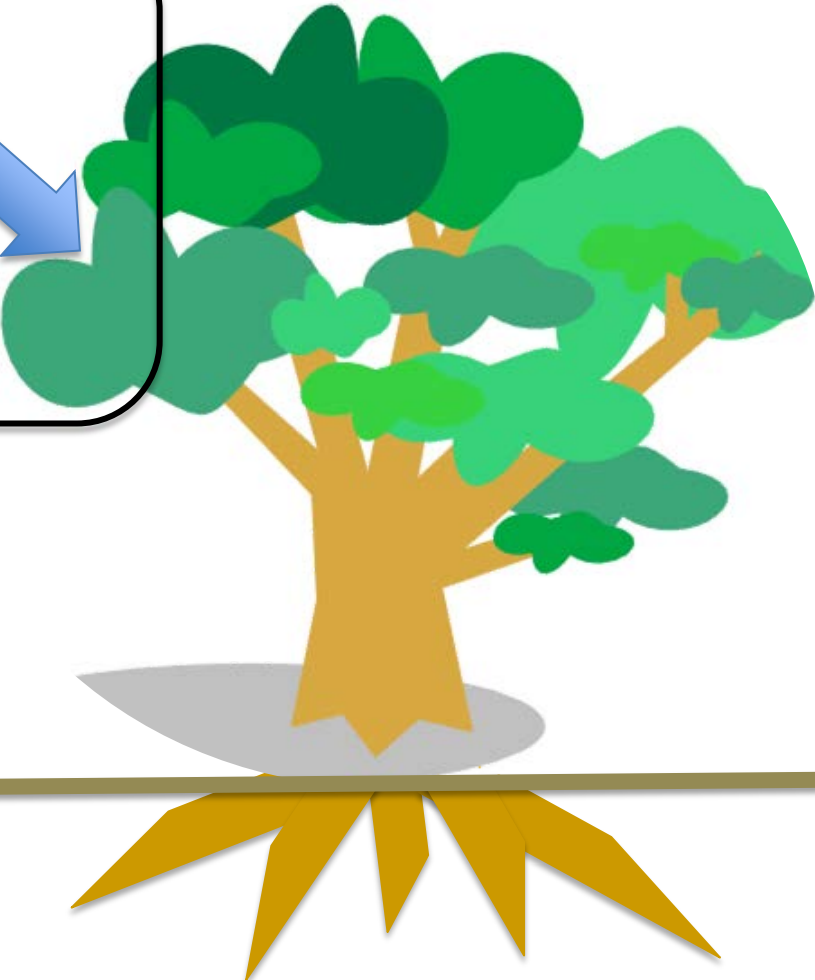
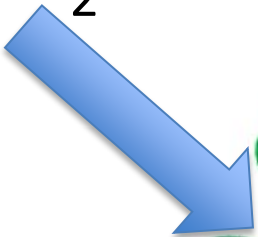


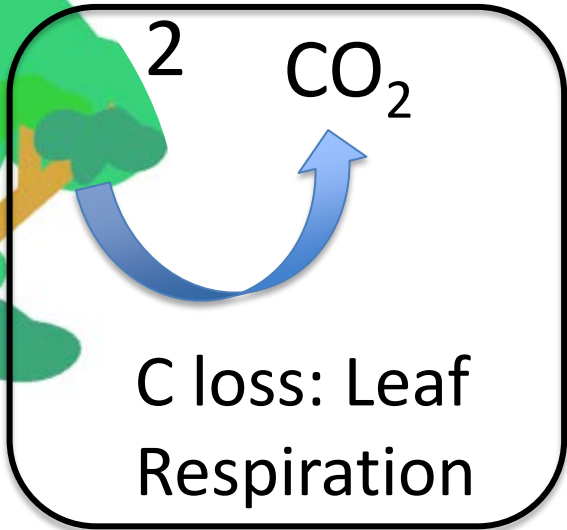
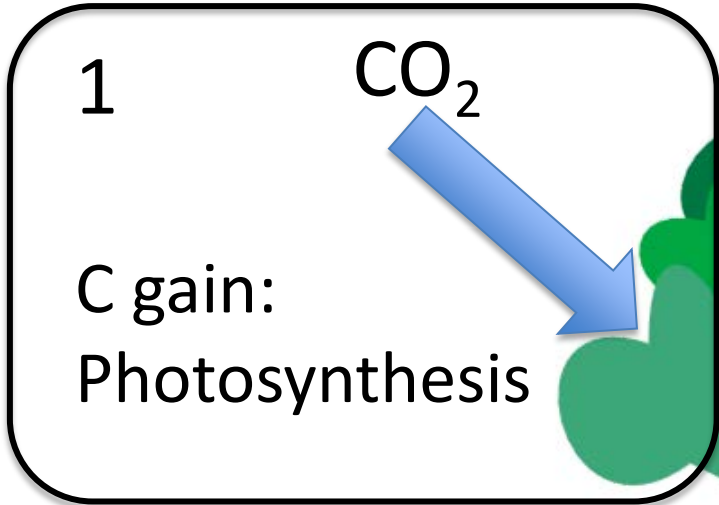
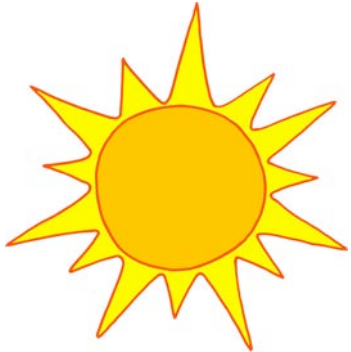


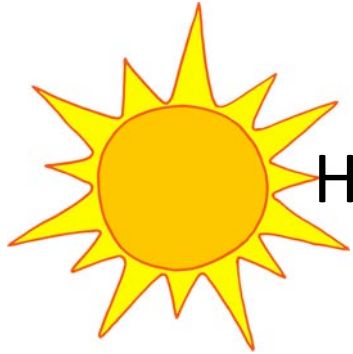
1

CO₂

C gain:
Photosynthesis





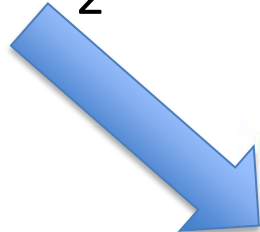


How does acclimation change carbon in the future?

1

CO₂

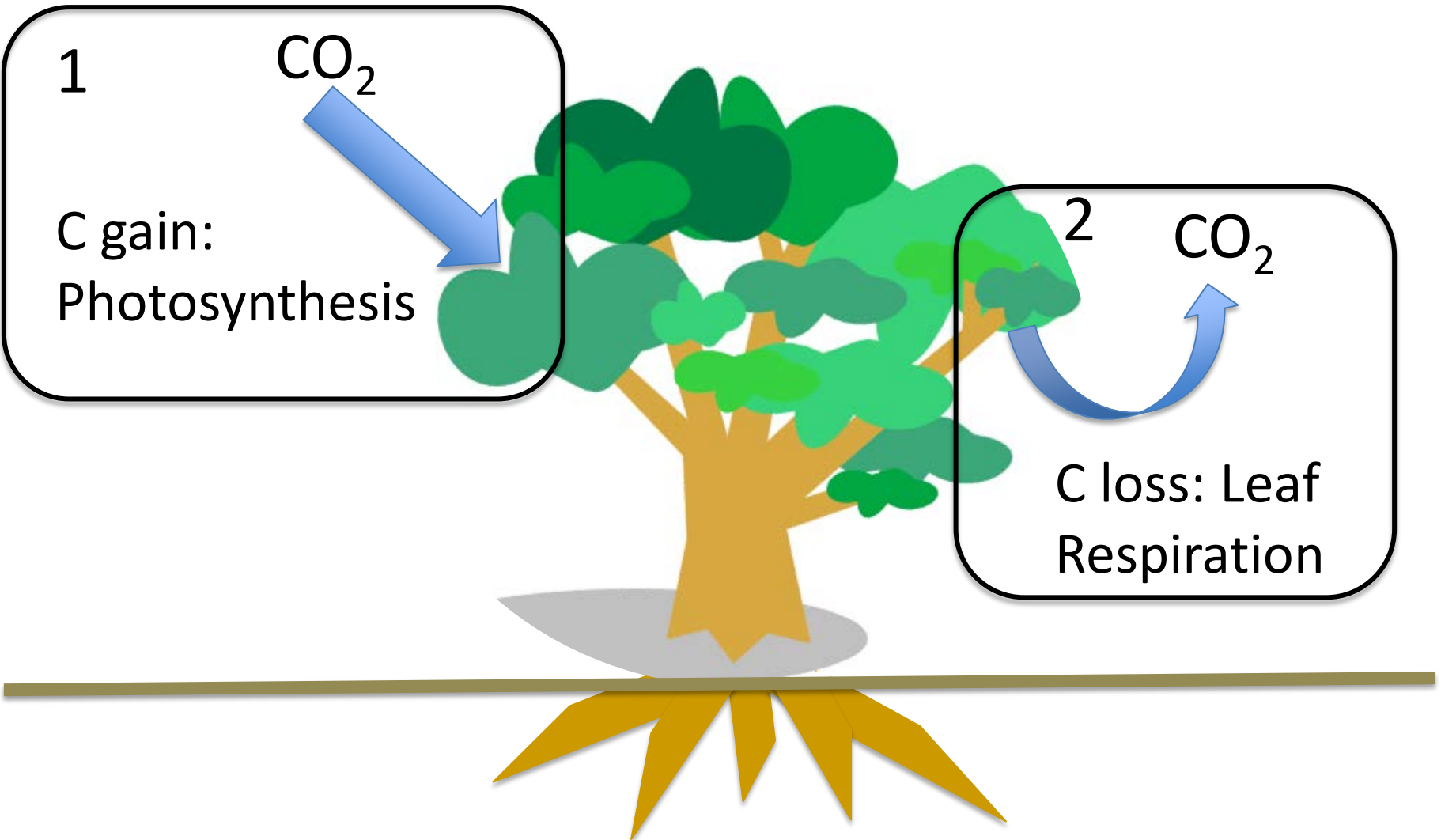
C gain:
Photosynthesis



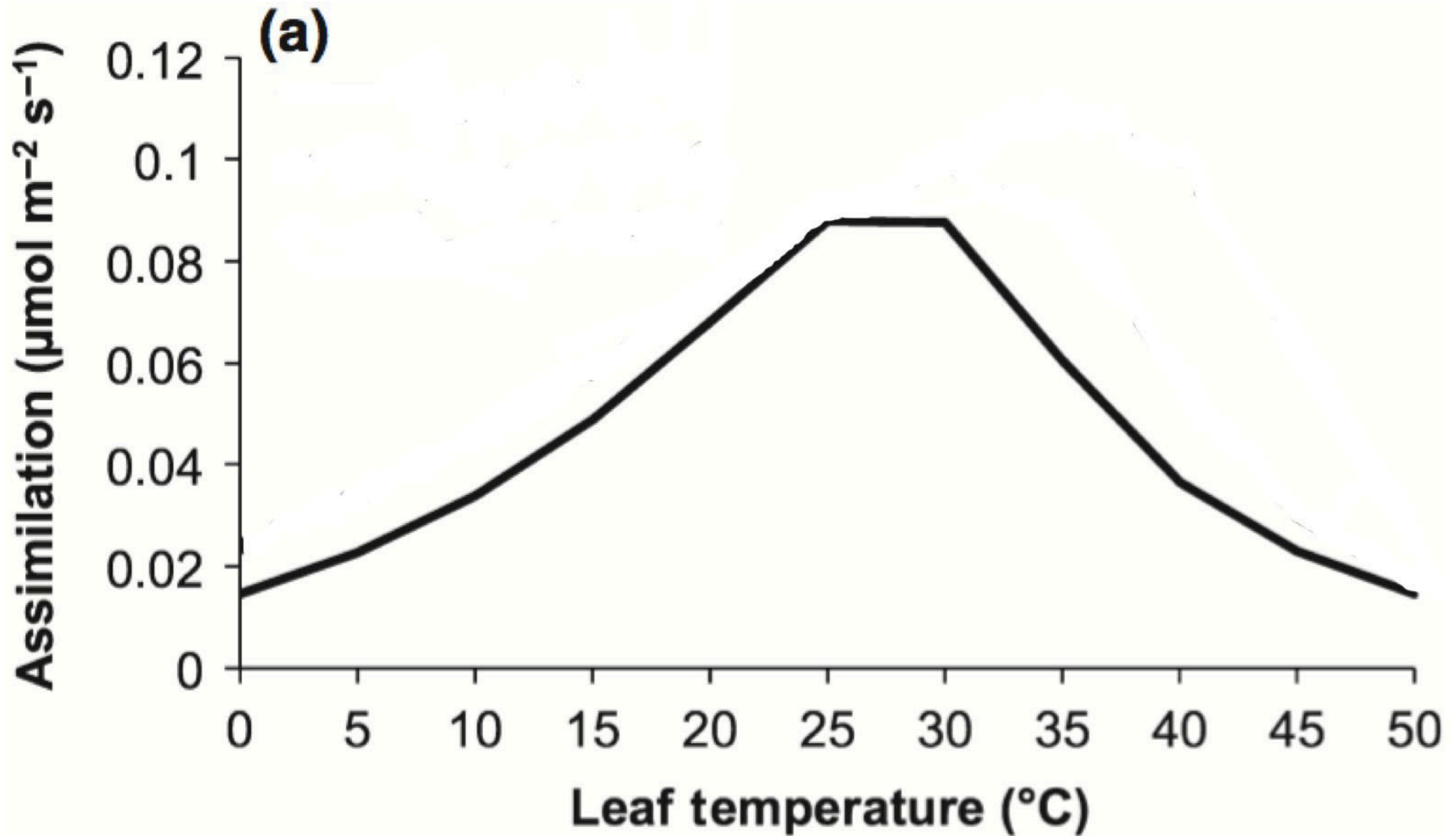
2

CO₂

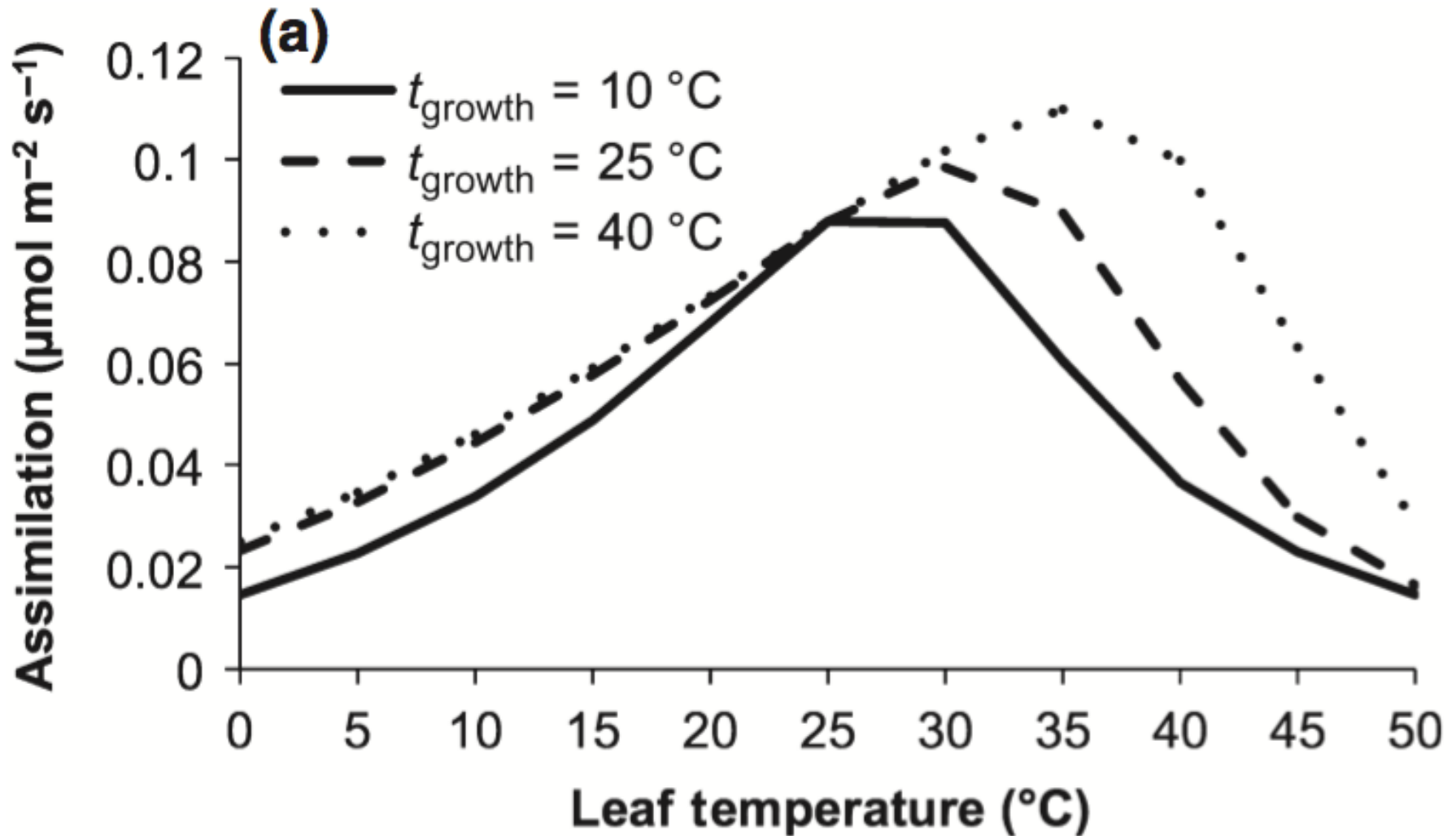
C loss: Leaf
Respiration



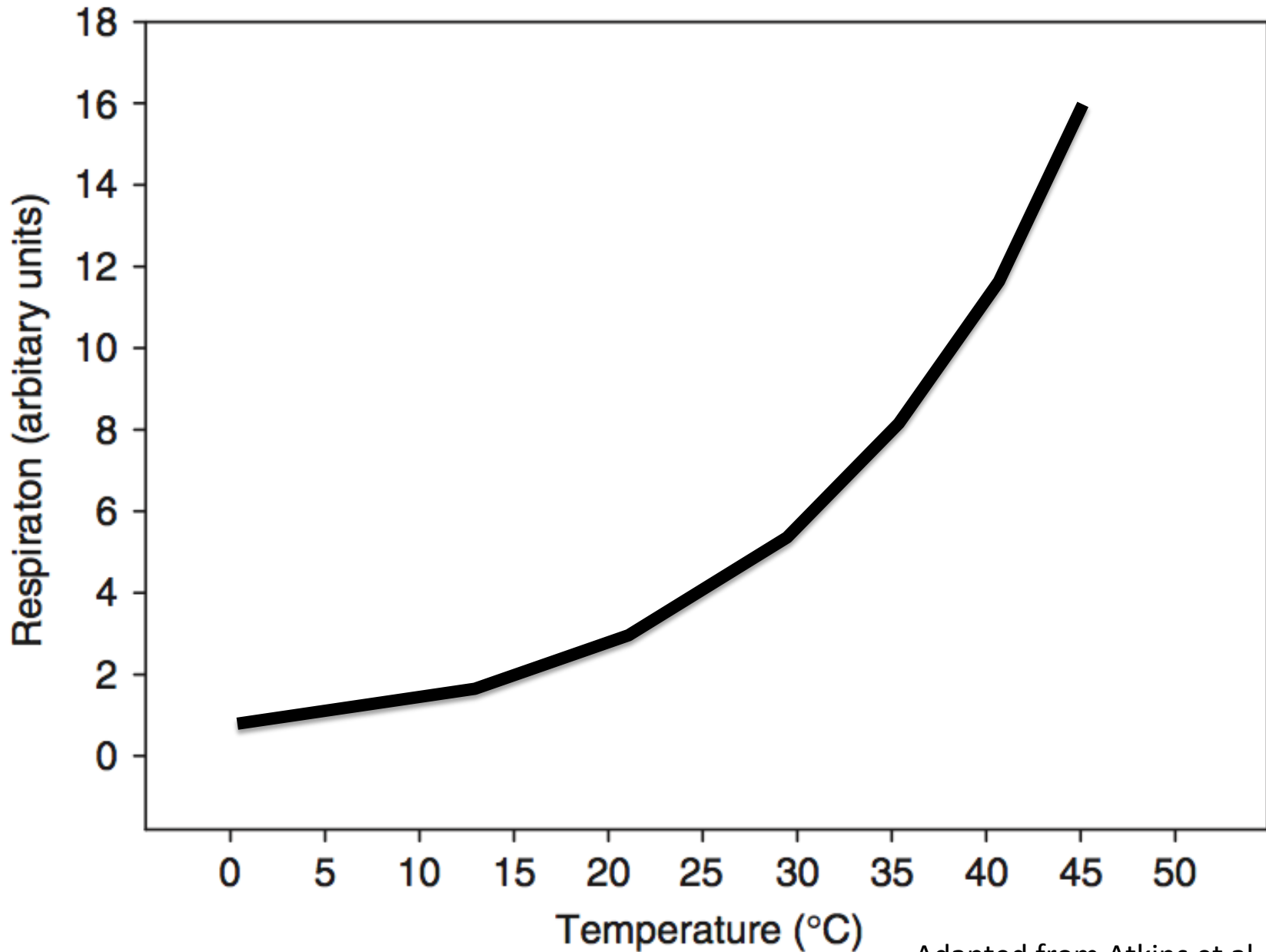
Photosynthetic response to temperature



Photosynthetic response to temperature

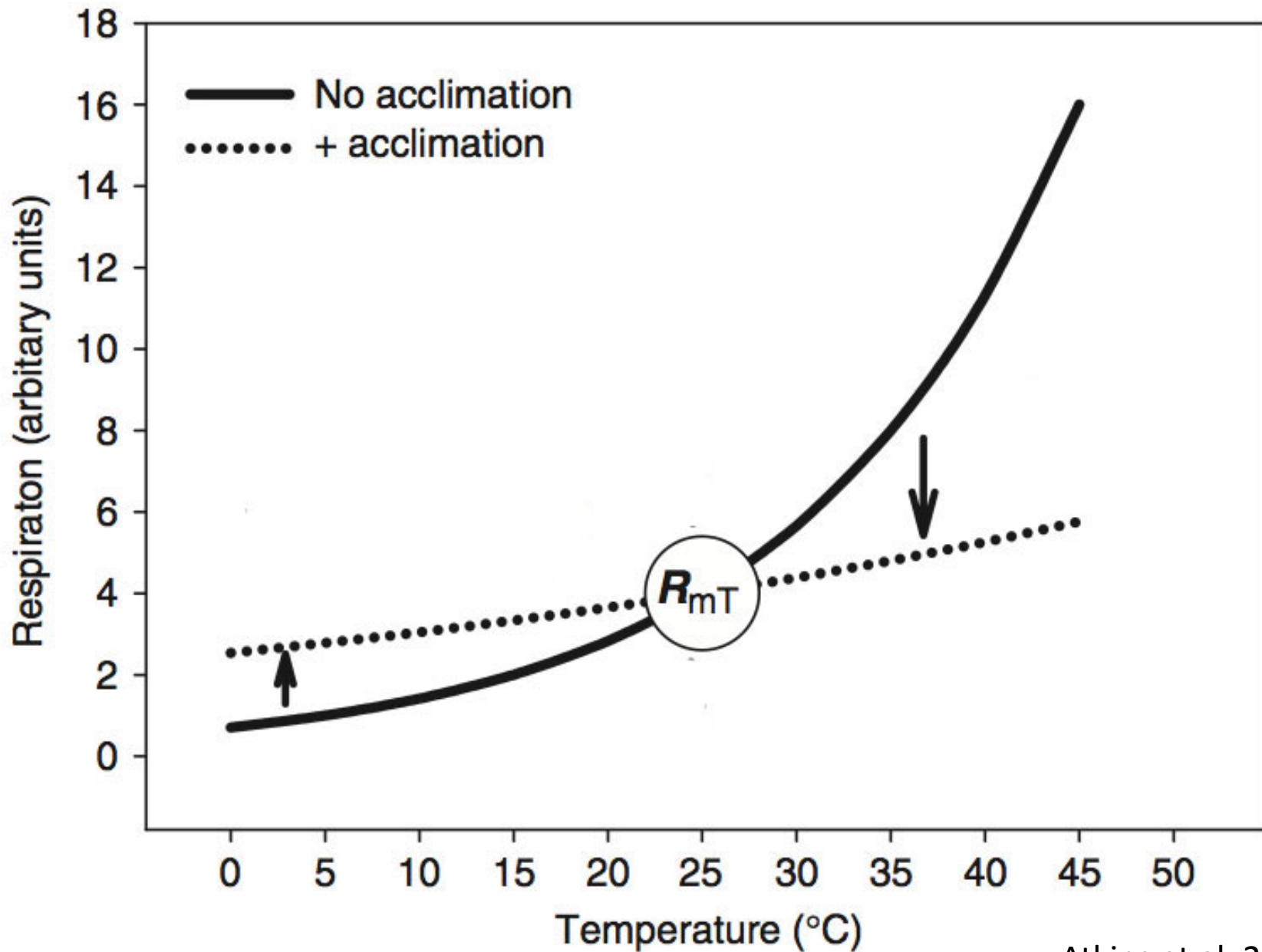


Respiration response to temperature



Adapted from Atkins et al. 2008, *GCB*

Respiration response to temperature



Hypotheses:

As future T increases, acclimation will...

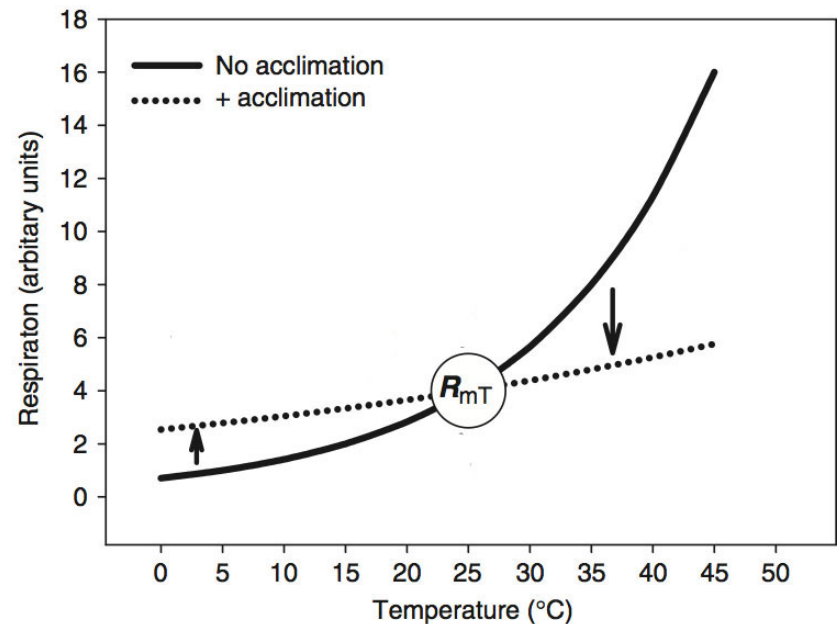
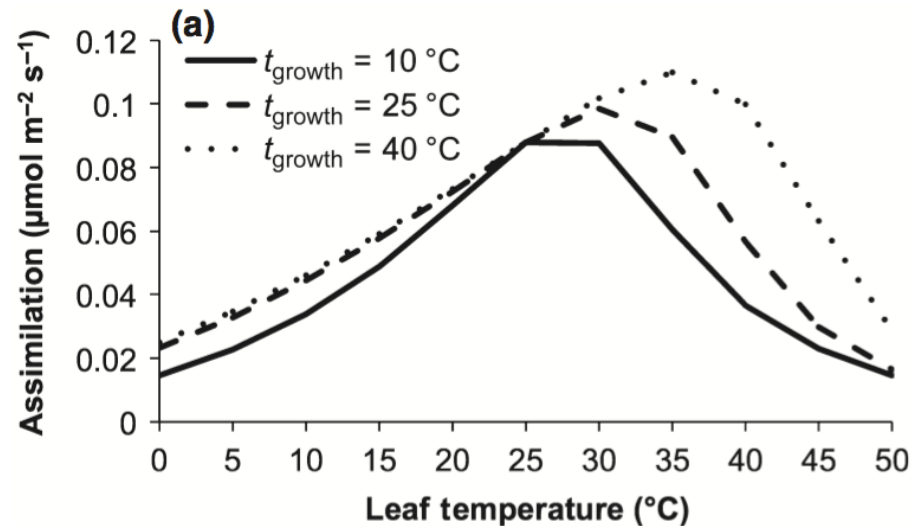
Increase C gain

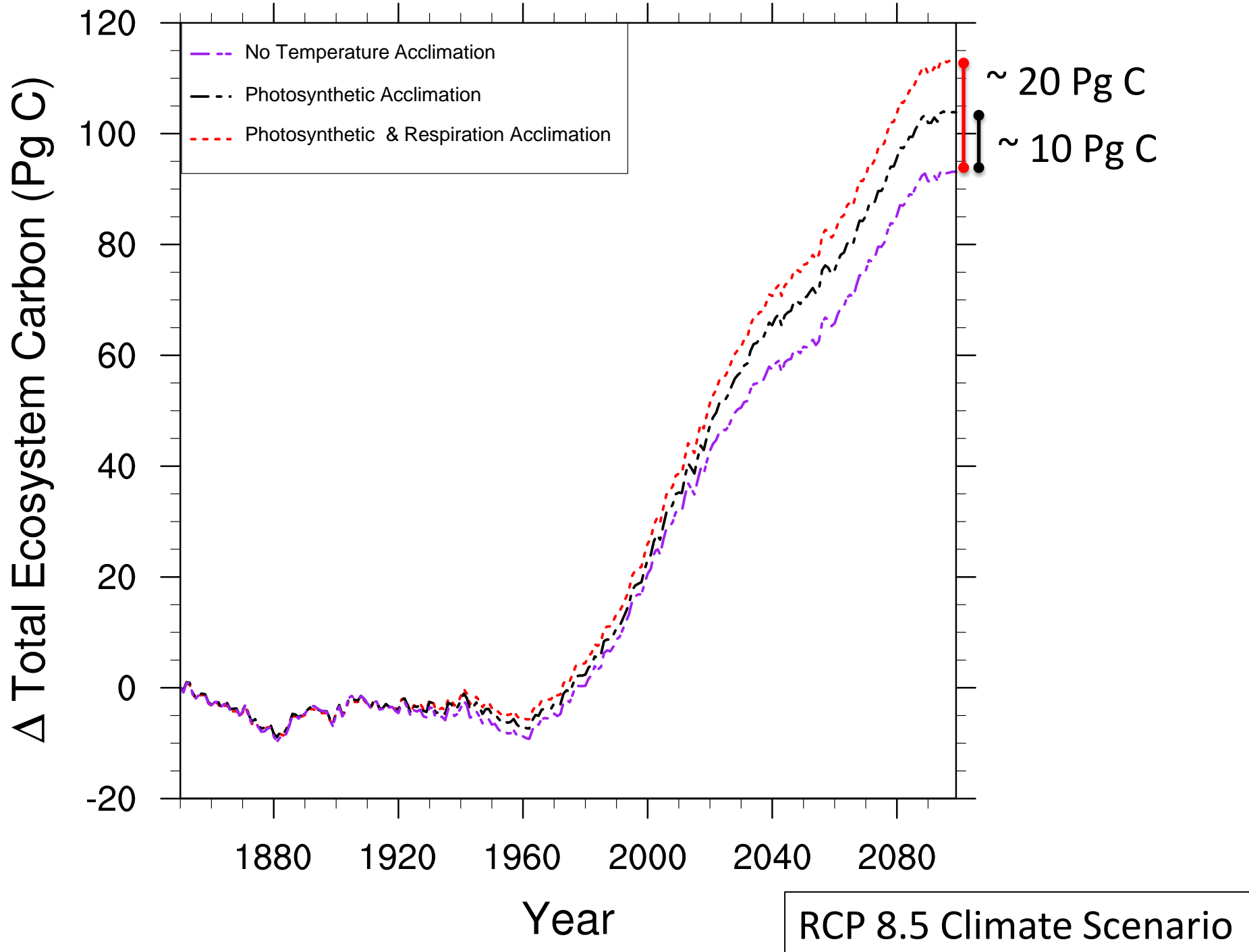
Warm ecosystems ($T > 25$):

Decrease C loss

Cool ecosystems ($T < 25$):

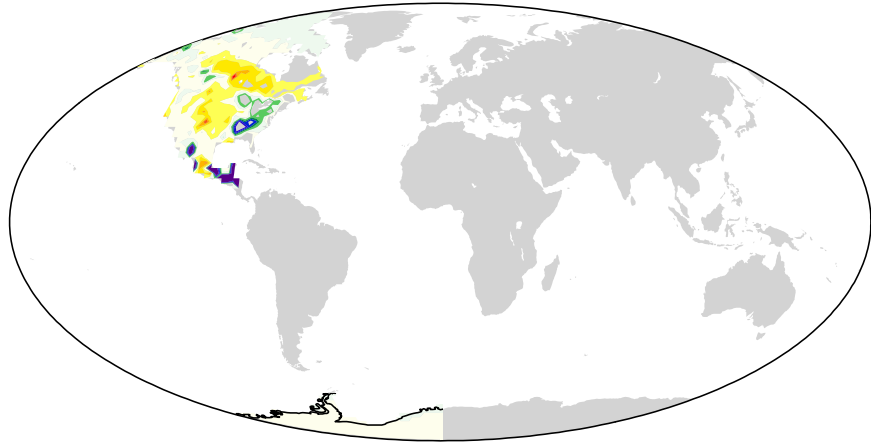
Increase C loss





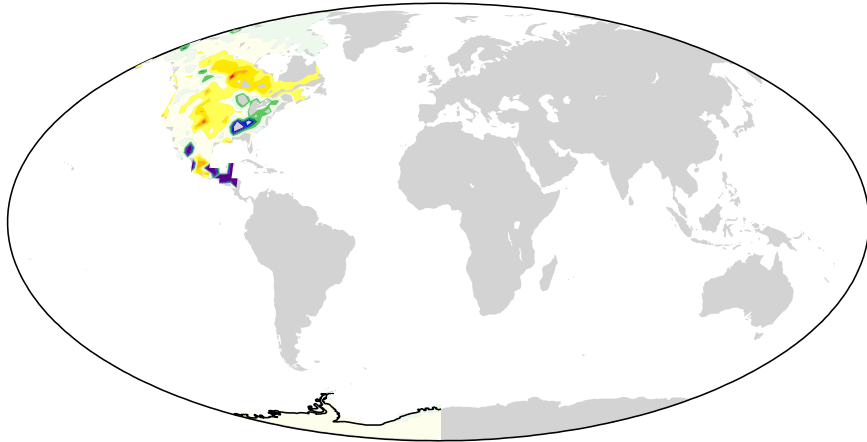
$$\Delta = 2100 - 1850$$

No Temperature Acclimation

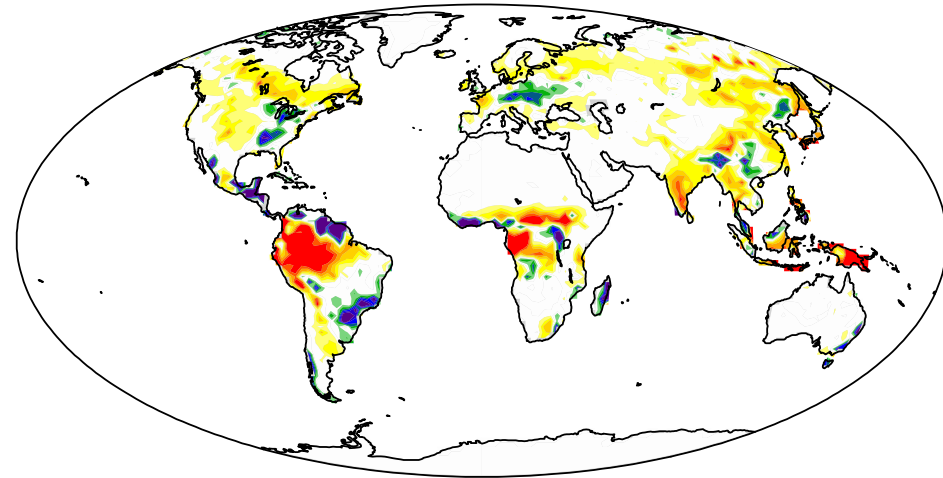


$$\Delta = 2100 - 1850$$

No Temperature Acclimation



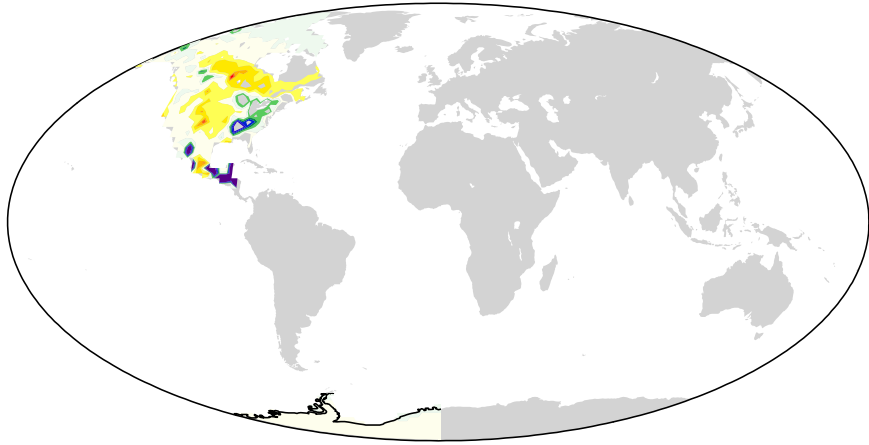
Photosynthetic Acclimation



Photosynthetic &

$$\Delta\Delta = (2100 - 1850 \text{ Acclimation}) - (2100 - 1850 \text{ No Acclimation})$$

No Temperature Acclimation

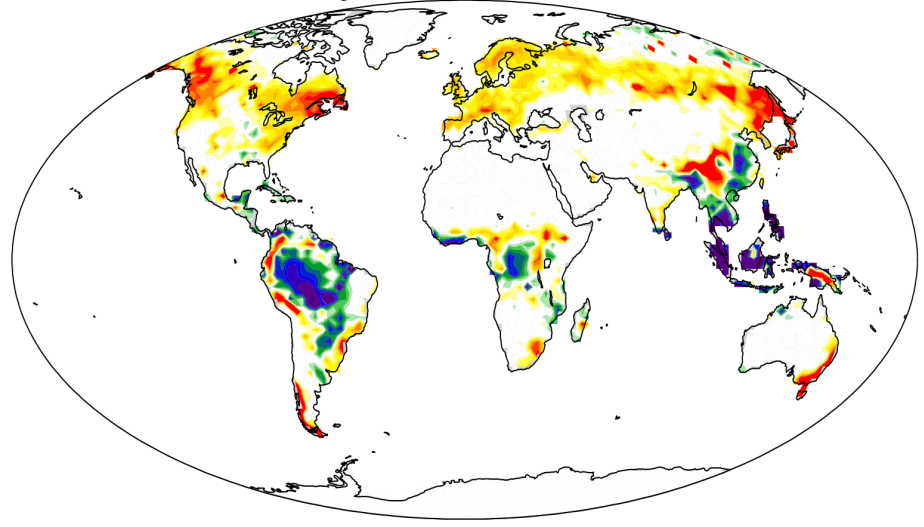
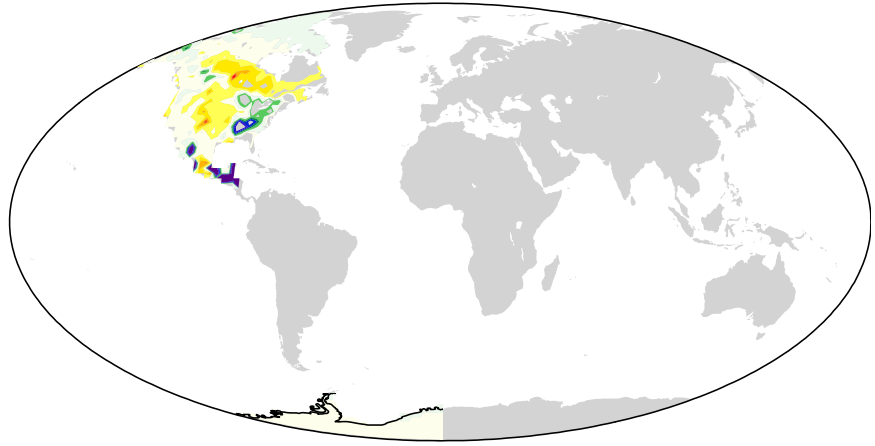


$$\Delta = 2100 - 1850$$

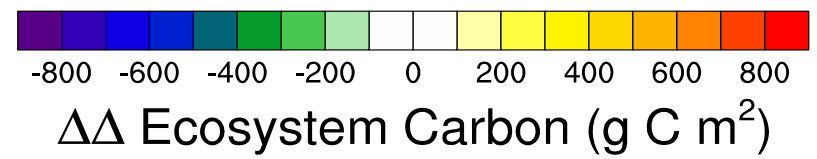
$$\Delta\Delta = (2100 - 1850 \text{ Acclimation}) - (2100 - 1850 \text{ No Acclimation})$$

Photosynthetic Acclimation

No Temperature Acclimation

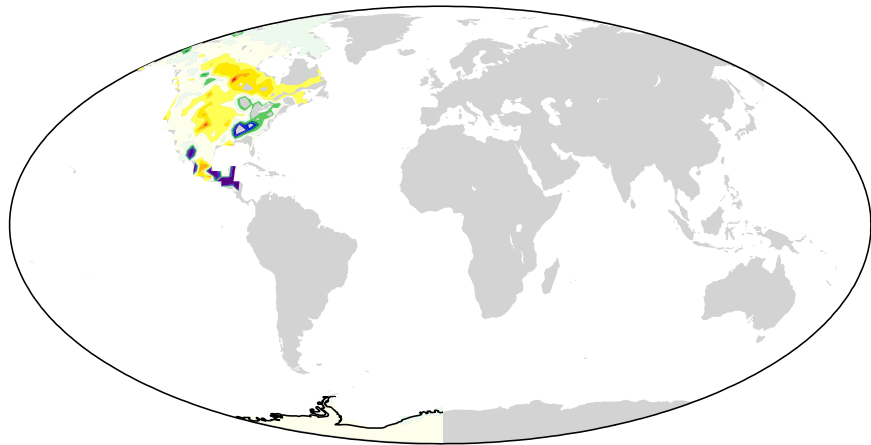


$$\Delta = 2100 - 1850$$



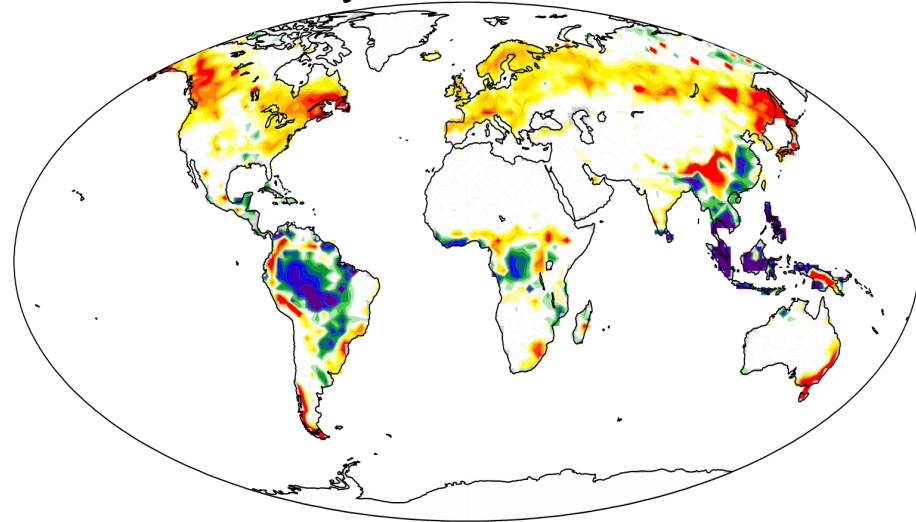
$$\Delta\Delta = (2100 - 1850 \text{ Acclimation}) - (2100 - 1850 \text{ No Acclimation})$$

No Temperature Acclimation

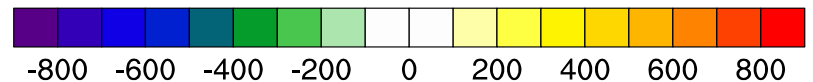
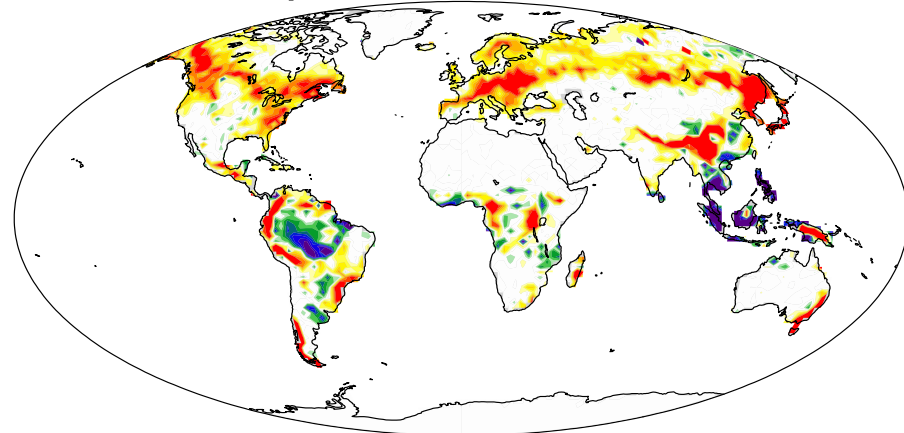


$$\Delta = 2100 - 1850$$

Photosynthetic Acclimation

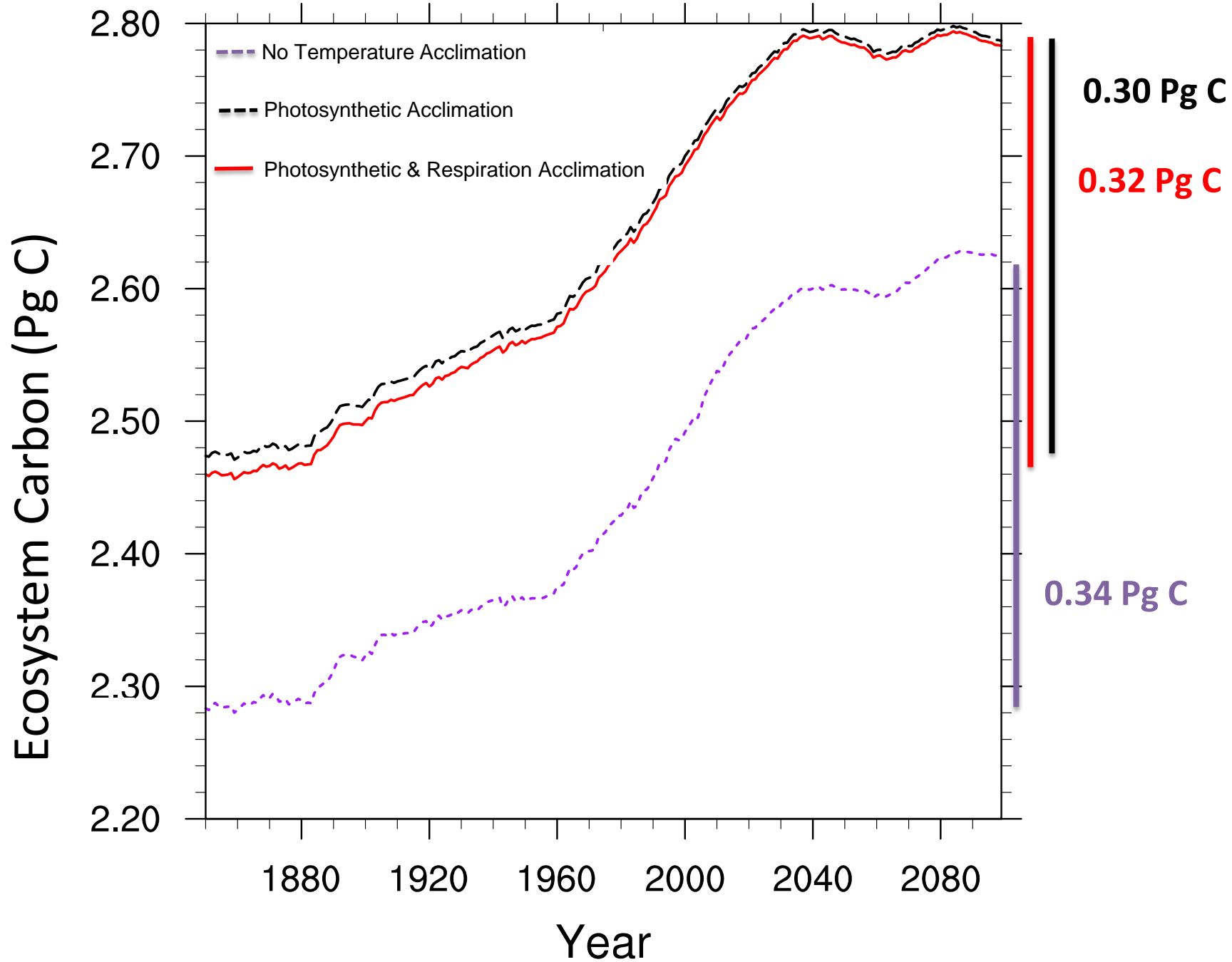


Photosynthetic & Respiration Acclimation



$\Delta\Delta$ Ecosystem Carbon (g C m²)

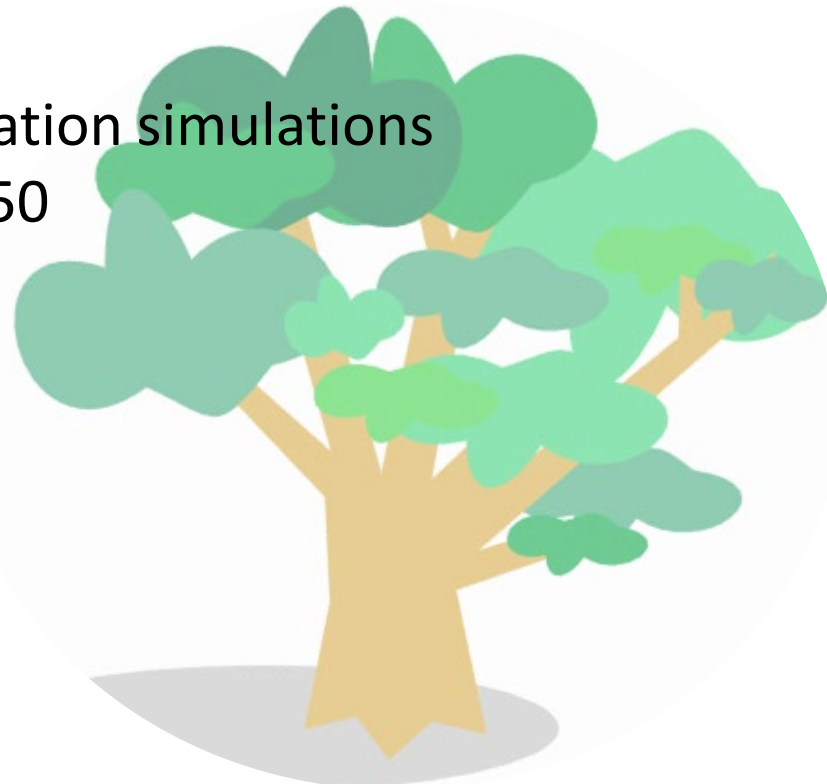
Amazon



Summary

Including Temperature Acclimation...

- increases global ecosystem C by 10-20 Pg
- increases ecosystem carbon in the Amazon, though rates are slower with acclimation
- changes initial stable states: acclimation simulations have more ecosystem carbon in 1850

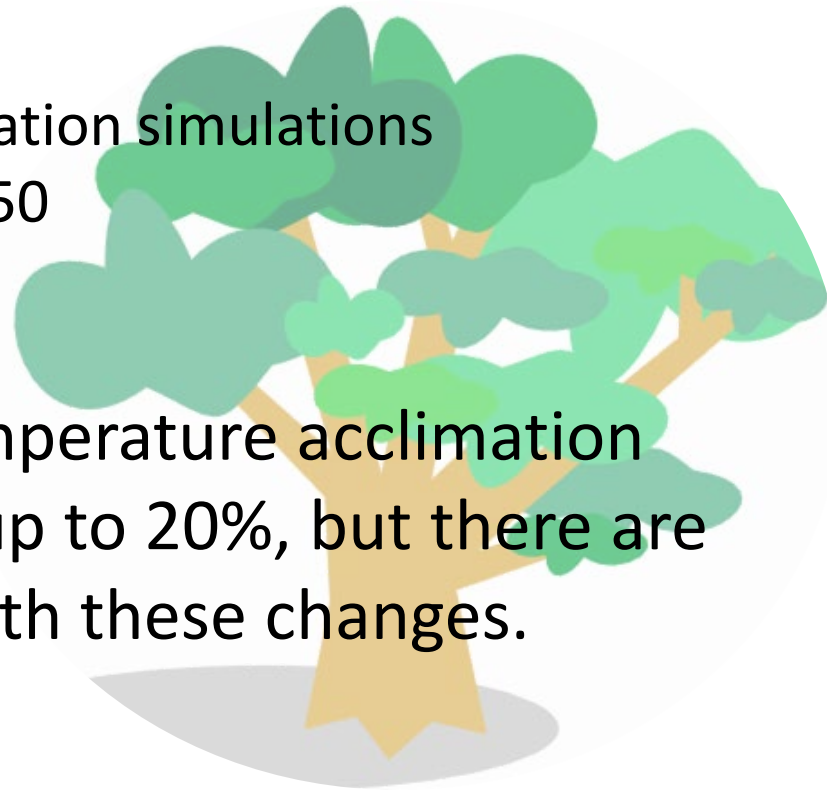


Summary

Including Temperature Acclimation...

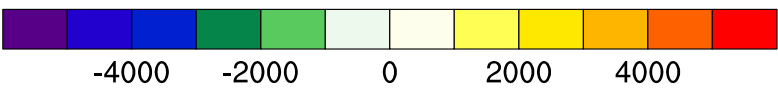
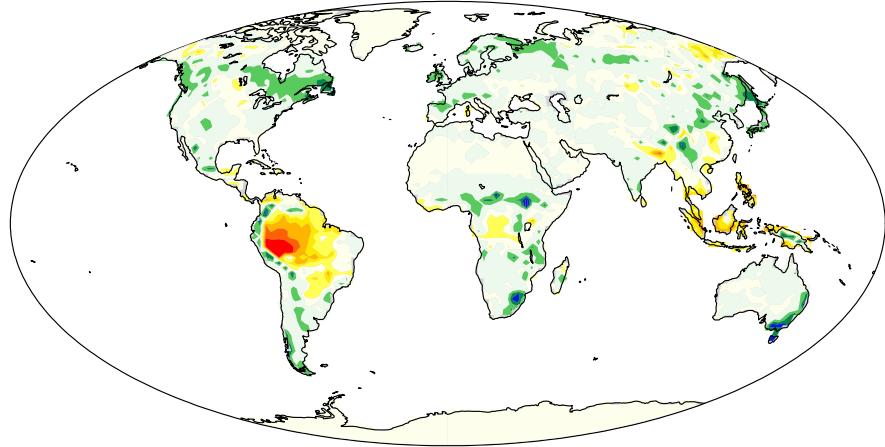
- increases global ecosystem C by 10-20 Pg
- increases ecosystem carbon in the Amazon, though rates are slower with acclimation
- changes initial stable states: acclimation simulations have more ecosystem carbon in 1850

Throughout the 21st century, temperature acclimation can increase ecosystem carbon up to 20%, but there are large uncertainties associated with these changes.

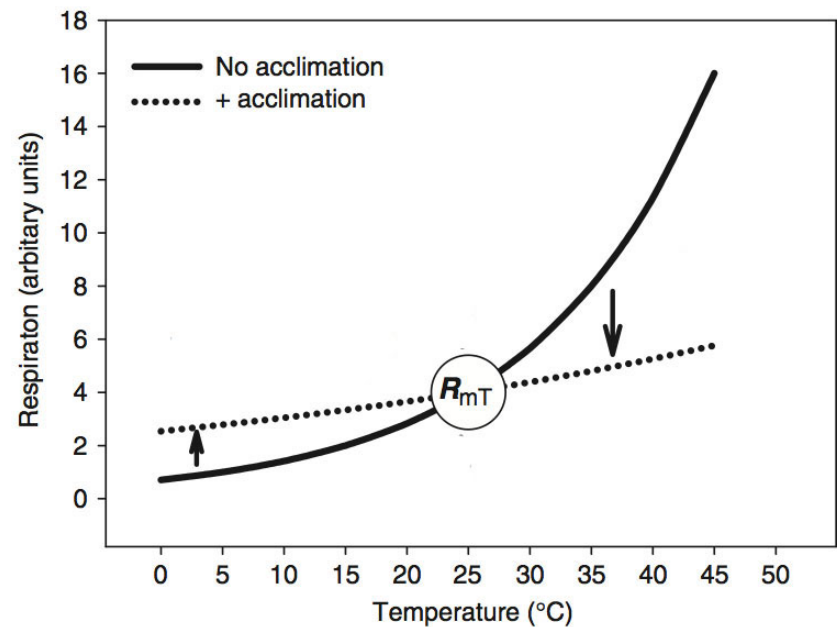
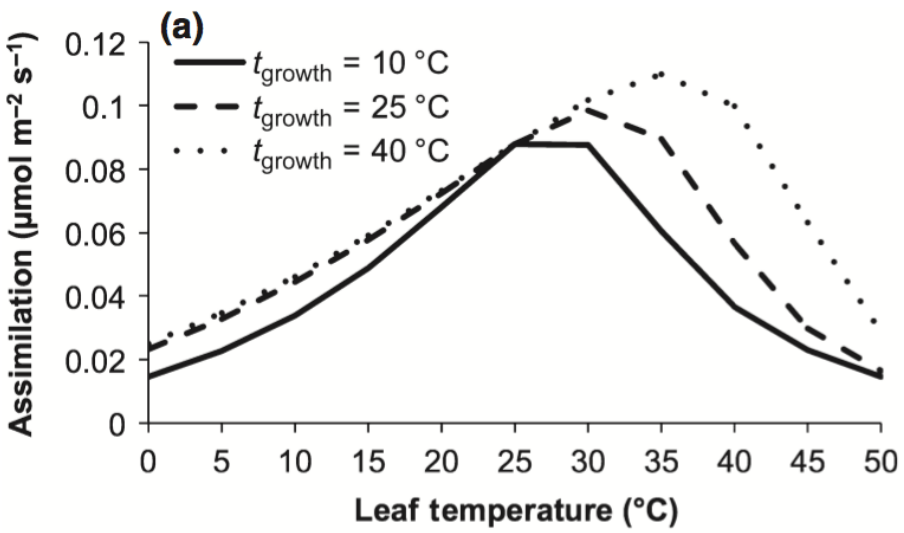
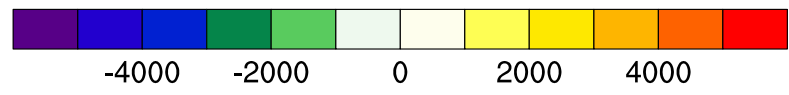
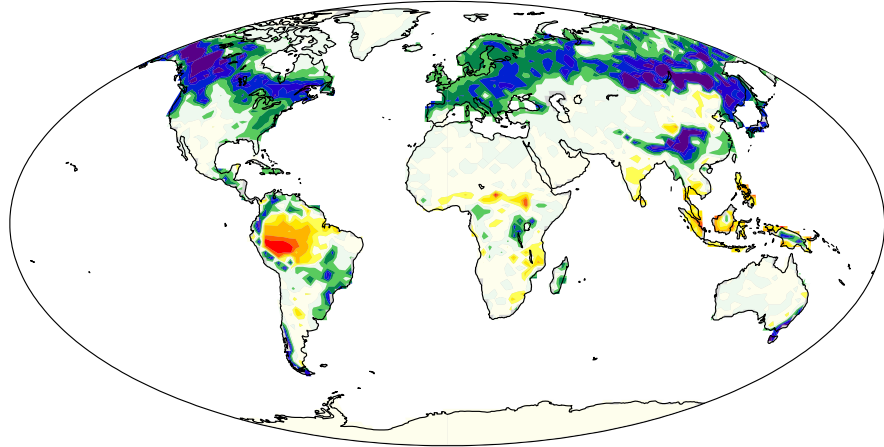


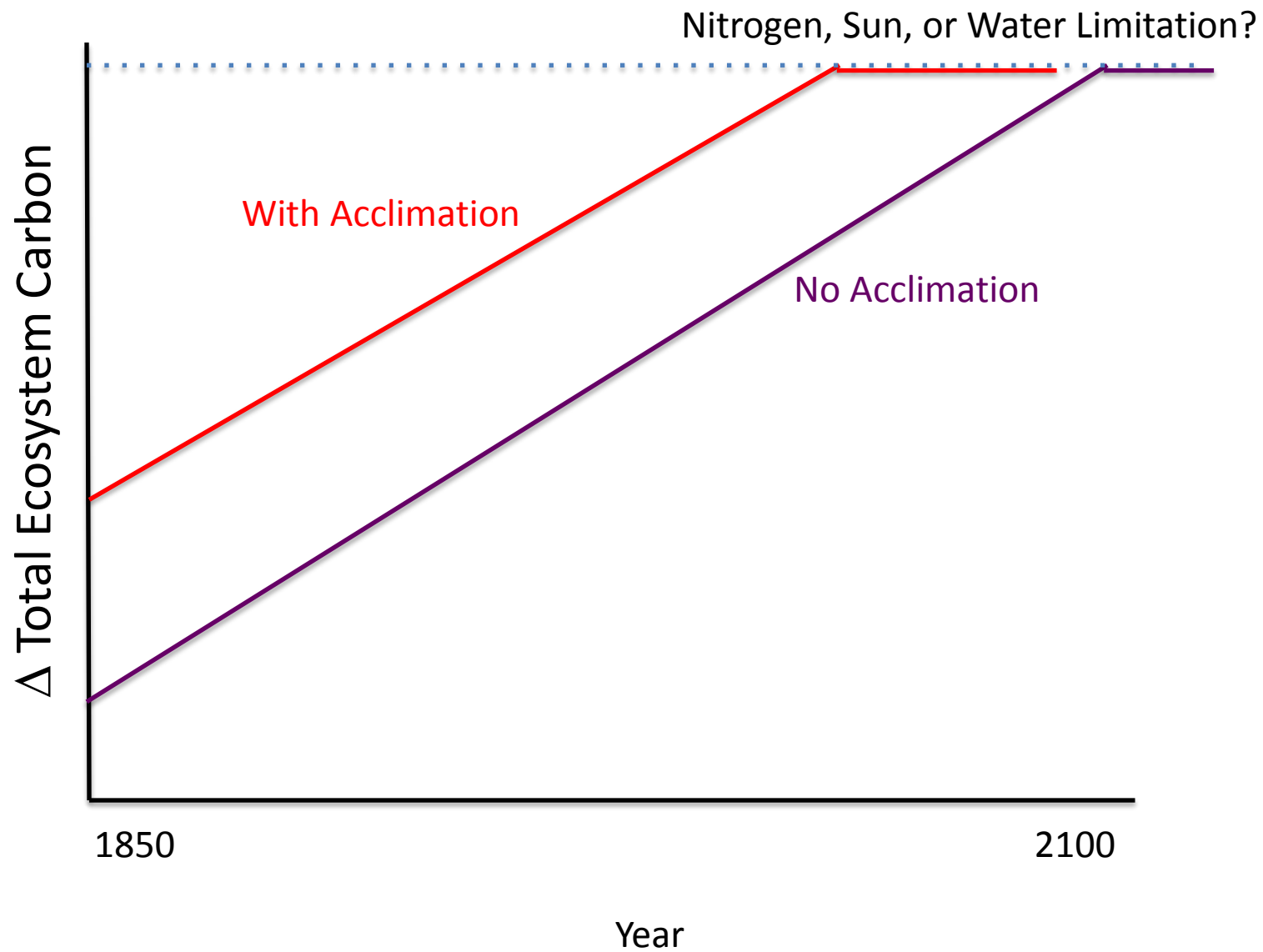
Difference in Initial State Ecosystem Carbon (Pg C)

Photosynthetic Acclimation

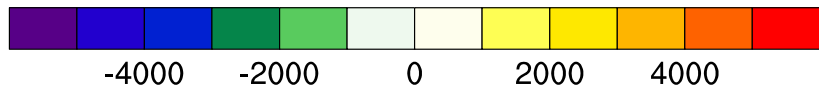
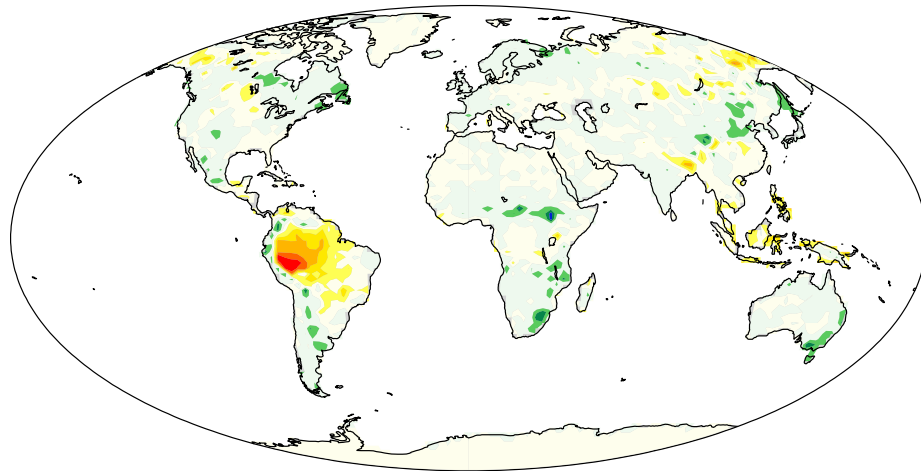


Photosynthetic & Respiration Acclimation



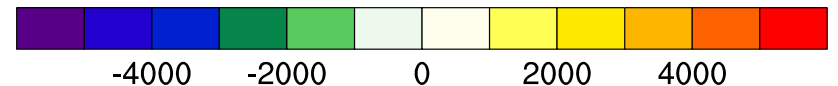
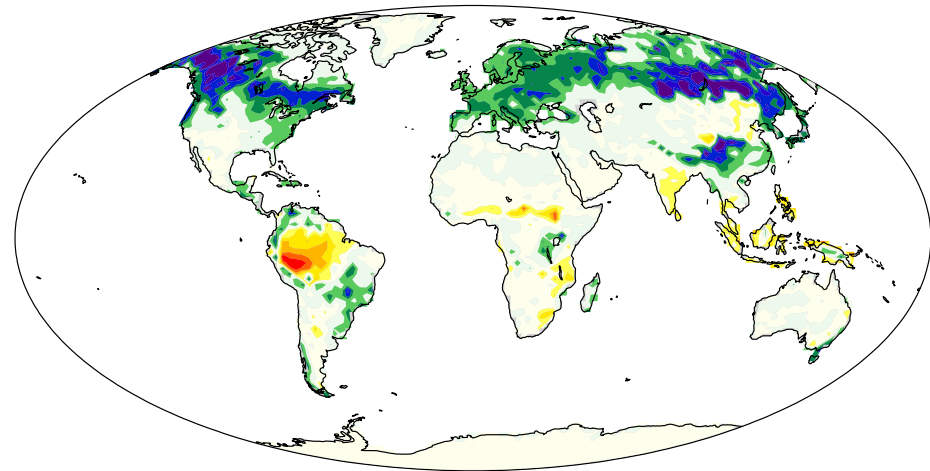


Photosynthetic Acclimation



2100 Δ Ecosystem Carbon (g C m²)

Photosynthetic & Respiration Acclimation

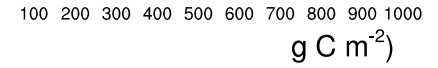
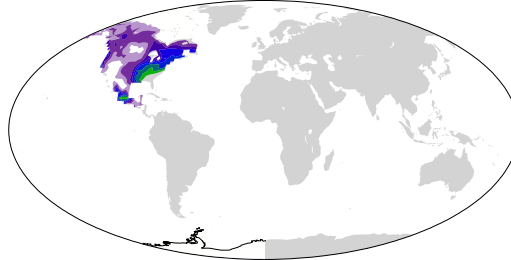
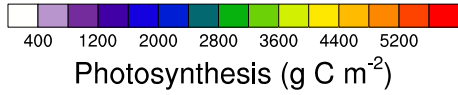
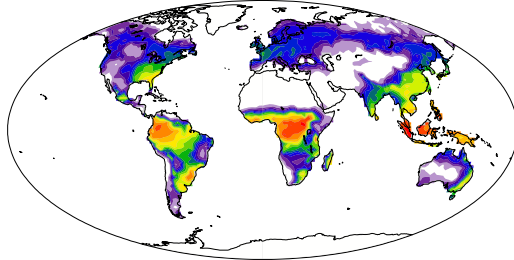


2100 Δ Ecosystem Carbon (g C m²)

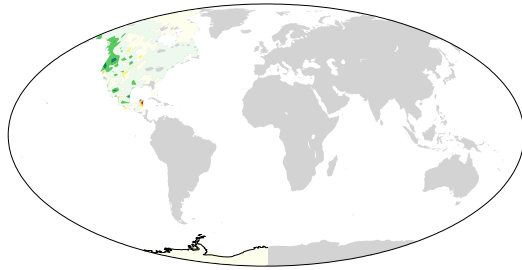
Compared to simulations with no temperature acclimation:

$$2100 \Delta = (2100 \text{ Acclimation}) - (2100 \text{ No Acclimation})$$

No Temperature Acclimation



Photosynthetic Acclimation



Photosynthetic + Respiration Acclimation

Δ = Change from No Acclimation